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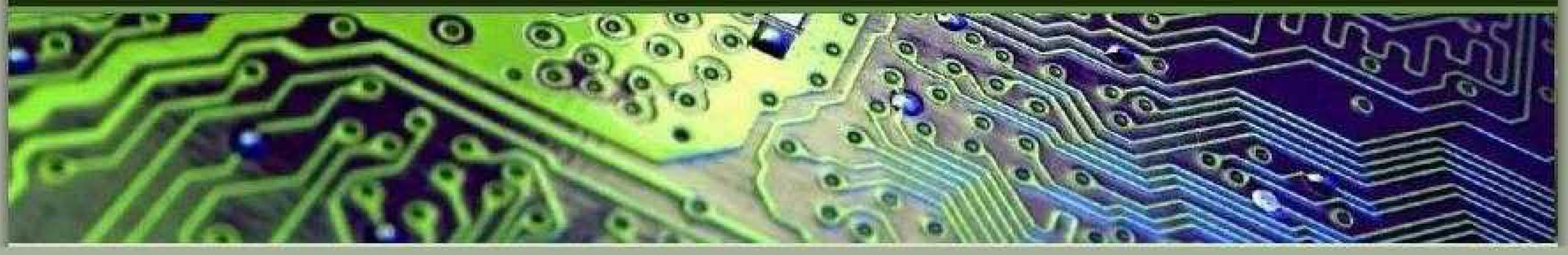

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1932

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Radio Service Manual

Complete Directory of all
1931-1932 Radio Receivers

FULL RADIO SERVICE GUIDE

Vol. No. 2

HUGO GERNSBACK
Editor

C. E. DENTON
Associate Editor

C. H. W. NASON
Associate Editor

GERNSBACK PUBLICATIONS, INC.
PUBLISHERS
96-98 PARK PLACE
NEW YORK

DEC 16 '31

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Please read the notice at the top of each index page. Note carefully that diagrams in the 1931 Manual are listed with one asterisk (*) before the page number; diagrams in the 1931 supplements are listed with two asterisks (**); and diagrams in the 1932 Manual or its supplements have no asterisks at all. It is not necessary to distinguish between the 1932 Manual and its supplements because the latter were issued free to everyone who bought the original Manual. The supplements to the 1931 Manual were sold separately, and therefore the diagrams in them are specially marked with the two asterisks.

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3390 ..... **304A
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6-EP 570
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ZE-6 Filter Unit 578
ZE-7 Power Supply 568
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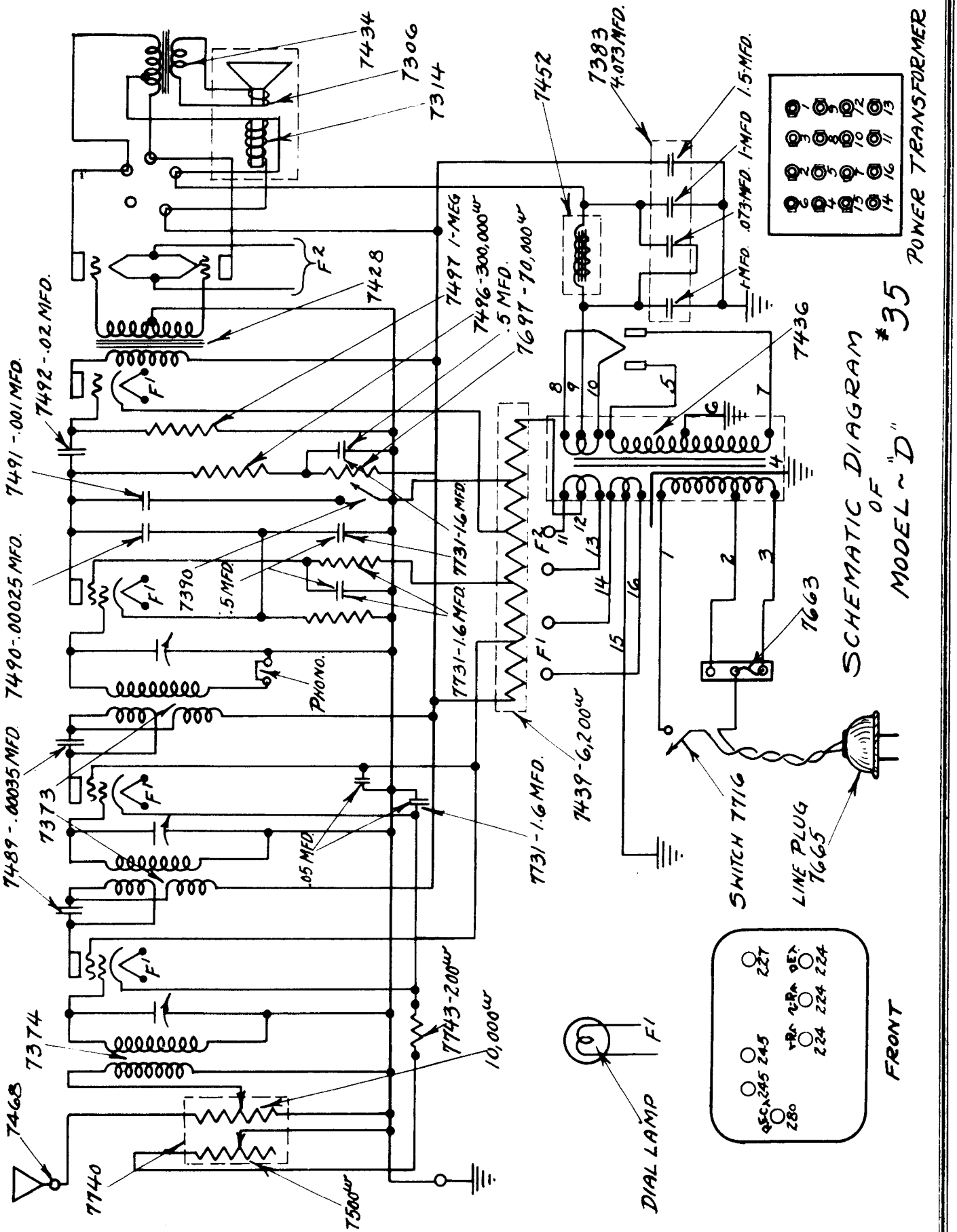
Model VII 566
Record Changer 578

ALL-AMERICAN MOHAWK CORP.



SUPPLEMENT No. 6

Index and Incidental Information

This is the sixth and final supplement to the 1932 OFFICIAL RADIO SERVICE MANUAL. Insert this sheet directly after page 4H and distribute the others in the proper numerical order.

Users of the MANUAL are again requested to read the rules of the free question service, published on page 578F. Observance of these rules will save a lot of time for every one concerned. We wish particularly to emphasize the fact that service data on some sets—even the simplest kinds of diagrams—is not available because the manufacturers have been out of business for years, or, if they are still in existence, they have no records of their older products.

In all cases it is absolutely necessary for us to know the model number of any receiver under consideration. We again repeat that we are not mind readers or magicians, and cannot identify sets from such meagre descriptions as "a seven tube Majestic" or "a Crosley battery model brought out in 1927". If you want us to help you, give us some information to work on.

ATWATER KENT MFG. CO.
Electric values of condensers and resistors in all A-K receivers 1924-1932 inclusive 168A-168X

BELMONT RADIO CO.
Models 525, 560 . . . . . 4Ha

BRANDES PRODUCTS CORP.
B-10 . . . . . 198A
B-15, B-16 . . . . . 198A
K-110, K-112, K-120 . 198B
K-130, K-132 . . . . . 198B

CANADIAN MARCONI CO.
32-B
33, 33-AW
34, 35, 36, 37 . . 214E-214M

CAPEHART CORP.
200, 300 phono-radio . 4Hb

CROSLEY RADIO CORP.
90, 91, 92 auto radio . 214A
95, 96 auto radio . . . 214B
132-1 "Chief" 214C

DE FOREST CROSLEY
(A division of Consolidated Industries Products Ltd.)
902 chassis (A, B and F models)
"Montrose" . . 218A-218F

FADA RADIO & ELECTRIC CORP.
103 "Fadalette" 214N

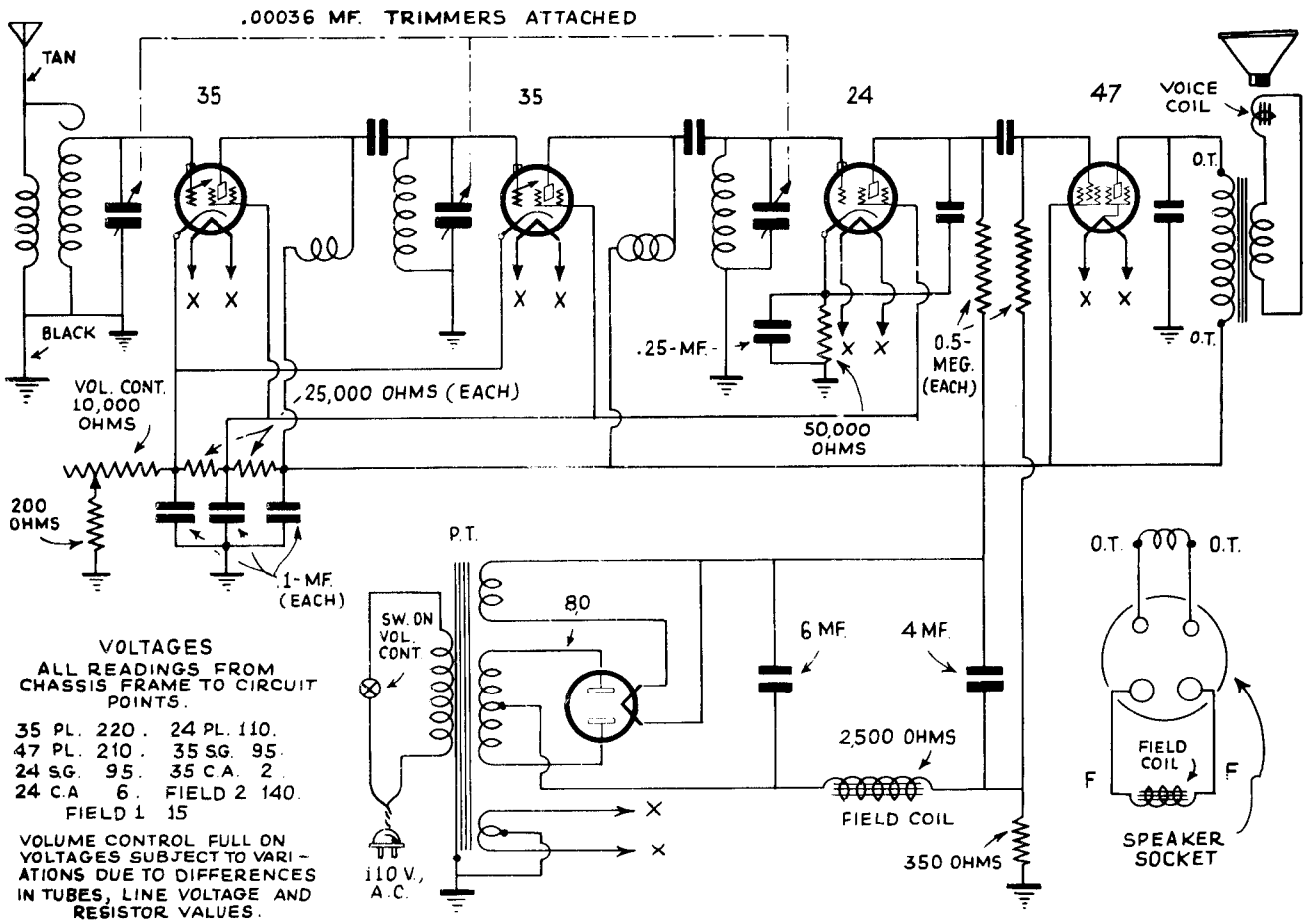
PHILCO RADIO & TELEVISION CORP.
53 ultra midget 214D

PIERCE-AIRO, INC.
DeWald 54 "Dynette" 214N

RCA VICTOR, INC.
R-27 ultra midget . . . 214D

STEWART WARNER CORP.
Series 108 . . . . . 214N

BELMONT RADIO CO.



VOLTAGES
ALL READINGS FROM CHASSIS FRAME TO CIRCUIT POINTS.

35 PL. 220 . 24 PL. 110.
47 PL. 210 . 35 S.G. 95.
24 S.G. 95. 35 C.A. 2.
24 C.A 6. FIELD 2 140.
FIELD 1 15

VOLUME CONTROL FULL ON
VOLTAGES SUBJECT TO VARIATIONS DUE TO DIFFERENCES IN TUBES, LINE VOLTAGE AND RESISTOR VALUES.

BELMONT MODELS 560 & 525

CAPEHART CORP.

CAPEHART MODELS 200 AND 300 DE LUXE 11-TUBE AUTOMATIC PHONO-RADIO

(Visual tuning meter; phono. pickup pre-amplifier; tone control; silent-tuning control; automatic record-changer; delayed A.V.C.; superheterodyne circuit.)

The Model CK chassis incorporated in this automatic record-changer phonograph and superheterodyne radio receiver combination, manufactured by The Capehart Corporation, is produced by Howard Radio Corp. as their Model K chassis, the "C" designation indicating that the circuit has been modified by the Capehart concern to include a separate tube, V10 in the diagram, as a phono, pickup pre-amplifier. The "200" uses a Jensen 12 in. D-9 speaker and the "300" a 14 in. "Mastodon," and the cabinets and record changers are different. The sensitivity is 6 microvolts-per-meter; undistorted power output, 5 W., and; power consumption, 142 W. (set, 115 W.; motor, 17 W.; cabinet light, 10 W.).

Tube No.	Fil. Volts	Cath. Volts	S.G. Volts	Sup. G. Volts	Plate Volts
1	2.5	3	90	3	180
2	2.5	7	90	7	180
3	2.5	7	—	—	90
4	2.5	3	70	3	180
5	2.5	70	—	—	180
6	2.5	95	180	—	180
7	2.5	95	180	—	180
8*	2.5	—	—	—	—
9**	2.5	—	85	3	32
10	2.5	7	—	—	160
11	5.0	—	—	—	300

Voltages indicated at a line potential of 115 V. All readings taken between tube element and chassis, with R3 in the least effective position. *No data available for a 56 as V8; for a 57 [used in late models], the following figures are given: C.G., 90V.; Cath., 115V.; S.G. [grounded], zero V.; Sup. G. [tied to C.G.], 90V.; Plate, 3V. **The C.G. of V9 is 3V.

Condensers C1 to C3, tuning units shunted by trimmers; C4, padding condenser; C5 to C8, I.F. trimmers; C9, C15, C17, C18, C19, C20, 0.1-mf.; C10, C11, C12, C13, C14, 1.2 mf.; C16, C21, .001-mf.; C22, C23, 1.4-mf.; C24 to C26, 8 mf.; C27, 1. mf.; C28, .01-mf.

Resistors R1, R2, .125-meg.; R3, 10,000 ohms; R4, .25-meg.; R5, R8, R13, R16, R17, 0.2-meg.; R6, R20, 3,000 ohms; R7, R14, 500 ohms; R9, 2 megs.; R10, 2,500 ohms; R11, R12, .15-meg.; R15, R23, 10 ohms, center-tapped; R18, 30,000 ohms; R19, 0.1-meg.; R21, 4,150 ohms; R22, R25, 2,000 ohms; R24, 210 ohms. Choke coil section A 2,575 ohms, section B 170 ohms; phono pickup 40,000 ohms (at 1,000 cycles); field coil Ch. 220 ohms.

The Model 10-12-C automatic record changer used in this phono-radio combination operates at 78 r.p.m. To adjust the pickup change lever for playing 10 in. records, loosen the forward lever stop and hold it in such a position that the needle will come down onto a 10 in. record exactly 4 11/16 ins. from the edge of the center pin. When the correct location of the pickup change lever has been ascertained the front stop may be set snug against this lever and the screw tightened, which will allow the lever to always be thrown over to that exact position when playing 10 in. records. To adjust the playing for 12 in. records, loosen the back lever stop and hold the lever in such a position that the needle will come down exactly 5 11/16 ins. from the edge of the centering pin.

Adjust the weight of the pickup with only one record on the turntable. With a delicate pair of scales, having a range of 0 to 12 ozs., catch the needle screw and lift the pickup from the record until the A.F. quality breaks, at which time a reading of 5½ to 6 ozs. should be indicated.

There are five steps in adjusting the oscillating and spiral trip lever and the pickup silencer. (1), Turn the master cam until the large timing mark is exactly above the timing mark on the tone arm lifting lever; (2), Hold the switch lever and cam assembly against the driven clutch so that the radius of the cam will center against the clutch; (3), Set the pickup silencer switch against the casting bearing so that the shaft of the cam cannot be moved further toward the automatic switch; (4), Hold the tail of the cam against the lug on the inside of the master cam and adjust the trip lever until it is 1/16-in. beyond the catch in the oscillating trip lever; (5), Adjust the pickup silencer switch so that a good contact is made on the pickup short-circuiting switch *when the needle is on the record and the automatic switch has been tripped.*

Failure to correctly adjust the spiral trip cam, so that the automatic trip operates when the needle is 1 49/64 ins. from the edge of the turntable spindle, will cause the instrument to change records before the music is finished, or not to change records automatically.

The correct clearance for the needle to feed into the music groove, between the cork insert and the tone arm base is .015-in.

The record magazine pin must be so placed that the offset at the bottom extends directly away from the record support shelf, and the pin must have a clearance of exactly 4⅞ ins. between the back center of the offset, and the extreme right and left corners of the record support shelf, with the magazine in the 10 in. record playing position.

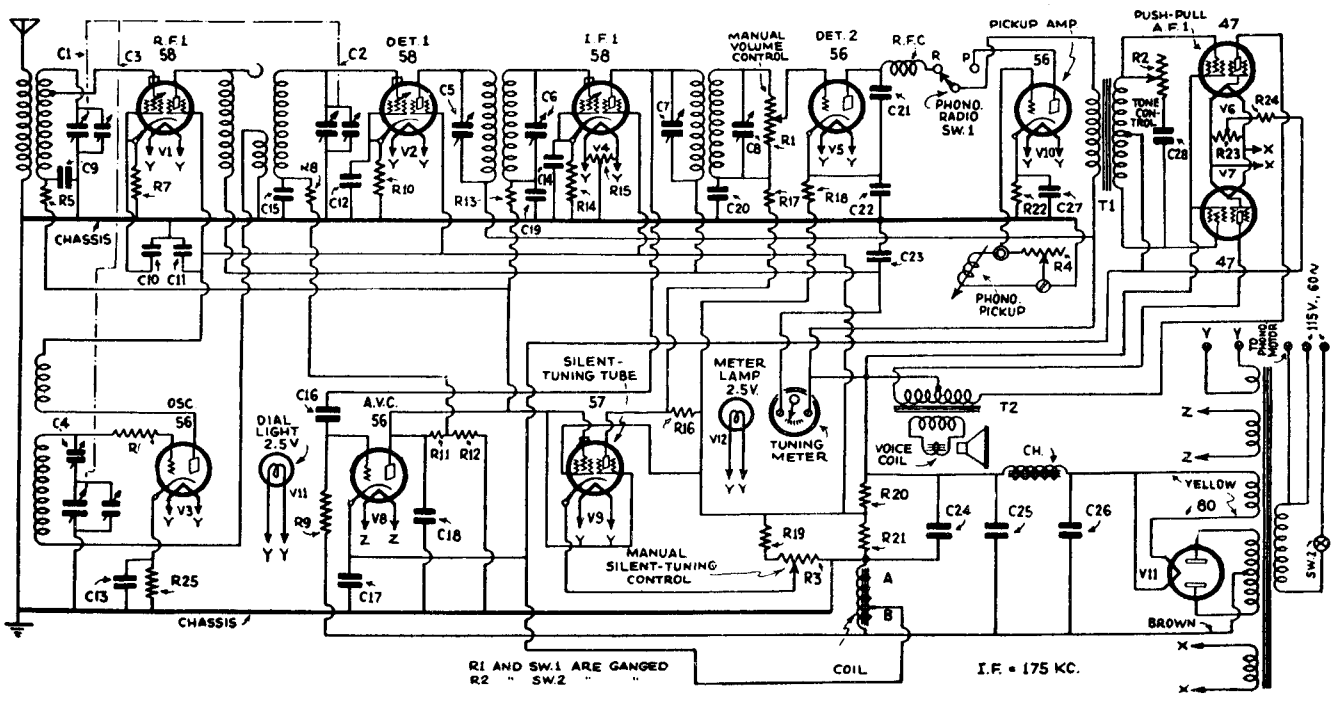
Adjust the record weight (at the bearing pivot) so that the lower edge clears the record slide shelf while in the 10 in. position but holds one record in correct position for the slide plate to unload it onto the turntable.

The receiver chassis incorporates a special A.V.C. circuit so that at low signal levels the A.V.C. is inoperative, due to the high bias on the grid of V10, and only when the received signal exceeds 50 microvolts input does the A.V.C. circuit operate, after which point it holds the output of the receiver substantially constant up to an input as high as 4 volts.

During the condition of "no signal," there is no current flow through R11, R12, and therefore the control-grid of V9 has zero potential, causing a large current to flow through R16, producing a blocking potential on the control-grid of V5. During the condition of "signal," V8 operates and develops a voltage across R11, R12, applying a negative potential on the control-grid of V9, reducing its plate current to zero and thus restoring the control-grid potential of V5 to normal. (For more positive noise suppressor action the control-grid and suppressor-grid of V9 are tied together.)

Use a low value of service oscillator output in realigning the circuits to counteract the apparent detuning effect due to the action of the A.V.C. circuit. Padding condenser C4 is accessible through a hole in the upper part of the variable condenser shield can.

Transformer color code: winding X, X, (3.5 A.) blk. & maroon; Y, Y, (1 A.) and Z, Z, (5 A.) yel.



SUPPLEMENT No. 5

Index and Incidental Information

The index which follows includes only the diagrams found in the fifth supplement. Therefore, it should be consulted in conjunction with the main index which formed part of Supplement No. 3 and the separate index (on page 4-II) for Supplement No. 4. Insert this page in your manual directly after page 4H, so that it will be conveniently accessible along with the other indexes. Distribute the other pages as indicated by their respective page numbers.

C

COLUMBIA PHONOGRAPH CO.
C-80-A 210E
C-80-B 210F
C-90-A, C-90-B.....210C
C-800 .....210D

CROSLEY RADIO CORP.
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D

DETROLA RADIO CORP.
Roadmaster 510D

F

FADA RADIO & ELECTRIC CORP.
RE 7 tube chassis..236A
KY 10 tube, first production 236B
KY 10 tube, second production 236C
RC 11 tube chassis..236D
43 .....236E

G

GALVIN MFG. CORP.
61 Motorola 264E

GENERAL ELECTRIC COMPANY
S-42-B 236F

GRIGSBY-GRUNOW COMPANY
220 Chassis, 250A to 250H

H

HAMMARLUND MFG. CO.
Comet, second edition, 264A to 246D

K

KOLSTER RADIO, Inc.
K-140, K-142 .....264F

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PHILCO RADIO & TELEVISION CORP.
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80 .....308D, E, F
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UNITED AMERICAN BOSCH CORP.
"Vibro-Power" 512, 4HHH

U. S. RADIO & TELEVISION CORP.
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28 .....488C, D

W

WELLS GARDNER & CO.
062 .....510A

WHOLESALE RADIO SERVICE CO., Inc.
40, 40A....534A, B, C, D

Z

ZENITH RADIO CORP.
210, 220 CAB...576-O, P
103, No. 5A.576Q, R, S, T

LIST OF TRADE NAMES and MODEL NUMBERS
.....510B

"Orphan" Sets Still a Problem

All users of the OFFICIAL RADIO SERVICE MANUAL are urged to read the article on page 482 of the February, 1933 issue of RADIO CRAFT, for a detailed account of the difficulties that members of the service fraternity are experiencing with unbranded or "orphan" sets. Just as a reminder, please bear these considerations in mind: 1) we *must* have the model number and the manufacturer's name in order to look up service "dope" on any set. 2) If the name of the manufacturer is not marked anywhere on the set, and you cannot trace the wiring yourself, don't waste time writing to us or anyone else for service information. It is impossible to identify unknown sets merely from the tube combination or a description of the chassis. Save yourself money and aggravation and tell your customer frankly that the set is an unknown orphan.

* * * *

Those Colorful Resistors

Hundreds of thousands of fixed resistors were manufactured and sold long before the Radio Manufacturers' Association adopted its present color code. Therefore, don't be surprised if you encounter sets having resistors that don't check at all with the R. M. A. markings. Many resistor manufacturers had private color systems of their own, and no public record of them has ever been made available.

Incidently, many Service Men who have tried to work out the R. M. A. designations report they are unable to obtain correct values, and question the accuracy of the system. The answer is that the system is perfect; the trouble is in the previously unsuspected *color-blindness* of the Service Men who are doing the complaining. Some people live their whole lives without ever knowing they are color blind. It isn't a bad idea at all to have your eyes examined for this condition: you may save the doctor's fee on your next service job.

* * * *

25 and 60 Cycle Power Packs

Power transformers designed for 25 cycle operation are usually about twice the size of 60 cycle transformers for the same receiver. Therefore, do not undertake revision of 60 cycle sets for the lower frequency unless you are sure the chassis will accommodate the larger transformer.

Heavier chokes and larger filter condensers are also required for 25 cycle operation, as the lower frequency naturally needs more ironing out.

* * * *

Kill the Switch First!

Warning: do not remove tubes, particularly power output tubes, from their sockets with the juice on. With the load suddenly removed the plate voltages will shoot sky high, and are quite likely to puncture filter or by-pass condensers and throw an unnecessarily heavy load on the bleeder resistors. Play safe and kill the line circuit *first*.

* * * *

Corrosion of Condenser Plates

Many Service Men are under the impression that all variable condenser plates are made of aluminum. This is not so at all; a little probing with a permanent magnet will reveal that iron is quite commonly used. From the service standpoint this means that rusting and corrosion must be expected and guarded against.

UNITED AMERICAN BOSCH CORP.

BOSCH "VIBRO-POWER" TRIPLE-ACTION MODEL 312 12-TUBE "GRAND OPERA" SUPERHETERODYNE

(Dual reproducers, inter-station noise cutout, A.V.C., tone control, push-push power amplification, local-noise control, tuning meter, antenna compensator, hum control, mercury-vapor rectifier, band selectors, low-drain tubes.)

The term "Vibro-Power" undoubtedly has puzzled many persons who may have come in contact with this generalization of Bosch. The term refers to the Bosch receiver ensembles which incorporate the features enumerated above.

Triple action is obtained in the A.V.C. circuit as follows: Reduction of station noise by the application of time-delay operation; complete elimination of inter-station noise by adjustment of an auxiliary tube circuit, and; equal anti-fading or automatic volume control operation over the entire tuning band.

Following are the characteristics of the components: Resistor R1, manual volume control, 0.5-meg.; R2, tone control, 0.1-meg.; R3 hum control, 20 ohms; R22, "individual-location" noise control, 2,000 ohms; R4, R5, R17, R26, 0.1-meg.; R6, 500 ohms; R7, 0.5-meg.; R8, R10, R11, R13, 1.0 meg.; R9, 2 megs.; R12, R19, R21, 1,000 ohms; R14, R15, R16, R29, 10,000 ohms; R18, 1,500 ohms; R20, 30,000 ohms; R23, 2,800 ohms; R24, 2,400 ohms; R25, R27, 5,000 ohms; R28, 4 ohms; R30, 3,000 ohms.

Condensers C1 to C4, tuning units C1A antenna compensator and R.F. trimmer, C2A to C4A R.F. trimmers; C5 to C9, I.F. trimmers; C10, oscillator padding condenser; C11, C13, 0.1-mf.; C12, C14 to C22, C24 to C26, C30, C31, C37, C39, .05-mf.; C23, C36, C38, 100 mmf.; C27, 0.5-mf.; C28, C42, C43, 8 mf.; C29, C33, C34, C35, C41, 4 mf.; C32, .06-mf.; C40, C45, .01-mf.; C44, 2 mf.

Tube operating voltages (except filament), measured to ground, are as follows: Filament potential, all tubes, 2.4 V. Plate potential, V1, V2, 180 V.; V3, 75 V.; V4, V5, 195 V.; V6, 0.0 V.; V7, 120 V.; V8, 290 V.; V9, V10, 430 V.; V11, 2 V. Control-grid potential, except V8, 0.0 V.; V8, 30 V. Screen-grid potential, V1, 85 V.; V2, V4, V5, 90 V.; V6, 2 V.; V7, 25 V.; V7, 1.0 V.; V.8, 290 V.; V9, V10, 0.0 V.; V11, 25 V. Cathode potential, V1, 3 to 6; V2, 4.5 to 10 V.; V4, V5, 3.5 to 6 V.; V6, 40 V.; V7, 45 V.; V11, 0 to 45 V.

Tuning meter M operates over a range of 0 to 16 ma. The receiver consumes 80 to 150 watts, depending upon the A.F. volume; the Underwriters Laboratory rating (12% above minimum current drain) would be 90 watts. The sensitivity of the Bosch model 312 receiver is 1 to 2 microvolts absolute, at a power output of 100 milliwatts. The A. F. response characteristics of the two reproducers (one model C and one model G) are nearly identical; each field coil has a resistance of 2,500 ohms. The recommended antenna length is 40 to 80 ft. At the front left of the chassis is the combination off-on switch and manual volume control R1; in the center, the tone control, R2; and right, tuning control; condenser C1A is located in back of the tuning control. The "individual location" control (on the side of the cabinet) varies the proportion of program background noise; sensitivity above the noise level is not affected.

The triple-diode second-detector is so designated since it acts as three diodes, as follows.

The modulated I. F. output of the I. F. amplifier is applied to the control-grid and cathode of V6; the A. F. output is developed across R1 and applied to the control-grid of V7; this disposes of one diode. The modulated I. F. output of the I. F. amplifier is also applied to the plate (to which also is tied the suppressor-grid) and cathode of V6; the A.V.C. potential is developed across R8 and applied to the control-grids of V1, V2, V4 and V5 only when this potential exceeds the control-grid potential of 40 volts (the D.C. drop across the total resistance of R22, one end of which connects to the secondary of I. F. T. 3); this disposes of the second diode. The modulated I. F. output of the I. F. amplifier at the same time is applied to the screen-grid and cathode of V6; the inter-station noise suppressor potential is developed across R9 and applied to the control-grid of V11 only when this potential exceeds a pre-determined screen-grid potential between 0 and 40 Volts (the D. C. drop across the portion of R22 between the ground end and the moving arm); this disposes of the third diode.

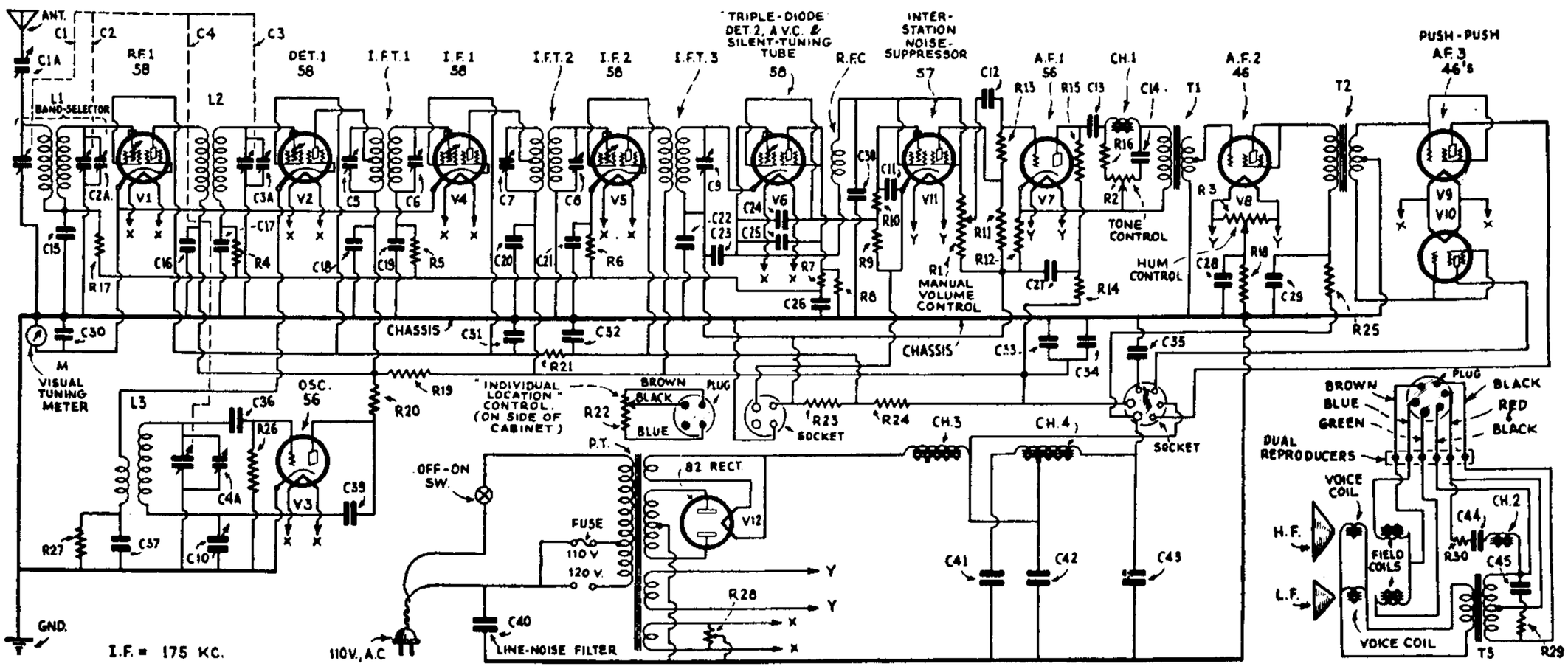
When there is no incoming signal, tube V11 has screen-grid potential, plate potential, and no control-grid potential. The plate therefore draws current and causes a drop across resistor R11; this potential is applied to the control-grid of V7, biasing it to plate current cut-off.

When there is an incoming signal the screen-grid of V6 draws current and the drop across R9 is applied to the control-grid of V11, biasing it to plate current cut-off, thus re-establishing the normal control-grid bias of V7. This action is assisted by the D. C. in R1 and to some extent reduces the screen-grid potential of V6 and V11.

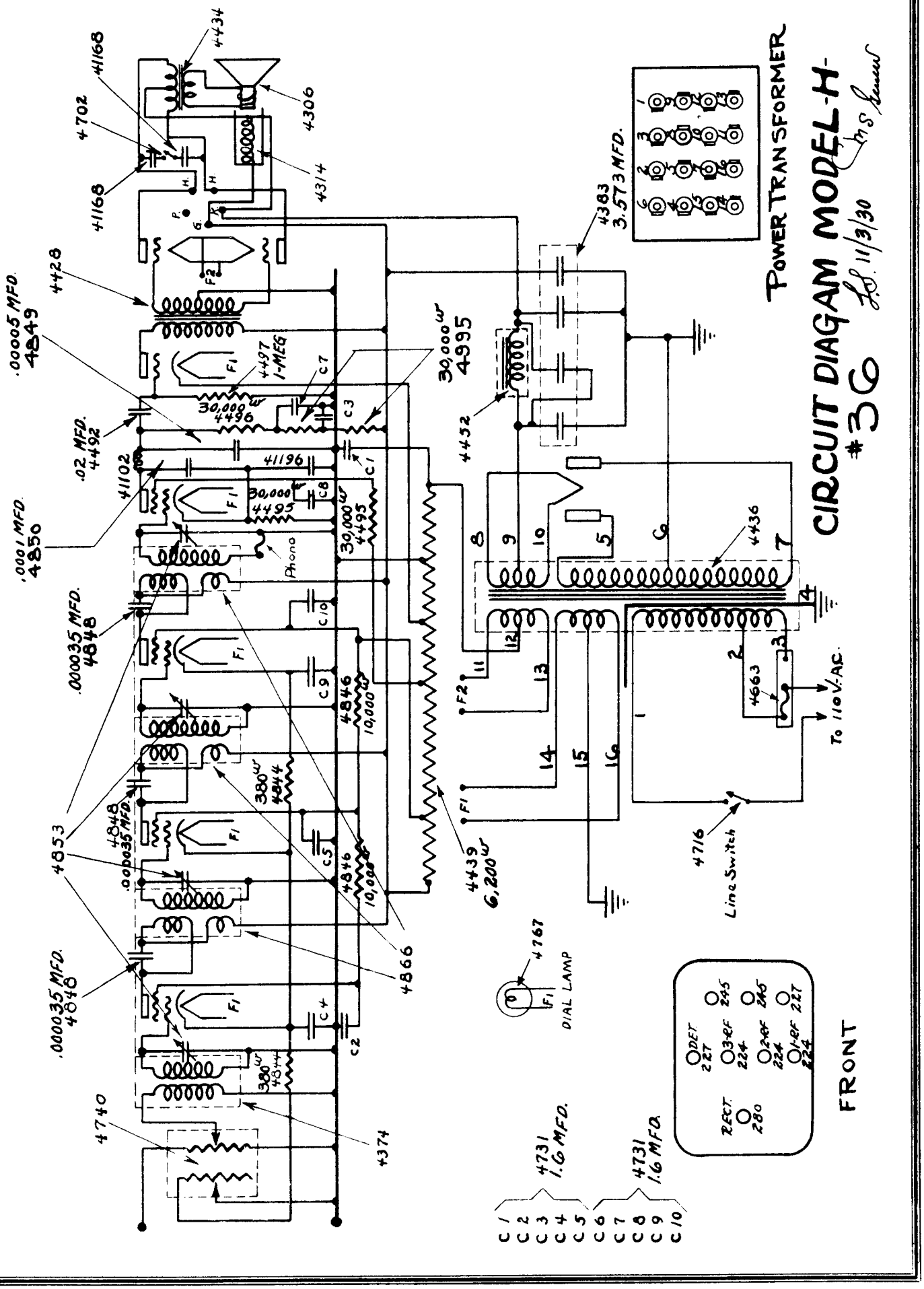
Note that while making adjustments on the chassis the service oscillator signal should not be permitted to overload the tubes, as this will result in incorrect settings.

To make adustments of the I. F. portion of the set, adjust R1 to maximum, set R2 on treble, and ground the antenna lead. Then, connect the 175 kc. service oscillator to the control-grid of V2, and align C9 for maximum output. Next, rig up an alignment "losser" consisting of a 25,000 ohm resistor and a 250 mmf. fixed condenser, and ground one of the two leads; the other end is to be connected either to the grid or the plate circuit of a tube, as directed. With the free terminal of the losser connected to the control-grid of V5, adjust C7; then, with the losser connected to the plate of V4, adjust C8. Finally, connect the losser to the control-grid of V4, and adjust C5; then, with the losser connected to the plate of V2, adjust C6.

To align the oscillator circuits, adjust trimmer C4A for maximum output (with the set pointer past 550 kc.) from a 1,400 kc. service oscillator connected to the control-grid of V2. Note that when adjusting C4A two peaks may be obtained; after tightening the C4A adjusting screw, release it about ½-turn until the peak at 1,575 kc. is obtained (otherwise the oscillator will not track in the center of the scale); then, align C1A, C2A and C3A. Finally, set the service oscillator for 600 kc. and adjust padding condenser C10.



ALL-AMERICAN MOHAWK CORP.



SUPPLEMENT No. 4

Index and Incidental Information

The index which follows includes only the diagrams found in this supplement. Therefore it should be consulted in conjunction with the main index which formed the front part of Supplement No. 3. Insert this page and the seven following directly after page 4H, so that the two indexes will be conveniently close together.

A

ATWATER KENT MFG. CO.
43 ..... 4JJ, 4KK
46 ..... 4JJ, 4KK
47 ..... 4JJ, 4KK
53 ..... 4JJ, 4KK

B

BROWNING-DRAKE CORPORATION
20 ..... 4MM
40 ..... 4NN
80 ..... 4-OO
100 ..... 4PP
Model Jr. 4PP

E

ELECTRICAL RESEARCH LABORATORIES, Inc.
Battery operated screen grid receiver 232A, 232B, 232C

G

GENERAL ELECTRIC COMPANY
"Convention" Model J-125 ..... 424N

GRIGSBY-GRUNOW COMPANY
290 chassis (also Madison Model 291, Adams Model 293, Monroe Model 294) 4LL

P

PHILCO RADIO & TELEVISION CORP.
Model 47 Series, 232D, 232E, 232F, 232G
Code numbering of Philco coils 232H
Parts Information on 25 cycle models 232-I
Auto Radio Hints 232-I

R

RCA-VICTOR, Inc.
R-78 ..... 424N

S

STEWART WARNER CORPORATION
Series 950 Screen receivers ..... 424A to 424M

T

TRANSFORMER CORPORATION OF AMERICA
Series 200 short wave ..... 468A to 468G
Model 220 ..... 468H to 468P

W

WESTON ELECTRICAL INSTRUMENT CORP.
Adapters for Weston and Jewell analyzers 232J, 232K, 232L

Z

ZENITH RADIO CORPORATION
91 ..... 576A to 576-I
92 ..... 576A to 576-I
Model 2009-C-P (LP) 576L
Model 2009-C 576M
Model 2022 (LH, WH, MH) 576J
Models A, B, C, D 576K
Model BH-LHB 576N

The outstanding problem that seems to have bothered Service Men during the past several months is mysterious fading that is obviously due to the receivers themselves and not to atmospheric conditions. All ordinary service tests with standard analyzers reveal nothing out of order. In many cases a set of new tubes works a cure, but in other cases this does not help.

The best thing to do under these circumstances is to measure the values of all important resistors and condensers, first with the set absolutely cold and then again after it has warmed up thoroughly. You may notice some surprising differences in values that may give you a valuable clue to the trouble.

* * *

We cannot under any circumstances supply copies of diagrams not already listed in the indexes. Individual sheets from either the 1931 or 1932 Manuals cost 25 cents each. We are forced to charge for these because the removal of single sheets breaks up a complete Manual or a supplement. Do not send question coupons for such sheets; the questions coupons are good for legitimate service questions only.

* * *

Many Service Men regard the avalanche of new tubes with considerable anxiety. They really have nothing to worry about, as the shape of many of these tubes is more imposing than their actual "insides." They are still electron tubes, even if they have three or four odd grids. If you have been following the data on them as given in RADIO CRAFT you will have no difficulty in servicing next season's receivers.

* * *

Many Service Men, particularly in the farm districts where 110 volts A.C. is something to dream about, write in for "dope" on revamping old style battery receivers using '01A tubes so as to employ up-to-date screen grid tubes. Our usual answer is that such revision is hardly worth while, in view of the very low prices of new receivers. When you consider the cost of new R.F. transformers, the necessary shields and the tubes themselves, and also the amount of labor involved in the change, the futility of the whole thing becomes apparent. It can be done, undoubtedly, but what's the use of doing service work if you don't make a profit on your labors?

* * *

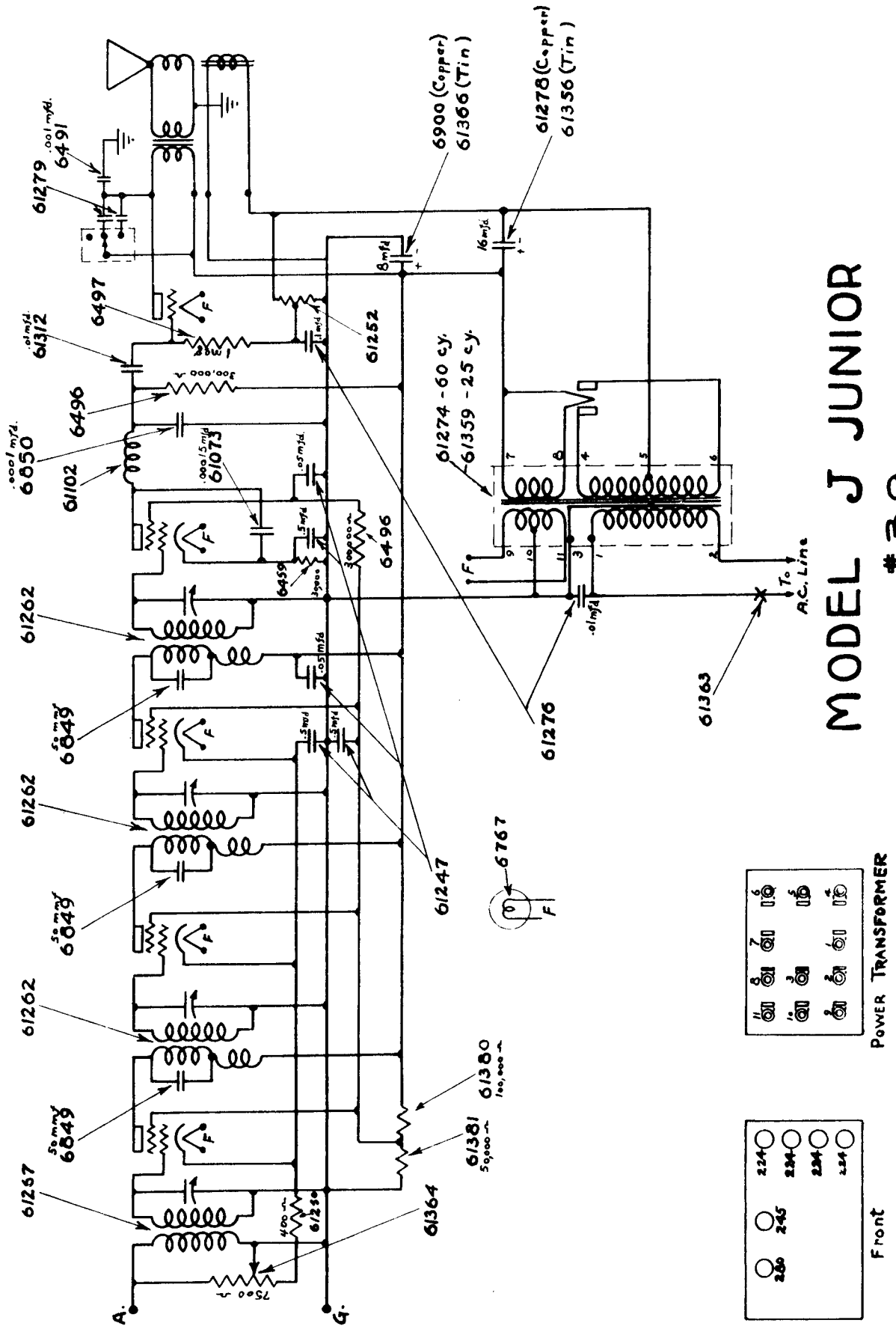
Warning!! Don't try to use the new type 82 rectifier tube in power packs designed for the 80. Many people have the idea that the use of the 82 will increase the output voltages, because the voltage drop through it is only 15 volts. What they overlook is the fact that the filament of the 82 is rated at 2½ volts, as compared to 5 volts for the 80. This difference alone, aside from the seriously different output characteristics, makes the change impracticable.

* * *

"Orphan" receivers continue to be a source of annoyance. As we have stated in previous supplements, we are not magicians, and we cannot look up service data on a set without knowing at least the name of the manufacturer. If there is no mark of identification of any kind on an ailing set and you cannot trace out the circuit with the aid of an analyzer, you simply have to make the best of things.

We might mention that many "stencil" receivers made for the mail order and furniture houses bear the name of the manufacturer in some inconspicuous spot under the chassis. Before giving up a set as hopeless look inside carefully for concealed name plates.

ALL-AMERICAN MOHAWK CORP.



ATWATER KENT MFG. CO.

MODEL 43, 46, 47 AND 53 CHARTS

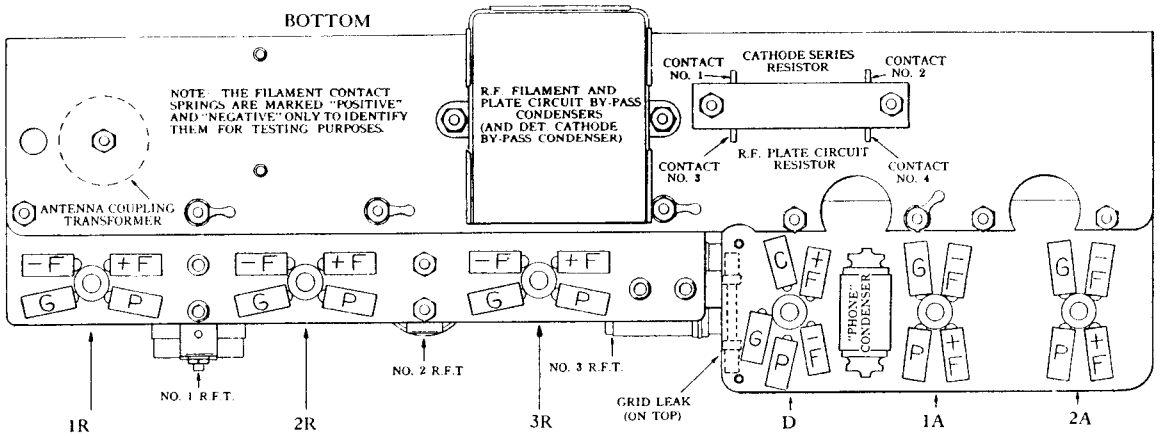


FIG. 113. TEST CHART FOR MODEL 43, 46 AND 53.
Model 47 chart is similar except that it has four separate R. F. sockets.

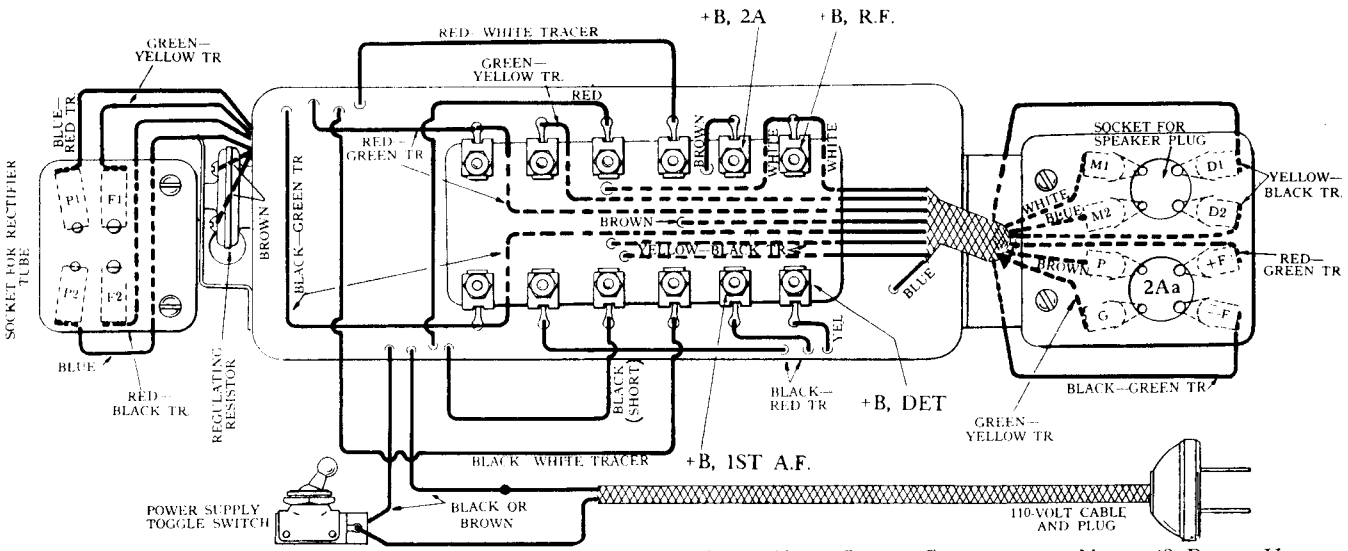


FIG. 114. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN MODEL 43 POWER UNIT.
In early type of power unit for Model 43, two brown leads from the primary-shunt condenser connect to the +B, 2A terminal and to the brown P2Aa lead respectively. In later models these connections are made internally.

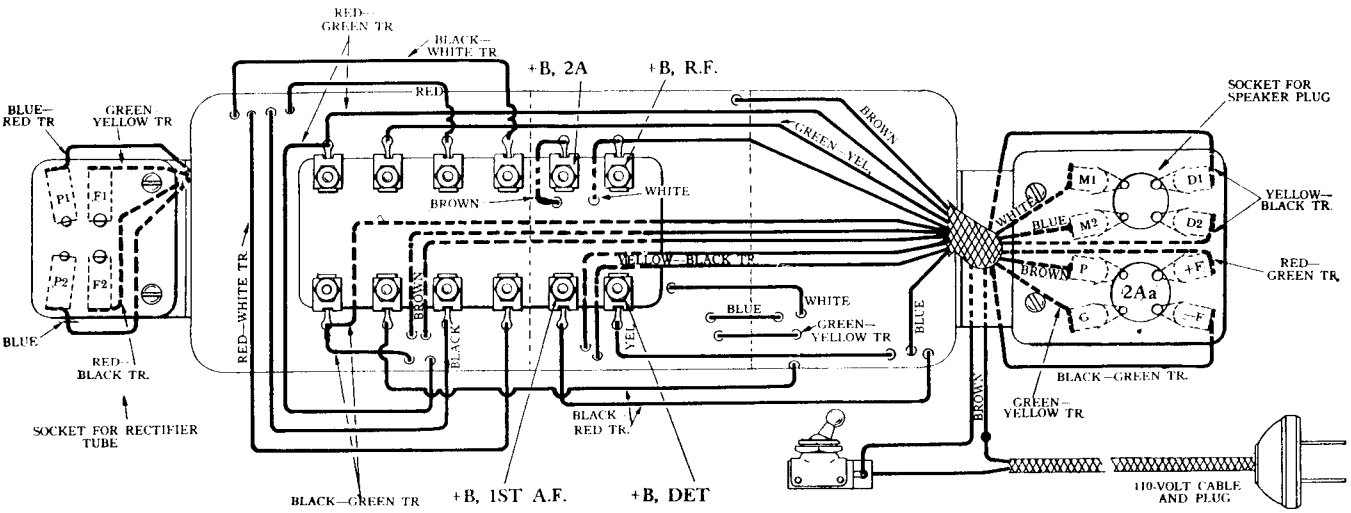
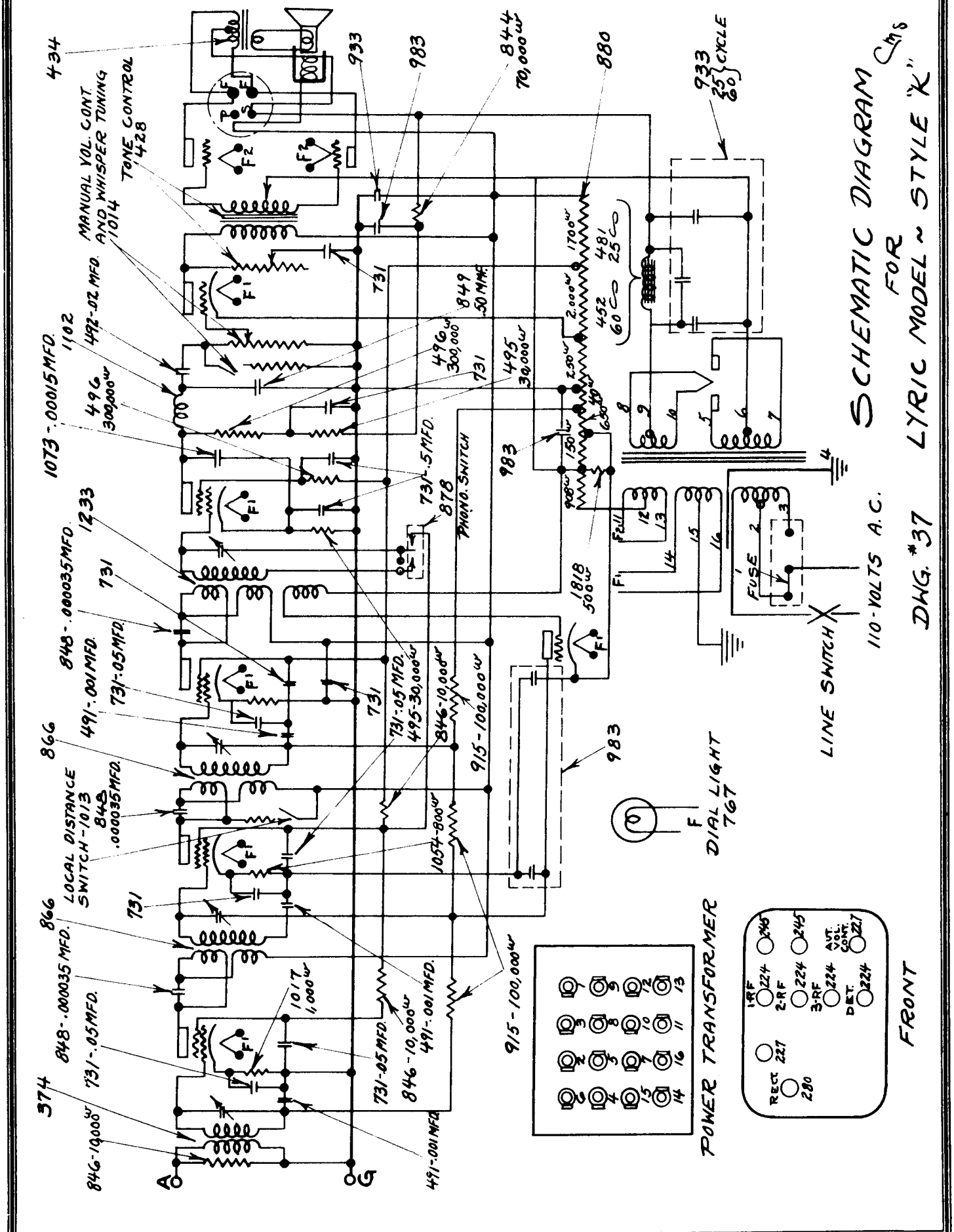


FIG. 115. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN POWER UNIT FOR MODEL 46, 47 AND 53.

This view shows the panel assembly moved to the left of its normal position. The replaceable condenser assembly is in the right-hand end of the container. A black lead from the condenser assembly, and a green lead from the transformer assembly are connected to a ground lug under the left-hand panel mounting angle. (Wiring diagram is similar to that on Page 69.) In some units of this type the two leads to D1 and D2 are red (No. 18 wire) instead of yellow-with-black-tracer.

ALL-AMERICAN MOHAWK CORP.



ATWATER KENT MFG. CO.

MODEL 43, 46, 47 AND 53 DIAGRAM

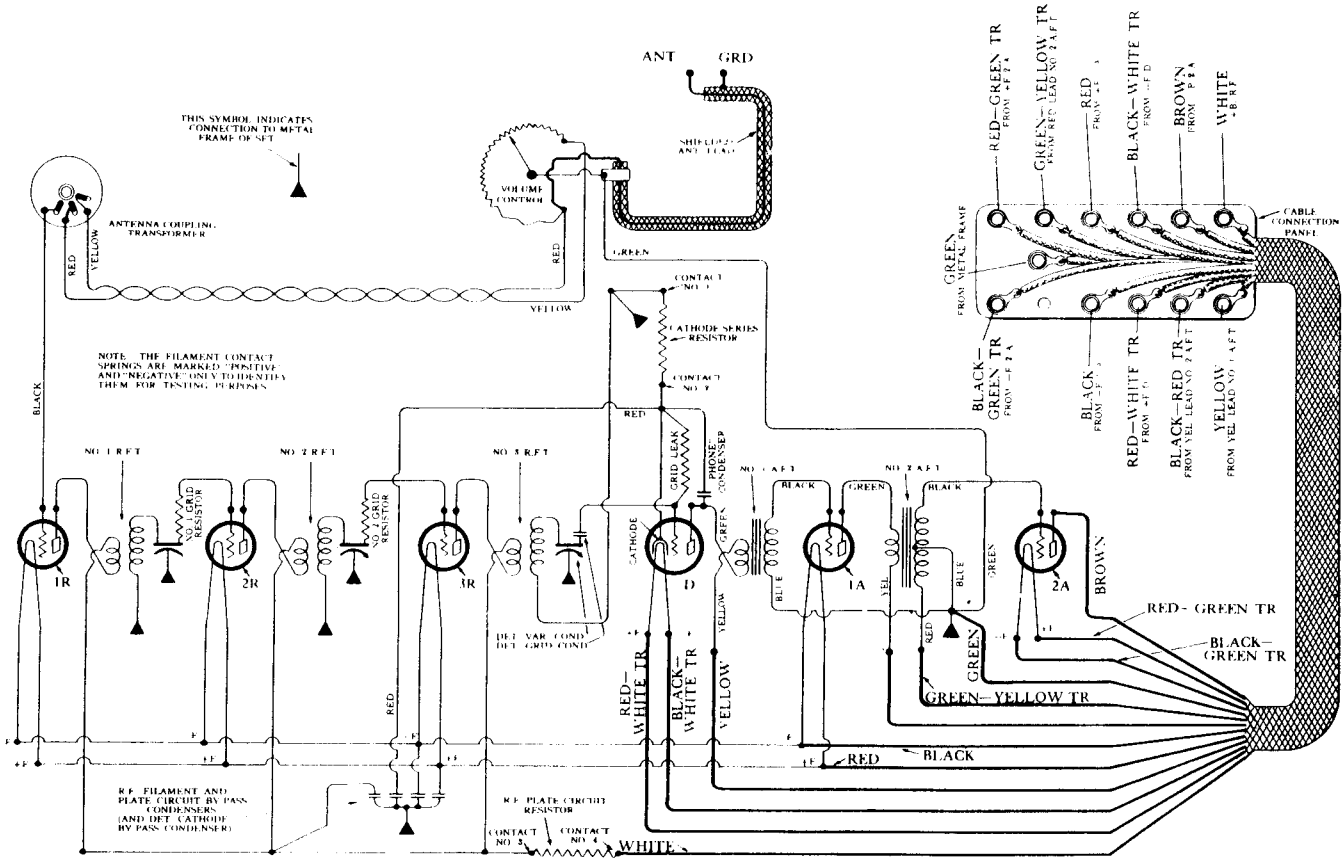


FIG. 111. WIRING DIAGRAM OF MODEL 43, 46 AND 53.
The +B, 1st A. F. cable lead is black with a red tracer.
Model 47 is similar but has one additional stage of R. F. amplification and a local-distance switch like that on Model 44.
See Page 59 for R. F. transformer connections.

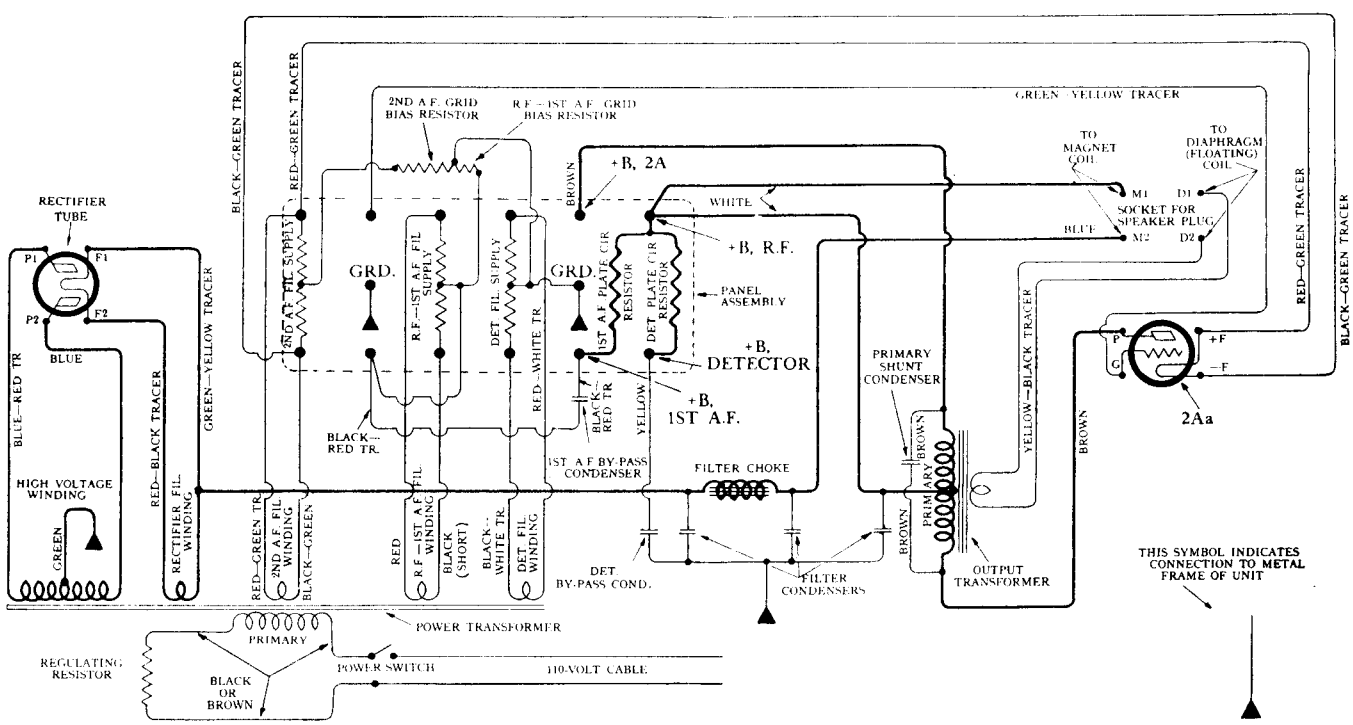
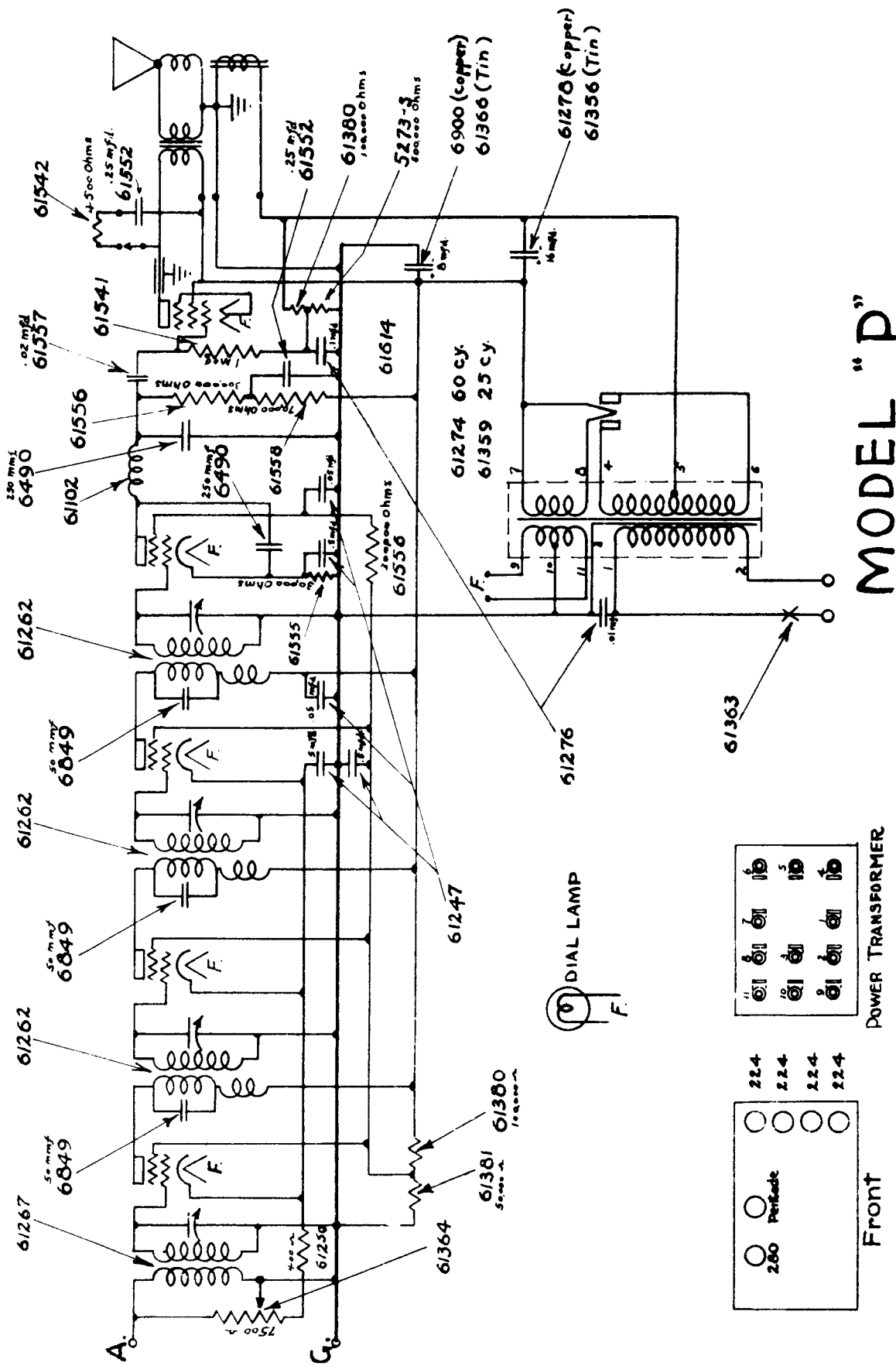


FIG. 112. WIRING DIAGRAM OF POWER UNIT IN MODEL 43.

ALL-AMERICAN MOHAWK CORP.



GRIGSBY-GRUNOW COMPANY

MAJESTIC 9-TUBE SCREEN-GRID SUPERHETERODYNE, A.V.C. MODEL 290 CHASSIS

(Madison Model 291, Adams Model 293 and Monroe Model 294 receivers incorporates silent tuning and new tube types.)

The circuit in the Model 290 chassis follows in general the connections employed in the earlier models 200, 210 and 220 chasses.

Following are the electrical characteristics of the components of this receiver.

Resistor R1, manual volume control, .25-meg.; R2, noise suppressor, 6,000 ohms; R3, tone control, 50,000 ohms; R4, R8, R14, 0.1-meg.; R5, R9, R10, R11, R12, R13, 0.3-meg.; R6, 5,000 ohms; R7, 10,000 ohms (12,000 ohms, in a few early models); R15, 2,000 ohms; R16, 400 ohms; R17, 700 ohms; R18, 180 ohms; R19, 18,000 ohms; R20, 2,400 ohms; R21, 6,700 ohms; R22, 230 ohms; R23, hum control, 20 ohms, center-tapped. The field coil has a resistance of 1,260 ohms.

Tuning condensers C1, C2, are the R.F. tuning units of 18-363.4-mmf. and condenser C3 is the oscillator tuning unit of 21-335 mmf.; C1A, C2A, R.F. trimmers, 20-30 mmf. and C3A, oscillator trimmer, 20-40 mmf.; C4, C5, C6, C7, I.F. trimmers, 28-190 mmf.; C8, 10 mf. (electrolytic); C9, C11, C13, C15, .25-mf.; C10, .05-mf.; C12, 0.1-mf.; C14, C16, C17, C19, C22, C23, .01-mf.; C18, C21, 500 mmf.; C20, C24, .03-mf.; C25, C26, 8 mf. (electrolytic); C 27, 7 mf. (electrolytic); C28, .001-mf.

Condensers C9 to C13 are located in one shield can; units C22, C23, C24, C28 are located in another.

The aligning condensers for this receiver are located on top of the condenser gang. The oscillator is designed to dispense with the "padding" unit required in earlier circuit arrangements.

The current consumption of this receiver is 75 watts.

Operating tube characteristics follow (line potential, 115 V.; silent-tuning control all the way clockwise; all D.C. voltage readings are to ground):

Filament potential, all tubes, 2.5 volts; plate potential, V1, V2, V4, 265 V.; V3 90 V.; V5, 0 V.; V6, 155 V.; V7, 240 V.; V8, 85 V. Cathode potential, V1, V4, 3 V.; V2, 6 V.; V3, 15 V.; V5, V8, 0 V.; V6, 90 V. Plate current, V1, 4.4 ma.; V2, 3 ma.; V3, 1.6 ma.; V4, 5.8 ma.; V5, 0 V.; V6, 0.6-ma.; V7, 28 ma.; V8, 1.4 ma.; V9, 70 ma. (total). Screen-grid potential, V1, V2, V4, 90 V.; V6, 135 V.; V7, 265 V.; V8, 0 V. Screen-grid current, V1, 1.0 ma.; V2, 0.6-ma.; V4, 1.5 ma.; V6, 0.1-ma.; V7, 7 ma.; V8, 0 ma.

To eliminate background noise while tuning, some receiver models incorporate a "mute tuning" switch; to eliminate the need for this manual operation there was developed the "synchronous silent tuning" circuit which is incorporated in the model 290 chassis. To obtain this action a "synchro." tube, V8 in the diagram below, is connected to control the plate-current cutoff of the first A.F. tube V6.

The synchro. tube V8 obtains its plate supply through resistor R6, which also is in the control-grid circuit of A.F. amplifier V6. Tube V8 obtains its control-grid potential from the A.V.C. circuit.

Therefore, when a station carrier is not tuned in, there is no A.V.C. potential and hence the potential of the control-grid of V8 is approximately zero voltage. This causes the plate of V8 to draw current through resistor R6. Now, the voltage drop across this unit biases the control-grid of V6 so high that V6 is "blocked."

On the other hand, when a station is tuned in, an A.V.C. potential develops across load resistors R13 and R14 (in the anode-return circuit of the duodiode tube V5); this A.V.C. potential is impressed in the form of a negative bias on the control-grid of V8.

The plate of V8 now draws little or no plate current and hence the bias across R6 disappears, leaving nothing but the normal operating bias on V6.

In this condition the entire set is operative just as though there were no synchro. tube in the circuit. In fact, it is possible after tuning in a station to remove the synchro. tube without noticing any difference. On the other hand, if this tube is removed when a station is not tuned in, the customary inter-station noises are heard.

Because of the variation in antennas, and noises in different locations, it is necessary to provide a control to govern the point at which the synchro. tube takes hold. Potentiometer R2, the "noise suppressor," is therefore included in the screen-grid circuit of V8.

In correctly setting the value of R2 the following steps should be followed.

(1). Set the suppressor knob to the position of no suppression (full clockwise, facing control);

(2). Tune the receiver to a position off the setting for a station and preferably near the low-frequency end of the dial;

(3). Next, turn the volume-control resistor R1 full on. In this position noise will be heard in a degree dependent upon the location;

(4). Now, adjust the noise suppressor control by rotating counter-clockwise, slowly, until the noise just stops. It will be found that the noise drops out quite suddenly, making it desirable that the control be set only to the position required to take out the noise and no further counter-clockwise than necessary;

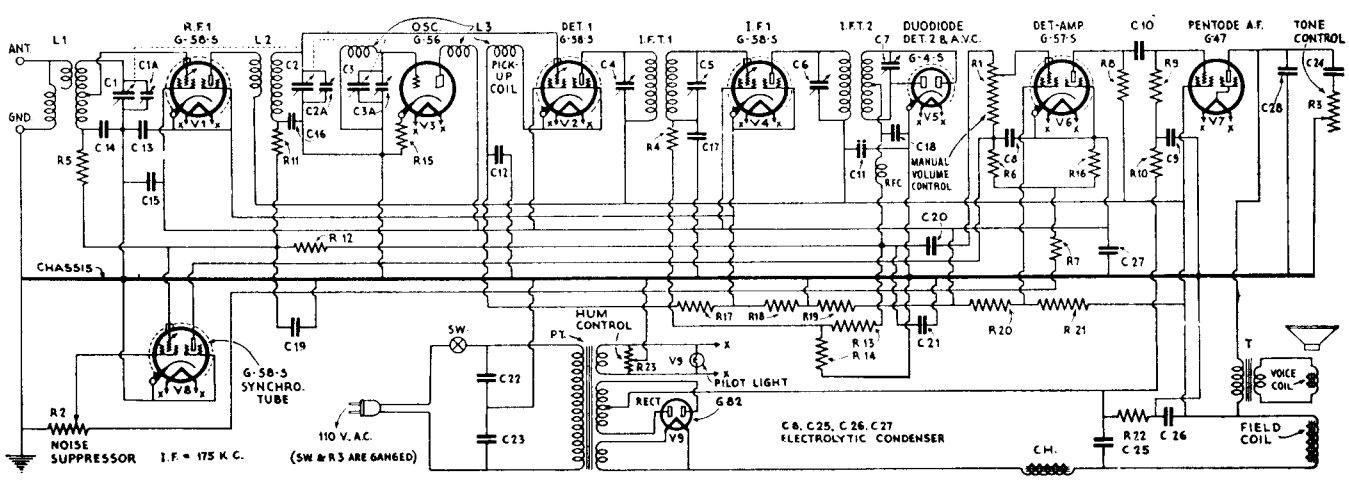
(5). Although the set now is in operating condition, it may be found that in some particular locations the noise is greater at one end of the dial than at the other, so that if the noise suppressor is adjusted to take out noise at the low-frequency end of the dial, some noise may come in at the high-frequency end. In this case, it is advisable to readjust the noise suppressor at the high-frequency end of the dial;

(6). The final step in operating this type of circuit concerns its adjustment for greatest sensitivity. When extreme distance reception is desired, without regard to the noise-level between stations, simply turn the "automatic synchro-silent tuning control" knob as far clockwise as possible.

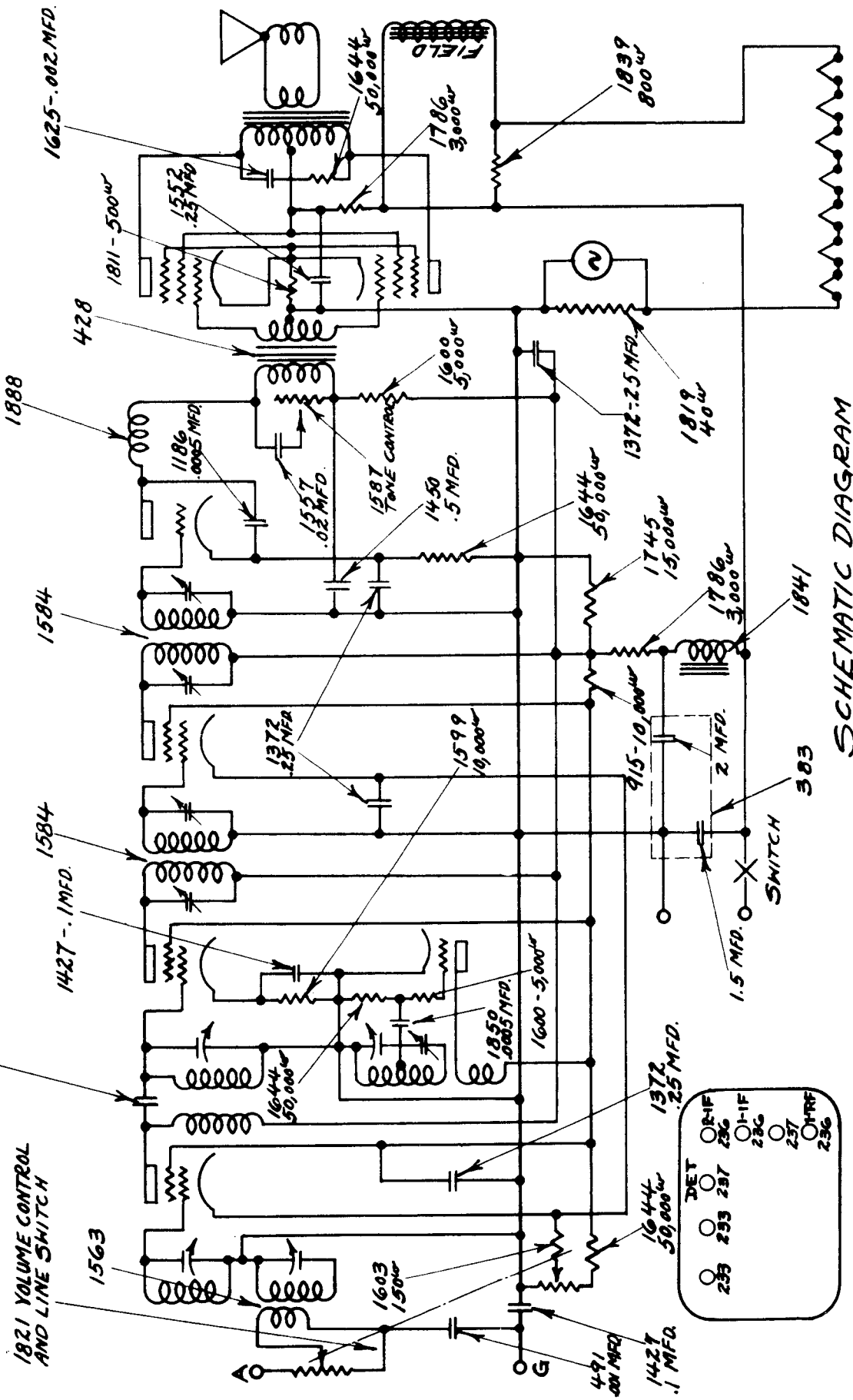
The normal antenna length for this chassis is 40 to 60 feet. The reproducer is a type G-19-A unit having improved characteristics.

The variable-mu characteristic of the type 58 tube makes it particularly suitable as an R.F., first-detector, and I.F. amplifier. The type G-4-S spray-shield duodiode tube used as second-detector and A.V.C., V5, is similar in design to the type G-2-S tube (described in the May, 1932 issue of RADIO CRAFT), except for the smaller dimensions of the G-4-S; also, the latter tube has a heater current rating of 1. A., against 1.75 A. for the former.

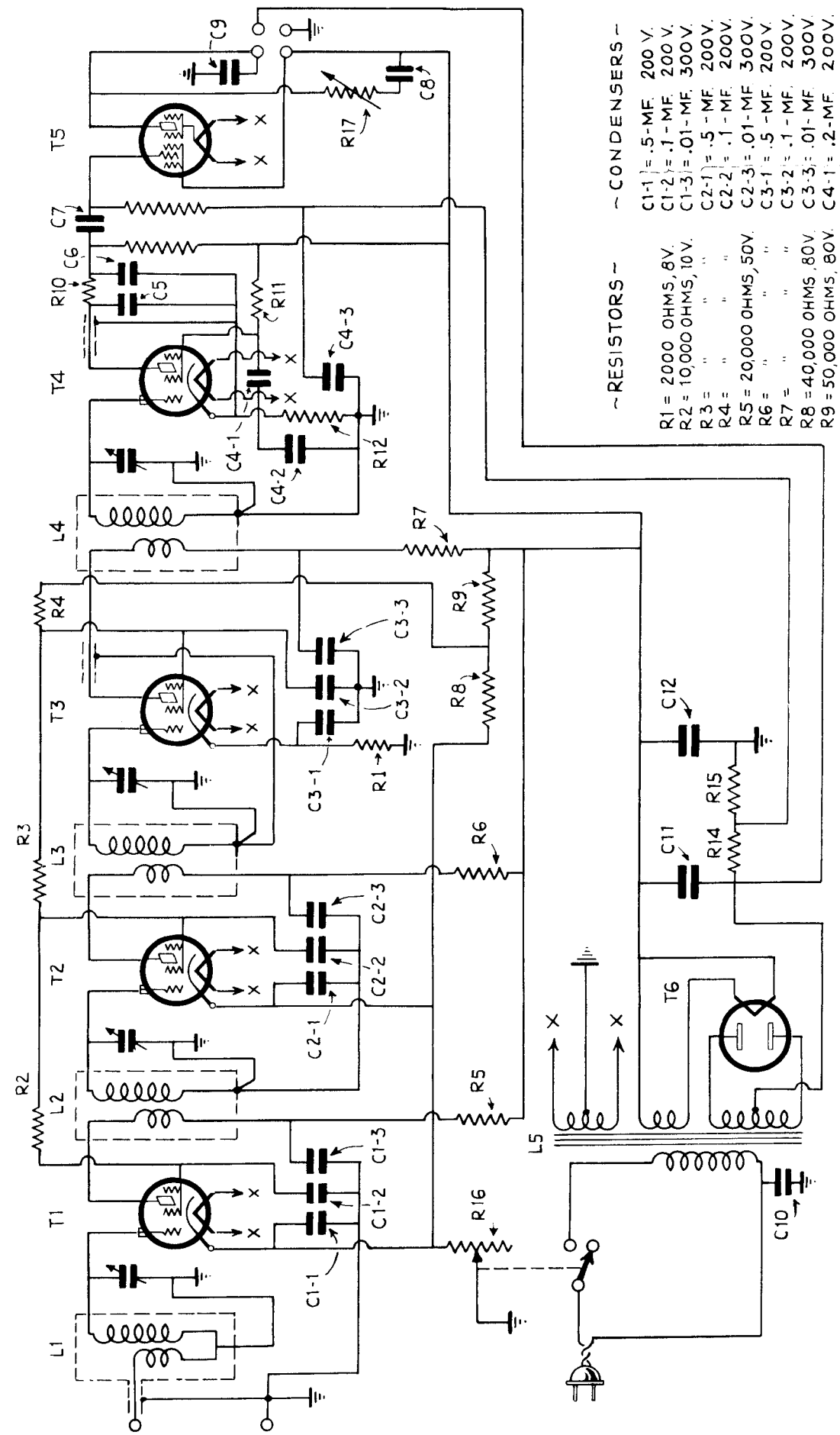
The initial bias on the control-grids of the R.F. and I.F. tubes is obtained from resistor R18; the bias for the first-detector is the drop across R17. To these three tubes is applied the A.V.C. bias potential which is developed across resistors R13 and R14. Resistors R5, R11, R4, and R12, are bypassed filter resistors.



ALL-AMERICAN MOHAWK CORP.



BROWNING-DRAKE CORP.



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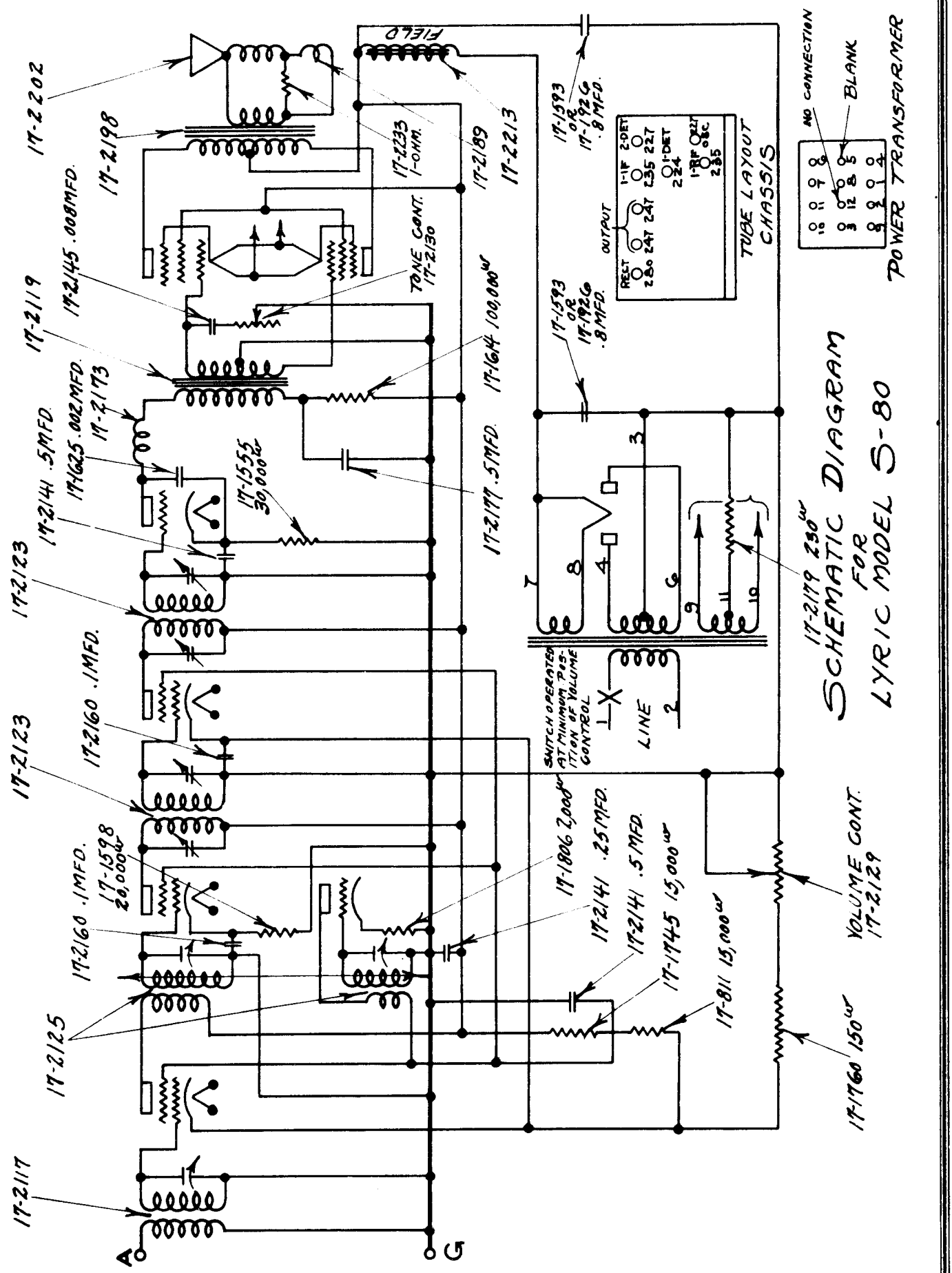

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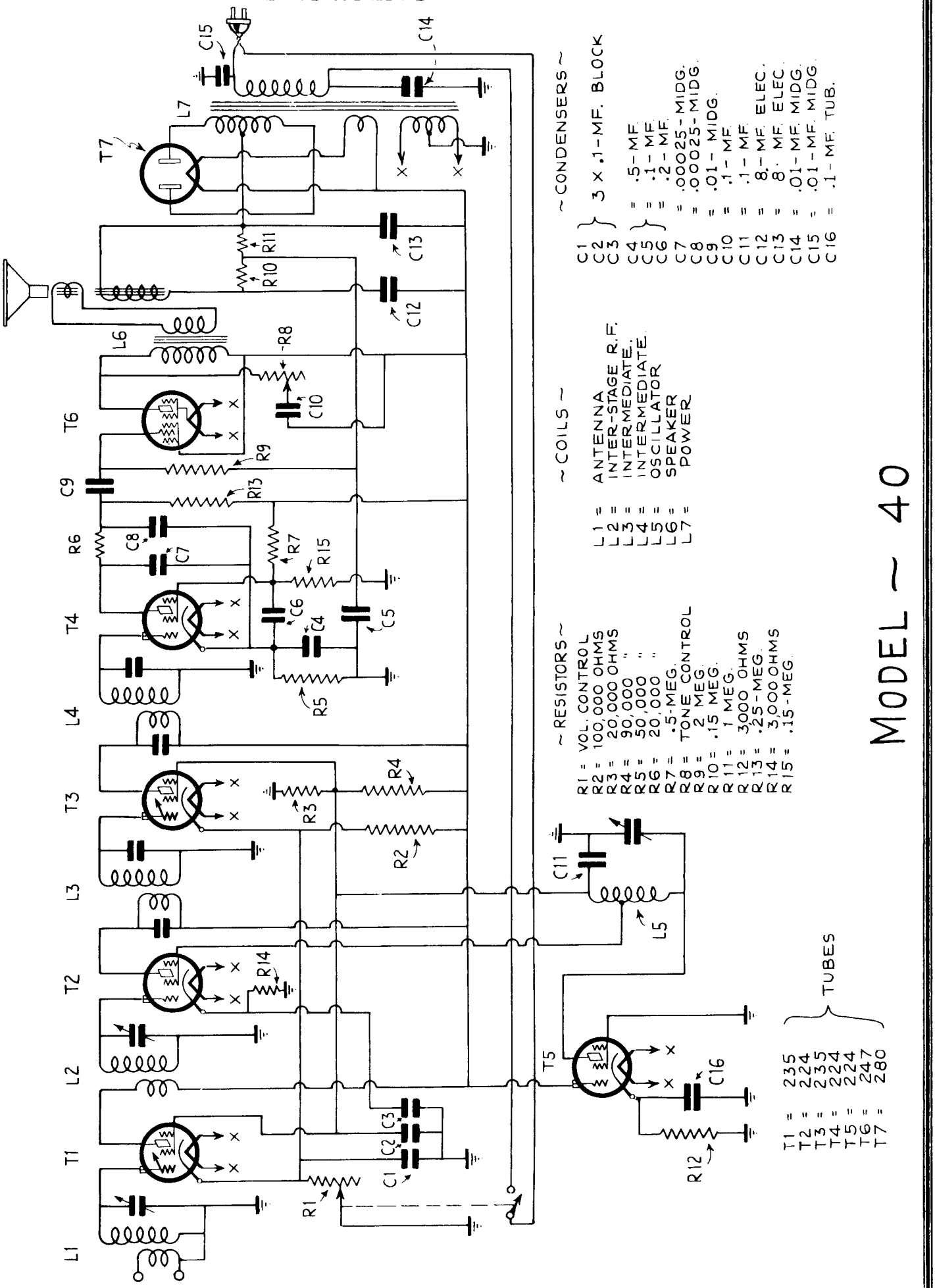

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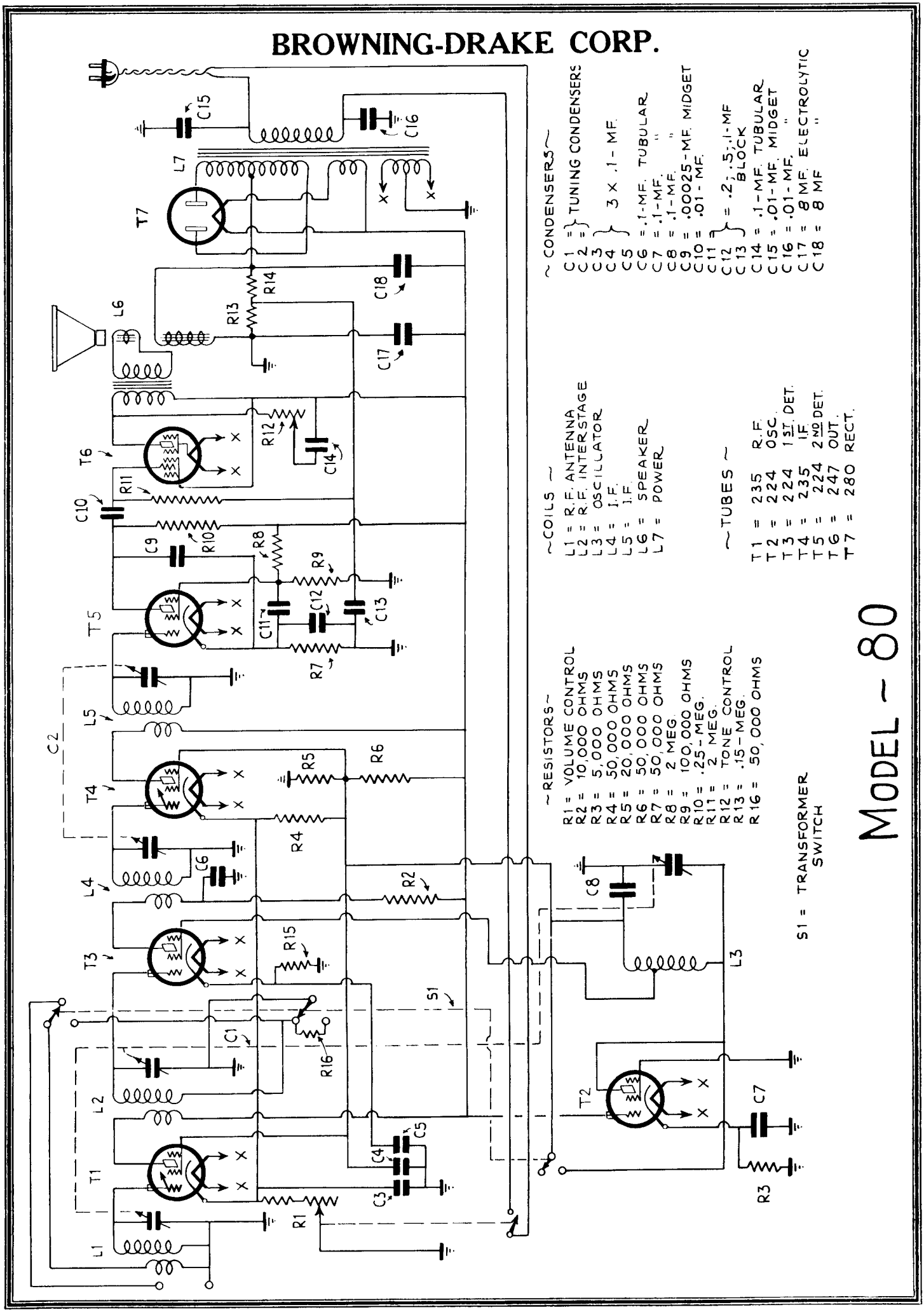
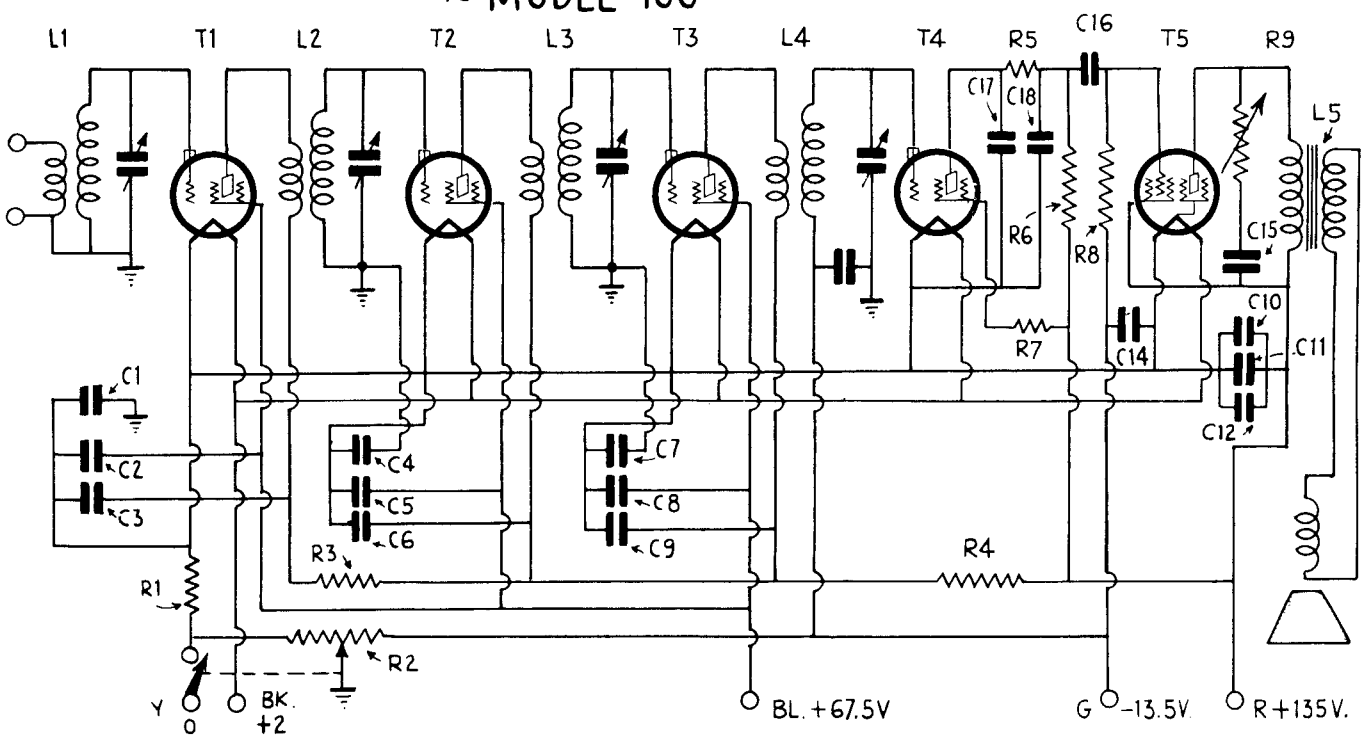


BROWNING-DRAKE CORP.

~ MODEL 100 ~



CONDENSERS

C1, C2, C3 = 3 X .1-MF.
C4, C5, C6 = 3 X .1-MF.
C7, C8, C9 = 3 X .1-MF.
C10, C11, C12 = 3 X .1-MF.
C13 = .1-MF. TUB. C14 = .1-MF. TUB.
C15 = .1-MF. TUB. C16 = .01-MF MIDGET
C17 = .00025-MF C18 = .00025-MF.

COILS

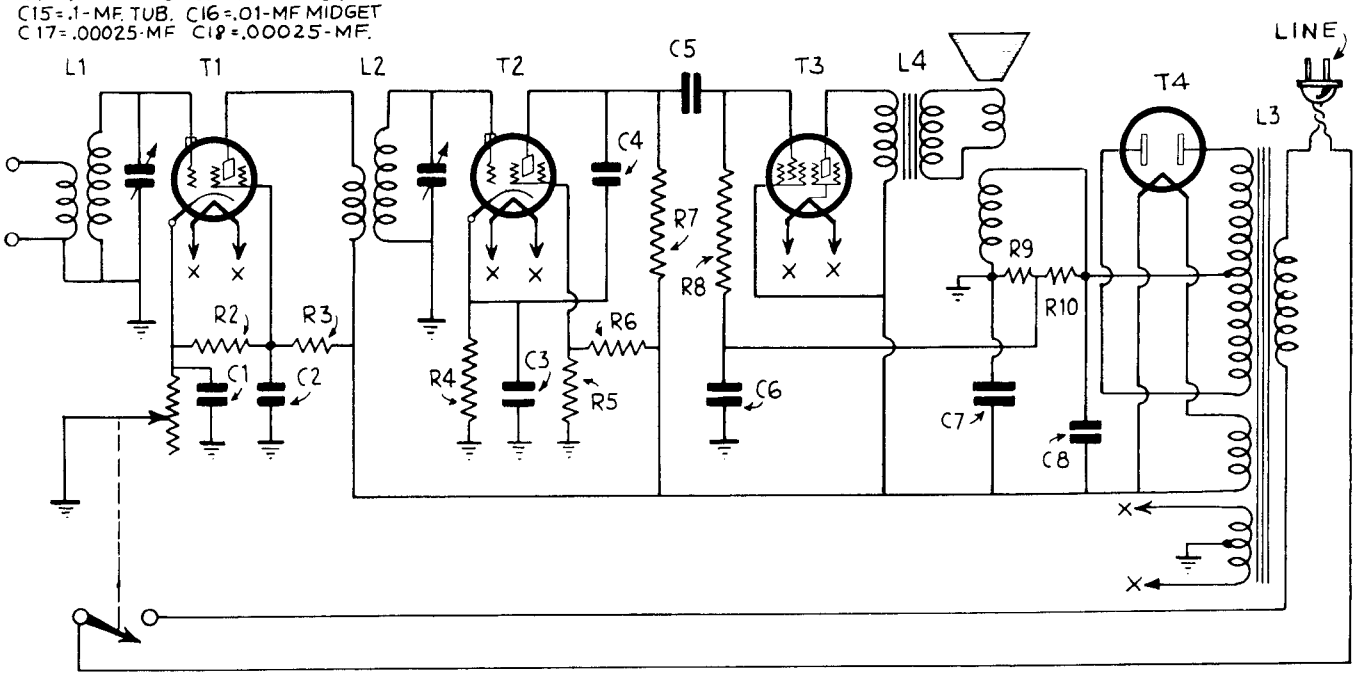
L1 = ANT.
L2 = INT.
L3 = INT.
L4 = INT.
L5 = SPKR. OUTPUT

TUBES

T1 = 232
T2 = 232
T3 = 232
T4 = 232
T5 = 233

RESISTORS

R1 = 1 OHM ADJ.
R2 = VOL. CONT.
R3 = 2000 OHMS
R4 = 2000 OHMS
R5 = 20,000 OHMS
R6 = .25-MEG
R7 = 2 MEG
R8 = 2 MEG
R9 = { TONE CONTROL



CONDENSERS

C1 = .1-MF. 200V. N.I.
C2 = .01-MF. M.
C3 = .1-MF. 200V N.I.
C4 = .00025-MF. M.
C5 = .01-MF. M.
C6 = .1-MF. 200V. N.I.
C7 = 8 MF. ELEC.
C8 = 8 MF. ELEC.

COILS

L1 = ANT.
L2 = INT.
L3 = P.T. RAD. CO. MB-2
L4 = SPKR 2500 OHMS FIELD 7000 OHMS INPUT

TUBES

T1 = 235
T2 = 224
T3 = 247
T4 = 280

RESISTORS

R1 = 10,000 OHMS VOL. CONTROL
R2 = 40,000 OHMS. R3 = 40,000 OHMS
R4 = 50,000 OHMS. R5 = .1-MEG
R6 = 2 MEG. R7 = .25-MEG, R8 = 2 MEG.
R9 = .1-MEG. R10 = .5-MEG.

~ MODEL JR. ~

+ INTRODUCTION +

IN compiling the new 1932 edition of the OFFICIAL RADIO SERVICE MANUAL, the editors have been inspired by the tremendous interest shown by Service Men all over the country.

Of the first edition, a total of 38,000 copies have been sold, and many more thousands will be sold in the future for the reason that there is no duplication between the information published in the first issue and the material published in the 1932 issue, or subsequent volumes.

The thousands of letters filled with helpful suggestions, criticisms, and praise, have been all carefully read, and the many ideas which, in the opinion of the editors, would enhance the value of the new volume, have been included in the present Manual.

The editors take this occasion to thank all of their many friends for the letters submitted during the year.

The electrical circuits of the most modern types of receivers naturally take up the major portion of the Manual. Radio Service Men will, no doubt, appreciate the increased information about the resistance, capacity and voltage values, which is so essential today, when time-saving and accurate knowledge are such important considerations to the Service Man.

The inclusion of the graphs on the characteristics of the various types of tubes now standard in the market, we are certain, will interest all radio men. The heart of the modern radio receiver is the vacuum tube, and no one can afford to ignore this information, which has never before been available in such compact and usable form.

For the radio Service Man just starting in the field, the section devoted to "Analysis of a Typical Receiver" will be of extreme helpfulness. No single receiver on the market contains every important feature of interest to the Service Man; for that reason, the presentation of a hypothetical radio receiver was considered necessary. This receiver embraces the outstanding variations, sectionalized into the radio-frequency, detector, and audio-frequency circuits. The various types of power supplies, automatic volume controls, and remote controls receive sufficient treatment so that the underlying theory covering the function of the various components employed will be clearly understood.

A new section in the back of the book covers the circuits, with data, on sound-picture and public-address systems. This is in answer to the many inquiries on this subject.

While it is true that not every Service Man will have occasion to use such information, it often happens that he may be called in to service such apparatus, and then this information will prove invaluable.

It has been a source of great satisfaction to the editors to welcome the change of policy by the radio set manufacturers. Only a year ago, it was most difficult for the editors to procure all the available data on manufactured sets. This year, with practically no exception, set manufacturers have vied with each other to cooperate with the editors to make this Manual the outstanding one in print. The reason, of course, is that the set manufacturers realize today the great and growing importance of the Service Man who makes the actual, and often the only, personal contact with the set owner. Then, too, the opinion of the Service Man, as a rule, makes a lasting impression on the ultimate consumer as to the relative merits of a radio set or other radio equipment.

We will be pleased to receive suggestions and criticisms from the men in the field as to how this Manual can be further improved. This Manual has been created for the Service Man, and the editors naturally feel that he is the one who can best tell what would be necessary to enhance the value of the book to them.

It should be noted that there is not a line of duplication between the 1931 Manual and the present one. All the material published in the 1932 Manual is original, and new. It is the intention of the Publishers to bring out a new Manual every year, and every Manual will be new from start to finish.

To the radio set manufacturers and radio equipment manufacturers who have so generously furnished service data and information on their respective products, and to the thousands of well-wishers who have written in during the course of the year, we wish to extend our sincere thanks, with the hope that the present volume will be of growing usefulness to the radio industry, and particularly to the radio Service Man.

New York, October, 1931.

THE EDITORS.

ELEMENTARY RADIO SERVICING

FIRST PRINCIPLES

IT is not essential that we delve into the scientific reasons for various phenomena—merely that we gain a clear idea of the inter-relation of electrical units so that we may more readily picture what is going on behind the scenes in a radio receiver and attack our service problems in a sane manner.

Electrical quantities are expressed in *volts* or *amperes*. If we were to draw an analogy from hydraulics we might say that voltage corresponds to the water pressure in a pipe or tank expressed in pounds per square inch and that the amperage corresponds to the rate of flow through a pipe in gallons per minute. It is obvious that in order to force a large quantity of water through a small pipe in a given time a large pressure must be developed. If, for example, we were to block the flow of water by shutting a valve, the pressure would still remain—but the rate of flow would drop to zero—likewise, if we were to open the valve but slightly the pressure would still be the same but the rate of flow would be small. There is, therefore, some other factor which determines the rate of flow as compared with the pressure and this is the "resistance" of the pipe line.

RESISTANCE

One Ohm of resistance has been defined as the resistance of a circuit in which a pressure of one volt develops a rate of flow of one ampere. Calculations in circuits where the units are expressed in Ohms, Volts, and Amperes are dependent upon the simple relations laid down in Ohm's Law. Accordingly the following relations are evolved from the expression E=I R which means that the voltage (E) is equal to the Current in Amperes (I) times the resistance in Ohms (R):

$$E=IR$$
$$I=E/R$$
$$R=E/I$$

From these three equations we may determine the unknown quantity where two quantities are known.

Example: Determine the resistance of a 201A filament when it is known that the current is .25-ampere when 5 volts are across the terminals. If R=E/I we must divide 5 by .25 and we obtain 20 ohms for our answer.

Example: A resistor of 20 ohms is connected across a 6-volt storage battery. What will be the current flow in amperes? If I=E/R we simply divide the value of the resistor in ohms into the voltage of the battery which is 6 volts thus: 6/20 equals .3-ampere, the current flowing in the circuit.

VOLTAGE DROP

There is a difference in voltage between any two points on a circuit having resistance and this difference is known as the Voltage Drop. The difference in voltage is determined by the resistance between the two points and the current flowing. If we desire to know the value of resistance to place in series with a 201A tube in order to operate its filament from a 6-volt battery we first determine the voltage drop required between the battery and the filament of the tube—namely, 1 volt. We therefore know the voltage (1 volt), the current (.25-ampere), and may find the resistance required by resorting to the equation once more that R=E/I and discover that the resistance must be 4 ohms.

COMBINATIONS OF RESISTANCES
RESISTANCES IN SERIES

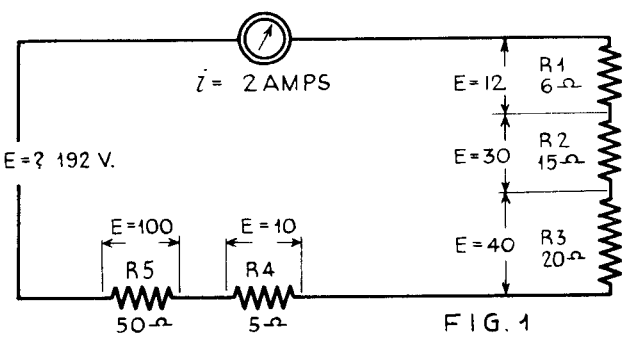


FIG. 1

If resistances are connected in series the total resistance is the sum of all the resistors in the circuit. See Fig. 1. Thus the equation may be written

$$R \text{ eff.} = R_1 + R_2 + R_3 + R_4 + R_5 \text{ etc.}$$

It will be noted on examination of the diagram that in series circuits the current is the same through all of the resistors but that the voltage drop across the resistors depends upon the value of the individual resistor.

RESISTORS IN PARALLEL
EQUAL VALUES OF RESISTANCES IN PARALLEL

In many circuits there are combinations of resistors

in parallel. That is to say, the current path is divided through two or more resistors. If the numerical values of the resistances are equal then the effective circuit resistance can be obtained from the following equation:

$$R\ \text{eff} = \frac{R}{N}$$

wherein R is the value of one of the resistors and N is the number of resistors in the circuit.

Example: There are 6 resistors in a circuit and they are in parallel. The resistance of each one is 12 ohms. Then by dividing by 6 we have the effective resistance which is 2 ohms.

The solution of equal values of resistance in parallel is an extremely simple operation but it must be remembered that the formula is useful only when the resistors are equal in value.

UNEQUAL VALUES OF RESISTANCES IN PARALLEL
(Two Resistors)

Many times we will come across resistances in parallel which are unequal in value. This is shown in Fig. 2. If there are but two resistances in the circuit as shown then we can use the following formula:

$$R\ \text{eff.} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Example: We have two resistors of 5 and 10 ohms value, respectively. What is the effective value of resistance? 5 times 10 is 50; 5 plus 10 is 15; 50 divided by 15 gives us the effective value of resistance which

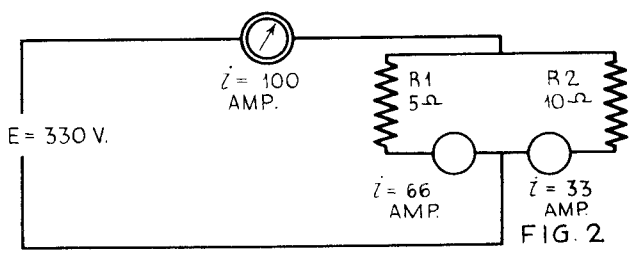


FIG. 2

is 3.3-ohms.

It will be noted in circuits with resistances in parallel that the same voltage will appear across the resistors but the current through the resistors will vary with the value of the individual resistor.

Mention should be made of the fact that when we have resistors of equal value in parallel that the current will be the same in all the resistors and that the same voltage will appear across all of the resistors.

UNEQUAL VALUES OF RESISTANCES IN PARALLEL
(Two or More Resistors)

Fig. 3 shows a circuit in which there are four resistors in parallel and unequal in value. In this

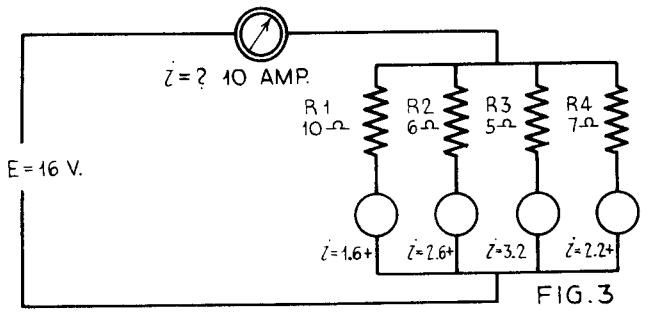


FIG. 3

case we would use the formula commonly known as the "Reciprocal of the sums of the reciprocals" Thus

$$R\ \text{effective} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \text{etc.}}$$

Substituting:

$$\frac{1}{\frac{1}{10} + \frac{1}{6} + \frac{1}{5} + \frac{1}{7}}$$

Solving: $\frac{1}{10} = .1$; $\frac{1}{6} = .166$; $\frac{1}{5} = .2$; $\frac{1}{7} = .14$

Adding: $.1 + .166 + .2 + .14 = .606$.

Finding the reciprocal $\frac{1}{.606} = 1.6$-ohms effective.

Proof: The sum of the currents in the branches of a parallel circuit will equal the total current flowing into the circuit. From examination of the circuit we find that the sum of the currents is 9.6 plus amperes. The answer would have come out exactly 10 amperes if we had carried the solution of the various reciprocals to more than four places beyond the decimal point.

The complete solution of a problem is carried out above so that any one desiring to do so can use it as a model to aid him in studying just how the formula is handled. The author has gone to some lengths here in the solution of the problem but his experience as an instructor of servicemen indicates that there is never enough said on this phase of the study of electrical circuits.

RESISTANCE NETWORKS WITH RESISTORS IN SERIES AND IN PARALLEL

Circuits often have combinations of resistors in series and in parallel. The solution of the effective value of resistance is obtained by breaking up the circuit into its local circuits, solving each portion consisting of parallel circuits and then resolving them into simple series circuits. Fig. 4 shows a circuit along with the values for the various resistors.

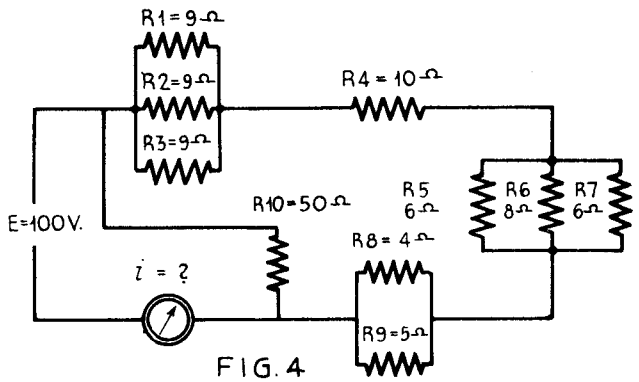


FIG. 4

Solution: The first thing to do is to solve all of the branch circuits.

Circuit R_1; R_2; R_3 has an effective resistance of 3 ohms.

Circuit R_5; R_6; R_7 has an effective resistance of 2.5-ohms.

Circuit R_8; R_9 has an effective resistance of 2.2-ohms.

As the above parallel circuits are in series with resistor R_4 we find the effective value of resistance by adding 10, 3, 2.5, and 2.2 together. This totals 17.7-ohms.

Resistor R_{10} is connected across the voltage supply and the effective value of the resistance network R_1 to R_9 is in turn connected across R_{10}. Thus R_{10} is in parallel to the 17.7-ohm resistance of the network.

Solving for parallel circuits $50\times17.7/50+17.7$ we have the effective total circuit resistance of 12.8-ohms.

Knowing that the voltage applied is 100 volts and the effective resistance is 12.8-ohms and using the rule "I" equals "E" over "R"; then 100 divided by 12.8 is 7.8 or the current flowing in the circuit.

CONDUCTANCE

It seems peculiar that we have dealt with resistances when in reality the thing that we require of any portion of an electrical circuit is conductance—*the ability* and not *the inability* with which it carries electricity is the important factor. The unit of Conductance is the Mho and the Conductance of a circuit is

$$G=1/R.$$

It is thus that a Resistance of 2 ohms has a conductance of ½ Mho. In operating upon parallel circuits it is much simpler to employ conductances in our calculations so as to avoid the many reciprocal factors involved. This may be seen readily from the comparison of the two equations

$$\text{R. eff.}=\frac{1}{1/R_1+1/R_2+1/R_3}$$

$$\text{G eff.}=G_1+G_2+G_3$$

POWER

The power consumed in a circuit is equal to the product of the voltage and the current thus

$$P\ (\text{watts})=E\times I$$

or it may be expressed by the product of the current squared and the resistance

$$P=I^2R$$

This latter relation is useful in determining the power rating requirements of a resistor. Thus a resistance of 10 ohms having a current of 2 amperes flowing through it must be rated at 40 watts at least if overheating is to be avoided.

ALTERNATING CURRENTS

A Direct Current has a definite polarity—that is the current flow is always in one direction. Alternating currents are employed commercially because of economies which can be gained in the transmission of current over long distances. An alternating current has its polarity or direction of flow constantly changing. The frequency of the current is determined by the time required for each complete alternation or change of direction. In Fig. 5 this is shown

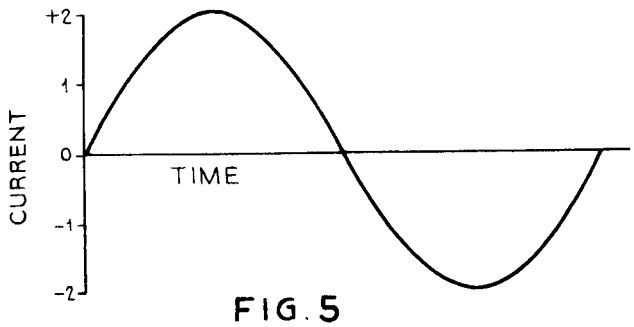


FIG. 5

graphically and it may be seen that over a period of time equal to 1/60th second corresponding to a 60 cycle current the current direction starts at zero—rises to a maximum positive value of 2 amperes—falls to zero again and passes through a maximum negative value of 2 amperes to return to a zero again.

The peak or maximum value is seen to be 2 amperes—but the effective value is not 2 amperes but the "root mean square" or r.m.s. value which is the value read from an alternating current meter in the circuit. This value is calculated from the maximum value by the equation

$$I_{r.m.s.}=I_{peak}\times.707 \text{ or conversely}$$

$$I_{peak}=I_{r.m.s.}\times1.414$$

How these factors are arrived at is immaterial to our purposes. The voltage in A.C. circuits will follow exactly the same laws and the Ohm's Law for alternating currents is expressed by

$$E=IZ$$

IMPEDANCE AND REACTANCE

The alternating counterpart of Resistance is the Impedance (Z), which is the effective resistance of the circuit. "Z" is the resultant effect of pure resistance, capacitance, and inductance in a circuit. The

effect of inducance or capacitance alone in a circuit is "X", the Reactance.

The reactance of a circuit is dependent upon the frequency of the alternating current flowing and the reactance of a condenser is equal to

$$Xc = \frac{1000000}{6.28\ f\ C}\ \text{Ohms.}$$

Condenser Capacity in Mfds.	Reactance in Ohms at Various Frequencies							
	60	100	250	500	1000	10,000	100,000	1,000,000
0.001	2666000	1600000	640000	320000	160000	16000	1600	160
0.005	533200	320000	128000	64000	32000	3200	320	32
0.01	266600	160000	64000	32000	16000	1600	160	16
0.1	26660	16000	6400	3200	1600	160	16	1.6
0.5	5332	3200	1280	640	320	32	3.2	.32
1.0	2666	1600	640	320	160	16	1.6	0.16
2.0	1333	800	320	160	80	8	0.8	0.08
4.0	666	400	160	80	40	4	0.4	0.04
8.0	333	200	80	40	20	2	0.2	0.02
10.0	267	160	64	32	16	1.6	0.16	0.016

FIG 6

From examination of the chart in Fig. 6 it may be seen that the reactance decreases with increasing frequency. The capacity in the above formula is stated in microfarads.

The reactance of an inductance is determined by the equation

$$X_1 = 6.28\ f\ L\ \text{Ohms.}$$

Coil Inductance in Henries	Reactance in Ohms at Various Frequencies						
	60	100	250	500	1000	10,000	100,000
0.01	3.77	6.28	15.7	31.4	62.8	628	6,280
0.05	18.8	31.4	78.5	157	314	3,140	31,400
0.1	37.7	62.8	157	314	628	6,280	62,800
0.5	188.5	314	785	1,570	3,140	31,400	314,000
1.0	377	628	1,570	3,140	6,280	62,800	628,000
2.0	754	1,256	3,140	6,280	12,560	125,600	1,256,000
5.0	1,885	3,140	7,850	15,700	31,400	314,000	3,140,000
10.0	3,770	6,280	15,700	31,400	62,800	628,000	6,280,000
20.0	7,540	12,360	31,400	62,800	123,600	1,236,000	12,360,000
30.0	11,310	18,840	47,200	94,200	188,400	1,884,000	18,840,000
40.0	15,080	24,720	61,800	123,600	247,200	2,472,000	24,720,000
50.0	18,850	31,400	78,500	157,000	314,000	3,140,000	31,400,000
100.0	37,700	62,800	157,000	314,000	628,000	6,280,000	62,800,000

FIG 7

That the reactance of the inducance increases with the increase in frequency is apparent from Fig. 7. This is an important point to keep in mind. In the above equation L is in henries.

Inductive and capacitative reactances differ in their relative effects upon the circuits in which they occur and a combination of the two has an effect determined by the equation.

$$X = X_L - X_C$$

Circuits containing both Reactance and Resistance—and no circuit can be said to be purely reactive with no resistance effects—have an effective resistance noted as their impedance (Z) and the equation for this quantity is

$$Z = \sqrt{R^2 + (X_1 - X_C)^2}$$

Such a quantity is known as the "square root of the sum of the squares."

RESONANCE

You may already have asked yourselves what would happen if the reactance due to inductance were equal to that due to capacitance and you may have answered the question in a manner satisfactory to yourself—that the resistance of the circuit alone would remain. In a measure this would be correct —but in an important sense it would fail.

When a circuit is tuned to resonance the two reactances are equal and cancel and the frequency at which any combination achieves this condition may be determined from the equation

$$f = \frac{1}{\sqrt{L \times C}}$$

where f is the frequency in cycles per second, L the inductance of the coil measured in a unit termed the "henry", and C the capacitance of the condenser measured in a unit termed the "farad." In radio work it is more convenient to speak of a smaller unit than the "henry," thus a unit known as the "microhenry," or μ h, is used, one million of which when added together make a henry. It is also more convenient to speak of a smaller unit than the farad, known as the "microfarad," or mf., thus a unit is used, one million of which when added together make a farad. The formula just quoted then becomes

$$f = \frac{159{,}200}{\sqrt{L\ \text{in microhenries} \times C\ \text{in microfarads}}}\ \text{c.p.s.}$$

As an example, a coil having an inductance of 203 microhenries is tuned with a condenser set at 0.0005-microfarad. To what frequency does the combination tune?

$$f = \frac{159{,}200}{\sqrt{203 \times 0.0005}}\ \text{c.p.s.}$$
$$= 500{,}000.$$

Instead of saying "five hundred thousand cycles per second," the term five hundred kilocycles is often used. A "kilocycle" (abbreviated "kc.") is one thousand cycles.

Sometimes the term "wavelength" symbolized by the Greek letter λ (lambda) is used in place of the term frequency, and vice versa. In the case of an electric wave sent through free space, its velocity is constant, and is equal to that of light. The product of the wavelength and the frequency equals this velocity, for the wavelength is the distance a given point in the wave travels during one cycle, or

$\lambda \times f = 299{,}800{,}000$ meters per second

or (very nearly) 300,000,000

where λ is the wavelength measured in meters and f is the frequency in cycles per second. Thus if it is desired to know the wavelength of a radio wave of a frequency of 500,000 c.p.s.

$$\lambda = \frac{300{,}000{,}000}{f} = \frac{300{,}000{,}000}{500{,}000} = 600.\ \text{meters}$$

Instead of calculating the wavelength every time it is necessary, the chart shown in Fig. 8 may be referred to.

In circuits consisting of Inductance, Capacitance, and Resistance in a series combination such as is shown in Fig. 9, the term within the parenthesis in the equation

KILOCYCLES (kc) TO METERS (m), OR METERS TO KILOCYCLES

[COLUMNS ARE INTERCHANGEABLE]

kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc
10	29, 982	1, 010	296. 9	2, 010	149. 2	3, 010	99. 61	4, 010	74. 77	5, 010	59. 84	6, 010	49. 89	7, 010	42. 77	8, 010	37. 43	9, 010	33. 28
20	14, 991	1, 020	293. 9	2, 020	148. 4	3, 020	99. 28	4, 020	74. 58	5, 020	59. 73	6, 020	49. 80	7, 020	42. 71	8, 020	37. 38	9, 020	33. 24
30	9, 994	1, 030	291. 1	2, 030	147. 7	3, 030	98. 95	4, 030	74. 40	5, 030	59. 61	6, 030	49. 72	7, 030	42. 65	8, 030	37. 34	9, 030	33. 20
40	7, 496	1, 040	288. 3	2, 040	147. 0	3, 040	98. 62	4, 040	74. 21	5, 040	59. 49	6, 040	49. 64	7, 040	42. 59	8, 040	37. 29	9, 040	33. 17
50	5, 999	1, 050	285. 5	2, 050	146. 3	3, 050	98. 30	4, 050	74. 03	5, 050	59. 37	6, 050	49. 56	7, 050	42. 53	8, 050	37. 24	9, 050	33. 13
60	4, 997	1, 060	282. 8	2, 060	145. 5	3, 060	97. 98	4, 060	73. 85	5, 060	59. 25	6, 060	49. 48	7, 060	42. 47	8, 060	37. 20	9, 060	33. 09
70	4, 283	1, 070	280. 2	2, 070	144. 8	3, 070	97. 66	4, 070	73. 67	5, 070	59. 13	6, 070	49. 39	7, 070	42. 41	8, 070	37. 15	9, 070	33. 06
80	3, 748	1, 080	277. 6	2, 080	144. 1	3, 080	97. 34	4, 080	73. 49	5, 080	59. 02	6, 080	49. 31	7, 080	42. 35	8, 080	37. 11	9, 080	33. 02
90	3, 331	1, 090	275. 1	2, 090	143. 5	3, 090	97. 03	4, 090	73. 31	5, 090	58. 90	6, 090	49. 23	7, 090	42. 29	8, 090	37. 06	9, 090	32. 98
100	2, 998	1, 100	272. 6	2, 100	142. 8	3, 100	96. 72	4, 100	73. 13	5, 100	58. 79	6, 100	49. 15	7, 100	42. 23	8, 100	37. 01	9, 100	32. 95
110	2, 726	1, 110	270. 1	2, 110	142. 1	3, 110	96. 41	4, 110	72. 95	5, 110	58. 67	6, 110	49. 07	7, 110	42. 17	8, 110	36. 97	9, 110	32. 91
120	2, 499	1, 120	267. 7	2, 120	141. 4	3, 120	96. 10	4, 120	72. 77	5, 120	58. 56	6, 120	48. 99	7, 120	42. 11	8, 120	36. 92	9, 120	32. 88
130	2, 306	1, 130	265. 3	2, 130	140. 8	3, 130	95. 79	4, 130	72. 60	5, 130	58. 44	6, 130	48. 91	7, 130	42. 05	8, 130	36. 88	9, 130	32. 84
140	2, 142	1, 140	263. 0	2, 140	140. 1	3, 140	95. 48	4, 140	72. 42	5, 140	58. 33	6, 140	48. 83	7, 140	41. 99	8, 140	36. 83	9, 140	32. 80
150	1, 999	1, 150	260. 7	2, 150	139. 5	3, 150	95. 18	4, 150	72. 25	5, 150	58. 22	6, 150	48. 75	7, 150	41. 93	8, 150	36. 79	9, 150	32. 77
160	1, 874	1, 160	258. 5	2, 160	138. 8	3, 160	94. 88	4, 160	72. 07	5, 160	58. 10	6, 160	48. 67	7, 160	41. 87	8, 160	36. 74	9, 160	32. 73
170	1, 764	1, 170	256. 3	2, 170	138. 1	3, 170	94. 58	4, 170	71. 90	5, 170	57. 99	6, 170	48. 59	7, 170	41. 82	8, 170	36. 70	9, 170	32. 70
180	1, 666	1, 180	254. 1	2, 180	137. 5	3, 180	94. 28	4, 180	71. 73	5, 180	57. 88	6, 180	48. 51	7, 180	41. 76	8, 180	36. 65	9, 180	32. 66
190	1, 578	1, 190	252. 0	2, 190	136. 9	3, 190	93. 99	4, 190	71. 56	5, 190	57. 77	6, 190	48. 44	7, 190	41. 70	8, 190	36. 61	9, 190	32. 62
200	1, 499	1, 200	249. 9	2, 200	136. 3	3, 200	93. 69	4, 200	71. 39	5, 200	57. 66	6, 200	48. 36	7, 200	41. 64	8, 200	36. 56	9, 200	32. 59
210	1, 428	1, 210	247. 8	2, 210	135. 7	3, 210	93. 40	4, 210	71. 22	5, 210	57. 55	6, 210	48. 28	7, 210	41. 58	8, 210	36. 52	9, 210	32. 55
220	1, 363	1, 220	245. 8	2, 220	135. 1	3, 220	93. 11	4, 220	71. 05	5, 220	57. 44	6, 220	48. 20	7, 220	41. 53	8, 220	36. 47	9, 220	32. 52
230	1, 304	1, 230	243. 8	2, 230	134. 4	3, 230	92. 82	4, 230	70. 88	5, 230	57. 33	6, 230	48. 13	7, 230	41. 47	8, 230	36. 43	9, 230	32. 48
240	1, 249	1, 240	241. 8	2, 240	133. 8	3, 240	92. 54	4, 240	70. 71	5, 240	57. 22	6, 240	48. 05	7, 240	41. 41	8, 240	36. 39	9, 240	32. 45
250	1, 199	1, 250	239. 9	2, 250	133. 3	3, 250	92. 25	4, 250	70. 55	5, 250	57. 11	6, 250	47. 97	7, 250	41. 35	8, 250	36. 34	9, 250	32. 41
260	1, 153	1, 260	238. 0	2, 260	132. 7	3, 260	91. 97	4, 260	70. 38	5, 260	57. 00	6, 260	47. 89	7, 260	41. 30	8, 260	36. 30	9, 260	32. 38
270	1, 110	1, 270	236. 1	2, 270	132. 1	3, 270	91. 69	4, 270	70. 22	5, 270	56. 89	6, 270	47. 82	7, 270	41. 24	8, 270	36. 25	9, 270	32. 34
280	1, 071	1, 280	234. 2	2, 280	131. 5	3, 280	91. 41	4, 280	70. 05	5, 280	56. 78	6, 280	47. 74	7, 280	41. 18	8, 280	36. 21	9, 280	32. 31
290	1, 034	1, 290	232. 4	2, 290	130. 9	3, 290	91. 13	4, 290	69. 89	5, 290	56. 68	6, 290	47. 67	7, 290	41. 13	8, 290	36. 17	9, 290	32. 27
300	999. 4	1, 300	230. 6	2, 300	130. 4	3, 300	90. 86	4, 300	69. 73	5, 300	56. 57	6, 300	47. 59	7, 300	41. 07	8, 300	36. 12	9, 300	32. 24
310	967. 2	1, 310	228. 9	2, 310	129. 8	3, 310	90. 58	4, 310	69. 56	5, 310	56. 46	6, 310	47. 52	7, 310	41. 02	8, 310	36. 08	9, 310	32. 20
320	936. 9	1, 320	227. 1	2, 320	129. 2	3, 320	90. 31	4, 320	69. 40	5, 320	56. 36	6, 320	47. 44	7, 320	40. 96	8, 320	36. 04	9, 320	32. 17
330	908. 6	1, 330	225. 4	2, 330	128. 7	3, 330	90. 04	4, 330	69. 24	5, 330	56. 25	6, 330	47. 36	7, 330	40. 90	8, 330	35. 99	9, 330	32. 14
340	881. 8	1, 340	223. 7	2, 340	128. 1	3, 340	89. 77	4, 340	69. 08	5, 340	56. 15	6, 340	47. 29	7, 340	40. 85	8, 340	35. 95	9, 340	32. 10
350	856. 6	1, 350	222. 1	2, 350	127. 6	3, 350	89. 50	4, 350	68. 92	5, 350	56. 04	6, 350	47. 22	7, 350	40. 79	8, 350	35. 91	9, 350	32. 07
360	832. 8	1, 360	220. 4	2, 360	127. 0	3, 360	89. 23	4, 360	68. 77	5, 360	55. 94	6, 360	47. 14	7, 360	40. 74	8, 360	35. 86	9, 360	32. 03
370	810. 3	1, 370	218. 8	2, 370	126. 5	3, 370	88. 97	4, 370	68. 61	5, 370	55. 83	6, 370	47. 07	7, 370	40. 68	8, 370	35. 82	9, 370	32. 09
380	789. 0	1, 380	217. 3	2, 380	126. 0	3, 380	88. 70	4, 380	68. 45	5, 380	55. 73	6, 380	46. 99	7, 380	40. 63	8, 380	35. 78	9, 380	31 96
390	768. 8	1, 390	215. 7	2, 390	125. 4	3, 390	88. 44	4, 390	68. 30	5, 390	55. 63	6, 390	46. 92	7, 390	40. 57	8, 390	35. 74	9, 390	31. 93
400	749. 6	1, 400	214. 2	2, 400	124. 9	3, 400	88. 18	4, 400	68. 14	5, 400	55. 52	6, 400	46. 85	7, 400	40. 52	8, 400	35. 69	9, 400	31. 90
410	731. 3	1, 410	212. 6	2, 410	124. 4	3, 410	87. 92	4, 410	67. 99	5, 410	55. 42	6, 410	46. 77	7, 410	40. 46	8, 410	35. 65	9, 410	31. 86
420	713. 9	1, 420	211. 1	2, 420	123. 9	3, 420	87. 67	4, 420	67. 83	5, 420	55. 32	6, 420	46. 70	7, 420	40. 41	8, 420	35. 61	9, 420	31. 83
430	697. 3	1, 430	209. 7	2, 430	123. 4	3, 430	87. 41	4, 430	67. 68	5, 430	55. 22	6, 430	46. 63	7, 430	40. 35	8, 430	35. 57	9, 430	31. 79
440	681. 4	1, 440	208. 2	2, 440	122. 9	3, 440	87. 16	4, 440	67. 53	5, 440	55. 11	6, 440	46. 56	7, 440	40. 30	8, 440	35. 52	9, 440	31. 76
450	666. 3	1, 450	206. 8	2, 450	122. 4	3, 450	86. 90	4, 450	67. 38	5, 450	55. 01	6, 450	46. 48	7, 450	40. 24	8, 450	35. 48	9, 450	31. 73
460	651. 8	1, 460	205. 4	2, 460	121. 9	3, 460	86. 65	4, 460	67. 22	5, 460	54. 91	6, 460	46. 41	7, 460	40. 19	8, 460	35. 44	9, 460	31. 69
470	637. 9	1, 470	204. 0	2, 470	121. 4	3, 470	86. 40	4, 470	67. 07	5, 470	54. 81	6, 470	46. 34	7, 470	40. 14	8, 470	35. 40	9, 470	31. 66
480	624. 6	1, 480	202. 6	2, 480	120. 9	3, 480	86. 16	4, 480	66. 92	5, 480	54. 71	6, 480	46. 27	7, 480	40. 08	8, 480	35. 36	9, 480	31. 63
490	611. 9	1, 490	201. 2	2, 490	120. 4	3, 490	85. 91	4, 490	66. 78	5, 490	54. 61	6, 490	46. 20	7, 490	40. 03	8, 490	35. 31	9, 490	31. 59
500	599. 6	1, 500	199. 9	2, 500	119. 9	3, 500	85. 66	4, 500	66. 63	5, 500	54. 51	6, 500	46. 13	7, 500	39. 98	8, 500	35. 27	9, 500	31. 56
510	587. 9	1, 510	198. 6	2, 510	119. 5	3, 510	85. 42	4, 510	66 48	5, 510	54 41	6, 510	46. 06	7, 510	39. 92	8, 510	35 23	9, 510	31. 53
520	576. 6	1, 520	197. 2	2, 520	119. 0	3, 520	85. 18	4, 520	66 33	5, 520	54. 32	6, 520	45. 98	7, 520	39. 87	8, 520	35. 19	9, 520	31. 49
530	565. 7	1, 530	196. 0	2, 530	118. 5	3, 530	84. 94	4, 530	66 19	5, 530	54. 22	6, 530	45. 91	7, 530	39. 82	8, 530	35. 15	9, 530	31. 46
540	555. 2	1, 540	194. 7	2, 540	118. 0	3, 540	84. 70	4, 540	66 04	5, 540	54. 12	6, 540	45. 84	7, 540	39. 76	8, 540	35. 11	9, 540	31. 43
550	545. 1	1, 550	193. 4	2, 550	117. 6	3, 550	84. 46	4, 550	65 89	5, 550	54. 02	6, 550	45. 77	7, 550	39. 71	8, 550	35. 07	9, 550	31. 39
560	535. 4	1, 560	192. 2	2, 560	117. 1	3, 560	84. 22	4, 560	65. 75	5, 560	53. 92	6, 560	45. 70	7, 560	39. 66	8, 560	35. 03	9, 560	31. 36
570	526. 0	1, 570	191. 0	2, 570	116. 7	3, 570	83. 98	4, 570	65. 61	5, 570	53. 83	6, 570	45. 63	7, 570	39. 61	8, 570	34. 98	9, 570	31. 33
580	516. 9	1, 580	189. 8	2, 580	116. 2	3, 580	83. 75	4, 580	65 46	5, 580	53. 73	6, 580	45. 57	7, 580	39. 55	8, 580	34. 94	9, 580	31. 30
590	508. 2	1, 590	188. 6	2, 590	115. 8	3, 590	83. 52	4, 590	65 32	5, 590	53. 64	6, 590	45. 50	7, 590	39. 50	8, 590	34. 90	9, 590	31. 26
600	499. 7	1, 600	187. 4	2, 600	115. 3	3, 600	83. 28	4, 600	65. 18	5, 600	53. 54	6, 600	45. 43	7, 600	39. 45	8, 600	34. 86	9, 600	31. 23
610	491. 5	1, 610	186. 2	2, 610	114. 9	3, 610	83. 05	4, 610	65. 04	5, 610	53. 44	6, 610	45. 36	7, 610	39. 40	8, 610	34. 82	9, 610	31. 20
620	483. 6	1, 620	185. 1	2, 620	114. 4	3, 620	82. 82	4, 620	64. 90	5, 620	53. 35	6, 620	45. 29	7, 620	39 35	8, 620	34. 78	9, 620	31. 17
630	475. 9	1, 630	183. 9	2, 630	114. 0	3, 630	82. 60	4, 630	64. 76	5, 630	53. 25	6, 630	45. 22	7, 630	39. 29	8, 630	34. 74	9, 630	31. 13
640	468. 5	1, 640	182. 8	2, 640	113. 6	3, 640	82. 37	4, 640	64. 62	5, 640	53. 16	6, 640	45. 15	7, 640	39. 24	8, 640	34. 70	9, 640	31. 10
650	461. 3	1, 650	181. 7	2, 650	113. 1	3, 650	82. 14	4, 650	64. 48	5, 650	53. 07	6, 650	45. 09	7, 650	39. 19	8, 650	34. 66	9, 650	31. 07
660	454. 3	1, 660	180. 6	2, 660	112. 7	3, 660	81. 92	4, 660	64. 34	5, 660	52. 97	6, 660	45. 02	7, 650	39. 14	8, 650	34. 62	9, 660	31. 04
670	447. 5	1, 670	179. 5	2, 670	112. 3	3, 670	81. 70	4, 670	64. 20	5, 670	52. 88	6, 670	44. 95	7, 670	39. 09	8, 670	34. 58	9, 670	31. 01
680	440. 9	1, 680	178. 5	2, 680	111 9	3, 680	81. 47	4, 680	64. 06	5, 680	52. 79	6, 680	44. 88	7, 680	39. 04	8, 680	34. 54	9, 680	30. 97
690	434. 5	1, 690	177. 4	2, 690	111. 5	3, 690	81. 25	4, 690	63. 93	5, 690	52. 69	6, 690	44. 82	7, 690	38. 99	8, 690	34. 50	9, 690	30. 94
700	428. 3	1, 700	176. 4	2, 700	111. 0	3, 700	81. 03	4, 700	63. 79	5, 700	52. 60	6, 700	44. 75	7, 700	38. 94	8, 700	34 46	9, 700	30. 91
710	422. 3	1, 710	175. 3	2, 710	110. 6	3, 710	80. 81	4, 710	63. 66	5, 710	52. 51	6, 710	44. 68	7, 710	38. 89	8, 710	34. 42	9, 710	30. 88
720	416. 4	1, 720	174. 3	2, 720	110. 2	3, 720	80. 60	4, 720	63. 52	5, 720	52. 42	6, 720	44. 62	7, 720	38. 84	8, 720	34. 38	9, 720	30. 85
730	410. 7	1, 730	173. 3	2, 730	109. 8	3, 730	80. 38	4, 730	63. 39	5, 730	52. 32	6, 730	44. 55	7, 730	38. 79	8, 730	34. 34	9, 730	30. 81
740	405. 2	1, 740	172. 3	2, 740	109. 4	3, 740	80. 17	4, 740	63. 25	5, 740	52. 23	6, 740	44. 48	7, 740	38. 74	8, 740	34. 30	9, 740	30. 78
750	399. 8	1, 750	171. 3	2, 750	109. 0	3, 750	79. 95	4, 750	63. 12	5, 750	52. 14	6, 750	44. 42	7, 750	38. 69	8, 750	34. 27	9, 750	30. 75
760	394. 5	1, 760	170. 4	2, 760	108. 6	3, 760	79. 74	4, 760	62. 99	5, 760	52. 05	6, 760	44. 35	7, 760	38. 64	8, 760	34. 23	9, 760	30. 72
770	389. 4	1, 770	169. 4	2, 770	108. 2	3, 770	79. 53	4, 770	62. 86	5, 770	51. 96	6, 770	44. 29	7, 770	38. 59	8, 770	34. 19	9, 770	30. 69
780	384. 4	1, 780	168. 4	2, 780	107. 8	3, 780	79. 32	4, 780	62. 72	5, 780	51. 87	6, 780	44. 22	7, 780	38. 54	8, 780	34. 15	9, 780	30. 66
790	379. 5	1, 790	167. 5	2, 790	107. 5	3, 790	79. 11	4, 790	62. 59	5, 790	51. 78	6, 790	44. 16	7, 790	38. 49	8, 790	34. 11	9, 790	30. 63
800	374. 8	1, 800	166. 6	2, 800	107. 1	3, 800	78. 90	4, 800	62. 46	5, 800	51. 69	6, 800	44. 09	7, 800	38. 44	8, 800	34. 07	9, 800	30. 59
810	370. 2	1, 810	165. 6	2, 810	106. 7	3, 810	78. 69	4, 810	62. 33	5, 810	51. 60	6, 810	44. 03	7, 810	38. 39	8, 810	34. 03	9, 810	30. 56
820	365. 6	1, 820	164. 7	2, 820	106. 3	3, 820	78. 49	4, 820	62. 20	5, 820	51. 52	6, 820	43. 96	7, 820	38. 34	8, 820	33. 99	9, 820	30. 53
830	361. 2	1, 830	163. 8	2, 830	105. 9	3, 830	78. 28	4, 830	62. 07	5, 830	51. 43	6, 830	43. 90	7, 830	38. 29	8, 830	33. 95	9, 830	30. 50
840	356. 9	1, 840	162. 9	2, 840	105. 6	3, 840	78. 03	4, 840	61. 95	5, 840	51. 34	6, 840	43. 83	7, 840	38. 24	8, 840	33. 92	9, 840	30. 47
850	352. 7	1, 850	162. 1	2, 850	105. 2	3, 850	77. 88	4, 850	61. 82	5, 850	51. 25	6, 850	43. 77	7, 850	38. 19	8, 850	33. 88	9, 850	30. 44
860	348. 6	1, 860	161. 2	2, 860	104. 8	3, 860	77. 67	4, 860	61. 69	5, 860	51. 16	6, 860	43. 71	7, 860	38. 14	8, 860	33. 84	9, 860	30. 41
870	344. 6	1, 870	160. 3	2, 870	104. 5	3, 870	77. 47	4, 870	61. 56	5, 870	51. 08	6, 870	43. 64	7, 870	38. 10	8, 870	33. 80	9, 870	30 38
880	340. 7	1, 880	159. 5	2, 880	104. 1	3, 880	77. 27	4, 880	61. 44	5, 880	50. 99	6, 880	43. 58	7, 880	38. 05	8, 880	33. 76	9, 880	30. 35
890	336. 9	1, 890	158. 6	2, 890	103. 7	3, 890	77. 07	4, 890	61. 31	5, 890	50. 90	6, 890	43. 52	7, 890	38. 00	8, 890	33. 73	9, 890	30. 32
900	333. 1	1, 900	157. 8	2, 900	103. 4	3, 900	76. 88	4, 900	61. 19	5, 900	50. 82	6, 900	43. 45	7, 900	37. 95	8, 900	33. 69	9, 900	30. 28
910	329. 5	1, 910	157. 0	2, 910	103. 0	3, 910	76. 68	4, 910	61. 06	5, 910	50. 73	6, 910	43. 39	7, 910	37. 90	8, 910	33. 65	9, 910	30. 25
920	325. 9	1, 920	156. 2	2, 920	102. 7	3, 920	76. 48	4, 920	60. 94	5, 920	50. 65	6, 920	43. 33	7, 920	37. 86	8, 920	33. 61	9, 920	30. 22
930	322. 4	1, 930	155. 3	2, 930	102. 3	3, 930	76. 29	4, 930	60. 82	5, 930	50. 56	6, 930	43. 26	7, 930	37. 81	8, 930	33. 57	9, 930	30. 19
940	319. 0	1, 940	154. 5	2, 940	102. 0	3, 940	76. 10	4, 940	60. 69	5, 940	50. 47	6, 940	43. 20	7, 940	37. 76	8, 940	33. 54	9, 940	30. 16
950	315. 6	1, 950	153. 8	2, 950	101. 6	3, 950	75. 90	4, 950	60. 57	5, 950	50. 39	6, 950	43. 14	7, 950	37. 71	8, 950	33. 50	9, 950	30. 13
960	312. 3	1, 960	153. 0	2, 960	101. 3	3, 960	75. 71	4, 960	60. 45	5, 960	50. 31	6, 960	43. 08	7, 960	37. 67	8, 960	33. 46	9, 960	30. 10
970	309. 1	1, 970	152. 2	2, 970	100. 9	3, 970	75. 52	4, 970	60. 33	5, 970	50. 22	6, 970	43. 02	7, 970	37. 62	8, 970	33. 42	9, 970	30. 07
980	303. 9	1, 980	151. 4	2, 980	100. 6	3, 980	75. 33	4, 980	60. 20	5, 980	50. 14	6, 980	42. 95	7, 980	37. 57	8, 980	33. 39	9, 980	30. 04
990	302. 8	1, 990	150. 7	2, 990	100. 3	3, 990	75. 14	4, 990	60. 08	5, 990	50. 05	6, 990	42. 89	7, 990	37. 52	8, 990	33. 35	9, 990	30. 01
1, 000	299. 8	2, 000	149. 9	3, 000	99. 94	4, 000	74. 96	5, 000	59. 96	6, 000	49. 97	7, 000	42. 83	8, 000	37. 48	9, 000	33. 31	10, 000	29. 98

FIG 8

(OVER)

$$Z=\sqrt{R^2+(X_1-X_c)^2}$$

is equal to zero and the impedance of the circuit is simply

$$Z=\sqrt{R^2}$$

or $Z=R$

In a series circuit comprising inductance and capacitance only the current could rise to large proportions at resonance—it being effectively a short circuit across the supply. This effect is held in check by the fact that some resistance is always in the circuit.

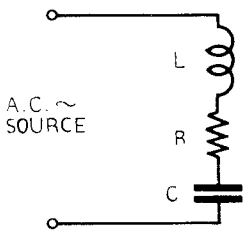


FIG. 9

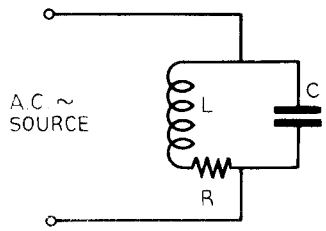


FIG. 10

In a parallel circuit a somewhat different effect occurs. Here we have a circuit arrangement substantially as shown in Figure 10. In such a circuit the current does not pass through both elements but is divided between the two as was the case in parallel resistance circuits carrying direct current.

Without resistance in the circuit the currents flowing in the two branches would counteract each other because of the opposing effects of the capacitance and the inductance and the current flowing through the circuit would be zero. This would correspond to an infinite impedance across the line.

As your studies become more advanced it is well to bear in mind that though the current through the circuit be zero relatively large currents may be flowing in the two branches. The presence of resistance modifies this idea of an infinite Impedance and we find that the effective Impedance of a parallel resonant circuit is equal to

$$\frac{L}{C}\ \frac{I}{R}=Z$$

L is in henries
C is in farads
R is in ohms
Z is in ohms

Let us consider that the coil has an inductance of 250 microhenries and a radio frequency resistance of 15 ohms and that the condenser shunted across the coil has a capacity of 102 micromicrofarads. This is the value of capacity to tune the circuit to a frequency of 1000 K.C.

Substituting the above value in the equation we have

$$\frac{.00025}{.000000000102}\times\frac{1}{15}=163333 \text{ ohms.}$$

The resistance in the circuit is the effective resistance of the coil at radio frequencies which is usually a figure somewhat larger than the direct current resistance. It can be seen that the lower the resistance the higher will be the impedance of the circuit.

The important difference between series and parallel circuits at resonance is obviously that the one has an impedance approaching zero but limited by the resistance while the other has an impedance which would be infinitely high—were it not for the effects of resistance.

In the series circuits the current flowing is large and although the voltage developed across the whole is small the voltage across any one element may rise to unprecedented heights as we shall later find.

In all the above equations solution may be obtained only where the Resistance is expressed in ohms, Frequency in cycles per second, the Capacitance in Farads and the Inductance in Henries.

We must therefore reduce all values to these terms. To this end it is worth noting that the familiar prefixes milli, micro, micromicro denote that the term indicated must be multiplied by .001, .000,001 and .000,000,000,001 in order to change them into fractional parts of the Henry or Farad as the case may be. Thus 250 micromicrofarads will become .000,000,000,250 Farads before insertion into the above equations as 200 microhenries must become .0002 Henries.

No mention of "phase relations" or other complex factors has been made as these interpretations were thought to involve too great a degree of mathematics to warrant their inclusion.

SERVICING RADIO RECEIVERS

The Service Man's Tools.

THERE is nothing that will tend to create in the mind of the customer a feeling of confidence as much as a well chosen kit of tools, which should be carried to the job in a convenient bag. This, along with the test kit gives the desired impression of completeness which goes for rapid and accurate work.

The usual tools other than the special measuring instruments which should be a part of the portable equipment are as follows:

Diagonal Pliers
Long Nose Pliers
Side Cutting Pliers
Spintite Wrench Set
Electricians' Knife
Insulated Test Probes
Neutralizing Tool
Alcohol Torch
Soldering Iron
Self Fluxing Solder—Rosin Cored
Heavy Screw Driver
Long Thin Screw Driver
Hand Drill and Drill Set
Friction Tape
Set of Files
Polishing Cloth and a small quantity of Furniture Polish
Emery Cloth
Hydrometer
Large Piece of Canvas
Flash Light

In addition to the above the technician should carry an assortment of fixed resistances of the values found to be most useful in service work, replacement A.F. transformer, spare pilot lights, set of R.F. coils, howl arrester, complete set of tubes, such batteries as may be necessary, spare power switch, aerial and lead wire, insulators, lead-in strips, lightning arrester, screws, etc.

Testing Instruments.

Confident and rapid servicing of the modern radio receiver requires the intelligent use of the following instruments:

Set Analyzer
Ohmmeter
Modulated Oscillator
Output Meter or Resonance Indicator.

Too great stress cannot be laid upon the necessity for clean cut and accurate equipment. Not only does this save time but it creates a confidence which is likely to result in a return call. The modern receiver is so constructed that servicing is virtually impossible without the apparatus noted.

The Set Analyzer.

The radio set analyzer is an instrument so constructed that the conditions under which any one of the tubes in the receiver operates can be readily determined at a glance. There are of course certain conditions which cannot be localized by this means —these will be taken up later—but in the majority of cases the analyzer will give a thorough diagnosis of the trouble.

The analyzer may be constructed in many ways—it may have a number of meters or it may be so constituted as to require but a single meter with a number of push buttons to make the required connections in the tube circuit and to rearrange the internal circuit of the analyzer so as to cope with the changing conditions.

Many of the more recent analyzers employ rectifier type meters so that a single D.C. meter with the proper shunts and series resistances will be operative over all required ranges of direct and alternating currents and voltages. This effects a saving in the initial cost of the apparatus without affecting the accuracy of the equipment in any way. The majority of the models now on the market use at least two meters, the one being for A.C. measurements and the other for D.C.

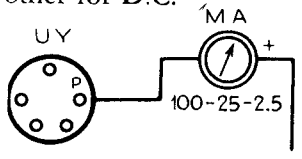


FIG. 11

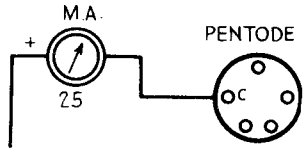


FIG. 12

The schematic circuits shown in the text give an idea as to how the meter ranges are shifted and the internal changes made by means of the push buttons. Figs. 11, 12 and 13.

The instruments are so arranged that the various meter ranges are available for separate external

measurements by means of binding post connections and test probes and in some cases provision is made for the use of the equipment as an ohmmeter or as a capacity meter. Instruction pamphlets obtainable from the manufacturers of the various equipment give these details.

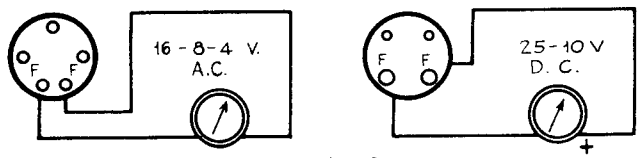


FIG. 13

Testing the Receiver Circuits.

Set analyzers are provided with adapters which make the necessary connections automatically. This is of course necessary when we intend to test circuits involving rectifier tubes or tubes with four and five prong bases. Modern testers are now so complete that it is seldom necessary to use special adapters except for the change from five to four prong plugs.

Selecting the proper adapter we remove the tube from the socket and replace it by the adapter. The tube is then placed in the socket provided in the analyzer.

You will note that the meter will have various ranges of voltage and current reading scales and it is important not only that the correct button be pressed but that the reading be taken from the proper scale. This is in no way confusing but demands a certain degree of alertness on the part of the technician.

The accompanying Fig. 14 shows the correct readings to be obtained in the analysis of the Radiola 64. This data is available from the manufacturer of the particular test set for which these readings hold good. Charts such as that shown in the figure are available and it is a good idea to fill out the chart as you go along so that even though no trouble may be found in the receiver you may hold the chart for future reference. A file of such charts giving a case history of a particular receiver is sometimes a valu-

RADIOLA—Model 64
Line Voltage 112—Volume Control Full

TUBE NO IN ORDER	TYPE OF TUBE	POSITION OF TUBE (1 ST. R.F. DET. ETC.)	READINGS PLUG IN SOCKET OF SET									
			TUBE OUT		TUBE IN TESTER							
			A VOLTS	B VOLTS	A VOLTS	B VOLTS	C VOLTS	CATHODE VOLTS	NORMAL PLATE M A	PLATE M A GRID TEST	PLATE M A CHANGE
1	227	Ant.Coup.St.	2.5	128	2.4	124	25	13.5	3.4	7.8	4.4
2	227	Tuned R.F.	2.5	128	2.4	124	25	16.0	3.3	7.1	3.8
3	227	Tuned 1stDet	2.5	80	2.4	75	25	16.0	.2	2.9	2.7
4	227	1st. I.F.	2.5	128	2.4	124	9	13.5	3.4	7.8	4.5
5	227	2nd. I.F.	2.5	128	2.4	124	9	13.5	3.4	7.8	4.5
6	227	Oscillator	2.5	80	2.4	75	25	13.5	7.0	7.6	.6
7	227	2nd. Det.	2.5	120	2.4	176	25	13.5	-	-	-
8	227	Vol. Control	2.5	80	2.4	75	4	-	-	-	-
9	250	Power	7.5	584	7.2	392	65	-	52	55	3.0
10	281	Rectifier			7.4				50		
11	281	Rectifier			7.4				50		

FIG 14

able thing in that it will indicate the fact that tubes are not quite up to scratch and that new ones should be taken on the call. The reverse of the chart will serve to record the work done on each visit. A reference to the chapter bearing upon the analysis of a complete receiver circuit will indicate the possible causes of trouble where the readings taken are not up to standard.

There are of course certain points where the analyzer will fail and it is these exceptions which make necessary the use of other apparatus in testing.

This statement must not be construed as an indictment of the analyzer as having failed in its purpose for the technician cannot possibly render efficient service without it. At times the very failure of the analyzer to point out the fault may lead to its detection.

When the Analyzer Fails.

As we noted there are certain conditions in the radio receiver which defy detection by means of the analyzer. As an example of this, the analyzer cannot detect a shorted variable condenser as the path from grid to ground remains substantially unchanged. In Fig. 15 the voltmeter is connected so

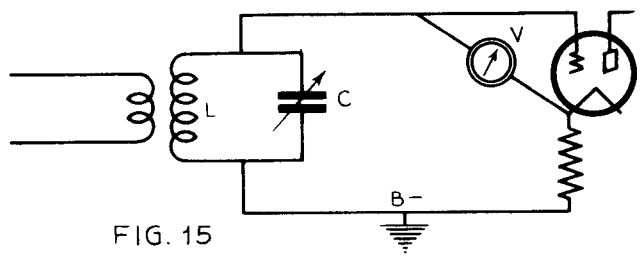


FIG. 15

as to measure the value of the bias. It can be seen that a shorted condenser (C) will have no effect on the reading of the voltmeter (VM) because of the extremely low coil (L) resistance.

In general, short circuits in the antenna coupling circuit or in the R.F. transformers do not affect the meter readings as these are low resistance circuits and the change in constants due to the short circuit will have no effect on the voltages or current in the tube circuit. Short circuits to ground in the plate circuits of the tubes naturally cause a loss of plate voltage accompanied by high plate currents and in cases where the bias is obtained from the voltage divider in the manner described in another section such a short circuit of the R.F. transformer secondary or of the variable condenser would result in a loss of bias, Fig. 16.

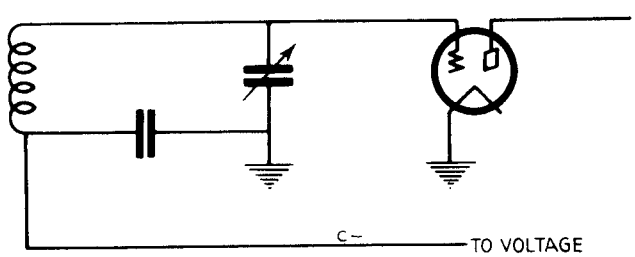


FIG. 16

Open condensers do not in any way affect the voltage readings as they do not offer a direct current path at any time. Resistances connected across transformer windings either as stabilizing agents limiting the amplification or as volume controls will show no changes in applied voltages whether they are open or short-circuited. The center tapped resistances across the filament or heater circuits will cause hum if open or short-circuited in one section. These defects will not show up, however, in the meter readings.

Then why—you ask—is the set analyzer so necessary a piece of apparatus? The answer is that in the majority of cases the trouble is shown up by the analyzer readings—if not we may resort to the manner of deduction employed by the late Sherlock Holmes and rest assured that the trouble lies in some circuit defect not noted in the analyzer readings. Troubles are evidenced by the following conditions.

Excessive and uncontrollable volume.

Regeneration.

Failure of one or more of the tuned circuits to tune sharply to resonance.

Hum or noise.

Audio howl or acoustic regeneration.

No signal.

Excessively broad or sharp tuning.

Tunable hum appearing on station carrier but when no signal is received.

Most of these conditions may be checked by the use of the other apparatus listed and will be taken up in turn.

A note of the fact that an open grid biasing resistance in series with the cathode of the tube will not be evidenced by zero voltage and zero bias together with a high plate current when checked with the analyzer should be made. The reason for this is that when the analyzer is switched so as to measure the voltage between cathode and ground a high resistance is placed across this circuit. With the biasing resistance intact this high resistance has little effect but if the biasing resistance be open the meter resistance will fill the gap with the result that the tube receives a high grid bias. Fig. 17. The plate

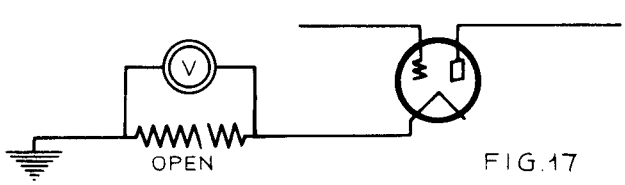


FIG. 17

voltage will then be relatively low and the current will be close to zero while the meter is across the cathode and ground. These facts need nothing but a little study to fix them firmly in the technician's mind so that he can recognize them at a glance.

Open or shorted neutralizing condensers will have no effect upon the meter readings except where the circuit arrangement is such that a short circuit results in a connection between the grid and plate through

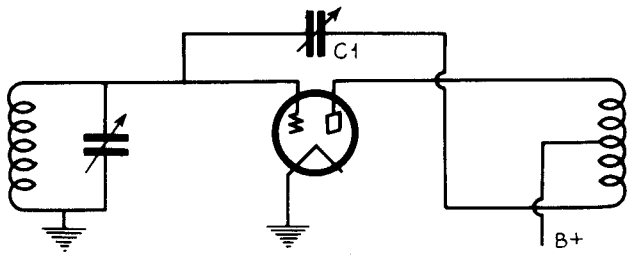


FIG. 18

capacity C_1. Fig. 18.

Continuity Testing.

The Ohmmeter listed as among the equipment desirable is useful not only in the measurement of resistance values but in checking receiver troubles not noticeable through changes in the operating voltages. Many manufacturers give routine data charts on the servicing of their receivers with the ohmmeter. These charts give the points between which the tests should be made and the correct resistance reading.

An ohmmeter is a milliammeter in series with a resistance and a battery with the scale so calibrated as to read directly in the effective ohms resistance between the test prods. A variable resistance is included so that adjustment can be made for variations in the battery voltage.

The Figs. 19, 20, 21 and 22 show the circuit arrangements of a Brunswick receiver which is typical of modern design practice. The power supply and the receiver chassis are separate units but this has no effect on the adaptability of the procedure to other sets. We have also reproduced here the continuity test chart of the receiver as recommended by the manufacturer. This chart indicates the correct effect and the possible incorrect effects which may be apparent together with their probable cause.

A check of any receiver by means of the analyzer —which failing in diagnosis can be followed by a continuity test of the circuits—will undoubtedly result in a discovery of the trouble.

Continued oscillation or lack of sensitivity through disalignment of the circuits may be checked by the use of the modulated oscillator to be described. This is particularly necessary in the case of the superheterodyne receiver and also with neutrodyne receivers. The manner of operation in checking neutralization and alignment of circuits follows:

The Modulated Oscillator and Its Uses.

The modulated oscillator is in reality a miniature and portable broadcast transmitter which places a controllable signal in the hands of the technician at all times. The instrument is to be operated in conjunction with an output meter or a resonance indicator such as will be described

The oscillator should be tunable over the entire broadcast band and should have a second range of from about 100 to 200 kc. for checking the character-

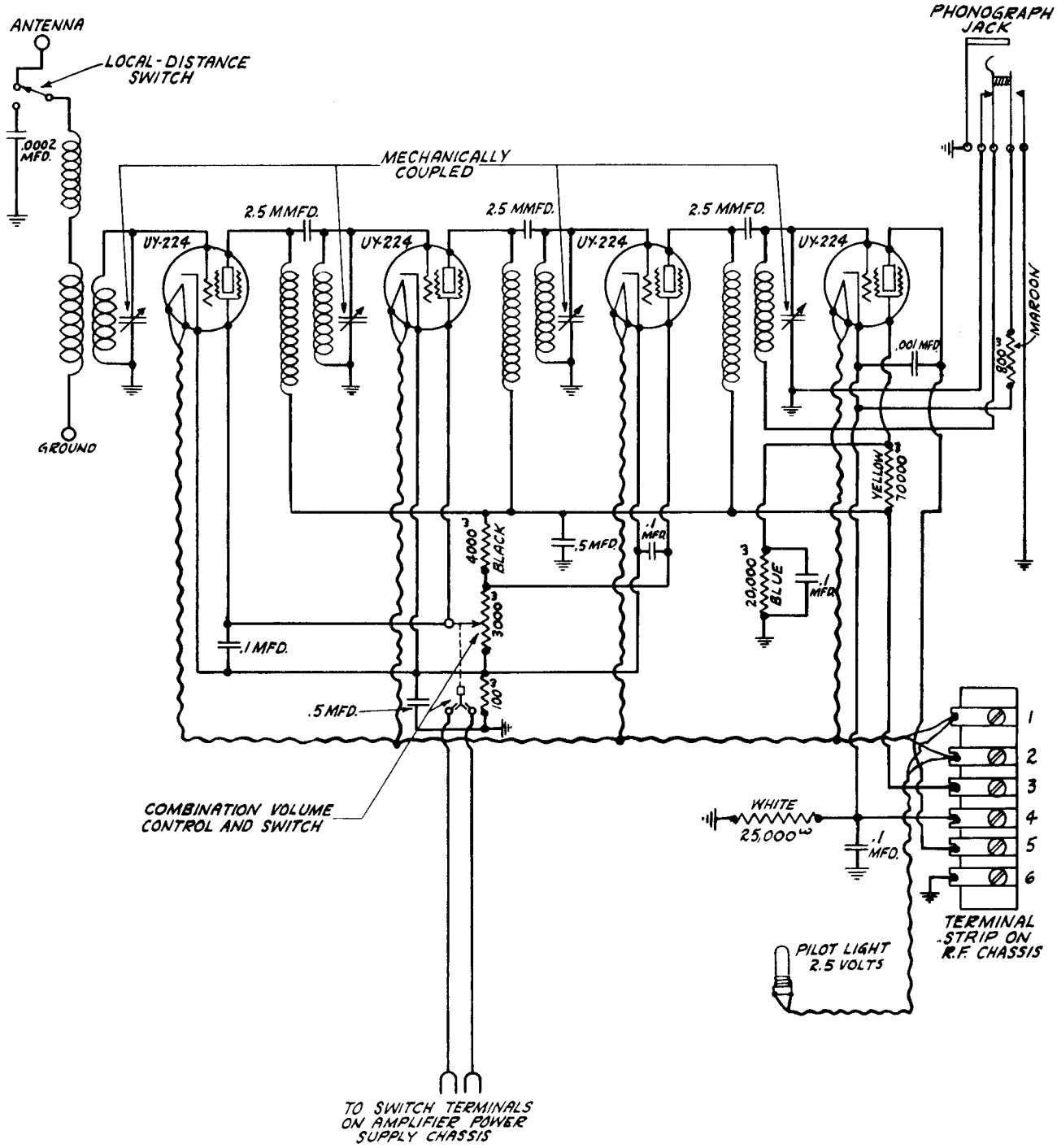


FIG. 19

SCHEMATIC CIRCUIT OF RADIO CHASSIS

7003

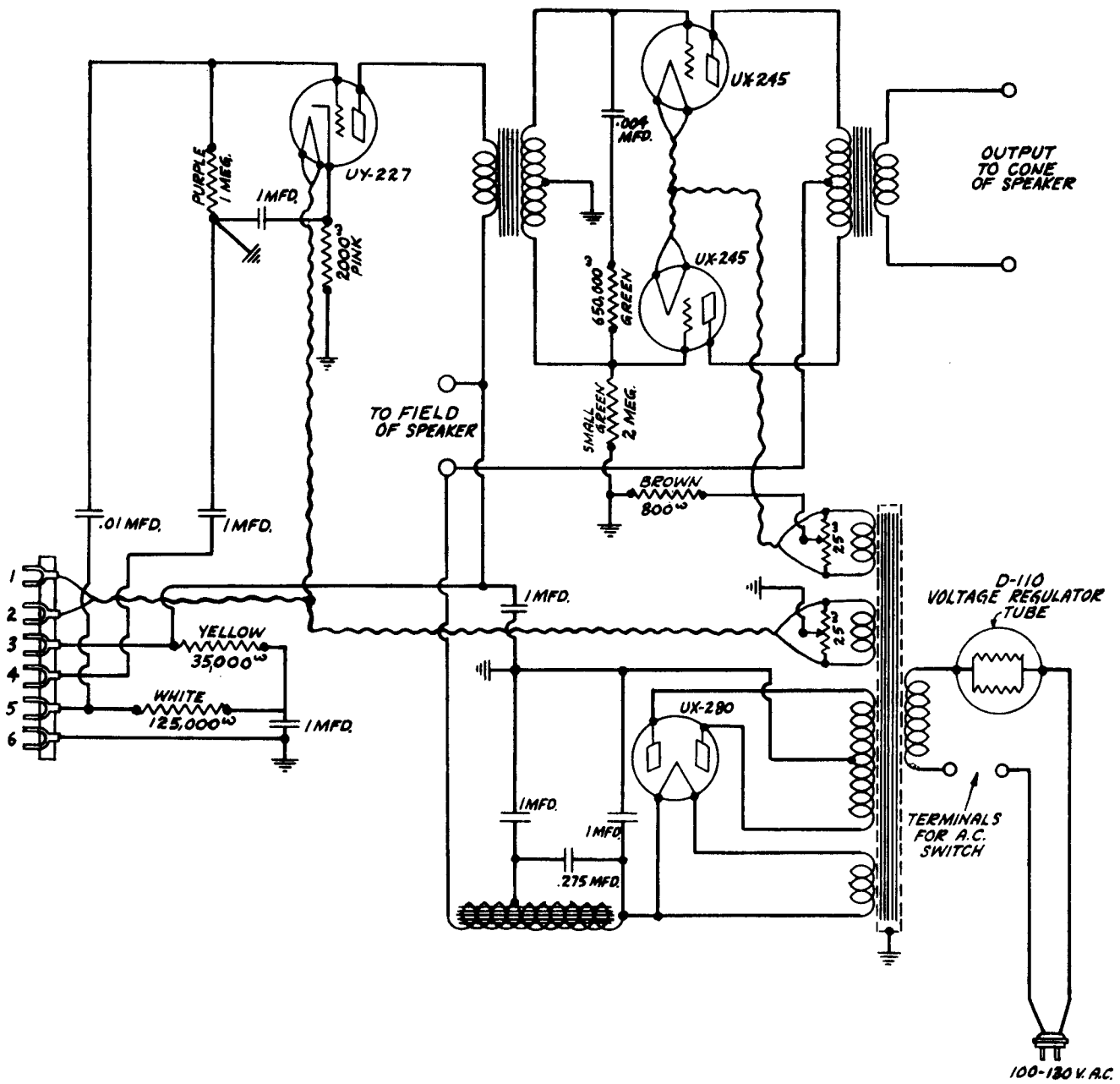


FIG. 20

SCHEMATIC CIRCUIT OF AUDIO AMPLIFIER POWER SUPPLY CHASSIS USED ON STRAIGHT RADIO-60 CYCLE

7004

CONTINUITY TEST CHART

Test No.	Under Test	Test Positions	Correct Effect	Probable Incorrect Effect	Caused By
1	R. F. Grid Circuits	Ground to 1st, 2nd and 3rd grid caps	Closed thru 4Ω (B1.3)	Open or shorted	Open in flexible lead Open in R. F. coil Bent condenser plate
2	Detector Grid circuit	Ground to detector grid cap	Closed thru 4Ω (B1.3)	Open Shorted	Open in flexible lead Defective phonograph jack Open in R. F. coil Bent condenser plate
3	1st A. F. grid circuit	Ground to 1st A. F. socket grid contact	Closed thru 1 meg (A0)	Shorted thru 165.000 Ω (A.02)	Shorted .01 mfd. coupling condenser
4	Power tube grid circuits	Ground to alternate power tube socket grid contacts	Closed thru 6000 Ω (A0.7)	Shorted Open	Filter resistance lead touching hum potentiometer frame Shorted .004 cond. Open transformer winding
5	Antenna circuit	Ground to ant. post (switch set for distance)	Closed thru 30 Ω (B3.6)	Closed thru 5Ω (B1.6) Open	Shorted antenna loading coil Open antenna loading coil Open transformer primary Defective switch
6	Antenna circuit	Ground to high side ant. primary coil	Closed thru 5Ω (B1.6)	Open	Open primary
7	Antenna circuit	Ground to ant. post (switch set for local)	Open	Closed thru 30Ω (B3.6)	Defective switch
8	Phonograph jack	Ground to cathode contact of detector socket (open plug inserted in jack)	Closed thru 800Ω (A3.3)	Closed thru 25,000Ω (A0.17)	Open connection or defective jack
9	Phonograph jack	Ground to grid cap of detector (open plug inserted in jack)	Open	Closed thru 4Ω (B1.3)	Defective jack
10	Radio Frequency plate circuit	Ground to 1st, 2nd and 3rd R. F. socket plate contacts (Volume control at maximum)	Closed thru 7000Ω (A0.6)	Closed thru 60Ω (B4.2) Closed thru 4100Ω (A0.9) Closed thru 100,000Ω (A0)	Shorted .5 mfd. by-pass condenser R. F. choke lug shorted to antenna wire shielding Shorted coupling condenser Shorted screen-grid by-pass condenser Open volume control Open 100Ω grid bias resistor
11	Detector plate circuit	Ground to detector plate	Closed thru 165,000Ω (A0.02)	Closed thru 25,000Ω (A.17)	Shorted .001 mfd. by-pass condenser
12	1st A. F. plate circuit	Ground to plate contact 1st A. F. tube	Closed thru 9800Ω (A0.4)	Closed thru 2700Ω (A1.3) Short Open	Shorted condenser in filter block Shorted .5 mfd. condenser in radio chassis Plate connections touching potentiometer frame Open primary in transformer Open volume control Open 100Ω grid bias resistor

FIG 21

CONTINUITY TEST CHART—*Continued*

Test No.	Under Test	Test Positions	Correct Effect	Probable Incorrect Effect	Caused By
13	Power tube plate circuit	Ground to alternate power tube socket plate contacts	Closed thru 12,300Ω (A0.3)	Open Closed thru 600Ω (A3.0) 750Ω (A3.3) 5200Ω (A0.7)	Open field coil Open primary windings Shorted condensers in filter block
14	Screen-grid circuits	Ground to 1st, 2nd and 3rd R. F. socket grid contacts (Volume control at max.)	Closed thru 3100Ω (A1.2)	Short Closed thru 100Ω (A4.5)	Grounded volume control Shorted.1 mfd. by-pass. cond.
15		Ground to 1st and 2nd R. F. socket grid contacts (Volume control at minimum	Closed thru 100Ω (A4.5)	Closed thru 100,000Ω (A.05) Short	Open 100Ω grid bias resistor Defective volume control Shorted .5 mfd. cathode by-pass condenser Grounded volume control
16	Detector Screen-grid circuit	Ground to detector socket grid contact	Closed thru 17,000Ω (A0.25)	Short	Shorted .1 by-pass condenser
17	R. F. return circuit	Ground to 1st, 2nd and 3rd R. F. socket cathode contacts	Closed thru 100Ω (A4.5)	Short Closed thru 100,000Ω (A.05)	Shorted .5 mfd. cathode by-pass condenser Open 100Ω resistor
18	Detector return circuit	Ground to detector socket cathode contact	Closed thru 25,000Ω (A.17)	Short Closed thru 800Ω(A2.7)	Shorted .1 mfd. by-pass cond. Defective phonograph jack
19	1st A. F. return circuit	Ground to 1st A. F. socket cathode contact	Closed thru 2000Ω(A1.5)	Short	Shorted condenser in filter block
20	Power tube return	Ground to filament contact both power tube sockets	Closed thru 800Ω (A2.7)	Short	Grounded hum potentiometer Grounded filament winding on power transformer
21	Plate supply	Ground to rectifier socket filament contact	Closed thru 11,000Ω (A.37)	Short Closed thru 150Ω (A4.3) Open	Shorted 1st condenser in filter Shorted 2d condenser in filter Open choke coil Open field coil
22	High voltage secondary of power trans.	Ground to alternate rectifier socket plate contacts	Closed thru 250Ω (A3.9)	Open	Open high voltage secondary winding
23	Primary of power trans.	Ground to side of primary winding	Open	Short	Grounded power switch Grounded transform.primary
24	Speaker field	Across terminals of plug	Closed thru 4750Ω(A0.8)	Open Short	Open field coil Shorted field coil
25	Choke coil	Rectifier filament to blue or maroon wire on field	Closed thru 160Ω(A4.2)	Closed thru 20Ω (B3.2)	Shorted .275 cond. in block

Note—

FIG.22

istics of the intermediate frequency amplifier of a superheterodyne receiver. This may be a commercial item or it may be a home-made job. The main difficulty in the home-made oscillator lies in the inability of the average technician to effect a calibration of the intermediate frequency circuit.

It is of course possible to construct all service apparatus but the difficulties attendant upon the construction of a really good analyzer are so manifold as to make it a momentous undertaking for any but the most skilled craftsmen.

Resonance indicators and output meters are readily home constructed and they will be described in detail as will the various service tools necessary in conjunction with the oscillator.

Trouble and Causes.

Before going into detail in the use and construction of these items we will review the possible troubles in Radio Receivers and the causes which may be connected therewith.

Dead Receiver.

Power off due to switch not on, blown fuse, open cord, or power line dead.
Tube not in socket.
Antenna shorted to ground.
Broken lead-in.
Grounded lightning arrester.
Shorted variable condenser or equalizer.
Open or short circuits within receiver.
Defective tubes.
Polarity reversed (D.C. receivers only).
Open R.F. coils.

Weak Signals.

Defective tubes.
Defective antenna.
Loose or poor ground connection.
Aligning trimmers out of adjustment.
Oscillator alignment out (superheterodyne only)
Intermediate frequency amplifiers improperly tuned.
Open or short circuits within the receiver.
Incorrect line voltage (low).
Antenna connected to wrong input post (receivers with long and short antenna connections only).
Defective audio transformer.

Hum.

Defective detector or power tubes.
Weak rectifier tube.
Shorted filter choke.
Open filter condenser.
Open or shorted center tap resistance.
Unmatched push-pull tubes.
Improper bias on tubes.
Cathode to heater short circuit in detector tube.
Heater voltage grounded.
Frozen or inoperative elctrolytic condenser.
Defective audio transformers.
Poor ground connection.
Loose laminations in power transformers.
Hum on broadcast carrier.
Tunable hum due to oscillation in power transformer secondary.

Fading or Intermittent Operation.

Atmospheric conditions which are unavoidable.
Thermostatic short or open circuit in tube.
Swinging ground in antenna circuit.
Extreme fluctuation in line voltage.
Excessive heater voltage.
Dirty tube prongs.

Distortion.

Receiver improperly tuned to signal.
Defective output tubes.
Mismatched push-pull tubes.
Defective audio transformers.
Detector overloaded.
Incorrect grid bias on audio tubes.
Defective speaker.
Improper detector bias.
Oscillation in R.F. amplifier.

Noise (Outside Receiver).

Atmospheric conditions.
Elevators in building.
Antenna shorting on grounded objects such as roof, etc.
Defective electrical or electromedical appliances nearby.
Poor antenna contact where lead-in joins antenna.

Noise (Inside Receiver).

Defective tubes.
Loose contact in tube sockets.
Intermittent short circuits.
Dirty variable condensers.
Defective by-pass condenser.
Loose dial light.
Poor resistors.

Audio Howl or Acoustic Feed-Back.

Microphonic tube.
Loose speaker (not properly fastened in cabinet).
Open circuit in A.F. transformers.
Open by-pass condensers.
Weak batteries (battery receivers only).

High resistance soldered joints in A.F. circuits.

Oscillation.

Circuit not neutralized.
Interaction between two stations on adjacent channels.
Antenna lead run too close to unshielded receiver.
Open by-pass condenser.
Shorted R.F choke.
Incorrect voltages on tubes.
Loose shields.
Open or reversed R.F. transformer winding.
Poor ground connection.
Defective tubes.
Loose tube shield.

Motor Boating.

Defective output tube.
Open grid in output circuit.
Defective transformer.
Open by-pass condenser.

Broad Tuning.

Improper coupling in band-selector circuits.
Trimmers out of alignment.
Condenser loose on shaft.
Unmatched coils.
Too long antenna.
No ground connection or long ground lead.
Defective tube.
Antenna connected to wrong input point.

Hot Rectifier Tube.

Shorted filter condenser.
Internal short in power transformer primary.
Filter choke coil winding shorted to iron core.
Most of these pointers suggest their own remedies. We will, however, recapitulate so as to be certain that we have covered every point.

Dead Receiver.

Check power supply to see that the tubes are receiving their proper voltages. Test tubes and circuits with analyzer. Check antenna system and disconnect lightning arrester. Check circuit noted with continuity tester if analyzer fails to points out trouble.

Weak Signals.

Check antenna system. Check tubes and circuits with analyzer for improper voltages and check tuning circuits for alignment.

Hum.

Check all circuits noted. Change tubes. Inoperative electrolytic condensers can be repaired by removing all tubes but the rectifier leaving the set turned on for fifteen minutes or so. The excess voltage delivered under these conditions will but put the condensers back into operating shape. Tunable hum can be cured by placing small (.01-mf.) condensers across the two halves of the high voltage winding. This is due to oscillation in this circuit and is evidenced by hum appearing only when a station is tuned in. Be sure that the hum is not on the station carrier before resorting to this expedient.

Fading.

If fading is on all stations it is probably not due to atmospheric conditions and the circuits mentioned above should be checked. Tubes are often found with shorts or opens which do not appear until the tube heats thoroughly. Operation of the heaters at an excessive voltage results in "paralysis" of the tube.

Distortion.

Volume control should be effected by means of the control provided—not by detuning the receiver. In some cases this practice results in distortion. Check voltages and tubes. Look for oscillation in R.F. stages and check loud speaker.

Noise (Outside Receiver).

This may be checked by removing the antenna. If the receiver is now quiet the noise is due to some external condition. If elevators are noisy suggest that they be overhauled. A line filter in the receiver power supply is often effective but in most cases the filter *must be placed at the source of the disturbance* if it is to be cured.

Noise (Within Receiver).

Check all circuits mentioned for loose contacts or dirty joints. Check variable condensers for dust which can be removed with a pipe cleaner. Some condensers are cadmium plated and the plating has been known to "grow" under certain conditions. If the condenser cannot be replaced you may remove it from the set and connect it to the terminals of a six volt battery. Rotating the condenser will cause the fuzz to arc and burn off.

Audio Howl.

This is in most cases due to the feeding back of acoustic energy from the speaker to the detector tube which is very sensitive to mechanical vibration. Replacing the detector tube may effect a cure or the tube may be covered with a lead shield to weight it

against vibration. A piece of Ford lower radiator coupling hose will fit over a '27 or '24 and is ideal for the purpose. Failing in this manner the mounting of the receiver chassis on sponge rubber might effect a cure. See also that the cover of the set is not vibrating. Sometimes a first A.F. tube causes this type of howl also.

Oscillation.

Oscillation may not exist in the receiver but may be due to the heterodyne whistle of two stations close together in the broadcast frequency spectrum. This will be immediately noticeable to the technician but he may have to explain the fact to his customer. Oscillation in screen grid receivers is usually due to loose shielding or incorrect voltages. Open by-pass condensers or shorted R.F. chokes may also result in feed-back between stages. In the case of neutralized receivers every possible cause should be checked before attempting to adjust the neutralizing condensers. If the cause is in a reversed coil winding it will not be possible to neutralize the set. The process of neutralization will be described shortly in the section covering the use of the service oscillator.

Motorboating.

This is usually due to feed-back between stages due to a high impedance circuit common to two or more stages. In battery receivers this often occurs when the batteries lose their voltage and develop a high internal resistance. It is characterized by a slow putt-putt or a howl which may be differentiated from acoustic feed-back by the fact that tapping the tubes does not greatly aggravate the condition. In A.C. receivers look for open by-pass condensers, defective transformers, or defective output tubes.

Broad Tuning.

This may result from the use of too long an antenna or through the lack of a proper ground connection. It may also result from improper coupling in band-selector circuits. This is mentioned in detail in the section describing a typical receiver. Improper voltages on screen grid tubes may also have this result as well as disaligned trimmers or a loose condenser rotor. High resistance connections in one of the R.F. circuits must be watched for. A high resistance connection is due to poor soldering—the flux coating the joint so that the solder cannot make a good contact.

Coils improperly matched may also have this result. To be sure of this in making a replacement it is well to employ an entire new set of coils as matched at the factory except in the cases of certain receivers where the coils are all matched with extreme accuracy. The new RCA and Victor sets are in this class as a special method of coil matching is used at the factory and all coils are uniform within narrow limits. Alignment of the tuning elements should be carried out with an oscillator and output meter or by the use of the output meter or resonance indicator alone where a station can be tuned in. The process is described in the section devoted to the operation of the service oscillator.

Overheated Rectifier.

If the receiver is inoperative and it is seen that the rectifier tube plates are red hot the probable trouble is a shorted filter condenser. A primary short circuit in the power transformer will result in an excessively high secondary voltage which may also have this effect but this is doubtful as the new rectifiers are rated at an extremely high voltage as compared with the earlier types.

Careful study of these pages should enable the technician to spot trouble not evidenced by off readings on the analyzer. These analyzers are required equipment by all the larger service organizations and while no doubt the technician can effectively service a receiver without one it is certain that the necessity for getting into awkward positions to obtain readings with a simple voltmeter will slow up the work tremendously. Manufacturers of such apparatus have made arrangements for partial payment plans which place the equipment within the reach of all and there is now no reason why the service technician should be without proper equipment.

The Service Oscillator and Its Use.

We noted before that the service oscillator is nothing more than a miniature radio transmitter giving a modulated signal output of any desired frequency. It is possible to build such an oscillator with a grid leak and condenser combination which gives a modulated signal due to rapid blocking of the grid circuit. This occurs through the use of such a combination of resistance and capacitance that the charge on the grid does not leak away rapidly but builds up and discharges in such a manner as to modulate the signal.

This is an excellent simplification of the apparatus but does not give as flexible a piece of apparatus as would be the case where the modulation is obtained from a separate source as in the case of a broadcast transmitter.

An oscillator of the first type is shown in schematic in Fig. 23. The equipment should be completely shielded in an aluminum case such as is obtainable on the open market so that the signal can be picked up only at the terminals provided. In the circuit shown the 125-ohm resistor effects the required variation of the signal output in accordance with the signal strength desired. The grid leak should be varied over a range between .5 and 10 megohms until the value giving the desired modulation tone is obtained. The batteries should be enclosed di-

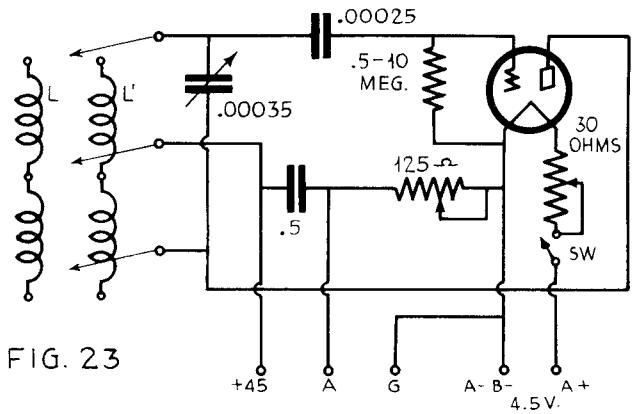


FIG. 23

rectly in the shield so that no pick-up in the receiver from stray signals in the battery leads will affect the adjustment of the receiver. This is important.

The values of the various parts are given directly on the schematic circuit diagram. It will be noted that by simply throwing an anti-capacity key switch the range of the signal may be either in the broadcast band or in the range of the intermediate frequency amplifier of a superheterodyne receiver. This is the simplest form of oscillator which can be effectively used in service work and we will continue our notes on the use of the apparatus with this type of oscillator in mind. Later we will take up the construction of a more complex device and its calibration.

Inasmuch as we will not use the receiver antenna during operations with the test oscillator it will be necessary to replace it with a device known as a "Dummy Antenna" and having equivalent characteristics—except in its capabilities of picking up a signal. In Fig. 24 there is a sketch of a "dummy antenna" together with data on the parts going into its structure.

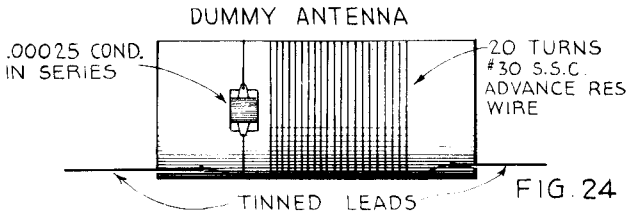


FIG. 24

Output meters are available on the market for connection in place of the loud speaker so that a visible indication of the output is obtained. Such an indication is necessary in all operations with the service oscillator. A satisfactory output meter for most service work may be made by employing a '12A tube with the grid and plate tied together in the manner shown in Fig. 25. The filament battery may be two 4.5-volt "C" batteries in parallel.

Maximum output is indicated by the maximum deflection on the milliammeter scale. Such a meter may be connected directly across the loud speaker windings. It is a simple matter to mount a meter of this type in a small aluminum shield together with the necessary batteries so that it becomes a permanent part of the technician's equipment.

A second type of output meter is the "resonance indicator" which consists of a milliammeter in series with the detector plate lead. An adapter is made from an old tube base and a socket in such a manner that two leads are brought out for the insertion of a 0-1 milliampere meter. Fig. 26. When used with a "bias" detector the maximum signal will be indicated by the maximum reading on the milliammeter.

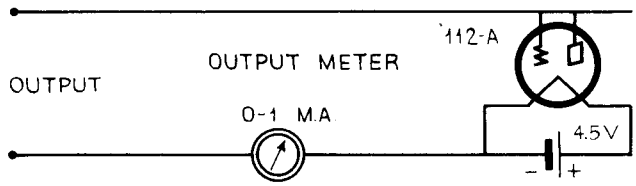


FIG. 25

Alignment of Radio Frequency Amplifiers.

In aligning a receiver by means of the oscillator and the output meter or by means of the resonance indicator it is necessary to connect the dummy antenna between the oscillator antenna post and the antenna input of the receiver as shown in Fig. 27.

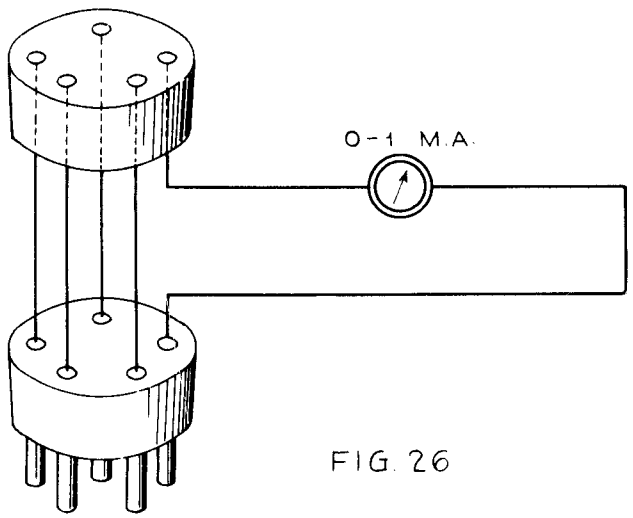


FIG. 26

The oscillator is set to some high frequency within the broadcast range and the output of the oscillator is adjusted so that with the volume control of the receiver set at about 50% of the maximum output the reading on the output meter is something less than the maximum.

Now starting with the trimmer condenser in the detector circuit each trimmer should be adjusted so that the maximum reading is obtained in the output. Use a bakelite or other non-metallic screw driver in making this adjustment.

If at any time during the process the output meter runs off scale readjust the output of the oscillator to bring it back into the range of the meter. Once having completed the adjustments of the trimmers, the oscillator output should be shifted to some lower frequency and the adjustments of the trimmers

checked again. The receiver will now be in correct alignment but if the receiver dial is calibrated directly in kilocycles you may have disturbed this calibration. If so tune in a station of known frequency, release the dial mechanism and shift it so that the calibration is correct.

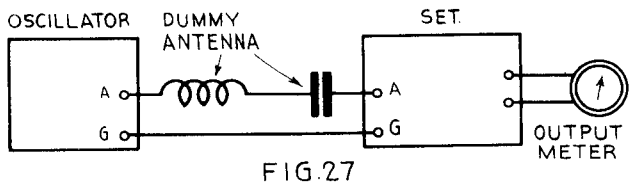


FIG.27

Aligning the Intermediate Frequency Amplifier in a Superheterodyne.

To effect an alignment of the intermediate frequency stages of a superheterodyne receiver the procedure is not dissimilar to that just described.

Connect the antenna post of the oscillator directly to the grid of the first detector tube. Connect the ground terminal of the oscillator to the receiver ground. In order to be certain that no broadcast interference is picked up it is necessary to ground the antenna post of the receiver.

Now with the oscillator tuned to the correct intermediate frequency as ascertained from the manufacturer's data adjust the output of the oscillator so as to give a convenient reading at the output meter with the receiver volume control at about mid-range. The adjustment is now continued in the same manner as in the case of the radio frequency stages. In the superheterodyne it is best to complete the alignment of the intermediate frequency before attempting any adjustment of the R.F. or oscillator.

Neutralizing a Receiver.

In neutralizing a receiver by means of the oscillator we require a dummy tube. This dummy is made by taking a *good* tube and cutting off one filament or heater terminal at the base so that the tube is inoperative.

An easy way to insulate the filament prong from the socket is to slip a short piece of soda straw over one of the prongs and exercise a little care in inserting the tube in the socket. This does not spoil the tube.

Connect up the oscillator with the dummy antenna as described and place the dummy tube in the first socket. Shift the neutralizing condenser with an insulated tool or screw driver so that it is completely off neutralization and tune in the signal from the oscillator so that a good, strong indication is evident in the output meter. Now adjust the neutralizing condenser until no signal comes through. With the condenser off neutralization a certain amount of the signal is passed through the dummy tube through the capacitance between the electrodes. When neutralization is complete this tube capacitance is balanced out and no signal passes through the dummy tube. Having completed the balancing of the first stage replace the dummy tube with one known to be good and repeat the process from stage to stage until all of the circuits are balanced. The receiver is now completely neutralized and any oscillation taking place is due to other causes. If the primary coil wiring is reversed you will not be able to effect a complete neutralization of the receiver. Be careful in making changes in wiring of neutralizing windings and replace wires in proper positions.

Balancing the Oscillator of a Superheterodyne.

Some superheterodyne receivers employ a bridge type of circuit in the oscillator tuning condenser system. This consists of a unit of the gang condenser—a large fixed condenser and two trimmers. After having effected alignment of both the R.F. and intermediate frequency stages continued insensitivity is possible due to this circuit being out of alignment.

With the output meter in place and the oscillator connected to the receiver through the dummy antenna tune the oscillator to about 1400 kc. and adjust the receiver so as to obtain a reading at the output meter of about half scale. Now adjust the trimmer across the portion of the gang condenser which tunes the oscillator for maximum output at high frequencies. Now retune the oscillator and receiver to 600 kc. and adjust the trimmer across the oscillator fixed condenser for maximum output at the low frequencies. Return again to the 1400 kc. position and make any final corrections necessary.

Certain superheterodyne receivers have one section of the gang condenser cut to the proper shape for tuning the oscillator and do not employ the bridge circuit arrangement. Alignment of the oscillator in such receivers is carried out at the same time and in the same manner as the R.F. alignment.

Special Tool for R.F. Alignment.

A special tool for alignment of R.F. circuits is shown in Fig. 28. This is called a balancing ring. It consists of a ring of No. 14 wire covered with spaghetti tubing mounted on the end of a bakelite rod.

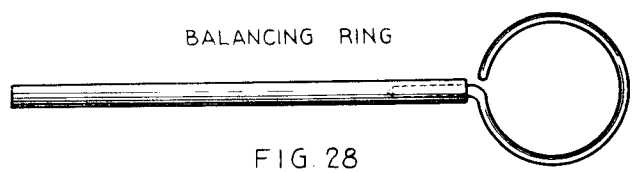


FIG. 28

In aligning the tuning circuit press gently on each tuning condenser rotor end plate. If the output reading increases it indicates that insufficient capacity is in the circuit and the trimmer should be tightened. If the ring is placed over each R.F. coil in turn and the reading increases, too much capacity is in the circuit and the trimmer should be loosened. This

test is only of value in those receivers where the coils are open for test by placing the ring over one end of the coil and the test cannot be used where the coils are shielded completely. If both these tests result in a decreased output reading it indicates that the adjustment is already correct and that stage needs no adjustment.

The end of the bakelite tool may be ground down so that the tool may be used also as an insulated screw driver for trimmer adjustment. The use of a metallic screw driver for such a purpose throws everything out of balance.

Making an Ohmmeter for Resistance and Continuity Tests.

Through the courtesy of the International Resistance Company we are including two sketches for the adaptation of 0-1 ma. meters to use as ohm-

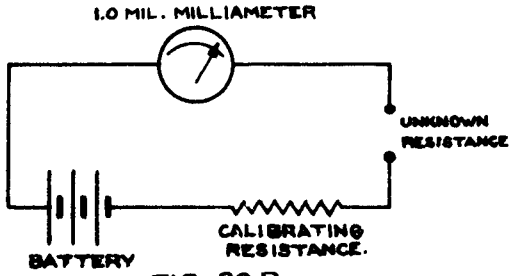


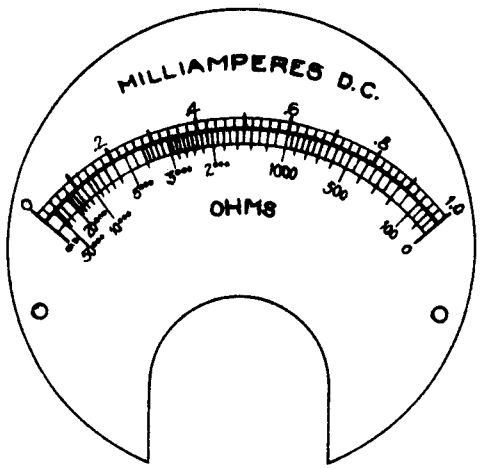
FIG. 29 B

meters. These two scales shown in Fig. 29A may be cut out and pasted over the original scale of the meters indicated in Fig. 29B.

The following chart gives the values for the series resistance and the battery. The scale may be extended to 3 and 15 times the value shown by using the higher battery voltages and higher series resistances. This means that with the multiplying factor of 3 the reading of 100 ohms will be really 300 ohms and the reading of 2000 ohms—6000. Use of the factor of 15 would mean that 100 ohms on the scale would correspond to a resistance across the terminals of 1500 ohms, and 2000 ohms—30,000.

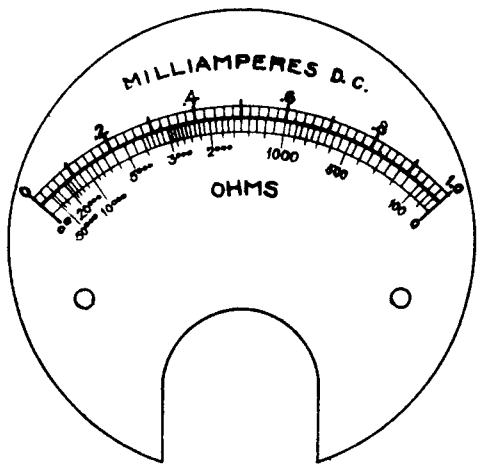
Battery Voltage	Series Resistance	Scale Multiplying Factor
1.5	1,500	1
4.5	4,500	3
22.5	22,500	15

In each case prior to use the test prods should be shorted and the zero adjustment of the meter set so that the reading is zero resistance. This compensates for loss of battery voltage through service. When the setting can no longer be made at zero the battery should be replaced. The two ranges having the 1 and 3 factors are the most useful for our purpose and the meter can be set up in a cabinet with a change-over switch and a tapped "C" battery so as to cover both ranges at will.



ADAPTED FOR WESTON METER, MODEL 301.

FIG. 29 A



ADAPTED FOR JEWELL METER PATTERN 88.

DIRECTIONS FOR USE OF OHMMETER SCALES.

REMOVE METER FROM CASE BY LOOSENING THE THREE MOUNTING SCREWS. REMOVE THE TWO SCREWS HOLDING THE MILLIAMMETER SCALE IN POSITION. PLACE OHMMETER SCALE ON TOP OF OLD SCALE, FASTENING WITH A FEW SPOTS OF GLUE IF DESIRED, AND REPLACE SCALE MOUNTING SCREWS. CONNECT METER, BATTERY AND CALIBRATING RESISTANCE IN SERIES, AS IN DIAGRAM, AND SHORT-CIRCUIT "UNKNOWN" TERMINALS. METER SHOULD READ ZERO ON OHMMETER SCALE. IF NOT, ADJUST POINTER WITH ZERO SET SCREW. REPLACE METER IN CASE.

ANALYSIS OF TYPICAL RECEIVER

We are going to learn how to service radio sets in an entirely unorthodox fashion. By this is meant that we are going to assume a hypothetical receiver —one not of any particular type or design and give it all the features found in the most modern radio sets. We will then analyze this imaginary set step by step, learning what each part contributes to the over-all efficiency of the receiver and in what manner the failure of that part might affect the operation of the receiver as a whole.

The average receiver of today has two screen-grid radio frequency amplifying tubes, a detector, a first A.F. stage and a second A.F. stage which may employ one or more tubes. There is also a rectifier tube which serves to convert high voltage alternating current into a pulsating direct current which is smoothed out by means of filter circuits and furnishes the necessary operating voltages for the receiver.

We will design our receiver along these lines—analyze its structure and then retrace our steps to see what possible variations might be found in manufacturers' designs and how they might affect the operation of the receiver. These variations involve the use of unusual forms of coupling between tubes —resistance coupling in amplifiers—unusual volume controls—special types of detectors—automatic volume controls—etc.

Of course no one treatise can hope to cover in detail the foibles and fancies of all the radio engineers at large in the country, for each man has pet ideas which he incorporates in receivers of his design—ideas based on personal likes and dislikes and upon the necessity for avoiding patent infringement. We will, however, take into consideration the more usual arrangements of various radio circuits in a manner calculated to aid in service work.

Analysis of a Radio Receiver.

In Fig. 30 we find a receiver in schematic which incorporates in a good measure the best features of everyday engineering practice. Peculiar and involved circuit arrangements have been avoided entirely but will be taken up later.

You will note that three input terminals are provided. In using a fairly short antenna, connection should be made to the S.A. binding post. If a long or low antenna is used, the L.A. post should be employed so that the fact that C_1 is in series with the antenna will effectively shorten it and prevent the large antenna capacitance from affecting the tuning of the first condenser and coil.

If C_1 were shorted the use of a long antenna would broaden the tuning of the receiver as a whole and considerable interference would result. The same effect would be true if we connected an antenna of too high capacitance to the S.A. post. Connecting any antenna to the L.A. post with the condenser unsoldered or open would result in no signal whatever or at best a very weak one.

In this receiver a portion of the volume control is in the antenna circuit, its adjustment affecting the amount of signal voltage furnished across the terminals of the primary winding L_1. Even with such a volume control in its minimum signal position a certain amount of signal will get through by capacity coupling unintentionally introduced through the proximity of the two windings, L_1, L_2, and we must include another volume control at some point in the receiver if a true *zero volume* setting is desired.

This second control is labelled R_2 and the two may be coupled to the same shaft for simplicity of operation. Another reason for the use of the two controls will be shown in another section of this book under the heading of "Cross Modulation."

If R_1 were open-circuited we would find that the volume was not changed in the normal manner as we rotated the control knob and that extremely loud signals resulted when the knob was in the "maximum" position. Derangement of R_2 has similar effects which will be noted a bit further on.

The peculiar circuit structure between the antenna and the grid of the first R.F. tube constitutes a "band-selector" or "band-pass filter" arrangement. Theoretically, a radio signal consists of a carrier wave and two *side-bands*, the width of which depends upon the modulation impressed upon the carrier. If two circuits be coupled so that a common impedance exists between the two, a double-peaked response will be obtained. In Fig. 31, there are shown the response characteristics of two tuned circuits coupled in a normal fashion as with a tube; the same two circuits coupled by means of an impedance common to both circuits are shown in comparison

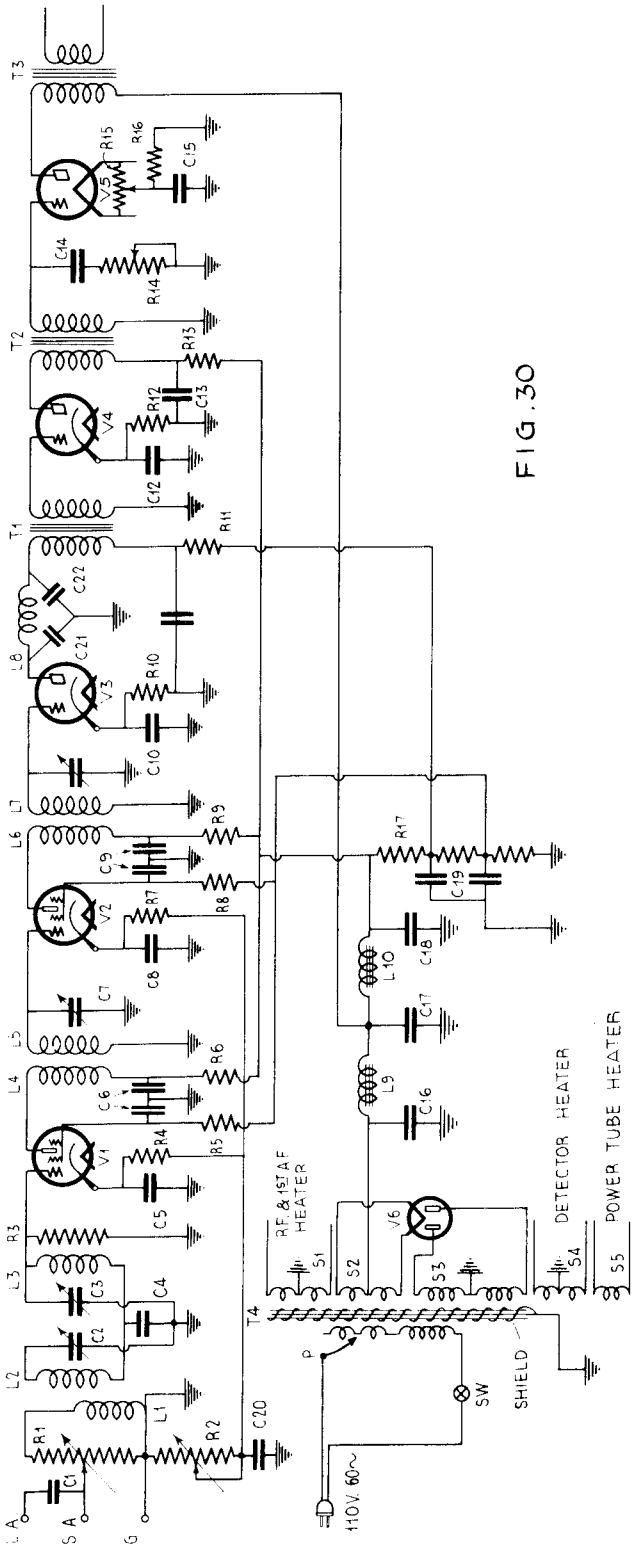


FIG. 30

with the double peak characteristic readily noticeable.

The manner in which the double-peak or "band-pass" circuit approaches the ideal square response curve is obvious. Another and more important use for the band-selector is described later under the heading of "cross-modulation." This peak separation does not remain constant over the tuning range and a value of C_4 (the coupling impedance) should be chosen such as to give the best effect over the entire band. With capacitative coupling as shown in Fig. 30, a condenser in the neighborhood of .01-mf. is usual. The short-circuiting of C_4 will result in no signal.

The resistance R_3 has no effect upon the circuit operation and is there merely to provide a return path for the grid circuit. Its value is usually about 3 megohms. Normally the resistance measured to ground from the grid of the first tube would be 3 megohms but with C_4 short-circuited the reading would indicate zero resistance.

An open circuit at C_4 results in loss of signal strength while an improper value of capacitance at this point will result in too broad tuning either at one portion or throughout the tuning range— or in excessively sharp tuning at one end.

The tuned circuits L_2C_2 and L_3C_3 are to all intents identical with the circuits employed in coupling the radio frequency amplifier stages except that they lack the primary circuits. The usual value for the maximum capacitance of each section of the gang tuning condenser is about .00035-mf. This calls for a tuning inductance of about 240 microhenries for covering the broadcast band.

Open or short circuits at any of these points will cause loss or weakening of the signal.

The Radio Frequency Amplifier Stages.

Plate voltages from the power supply are furnished to each tube by taking taps off at the proper point on the voltage divider. As is the common practice the grid circuits are returned directly to ground. Seemingly this would mean that the grids did not obtain a negative bias such as is required for the correct operation of the tubes. The bias is obtained by means of a resistance in the cathode circuit of each tube through which the plate current of the tube must flow.

Operation of the tube requires that the grid should always have a negative potential with respect to the cathode circuit. The true meaning is not distorted if we say that the cathode should be positive with respect to the grid. The current flowing through the resistance creates a voltage drop according to Ohm's Law and makes the cathode positive with respect to ground (and the grid) by that amount.

In determining the voltage characteristics of each R.F. stage we must first set the volume control at its maximum position. This short-circuits R_2 and leaves R_4 between the cathode of V_1 and ground. The condenser C_5 is in shunt across R_4 so as to effectively short circuit it as far as R.F. is concerned. This as-

sures us that the biasing resistance has no effect on the signals.

The value of the by-pass condenser should be large enough that its reactance is substantially lower than the resistance of R_4 at all frequencies within the broadcast band.

The gain through the tube and consequently the "volume" can be controlled by varying the bias of the grid. This is done by increasing the resistance of R_2.

The resistances R_4 and R_7 provide a minimum bias for the tubes below which excessive plate current would be drawn. Increasing the resistance of R_2 increases the bias of the tubes and thus decreases their amplification. Short-circuiting of R_2 would mean that neither tube would vary in amplification with rotation of the volume control knob. This would be shown by means of a set analyzer if the plate current of the tubes failed to change when the volume control was rotated.

Open circuits in R_2, R_4, or R_7 would be indicated by no plate current flowing in one or both tubes. Short-circuiting of either R_4 or R_7 causes excessive current to flow in the plate circuit of the tube involved, since no bias would be applied to the grid of that tube at maximum volume setting.

An open resistance R_3 would result in loss of bias for the first grid and V_1 would consequently draw excess current. Short-circuiting of C_5 or C_8 also removes the biasing potential from the grids of their respective tubes and allows excess current to flow.

R_5, R_6, R_8, and R_9 are what is known as isolating resistances. C_6 and C_9 are each double condenser units by-passing the isolating resistance to which they are connected. The capacitance is made large enough so that it presents a lower impedance path to ground for stray R.F. voltages than do the resistances.

These circuits are another means of assurance that the radio frequency voltages stay in the circuits provided for them. Their failure to stay "put" results in oscillation. Short circuits at these points will result in loss of voltages on the tubes. Open condensers will cause loss of signal or oscillation.

Shielding of the individual stages has not been indicated in the sketch but it is necessary in all screen-grid stages and is preferable even in circuits employing three element tubes. The two coils L_2 and L_3 should be shielded one from the other. Individual shields or partial shields should be over the screen-grid tubes.

It is also desirable that the filtering resistances and condensers pertaining to each stage be shielded within the same enclosures as the coils.

The R.F. transformers consist of a primary (L4 and L6) and a secondary (L5 and L7). Design factors attendant upon the use of the screen-grid tube call for a primary with often as many or more turns than are on the secondary winding if the maximum available gain is to be realized.

The windings may be one over the other or the primary may be wound with fine wire on a small bobbin at the end of secondary or placed within the coil form. Open circuits in the primaries are readily traced by loss of plate voltage while open secondaries result in loss of grid bias and consequent heavy plate current. Poor connections may cause broadness of tuning and short circuits in either winding will result in loss of signal.

The Bias Detector.

The function of the detector is one of converting modulated R.F. signals into a direct current pulsating at the modulation frequency. In bias detectors such as that shown the tube is operated on a portion of its characteristic curve so that changes in the signal occurring in the negative sense have no effect while changes in the positive direction cause plate current to flow.

The choice of the resistance R_{10} is such that the plate current is close to zero when no signal is impressed on the grid. Fig. 32 shows this effect

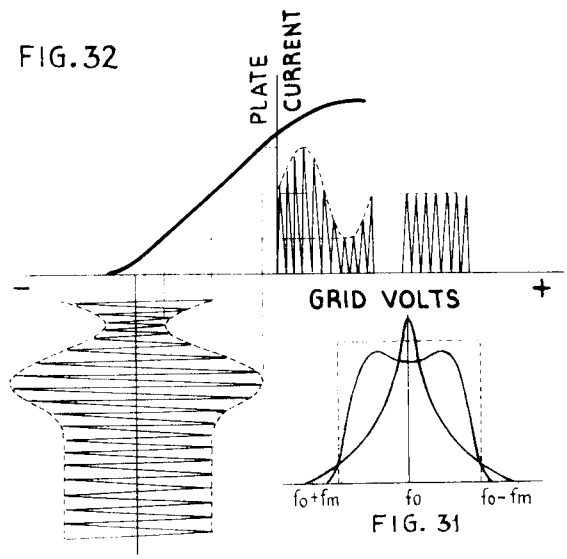


FIG. 31

graphically. It is essential that enough signal be impressed on the detector grid that changes under modulation occur only upon the straight portion of the characteristic curve of the tube. Otherwise the variations in plate current will not be images of the corresponding changes in the signal applied to the grid.

The by-pass condenser across R_{10} must be of sufficient capacitance to effectively by-pass the resistor at audio frequencies. This means that a capacitance of from .5 to 2 mf. must be used at C_{10}.

The plate impedance of tubes biased close to the plate current cut-off region is high and if the lower modulation frequencies are to be passed, the primary of the transformer T_1 must have a high value of inductance if it is to present a favorable load to the detector.

The system C_{21}, L_8, C_{22} represents a low pass filter which allows the passage of currents of audio fre-

quencies but by-passes to ground all R.F. energy. C_{22} might well be omitted from the circuit but C_{21} may not be omitted without severe loss of signal energy and the possibility of a portion of the R.F. energy in the plate circuit of the detector tube being fed back to the R.F. amplifiers where it might cause serious oscillation problems. If we employ C_{21} only it must be of about .001-mf. or .002-mf. in which case a slightly deleterious effect on the high frequencies may be noted. Careful design of a system as shown permits the use of relatively small condensers —about .0005-mf. with a 10 millihenry choke having but little effect upon the higher frequencies of modulation. Total exclusion of any such arrangement results in choking of the detector tube at high volume due to the R.F. energy in its plate circuit as well as the possibility of regeneration.

A short circuit in L_8 may be detected by means of an ohmmeter but its effects will be rather obscure. An open R.F. choke will be instantly noted by loss of detector plate voltage. Short circuits in either of the two condensers will be obvious as they will result in loss of plate voltage and a drop in voltage across the lower portion of R_{17}. Opens in these circuits will necessitate a bit of trouble-shooting on the part of the service man as they will not be apparent on any set testers, and in cases of weak signals and regeneration they will probably escape attention except as a last resort.

R_{11} and C_{11} constitute another isolating filter and need little mention except that the condenser reactance should be small compared with the resistance at all audio frequencies. Open circuits in the condenser leads may mean poor quality and a short circuit will result in loss of plate voltage for all tubes obtaining voltage from a common tap on the voltage divider. An open resistance R_{11} will result in loss of the detector plate voltage and a shorted resistance at this point will cause excessive voltage to be applied.

Normally T_1 will be a low ratio transformer because of the requirement of high primary inductance. With the higher ratios the large primary would call for an excessively bulky secondary winding and one having a large self-capacitance. This latter fact would result in loss of the high audio frequencies. The circuit fed by this transformer needs little said about it as the effects of the various circuit elements normally and abnormally have been covered. T_2 may be of higher ratio than T_1 as its primary inductance need not be so high.

The circuit across the secondary of the transformer C_{14}, R_{14} constitutes a tone control. With the maximum resistance in the circuit the high frequencies would be transmitted undiminished while gradual decrease of the resistance permits the condenser to be more and more effectively in shunt across the secondary of the transformer. An open or short circuited resistance would be evidenced by the fact that the tone was either high or low pitched regardless of the setting of the resistance. An open condenser would show itself by constant passage of the highs regardless of the control setting. A shorted condenser in the tone control circuit would be indicated by the fact that the tone control would become a volume control with no signal passing when the control was in the "bass" position.

V_5 is the power output tube which differs but little from the circuit arrangement of the stage previous. The output tubes available are of the filament type and not indirectly heated as in V_4.

A center tapped resistance (R_{15}) provides a balanced point for taking off the filament end of the biasing resistance. This center tapped resistance should be large enough so as not to affect the regulation of the filament supply winding of the transformer by adding an appreciable load but should be small in comparison with R_{16}. Failure of R_{15} due to short circuit of one portion or open circuit of one side will result in excessive hum.

Opening of the biasing resistor will result in loss of plate current while a short circuit of either the resistance or its by-passing condenser (C_{15}) will result in the removal of the grid biasing potential with consequent dangerous increase in plate current.

It might be noted here that low output impedance tubes such as are employed in output circuits *must not be operated without* sufficient bias on the grid. *Total destruction of the tube will* result if the biasing potential is removed for even a few moments. Neither may tubes of this class be employed as resistance coupled amplifiers with the grid return path provided by a resistance of high value. Any slight overloading which causes grid current to flow will create a voltage drop across the grid leak resistance which will lower the effective grid bias and may result in the destruction of the tube. Where the bias is provided by the means shown in Fig. 30, this cannot occur since the increasing plate current will also increase the bias in a manner such as to bring conditions quickly back to normal.

The output transformer (T_3) serves to couple the output tube to the loud speaker which may be of any type—the ratio of the transformer being adjusted to match the impedance of the tube to that of the speaker winding. Open circuits in the primary of the output transformer result in loss of plate voltage.

The Power Supply System.

The primary winding of the power transformer (T_4) is shown with taps taken out so that the transformation ratio of the transformer may be adjusted to compensate for abnormally high or low line voltages such as are encountered in many districts. The higher the line voltage the greater should be the number of active turns in the primary.

Most modern power transformers are equipped with an electrostatic shield between the primary and

secondary of the transformer which is either a thin sheet of copper foil or a winding of fine wire. This is grounded to the chassis and aids in reducing the effect of line noises on the output of the receiver.

If the primary winding has a number of short-circuited turns they will act as a shorted secondary and the power drawn from the line will be increased —the increased drain may not be great enough to blow the line fuses and the fault may be discovered but with great difficulty. Shorted turns in the primary circuit will, however, increase the ratio of transformation by lowering the number of active primary turns and the result will be evident in increased secondary voltages. An open primary will result in a completely dead receiver and the fault will be obvious. Open secondary or shorted secondary windings will result respectively in zero or low voltage readings. Short-circuited turns are usually evidenced by excessive heating and the service man should familiarize himself to the "feel" of transformers under operating conditions so that overheating may be recognizable.

In cases where all tubes operate at a single voltage —2.5 volts for example—many designers use a single secondary winding for all heaters and filaments. This will work out well in most cases although some stubborn cases of oscillation and hum have been traced to this source. In our receiver the secondary windings are provided so that the R.F. and first A.F. heaters operate from S_1, the detector from S_4 and the output tube from S_5.

The heaters are kept at ground potential by center-tapping the windings of the first two named directly to the chassis. The power tube winding is not center-tapped—the electrical center of the system being obtained by means of a center-tapped resistance R_{15}.

The biasing resistance can just as well be connected between the center tap of the transformer winding as in the manner shown. Short-circuiting of either half of any of these windings will result in a half-voltage reading at the heaters. S_2 and S_3 are the rectifier filament and high voltage windings feeding the rectifier tube (V_6).

Partial short-circuiting of one half of the high voltage winding will result in a lowered output voltage and excessive hum. An open circuit in one half will result in reduced output and hum. Either condition may be readily recognized by measuring the voltage across each half with an A.C. voltmeter.

The negative leg of the rectifier circuit is taken off at the center tap of the transformer and the positive terminal is at the mid-tap of the rectifier filament winding. The positive side may be taken off at either side, as well as at the center, as the voltage drop across the rectifier filament is so small as to create but slight unbalance of the circuit.

The ripple in a full-wave rectifier circuit such as is shown is a 120 cycle pulsation if a 60 cycle supply is used. In consequence, a low pass filter system designed to cut off all frequencies from 120 cycles up is employed in filtering out this ripple.

This is the simplest type of filter where design considerations are taken into account and employs two inductances and three condensers arranged as shown in the circuit. The output stage does not require a great deal of filtration because of the fact that the hum voltages in its plate supply are not large and are not subject to any amplification before reaching the speaker.

The inductance of a choke varies with the D.C. flowing through it and for this reason we effect a better over-all filtration by taking off the voltage supply for the power stage after it has been passed through but one section of the filter. The added inductance gained in the second choke by not passing the full load through it aids in the perfect filtration of the detector and other plate voltages where freedom from ripple is most demanded. Short-circuited condensers may be readily noted by the overheating of the rectifier tube and by loss of plate voltage in all circuits. Open condensers may be noted by added hum. Shorted turns in chokes are also noticeable because of increased hum and by slightly higher filter output voltages.

The total value of the resistance across the filter output depends upon the load of the various tubes brought to bear on the power supply and upon the desired output voltage. This is covered fully in the section on Vacuum Tubes. The voltage taken off for the plate voltage of the amplifier tubes is determined by the values of the isolating resistances in series with the plate leads. The voltage taken off at the power supply must be high enough to compensate for the voltage drop through these resistances. So also must the voltages tapped off for the detector and screen-grid circuits be correspondingly higher so as to compensate for this voltage drop.

In all the circuits the voltage at the plate must be high enough to compensate for the loss in voltage due to the fact that the grid biasing potential is, in each case, subtractive from the plate voltage. Thus, if the power tube is a '45 designed to operate with a plate voltage of 250 and a grid bias of -50 volts the voltage at the junction between the two chokes must be slightly over 300,—slightly over 300 because we must also compensate for the drop in voltage through the primary of the output transformer.

An open circuit in the most positive section of R_{17} would result in a higher voltage on all amplifier plates and a loss of screen-grid and detector plate voltage. A short circuit in this section would result in an excessive screen-grid potential on the R.F. tubes and a high plate voltage on the detector. Similar faults in the other sections of the resistance would have like effects depending upon the location of the fault. Breakdown of the resistance to ground would cause loss or gain in voltage in certain cir-

cuits dependent upon the location of the fault.

The by-pass condenser unit C_{19} is a further precaution against interstage reaction due to an impedance common to two or more circuits. This is a precaution made fairly unnecessary by the use of the isolating filters.

This is about all as far as our particular circuit is concerned, and we may now go on to discuss more specialized circuit arrangements. It should be borne in mind throughout the study of this section that our purpose is not to describe the servicing of any particular receiver but to instruct the student in the rapid location of faults through a knowledge of "cause and effect."

Variations in Circuit Design.

Now let us see the various means which may be applied to bring about the same end. Some of the variations to follow have little to recommend them other than their originality, while others enable the manufacturer to produce a cheaper though better receiver. Starting at the antenna and skipping the volume control, the first item is the antenna input circuit.

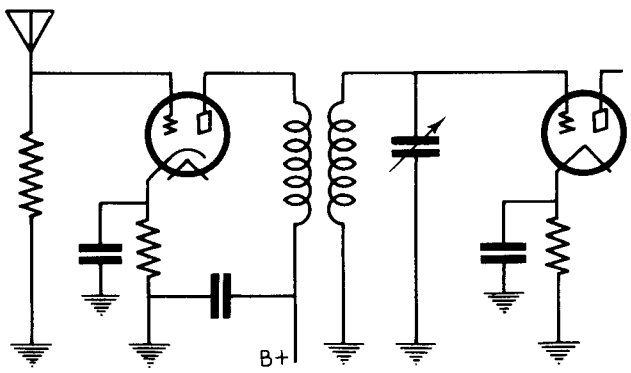


FIG. 33

Some receivers—now more or less obsolete—achieved single control without the necessity of careful design by the simple expedient of using an untuned vacuum tube as a coupling device. This saved the labor of designing an input circuit in which the antenna characteristics did not affect the tuning of the first circuit, but otherwise was rather useless since the gain through the coupling tube was negligible. Without this tube, in the absence of accurate inductances and condensers, it was necessary to employ an additional control in the antenna circuit or a device which changed its value with the tuning of the circuit.

In Figs. 33 and 33A there are shown an untuned input circuit and the input circuit of one of the earlier Bosch single control sets in which a variometer (variable inductance) was coupled to the condenser shaft and counteracted the effects of the antenna over the entire band. Employing the first type in the neighborhood of a strong local transmitter allows cross-talk to take place, cross-talk being the condition in which the local signal is superimposed upon others quite removed from it in frequency as differentiated from ordinary broadness of tuning where the interference takes place only on desired stations having a frequency close to that of the nearby transmitter. A wave trap might cure this condition if it were not too aggravated. Misadjustment of the variable inductance on its shaft in the second type would result in broadness of tuning accompanied by a loss in signal strength.

In some types of receivers the antenna is connected to the high potential (farthest from ground) end of the first tuning inductance and is coupled

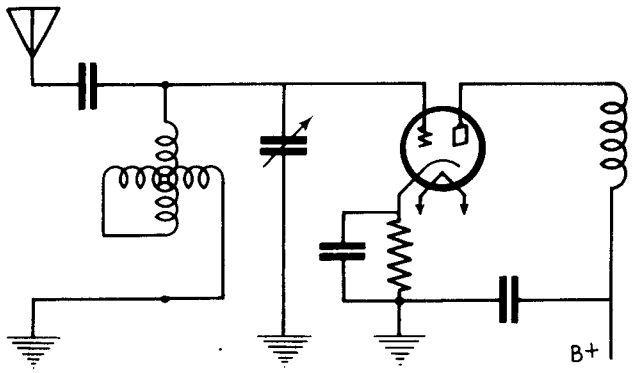


FIG. 33-A

thereto by means of a small variable condenser. This means that the receivers are ganged on a standard antenna at the factory with the coupling condenser set at its mid-point. After installation, it is necessary to make an adjustment of the coupling condenser which will remain in a fairly efficient state of operation until the constants of the antenna are changed to a marked degree.

In the majority of modern receivers, the tuning arrangement between the antenna and the grid of the first radio frequency amplifier tube has been made independent of the antenna characteristics by virtue of long research in the laboratory.

In certain of the receivers licensed under the patents of the Hazeltine Corporation, the antenna coupling transformer (two windings coupled magnetically are always referred to as a transformer) has a primary or antenna coil consisting of many turns of fine wire in a slotted form placed inside the tuning coil or secondary. This antenna coil resonates at some frequency just outside the broadcast band—at about 500 kc. for example—the capacitance tuning the coil being the inherent capacitance of the antenna. In changing from an antenna of fairly usual characteristics to a very short one, resonance is maintained by shunting a small condenser across the antenna and ground terminals as shown in Fig. 34. This condenser makes up the deficiency in capacitance. Trouble in such systems may be due to an open or a short-circuited primary winding—or in the "short antenna" position, to a shorted or open compensating condenser.

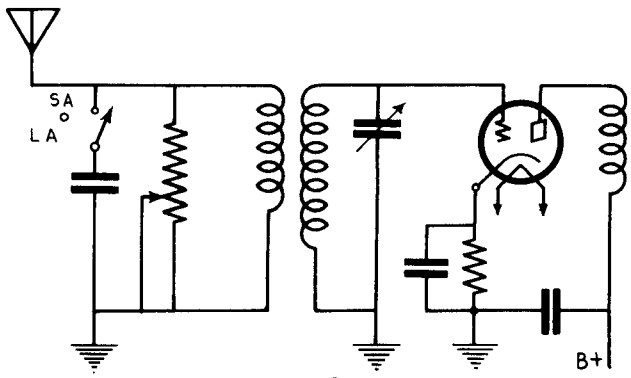


FIG. 34

Band-Selectors.

Band-Selectors, Band-Pass Circuits or Coupled Circuit systems, such as we have employed in the preliminary portion of our receiver, are used not only in an attempt to attain the square response characteristic shown in the dotted line in Fig. 31, but because of the fact that, even though the circuits are less "sharply tuned" as far as cutting off of the desired side-bands is concerned, designers are often able to obtain better selectivity so far as the sloping off of the "petticoats" of the curve is concerned. This is shown in the figure.

Band-Selectors may be coupled in several ways as shown in Fig. 35. In the first two, where the coupling is obtained by an inductance common to the two circuits and by magnetic coupling, the distance separating the two peaks becomes greater as the frequency becomes higher. Where the coupling is capacitative the separation is greater at the low frequency end of the tuning range.

It is also possible in the manner shown to achieve a combination of capacitative and inductive coupling so as to render the separation between the peaks constant throughout the range. The choice is in the hands of the individual designer as an efficient arrangement can be made in either fashion. Where the coupling is inductive, the extra resistance providing the grid return for the first tube is unnecessary as the circuit is not broken.

Interstage Coupling Devices.

In receivers in which an attempt is made to actually achieve the ideal square response curve, use is made of band selectors as interstage couplings replacing the transformer coupled system of Fig. 30. The simplest way of doing this is to tune both primary and secondary circuits of a transformer so arranged, so that the inductive coupling between the windings is of the correct value.

This method is shown in Fig. 35 where it may be readily seen that the first condenser is at high potential. This is not theoretically wrong, but care must be taken in working with receivers of this type if accidental short circuits are to be avoided. The other arrangements in Fig. 35 are methods of coupling by feeding the plate supply of the tube through

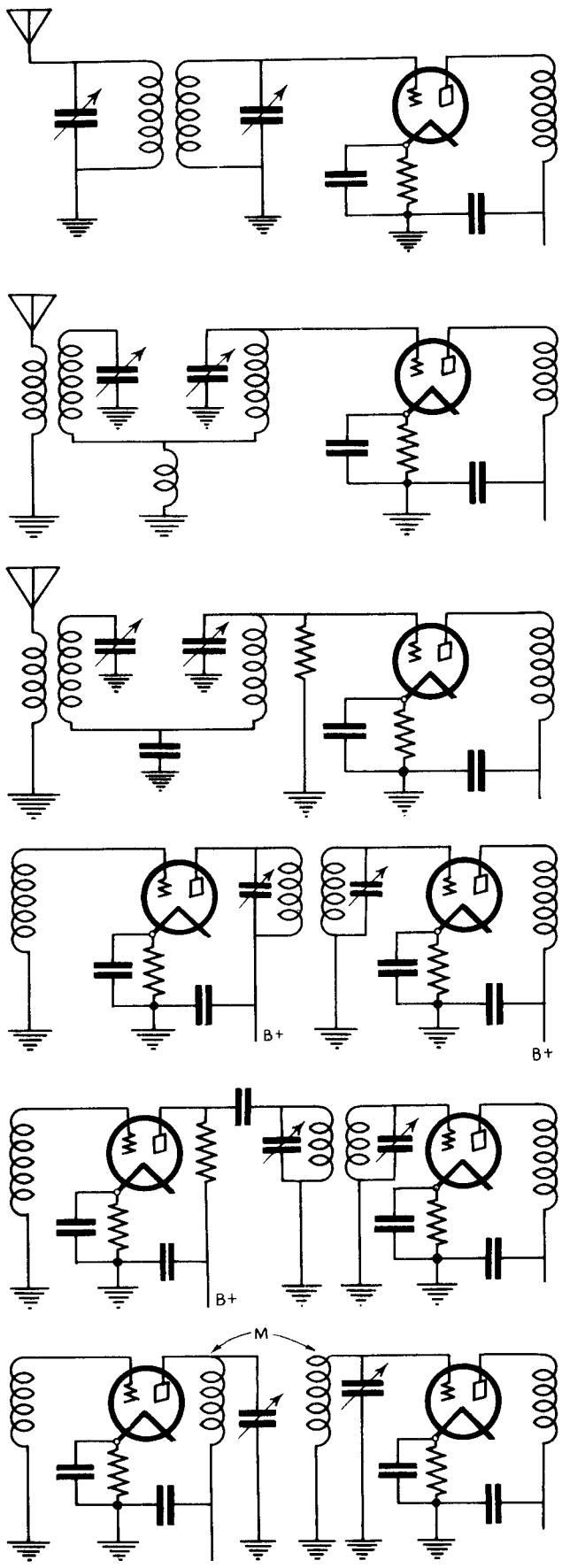


FIG. 35

a choke or resistance so as to keep the D.C. out of the coupling circuits. This may also be done by the use of a large fixed condenser in series with the plate tuning coil and condenser—so large as to have no effect on the constants of the circuit. The numerous circuits shown in the figure have been used in various commercial receivers.

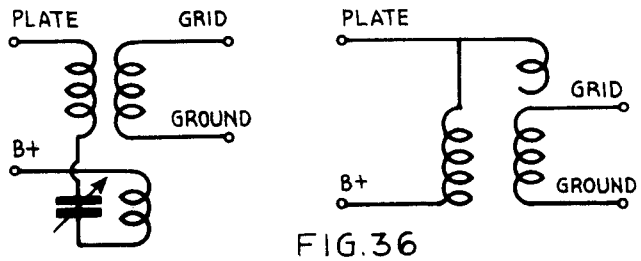


FIG. 36

In order to make the sensitivity of a receiver at the low frequency end of the range equal to that at the high frequency end, it is at times necessary to employ special circuit arrangements. One method used in many receivers of today is that of resonating a portion of the primary to some frequency just outside the low frequency end of the broadcast band.

The increased response, due to the approach of the resonant condition as the low frequency end of the range is reached, is then used to counteract any relative inefficiency existing in the coupling system. Another method utilizes a single turn of wire wound close to the secondary to achieve a capacitative coupling which reduces the amplification at the high frequency end of the range, thus equalizing the over-all gain. These two systems are shown in schematic in Fig. 36.

Introduction of the additional windings and the tuning condenser adds to the possibility of failure and in receivers where these arrangements are employed careful note should be taken that all is well in each coupling system. In the first mentioned where the double primary is employed, it should be noted that the one primary is wound in the reverse direction from the other. In replacing interstage coupling transformers, care should be taken that the leads are properly connected.

A single tuned winding may be employed in the so-called "tuned impedance" systems—the tuned

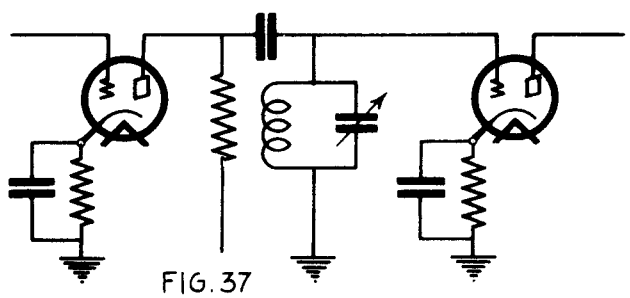


FIG. 37

circuit being either in the grid or plate circuit as shown in Fig. 37. The coupling condensers are very small and are, in some cases, subject to failure. Failure of the condenser results in a simple short circuit to ground of the plate voltage of the preceding tube in the system shown in Fig. 37.

In Fig. 37A, a more serious condition exists, as a short circuit of the coupling condenser will result in the plate voltage of the preceding tube being directly on the grid of the next. This high positive grid bias will result in the destruction of the tube due to the enormous plate current which will flow. Subsidiary apparatus may also suffer if such failure takes place.

Receivers employing the screen-grid tube depend for freedom from oscillation upon the inherent characteristics of the tube and a complete isolation of the various circuits by filtering and by shielding.

With the three electrode tube, the grid to plate capacitance of the tube was so high that a portion of the amplified voltage was fed back to the grid circuit through the tube itself resulting in oscillation.

Many "losser" methods were employed for the remedy, such as the insertion of a resistance in series with each grid. These resistors might give trouble due to a short circuit causing oscillation, or an open circuit resulting in a dead receiver, with no bias applied to the grid of the tube in question.

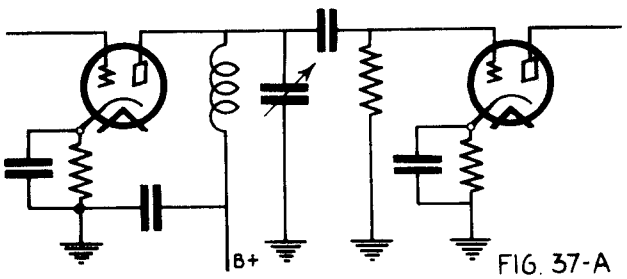


FIG. 37-A

The most satisfactory methods were those in which a capacitance, or a network of inductance and capacitance, was employed to balance out this feedback voltage. This is not a technical work and we will not enter here into a description of "neutralization". It suffices to say that the adjustment of these circuits is quite delicate and any disturbance of the neutralizing condensers requires a complete re-neutralization of the set. The manner in which this is done is described in another portion of this manual under the use of service apparatus. Fig. 38 shows a representative group of such arrangements in which the short circuits which might cause trouble are readily apparent.

Some receivers—notably the Sparton line, employ a four-circuit band-selector in which a fair approximation of the ideal square response characteristic is obtained. This is followed by a "broadband" R.F. amplifier employing untuned transformers. These are highly developed air core transformers giving amplification over the entire broadcast band. In these receivers, it is interesting to note that the functions of selectivity and of amplification are isolated one from the other. Connected to an open antenna without the tuning unit, the amplifier

would pick up and amplify a conglomeration of everything that happened to be on the air at the time.

These receivers are of more interest than importance, but a mention of untuned amplifiers is essential as many modern receivers employ a single untuned stage for one reason or another. The reason may be one of desiring slight additional gain without the necessity of an extra condenser or it may be, as will be seen shortly, that the succeeding tube has characteristics which do not fit in well with the operation of tuned circuits.

Detectors are probably the least understood of all the circuit elements which the service man may be called upon to check, and while we are mostly interested in circuit arrangements in this particular chapter, the one covering "Vacuum Tubes" will deal at length with the problem.

Detector Circuits.

There are as many types of detectors as one can shake the proverbial stick at. For the most part, they are divided into two classifications—"grid circuit" and "plate circuit," depending upon whether the audio frequency component first makes its appearance in the grid or the plate circuit of the detector tube. Plate circuit detection was shown in our receiver and the curve in the figure showed that the tube received a large negative bias so as to operate on a portion of its characteristic favorable to the detector action.

Grid circuit detectors differ from the others in that they are not biased negatively, employ the familiar grid condenser and leak, draw a rather high plate current for the plate voltage applied, and have a low plate impedance in comparison. While the majority of grid leak detectors are found to have a grid condenser of .0005- or .00025-mf. and a leak of from 1 to 5 megohms, the quality of reproduction may be distinctly improved at a slight loss in sensitivity by replacing these with .0001-mf. condensers and leaks not larger than 250,000 ohms. If the sensitivity is not cut down too much, replacement of the old leak by one of 100,000 ohms is still better. Except that one may expect to find a fairly high plate current flowing, the grid circuit detector shown in Fig. 39A

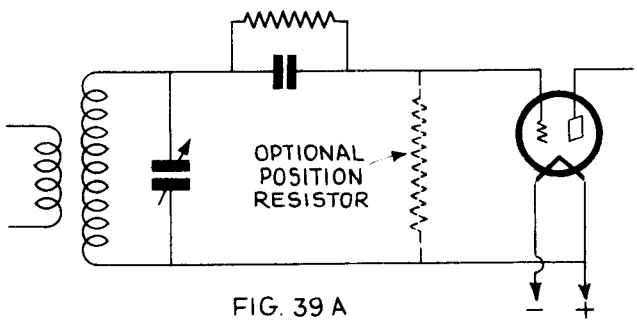


FIG. 39 A

does not differ greatly from the plate circuit type as far as service requirements are concerned.

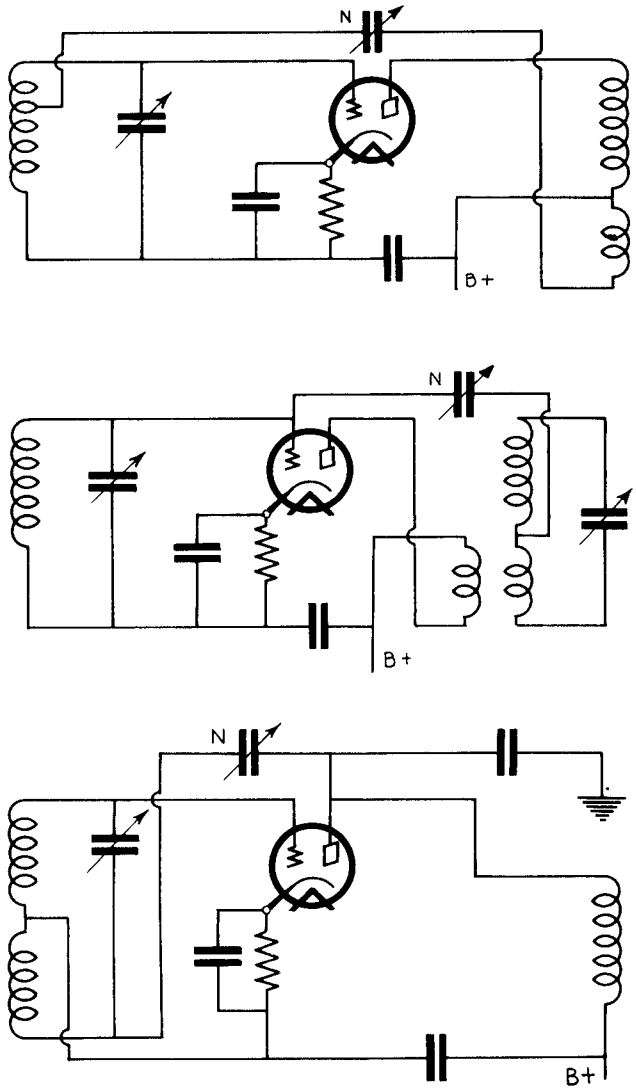


FIG. 38

There is one important fact in connection with the two types of detectors which will be put to use as a service aid in another section of this publication. The plate circuit detector normally operates with a rather low plate current which increases with the signal intensity, whereas the grid circuit detector operates with a relatively high plate current which decreases in value under the effects of the signal.

The choice of detectors rests with the individual designer and equally good quality of output can be obtained with either, provided the limitations of each are recognized.

The original vacuum tube detector was the Fleming valve—a two-element valve consisting of a hot filament and a plate not unlike those of the rectifier tubes in use in many receivers today. Its ability as a detector of radio signals was based upon the fact that it is conductive in one direction only. That is to say, that current will flow only at such times as the plate is at a positive potential with respect to

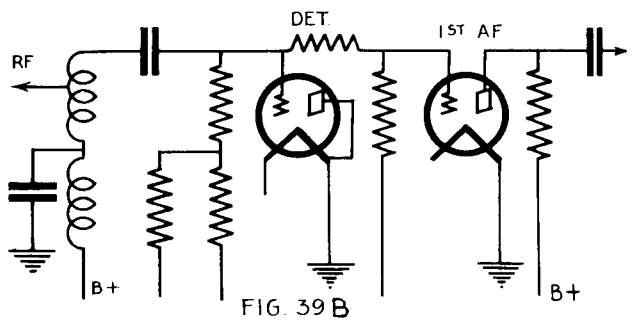


FIG. 39B

the filament or cathode.

A device of this type is not as efficient a detector as a three-element tube, but certain designers have found that by employing a three-element tube with the grid and plate elements tied together so as to operate as a two-element detector, a certain freedom from distortion in the detector stage can be obtained.

A circuit of this nature such as employed commercially in the Philco Transitone receiver is shown schematically in Fig. 39B. It should be noted here that little can be learned of what is actually going on in the circuit through the use of the usual testing equipment, and that lack of sensitivity in the receiver due to a detector tube which is under par had best be checked by replacing the tube in question by one having known characteristics. Note that no active plate voltage is applied to any of the tubes employed in various receivers as "diode" detectors.

Volume Control.

It should be noted that but few of the receivers on the market today have volume controls following the detector. This is because of the fact that the major portion of the distortion normally encountered in radio receivers is due to overload of the detector.

Volume control is achieved either by the use of a resistance across the antenna input circuit, by varying the grid bias or screen grid potential, or by a combination of the two.

In the latter case, the two controls are so arranged that they are driven by a single control shaft. In one particular instance—as shown in Fig. 40, a

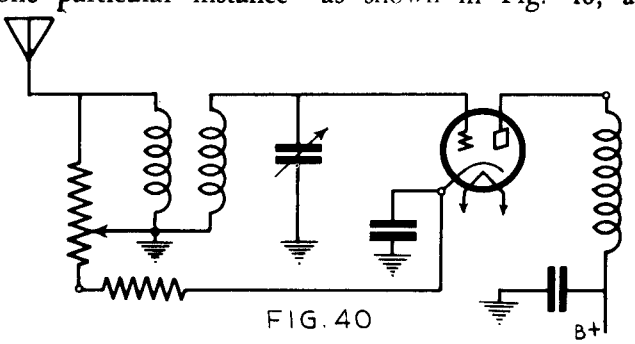


FIG. 40

single resistance is employed to operate in such a fashion that rotating it toward the minimum setting decreases the resistance across the input circuit at the same time that the bias is being increased.

This is done by employing a potentiometer having its center arm to ground, one end connected to the high potential end of the antenna input coil, and the other to the cathodes of the R.F. tubes. A single fixed resistor in series with the cathode end of the potentiometer assures us that a certain minimum bias is applied to the grids of the R.F. tubes at the maximum volume setting.

We have already set forth, as our reason for employing an additional control, the fact that, with the volume control in the antenna or across any one of the tuned circuits, sufficient stray coupling would exist to make a zero setting impossible. Now one may ask why it is not sufficient to increase the bias or decrease the screen-grid potential over such a range that the signal would be entirely wiped out if desired. This would also involve certain difficulties, for under these conditions the tubes are operating on portions of their characteristic curves conducive to the effects of cross-modulation. If, however, we employ a mixture of the two, the decreased input voltage due to the smaller resistance across the input circuit removes the undesired signal likely to cause cross-talk at the same time that the volume is being decreased by the increase in biasing potential or the decrease in the screen-grid voltage. The method employed in varying the screen-grid potential is shown in Fig. 41.

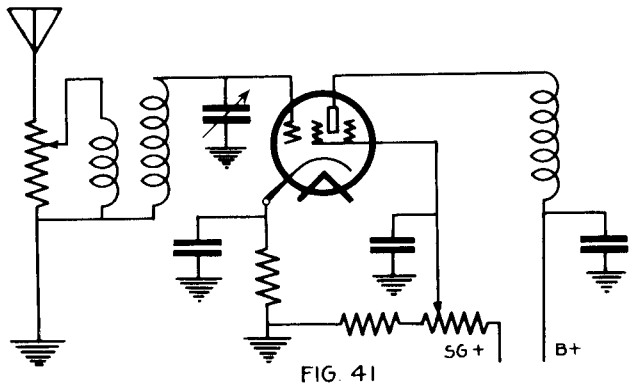


FIG. 41

Automatic Volume Controls.

Sales bulletins on receivers employing automatic volume controls give two reasons for their use—one being the reduction of "fading" and the other the ability to tune through locals without a terrific "blatt" from the speaker as the dial is moved across the frequency setting of some near-by transmitter.

By setting the manually operated control at some one position, the dial may be swung across its full range without the volume of any single station being greater than that of the others. The majority of the commercial receivers employing this feature do so in a manner whereby the automatic control is effected by a variation in the bias on the R.F. tubes, depending for its degree on the amplitude of the received carrier.

Quite naturally, if the volume control operates so

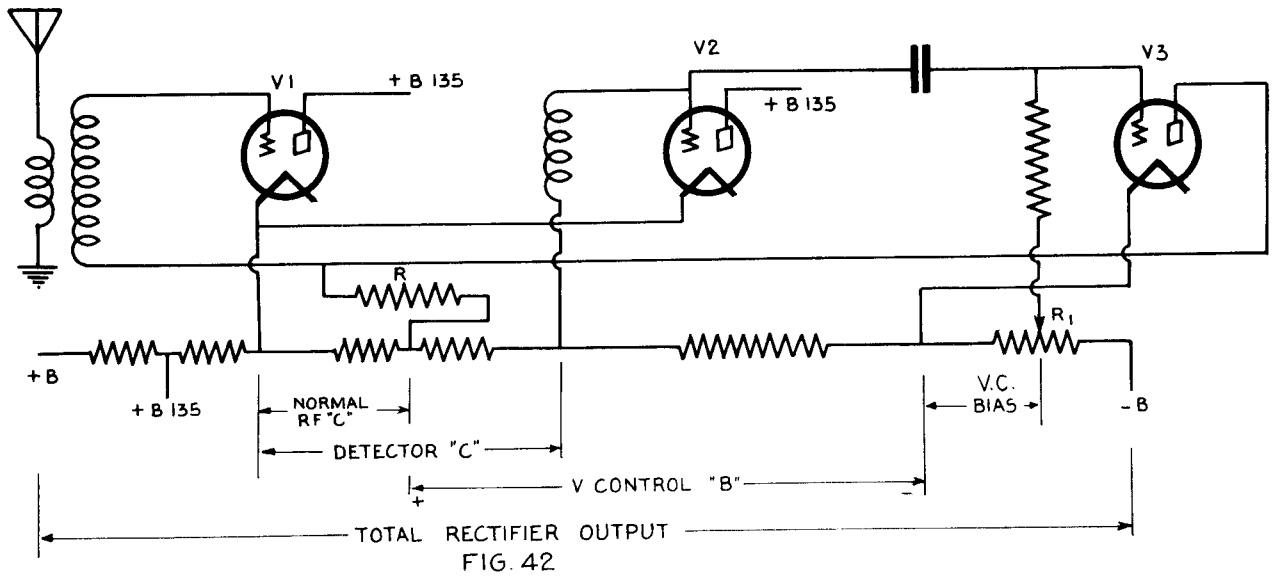


FIG. 42

as to limit the gain through the amplifier, it is essential that it should not work fast enough to wipe out the variations in carrier amplitude due to modulation. This is determined by choosing the value of coupling condenser feeding the controlling tube in such a manner that the system will not operate rapidly enough to affect the quality of reproduction. For this reason, service men working on such receivers should not replace this condenser with one of another value should a replacement become necessary.

Since the majority of automatic volume control tubes operate on a similar principle, it will not be necessary to describe a great many systems—representative ones of each type will suffice to demonstrate the principles of their operation.

Fig. 42 shows the type of control employed in some of the Radiola models. The R.F. amplifier tubes are represented by a single tube V_1 biased to a certain minimum value by tapping off at a point on the voltage divider about three volts negative, with respect to ground, through a resistance "R" which normally has no current flowing through it and, in consequence, does not affect the operation of the receiver. V_3 is the volume control tube which takes its operating signal from the grid of the detector tube.

This tube is in reality a form of vacuum tube voltmeter and is so biased, by means of the manual control R_1, as to permit a certain value of plate current to flow for a given amount of signal on its grid; note that "R" is also the plate circuit resistance of the volume control tube. If the control tube is biased so that no plate current flows, the drop across "R" is zero but, when under the influence of a signal the control tube draws plate current, there is a voltage drop across "R" in such a sense as to increase the negative R.F. bias. The biasing potential applied to the R.F. grids is now the normal bias plus an additional negative potential due to the drop across "R" and the volume is reduced to a degree determined by the manual setting of the control tube bias.

It is still necessary to employ a manual volume control in the antenna circuit as, otherwise, tuning across the range between stations would leave the receiver in its maximum condition of sensitivity and the noise level would be high. With the constants of the circuit in correct proportion, all signals will give the same output across the speaker—an output which is controllable by adjustment of the bias on the grid of the control tube.

Certain of the Stromberg-Carlson receivers employ an automatic volume control which is theoretically similar, but is slightly more refined in the sense that the first R.F. tube receives a different control voltage than does the second—the third is not controlled. In these receivers, the input for the control tube is taken from the plate circuit of the third R.F. stage through a .00025-mf. condenser and a 2-megohm leak. The plate circuit of the control tube is connected to ground through a pair of 100,000-ohm resistors in series. The drop across one of the resistances furnishes the additive bias for the second R.F. tube, and the drop across the other, the bias for the first R.F. tube. The skeleton arrangement of the circuit as employed in the Stromberg-Carlson 846 receiver is shown in Fig. 43. An almost identical arrangement is employed in the Kellogg 523 receiver.

The Two Element or "Diode" Detector as an Automatic Volume Control.

Certain manufacturers—Philco, for example—employ the diode detector as an automatic volume control tube. The circuit arrangement of such a control device is shown in Fig. 44. Note that the detector input is through a special type of untuned transformer as the low input resistance of the diode does not lend itself to the use of tuned circuits. The diode detector gives a relatively small output requiring an additional stage of A.F. amplification but has the advantage of not requiring an added tube for the purpose of automatically controlling volume.

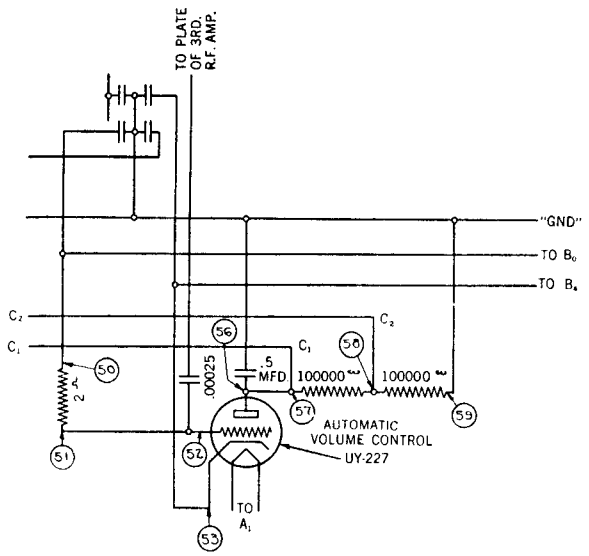


FIG. 43

The grid and plate of the tube are tied together and act as the plate of the diode. Connected between this plate and the cathode are two 100,000-ohm resistors. The midpoint of these series resistors connects through a 500,000-ohm isolating resistance to the grid of the third R.F. tube. The grids of the first and second R.F. tubes take their bias through the 250,000-ohm resistance which couples the detector to the first A.F. tube. Appropriate isolating resistances are employed as shown to prevent coupling between the R.F. circuits.

In this type of receiver, the automatic effect is not under manual control, the circuits being so proportioned that the output of the first amplifier tube (called the "detector amplifier") is a constant value regardless of the strength of the incoming signal. In receivers of this type where the signal at the detector output is limited at all times to a fixed value, the sensitivity of the receiver is at all times varying in accordance with the received signal.

Distortion Limiting Devices.

The same end may be accomplished where a three-element detector is used by a circuit arrangement such as appears in Fig. 45 where the grid returns of the R.F. stages and the detector are connected to ground through a series of 60,000-ohm resistances. The criterion of distortion is the flow of grid current in the detector circuit.

The bias of the R.F. and detector circuits is taken in the usual manner by the use of resistances between the cathodes and ground. Additional bias is provided due to the drop through the 60,000-ohm resistance in the detector grid circuit which occurs when overload of the detector causes grid current to flow. This system is not a true automatic volume control as it has no effect in leveling all signals to a single output strength—it merely acts as a volume limiting device preventing overload on strong signals. This arrangement is employed in the Amrad 84 receiver and in the Crosley 77 and 84 models.

Although there are other methods of automatic volume control, they are not common in commercial receivers and when encountered can readily be understood by reference to the types described here. As we noted before, the characteristics of volume control tubes are not readily checked by service instruments, and the best method of checking them is by a continuity test of the circuits and by the replacement of the control tube by a tube known to have good characteristics in other circuits.

Phonograph Pick-ups.

Most receivers sold today are equipped with input connections for phonograph pick-ups. There are many ways in which a device of this character can be connected into the circuit, the major consideration being whether the pick-up must be connected into the detector circuit or into the input to the first A.F. tube.

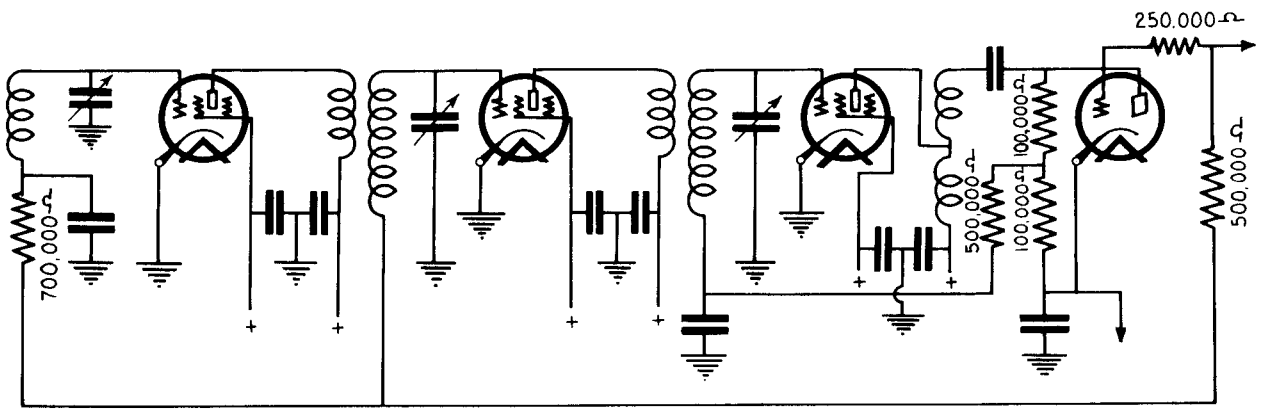


FIG. 44

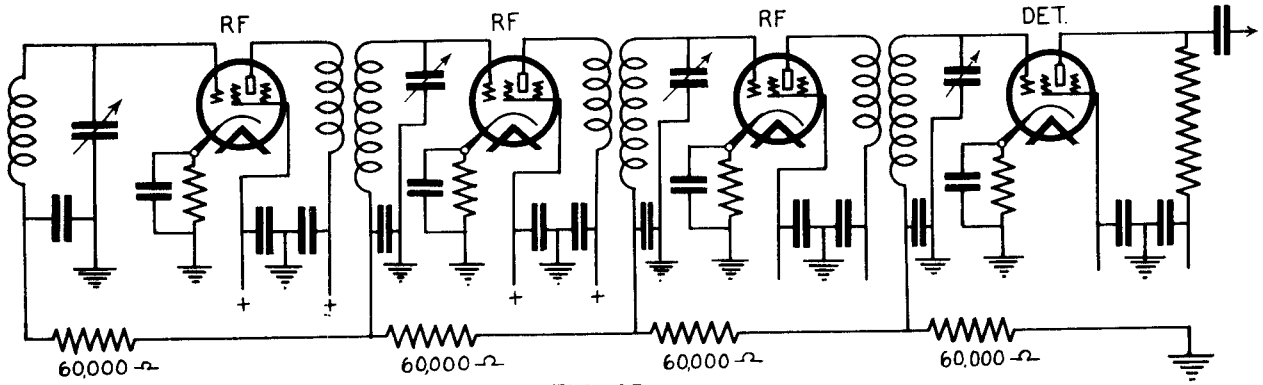


FIG. 45

In those receivers which employ a single stage of A.F. amplification, the gain between the A.F. input and the speaker is insufficient for the purpose. and connection must be made in such a manner that the detector is used as an A.F. amplifier when playing records. This demands also that the detector be biased as an amplifier when so used. There are so many ways in which this may be accomplished that the writer will take only three examples to establish the point.

In the Victor model 7-26, the coupling transformer between the detector and the first A.F. tube has a tapped primary, so that one section of the winding matching the impedance of the pick-up device can be tapped off by means of a change-over switch. When making the change-over, the switch automatically breaks the plate voltage connection to the detector tube so that interference from broadcast programs can not be superposed on the recorded music. Fig. 46 illustrates this point.

In this receiver, the two A.F. stages give adequate gain, but in a receiver such as the Sparton model 931 where a single A.F. stage is employed, it is necessary to employ the detector as an A.F. amplifier when reproducing recorded music.

When the pick-up is plugged into its jack, the jack sleeve shorts out the detector biasing resistance with a 1000-ohm unit as shown in Fig. 47. At the same time, the pick-up is connected in series with the input of the detector. When a method of this kind is employed, care should be taken that broadcast interference does not spoil the reproduction.

In the Stromberg-Carlson receivers, the pick-up is connected as shown in Fig. 48—without changing

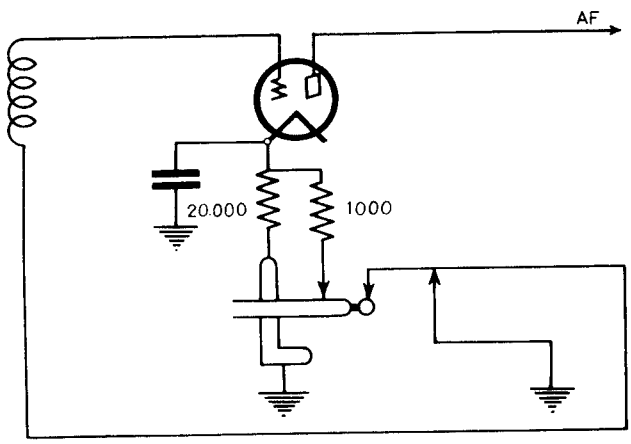


FIG 47

the detector bias. The level of the input to the detector is so low, that the distortion incurred by this use of the detector tube as an A.F. amplifier with

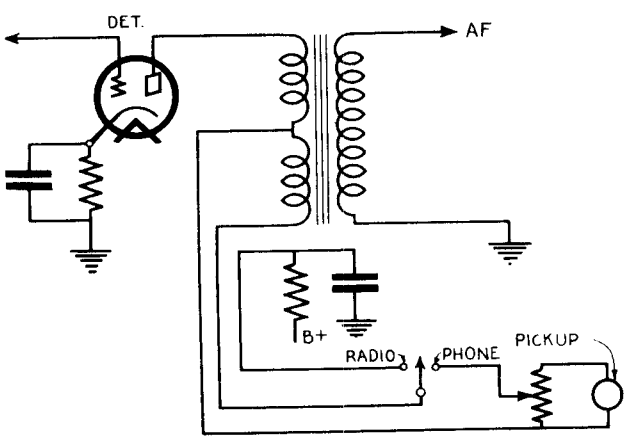


FIG. 46

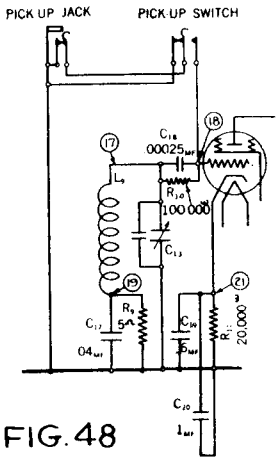


FIG. 48

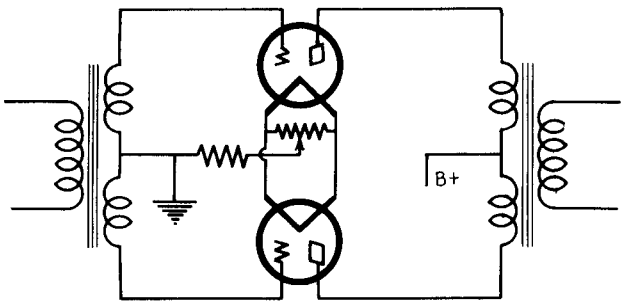


FIG. 49

improper bias results in negligible distortion. Connecting the pick-up from grid to ground in this fashion effectively short-circuits the broadcast reception while the pick-up is in use, so that no interference from this source occurs.

From the figure, it will be seen that although "bias" detection is used, a grid leak and condenser are in the circuit. These have no effect on the operation of the circuit either for radio or phonograph reproduction, the reason being the prevention of short circuit of the phonograph pick-up by the secondary of the R.F. transformer.

The pick-up may also be connected directly across the secondary winding of the first A.F. transformer in sets having two A.F. stages. The impedance is so high in the transformer secondary circuit that it has little or no short-circuiting effect on the pick-up. In all of the circuits described, a volume control separate from the receiver is necessary. In those sets which have been described which use manual volume control following the detector, a method of pick-up connection might be employed which permitted the use of the regular volume control during record reproduction.

Push-pull Amplifiers.

There are many advantages to be gained through the use of vacuum tubes in the push-pull connection. First, the fact that the circuit cancels out harmonic distortion enables one to obtain an output far greater than twice that obtainable with the single tube. Secondly, the ripple voltages due to poor filtering of the supply are also canceled out so that less filtration is necessary. Thirdly, the fact that the direct currents in the output transformer cancel out enables the use of a cheaper output transformer than is possible with the single tube.

Other advantages, such as the fact that the biasing resistance does not require a by-pass condenser across it, are also useful in cheapening the receiver without loss of quality. All in all, it may be said that a push-pull output stage more than doubles the output of a single tube without adding more than the cost of the additional tube to the price of the receiver.

Troubles in push-pull circuits caused by an open in one side of the input or output transformer, result in loss of grid or plate voltage in the tube involved. These faults are readily checked with the normal type of servicing equipment. A typical push-pull circuit is shown in Fig. 49.

The Single A.F. Stage.

Many types of detectors are operated with so high an input from the R.F. amplifier that an intermediate A.F. amplifier preceding the output stage is not necessary. There is no need for special mention of the circuits as they do not involve the use of any unusual connections or apparatus.

It has already been noted that in such receivers a phonograph pick-up must be connected into the detector circuit in order to achieve adequate gain for operation of the loud speaker at a reasonable degree of volume.

Some of the newer receivers, employing screen-grid detectors with push-pull amplifiers, employ slightly involved circuits such as that shown in Fig. 50 and used in the Victor model R-15. In this case, the split choke acts as an autotransformer of 1 to 1 ratio and feeds the plate voltage to the screen-grid tube as well as providing the signal for the grid of one of the output tubes.

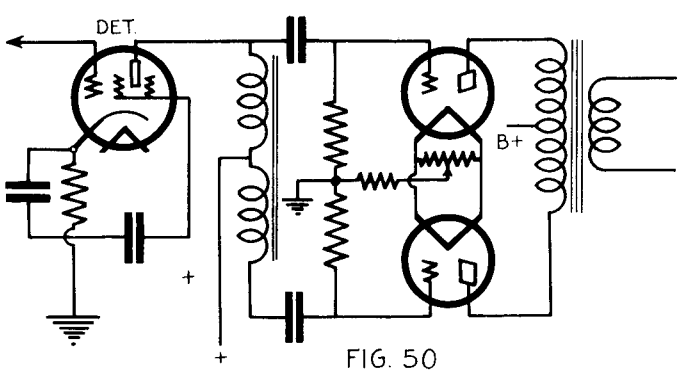


FIG. 50

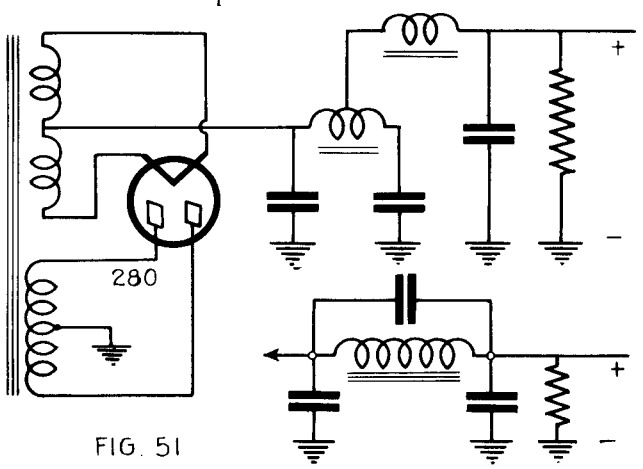


FIG. 51

The coupling condensers are .025-mf. units and the grid leaks providing the grid return path are 430,000 ohms each.

Breakdown of the coupling condensers will put the full plate voltage on the grid of one of the output tubes. The high plate current resulting from this positive grid bias will result in destruction of

the tube before the service man has an opportunity to correct the defect. Open circuit in either of the grid leaks will result in loss of bias and high current through the tube involved.

Tone Controls.

The tone controls employed in modern receivers are employed to limit the higher frequencies so as to produce a more "mellow" effect. They may be of the type shown in our Fig. 30, or may be made up of a series of condensers with a switching arrangement to vary the capacitance introduced in shunt with the A.F. channel.

In neighborhoods where the "man-made" interference is exceptionally great, a control of this nature helps to cut down the interference which consists mainly of high frequency impulses.

In extreme cases, the service man called in to remedy such noise in a receiver not equipped with "tone control" can effect a cure by connecting a condenser of from .00025- to .01-mf. across one of the A.F. transformers.

Filter Variations.

Filter systems for radio power supplies may be of the tuned or "brute force" type. In the tuned type, an example of which is shown in Fig. 51, various savings in the total capacitance of the condensers required in the system may be effected. They require extremely careful design, however, and it is essential that, in making replacements, the parts used be identical with the original. Otherwise, hum may result regardless of the fact that a larger condenser than was originally employed may have been used in replacement.

The theory of the type shown is that the small portion of the first choke and the condenser which connects it to ground are resonated to the ripple frequency (120 cycles for a full wave rectifier with 60 cycle supply), and if the resistance of the choke is low compared with its inductance, they offer as a "series resonant circuit" a virtual short circuit to ground for all currents of that frequency.

The second type of tuned filter, where the condenser is connected in parallel with the choke, operates on the opposite principle—that the parallel resonant circuit formed offers a high impedance to the resonant frequency.

Brute force filters are simply low-pass filters so designed that the cut-off point above which frequency they will transmit nothing is below the ripple frequency. This means that a larger filter is necessary with half wave than with full wave rectifier circuits.

Despite the savings possible with tuned filters, many manufacturers do not use them, for the high capacitance with small bulk available in the shape of electrolytic condensers offers as economical a means of filtration.

The filter circuits we have shown so far show the chokes in the positive side of the filter system with the entire negative portion of the circuit at ground potential.

Certain receivers employ variations in which the filter chokes are in the negative portion of the circuit. The method employed in the Victor R-15 is shown in Fig. 52. The second inductance which connects to ground from the tap on the first inductance is the field winding of the dynamic speaker.

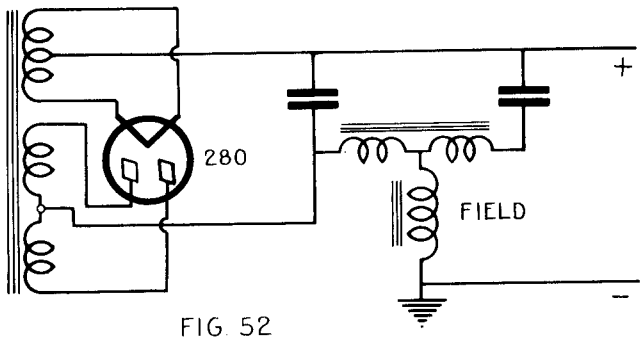


FIG. 52

Do not assume that the chokes in a receiver are at maximum potenial and that grounds at that point will be indicated by a loss of plate voltage in all cases. A ground in the filter reactor will result in a short-circuited field coil in the speaker and a high plate voltage at all points in the receiver.

This is, of course, not the only case in which the field winding of the dynamic speaker forms a portion of the filter circuit. In nearly all cases, the field is energized by passing the plate current through it. There are countless methods by which this may be done and a very few of them are shown in Fig. 53. In the first sketch, the field winding is the only inductance in the filter system, the capacitance being obtained from high-capacity electrolytic units.

In the second sketch, the field winding has been designed with the proper D.C. resistance to act as the biasing resistor for the output tubes. An advantage of this system is the fact that the speaker can be replaced with a resistance of the correct value if it is desired to operate the receiver with a magnetic speaker or any other external speaker.

In the third method shown, the speaker field provides the voltage drop for the negative bias of the output tubes. The drop is slightly high for this

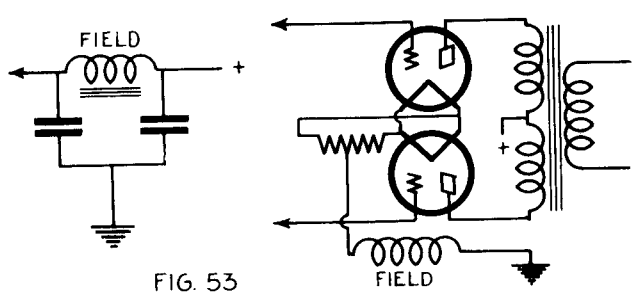


FIG. 53

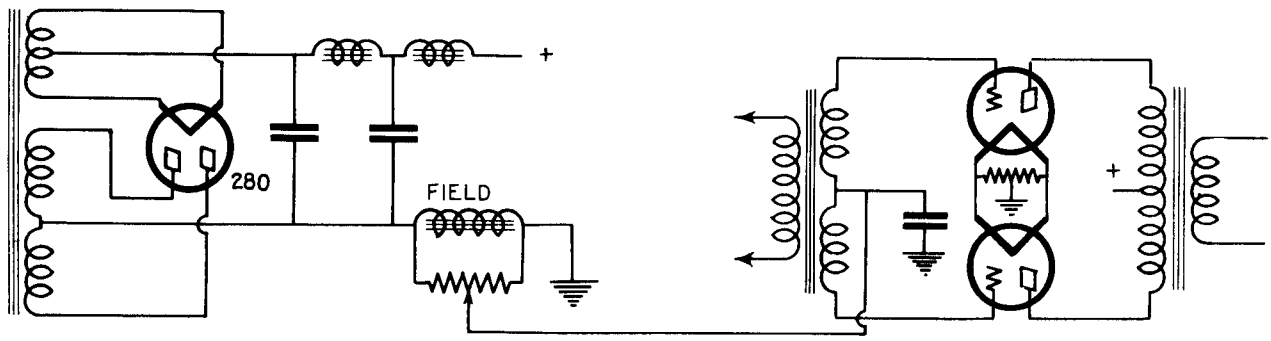


FIG. 53 A

purpose in the Atwater Kent 55, from which the circuit is drawn, and a voltage divider across the field winding taps off the proper voltage. This divider carries but a slight portion of the current and no current whatever flows in the biasing circuit.

The speakers employed in these connections are specially designed for the purpose and, where replacement of the loud speaker is found necessary, care should be taken that one having the proper field winding characteristics is chosen if an identical one is not available.

Voltage Distribution in Power Supply Circuits.

In the circuit shown in Fig. 30, the voltages for the plate circuits of the various tubes are obtained by a combination of the voltage divider and voltage drop methods. Either of these may be employed in a receiver and a combination of the two is not at all unusual.

In any event, the "bleeder" resistance across the output of the rectifier is essential to the safe operation of the power supply, especially in the case of heater type tubes, where there is a short interval following the throwing of the switch during which no plate current is drawn by the tubes. If there were not some sort of load across the power supply output, the voltage across the power supply condenser would rise to high values during the initial surge.

The load is also necessary if we are to operate the power supply in a manner so as to allow for considerable variation in plate current without unprecedented departure from the desired voltages. This wasted current establishes a condition where variations in the plate current, drawn by one or more of the tubes, represent so small a percentage of the total current drawn from the rectifier tube that there is but slight change of the output voltage. The methods of design will be taken up later in discussing the characteristics of the rectifier tubes.

The voltage across the output of the rectifier and filter must be at least as high as the total plate and bias voltages required by the output tube—300 volts in the case of the '45. For the tubes employing lower plate voltages, the drop may be secured either by using the "bleeder" resistance as a potentiometer or by inserting series resistances between the plate circuits of the various tubes and the positive side of the power supply. Examples of each system are shown in Fig. 54.

Biasing potentials may also be obtained from the voltage divider rather than by the methods shown in the original sketch. This is done by making "ground" positive by an amount equal to the highest biasing potential required. In Fig. 55, it will be seen that the various cathodes and filaments are brought directly to ground and that the grid returns are brought to a point negative with respect to ground by the required amount.

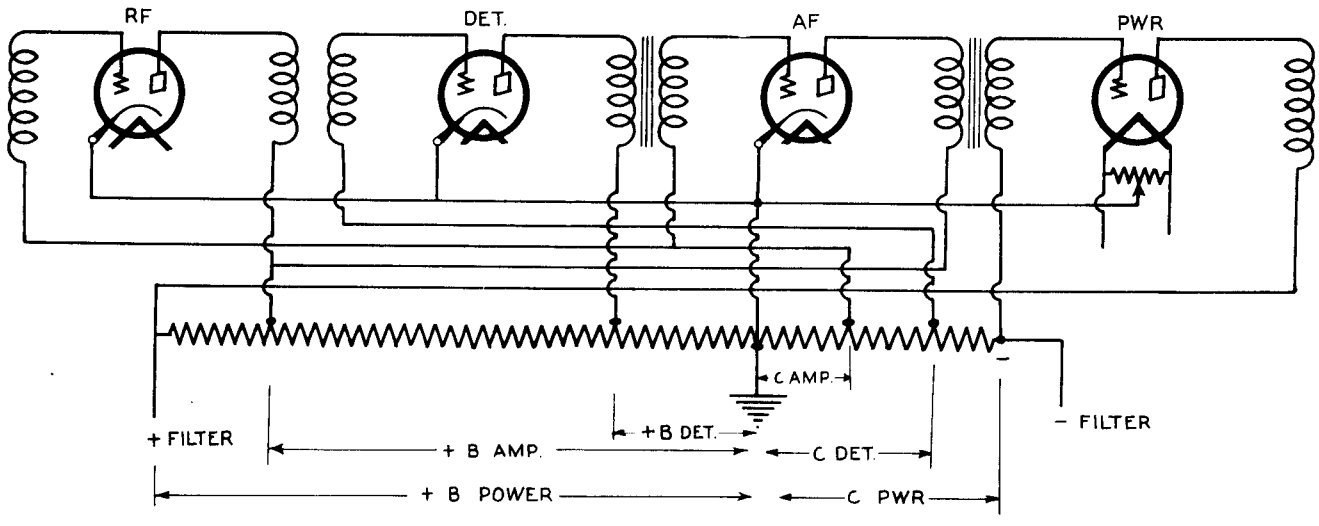
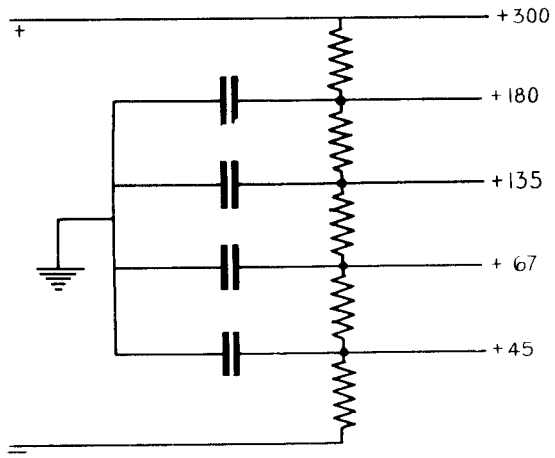


FIG. 55



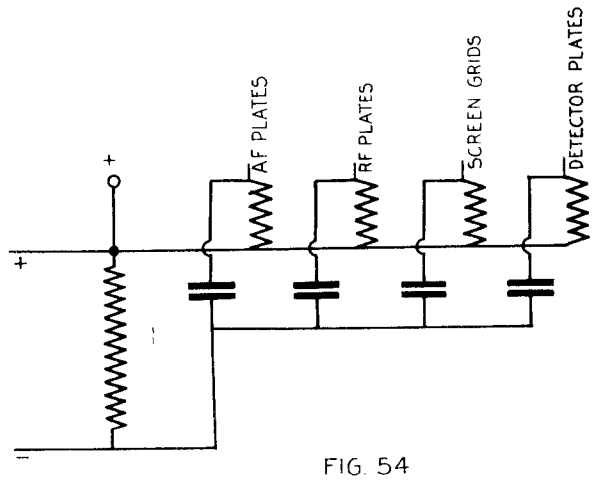


FIG. 54

This may aid in the explanation of the automatic volume control sketches previously shown if any obscurity concerning them still exists. As was noted before in respect to the plate voltages, a combination of the two methods may be effected if it seems necessary to do so.

In Fig. 56, this also has been done. Note that the minimum bias for the R.F. tubes has been obtained by the use of individual resistances in each cathode circuit, whereas the additional bias necessary for volume control has been obtained by returning the grids to some point negative with respect to ground.

In some receivers, the detector plate voltage has been obtained by connecting the plate lead of the detector circuit to the positive end of the biasing resistance serving the output tubes. This gives a plate voltage equivalent to the biasing voltage of the output tube. A studious tracing of circuits having an, at first, unfamiliar appearance will clear up many difficulties if the basic principles are borne in mind.

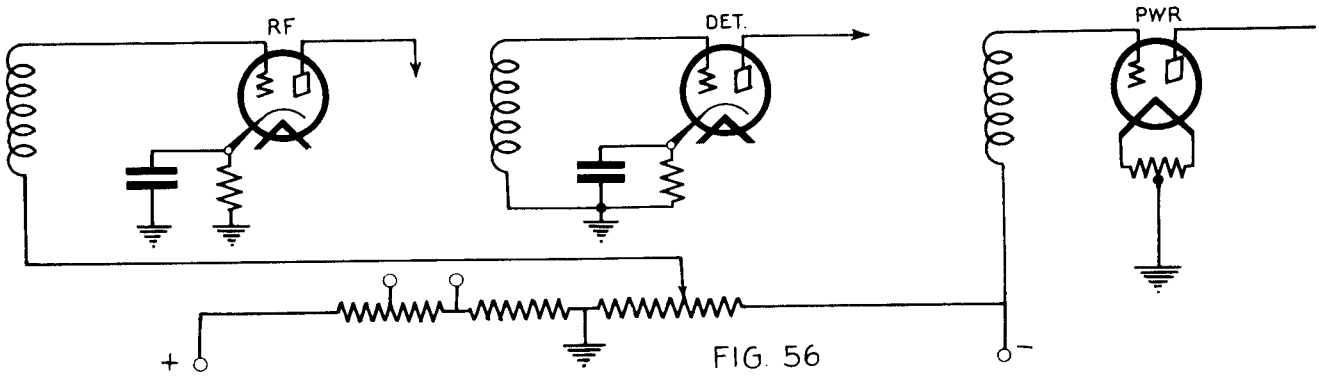


FIG. 56

The circuit diagrams given in this manual can never be more than a time-saving aid and are, even as such, worthless, if the service man fails to use everyday "horse sense" in attacking his problems. It is this "horse sense" that keeps customers by making up the difference between a mediocre man and an expert.

DIRECT CURRENT RECEIVERS

Receivers for Direct Current Operation.

Receivers for D.C. operation present a problem because of the initial low voltage available for the power tubes. If, with a maximum plate supply of 90 to 100 volts, any power output is to be attained some system of parallel operation of the output tubes must be employed.

In Fig. 57, the filament circuits of the Stromberg-Carlson 638 receiver are shown isolated from the balance of the receiver. Five 201A tubes are employed in the preliminary stages with their filaments connected in series. If one tube should burn out, the balance would not light and no tests could be made until the defective tube had been located.

The four '71A tubes in the output are connected in parallel both as to filaments and as to grids and plates. Do not remove one of these output tubes from the socket without first turning off the set, as the remaining three filaments would be seriously overloaded.

Plate voltages for all stages in this set are taken from the maximum positive point as shown in Fig. 58. Grid bias is obtained by bringing each grid return of each tube to a point on the filament system negative by the required amount with respect to its own filament. For example, the grid return of the first stage is to the negative filament terminal of the second tube and thus receives a 5-volt negative bias. Grid return of the four '71A tubes is to the negative side of the 12-ohm series resistance —thus giving their grids a negative potential of 12 volts.

The power output available with the four tubes in parallel is approximately that obtained with a single '71A with the full plate voltage, 180 volts, applied.

Biasing of D.C. receivers is simpler in those sets employing heater type tubes, as the bias may be obtained by a resistance between the cathode and ground as in the case of A.C. receivers.

The circuit arrangement of such a receiver is quite simple, as shown in Fig. 59, where a system employing a series of two '24 tubes as radio frequency amplifiers, a '27 detector and two '45's in push-pull is used. The current requirements of such a filament supply system are large—there being a dissipation in the series resistor of about 175 watts.

Biases for all except the output tubes are taken through the use of resistors in series with the cathodes. The secondary of the transformer feeding the power stage is split, so that the fact that one '45 filament is more negative by 2.5 volts than the other can be compensated for by obtaining the bias for that tube at a point differing from the other by 2.5 volts. The plate circuits are connected in normal push-pull fashion.

The D.C. receiver is difficult to service without the schematic circuit available because of the many systems which can be employed in obtaining the fila-

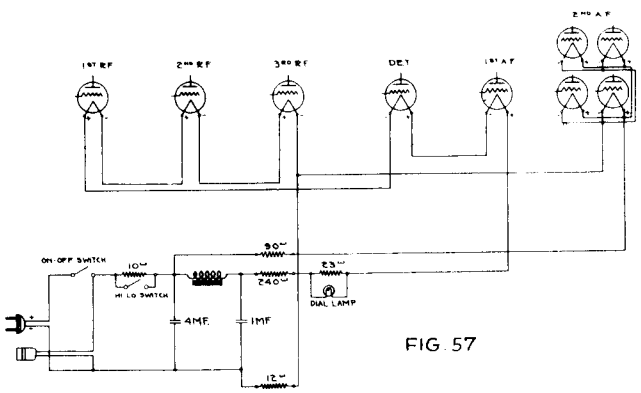


FIG. 57

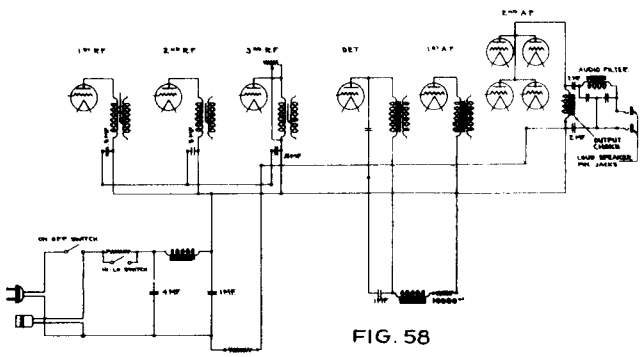


FIG. 58

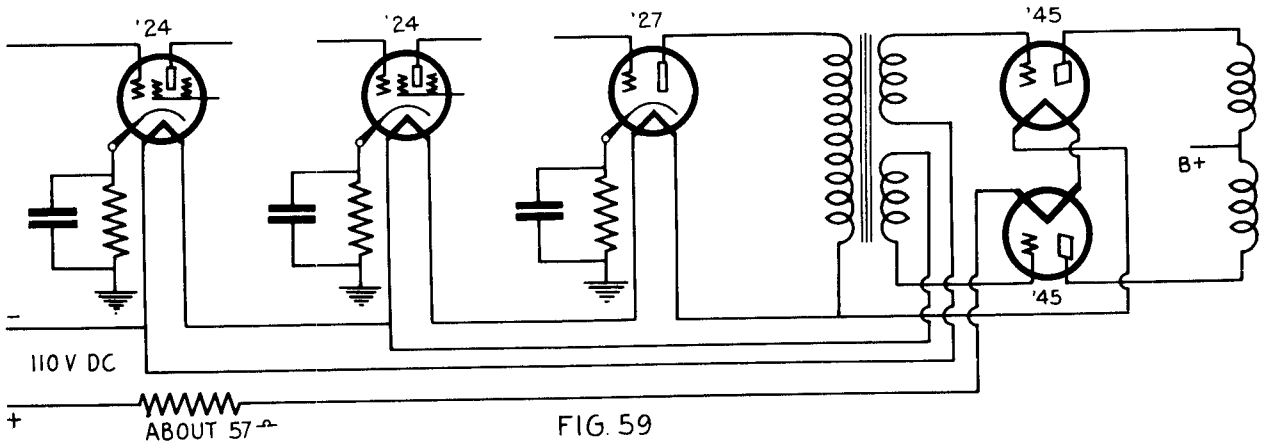


FIG. 59

ment and grid voltages. A hint on what may be expected is contained in the fact that receivers employing separate biasing batteries for use with the power tubes usually have those tubes placed at the most negative end of the circuit, so that the filament and plate of each tube will have the maximum possible potential difference.

Where the power stage biases are obtained by a method similar to that shown in Fig. 59, the power tube filaments are positive so that the negative biases may be obtained from the voltage drop across the other filaments. The first method is employed so as to obtain the highest possible plate voltage from the line at a sacrifice of the "all electric" feature.

While working on this section, the writer was informed of the introduction of three new tubes for use in automotive and direct current receivers. These are heater type tubes having filaments operating at 6.3 volts and .3-ampere. In automotive receivers, these tubes take their filament supply directly from the storage battery of the car. In D.C. receivers, the fact that the heaters are isolated from the actual circuits of the receiver makes filtering of the heater supply entirely unnecessary.

The reduced current at which the tubes operate effects another economy in that the receiver will draw about 35 watts from the line as compared with 175 to 200 watts required by most modern D.C. receivers employing '27's or '24's and '45's.

The tubes are designated as the '36, '37, and '38 types and are, respectively, a screen-grid tube for radio frequency amplification and detection, a three-element general purpose tube, and a Pentode output tube comparable with the '47 mentioned in the vacuum tube section of this book except for the fact that a heater type cathode is employed. Because of the economy possible, both in construction and in operation, it is probable that a great many receivers issued this season will employ the tubes.

In anticipation of this fact, the circuit in Fig. 60 shows the filament circuit arrangement which will be employed with these tubes. For reasons stated in the discussion of Pentode tubes in another section of this book, it is not desirable to obtain the bias of a Pentode circuit by means of a resistance from cathode to ground except where push-pull circuits are employed. Fortunately, we are able, in a circuit of the nature shown, to connect the cathode of the output tube directly to a point positive by the required amount with respect to ground. To be sure, the voltage thus obtained is not filtered—but neither does the possible noise voltage, developed across the two filaments from which the bias is obtained, amount to enough to become troublesome. As was the case before, one can never tell how the filament circuits of a D.C. receiver are connected without first seeing the schematic or tracing the circuit itself; in consequence, do not remove a tube from any D.C. receiver without first disconnecting it from the power source—otherwise a few ruined tubes may be chalked up to your debit.

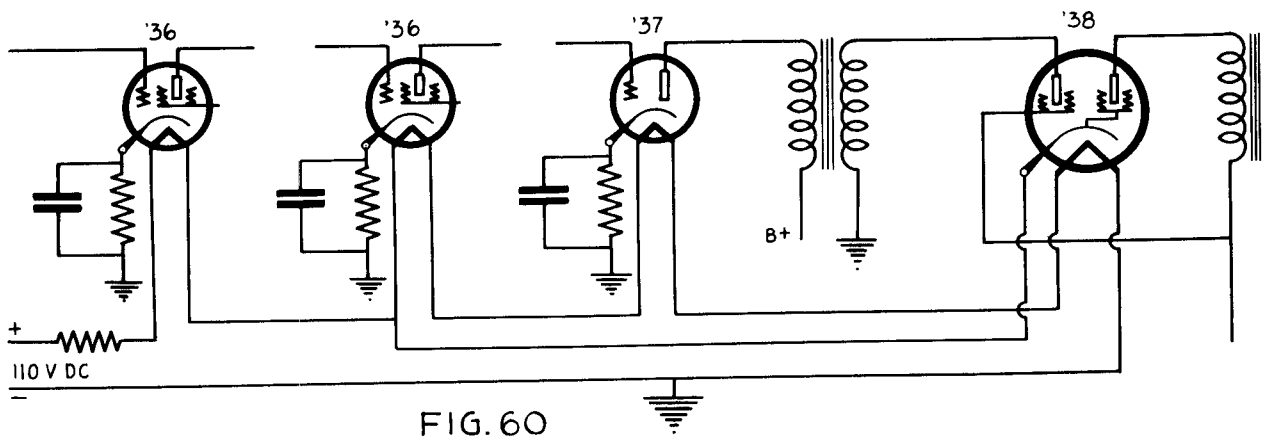


FIG. 60

SUPERHETERODYNE SERVICE NOTES

No analysis of the "Super" is complete without a brief historical note concerning the origin of the idea. At the time of the entry of the United States into the war, there were many European amplifiers constructed to amplify at radio frequencies coincident to the long waves which theretofore had been employed in all commercial work.

One of the first jobs handed the Signal Corps laboratory, maintained by our army in Paris, was that of developing a receiver to operate with extreme sensitivity in the short-wave band employed by the enemy in their army communications. This was prior to the development of neutralizing circuits, and the development of an extremely sensitive receiver in those bands would have been a long and tedious process.

Armstrong, who was among the engineers working in the Paris laboratory, hit upon the idea of modulating the incoming signal with a locally generated one and amplifying the resultant frequency which fell within the range of the existent and efficient radio frequency amplifiers then available.

From this idea grew the superheterodyne receiver of today—albeit by a long and devious pathway. It is only with the growing knowledge of radio engineering principles, that the present "super" has been made possible.

Let us, for example, assume two frequencies—an incoming signal of 1000 kc. and a local signal of 1175 kc. We may obtain beat-notes of either the sum of or the difference between the two frequencies. The difference frequency in this case is 175 kc. This frequency is a favorable one for amplification as its relatively low frequency enables the radio frequency amplifiers (known as "intermediate frequency" amplifiers) to operate at a relatively high gain per stage as compared with that obtainable at broadcast frequencies.

Not only is the amplication more favorable at the intermediate frequency, but the selectivity is also much greater. At 1000 kc., an interfering station 10 kc. away on 1010 kc. is separated from the desired signal by but 1% of its frequency. At 175 kc.—after being "beat" with a local oscillation of 175 kc.—the interfering station is at 165 kc. and the desired one is at 175 kc. The difference is still 10 kc. but now the interfering signal is removed from the desired one by approximately 6%.

Inasmuch as the selectivity is measured by the response a given percentage away from the frequency to which the circuit is tuned, the reader will have little difficulty in grasping the advantage which a properly designed "super" may well have over a receiver employing straight tuned radio frequency amplification.

Because of the high degree of selectivity available, it is essential that "band-selector" circuits be employed in the intermediate frequency stages if the "side-band" cutting common to excessively selective circuits is to be avoided. In this connection it might be noted that with the superheterodyne, it is possible to come quite close to a realization of the ideal "square" response characteristic evidenced in Fig. 31.

While discussing the selectivity of the "super", it might be well to note that it is essential that a certain degree of selectivity be obtained ahead of the first detector—that is, the selectivity cannot be localized in the intermediate frequency amplifiers so favorably disposed toward it.

For an example, it is readily seen that the oscillator set at 1175 kc. to produce an intermediate signal of 175 kc. from a signal of 1000 kc. will produce a similar 175 kc. signal from a station on 1350 kc. If we are not to have two signals interfering in the intermediate frequency circuits, it is essential that no portion of the 1350 kc. signal reach the grid of the mixer tube in which the 175 kc. signal is produced (this tube is known variously as the mixer, modulator or first detector).

In the case of the 1350 kc. signal being from a strong local station, it is difficult to prevent this and the average "super" has at least one stage of radio frequency amplification operating at the signal frequency located ahead of the mixer tube—not for the purpose of obtaining amplification so

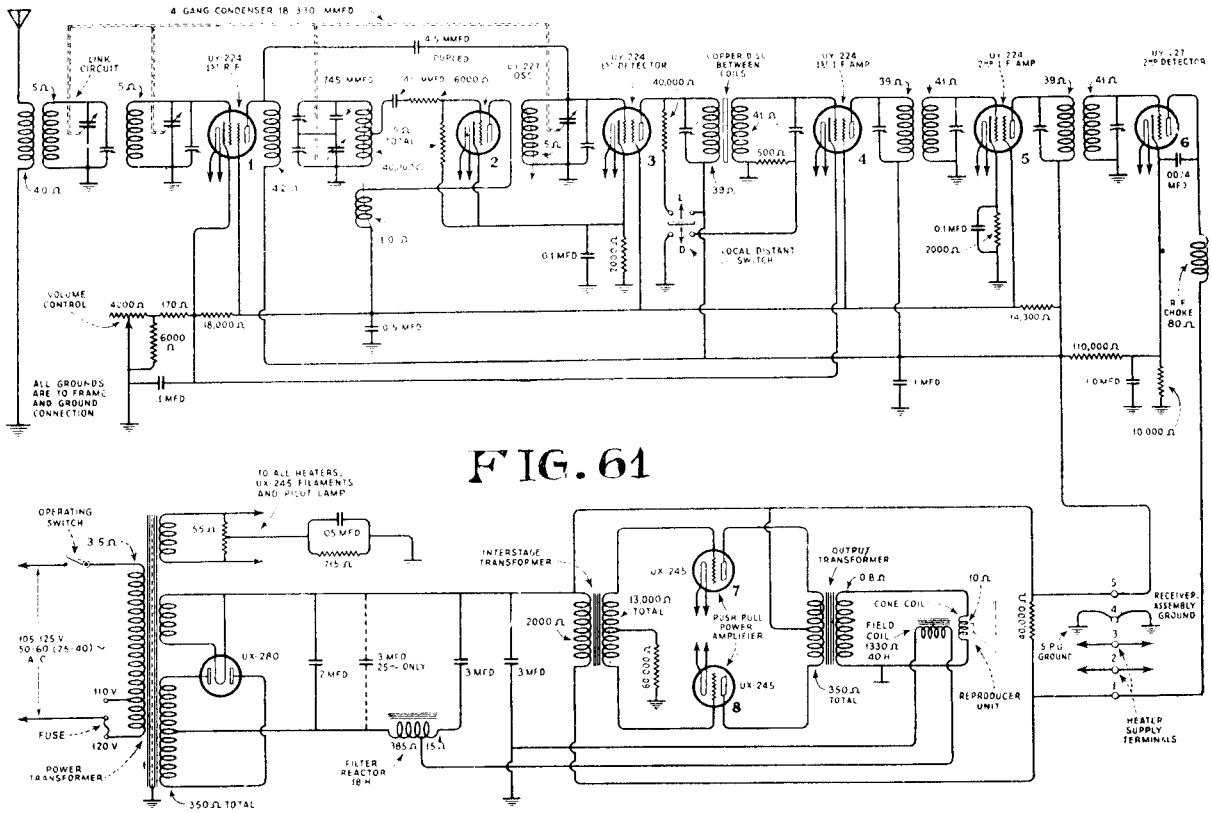


FIG. 61

much as for the additional selectivity obtainable.

The average detector tube has, in its plate circuit, strong radio frequency components of the harmonics of the intermediate frequency. Harmonics are caused by non-linear operation of the tube and result in spurious oscillations or currents having a frequency which is some multiple of the original.

Care must be taken in shielding the detector output of "supers" for this reason as, otherwise, stray harmonic voltages may find their way back to the input to cause trouble. Early superheterodynes were full of spurious signals of this character and it was this characteristic which prevented their becoming popular as commercial receivers.

In Fig. 61, there is a simplified diagram of the Radiola 80 receiver which is a characteristic example of the modern superheterodyne receiver. Here a "band-selector," in which the coupling is obtained by winding the coils adjacently on the same form, is employed in the antenna coupling.

The first tube is the radio frequency amplifier which operates at the frequency of the incoming signal. Coupled to this tube by means of a radio frequency choke and a small coupling condenser, is the first detector tube which is the third tube in from the antenna.

The second tube is a '27 which acts as the local oscillator. In order to make this oscillator track so that it will always have a frequency exactly 175 kc. higher than the frequency to which the other tuned circuits are adjusted, a special network of four condensers is employed in tuning the oscillator inductance. Note that the coupling between the first detector and the oscillator is secured by winding the oscillator and detector tuning inductances on the same form or on forms quite close to each other.

From the plate circuit of the first detector onward, the circuits are tuned to 175 kc., and a local-distance switch for cutting down the sensitivity of the receiver when receiving strong locals is provided in the coupling circuit between the first detector and the first intermediate or 175 kc. amplifier.

This arrangement is made up of two resistances of 40,000 and 500 ohms which are introduced into the tuned circuits of the 175 kc. band-selector when the switch is in the least sensitive position. Volume control is secured by varying the grid bias of the radio frequency amplifier simultaneously with that of the first intermediate frequency amplifier.

The grid biases for the other tubes are taken independently, that of the power output tubes being obtained by means of the voltage drop between the center of the filament winding and ground across a 715-ohm resistance.

It is interesting to note that the plate current of the oscillator tube flows through the biasing resistance in the cathode circuit of the first detector. This is arranged so that the bias received by the first detector tube will have a more constant character, since changes in the detector plate current due to the signal will have but slight effect on the total current flowing through the biasing resistance.

It is essential that the oscillator track exactly 175 kc. higher than the other tuned circuits across the band. To this end, two small trimmer condensers form a portion of the oscillator tuning network.

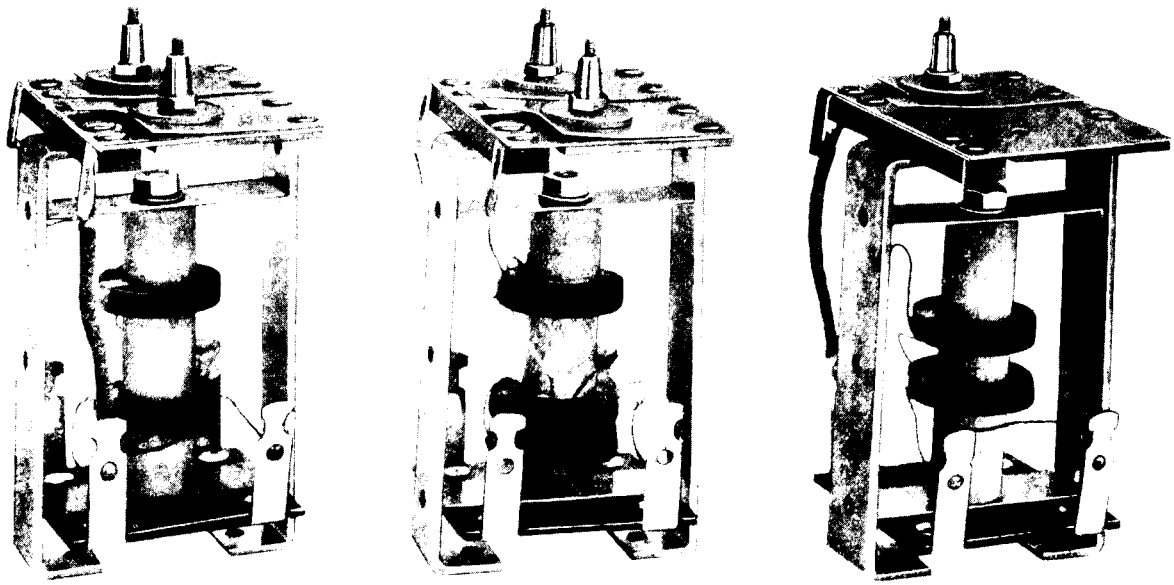
This network is so devised that the tracking along the mid-tuning range will be fairly good, but a cer-

tain amount of adjustment may be necessary at the high and low frequency limits of the range. The trimmer across the oscillator tuning condenser is used in adjusting for maximum sensitivity at the high frequency end of the band, while that across the fixed condenser is used in aligning the circuits at the low frequencies. A discussion of the alignment of the intermediate frequency amplifier will be found in the section of this manual devoted to the use of service apparatus.

Certain receivers employ oscillators which maintain their 175 kc. separation by the use of tuning condensers with specially cut rotors. These receivers do not require tracking in the same manner as those employing the condenser networks as shown —a simple adjustment of the trimmer condenser being all that is necessary in most cases.

Outside of the use of the oscillator and the fact that the latter R.F. stages are pretuned to 175 kc., the superheterodyne needs little explanation—service is carried out along lines parallel with tuned radio frequency receivers.

The sole differences in service procedure lie in the possible necessity for checking the oscillator alignment as mentioned or the alignment of the intermediate frequency transformers. The major faults manifest themselves in a manner identical with those found in other receivers—oscillation may be found difficult to trace to its source, however, and certain manifestations are described in the section on servic ing.



View of Three I. F. Transformers with the Shields Removed.

Stromberg-Carlson Telephone Manufacturing Company

REMOTE CONTROL DEVICES

During the past season, many remote control devices have made their appearance. So far as can be ascertained, these have enjoyed but a limited popularity—but however limited their distribution, there is no certainty that any service technician will be exempt from servicing them, and it is essential that they be a familiar subject so that time and trouble may be avoided.

The Sleeper Kinematic Control.

The Kinematic control system demands the use of two separate controlling systems—one to operate the station selector mechanism and the other to switch the set on and off and to control volume.

The apparatus involved consists of two motors at the receiver and two control devices in a small box at the control point. In A.C. neighborhoods, the control mechanism operates from 25 volts A.C., and in D.C. districts, an 18 volt supply is tapped from the line. In D.C. districts, the control switch operates to switch a motor generator on and off if an A.C. receiver is used.

Each driving member consists of a field winding with six pole pieces and a rotating steel armature as shown in Fig. 62. At the control box, a rotary switch is employed which operates as shown. With the switch at 1, the armature lines up across 1-1 of the poles. At 2, the alignment is across 2-2, while at 3, the alignment of the armature is across 3-3. It may be seen that the constant rotation of the switching member at the control point will result in a continuous rotation of the armature which is geared to the condenser shaft of the receiver or to the volume control and switch, as the case may be.

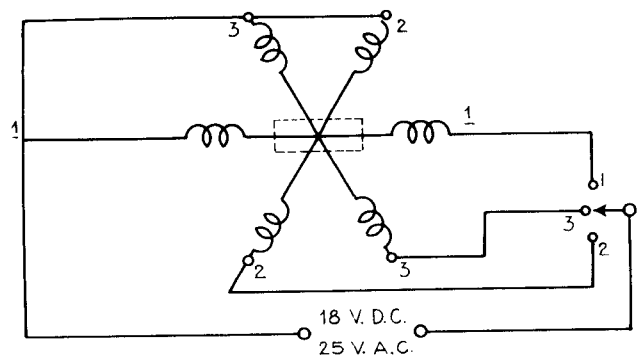


FIG 62

Westinghouse Remote Control.

In the Westinghouse remote control device, the same driving motor for both the volume and station selector motion is used. Normally, when the receiver is at rest, a spring holds the motor gears engaged with the volume control. Pressing buttons marked *Volume Control Plus* or *Volume Control Minus* will result in the motion of the driving member in the desired sense.

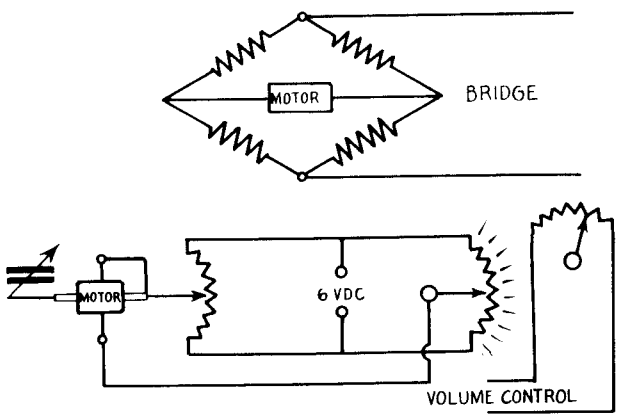


FIG. 63

Pressing one of the selector buttons will allow the motor to speed up so that the armature rises and the gears engage so as to rotate the tuning drive. A fine adjustment of the springs is necessary so that the armature does not rise when the volume control buttons are pushed, but rises completely when the station selector buttons are touched. This adjustment is easily carried out.

The control box contains on and off switches, the two volume control buttons, and six channel selec-

tors which are adjusted by the service man for the desired channels. A twelve-wire cable connects the two units.

This type of control is typical of many which employ contactors for shutting off the motor when the receiver is tuned to the desired channel. Adjustment of the tuning controls is quite simple. The station desired for number six contactor is tuned in manually. The cam for that contactor is then released from the shaft and rotated to the correct position. It is then tightened to the shaft again.

This same arrangement is used in both the ordinary models and in the Columaire. In the latter case, the gears are held engaged in the volume control position by gravity instead of by a spring. In testing the receiver, the manual control should not be operated unless the chassis is on end (vertical) as it is operated in the cabinet—otherwise, the gears may be damaged.

The Westinghouse arrangement is typical of the contactor-operated remote control units as a whole. The wiring arrangement is shown in the text dealing with Westinghouse receivers.

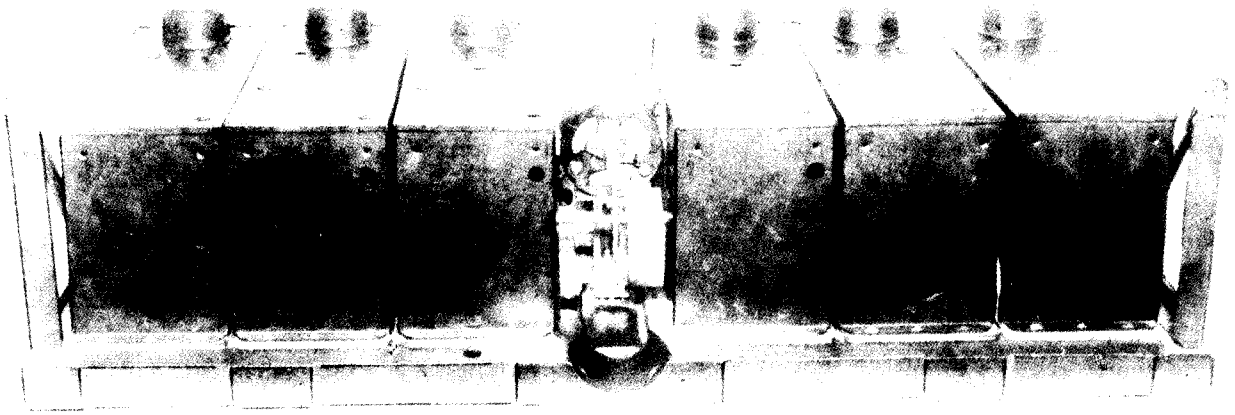
Other Remote Control Systems.

As is the case with every radio innovation, there are a thousand and one ways of doing the job. In Fig. 63 is shown a method which has given much promise but which has had no commercial realization so far. For those experimenters desiring to work up their own systems rather than to purchase units, this offers the best and simplest idea. The motor is in the indicator arm of a simple Wheatstone bridge such as is employed in laboratory testing. The motor moves automatically in either direction in an attempt to re-establish a balance of the bridge. The motor drives the moving arm of a potentiometer as well as the tuning elements of the receiver.

A very sensitive reversible motor is necessary to this device—a motor which will continue to run under load with a very small input—so that motion continues until an exact balance of the bridge elements is attained. In the balanced condition, the arm of the potentiometer on the motor shaft is in the same position as the arm of the potentiometer in the control box.

Volume control is achieved by placing the biasing resistance in the control box and connecting the R.F. cathodes and ground through this remote resistance. The motor should be geared to the condenser shaft through a reduction of about 60 to 1. Such gears are readily obtainable in nearly every location in the United States.

If your hardware dealer does not stock them, it is a certainty that he has a catalog of the Boston Gear Works from which you can make a choice. The disadvantage of this device in operating from a separate battery may be avoided by the use of a Tungar charger, either as a trickle charger on the battery or to drive the motor directly.



Stromberg-Carlson Special Remote Control Receiver

VACUUM TUBES AND THEIR OPERATION

Strange to say, it was Thomas Alva Edison who first noted the effect which later led to the development of the present day Vacuum Tube which made Radio a possibility.

In 1883, while working out problems concerning incandescent filaments, he sealed a metallic plate into the glass envelope with the filament and discovered that when the plate was electrically positive with respect to the filament a current flowed in the plate circuit but that when the plate was negative the current ceased to flow. Fig. 64.

Fleming, continuing the investigation of the "Edison effect," discovered that the path between the filament and plate exhibited effects of unilateral conductivity—that is to say, current would flow from the filament to the plate but not in the opposite direction.

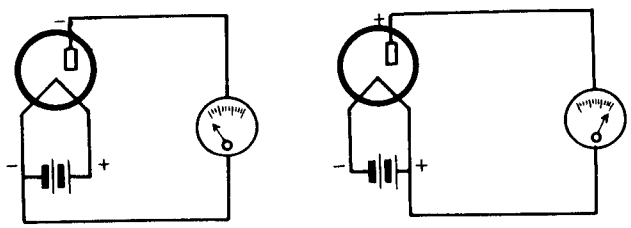


FIG. 64

For some time, the Fleming Valve was employed as a detector of wireless signals and the writer used quite effectively one which was made from an old style double filament automobile lamp—using one filament as the plate. The incoming signal was impressed upon the plate of the valve and, at any instant when the signal was positive in value, current flowed—while on the other portion of the wave, when the current was negative, no current flowed.

The curve shown in Fig. 65 indicates graphically the manner in which rectification of the signal occurs. The continuous line P is the graph of plate current against applied voltage. Note that this approximates a straight line up to a certain input voltage where "saturation" occurs. That is to say, the output current steadily increases with increased signal voltage up to a certain point where the curve flattens out. Increase of the signal beyond this point does not result in any increase in current.

The Fleming Valve had a decided superiority over the previous types of detectors, which rested in its reliability rather than its increased sensitivity.

It was no longer necessary to search for a sensitive point on the crystal nor to employ mechanical means for re-sensitizing as was required with certain other types of detectors.

It remained for De Forest to insert the third element into the envelope in order to improve the sensitivity of the valve and to start the long period of scientific development which followed.

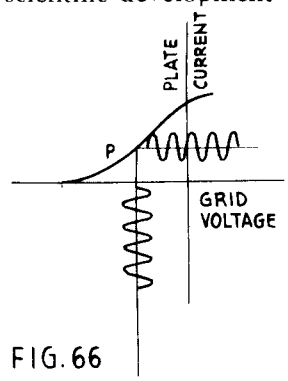


FIG. 66

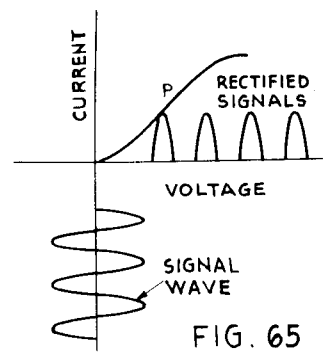


FIG. 65

Dr. Lee De Forest discovered that if the positive voltage were applied directly to the plate from an external source rather than from the signal, and if a third element—the grid—were inserted between the filament and the plate, there would be much larger changes in the current in the plate circuit for a given signal voltage. What is more, he discovered that by coupling together two or more of these three-element tubes, the signal voltage could be amplified to a tremendous extent.

The manner in which the amplification of the signal takes place is shown graphically in Fig. 66 where the characteristic curve of the tube—that is, the graph of the changes in plate current incident to a change in grid voltage—is given.

In order to operate the tube over a range where

the output variations will be identical in form with the input, it is necessary to apply a fixed grid voltage "e" about which the signal will produce a variation.

Operation of the three-element tube as a detector or rectifier may be obtained in two ways. The tube may receive a bias or initial grid voltage so large as to reduce its place current almost to zero as shown in Fig. 67, so that only the positive halves of the signal waves produce a change in plate current; or it may be adjusted so as to have the signal effect the plate current changes in the region of the upper bend in the curve where saturation takes place. The first method is known as "bias" or plate circuit detection, and the second as "grid-leak" 'or grid circuit detection.

The second method is shown in Fig. 68. In this second method, a resistance from grid to ground

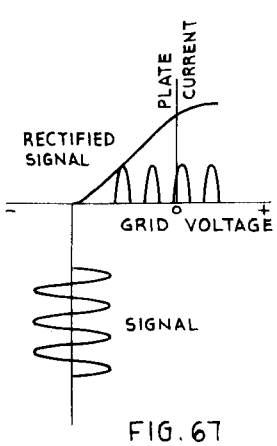


FIG. 67

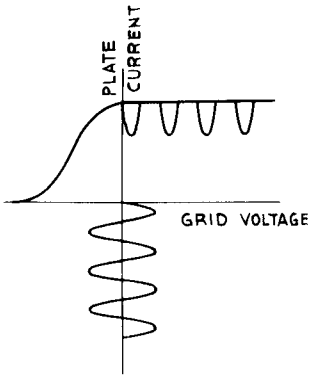


FIG. 68

is employed in order to prevent paralyzing of the tube, due to the fact that when the tube is so operated the grid will assume and retain an electric charge. The resistance permits this charge to leak off in time for the next cycle of the signal. Were it not for this, the charge on the grid would build up until the tube became inoperative.

The vacuum tube may be used as a generator of alternating current by virtue of its ability to amplify. In this connection, a portion of the voltage in the plate circuit is fed back to the grid in such a manner and in such magnitude as to sustain the tube in oscillation. This is due to the fact that a small portion of the output finds its way back to the input circuit by means of a capacitative or inductive coupling between the two.

There are many circuit arrangements which, properly proportioned, will permit of sustained oscillation. The small portion of the output fed back to the grid circuit is re-amplified—fed back to the grid again and reamplified so that the oscillation is continuous. The frequency of the oscillation thus produced is determined by tuning the grid or plate circuit to the required frequency.

The Factors Affecting Operation.

Certain definitions with respect to the vacuum tube are in order before a description of the operation of the device may be continued. The most important factors follow.

Cathode.

The cathode is the portion of the tube which emits electrons along the path of which the current from cathode to plate may flow. In general practice, the term "cathode" is applied to those emitters which are heated indirectly as in the case of the '27 tube.

Filament.

The filament is the cathode also, but in general is an emitter which is directly heated by the flow of current through it. The filament or cathode is constructed of some material which is capable of emitting a strong electronic stream.

Plate.

Plate and "anode" are interchangeable terms. This element is maintained at a potential, positive with respect to the cathode, so as to establish a current flow between the two elements.

Grid.

An electrode placed between the cathode and plate, and so constructed as to permit the flow of electrons through it.

Control Grid.

The control grid is an electrode placed between the cathode and plate through which the electrons may flow on their journey between the two. It is to this electrode that the incoming signal is applied. The name implies the effect of the electrode in varying the plate current in accordance with the voltage applied to it.

Screen-Grid.

A fourth electrode is included in some tubes to screen the electrodes one from the other in order to reduce the capacity existing between them.

Grid Voltage.

The voltage difference existing between the grid and the cathode.

Grid Bias.

The direct current portion of the grid voltage placed intentionally on the grid so as to operate the tube at some specified point on its characteristic curve.

Amplification Factor.

The effectiveness of the tube in effecting a change in the voltage in the plate circuit. It is the ratio between a change in grid voltage and the corresponding change in plate voltage with the plate current held constant. It is represented by the symbol μ (Mu).

A.C. Tube.

Any tube particularly designed for service with raw or unrectified alternating current on its filament is in this classification. A.C. tubes may be of the indirectly heated cathode type, such as the '27, or they may be made with particularly sturdy filaments as in the case of the '26. In this latter case, freedom from hum is gained by a high thermal inertia—that is to say, the filament is so bulky that it does not cool and heat again in step with the A.C. cycle as would be the case with a lighter and less sturdy filament.

Grid Emission.

This is an effect which takes place in some tubes when the filament is run at too high a temperature and the grid becomes hot enough to emit electrons.

Secondary Emission.

The kink so pronounced in the characteristic curves of screen-grid tubes is caused by secondary emission—or the emission of electrons from the plate under heavy bombardment from the filament, which are attracted to the screen-grid when the screen-grid potential is not sufficiently negative with respect to the plate.

Screen-Grid Tubes.

Screen-grid tubes are those in which an electrode has been added for the purpose of screening the plate from the grid in such a manner as to reduce the effective capacity between the grid and plate. This is done so that the tube may be used as a high gain amplifier without danger of its becoming an oscillator due to the feeding back of energy from the plate circuit to the grid through the inter-electrode capacity of the tube.

Dynatron Oscillator.

Reference to the curves of the screen-grid tubes will show that there is a portion of the characteristic curve which slopes steeply downward from left to right. In this range of operation, the tube exhibits a "negative resistance" characteristic—which is to say that the addition of greater voltage results in the flow of less, rather than more, current in the plate circuit of the tube. Tubes operated in this range will act as oscillators by the simple procedure of placing a tuned circuit in series with the plate.

Maximum Undistorted Power Output.

This is the highest power output obtainable with a tube at the voltages specified without the harmonic distortion exceeding 5% of the total output. Research workers have found that this condition obtains when the tube works into a load of twice its own plate impedance. Maximum undistorted power output should not be confused with maximum power output or with maximum efficiency.

Maximum power output is obtained when the load impedance is equal to the tube impedance, and maximum efficiency is obtained when the impedance of the load is many times that of the tube. In using the tube for operating commercial devices, one of the latter would be desirable, but in Radio, we are interested in the entertainment possibility which can only be realized to its fullest extent when the distortion is negligible. In Radio, then, we are interested in the maximum undistorted power output which is obtained when the impedance of the load is double that of the tube.

The new "Pentode" type of tube requires a load in the plate circuit approximately equal to one-fourth the plate resistance of the tube. The output of the pentode cannot be fully realized, due to the high second harmonic component present in this type tube. In order to minimize the second harmonic output, it then becomes necessary to reduce the operating load to such a value that the second harmonic output is less than 5% of the fundamental.

Plate Impedance.

The ratio of a change in plate voltage to the corresponding change in plate current with the grid voltage held constant. The A.C. impedance between the filament and the plate. This should not be confused with the D.C. resistance.

Mutual Conductance.

The mutual conductance of the tube is the figure of merit for tubes of a given type. It is the ratio between a change in grid voltage and the corresponding change in plate current. It is expressed in micromhos and is designated by the symbol Gm. In some texts, the mutual conductance is expressed in terms of milliamperes per volt and a tube exhibiting a change of 1.5 milliamperes has a mutual conductance (Gm) of 1500 micromhos.

Inter-electrode Capacitance.

The capacitance existing between the various elements by virtue of their proximity. These factors have no effect upon the plotting of the curves of the tubes with direct currents only applied, but are a large factor in the operation of the tube at high audio frequencies or at radio frequencies.

Plate Voltage.

The voltage difference effective between the plate and the cathode or filament.

Plate Current.

The direct current flowing between the plate and the cathode through the evacuated space within the tube.

Gassy Tubes.

The presence of gas in a vacuum tube will seriously affect its operation as at some voltage the gas becomes ionized and is conductive. When ionization occurs, the current through the tube is not flowing between filament and plate through the electron stream only, but also through the gas due to its conductivity when ionized.

Space Charge Grid.

An additional grid placed in the vacuum tube close to the filament, in most cases, for the purpose of dispelling the space charge existing in the region of the filament or cathode, which permits the formation of a cloud of electrons in this region impeding the flow of the electron stream from cathode to plate. This extra grid is found in the new Pentode output tubes and permits of increased sensitivity and efficiency.

Diode—Triode—Tetrode—Pentode.

The terminology applied to various forms of vacuum tubes accordingly as they have two, three, four or five operative electrodes. Some French tubes for special purposes have two control grids and are known as double grid or "bigrille" tubes.

As we have noted before, a profound study of vacuum tube theory is not essential to efficient radio servicing. It is, however, necessary that the service man have a good idea of the factors affecting the operation of the tubes so that various difficulties will make themselves at once obvious. It is a distinct advantage to the service man if he memorizes the electrical constants of the various tubes as tabulated on the tube chart shown in this manual. Set manufacturers generally design their sets so that the tubes are used at the recommended voltages.

Voltage Amplification.

Tubes which are employed as voltage amplifiers are concerned more with the "gain" or amplification which can be obtained within the individual stage than with the power available at the output. With three-element tubes, the amplification may readily be calculated through a knowledge of the amplification factor of the tube and of the load into which it will work. A simple relation exists here in which

$$\text{Amplification} = \frac{\mu Zo}{Rp+Zo}$$

where μ is the amplification factor of the tube as obtained from the manufacturer's data, and Rp and Zo are, respectively, the plate impedance of the tube and the load impedance at the frequency for which we desire to obtain the amplification. It should be remembered that, in case of audio frequency transformers the primary inductance must be high so that the impedance at a low frequency is sufficient to permit a fair degree of amplification — naturally, the impedance of the transformer will be high enough at the higher frequencies transmitted.

Transformer Coupled Audio Frequency Amplifiers.

Audio transformers to operate between vacuum tubes have a ratio of transformation—that is, a "step-up ratio"—of from 2:1 to 8:1. The amplification to be obtained from a stage would normally be thought to be the amplification factor of the tube times the step-up ratio of the transformer. At the medium frequencies to be amplified, this is true, but at the low frequencies we are limited by the primary inductance of the transformer. From the equation above, it will be seen that, if the primary impedance is equal to Rp, but half the amplification of the tube will be realized.

Bias detectors operate at extremely high plate impedances and, in consequence, transformers working out of the detector stage must have extremely large primary windings. At the medium frequencies, the impedance of even a small winding is sufficiently high to permit of the full amplification being realized. Now at the high frequencies, the gain is affected by the capacitance of the windings themselves and of the wiring. Resonance occurs between the leakage inductance of the windings and this capacitance, and results in an amplification peak followed by a rapid cut-off in response as is shown

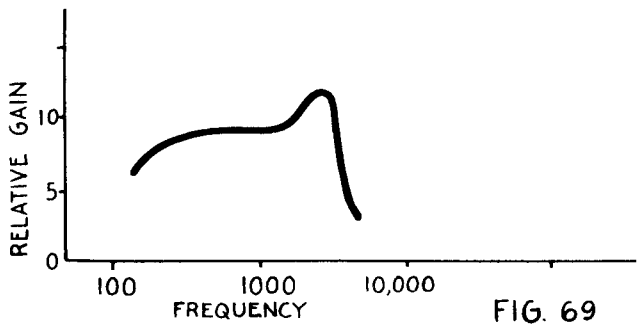


FIG. 69

in Fig. 69. This curve is that of a commercial transformer taken by the writer from a receiver of a season ago. The high peak is there for the purpose of compensating for lack in high frequency response due to the sharpness of tuning in the radio frequency circuits. Referring back to the previous sec-

tion in which we discussed resonance, it may be readily seen how this occurs.

Parallel Feed Circuits.

It is possible to improve the low frequency response of a transformer by resonance at some low frequency—you will remember that we made note of the fact that with series resonance we often obtained large voltages across the individual elements. Let us suppose that the plate voltage for the amplifier or detector tube is fed through a high resistance or an impedance as shown in Fig. 70, and that the transformer is coupled to the tube through a condenser. We then have a series resonant circuit across the output of the tube composed of the coupling condenser and the primary inductance of the transformer. By carefully choosing the value of the condenser, we can obtain a resonant effect which will increase the voltage across the primary at some particular frequency—50 cycles, for example—and the result will be a response curve of the type shown in Fig. 71. It is possible in this manner to achieve good response at the lower frequencies without having a very large primary.

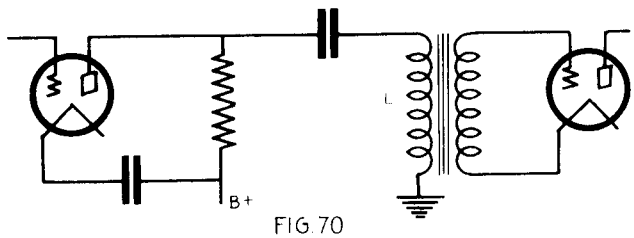


FIG. 70

The ratio of a transformer is limited by the bulk of the winding necessary to obtain satisfactory low frequency response, since a large winding would mean a large capacitance and a cut-off of the amplification at the higher frequencies.

Resistance Coupled Amplifiers.

Resistance coupled amplifiers and the direct-coupled type do not fall heir to many of these complications and they will be found in many commercial receivers. The resistance coupled amplifier has a mid-frequency response determined by the load across the plate circuit of the tube which is equivalent to the parallel value of the grid and plate resistances. The high frequency response is determined by the point at which the reactance of the condenser becomes low enough to effectively short-circuit the resistances. For this reason, the resistances must be sufficiently low to prevent this reactance from becoming low enough to affect them at the highest frequency desired. This is shown diagrammatically in Fig. 72. Note that the load is composed of R_1, R_2 and Xc in parallel.

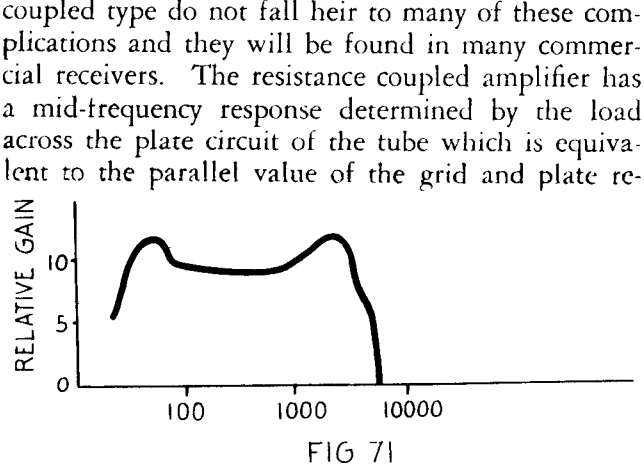


FIG 71

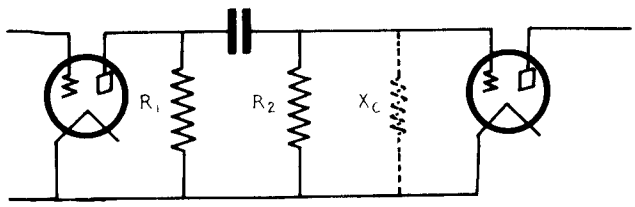


FIG. 72

Low frequency response in resistance coupled amplifiers is determined by the relative values of the coupling condenser and the grid leak. In Fig. 73, it is obvious that signal voltage is across the condenser and leak in series. The two should be chosen in such a manner that the reactance of the condenser is never high enough to become appreciable in value as compared to R_2. This means that the higher the resistance of the grid leak, the lower may be the value of the condenser.

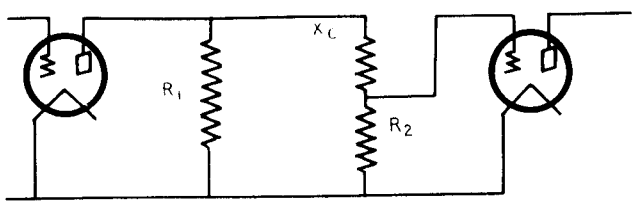


FIG 73

Direct Coupled Amplifiers.

Direct coupled amplifiers such as the Loftin-White are found to a great extent in commercial midget receivers, and in small sound systems. Characteristic of the circuit is the fact that the plate of one tube is connected directly to the grid of the succeeding tube. The tube elements are maintained at their correct relative operating voltages by virtue of the voltage drop through the various resistances in the circuit. A commercial application is shown in Fig. 74.

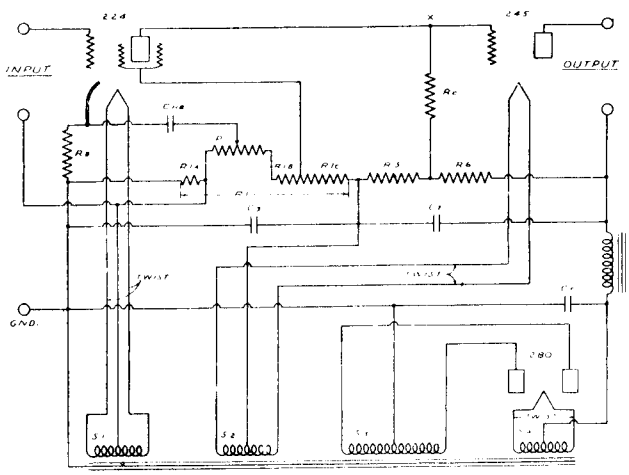


FIG. 74

OPERATING DATA ON COMMERCIAL VACUUM TUBES

THE previous section dealt briefly with the theoretical knowledge necessary to the service man who wishes to know more than the ordinary regarding the vacuum tubes which are his stock in trade. This second section on vacuum tubes will deal with the actual characteristics of the tubes now in use.

Although there are many special-purpose tubes to be found on the American market which are not listed they are rarely, if ever, found in commercial receivers—in fact, certain of the tubes to be noted in these columns are now obsolete but are included due to the fact that they are still to be found in some of the older receivers.

Where the designation is that of some particular manufacturer, no specific advertisement is intended—credit is merely given that particular manufacturer for the courtesy shown in allowing data to be drawn from certain sources which may not be available to the man in the field save through these columns.

'99 and 'X-'99.

These two tubes are employed as general purpose tubes for radio and audio frequency amplification in receivers designed for use with dry batteries, the sole difference between them being in the type of base employed.

The tubes employ the "thoriated" filament and are particularly sensitive to filament overload. This fact makes the use of a filament voltmeter desirable so that the operator may at all times be sure that the filaments are not receiving more than their rated voltage. The extreme delicacy of the filament is compensated in a measure by the fact that the tubes respond readily to reactivation. Where the single tube is used with a bank of dry cells having a terminal voltage of 4.5 volts, a 60-ohm rheostat is necessary. The correct rheostat for use with three tubes in parallel under the same conditions is 20 ohms.

As a Detector

When the tube is used as a grid circuit detector, the plate voltage should be about 45 volts with a grid condenser of .00025-mf. and a leak of about 3 to 5 megohms. The grid leak should be connected between the grid and the positive side of the filament.

As an Amplifier

When these tubes are used as amplifiers, a grid bias should be used whenever the plate voltage is over 45 volts. The following values of grid bias for various plate voltages are recommended:

Plate Voltage	Grid Bias
67.5	—3.0 volts
90.0	—4.5 volts

Rating

Filament Voltage	3.0-3.3 volts
Filament Current	0.060-0.063-ampere
Plate Voltage (maximum)	90 volts

Average Characteristics

Plate Voltage	90 volts
Grid Bias Voltage	-4.5 volts
Amplification Factor	6.6
Mutual Conductance	15500 micromhos
Plate Resistance	425 ohms
Plate Current	2.5 milliamperes
Undistorted Power Output	7 milliwatts
Grid-Plate Capacitance	3.3 mmf.

Average Characteristic Curves

Filament and Emission Characteristics—Fig. 75 shows the change of filament current with various filament voltages.

Grid Characteristics—Fig. 76 shows the relation between grid current and grid voltage.

Plate Characteristics—Fig. 77 shows a family of plate voltage—plate current curves at various grid bias voltages.

Mutual Characteristics—Fig. 79 shows a family of grid voltage—plate current curves for various plate voltages.

Dynamic Characteristics—Fig. 78 shows the effect of grid voltage upon the amplification factor, mutual conductance and plate resistance.

'-X-'20.

The '20 tube is used as a power output tube in circuits employing the '99 in the preliminary stages. Its filament voltage is the same but the current drawn is twice that drawn in the case of the '99. With a plate voltage of 135 volts and a bias of --22.5 volts, the maximum power output obtainable is quite satisfactory for home use in locations where commercial current is not available. Two of these tubes may be used in push-pull with exceedingly gratifying results.

It is not necessary to use an output transformer with this tube and a cushion or spring mounting need not be provided when it feeds directly into a loud speaker.

Rating

Filament Voltage	3.0-3.3 volts
Filament Current	0.125-0.132-ampere
Plate Voltage (maximum)	135 volts

Average Characteristics

Plate Voltage	90	135 volts
Grid Bias Voltage	16.5	--22.5 volts
Amplification Factor	3.3	3.3
Mutual Conductance	415	525 micromhos
Plate Resistance	8000	6300 ohms
Plate Current	3	6.5 ohms
Undistorted Power Output	45	110 milliwatts

Average Characteristic Curves

Filament Characteristics—Fig. 80 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 82 shows the relation between the plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 81 shows a family of grid voltage—plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 83 shows the effect of grid voltage upon the amplification factor, mutual conductance and plate resistance.

Output Characteristics—Fig. 84 shows the undistorted power output obtainable at various load resistances.

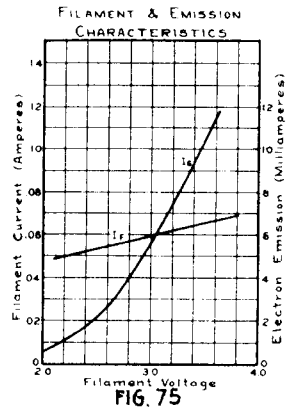


FIG. 75

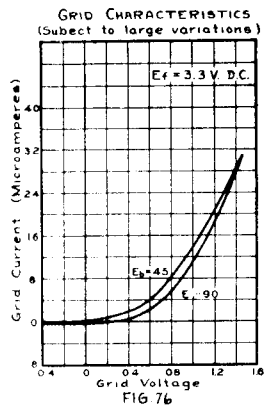


FIG 76

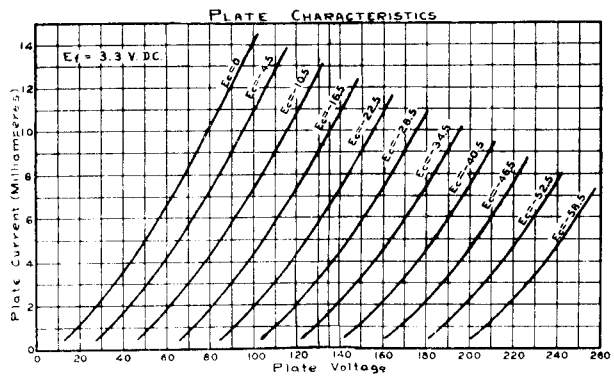


FIG 77

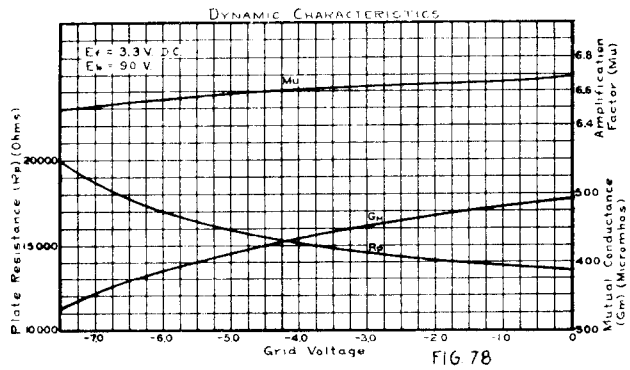


FIG 78

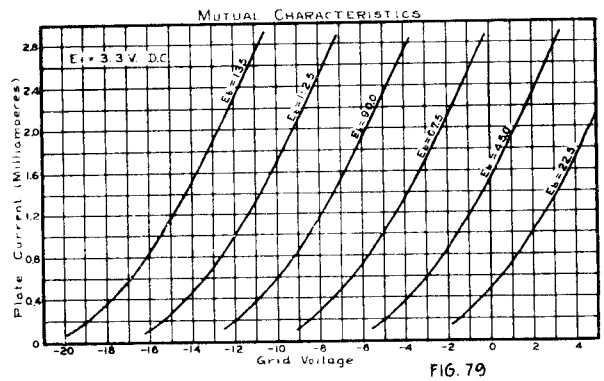


FIG. 79

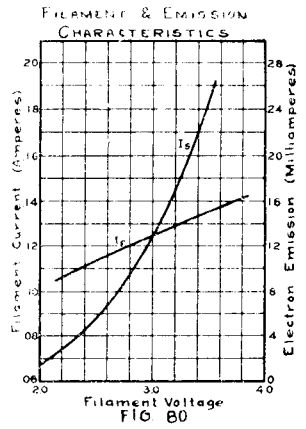


FIG. 80

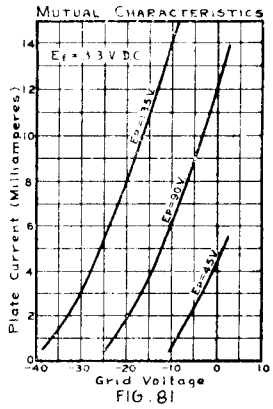


FIG. 81

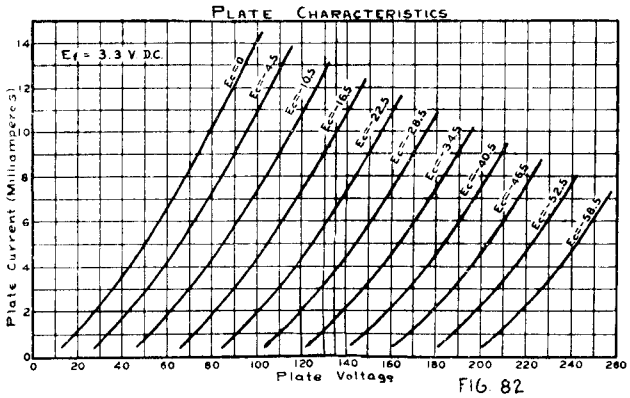


FIG. 82

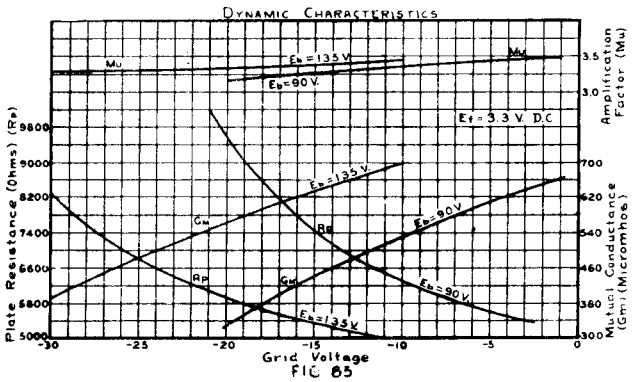


FIG. 83

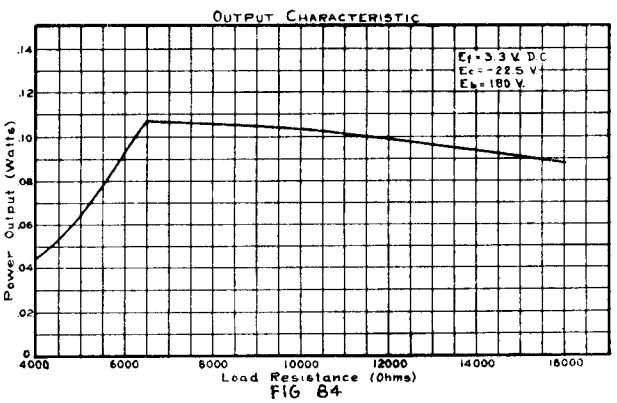


FIG. 84

'01A.

This is the "grand old man" of Radio. It first appeared on the market when a single tube drew a full ampere of current at five volts and a three tube receiver wrought havoc with a storage battery in a single night of operation. The '01A is still used in many receivers of quite recent vintage—particularly those designed for use on direct current supply lines. This tube will be found used in all circuits. It suffers in some measure from the weakness noted in the case of the '99 but responds fully as well to reactivation.

As a Detector

When the '01A is used as a detector with grid leak and condenser, the plate voltage should preferably be not more than 45 volts. The grid condenser should have about 0.00025-mf. capacity and the grid leak should have a resistance of 2 to 9 megohms, the latter giving greater sensitivity on very weak signals but with somewhat inferior fidelity.

As an Amplifier

The '01A, when used as an amplifier, should have the following recommended grid biases applied whenever the plate voltage is over 45 volts:

Plate Voltage	*Negative Grid Bias*
67.5	3.0
90.0	4.5
135.0	9.0

In radio frequency circuits, there is little advantage in using more than 90 volts on the plate and when used for loud-speaker operation, the plate voltage should be 135 volts with suitable bias.

Rating

Filament Voltage	5.0 volts
Filament Current	.25-ampere
Plate Voltage (maximum)	135 volts

Average Characteristics

Plate Voltage	90	135 volts
Grid Bias Voltage	—4.5	—9.0 volts
Amplification Factor	8.0	8.0
Mutual Conductance	725	800 micromhos
Plate Resistance	11000	10000 ohms
Plate Current	2.5	3.0 milliamperes
Undistorted Power Output	15	55 milliwatts
Grid-Plate Capacitance	8.1 mmf.	
Grid-Filament Capacitance	3.1 mmf.	
Plate-Filament Capacitance	2.2 mmf.	

Average Characteristic Curves

Filament and Emission Characteristics—Fig. 85 shows the change of filament current and electron emission with various filament voltages.

Grid Characteristics—Fig. 86 shows the relation

between grid current and voltage.

Plate Characteristics—Fig. 87 shows a family of plate voltage—plate current curves at various grid bias voltages.

Mutual Characteristics—Fig. 89 shows a family of grid voltage—plate current curves for various plate voltages.

Dynamic Characteristics—Fig. 88 shows the effect of grid voltage upon the amplification factor, mutual conductance and plate resistance.

'12 or '12A.

The '12 and '12A differ only as to the type of filament employed. Certain other minor differences may be forgotten. The '12 draws .5-amp. at 5 volts and the '12A, .25-amp. at 5 volts. The tube is ideally suited to use as a general purpose tube replacing the '01A and in certain cases a distinct improvement in results may be so gained. Operating conditions in amplifier circuits are indicated in the Tube Data Chart.

The tube has been used in some circuits with alternating current on its filament in the last audio frequency stage. This is an economy not practiced today and is only possible because of the use of push-pull circuits in which the hum voltages present in the output stage cancel out. The high thermal inertia of the filament as compared with earlier tubes helps to make this type of operation possible.

As a Detector

When grid bias detection is used, plate voltages up to 180 volts may be applied. The grid bias should be such that the plate current is about .1-milliampere when no signal is being received.

The requirements for grid leak-condenser detection with the '12A are that the plate voltage should be not more than 45 volts, the grid condenser should be about .00025-mf. capacity and the grid leak should have a resistance of 2 to 9 megohms. For maximum sensitivity, it is best to use the higher values of grid leak and for more stable operation, the lower values should be used.

As an Amplifier

The '12A may be used as an R.F. or A.F. amplifier and should always be operated with the proper value of grid bias to secure maximum undistorted amplification. When used in the last audio stage, the power output can be calculated from the curve shown in Fig. 94.

Average Characteristics

Plate Voltage	90	135	180 volts
Grid Bias Voltage	-4.5	-9	-13.5 volts
Amplification Factor	8.5	8.5	8.5
Mutual Conductance	1500	1600	1700 micromhos
Plate Resistance	5600	5300	5000 ohms
Plate Current	5.2	6.2	7.6 milliamperes
Undistorted Power Output	30	115	260 milliwatts
Grid-Plate Capacitance	8.1 mmf.		

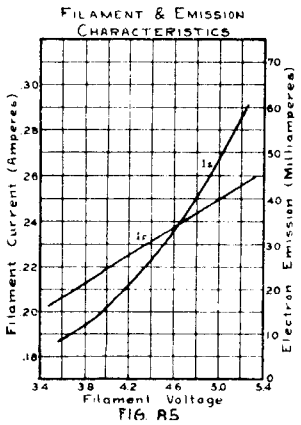


FIG. 85

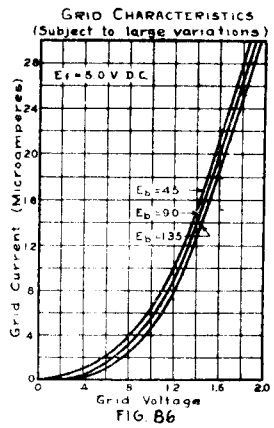


FIG. 86

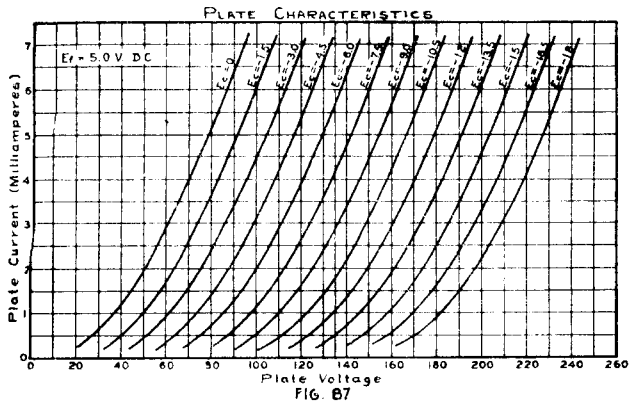


FIG. 87

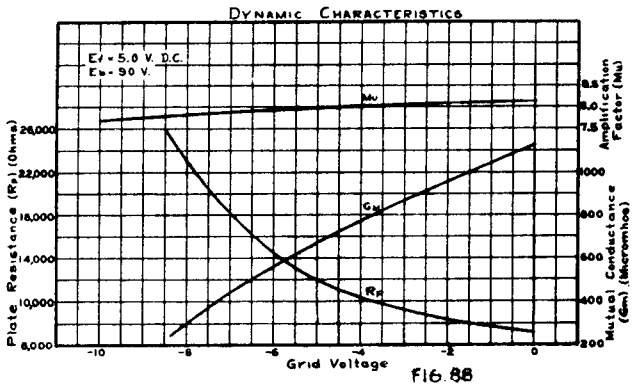


FIG. 88

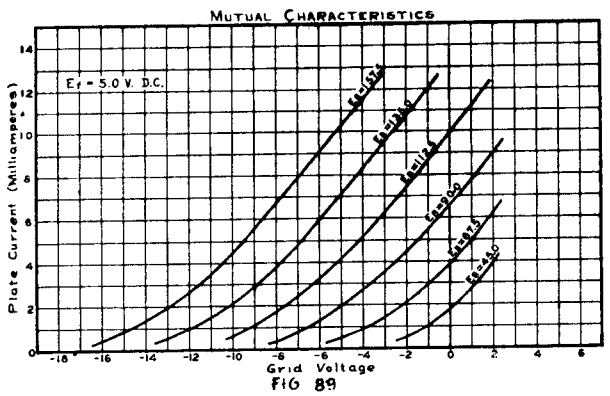


FIG 89

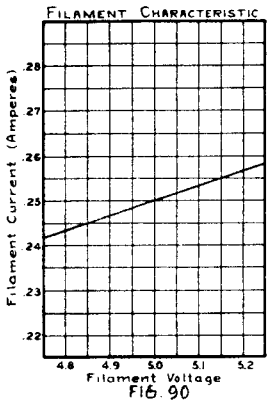


FIG. 90

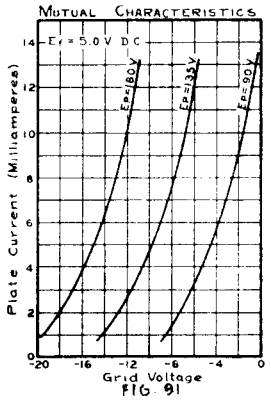


FIG. 91

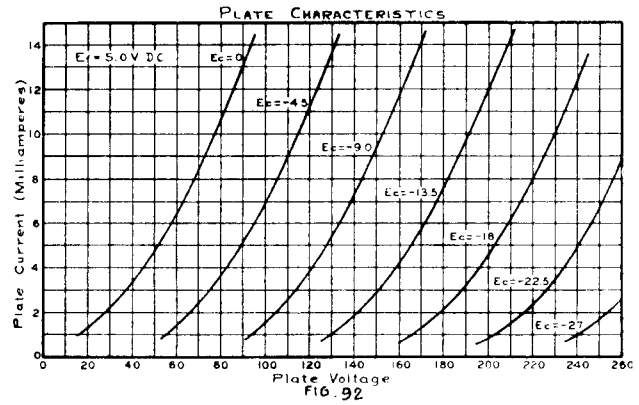


FIG. 92

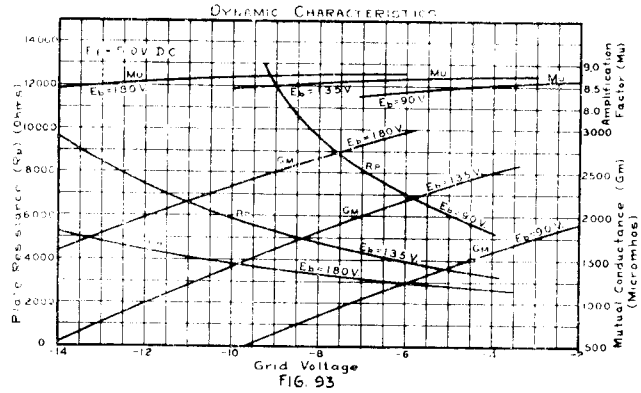


FIG. 93

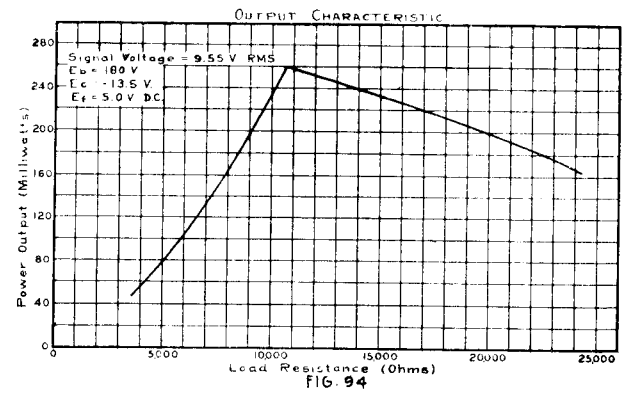


FIG. 94

AVERAGE CHARACTERISTIC CURVES

Filament Characteristics—Fig. 90 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 92 shows the relation between plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 91 shows a family of grid voltage—plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 93 shows the effect of grid voltage upon the amplification factor, mutual conductance and plate resistance.

Output Characteristics—Fig. 94 shows the undistorted power output obtainable at various load resistances.

'71 and '71A.

Here again are two tubes which differ only with regard to their filament characteristics. The difference is the same as in the case of the '12. Since certain of the early A.C. receivers employed these tubes in the output stage in a single or push-pull connection, care should be taken in cases where the "A" type is used in replacement in receivers originally designed for use with the '71 as the decreased current consumption may result in too high a filament voltage where the power transformer has been economically designed. In case this condition is found the 5-volt secondary of the transformer may be loaded up by short-circuiting it with a 10-ohm resistance where two tubes were used, or a 20-ohm resistance where a single '71 was originally employed.

Grid bias is preferably obtained by the use of a resistance between the center point of the filament winding and ground. The resistance required to give the correct bias at the ordinary plate voltages found is as follows:

Plate Volts	Single Tube	Two tubes in parallel or Push-Pull	Total Plate Volts required
90	1580 ohms	790 ohms	106.5
135	1685 ohms	840 ohms	162
180	2150 ohms	1075 ohms	220.5

As in all cases where the grid bias is obtained by making the cathode or filament positive with respect to the grid in the manner described above, the plate voltage must be correspondingly greater as shown in the table. The filament of the tube is subject to failure when the plate voltage of 180 is applied and the voltage should be held down to 135 except in cases where the additional power output is necessary. The '71A is the smallest of the tubes in which the plate current is far beyond the limits of the carrying capacity of loud-speaker windings and some form of output device which prevents the flow of direct current through the speaker windings is required. These arrangements may be obtained either through the use of a choke and condenser or by means of an output transformer of such a turns ratio as to match the impedance of the output load to that of the tube.

Rating

Filament Voltage	5.0 volts
Filament Current	0.25-ampere
Plate Voltage (maximum)	180 volts

Average Characteristics

Plate Voltage	90	135	180 volts
Grid Bias Voltage	-16.5	-27	-40.5 volts
Amplification Factor	3	3	3
Mutual Conductance	1330	1520	1620 micromhos
Plate Resistance	2250	1960	1850 ohms
Plate Current	12	17.5	20 milliamperes
Undistorted Power Output	125	370	700 milliwatts

Average Characteristic Curves

Filament Characteristics—Fig. 95 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 97 shows the relation between plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 96 shows a family of grid voltage—plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 98 shows the effect of grid voltage upon the amplification factor, mutual conductance and plate resistance.

Output Characteristics—Fig. 99 shows the undistorted power output obtainable at various load resistances.

'**X**-'22.

The '22 was the first of the tubes to employ the screen-grid or shielded-grid principle, in which the plate of the tube was electrostatically shielded from the control grid by means of a screen which was given such a potential, with respect to the plate, as to permit the shielding effect without any detrimental action insofar as the operating characteristics of the tube were concerned. This tube made possible the construction of high gain stages of radio frequency amplification without the necessity for neutralization, but at the same time the high gain obtainable made it essential that the circuits and, in most cases, the tubes themselves be shielded from interaction between the stages.

Use as Detector

The tube may be used as a detector with grid leak and grid condenser or with grid bias. Resistance coupling is recommended as giving the most satisfactory frequency characteristics because of the high internal resistance of the tube. See Fig. 100 for recommended circuit.

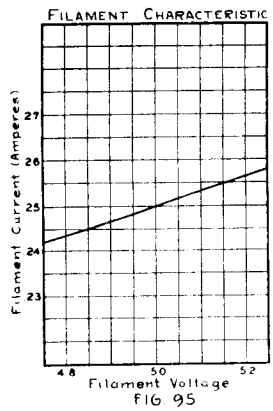


FIG 95

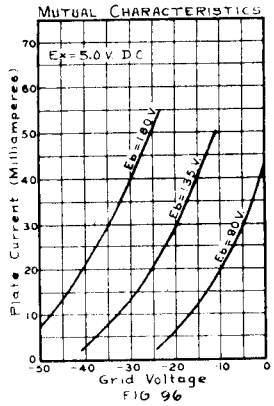


FIG 96

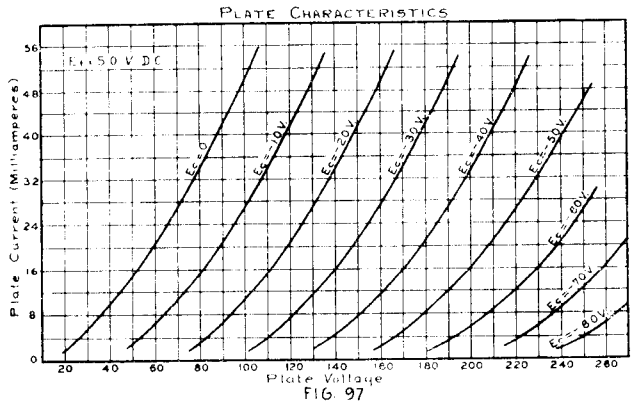


FIG. 97

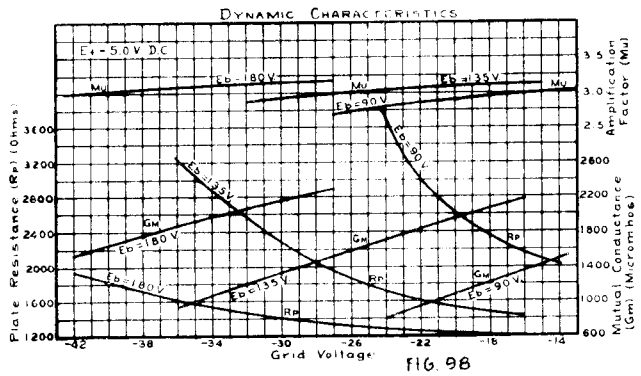


FIG. 98

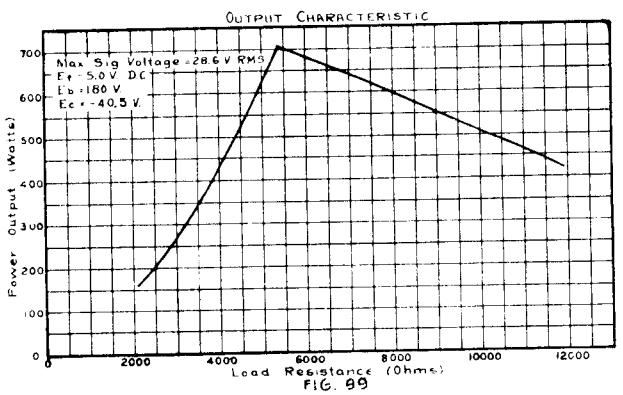
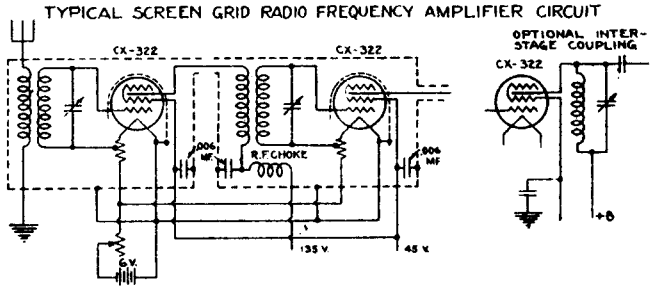


FIG. 99

Use as a Radio Frequency Amplifier

This tube has been especially designed for use as an R.F. amplifier. When so used, the most important advantage gained is elimination of all feed-back through coupling between grid and plate, due to capacity between these elements. It is also possible to obtain higher voltage amplification per stage, 25 to 50 in the broadcast range as compared with the

TYPICAL SCREEN GRID RADIO FREQUENCY AMPLIFIER CIRCUIT



TYPICAL SCREEN GRID AUDIO FREQUENCY AMPLIFIER CIRCUIT

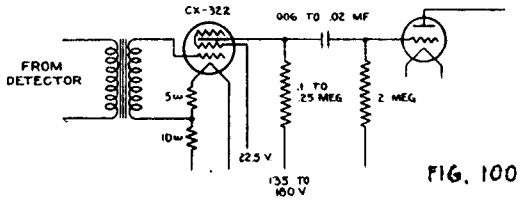


FIG. 100

usual range of 5 to 12 per stage with three-element tubes.

In the operating range the plate current does not vary appreciably with changes in plate voltage, this being due also to the screening effect of the second grid. As a result, the amplitude of the plate current change caused by a signal voltage impressed on the grid is scarcely affected by an increase in load resistance. Thus, it is of advantage to use a very high resistance or impedance in the plate circuit, in order to obtain high voltage amplification.

The voltage amplification depends only upon two factors:

A—The mutual conductance of the tube, which determines the amplitude of the plate current change, resulting from a signal voltage impressed on the control grid, and—

B—The load impedance. The voltage across the output load is directly proportional to the local impedance, since the amplitude of the signal current, with moderate loads, remains unchanged with an increase in impedance. This is unlike the condition with three-element tubes, where an increase in load resistance results in a decrease in the amplitude of the signal current.

At low radio frequencies, 50 to 100 kilocycles, it is possible to build up a very high load impedance by using a tuned plate circuit, and a voltage amplification of 200 per stage is obtainable. At broadcast frequencies it is not possible to obtain a sufficiently high load impedance to realize maximum voltage amplification, and the values quoted above represent average results (25 to 50 per stage).

Since the voltage amplification depends only upon the load impedance and mutual conductance, it may be quickly computed when these values are known. The voltage amplification obtained with a load impedance of 100,000 ohms, using a tube having a value of mutual conductance of 350 micromhos (.00035-mho).

Av.=100,000 x .00035=35 per stage.

With 250,000 ohms. Av.=250,000 x .00035=87 per stage.

It is possible to obtain the desired high load impedance by use of a tuned circuit connected in series with the plate, but it may be preferable to use a transformer connection with a ratio of 1:1 or slightly lower so that low frequency disturbances do not reach the grid of the succeeding tube and to facilitate the use of ganged condensers for uni-control. Both connections are shown in the circuit diagrams.

Although the internal shielding prevents feedback through the tube inter-electrode capacities, this is only one source of coupling between stages, and it is necessary to shield the input circuit from the output circuit. The amount of shielding necessary will depend upon the voltage amplification per stage and the circuit design. A metallic shield enclosing each tuned stage is usually sufficient, as indicated in the circuit diagram. It may be necessary, if the voltage amplification is high, to place a metal cap over the tube, extending to the base, and connected to ground. Clearance for the grid connection must be provided at the top.

Use as an Audio Freqency Amplifier

The tube may be used as an audio frequency amplifier with resistance coupling, the connections being the same as when the tube is used for radio frequency amplification, except that the screen-grid voltage should be lowered to compensate for the voltage drop in the load, unless a high plate voltage is available. With this connection, a voltage amplification of 35 per stage may be readily obtained with perfectly flat frequency characteristics down to 50 cycles and below (the lower limit is fixed only by the size of the blocking condenser); and extending on the high frequency and well above 10,000 cycles.

Operating Conditions

Filament Volts	3.3
Filament Amperes	.132
Control Grid Volts (Average)	−1.5
Screen-Grid Volts (Average)	45
Plate Volts	90 to 135

Average Tube Characteristics

Plate Voltage	135	135
Grid Voltage	−1.5	−1.5
Screen-Grid Voltage	45	67.5
Amplification Factor	300	290
Plate Resistance (ohms)	850,000	600,000
Mutual Conductance (Micromhos)	350	480
Plate Current (Ma.)	1.5	3.3

Inter-electrode Capacity

Plate to control grid (max) ..... .025-mmf.

Rheostat Recommendations

For use with 4.5-volt dry cells use a 20 to 30-ohm rheostat.

For use with 5-volt tubes; connect a fixed resistance of 15 ohms in series with the filament of the tube. It may then be connected in parallel with other 5-volt tubes, operating from a common rheostat. If placed in the negative lead a tap at 10 ohms will provide −1.3 volts bias for the control grid.

Modern Dry-Cell Tubes.

Within the past year, the announcement of new type dry-cell tubes for economical operation in localities not served with commercial electric service has done much to revive the battery-operated receiver. Many of the commercial manufacturers have developed receivers for this market and their schematics are included in this manual.

'30.

GENERAL PURPOSE TUBE

The '30 is a new general purpose tube designed to operate in battery receivers where economy of filament consumption is important. It may be used as a detector or ampliner and has an appearance similar to the '99, but has electrical characteristics which are considerably better. By using the '30 with the '31 (power tube) and '32 (screen-grid tube) it is possible to construct a modern radio receiver having screen-grid R.F. amplification and a power output stage.

CIRCUIT RECOMMENDATIONS

AS AN R.F. AMPLIFIER

The '30 may be used in circuits of conventional design, as a radio frequency amplifier in which case the grid and plate circuit return should be completed through correct batteries to the negative filament terminal of the tube. It is also possible to reduce the plate voltage to 67.5 volts and the grid bias to −3.0 volts and still secure proper amplification.

It is not recommended that a rheostat be used as a volume control unless provision is made that the highest voltage applied to the filament is never above 2.2 volts.

AS A DETECTOR

When used as a detector with grid leak and condenser, the plate voltage should not be higher than 45 and the grid return should be connected to the positive side of the filament. The grid condenser should have a capacitance of .00025-mf. and the grid leak a resistance of from ¼ to 5 megohms. The higher the value of grid leak, the greater will be the sensitivity on very weak signals, but the fidelity will be somewhat inferior to that obtained with the lower value.

The grid bias method of detection is recommended where better quality and selectivity are desired at the expense of sensitivity. The following table gives the approximate grid voltages to be used for a number of different plate voltages. Plate voltages above 90 volts should only be used when operating as a bias detector at the grid bias recommended below. The values of Ep are actual plate-filament voltages. The "B" battery voltage is higher by the drop in the plate resistance if resistance coupling is used.

Ep	Eg
90	−10.5
135	−15.0
165	−18.0

AS AN A.F. AMPLIFIER

As in R.F. amplification, the grid return should be connected to the negative filament terminal, when the '30 is used as an A.F. amplifier. With resistance coupling, the grid resistance should not be greater than 2 megohms.

OPERATING CONDITIONS

Filament Voltage	2.0 volts
Filament Current	0.06-ampere
Plate Voltage (maximum)	90 volts
Grid Bias Voltage	−4.5 volts

AVERAGE CHARACTERISTICS

Amplification Factor	9.3
Mutual Conductance	700 micromhos
Plate Resistance	13000 ohms
Plate Current	1.8 milliamperes
Maximum Undistorted Power Output	16 milliwatts
Grid-Plate Capacitance	6.0 mmf.
Grid-Filament Capacitance	3.5 mmf.
Plate-Filament Capacitance	2.0 mmf.

AVERAGE CHARACTERISTIC CURVES

Filament Characteristics—Fig. 101 shows the change of filament current with various filament voltages.

Grid Characteristics—Fig. 102 shows the relation between grid current and voltage.

Plate Characteristics—Fig. 103 shows a family of plate voltage—plate current curves at various grid bias voltages.

Mutual Characteristics—Fig. 105 shows a family of grid voltage—plate current curves for various plate voltages.

Dynamic Characteristics—Fig. 104 shows the effect of plate current upon the amplification factor, mutual conductance and plate resistance.

Detector Characteristics—Fig. 106 shows the relation between the radio frequency input and the audio frequency output, for several percentages of modulation.

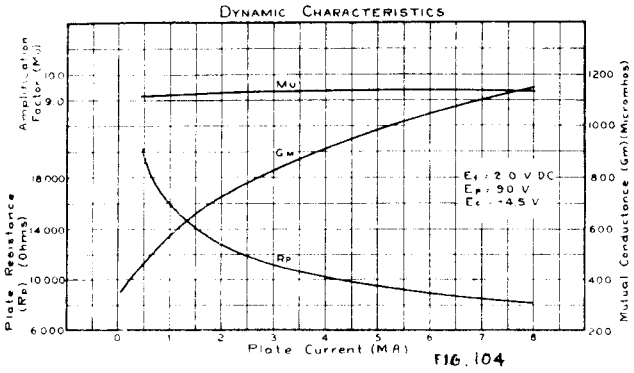


FIG. 104

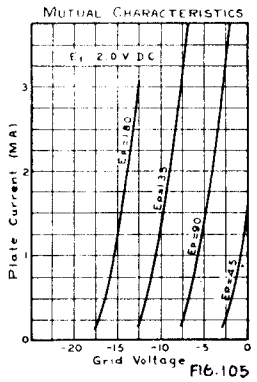


FIG. 105

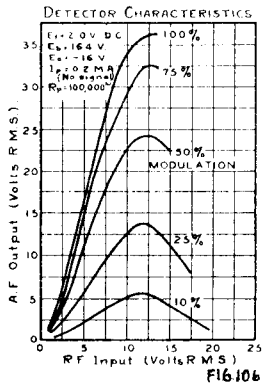


FIG. 106

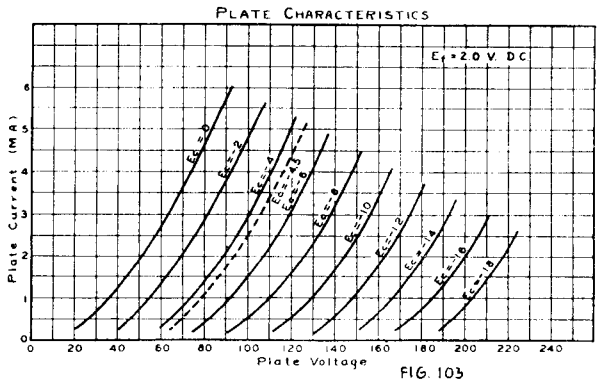


FIG. 103

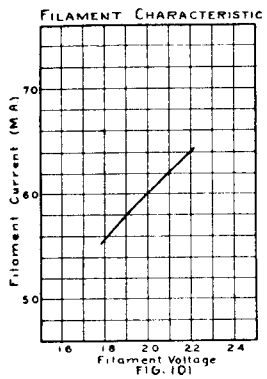


FIG. 101

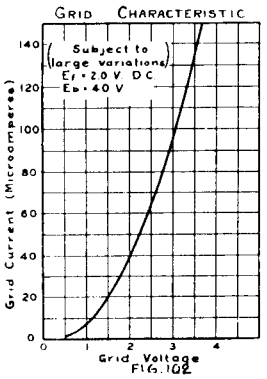


FIG. 102

'31.

POWER AMPLIFIER

The '31 is a new power amplifier tube designed to give good output volume from battery operated receivers where economy of filament consumption is important. It is the power output member of the "Two Volt Line" which has been developed for economical battery operation. The other tubes in this line are the '30 (general purpose tube) and the '32 (screen-grid tube). By employing these three types of tubes, it is possible to construct a modern radio receiver employing screen-grid tubes for R.F. amplification, general purpose tubes for detection and first audio amplification, and this special tube for power output purposes.

The power output of '31 is 150 milliwatts, which is probably sufficient for loud-speaker operation in portable sets, but where additional loud-speaker volume is required two of these tubes may be used in push-pull to give sufficient volume for ordinary home reception when an efficient loud-speaker is used.

FILAMENT

The '31 has a coated type filament which operates at a normal voltage of 2 volts and a current of 130 milliamperes.

AVERAGE CHARACTERISTICS

Amplification Factor	9.3
Mutual Conductance	700 micromhos
Plate Resistance	13000 ohms
Plate Current	1.8 milliamperes
Maximum Undistorted Power Output	16 milliwatts
Grid-Plate Capacitance	6.0 mmf.
Grid-Filament Capacitance	3.5 mmf.
Plate-Filament Capacitance	2.0 mmf.

AVERAGE CHARACTERISTIC CURVES

Filament Characteristics—Fig. 107 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 109 shows the relation between plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 108 shows a family of grid voltage—plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 110 shows the effect of plate current upon the amplification factor, mutual conductance and plate resistance.

Output Characteristics—Fig. 111 shows the undistorted power output obtainable at various load resistances.

'32.

SCREEN-GRID TUBE

The '32 is a new screen-grid tube designed for use as a radio frequency amplifier or detector in battery operated receivers where economy of filament consumption is important. This tube, used with the others of the new "Two Volt Filament" type, makes possible the construction of a most modern type of receiver operating with much greater economy than has heretofore been possible when using batteries.

The amplification factor of the '32 is 580 and the control grid to plate capacity is 0.020-mmf. This high amplification factor and low control grid to plate capacitance makes possible a high voltage amplification per stage.

Filament

The '32 has a coated filament which operates at a normal voltage of 2.0 volts and a current of 60 milliamperes. The filament should be operated in accordance with the data specified.

Plate Characteristics—Fig. 103 shows a family of plate voltage—plate current curves at various grid bias voltages.

Mutual Characteristics—Fig. 105 shows a family of grid voltage—plate current curves for various plate voltages.

Dynamic Characteristics—Fig. 104 shows the effect of plate current upon the amplification factor, mutual conductance and plate resistance.

Detector Characteristics—Fig. 106 shows the relation between the radio frequency input and the audio frequency output, for several percentages of modulation.

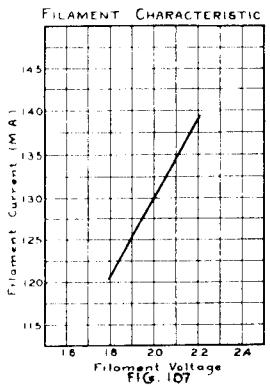


FIG. 107

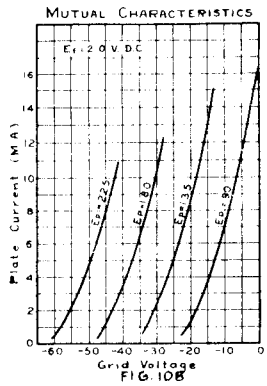


FIG. 105

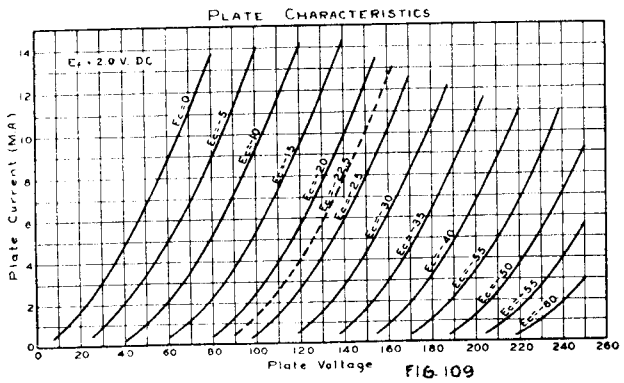


FIG. 109

'31.

Power Amplifier

The '31 is a new power amplifier tube designed to give good output volume from battery operated receivers where economy of filament consumption is important. It is the power output member of the "Two Volt Line" which has been developed for economical battery operation. The other tubes in this line are the '30 (general purpose tube) and the '32 (screen-grid tube). By employing these three types of tubes, it is possible to construct a modern radio receiver employing screen-grid tubes for R.F. amplification, general purpose tubes for detection and first audio amplification, and this special tube for power output purposes.

The power output of '31 is 150 milliwatts, which is probably sufficient for loud-speaker operation in portable sets, but where additional loud-speaker volume is required two of these tubes may be used in push-pull to give sufficient volume for ordinary home reception when an efficient loud-speaker is used.

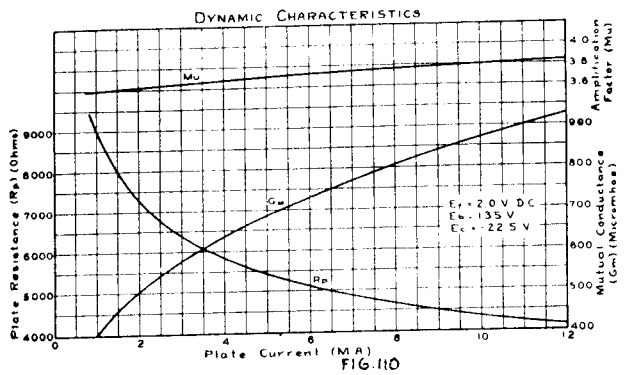


FIG. 110

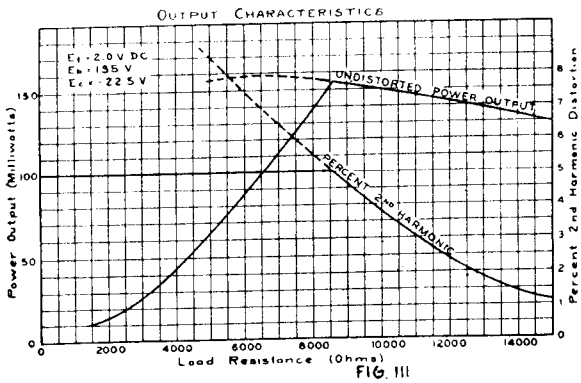


FIG. 111

Filament

The '31 has a coated type filament which operates at a normal voltage of 2 volts and a current of 130 milliamperes.

Average Characteristics

Amplification Factor	9.3
Mutual Conductance	700 micromhos
Plate Resistance	13000 ohms
Plate Current	1.8 milliamperes
Maximum Undistorted Power Output	16 milliwatts
Grid-Plate Capacitance	6.0 mmf.
Grid-Filament Capacitance	3.5 mmf.
Plate-Filament Capacitance	2.0 mmf.

Average Characteristic Curves

Filament Characteristics—Fig. 107 shows the change of filament current with various filament voltages.

Plate Characteristics—Fig. 109 shows the relation between plate current and plate voltage at various bias voltages.

Mutual Characteristics—Fig. 108 shows a family of grid voltage—plate current curves at various plate voltages.

Dynamic Characteristics—Fig. 110 shows the effect of plate current upon the amplification factor, mutual conductance and plate resistance.

Output Characteristics—Fig. 111 shows the undistorted power output obtainable at various load resistances.

'32.

Screen-Grid Tube

The '32 is a new screen-grid tube designed for use as a radio frequency amplifier or detector in battery operated receivers where economy of filament consumption is important. This tube, used with the others of the new "Two Volt Filament" type, makes possible the construction of a most modern type of receiver operating with much greater economy than has heretofore been possible when using batteries.

The amplification factor of the '32 is 580 and the control grid to plate capacity is 0.020-mmf. This high amplification factor and low control grid to plate capacitance makes possible a high voltage amplification per stage.

Filament

The '32 has a coated filament which operates at a normal voltage of 2.0 volts and a current of 60 milliamperes. The filament should be operated in accordance with the data specified.

As an R.F. Amplifier

Stable operation of this screen-grid tube in circuits designed to give maximum gain per stage, requires separation of the input and output circuit elements. Internal shielding of the screen makes neutralization of the plate to grid capacity unnecessary. However, the high amplifying ability of this tube makes it essential to prevent external coupling between circuit elements if the full capabilities of the tube are to be obtained. In general, with multi-stage amplifier circuits, it is necessary to use complete stage shielding including all the components of each stage. It is particularly necessary to shield the control-grid circuit from the plate circuit.

The use of filters in all leads entering the stage shields may be necessary in high gain amplifiers to reduce coupling in external parts of the circuits. In the construction of filters for the screen circuit, a by-pass condenser should be provided to keep the impedance from screen to ground as low as possible.

In general, properly designed radio frequency transformers are preferable to impedances for inter-stage coupling. If, however, impedance coupling is used, the grid resistance should not exceed 2.0 megohms.

As a Detector

The '32 may be used as a detector providing the audio amplification is comparatively low in order to prevent microphonic disturbances. The audio gain permissible depends on the type of cabinet, speaker design, and power output capabilities of the power output tubes. In any circuit a cushion type socket is recommended. The following operating conditions are suggested:

Plate Load Resistor	100000	100000
Screen-Grid Voltage	67.5	45
Control Grid Bias Voltage	−6	−4.0

The Plate Battery Supply Voltage may be either 135 or 157.5 volts.

In addition to its recommended application as a screen-grid-radio-frequency amplifier, this new tube may be employed in experimental circuits wherever a double grid, four-electrode tube is desired.

In circuits designed for the '22, the '32 may be substituted providing the filament and grid circuit voltages are altered to conform to the requirements of this new tube. A typical circuit diagram using the '32 as an R.F. amplifier is shown in Fig. 119.

Operating Conditions

Filament Voltage	2.0 volts
Filament Current	0.06-ampere
Plate Voltage	135 volts
Control Grid Voltage	−3 volts
Screen-Grid Voltage	67.5 volts

Average Characteristics

Amplification Factor	580
Mutual Conductance	505 micromhos
Plate Resistance	1150000 ohms
Plate Current	1.4 milliamperes
Grid-Plate Capacitance	0.020-mmf.
Input Capacitance	6.0 mmf.
Output Capacitance	11.0 mmf.

Average Characteristic Curves

Filament Characteristics—Fig. 112 shows the change of filament current with various filament voltages.

Inter-Electrode Characteristics—Figs. 113, 114

and 115 show the relations existing between the plate, control grid and screen-grid by means of the following curves:

Plate Voltage—Plate Current	Fig. 114
Plate Voltage—Screen Grid Current	Fig. 114
Control Grid Voltage—Plate Current	Fig. 113
Control Grid Voltage—Screen-Grid Current	Fig. 113
Screen-Grid Voltage—Plate Current	Fig. 115
Screen-Grid Voltage—Screen-Grid Current	Fig. 115

Dynamic Characteristics—Figs. 117 and 118 show the effect of control grid and screen-grid voltage (respectively) upon the amplification factor, mutual conductance and plate resistance of the '32.

Detection Characteristics—Fig. 116 shows the relation between the radio frequency input and the audio frequency output, for several percentages of modulation.

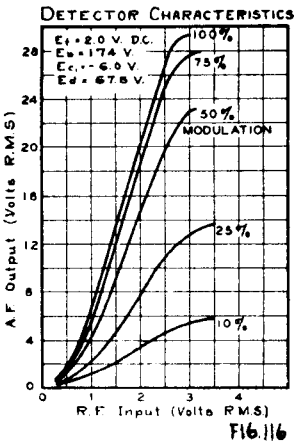


FIG. 116

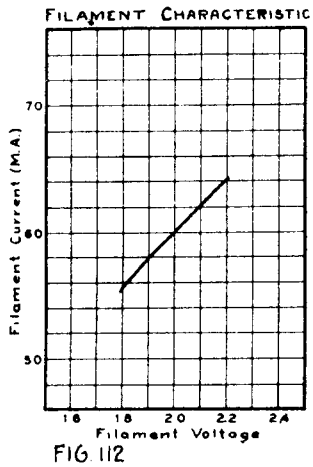


FIG. 112

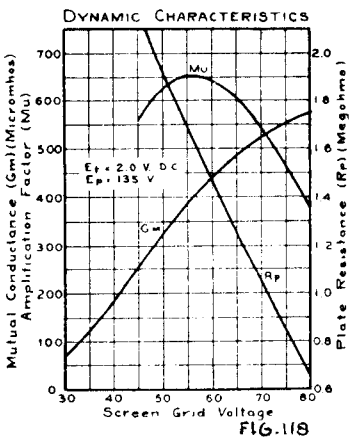


FIG. 118

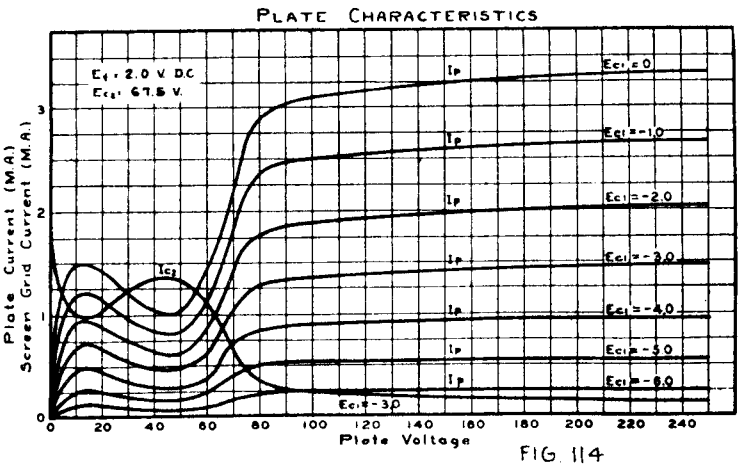


FIG. 114

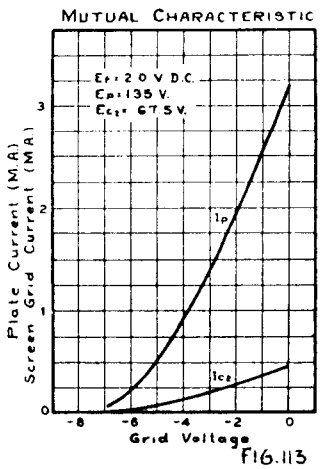


FIG. 113

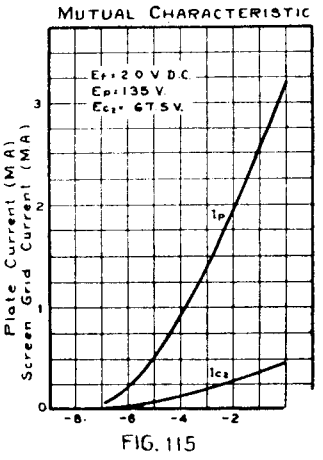


FIG. 115

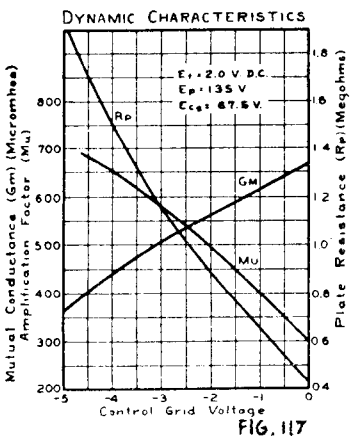
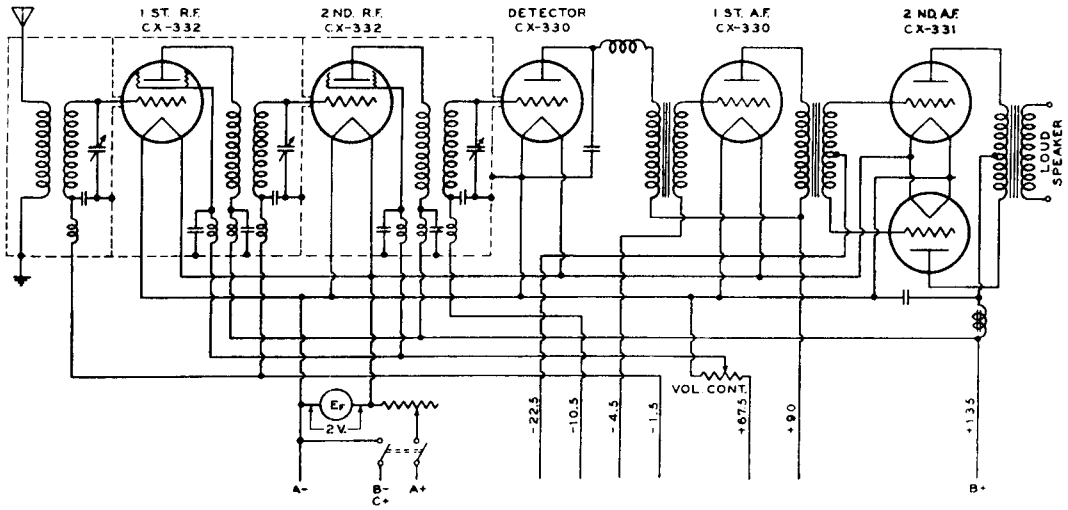


FIG. 117



Typical Circuit Using CX-330, CX-331, and CX-332 Two Volt Filament Tubes
FIG. 119

Alternating Current Tubes.

The tubes mentioned up to this point are suitable for use with batteries, as in no case do the power demands exceed the limits of the standard types of storage "A" batteries or the usual "B" batteries. With the exception of the special purpose tubes mentioned in the latter portion of this section, the tubes to follow place such demands upon the power supply equipment as to render the use of batteries uneconomical except in special services where peculiar situations demand their use.

'X-'26.

The '26 tube was originally designed for use in conjunction with the '27 in circuits where the latter was employed as the detector and special output tubes in the output stage. Recent developments have made the '26 obsolete—foremost among them being the cheapening of the '27 which was originally too high in price to be economical for use throughout a multi-tube receiver.

The '26 has an exceptionally sturdy filament which has a high degree of thermal inertia—which means, as has been explained before, that the cooling is so slow as not to follow the variations in applied voltage due to the alternating current cycle. Except for the fact that the filament draws a high current at a relatively low voltage, the tube does not differ materially from the ordinary three-element tube. Because of the extreme sensitivity of detector circuits to the effects of hum, the tube was never employed in detector circuits.

When used as an amplifier, the grid return is, in most cases, made to ground and the grid bias obtained by making the filament positive with respect to the grid by inserting a resistance of the required value between the center tap of the filament winding and ground. This gives the grid a bias equal to the voltage drop through the biasing resistance due to the total plate current flowing through it. It is essential that the center tap of the transformer, or of its shunting resistance, be accurate if no hum is to result. In most of the original A.C. receivers, this center tap was adjustable.

Operating Conditions

Filament Volts	1.5		
Filament Amperes	1.05		
Plate Volts	90	135	180
Grid Voltage	6.0	-9.0	-13.5

Average Tube Characteristics

Plate Voltage	90	135	180
Grid Voltage	-6.0	-9.0	-13.5
C Bias Resistor	1700	1500	1800 ohms
Amplification Factor	8.2	8.2	8.2
Plate Resistance	8600	7200	7000 ohms
Mutual Conductance	955	1135	1170 micromhos
Plate Current	3.8	6.3	7.4 milliamperes
Undistorted Output	30	80	180 milliwatts

The higher plate voltages are recommended only where the signal input to a particular stage might be large enough to cause overloading or a flow of gold current.

Use As An Amplifier

Operation as an amplifier for either A.F. or R.F. is essentially the same as for the '01A. The electrical characteristics are substantially the same and ordinarily do not require any changes in the characteristics of the A.F. and R.F. transformers as previously employed with the '01A. Grid and plate return leads should be connected to the movable arm of a low resistance potentiometer connected across the filament, and in operation this arm should be adjusted for minimum hum.

The '26 cannot be used satisfactorily as a bias detector when operated from alternating currents as the hum present under such conditions is objectionable.

Curves and Diagrams

The variation of filament current with filament voltage is shown in Fig. 120.

The relation between plate current and plate voltage at several values of bias is shown in Fig. 121 From this curve it is possible to determine approximately the plate current under given conditions of grid and plate voltage.

Fig. 122 shows the variation of plate current with grid voltage for various values of plate voltage.

The effect of plate voltage upon amplification factor, plate resistance and mutual conductance at various grid bias voltages is shown in Fig. 123.

'1-'27.

The '27 was originally intended for use as a detector in conjunction with the '26 and one of the power output tubes described here. As production of the tube increased, the list price of the tube fell and it became possible to use the tube throughout receivers. A considerable gain in sensitivity and in lack of hum resulted, as the '27 is of the indirect heater type in which the alternating current used in heating the cathode does not flow directly in the cathode circuit, but is insulated therefrom by a small ceramic sleeve which readily transmits the heat to the cathode proper.

The original indirect heater tubes required some thirty or forty seconds to reach their operating temperature and some annoyance was experienced because of the delay. Judicious cutting down of the material insulating the heater from the cathode and improvement of its thermal characteristics has resulted in considerable improvement in this time lag, and the present tubes heat up to their operating temperature in from five to six seconds.

Although the heater is rated at 2.5 volts at 1.75 amperes, it may be operated at considerably lower voltages as the maximum electron emission obtains at a filament voltage of about 1.9. Although perfect operation is achieved with this low voltage, the heating time is considerably increased. It will be noted in many receivers that the '27 is operated at some voltage between 1.9 and 2.5.

It is essential that the tube should not be operated at a voltage higher than 2.6 as the intense heat generated will, after a short period of operation, be

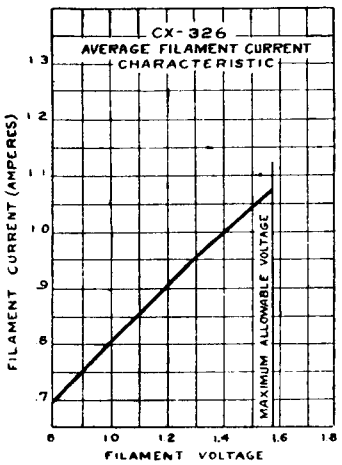


FIG. 120

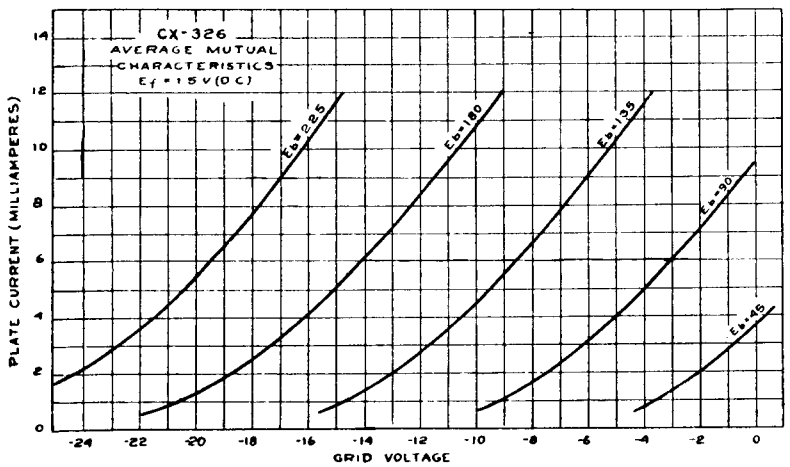


FIG. 122

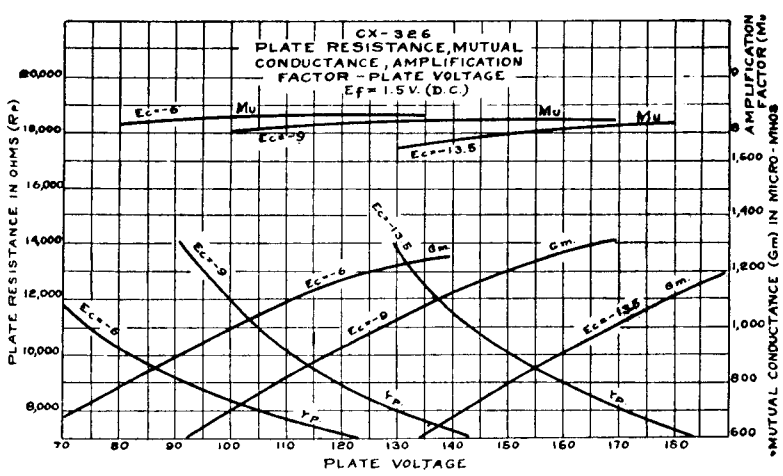


FIG. 123

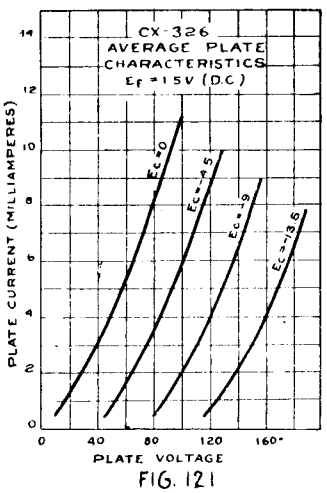


FIG. 121

sufficient to make the grid emit electrons—this is termed *grid emission* and is ruinous to reception. If you should, in the course of your travels, find a receiver which works well when first switched on but gradually loses volume, it is highly probable that the heater voltage is too high and that grid emission is taking place.

Before leaving the subject of the '27 cathode it should be noted that some of these tubes are found with thermostatic open circuits. That is to say, that while the tube is operating at a low temperature as when first switched on, there will be no trouble indicated, but as the temperature within the tube increases, expansion of the elements will cause an open circuit which will cut out the signal entirely until the tube cools off to a low enough temperature for contraction of the elements to complete the circuit again. This intermittent operation is easily recognized when met and a knowledge of the fact that such a condition may possibly exist is all that is needed to cure the fault.

Operation of the '27 as an audio frequency or radio frequency amplifier is described in the Data Chart. It may also be operated as a grid circuit detector with a plate voltage of 45 and a grid condenser and leak of .00025-mf. and 2 megohms, respectively. Operation as a "bias" detector requires the use of a biasing resistor of from 20,000 to 100,000 ohms in series with the cathode circuit. The higher the value of this resistance, the greater will be the allowable signal on the grid before distortion occurs. The tube may be operated as a power grid detector with 180 volts on the plate, and a grid condenser and leak of .0001-mf. and 100,000 ohms, respectively. This last type of operation gives the greatest freedom from distortion of all types of detectors.

Grid bias is obtained by inserting a by-passed resistance in series with the cathodes so that the plate current flowing through the resistance will create a voltage drop sufficient to place the cathode at the required potential positive with respect to ground. In such case, the grid return is brought directly to ground.

Although it is not recommended, the '27 may be used as a power output tube in cases where no large degree of volume is demanded. In this mode of operation the plate voltage is 180 and the grid bias —13.5 volts.

The '27 may not be operated as a radio frequency amplifier unless measures are taken either to prevent oscillation by the so-called "losser" methods or by some system of balancing out the inter-electrode capacity of the tube.

Although the center tap of the heater winding of the power transformer is normally grounded, there are cases where the heaters are on the same winding as the '45 output tubes and are at the same potential as the '45 filaments—about 50 volts positive with respect to ground. This should be taken into account when making measurements on the '27 circuits. In cases of obstinate hum, a cure may at times be effected by deliberately making the heaters positive with respect to the cathodes by returning their center tap to some point on the voltage divider rather than directly to ground.

Operating Conditions

	Detection		Amplification
Plate Volts	Grid Leak (Megs)	Grid Bias (Volts)	Grid Bias (Volts)
45	2	-5.0	
90		-10.0	-.60
135		-15.0	-9.0
180		-20.0	-13.5

Curves and Diagrams

Fig. 124 shows the variation of filament current with filament voltage.

Fig. 125 shows the variation of plate current with plate voltage for various values of bias voltage.

Fig. 126 shows the variation of plate current with grid voltage for various values of plate voltage.

Fig. 127 shows the variation of amplification factor, plate resistance and mutual conductance with grid voltage for various values of plate voltage.

Fig. 128 shows the detector action as a grid leak detector with plate voltage of 45 volts, 2-meg grid leak and for 22% modulations.

Fig. 129 shows the detector action of the '27 operating as a bias detector under various voltage conditions, with a plate load of 200,000 ohms and 22% modulation. The star marked on each curve indicates the point at which grid current begins to flow.

'Y-'24.

The '24 is a screen-grid tube with the same heater-cathode structure as the '27. The other elements are so proportioned as to have a definite gain over the structure of the '22 in so far as possible amplification is concerned. The control grid is brought out through the cap and the screen-grid is connected to the terminal provided for the grid in the case of the '27.

Operating Conditions

Heater voltage	2.5	2.5 volts
Heater current	1.75	1.75 amperes
Plate voltage	180	180 volts maximum
Control grid voltage	-1.5	-3.0 volts maximum
Screen-grid voltage	75	90 volts maximum

Average Tube Characteristics

Tube characteristics at above operating conditions

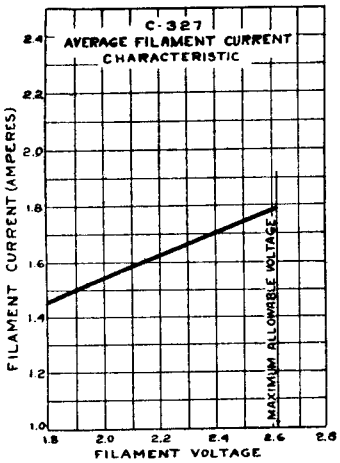


FIG. 124

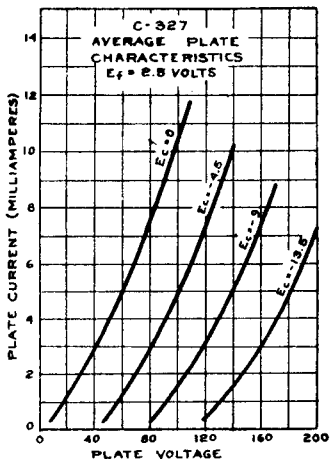


FIG. 125

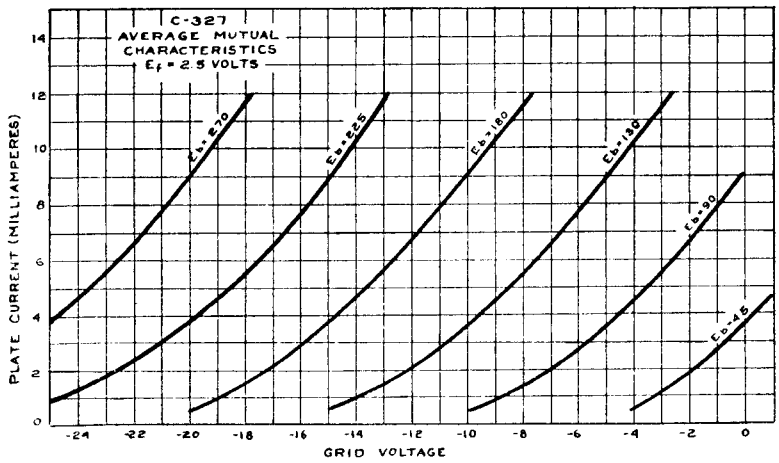


FIG. 126

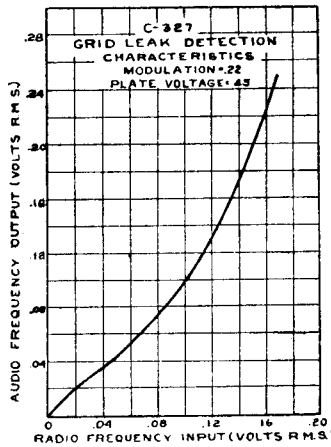


FIG. 128

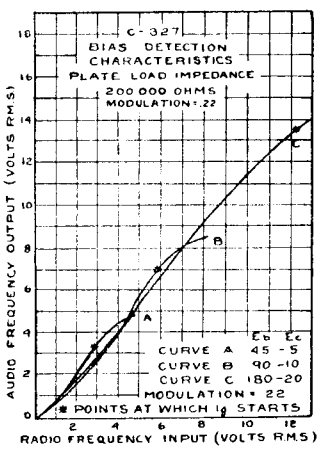


FIG. 129

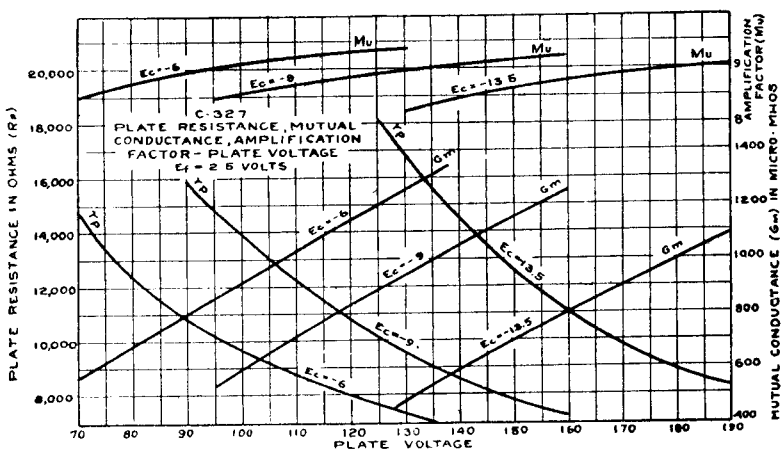


FIG. 127

Amplification factor	420	400
Plate resistance	400,000	400,000 ohms
Mutual conductance	1,050	1,000 micromhos
Plate current	4.0	4.0 milliamperes

Use as a Radio Frequency Amplifier

In order to obtain stable operation in circuits designed to give normal gain per stage, it is necessary to use shielding to separate the input and output circuits. The internal shielding of the tube makes neutralization unnecessary, providing extraneous external couplings are eliminated by means of shielding. Suitable ventilation must be provided through the shielding to prevent excessive tube temperatures. Radio frequency filters should be used in circuits employing more than two stages and also in circuits which are designed to give the maximum amplification per stage. The high plate circuit impedance necessary for obtaining the normal amplification may be obtained either with closely coupled R.F. transformers or by means of the tuned plate impedance method. At broadcast frequencies, a voltage amplification from 50 to 100 per stage can be obtained. To prevent regeneration or oscillation in a two-stage radio frequency amplifier, the amplification should not exceed 100 per stage at the highest broadcast frequencies.

The volume of the R.F. amplifier may be controlled by a potentiometer control on the screen-grid voltage so that the screen-grid voltage may be varied between zero and plus 75 volts. Control grid voltage adjustment may also be used as volume control providing the control grid bias is always greater than 1.5 volts negative. The negative grid bias maintains high input resistance, resulting in good gain and selectivity of the preceding circuit.

Use as a Detector

The '24 is an excellent bias detector either with small signal or high signal input. The screen-grid voltage and control grid bias should be so chosen that the control grid does not swing to a point where grid current is drawn. For small R.F. signals when a first audio stage is used, it is best to operate the screen-grid at 35 or 45 volts and the control grid at minus 3.5 or 4.5 volts, respectively. The output under this condition into a 200,000-ohm load choke fed with one volt R.M.S. radio frequency input modulated 22%, is 5.5 volts R.M.S. audio output. With 75 volts on the screen-grid and a control grid bias voltage of 7.5 volts, the audio output at the point where grid current starts is 49.5 R.M.S. audio voltage output with an input of 4.28 volts R.M.S. with 22% modulation. This is more than sufficient to operate a '45 to full output by means of direct coupling; or two '45 tubes in push-pull by means of a low gain audio stage.

Curves and Data

Fig. 130 shows the filament current and emission variation with filament voltage.

Fig. 131 shows the average plate current over a range of screen-grid voltages at various control grid voltages. A curve also of the screen-grid current is plotted for the control grid voltage of negative 1.5 volts.

Fig. 132 shows the variation of amplification factor, plate resistance, and mutual conductance for various control grid voltages at screen-grid voltages of 75 volts and plate voltage of 180 volts.

Fig. 133 shows the variation of amplification factor, plate resistance, and mutual conductance with various screen-grid voltages at a control voltage of minus 1.5 volts and plate voltage of 180 volts.

Fig. 134 shows the variation of plate current with plate voltage for various control grid voltages at screen-grid voltage of plus 75 volts.

Fig. 135 is similar to Fig. 134 except it has been plotted with a screen-grid voltage of plus 45 volts.

Fig. 136 shows the detector action in audio frequency volts output against radio frequency input, both measured in R.M.S. volts. The point where grid current starts to flow is noted on each curve. Curve A was taken at a plate voltage of 180 volts, a screen voltage of plus 45 volts and a control grid voltage of minus 4.5 volts. The plate voltage was fed through a high impedance choke and the resistance load so chosen to give a total plate circuit impedance of 200,000 ohms with a power factor of .96. The D.C. resistance of the choke was 3,000 ohms. Curve B was taken with the same circuit at a screen-grid voltage of plus 75 volts and control grid voltage of minus 7.5 volts.

While the high impedance tube is inherently possible of greater selectivity than the three-element tube, there are certain characteristics peculiar to the tube which make the apparent selectivity less. These are the effects of *cross-modulation* or "cross-talk" and of *beat interference.*

Because of its high amplification, the screen-grid tube is subject to the effects of cross-modulation as it requires but a slightly higher applied voltage on the grid of the tube to cause it to operate in the region favorable to detection. It will be noted from the preceding data, that the bias required for detection is but 4.5 volts. The voltage developed across the grid circuit of the first tube by a strong local signal is often sufficient to operate the tube as a detector even though the circuits are tuned to some frequency greatly removed from the interfering signal. Variations in the intensity of the interfering signal serve to modulate the desired signal accordingly, and the signal to which we are tuned is doubly modulated—once by its own modulation, and once by that of the interfering signal. Once this *cross-modulation* takes place, no amount of selectivity in the succeeding cir-

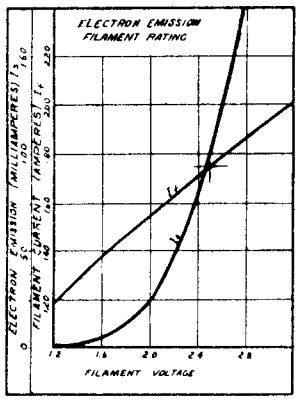


FIG. 130

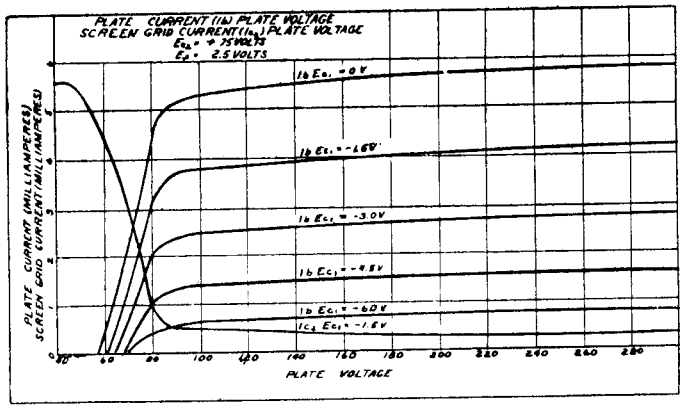


FIG. 134

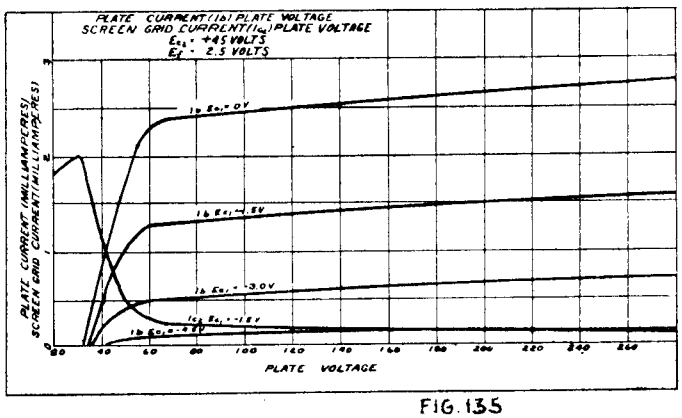


FIG. 135

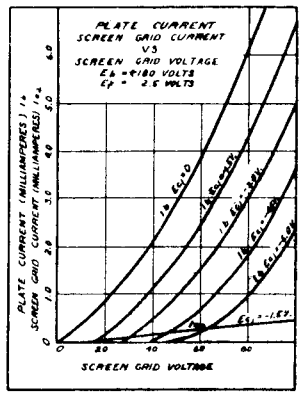


FIG. 131

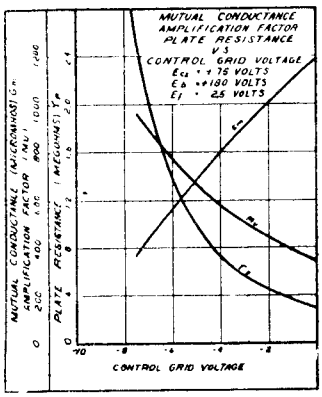


FIG. 132

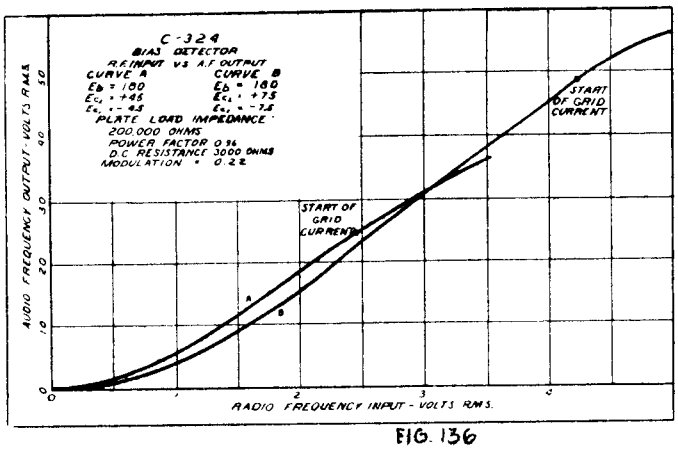


FIG. 136

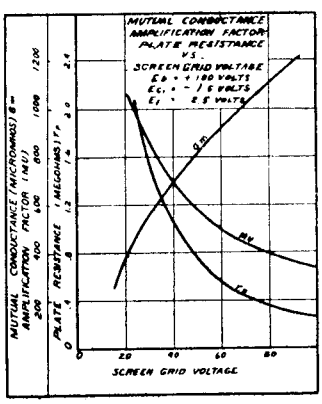


FIG. 133

cuits will serve to rid us of it as it is actually impressed upon the desired signal. To avoid this, it is now standard practice to employ "band-selector" or coupled circuit systems between the antenna and the first tube; these are an absolute necessity to successful operation of the screen-grid tube.

If two such local signals are impressed upon the grid of the first tube they will create *beats*, or secondary signals, having frequencies equal to the sum and difference of the two original signals. Thus, two signals at 550 and 900 kc. will produce beats at 350 and 1450 kc., the latter of which will appear in the receiver as a signal modulated by the modulations of both the original signals intermingled. It may readily

be seen that every precaution must be taken to prevent the appearance of strong locals across the input circuit of the first tube, and the use of at least two tuned circuits between the antenna and the first grid are necessary. The effects noted obtain only when the local signals are of sufficient intensity to operate the tube on a portion of its characteristic curve favorable to detection. The effects are not noticeable to a great degree with tubes other than the '22 or '24.

POWER OUTPUT TUBES

It has been fairly obvious throughout the previous discussion that the vacuum tube is a voltage operated device. Little or no power is consumed in the grid circuit of a vacuum tube and the sole purpose of the R.F. and A.F. amplifiers is to obtain the largest possible voltage output.

The loud speaker, however, is a power-consuming device and the purpose of the output tube, or last tube in the chain, is to provide the greatest power possible for the operation of the speaker. It is, of course, essential that the power supplied be free from distortion in as great a degree as possible and, as we noted in the definitions, the maximum undistorted power output is obtained when the load impedance is twice the output impedance of the tube except in the case of pentodes. The impedance of the tube is practically invariable over the range of frequencies employed but the impedance of the speaker is a variable factor and it is usual to take the speaker impedance at 200 cycles as the criterion in design. This may vary from about 5000 ohms in the case of the magnetic speaker to 15 ohms in the case of the dynamic type.

It is necessary that a transformer be used to match the impedance of the tube to that of the speaker, and the formula for obtaining a condition where the load of a power tube will be twice its own impedance is as follows:

$$T = \sqrt{\frac{2R_P}{R_S}}$$

Where T is the turns ratio of the transformer, Rp the tube impedance, and R1 the impedance of the loud-speaker winding at 200 cycles.

As an example let us assume that we desire to match the impedance of a '71A tube to a speaker having an impedance of 15 ohms. The impedance of the tube is 1850 ohms. Then by the formula

$$T = \sqrt{\frac{3,700}{15}}$$

=approximately 15.7

Where two tubes are in push-pull, the total tube impedance is double that of a single tube and the turns ratio of the transformer would be about 22.2.

The characteristics of output tubes involve relatively low plate impedance—high plate voltage and plate current and a high mutual conductance. It should be remembered that the signal voltage as measured by instruments in the grid circuit of the output tube is in R.M.S. readings, while the peak voltage is what swamps out the grid bias and permits distortion to occur by operating the tube on a curved portion of its characteristic curve. This means that we should never apply a voltage to the grid of a tube whose peak value exceeds the value of the bias.

The figures given in the Data Chart for the undistorted power output are those of the maximum obtainable with the tube without operating the tube on a curved portion of the characteristic.

It is often desirable to know what power output is obtained from a tube when the signal is not of the maximum allowable intensity. This figure may be obtained from the formula

$$P = \frac{P = 2(uEg)^2 \times 1000}{9Rp}$$

where P is the power output in milliwatts, u the amplification factor of the tube, Eg the value of the signal in R.M.S. volts, and Rp the plate impedance of the tube. Suppose that we wish to find the power output of a '71A with an input signal of 20 volts (R.M.S.) From the equation

$$P = \frac{P = 2x(60)^2\ 1000}{16630}$$

$$P = \frac{7200,000}{16630}$$

or P=432 milliwatts

There are certain advantages incident to the operation of tubes in push-pull which are not generally understood. In the first place the D.C. forces in the output transformer cancel out and permit of considerable economy of design and improved quality.

Secondly, no signal voltages are flowing in either the plate voltage circuit or in the grid biasing circuit. For this reason there is no necessity for by-passing in either circuit.

We might leave the discussion of the push-pull circuit here, while its advantages are fresh in our minds, to note that the biasing of power tubes should be such that normally no change in the plate current takes place under the influence of an applied signal. A fluctuation in plate current when a signal is present indicates overloading of the tube.

By-passing of the biasing resistances in all amplifier tubes should be sufficient to effectively short-circuit the bias resistance so far as all low frequencies are

concerned. In the case of the '71A, it is possible that the response is desired perfect as low as 50 cycles. With a biasing resistance of 2150 ohms, this means that a condenser of at least 15 microfarads would be necessary to effectively short-circuit the biasing resistance. This is on the basis of a condenser reactance of 212 ohms at 50 cycles. Otherwise, a signal exactly out of step with the input would appear across the biasing resistance in opposition to the input signal which would "buck out" the incoming low frequency signals.

'X-'10.

The '10 is a power output tube of relatively high impedance for use in A.C. receivers and low power transmitters. Its characteristics are fully described in the Data Chart. Subsequently released tubes, because of their improved power efficiency, have rendered the 10 somewhat obsolete.

RATING

Filament Volts	7.5
Filament Amperes	1.25
Type	Thoriated Tungsten

AVERAGE CHARACTERISTICS

Plate Voltage	425 volts
Plate Current	.018-ampere
Amplification Factor	8
Plate Resistance	5000 ohms
Mutual Conductance	1600 micromhos
Control Grid Voltage	35 volts
Load Impedance in ohms	10000
Output (5% second harmonic)	1.6 watts

'X-'45.

The '45 tube is the power output tube found in most of the modern receivers. Inasmuch as its undistorted power output of 4.5 watts, when two tubes are connected in push-pull, is sufficient to fill a good-sized auditorium, there is little reason why a larger tube should be desired in the average radio receiver. The characteristics of the '45 are such as to make it useless in positions other than in the output, although in certain power amplifiers requiring a large signal at the output, the '45 has been used as an intermediate A.F. stage. The filament is to be operated at not more than 5% above or below its normal rating. Operation of the tube without grid bias will result in the destruction of the filament due to the heavy current drawn. The biasing resistance with 250 volts on the plate is 1470 ohms, and with 180 volts is 1380 ohms. Total plate voltage required in the first case is 300 volts, and in the second, 214.5 volts. When connected with the bias obtained by the drop due to the plate current flowing through a resistance, the arrangement will effectively compensate for minor changes in line voltage. Note that in push-pull circuits, just half the normal biasing resistance is required.

OPERATING CONDITIONS

Filament Volts	2.5	
Filament Amperes	1.5	
Plate Volts	180	250
Grid Voltage (A.C.Fila.)	34.5	-50

AVERAGE TUBE CHARACTERISTICS

Plate Voltage	180	250
Grid Voltage (A.C. Fila.)	-34.5	-50
C Bias Resistor	1380	1470 ohms
Amplification Factor	3.5	3.5
Plate Resistance	1900	1750 ohms
Mutual Conductance	1850	2000 micromhos
Plate Current	27	34 milliamperes
Undistorted Output	780	1600 milliwatts

The curve of Fig. 137 shows the average filament current of type '45.

Fig. 138 gives the average plate current over a range of plate voltages at zero grid bias.

Fig. 139 shows the amplification factor (Mu), plate resistance (rp), and mutual conductance (Gm), plotted in relation to grid voltage at plate voltage of 180 volts.

Fig. 140 shows the amplification factor (Mu), plate resistance (rp), and mutual conductance (Gm), plotted in relation to grid voltage at plate voltage of 250 volts.

Many times it is convenient to know the tube characteristics when the plate current only is known at an approximate value of plate voltage. For this reason we have included Fig. 141 which shows the various characteristics plotted against plate current. At the normal operating current, there is little difference between the various values, but at the lower plate currents the variations are somewhat greater.

Fig. 142 shows the family of plate current—plate voltage curves which are useful in calculating power output and determining the proper "C" battery voltages for definite plate currents. If A.C. filament operation is used, add 1.5 volts to the grid bias values given on the curves.

'X-'50.

The '50 tube is employed either singly or in push-pull in many of the receivers now in use. The remarks passed regarding the '45 apply in full to the '50. It is essential that the resistance in the grid circuit of the tube be kept low to avoid decrease in bias due to the flow of grid current as the tube is not

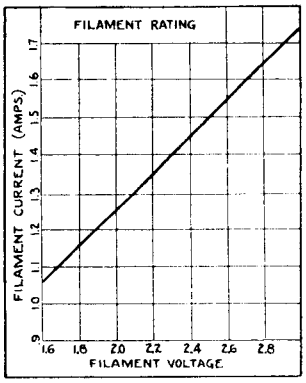


FIG. 137

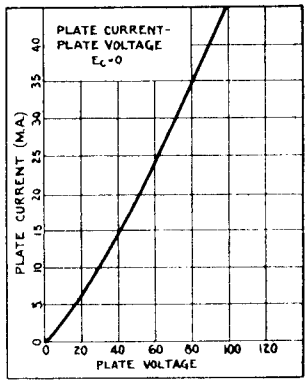


FIG. 138

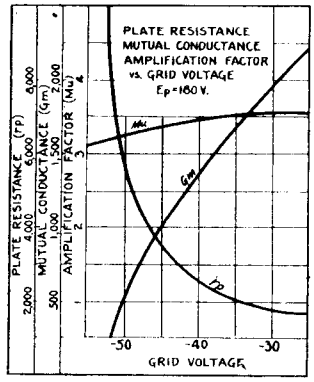


FIG. 139

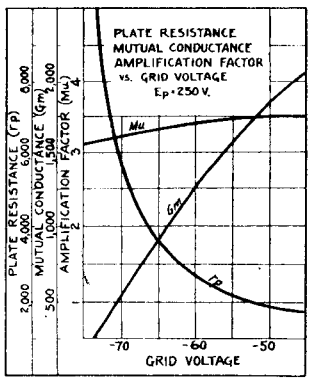


FIG. 140

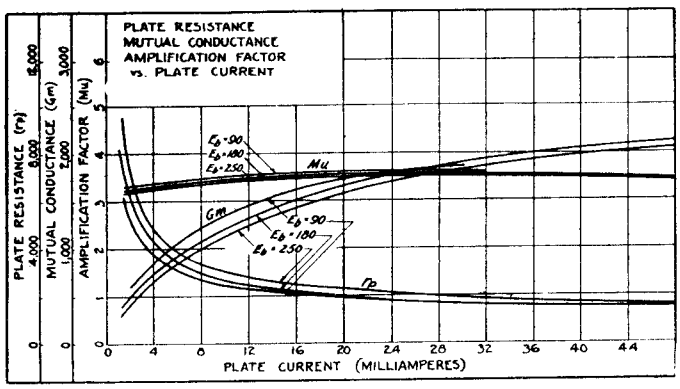


FIG. 141

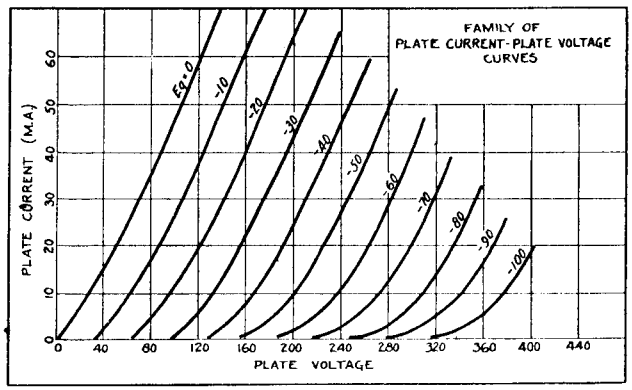


FIG. 142

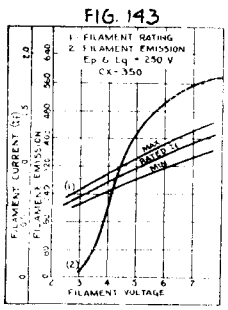


FIG. 143

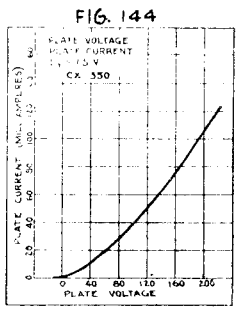


FIG. 144

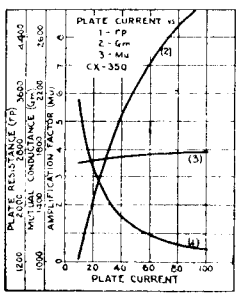


FIG. 145

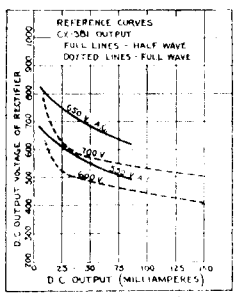


FIG. 146

entirely free from gas. This makes the use of the tube as a resistance coupled amplifier impossible unless it succeeds a tube of low plate impedance such as the '45. In this case a grid resistance of sufficiently low value may be employed without seriously affecting the gain of the preceding tube.

The life of the '50 is seriously limited by operation at its maximum plate voltage and this is not usually done except where large output is the paramount consideration. Biasing resistances and total voltages required for operation at various plate voltages follow:

Plate Voltage	Bias Resistance	Total Voltage
250	1600	295
350	1400	413
400	1300	470
450	1550	534

Resistance values are halved where two tubes are operated in parallel or in push-pull at the voltages specified.

Operating Conditions

Filament Volts	7.5
Filament Amperes	1.25
Plate Volts (Max.)	450.
Plate Current (Max.)	55 ma.
Grid Volts	See Table

Average Tube Characteristic

Plate Volts	Grid Bias	Mu	Plate Resis.	Mut. Cond.	Plate Ma.	Bias Resistor Ohms	Undis. Power O'put Mw.
250	-45	3.8	2100	1800	28	1600	1000
350	-63	3.8	1900	2000	45	1400	2400
400	-70	3.8	1800	2100	55	1300	3400
450	-84	3.8	1800	2100	55	1550	4600

Use

Maximum life is obtained from the '50 when the tube is used at conservative plate voltages. Voltages between 250 and 400 volts are recommended, and the voltage must not exceed a maximum value of 450 volts. When the tube is used in place of the '10 (as noted below circuit changes should be made before the tube is substituted for this type) the plate voltage need not exceed 300 volts if the power output obtainable from the '10 operated at 425 volts has proved adequate. Thus for equivalent power output a considerably lower plate voltage may be used with the '50, the total required for the tube and grid biasing voltage being 300+54, or 354 volts as compared with 425+35 or 460 volts for the '10.

The higher current required by the '50 can be conveniently supplied by an '81 rectifier (or by two such tubes with full wave connection). The average plate current required ranges from 28 ma. at 250 volts to 55 ma. at 400 volts. Since the '81 is rated at 85 ma. output (see Fig. 146) sufficient margin is available so that the same rectifier used for the '50 may also supply the plate current required by the remaining tubes in the receiver.

The grid bias must be applied at all times while the tube is in operation. If the grid circuit is opened the plate current will increase to a high value, overloading both the power tube and particularly the rectifier tube—if the current is supplied from such source—and is very apt to cause burn-out of the filament in the latter. It is very desirable to protect both by a fuse, or similar device, operating at about .1-ampere, and which should be placed in the rectifier circuit between the rectifier and the filter. It is possible to use the .1-ampere 6-volt dial lamp, type T3, which, although not designed for high voltage, will usually break the circuit.

The coated filament is not affected by traces of gas, and a slight blue glow will not impair or affect the performance of the tube provided the resistance in the grid circuit is kept low, preferably not over 10,000 ohms, to avoid a decrease in bias which may otherwise result from the flow of gas current to the grid. The tube is not intended for use in resistance coupled amplifiers.

It is desirable that the bias required by the tube be supplied from the drop across a resistor in series with the -B return. It will be found that this connection compensates almost completely for changes in plate voltage which may occur as a result of line voltage variations, as an increase in plate voltage causes a small increase in plate current which in turn raises the applied "C" bias sufficiently to compensate for the new value of plate voltage, thus maintaining the proper operating condition at all times. If a decrease in voltage occurs, the reverse action takes place. This desirable operating condition is sacrificed if a fixed "C" bias derived from a battery or other source is provided, as in such cases a decrease in plate voltage will cause a large decrease in plate current which will greatly reduce the power output obtainable from the tube, while an increase in plate voltage will overload the tube.

A low resistance output choke with a condenser, or a transformer capable of handling the heavy plate current of the '50 without saturation of the core, or overheating of the windings must be provided for this tube to prevent excessive voltage drop in the plate circuit and to protect the loud-speaker windings.

Curves and Data

The curves, Fig. 143, show the average filament current and the filament emission of type '50.

Fig. 144 gives the average plate current over a range of plate voltages, with no applied grid bias. In taking this data, the grid return was connected to the midpoint of the filament, and for this reason the plate current does not reach zero until a negative plate voltage is applied.

Fig. 145 shows the amplification factor (Mu), plate resistance (rp), and mutual conductance (Gm), plotted as a function of plate current. This method of showing tube characteristics is convenient, since a single measurement, that of plate current, suffices to determine the operating point.

Fig. 146, furnished for convenient reference, shows the voltage and current output of the '81 at various loads: The full lines show the output of a single '81

with the usual filter arrangement, while the dotted lines show the output obtained from two '81 tubes in a full-wave rectifier, using a filter in which the first filter condenser is omitted: The IR drop in the filter must be taken into consideration before this data is complete. As soon as the resistance of the filter chokes is measured the output voltage obtainable can be computed.

'40.

This tube is a high impedance tube with a high amplification factor for use in resistance coupled amplifier circuits where a filament supply of 5 volts is available. It may also be used as an R.F. amplifier in circuits specially designed for it. The tube is also a good detector under like conditions. The tube is now almost obsolete and, to the writer's knowledge, was employed in but one commercial receiver.

SPECIAL PURPOSE TUBES

'00 and '00A.

These tubes were originally intended for use as detectors in radio receivers. The first was a gassy, or poorly evacuated, type and the second was purposely filled with gas. Both are now obsolete and they will probably not be found once in ten thousand service calls. The tubes were extremely sensitive detectors but were not in the "high quality" class now so necessary. Critical voltage adjustment was their most notable requirement and you may remember the 22.5 volt "B" batteries with taps at 16 volts and on up for adjustment of the detector plate voltage. In no receiver that the writer can remember from the earliest days onward, were the full advantages of either of these tubes employed save in the case of the Garod "coffin" neutrodyne. This set was quite ordinary in performance with an '01A as detector, but with an '00 type it stepped out into the far reaches of the country when the critical adjustment was achieved. If ever you come upon one of these monster old receivers and want a real demonstration of what the "old-timers" were capable of, dig up a '00 detector, put 16 volts of "B" on it and twiddle the detector rheostat while your two helpers adjust the tuning controls. Then thank the particular "Djin" who watches over radio men for John V. L. Hogan and single-control.

'X-'74.

OUTPUT VOLTAGE REGULATOR

The '74 is a special "glow" type voltage regulator designed for service in "B" supply units where great flexibility in output is required or where the A.C. line voltage varies over rather wide limits. This tube accomplishes voltage regulation from its characteristic that on any current flow from 10 to 50 milliamperes the tube develops a constant voltage averaging 90 volts. It consists of two elements (an anode and a cathode) in a gas-filled space and shows a pronounced glow when in operation.

CIRCUIT REQUIREMENTS

This tube cannot be used without a series resistance to limit the maximum current to 50 milliamperes. The application of the tube to a typical "B" supply unit is shown in Fig. 147. If the tube connections are reversed a bright glow will occur at the small terminal, and the connections should be corrected. Proper results will not be obtained unless connections are made as indicated in the diagram. The terminals which would normally be "+F" and "plate" are connected together in the base of the tube and this short-circuited connection may be used as a line switch in the transformer primary. With this connection, the eliminator cannot be turned on until the '74 tube is inserted in the socket nor can the tubes be interchanged in such a way as to damage either the equipment or tubes themselves. If a rectifier or power tube is inserted in the socket intended for the '74, the transformer primary will remain open and no power will flow to the equipment.

Two '74 tubes may be placed in series to obtain 180 volts, a center tap between the two tubes then providing 90 volts.

RATING

Rated Voltage	90 volts D.C.
Starting Voltage	125 volts D.C.
D.C. Current	10-50 milliamperes

'76 and '86

The '76 and '86 are Iron filament tubes with the filament in a hydrogen atmosphere. They develop considerable heat in operation and are placed in a metal chimney for the purpose of creating a cooling draft and for protection of the operator from flying glass in the event of breakage. *Do not work in the vicinity of these tubes* unless the protective screening is in place, as a slight jar may fracture the glass and allow the hydrogen to ignite. A terrific detonation will result. This warning should therefore be taken into full account in working with equipment in which these tubes are placed. Their purpose is that of voltage regulation in the primary circuit of power transformers. They incur a voltage drop of about 50 volts and the power equipment used with them is designed accordingly. Apparatus designed for use at 60 cycles with the '76 can be employed on 40 cycle lines by the substitution of the '86. The circuit arrangement of a power supply circuit employing these tubes and the '74 appears in Fig. 147.

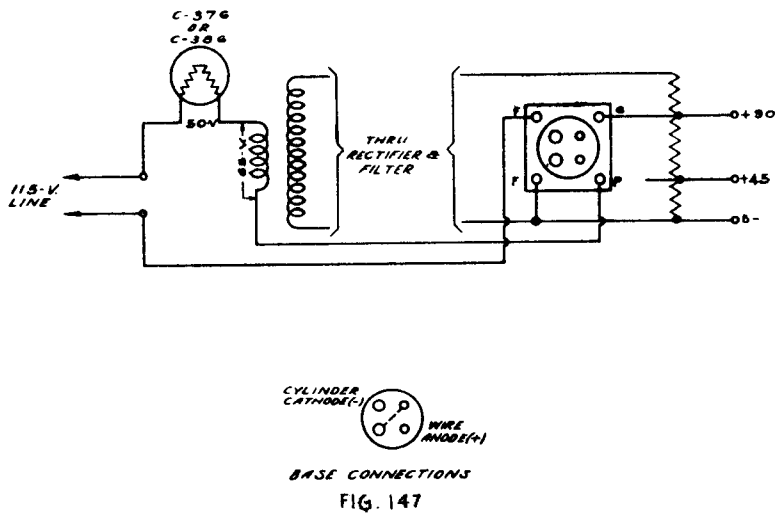


FIG. 147

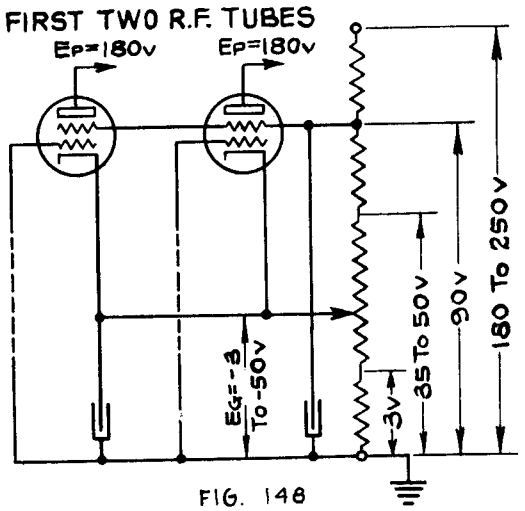


FIG. 148

'77

The '77 tube is a protective device placed in the negative "B" battery lead of receivers using '99 tubes. They are found in early Radiola 25 and 28 receivers. The filament characteristics of these tubes are such that should the "B" voltage be applied to the "A" circuit unintentionally, the voltage drop through the tube will be great enough to protect the tube filaments from destruction.

The Variable-Mu Tetrode

The Variable-Mu tube is similar in most respects to the screen-grid tube but is so designed that overloading of the grid does not cause cross-modulation in the manner peculiar to screen-grid type and, thus, the necessity for the use of band-selectors in the preliminary tuning is avoided. Volume control is achieved smoothly by variation of the grid bias over the range from the minimum specified to 40 or 50 volts negative for minimum volume. Note Fig. 148. While the tube is similar to the '24 in many respects, it is not interchangeable therewith. It may be used as the first detector in superheterodyne circuits but not as a high level detector as in normal usage.

Two types, '35 and '51, are now in commercial use having differing characteristics which will be described.

'51

TENTATIVE RATING AND CHARACTERISTICS

Heater Voltage	2.5 volts
Heater Current	1.75 amperes
Plate Voltage	250 volts
Screen Grid Voltage (Maximum)	90 volts
Control Grid Voltage	-3 volts
Plate Current	6 milliamperes
Screen Grid Current—Not more than 1/3 of Plate Current	
Plate Resistance	400,000 ohms
Amplification Factor	420
Mutual Conductance (Ecg=-3 Volts)	1050 micromhos
Effective Grid-Plate Capacitance (Max.)	0.010-mmf.
Input Capacitance	5 mmf.
Output Capacitance	10 mmf.

'35

TENTATIVE RATING AND CHARACTERISTICS

Heater Voltage	2.5 volts
Heater Current	1.75 amperes
Plate Voltage	250 volts
Screen Grid Voltage (Maximum)	90 volts
Control Grid Voltage	-3 volts
Plate Current	7 milliamperes
Screen Grid Current—Not more than 1/3 of Plate Current	
Plate Resistance	300,000 ohms
Amplification Factor	300
Mutual Conductance (Ecg= -3 volts)	1000 micromhos
Effective Grid—Plate Capacitance (Max.)	0.010-mmf.
Input Capacitance	5 mmf.
Output Capacitance	10 mmf.

NEW TUBES FOR AUTOMOTIVE AND D.C. RECEIVERS

The three tubes to follow are specially designed for operation directly from the 6-volt battery of the motor car or from D.C. lines with the heaters in series. There are three tubes in the group: a general purpose tube, the '37; a screen-grid tube, the '36; and a Pentode output tube, the '38. Their characteristics are as given below. Employment of the indirectly heated cathode tends to avoid a large part

of the noise found in auto and D.C. sets.

'36

CHARACTERISTICS

Heater Voltage			6.3 volts D.C.
Heater Current			0.3-ampere
Plate Voltage	90	135	135 volts
Screen Voltage	55	67.5	75 volts
Grid Voltage	-1.5	-1.5	-1.5 volts
Plate Current	1.8	3	3.5 milliamperes
Screen Current—Not over 1/3 of plate current			
Plate Resistance	200,000	300,000	250,000 ohms
Amplification Factor	170	315	275
Mutual Conductance	850	1,050	1,100 micromhos

'37

CHARACTERISTICS

Heater Voltage		6.3 volts D.C.
Heater Current		0.3-ampere
Plate Voltage	90	135 volts
Grid Voltage	-6	-9 volts
Plate Current	2.7	4.5 milliamperes
Plate Resistance	11,500	10,000 ohms
Amplification Factor	9	9
Mutual Conductance	780	900 micromhos
Load Resistance	14,000	12,500 ohms
Undistorted Power Output	30	75 milliwatts

'38

CHARACTERISTICS

Heater Voltage	6.3 volts
Heater Current	0.3-ampere
Plate Voltage, Recommended	135 volts
Screen Voltage, Recommended	135 volts
Grid Voltage	-13.5 volts
Plate Current	8 milliamperes
Screen Current	2.5 milliamperes
Plate Resistance	110,000 ohms
Amplification Factor	100
Mutual Conductance	900 micromhos
Load Resistance	15,000 ohms
Undistorted Power Output	375 milliwatts

THE PENTODE OUTPUT TUBE

The space charge in a vacuum tube causes a cloud of electrons to collect in the neighborhood of the cathode. This means that in order to draw electrons through this cloud, an extremely large proportion of the total plate voltage is used up. Scientists have discovered that by the inclusion of an extra grid in the neighborhood of the cathode, this cloud may be dispelled with a resultant increase in the sensitivity and efficiency of the tube. The pentode for a given output power requires but one third the input signal and makes possible the operation of the power stage directly out of the detector by resistance coupling. The distortion usually encountered in the intermediate A.F. stage is thus removed. Contrary to the case of the triode, the optimum output load for maximum undistorted power is not twice the plate impedance of the tube. This figure is specified definitely by the manufacturer in each case.

'47

This tube is a power output pentode of the type described above. The connections to the tube, which employs the UX base, are with the filament at the heater terminals (referring to the '27), the plate and grid to their usual terminals, and the screen-grid to the cathode terminal.

Because of the high gain of the tube it is not desirable to use the familiar type of biasing where the bias is provided by the drop through a resistor in series with the filament center tap. Because of the high amplification factor the out-of-phase voltage fed back to the input across this resistance would be abnormally high and any condenser suitable for bypassing of the resistance would be too large for economy. If return of the grid is made to some point in the voltage supply negative by the required amount with respect to the filament, no undesirable effects will be encountered.

CHARACTERISTICS

Filament Voltage	2.5 volts
Filament Current	1.5 amperes
Plate Voltage, Recommended	250 volts
Screen Voltage, Recommended & Maximum	250 volts
Grid Voltage	-16.5 volts
Plate Current	32 milliamperes
Screen Current	7.5 milliamperes
Plate Resistance	38,000 ohms
Mutual Conductance	2,500 micromhos
Load Resistance, Approximate	7,000 ohms
Power Output	2.5 watts

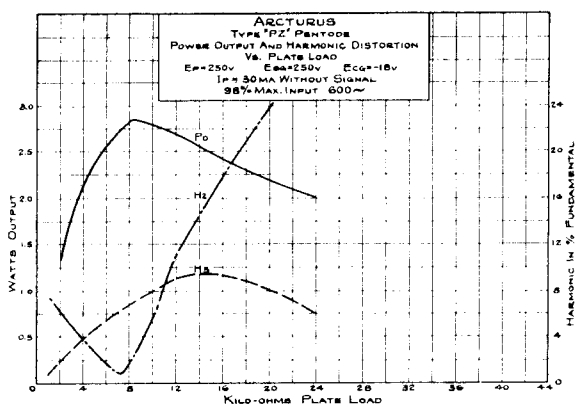


FIG. 149

HARMONIC DISTORTION

The output of the pentode tube when examined

for harmonic content at various loads in the plate circuit reveals the magnitudes shown in Fig. 149 where H represents the harmonic percentage of the fundamental. The second harmonic H2 rapidly diminishes as the load impedance is increased, reaching zero or a very small value at 7,500 ohms; then increasing at practically the same rate. Quite a different state of affairs is represented by the third harmonic H3 which continually increases until a maximum is reached at approximately two times the load impedance.

Power Output

While the usual graphical method of determining the undistorted power output of triodes by use of a family of plate current—plate voltage curves in conjunction with balanced load impedance lines are applicable to pentodes, the data here presented are those obtained from direct measurement of pentode output containing less than 5% harmonic distortion. The method of measurement is based fundamentally upon the harmonic analysis of the pentode output.

(See Standard methods of testing vacuum tubes, Chapter VI, paragraph D, IRE Committee on Standardization, 1930.)

The graphs of Fig. No. 150 illustrate the undistorted power output of the pentode when operated at various plate voltages. This graph also shows the optimum load impedance for minimum second harmonic and the degree of third harmonic present at various plate voltages. Curve No. 151 illustrates the change of power output of the pentode as the input is varied. It should be noted that the harmonic distortion does not increase in proportion to the input but as maximum input is approached the harmonic content increases at a lower rate.

Fig. 152 shows characteristic variation with changes in plate voltage.

Power Sensitivity

The power sensitivity of an output tube has been defined by Stuart Ballantine as the ratio:

$$\text{Power Sensitivity } S = \sqrt{Po}/Eg1$$

where S is the Power Sensitivity
Po the power delivered to the load
and Eg1 the R.M.S. value of the A.C. sinusoidal grid voltage.

This factor possesses several advantages not found in previous definitions and is employed in this report.

Accepting the value of the grid bias as a measure of the peak signal voltage required to deliver maximum useful power output, the following table is arranged to illustrate the power sensitivity of the pentode in comparison with various triodes.

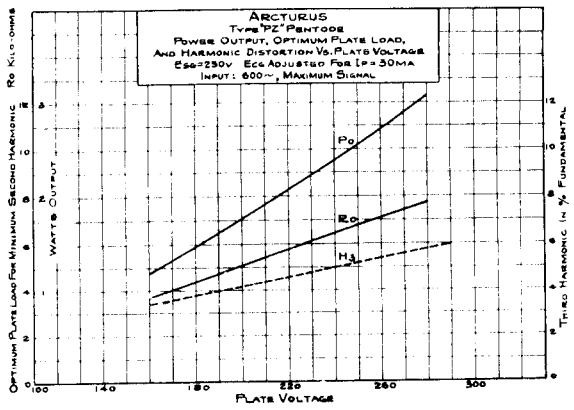


FIG. 150

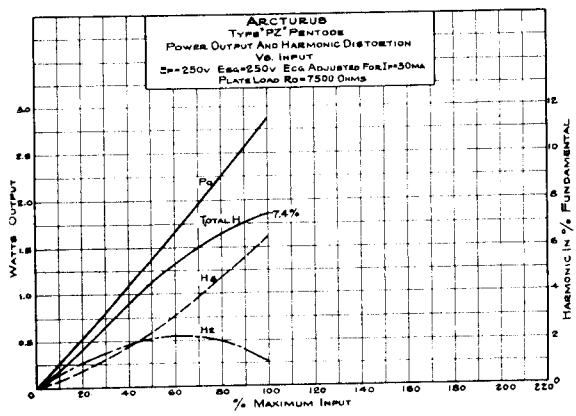


FIG. 151

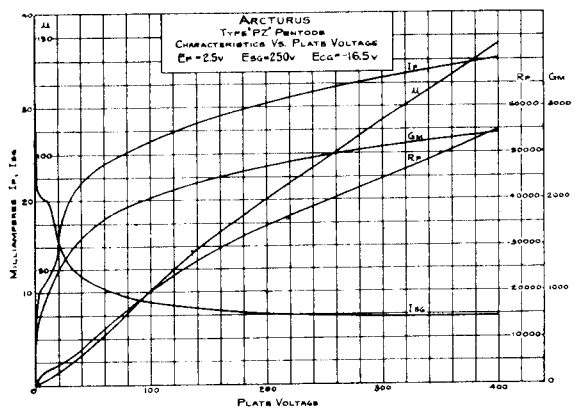


FIG. 152

Power Sensitivity of Output Tubes

Type Tube	Ep	Eg1	Po	S
'12-A	157.5	10.5	.195	.0594
'71-A	180	20.5	.700	.0292
'45	250	50	1.60	.0358
PZ, '47	250	18	2.85	.1326
'50	450	84	4.05	.0239

'33 Power Pentode

The low power output of the '20 and '30 type power tubes, plus their low amplification constant,

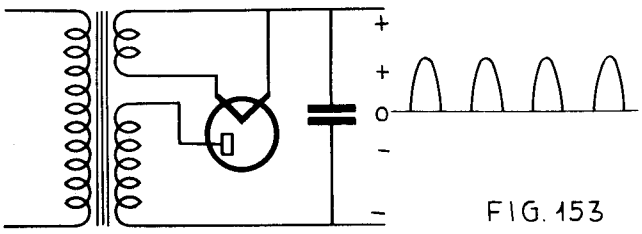


FIG. 153

was a serious drawback to those interested in battery type tubes.

The new power pentode, known as the '33, when introduced, offered a satisfactory tube for the portable set or for sets used in isolated places such as farms not equipped with electrical supply.

This tube has considerably greater power output and sensitivity than three-electrode power tubes of the '31 type. In fact, when used in push-pull they will deliver a power output of over 1.3 watts.

Tentative Rating and Characteristics

Filament Voltage	2.0 volts
Filament Current	0.260-ampere
Plate Voltage	135 volts
Screen Voltage	135 volts
Control Grid Voltage	13.5 volts
Plate Current	14 milliamperes
Screen Current	3 milliamperes
Plate Resistance	45,000 ohms
Mutual Conductance	1,400 micromhos
Amplification Factor	63
Load Impedance	7,500 ohms
Undistorted Power Output	650 milliwatts

The '33 utilizes 5 electrodes concentrically arranged in the following order; cathode (filament type), control-grid, screen-grid, cathode grid and plate. The cathode grid is connected to one end of the cathode and serves to practically eliminate secondary emission effects. The screen-grid acts as an electrostatic shield between the control grid and plate elements.

The cathode is an oxide-coated ribbon type filament and it is extremely important that it should not be operated above its normal rated voltage.

Fixed grid bias or preferably self-bias may be used with the '33, and its grid circuit should not include more than 500,000 ohms of external resistance.

In order to minimize second harmonic distortion, the '33 should work into a load having substantially constant impedance approximately equal to the rated load impedance of the tube.

RECTIFIER TUBES AND CIRCUITS

Rectifiers are classified as half wave, full wave, and voltage-doubling for the elementary consideration we will give. In the half wave type, rectification such as to cut off one half of the A.C. cycle is provided. In this case, the ripple has a 60 cycle tone, and the gaps as shown in Fig. 153 require considerable filtration for smoothing the resultant pulsating D.C. into a form suitable for use as the supply voltage for vacuum tubes. By connecting two tubes, or a single specially designed tube, in the manner shown in Fig. 154, both halves of the A.C. wave are brought into play, and the resulting tone is 120 cycles. This type of pulsating D.C. is much easier to filter as may be imagined from the sketch.

'80 and '81 Rectifiers

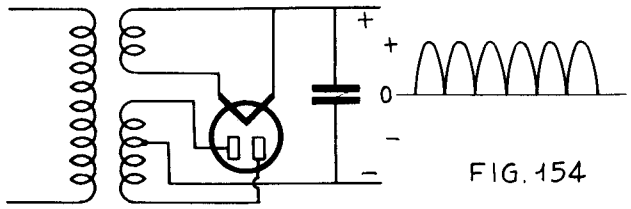


FIG. 154

These two tubes are very popular, especially the '80 type which is used in practically every modern radio set today.

'80

Full Wave Rectifier

The '80 is a full-wave rectifying tube intended for use in power supply devices that operate from an alternating current supply.

Filament

The filament of this tube is of the oxide coated type and is designed to operate at 5 volts. The filament current is supplied from one of the windings of a power transformer, the leads to which should be of high current carrying capacity.

Plate

There are two plates in the '80, both designed to operate at voltages *no higher than* 550 volts A.C. each, which value is permissible only with filter circuits having an input choke of at least 20 henries. Under these conditions it is possible to obtain a D.C. load current of 135 milliamperes. Where ordinary type filters are used lower ratings are indicated below and should all be carefully observed, otherwise the life and performance of the tube may be seriously affected.

Circuit Recommendations

The most generally used full-wave rectifier circuit employing the '80 is shown in Fig. 156A. The filter used may be either of the condenser or choke in-

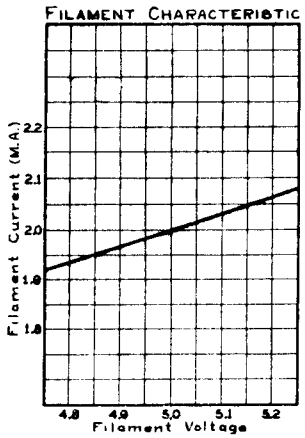


FIG. 155

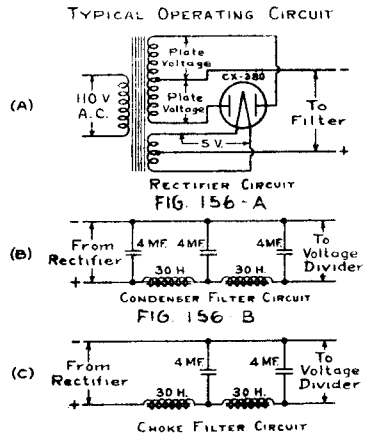


FIG. 156 C

put types. With condenser input (as shown in Fig. 156B) care must be taken that this input condenser should have a rating sufficiently high to withstand the instantaneous peak value of the A.C. input voltage.

In the case of the choke input method (Fig. 156C) where the input condenser of Fig. 156B is omitted, there will be a somewhat lower available D.C. output voltage for a given A.C. plate voltage than with the condenser input method. However, improved regulation with lower peak current will be obtained. When using 550 volts per plate, this type of filter is necessary as mentioned before and an input choke of at least 20 henries must be used. If desired, a condenser of not more than 0.1-mf. may be used across the input.

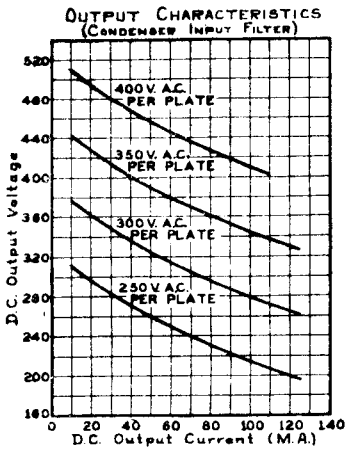


FIG. 157

OPERATING CONDITIONS

Filament Voltage . . . . . 5.0 volts
Filament Current . . . . . 2.0 amperes
A.C. Voltage per Plate with
135 ma. D.C. Output Current (max.) 550 volts (R.M.S.) —permissible only with filter circuits having an input choke of at least 20 henries. If desired, a condenser of not more than 0.1-mf. may be used across the input of the filter.
125 ma. D.C. Output Current (max.) 350 volts (R.M.S.)
110 ma. D.C. Output Current (max.) 400 volts (R.M.S.)

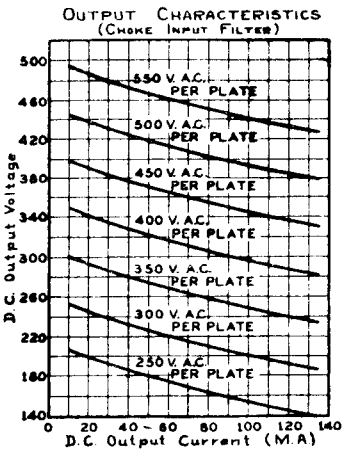


FIG. 158

AVERAGE CHARACTERISTIC CURVES

Filament Characteristics—Fig. 155 shows the change of filament current with various filament voltages.

Output Characteristics—Fig. 157 shows the relation of load current to the rectified voltage at various plate voltages when using a condenser input filter.

Fig. 158 shows the relation of load current to the rectified voltage when using a choke input filter.

Because of their internal resistance, i.e., the resistance of the path between the filament and the plate, the voltage output varies with the load drawn. For this reason a number of factors enter into the design of a power supply to provide a given output voltage. To begin with, we are at a loss to perform

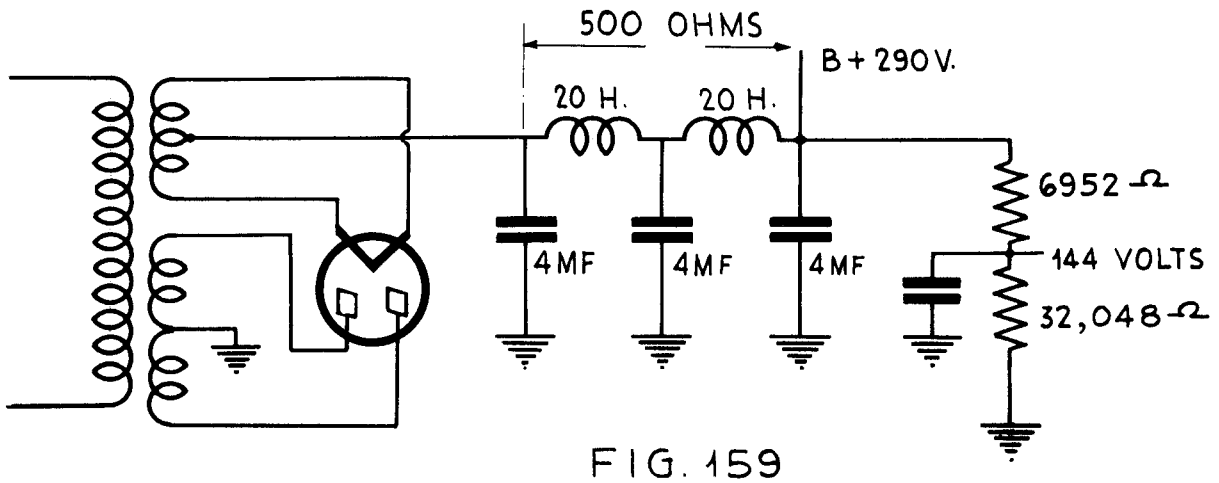


FIG. 159

any calculations until we are certain of the power transformer we intend to use—its voltage output and its regulation—that is, its ability to maintain a constant output voltage across its secondary terminals regardless of the load drawn. Note that a filter may be of either the inductance input or condenser input type. The voltage obtained across the filter output is not so great with the inductance input filter, but the load on the tube is much less, the regulation is better, and the initial surge as the power is switched on is much slighter.

It is this initial surge, by the way, which sends the filter condensers "galley-west" and it ruined more than one manufacturer in the early days of A.C. operation. By all means, if you are building any equipment of your own use the inductance input. It is much easier to explain the process of power supply design by taking an actual example than by "beating around the bush," so we will assume that we require power for a receiver employing 4 '27 tubes and a '45 as an output tube.

First, we know that the voltage requirements for the power stage are 250 volts plate and 50 volts grid —total, 300 volts. This sets the maximum voltage for our power supply system at 300 volts. Tabulating the rest of the receiver as follows:

Number	Tube	Plate volts	Grid volts	Total volts	Total Plate Cur.
2 R.F.	'27	135	9	144	9 ma.
1 Det.	'27	135	variable	144	.1-ma.
1 A.F.	'27	135	9	144	4.5 ma.
1 A.F.	'45	250	50	300	34 ma.

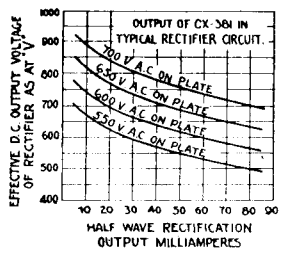
The total plate current for all tubes is seen to be 47.6 ma.

We must take into account now the voltage drop through the filter chokes which will have a resistance of at least 500 ohms. Inspection of the regulation curves for the '80 tube will show a voltage output of about 315 volts D.C. at 300 volts A.C. per plate each side of center tap, when the current drawn is 60 ma. at 60 ma., the voltage drop through the chokes is 30 volts (500 ohms x .06-amp). This leaves us a bit less than 300 volts total and we must try again. A load of 55 ma. would give a terminal voltage of 320 and the drop through the chokes would be 27.5 volts. This would leave us just a bit short of our total 300 volts again. The discrepancy does not amount to a great deal and we can continue on this basis—a terminal voltage at the filter output of 293.5 volts, or 290 volts to make things even. We must, however, arrange for a loss of some 7.4 ma. in order to bring our total drain up to 55 ma. This is done by inserting a resistance across the output of such a value as to provide a drain of 7.4 ma. at 290 volts. From Ohms Law (R=E/I or 290/.0074=39189 ohms) we obtain a value for this resistance of about 39,000 ohms.

The next process is to discover where we must place the tap on this resistance in order to obtain 144 volts for our detector and amplifier stages. We desire to drop the output voltage from 290 to 144, or 146 volts—the current for the four tubes receiving this voltage is 13.6 ma. and there are already 7.4 ma. flowing through the output resistance. With this total of 21 ma., the resistance required to give a drop of 146 volts is 6,952 ohms. This means that our output resistance will have a tap at this point to provide the plate voltage for the tubes other than the power tube. This is shown in Fig. 159. If more than a single tap were required we would proceed in the same fashion.

'81

The type '81 is a half-wave rectifier tube with a rating of 700 volts A.C. input and 85 ma. D.C. output permitting D.C. voltages on the order of 600 volts to be obtained from a single wave rectifier, and of 700 volts with a full wave connection. When higher voltages are required it is posible to use a single or full wave voltage doubling arrangement by which voltages of 1000 to 1500 volts may be obtained (using low transformer voltages), two to four '81 tubes being required.



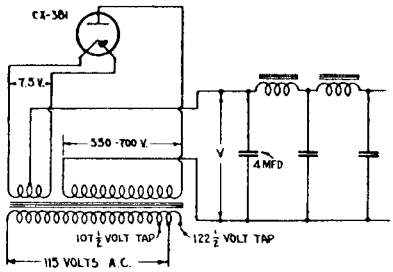
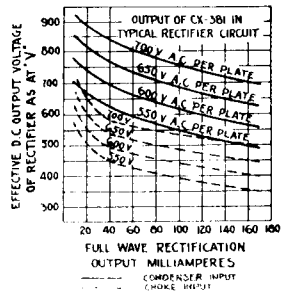


FIG. 160



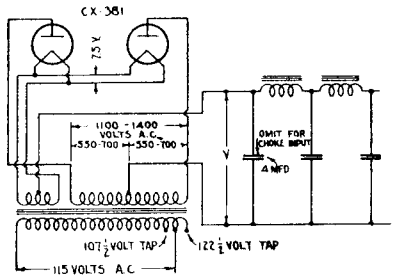
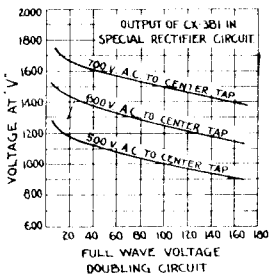


FIG. 161



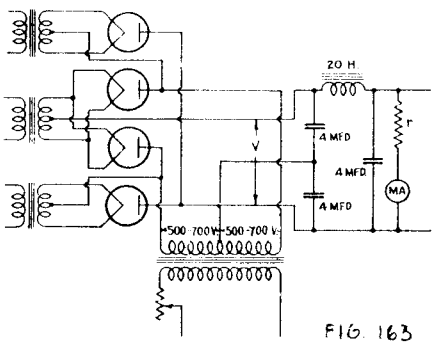
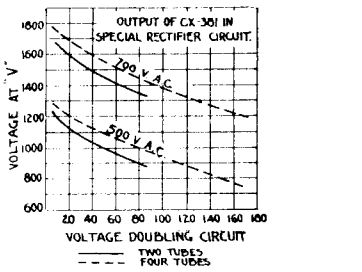


FIG. 163



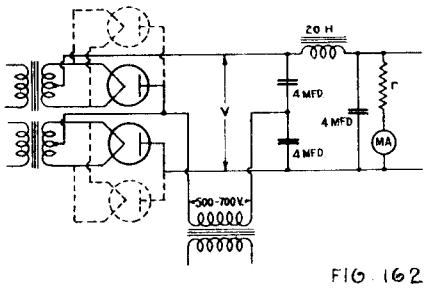


FIG. 162

Normal Service

Typical connections and output voltage secured from the '81 in a half wave rectifier circuit are shown in Fig. 160, while Fig. 161 shows similar data for two 81 tubes used in a full wave circuit. When an output voltage under 500 volts is required the first filter condenser should be omitted. The effect of this connection is to greatly reduce the peak current supplied by the '81 tubes, which will run cooler and give much better life service under such conditions. The regulation is also much improved, as may be seen by comparing the output voltage curves.

This latter system of filtering was tried at station 2AQO, in place of a single section filter, with improved results when supplying a Hartley oscillator and especially for phone modulation. The filtering action was better than necessary for crystal controlled operation, some A.C. modulation being found preferable. The input choke in these tests was a 7-henry inductor, the self-inductance being measured with full load current of 85 ma. flowing.

Higher Voltages

A familiar type of voltage doubling connection was tested (Fig. 162). The voltage regulation was rather poor, as indicated, but for low currents the small amount of apparatus required makes it convenient. The regulation can be improved by using two '81 tubes in parallel on each side as indicated by the dotted lines. The voltage increases rather rapidly below a load of 20 ma., and to prevent it from rising a fixed load (r) is indicated in the diagram. This

may be a 100,000-ohm resistor capable of carrying 20 ma. A milliammeter in series with this resistor is indicated (M.A.), and will give an indication of the output voltage. The scale reading with the resistor specified becomes 100 volts per milliampere; thus a full scale reading of 200 milliamperes indicates an output voltage of 2000 volts.

Much improved results were obtained with the full wave voltage doubling circuit shown in Fig. 163. The adjacent curves show the very high output voltage obtainable with this circuit, and the excellent regulation secured. The high voltage transformer may be a 1400-volt winding center tapped, or two similar 700-volt transformers connected in series. Regulation curves are shown for transformer voltages of 1000 and 1400 volts. The current output should not exceed 170 ma. Three separate filament transformers insulated for the full output voltage are required.

When tested at Station 2ABQ this latter arrangement, with a 10-henry choke, gave slightly better results than the equipment formerly used, a 3000-volt transformer center tapped two 1500-volt rectifiers and a 50-henry choke. The transformer used was a 1200-volt unit, center tapped. The '81 tubes, supplying 100 ma. ran quite cool, the output being well below rated maximum.

The filter condensers, C1, must be capable of withstanding one-half the load voltage as the normal working voltage. A condenser larger than 4 mf. should not be used unless it is possible to close the filament circuit of the rectifier tubes before the high voltage is applied. The initial charging surge may overheat the tubes and cause an arc if the filament is allowed to come up to temperature with the high voltage turned on.

Filament

The filament used in type '81 is of the rugged coated type. With this filament the difficulties in handling the shipping are overcome, as severe mechanical shocks cannot break the filament. The filament should be operated at, or slightly below, the rated voltage of 7.5 volts, and the voltage across the filament should never exceed 7.9 (rated voltage+ 5%).

The main precaution to be observed in operating the '81 tubes is that of avoiding an overload with respect to plate current. The shorting of the rectifier output, such as may occasionally occur due to the failure of some part of the apparatus (as by the breakdown of a filter condenser) will overload the filament and result in filament failure, unless the current is turned off promptly. An indicating lamp may be placed in the circuit in series with each plate lead adjacent to the plate; if a .15-ampere 6-volt dial lamp is used in this position it will glow at normal brilliancy when the full rated current of 85 ma. is flowing through each tube (170 ma. from a full wave rectifier). Excessive brilliancy of this lamp will immediately indicate an overload on the tube, which can be corrected before damage results.

'66 Half-Wave Rectifier

This new tube was introduced for use in conjunction with the newer high power audio systems such as employed in public address systems, talking picture reproducing equipment, and radio transmitters.

The voltage and current limitations of the '81 type tube are such as to make it unsatisfactory or impractical for use especially where the voltage exceeds 1000 volts with current drains of more than 150 milliamperes.

The Cunningham '66 is a half-wave, hot-cathode, mercury vapor rectifier tube for use in suitable rectifying devices designed to supply D.C. power from A.C. supply lines. This tube is particularly suited for use in the "B" supply of amateur power transmitting equipment where it has been necessary heretofore to use a combination of '81's for such purposes. Full wave rectification is accomplished by using two of these tubes.

Filament

The filament of this tube is of the ribbon coated type and should be operated from a filament transformer capable of delivering 5 amperes at 2.5 volts to the filament terminals.

Plate

There is one plate in the '66 and it is in the form of a circular pan mounted above the filament with a cap provided at the top of the bulb for external connection. It is rated at what is known as a peak inverse voltage of 5000 volts (max.). By peak inverse voltage is meant the maximum instantaneous voltage that exists across the plate to filament during that half of the cycle in which the plate is negative with respect to the filament.

Installation and Operation

The 66 is designed for use with the standard X socket and a plate clip. It must be mounted so that it is in a vertical position with the filament end down. Fig. 164 shows details of base and cap connections. This tube is designed to operate without forced ventilation at an air temperature of from 32° to 122° Fahrenheit. Where higher temperatures are encountered, forced ventilation should be provided. As the bulb becomes rather hot in operation, precautions should be taken to prevent any inflammable material or metallic body from making contact.

Upon initial installation, the filament of the '66

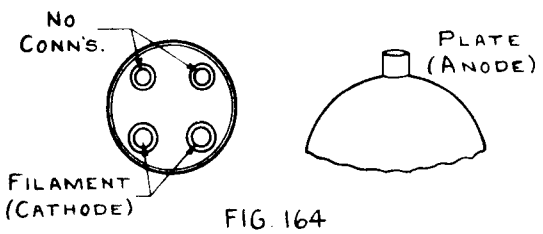


FIG. 164

SINGLE PHASE FULL WAVE RECT. CKT.

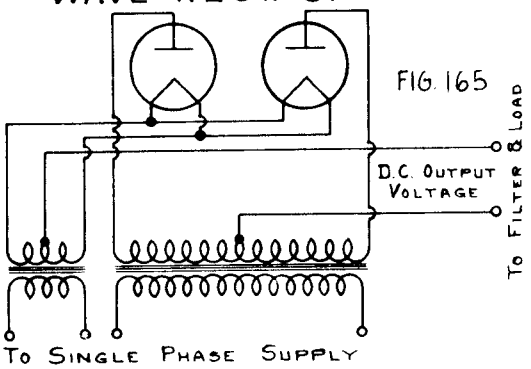


FIG. 165

THREE PHASE HALF WAVE RECT. CKT.

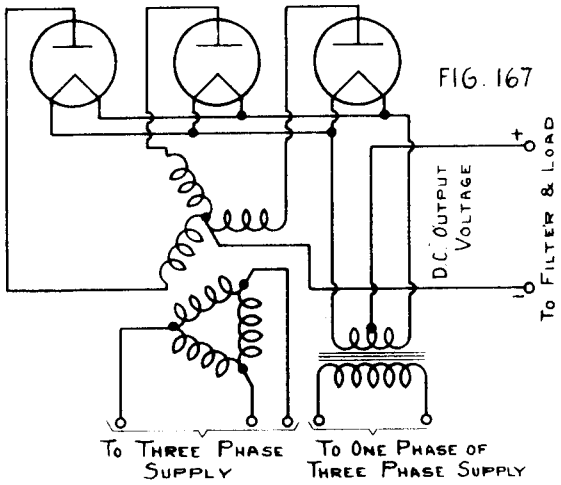


FIG. 167

THREE PHASE HALF WAVE DOUBLE "Y" (INTERCONNECTED) RECTIFIER CKT.

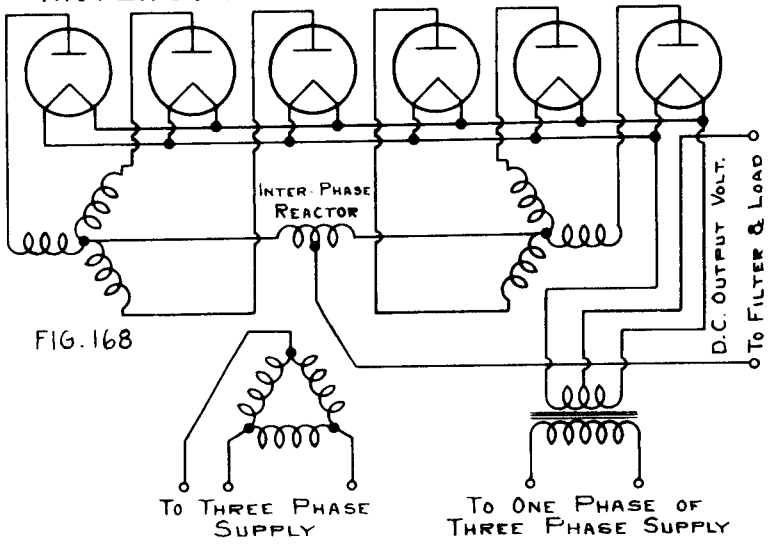


FIG. 168

SINGLE PHASE FULL WAVE RECT. CKT.

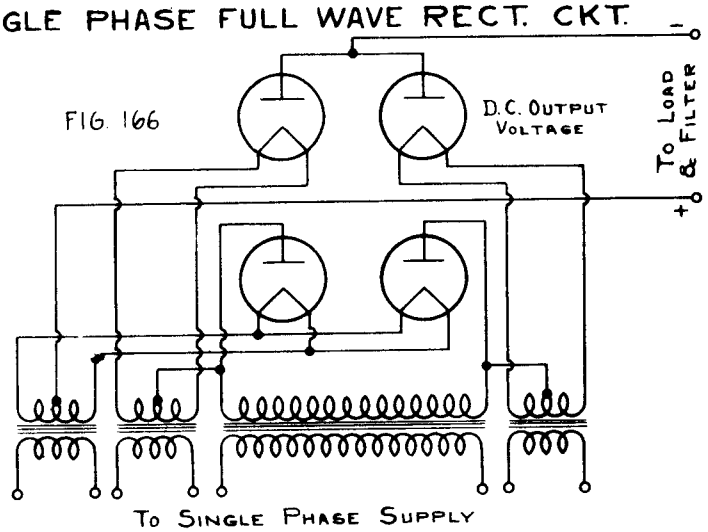


FIG. 166

THREE PHASE FULL WAVE RECTIFIER CIRCUIT

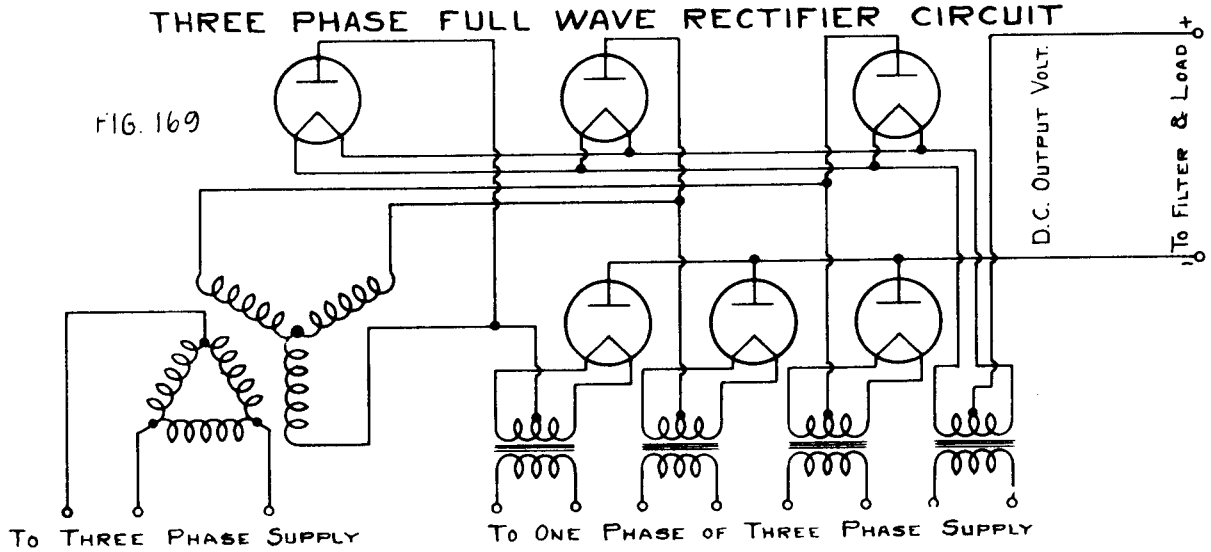


FIG. 169

should be lighted at rated voltage for approximately 15 minutes without any applied plate voltage, in order to properly distribute the mercury.

The filament should always be operated at rated voltage. Less than this voltage may cause a high tube voltage drop, eventually leading to loss of emission. Greater than rated voltage will shorten the life of the tube.

On account of the high filament current drain, it is extremely important that the socket makes good filament contact and is capable of passing 5 amperes continuously, otherwise high contact resistance will be encountered. The filament voltage should be measured at the terminals of the socket and should be controlled by means of a rheostat placed in the primary circuit of the transformer.

If an inverse peak voltage of more than 2100 volts is used, the plate supply of the circuit should be provided with a time delay relay having a period of at least 30 seconds so that the filament will be allowed to come up to temperature before plate voltage is applied.

In operation, the performance of the '66 is limited by the peak inverse voltage applied to it and by the peak plate current passed through it. The maximum peak inverse voltage should never exceed 5000 volts. This is the safe flash back limit for the '66 operating within its normal temperature range. The maximum peak plate current should never exceed 0.6-ampere.

TABLE I.

Type of Circuit	Number '66's required	Input Voltage R.M.S. volts	Output Voltage D.C. volts	Output Current D.C. amperes
Single Phase Full Wave (Fig. 165)	2	1750 per tube	1570	0.4
Single Phase Full Wave	2	1750 per tube	1980*	0.22*
Single Phase Full Wave (Fig. 166)	4	3500 total	31510	0.4
Single Phase Full Wave	4	3500 total	3960*	0.22*
Three Phase Half Wave (Fig. 167)	3	2050 per leg	2400	0.5
Three Phase Half Wave Double Y (Fig. 168)	6	2050 per leg	2400	1.2
Three Phase Full Wave (Fig. 169)	6	2050 per leg	4800	0.6

*Condenser input to filter

The use of a choke input filter is to be preferred to condenser input whenever possible because the peak current demand during rectification is considerably less with the former method.

The terminal connections are shown in Fig. 164.

CIRCUIT RECOMMENDATIONS

Several circuits particularly suited for use with the '66 are schematically given in the diagram of Figs. 165 to 169. Their circuits together with their safe maximum input and output operating conditions are shown in Table I.

The values given in Table I are based on the use of a suitable choke preceding any condenser in the filter circuit, except as indicated for the single phase connections. If the choke is not used, the tabulated D.C. output current values cannot be obtained without exceeding the peak current rating of the tube. In the case of the double Y circuit (Fig. 168) the interphase reactor itself acts as a choke.

Each tabulated value of D.C. voltage is the effective D.C. output voltage from the tube and any drop in the filter, therefore, must be subtracted from the value given, in order to obtain the available output. Owing to the low tube voltage drop of approximately 15 volts, the only reduction in rectified voltage when the load is increased, is due to drop in the transformer and filter windings.

In the case of the three phase full wave (Fig. 169) and single phase full wave (Fig. 166) circuits, two '66's are used in series. This arrangement is made possible by the low and constant voltage drop within this tube. These two circuits are desirable where higher D.C. voltages are required. In the three phase full wave circuit, six phase wave form is obtained.

The '66 has a characteristic blue glow when it is operating. In service the bulb will eventually darken but this change has no effect on the performance of it.

OPERATING CONDITIONS

Filament Voltage	2.5 volts
Filament Current	5.0 amperes
Maximum Peak Inverse Voltage	5000 volts
Maximum Peak Plate Current	0.6 amperes
Approximate Tube Voltage Drop	15 volts

DIMENSIONS

Length	6-5/8"
Diameter	2-7/16"
Base	Large CX

Raytheon BH Tube

This rectifier was the old time favorite and still finds considerable use today. At one time, there were more than one hundred manufacturers of "B" supply units, for which the BH tube was standard.

To most service men, this tube is an old acquaintance but as most of the circuits of the eliminators incorporated this tube, we are including it for reference as there is no telling when or where you will meet up with the BH.

The best way to test this tube is to make an adapter or buy one of the Alden Adapters made for this purpose. Fig. 170 shows how to make the connections in the adapter. Be careful that there are no short circuits in the power unit which would place a

dead short through the milliammeter and burn it out. It would be best to use a meter with a 150-ma. range. Place the tube in the adapter and the adapter in the Ratheon tube socket. The milliammeter will indicate the total current being delivered by the tube.

The tube is of rugged construction comprising a glass bulb containing helium gas and internal elements consisting of a hollow cap or cathode and two rods or anodes protruding into the hollow cap and insulated by the short path method of insulation.

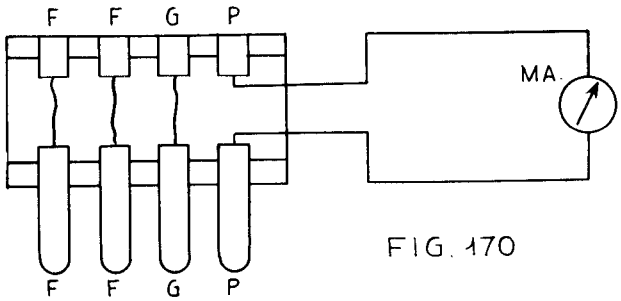


FIG. 170

The ionization of the gas, which is the basis of the rectifying action of the BH tube, takes place inside of the cap and is therefore concealed from view. The only sign of the operation of the tube is in the heating of the glass bulb.

RATING

The BH has an output rating of 125 milliamperes with a maximum allowable input voltage of 350 volts R.M.S. per anode. Typical output regulation curves are shown in Figs. 171 and 172. The solid curves in Fig. 171, show the values of D.C. voltage and current delivered to the filter with the circuits shown in Fig. 174, with choke coils L_1 and L_2 each having inductance values of 15 henries. The broken line curves show the corresponding values when the condenser C_1 is increased to 4 mf. The curves in Fig. 172, show the corresponding values when the condenser C_1 is omitted. To obtain the value of D.C. voltage delivered by the power unit to the receiver set the D.C. voltage drop in the choke coils must be subtracted from the values shown on the curves. The output voltages will also be affected by the characteristics of the particular transformer used.

Fig. 173 shows the socket terminal connections for the BH tube while Fig. 174 shows the more or less standardized circuit of power supply units which use this tube.

Raytheon Type BA 350 Milliampere Rectifier

The BA tube was used extensively several years ago in the radio receivers that had their filaments connected in series. Early model radio sets of the battery type using '01A tubes with the filaments connected in parallel could be converted into electric sets by changing the filament circuits over to a series arrangement as indicated in the revised circuit of the A.K. 30 shown in Fig. 175.

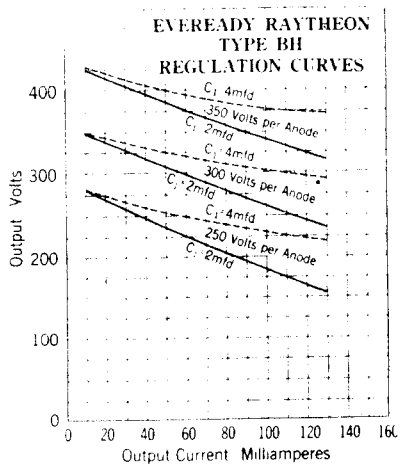


FIG. 171

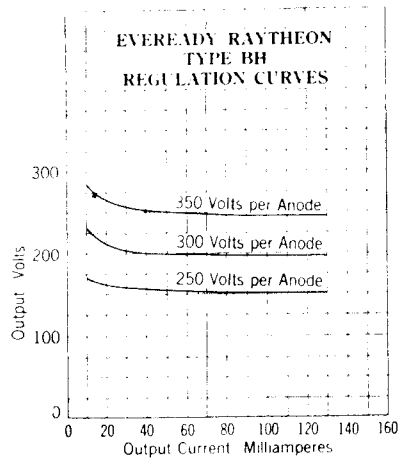


FIG. 172

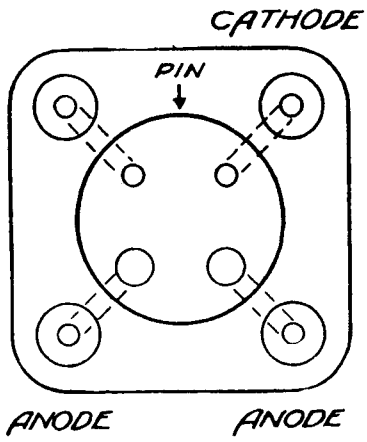


FIG. 173

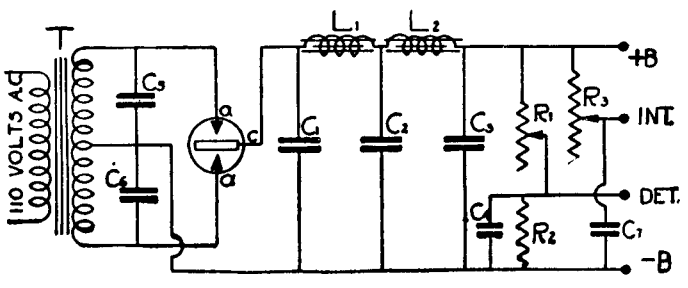


FIG. 174

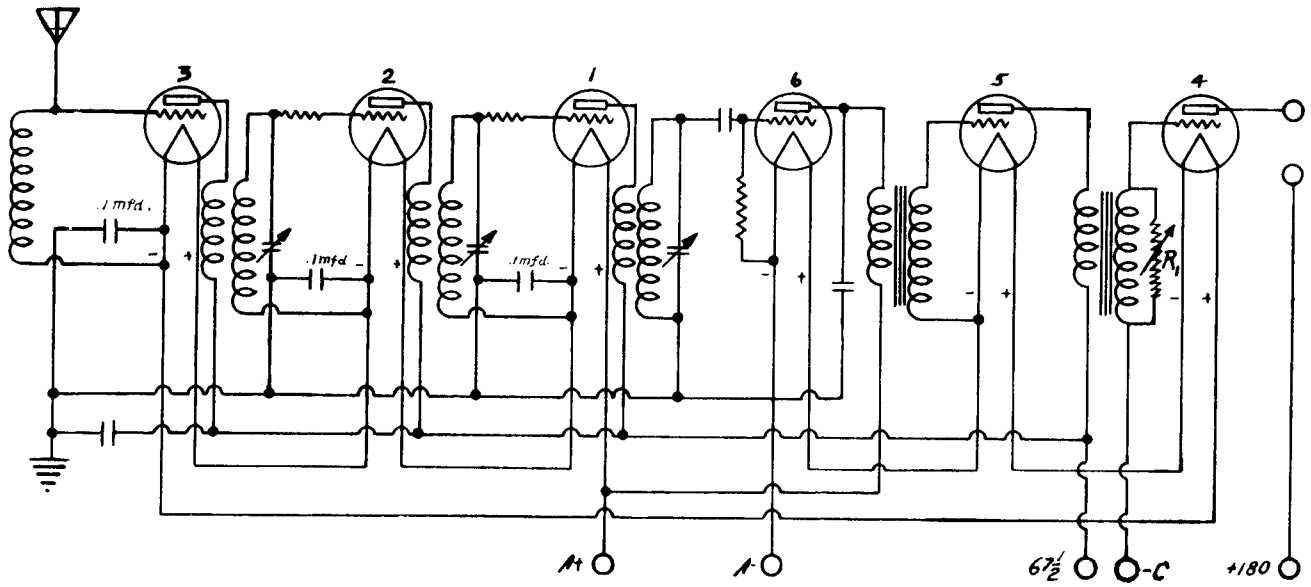


FIG. 175

Voltage Regulation Curves of Raytheon 350 M.A. Full Wave Rectifying Tube.

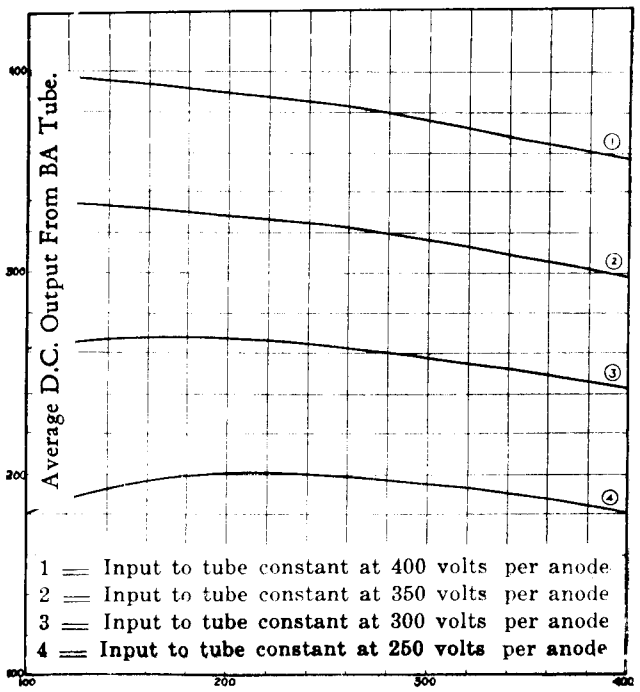


FIG. 177

DESCRIPTION

The tube makes use of the ionized helium method of rectification.

RATING

Maximum A.C. Input Voltage (per anode) 350 R.M.S. volts.

Maximum Rectified Output (both anodes) 350 milliamperes.

Maximum Output Voltage, 250 volts.

Fig. 177 shows the voltage regulation curves of the BA. The voltage drop through the tube with an increase in the load is not as great in the new models of this tube as it was in the old. Thus the new tubes have much better output regulation. The BA tube is not recommended for loads of less than 200 ma., its range of efficiency lying between 200 and 350 ma. The conventional circuit of an ABC power unit is indicated in Fig. 178.

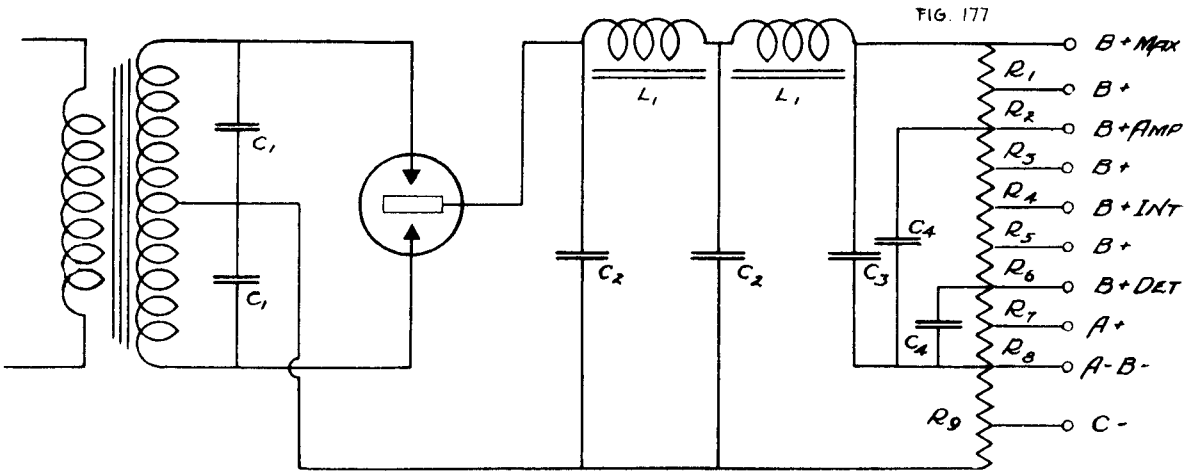


FIG. 178

RADIO TUBE CHART

LATEST TECHNICAL INFORMATION
ON STANDARD RADIO TUBES SUCH AS
EVEREADY RAYTHEON 4-PILLAR TUBES

DETECTOR AND AMPLIFIER TUBES

TYPE	USE	BASE	MAX. OVERALL DIMENSIONS HGT.	MAX. OVERALL DIMENSIONS DIAM.	FILAMENT SUPPLY	FILAMENT VOLTAGE	FILAMENT CURRENT (AMPERES)	SCREEN GRID VOLTAGE	WHEN USED AS	PLATE SUPPLY VOLTAGE	GRID BIAS VOLTAGE	PLATE CURRENT MILLIAMP.	AMPLIFICATION FACTOR	PLATE RESISTANCE (OHMS)	MUTUAL CONDUCT. MICROMHOS	MAXIMUM UNDISTORTED OUTPUT MILLIWATTS	OPTIMUM LOAD RESIS. (OHMS)
ERV-199	DETECTOR	UV	3 1/2"	1 1/16"	DRYCELL 4 1/2 V.	3.3	0.063		DETECTOR	45	+A	1.5	6.6	17000	370		
ERX-199	AMPLIFIER	UX	4 1/8"	1 3/16"	STORAGE 4 V.				AMPLIFIER	90	4.5	2.5	6.6	15500	425	7	15500
ER-120	POWER AMPLIFIER	UX	4 1/8"	1 3/16"	DRYCELL 4 1/2 V. STORAGE 4 V.	3.3	0.132			90	16.5	3	3.3	8000	415	45	9600
										135	22.5	6.5	3.3	6300	525	110	6500
ER-200A	DETECTOR	UX	4 11/16"	1 13/16"	STORAGE 6 V.	5	0.25			45	-A	1.5	20	30000	670		
ER-201A	DETECTOR	UX	4 11/16"	1 13/16"	STORAGE 6 V.	5	0.25		DETECTOR	45	+A	1.8	8	12000	670		
	AMPLIFIER								AMPLIFIER	90	4.5	2.5	8	11000	725	15	11000
										135	9	3	8	10000	800	55	20000
ER-240	DETECTOR	UX	4 11/16"	1 13/16"	STORAGE 6 V.	5	0.25		DETECTOR WITH 1/4 MEGOHM COUP. RESISTOR	180	+A	0.5	30	90000	330		
	AMPLIFIER								RADIO FREQUENCY AMPLIFIER	135	1.5	0.6	30	65000	450		
									AUDIO AMP. WITH 1/4 MEGOHM COUP. RESIS.	180	3	0.2	30	150000	200		
ER-222	AMPLIFIER	UX	5 1/4"	1 13/16"	DRYCELL 4 1/2 V. STORAGE 4-6 V.	3.3	0.132	67.5	RADIO FREQUENCY AMPLIFIER	135	1.5	3.3	290	600000	480		
								22.5	AUDIO AMPLIFIER WITH 1/4 MEGOHM COUP. RESISTOR	180	1.5	0.3	350	2000000	175		
ER-112A	DETECTOR AMPLIFIER	UX	4 11/16"	1 13/16"	STORAGE 6 V.	5	0.25		DETECTOR	45	+A	4	8	6100	1300		
									AMPLIFIER	90	D.C. 4.5 / A.C.	5.2	8.5	5600	1500	30	5600
	POWER AMPLIFIER				STORAGE 6 V. OR A.C.				OR POWER AMPLIFIER	135	9 / 11.5	6.2	8.5	5300	1600	115	8700
										180	13.5 / 16	7.6	8.5	5000	1700	260	10800
ER-171A	POWER AMPLIFIER	UX	4 11/16"	1 13/16"	STORAGE 6 V. OR A.C.	5	0.25			90	-16.5 / -19	12	3	2250	1330	125	3200
										135	-27 / -29.5	17.5	3	1960	1520	370	3500
										180	-40.5 / -43	20	3	1850	1620	700	5350
ER-226	AMPLIFIER	UX	4 11/16"	1 13/16"	A.C.	1.5	1.05			90	6	3.8	8.2	8600	955	30	9800
										135	9	6.3	8.2	7200	1135	80	8800
										180	13.5	7.4	8.2	7000	1170	180	10500
ER-227	DETECTOR AMPLIFIER	UY	4 11/16"	1 13/16"	A.C.	2.5	1.75		DETECTOR GRID LEAK	45	0	3.5	10	9000	1100		
									DETECTOR BIAS	180	25	CHARACTERISTICS DEPEND UPON SIGNAL AMPLITUDE & CIRCUIT					
									AMPLIFIER	135	9	4.5	9	9000	1000	80	13000
										180	13.5	5	9	9000	1000	165	18700
ER-224	DETECTOR AMPLIFIER	UY	5 1/4"	1 13/16"	A.C.	2.5	1.75	45	WITH 1/4 MEGOHM COUP. RESIS. DETECTOR	180	4	CHARACTERISTICS DEPEND UPON SIGNAL AMPLITUDE & CIRCUIT					
								45	AMPLIFIER	180	3	0.3	300	600000	500		
								90	R.F. AMPLIFIER	180	3	4	400	400000	1000		
								90		250	3	4	615	600000	1025		
ER-235	AMPLIFIER	UY	5 1/4"	1 13/16"	A.C.	2.5	1.75	90		180	3	6.3	255	250000	1020		
								90		250	3	6.5	370	350000	1050		
ER-551	AMPLIFIER	UY	5 1/4"	1 13/16"	A.C.	2.5	1.75	90		180	3	5.8	280	275000	1020		
								90		250	3	6.0	430	410000	1050		
ER-245	POWER AMPLIFIER	UX	5 5/8"	2 3/16"	A.C.	2.5	1.50			180	34.5	27	3.5	1900	1850	780	3500
										250	50	34	3.5	1750	2000	1600	3900
ER-247	POWER AMPLIFIER	UY	5 5/8"	2 3/16"	A.C.	2.5	1.50	250		250	16.5	32	95	38000	2500	2500	7000
ER-210	POWER AMPLIFIER	UX	5 5/8"	2 3/16"	A.C.	7.5	1.25			250	22	10	8	6000	1330	400	13000
										350	31	16	8	5150	1550	900	11000
										425	39	18	8	5000	1600	1600	10000
ER-250	POWER AMPLIFIER	UX	6 1/4"	2 11/16"	A.C.	7.5	1.25			250	45	28	3.8	2100	1800	1000	4300
										350	63	45	3.8	1900	2000	2400	4100
										450	84	55	3.8	1800	2100	4600	4350
ER-230	DETECTOR AMPLIFIER	UX	4 1/4"	1 9/16"	AIRCELL 2 V. STORAGE 2 V.	2	0.060		DETECTOR GRIDLEAK	45	+A	1.5	9.3	14000	660		
									DETECTOR BIAS	135	7.5	CHARACTERISTICS DEPEND UPON SIGNAL AMPLITUDE & CIRCUIT					
									AMPLIFIER	90	4.5	1.8	9.3	13000	700	16	15000
										135	9	2.2	9.3	12000	775	55	20000
ER-231	POWER AMPLIFIER	UX	4 1/4"	1 9/16"	AIRCELL 2 V. STORAGE 2 V.	2	0.130			135	22.5	6.8	3.8	4950	760	150	9000
ER-232	DETECTOR AMPLIFIER	UX	5 1/4"	1 13/16"	AIRCELL 2 V. STORAGE 2 V.	2	0.060	40	DETECTOR WITH 1/4 MEGOHM COUP. RESIS.	135	3	CHARACTERISTICS DEPEND UPON SIGNAL AMPLITUDE & CIRCUIT					
								67.5	AMPLIFIER	135	3	1.4	580	1150000	505		
ER-233	POWER AMPLIFIER	UY	4 11/16"	1 13/16"	AIRCELL 2 V. STORAGE 2 V.	2	0.260	100		100	8	10.5	60	50000	1200	300	7000
								135		135	13.5	14	63	45000	1400	650	7500
ER-236	DETECTOR AMPLIFIER	UY	4 11/16"	1 9/16"	STORAGE 6 V. 110 V. DC LINE	6.3	0.30	55	AMPLIFIER	90	1.5	1.8	170	200000	850		
								75		135	1.5	3.5	275	250000	1100		
ER-237	DETECTOR AMPLIFIER	UY	4 1/4"	1 9/16"	STORAGE 6 V. 110 V. AC. LINE	6.3	0.30		AMPLIFIER	90	6	2.7	9	11500	780	30	14000
										135	9	4.5	9	10000	900	75	12500
ER-238	POWER AMPLIFIER	UY	4 11/16"	1 9/16"	STORAGE 6 V. 110 V. DC LINE	6.3	0.30	100		100	9	6.5	110	15000	750	170	17000
								135		135	13.5	8.0	100	11000	900	375	15000

RECTIFIER TUBES

								MAXIMUM A.C. VOLTS PER ANODE	MAX. DC OUTPUT CURRENT (AMPERES)	MINIMUM CHOKE BEFORE FILTER CONDENSER	MAXIMUM D.C. VOLTS DELIVERED TO FILTER (NOMINAL)
BH	FULL WAVE RECTIFIER	UX	4 5/8"	1 13/16"		GAS TYPE NO FILAMENT		350	0.125		300
BA	FULL WAVE RECTIFIER	UX	5 5/8"	2 1/16"		GAS TYPE NO FILAMENT		350	0.350		300
ER-280	FULL WAVE RECTIFIER	UX	5 5/8"	2 3/16"	A.C.	5.0	2.0	350	0.125		300
								400	0.110		370
								550	0.135	20 HENRIES	425
ER-281	HALF WAVE RECTIFIER	UX	6 1/4"	2 7/16"	A.C.	7.5	1.25	700	0.085		700

6-15-31

Arcturus 15-Volt Tubes

Type	22	26-28	30	32	40	48
Plate Voltage (max.)	135	90	180	135	180	90
Plate Current (ma.)	2.0	7.5	22	1.5	21	4.5
Plate Resistance (thousands of ohms)	475	9	3.5	32	2	9.2
Grid Bias (volts)	1.5	1.5	27	3	40.5	4.5
Amplification Factor (mu)	300	10.5	3.8	30	3	11
Mutual Conductance (Gm) or Transconductance (micromhos)	630	1165	1085	940	1500	1185

The filament consumption is 350 ma., except for the 40 type, which takes 400 ma.

The 26 is a detector, the 28 an amplifier. The 22 is a screen-grid tube, using 45 volts on the screen-grid, with 135 on the plate.

The Arcturus 15-volt tubes have but four terminals in the base; the cathode being connected to one side of the filament.

The Sonora RA-1 and SO-1 are equivalent, respectively, to the Arcturus 48 and 40.

Kellogg 2½-Volt A.C. Tubes

Type	K-24	K-27
Plate Voltage	180	90
Plate Current (minimum)	2.0	——
Plate Resistance (ohms)	400,000 to 1,000,000	——
Grid Bias (volts)	1.5	4.5
Amplification Factor	——	8 to 10
Mutual Conductance	800 to 1600	800 to 1200

These tubes draw 1.75 amperes at 2.5 volts across their filaments. The K-24 takes 75 volts on its screen grid.

SERVICING THE AUTOMOTIVE RECEIVER

THE public acceptance of the auto radio opens a new source of revenue for the service man. It is important that the service man understands the peculiar conditions which exist in the installation and servicing of these sets. For this reason the Editors have selected the most interesting and informative data compiled by the various manufacturers of this equipment during years of test and research.

THE ANTENNA

Differences in Antennas.

In considering the antenna system, it is safe to say that there are as many different types of antennas as there are different types of cars. No two types are the same either in physical dimensions or in electrical characteristics. The antenna which will perform most efficiently in one type of car will give very indifferent results in another. To understand the difficulties which must be overcome in each individual installation, it is necessary to understand certain fundamental laws which govern receiving antennas.

The Function of the Antenna.

When a distant broadcasting station is in operation, the electromagnetic lines of force radiated from the station's antenna impinge upon the car antenna and induce in it radio-frequency oscillations which pass through the receiver and are reproduced by the speaker in the form of voice or music. It will be seen therefore that the antenna is a collector of electrical energy. Each passing wave radiated by the broadcasting station striking the antenna creates a difference of potential between the antenna and the ground which is equal to the length of the antenna multiplied by the intensity of the passing wave.

The Most Efficient Antenna.

Up to certain limits a large antenna will deliver greater signal strength than a small one. The current flow in a receiving antenna is directly proportional to its length and to its effective height and inversely proportional to the resistance of the antenna. In simple language, this means that best reception is secured when the largest possible antenna is installed in the car top, when it is farthest separated from the ground, and when the antenna and lead-in wires are securely soldered and offer the least possible resistance to the flow of antenna current.

The Effective Height of the Antenna.

It must be understood that the effective height of the antenna does not necessarily mean the distance between the flat-top portion of the antenna and the earth. In the automobile, no earth connection is possible. In the automobile installation, the chassis of the car is used as a counterpoise which in a sense performs the same function, although not as efficiently. The effective height of the antenna, therefore, is the distance between the antenna and any metallic portion of the car.

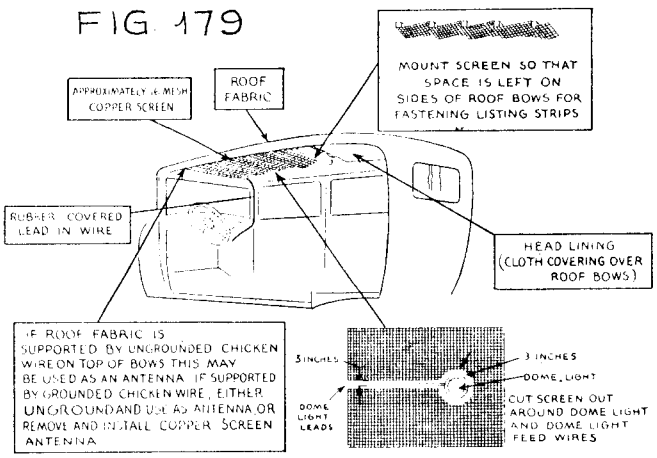
Physical Dimensions of the Antenna and the Ground Connection.

It will be seen that the physical dimensions of the car antenna must necessarily be limited, depending in each case on the type of the car and the construction of the body. It cannot be concluded that the most efficient antenna is to be secured by filling up the car roof with antenna screening. The trend of modern car design is toward all-metal body construction and as the over-all dimensions of the antenna are increased, the effective height is reduced. If the antenna approaches too close to the metallic body of the car, or to the dome light or associate wires located in the car roof, the efficiency of the antenna decreases in proportion to the separating distance. It will be seen, therefore, that some limit must be made in the antenna dimensions.

The Dome Light and Associate Feed Wires.

Experiments conducted over a period of four years have established the fact that the antenna should be separated from the metallic body of the car by at least three inches. It is well to note at this point that wood bodies do not offer this objectionable feature. The antenna screening must be cut out around the dome light and properly spaced from the mounting plate to prevent high frequency leakage. Precaution must be taken to see that the feed wires running to the dome light do not touch the antenna screening. These wires are usually insulated but they should never be allowed to rest upon the antenna. They should be fastened to the extreme upper portion of the bows to reduce the possibility or antenna leakage. See Fig. 179.

FIG. 179



Cars Equipped at the Factory with Antennas.

A number of car manufacturers are equipping certain models of their cars with antennas. Most of these cars will be marked with a sticker placed on the windshield indicating that the car is equipped with an antenna for operation with *Transitone* radio. Where this is not indicated by means of a windshield sticker, an investigation will show the lead-in from the antenna running down the right front body post and tucked under the cowl.

The Lead-in and Antenna Leakage.

The antenna lead-in offers another problem which must not be considered lightly. This wire, which extends from the flat-top portion of the antenna to the receiver behind the dash, must by force of circumstances run parallel with and close to the metal side post of the car. This close relation offers a path of leakage between the antenna and chassis which is objectionable and should be reduced to a minimum. By virtue of the capacity existing between the two, it also tends to destroy the electrical balance of the receiver. This in effect reduces the over-all efficiency and results in weaker signals.

Antenna Requirements for Limousine and Town Car.

The antenna and lead-in requirements of the limousine and town car differ slightly from the above. The limousine is divided into two sections, the forward compartment for the chauffeur and the rear compartment or tonneau for the owners and their guests. These compartments are separated from each other by a heavy glass window for the privacy of the passengers. As the dividing framework extends to the roof, it becomes necessary to install two separate antennas, one in front and one in the rear section, which must be connected together by wires extending through holes drilled in the dividing partition. Three wires are usually sufficient to bond the two sections of the antenna together. As the separating framework is usually constructed of metal, care must be taken that the two sections of the antenna do not approach closer than three inches to the structure.

Lead-in Requirements for the Town Car.

In some cases where time for installation is at a premium, and where the rear portion of the limousine is large enough to accommodate an efficient antenna, the forward section of the car may be disregarded. In this particular case, as in the case of the town car where the forward section is not roofed over, it becomes necessary to deviate from the standard system of running the lead-in wire. In these cases the lead-in is brought down at the front corner post of the rear section. Here the same precaution must be observed as in the sedan and coupé to see that the lead-in wire is run in non-metallic insulating housing. The lead-in should extend to the floor, where it is carried forward to the instrument board in a chiseled groove out in the floorboard.

Care must be taken that this lead-in is not run underneath the metal sill of the front door, as the sill is usually grounded. Such a procedure may materially overload the antenna system and destroy the electrical balance of the receiver. It is sometimes more convenient to carry the lead-in underneath the body of the car. In this case it is necessary to use non-metallic insulating housing as a protection against moisture and abrasion to which the under side of the car is subjected. This housing should extend above the floorboard at the front end and be rigidly supported.

The Metal Roof and Its Effect on Radio Reception.

It has been previously mentioned that the trend of modern car construction is toward an all-metal body. This refinement in body design is also carried to the car roof by many manufacturers. In a great many

cases the fabric of the roof is supported by an iron wire mesh which is laid on top of the wooden bows. In some cases the bows themselves are of metal. This metallic screen extends to the sides of the car and is usually grounded to the body.

This particular feature, while advantageous to the body-builder, offers a serious obstacle to the operation of a radio receiver in a motor car. In effect the iron wire mesh which supports the fabric roof, so sufficiently shields the antenna installed in the car that it prevents the operation of the receiver. The passing electromagnetic waves radiated by a broadcasting station strike the grounded screen supporting

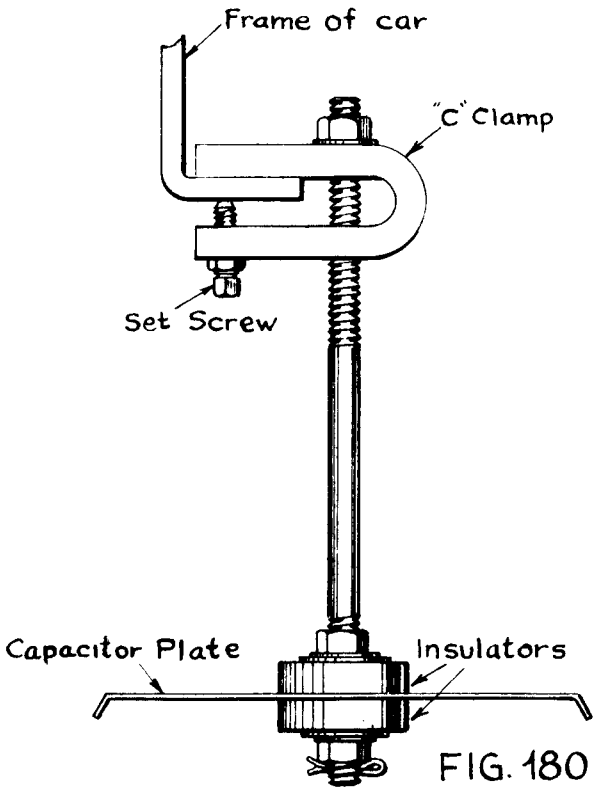


FIG. 180

the fabric top and pass directly to the ground. The iron mesh effectively shields the antenna and prevents the flow of antenna current. Obviously the practical solution to the problem is to remove the iron wire mesh before installing the car antenna or install capacitor plates under the running board. Fig. 180 shows how plates are mounted under car.

Supporting the Top-Fabric.

The purpose of the iron wire mesh must not be overlooked. It is placed over the bows of the roof to support the fabric top. Removing the mesh, while aiding the reception of radio broadcasting, defeats the purpose for which it was intended. In order to prevent the top from sagging, a practical substitute must be provided. This is accomplished by stretching upholsterers' webbing over the tops of the bows.

The exact number of webbing strips and their location in respect to one another are of considerable importance if the fabric is to be effectively supported. It has been found that eight or nine strips are necessary on cars having a bowed roof. On this type of roof, the webbing must not be separated by more than half an inch. If this requirement is neglected the roof will sag in unsupported portions. On flat roofs the webbing may safely be separated by two inches.

Installing the Closed Car Antenna.

The installation of the closed car antenna may be briefly summarized as follows:

It will be necessary to unfasten the front and sides of the head-lining, the back end remaining untouched, then carefully remove the tacks from the listing strips, which are the muslin strips used to support the head-lining at the bows.

Cut the iron mesh as closely as possible to the sides, front, and back of the car. Particular care must be observed that no sharp protruding wires are exposed which may cut into the top-fabric or head-lining.

Remove the iron mesh as well as the staples which are used to fasten it to the top of the bows. It will be found convenient to remove the mesh in small sections.

Stretch the upholsterers' webbing from the back to the front of the car on top of the bows. The number of strips to be used depends on the type of car, as outlined before.

The Screen Antenna.

Tack the copper antenna screen securely into position, making sure that it is separated from the dome light and the metal body of the car by at least three inches. See that lighting wires in the roof are separated from the antenna screen as far as possible.

Securely solder the lead-in wire to the proper corner of the antenna screen.

Testing the Antenna for Possible Grounds.

Test the antenna for possible ground by means of a voltmeter and battery. This test should be made from the antenna lead-in to any metallic portion of the chassis, preferably the gear shift lever.

Carefully replace the car head-lining, working from the middle of each listing strip, progressing toward the front of the car. After the listing strips are in position the sides and front of the head-lining should be replaced.

Run the lead-in as previously outlined.

Retest the antenna for possible ground.

The above installation data refers exclusively to closed cars of metal body construction having wood bows. Cars having metal bows do not come under the above classification. The antenna system used in this type of car will be discussed later.

Antennas for Roadsters and Touring Cars.

In cars of the open type, i.e., touring cars, roadsters, etc., the method of installing the antenna differs considerably from that of the closed type car. This is due to the fact that the tops of these cars are designed to fold back. It will be seen, therefore, that the employment of a copper screen is out of the question. It will also be seen that the antenna lead-in cannot be taken off the front portion of the antenna.

The most satisfactory antenna for this type of car consists of from 65 to 100 feet of No. 18 gauge rubber-covered stranded wire, laced in grid formation in drill cloth and sandwiched between the top of the car and a head-lining of the same material. If the car is not already equipped with a head-lining, the extra material may be procured from the local dealer in automobile fabrics. The stranded wire should be woven back and forth through holes punched in the drill cloth and be so located that the parallel sections of the wire do not approach closer than three inches to each other. The total length of the antenna wire depends upon the dimensions of the top. The touring car will naturally require more wire than the roadster.

The Lead-In of the Roadster and Touring Car.

The antenna lead-in in this type of installation must be taken from the back end of the car. It may be carried to the dash in a groove cut in the floorboards, or it may be run underneath the body of the car. (Refer to lead-in description of Sedan.) The antenna lead-in should always be run on the set side of the dash. If the lead is carried through the motor compartment it may be difficult to eliminate the ignition disturbances.

Installing the Open Car Antenna.

The installation of the open car antenna may be briefly summarized as follows:

Remove the top covering of the car, leaving underside flaps in place.

Cut a piece of drill cloth approximately 3 inches smaller than the width of the top and equal in length to the top.

Procure from the local dealer sufficient top material to construct a false top or head-lining. This material should match the top-fabric and be cut to the same length and width.

Secure this top material in its proper place over the cross-ribs and over the side flaps left exposed by removing the top-covering.

Fasten the drill cloth in which the antenna wire has been woven. This should be tacked to the bows at the front and rear of the car only.

Solder the antenna lead at the back end of the car.

Replace the top-covering.

Run the antenna lead as mentioned above.

Test the antenna for possible ground.

NOTE: *It should be seen* that the antenna wire is not allowed to approach closer than three inches to the top of the windshield. This frame is constructed of metal and if the antenna is not properly located, high frequency leakage will take place. In the event the bows are of metal construction, it must be seen that the antenna wire does not rest upon the bows. The same three-inch separation must be observed here if efficient operation is to be secured.

The Antenna for Cars Having Metal Bows.

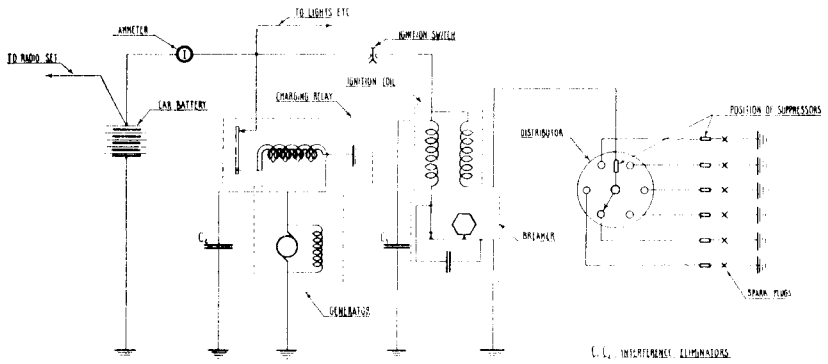
As has been previously mentioned, the trend of modern car design runs toward all-metal body construction. In some cases, as in the Dodge Victory Six, the bows are made of this material. Considering the high frequency leakage and the shielding effect that exists when the antenna is located too closely to the metallic body, it will at once be seen that the copper screen will not constitute an efficient antenna in bodies of this particular construction. Here, as in the open car, the only logical solution to the problem is to resort to the insulated stranded wire antenna properly separated from the metal bows. A number of staples or screw-eyes should be securely fastened around the top frame of the car and separated from the metal bows by not less than three inches. As the top frame is relatively close to the metal body, the stranded antenna wire must not be laced directly through the staples or screw-eyes. A section of heavy twine must be tacked to the top frame, and carried through the screw-eyes or staples in loop fashion. These loops must be long enough to afford the proper separation from the metal structure, after which the antenna wire should be laced grid fashion through the twine loops. No special requirements for the antenna lead-in are necessary.

THEORY OF INTERFERENCE ELIMINATION

In order to fully understand the application of the elimination system it is necessary to consider in a general way the cause of the electrical disturbances.

The Cause of Electrical Disturbances.

In considering the ignition system of the car with its ignition coil to supply high voltage to a series of spark plugs, one important fact cannot be overlooked. The system is, in every sense of the word, an exact duplication of a radio spark transmitter.



ELECTRICAL SYSTEM OF A CAR FIG. 181-A

The ignition system, therefore, is a radio transmitting station located directly under the antenna of the automobile receiver. Fig. 181A indicates electrical circuits of the average motor car.

Function of the Interference Suppressor.

When the ignition system is in operation, the high tension current sets up a series of electromagnetic and electrostatic fields about the high-tension wires which are propagated through space at the speed of light. These fields or impulses, due to the arrangement and physical dimensions of the ignition system, assume a more or less definitely tuned characteristic which is most pronounced over the lower dial settings. It is obvious that if this disturbance is to be avoided, the radiating characteristic of the energy must be reduced or destroyed. The reduction of the undesirable radiated energy is brought about by the introduction in the radiating circuits of units which have been designated as *ignition interference suppressors*. (Fig. 181B.) These are mounted in series with the high-tension leads directly at the plugs and distributor-head and effectively reduce the disturbance without in any way affecting the performance of the engine. Fig. 181C shows position of various resistors and condensers used in suppression systems.

The Magnetic Field.

To understand the function of the unit designated as an interference eliminator, it is necessary to consider the location of the source of the disturbance and its position in respect to the receiver and associate equipment. It will be noted that the high-tension wires of the ignition system are surrounded by the engine, hood, radiator, cowl and engine partition. This metal structure constitutes a shield which surrounds and confines a powerful magnetic field. The receiver, which is located on the instrument board and separated by the cowl and engine partition, is therefore shielded. The actual shielding, however, is more apparent than real. In many of the late model cars the ignition coil is mounted on the instrument board side of the engine partition or on the instrument panel. It will be seen, therefore, that in these particular cases the shielding effect of the engine partition will have little effect on the receiver. In this case the magnetic field is not confined to the engine compartment.

Possible Sources of Disturbances.

The wiring system of the car and the mechanical arrangement whereby the various units of the power plant are operated from the instrument board are also important factors which reduce the shielding effect of the engine compartment. The numerous heat rods, choke rods, thermostat lines, and oil pipes which are carried through the engine partition as well as the necessary wires incorporated in the lighting and ignition systems offer conducting paths which in some cases may cause considerable interference.

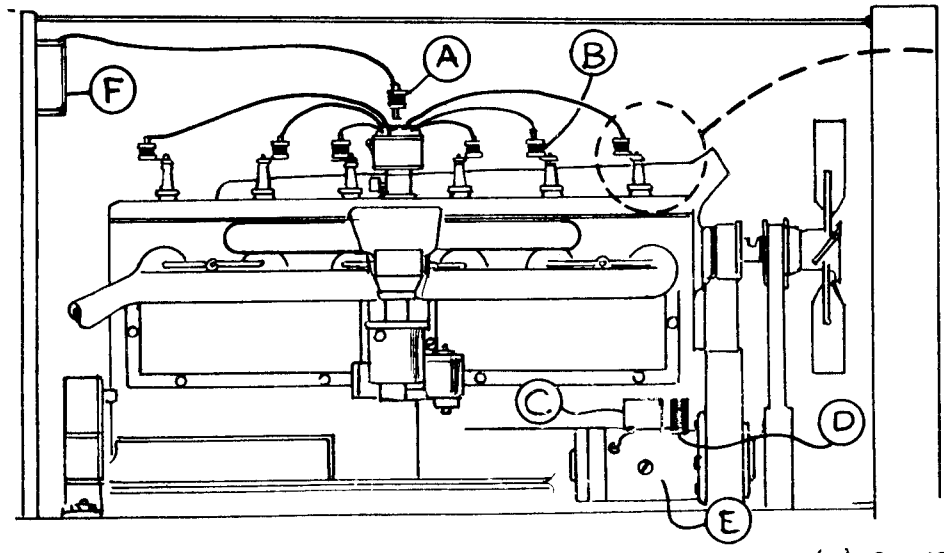
Grounding the Choke Rods, etc.

It is possible in the case of the metal conductors (oil pipes, choke rods, etc.), to eliminate them as a possible source of disturbance by grounding them to the frame of the car at the motor side of the partition. These leads must be as short and direct as possible, otherwise they may defeat the purpose for which they are intended.

Locating the Source of Disturbance.

The method employed in determining the conductor which is responsible for the disturbance is a relatively simple one. The various pipes and rods extending through the engine partition should be temporarily grounded to the metallic structure by means of a screw-driver or other convenient tool. This grounding should be done while the motor is running and the set is in operation, with the hood closed and with the hood clamps fastened.

Interference Eliminators.



A- SUPPRESSING RESISTOR AT DISTRIBUTOR
B- SUPPRESSING RES' AT PLUGS
C- GENERATOR CUT-OUT
(D)- CONDENSER
(E)- CAR GENERATOR
(F)- HIGH TENSION COIL
(H)- SPARK PLUG.

FIG. 181-C (SIDE)

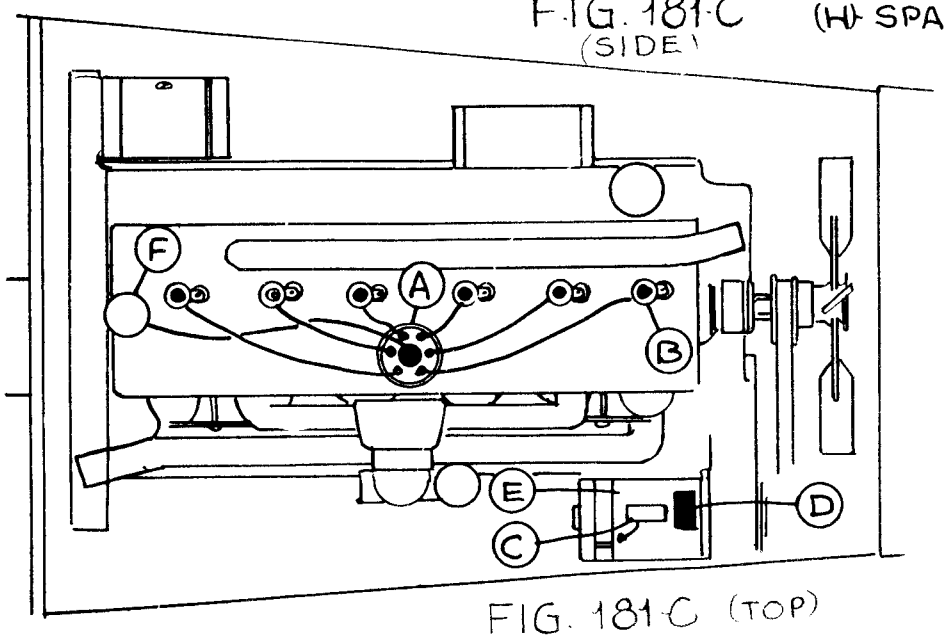
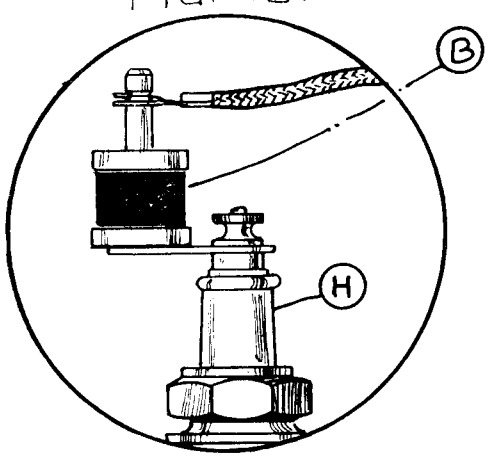


FIG. 181-C (TOP)

FIG. 181-B



This method of bonding or grounding the various conducting paths which allow the transfer of energy from the engine compartment to the receiver cannot be applied to the various wires which pass through the engine partition. Such an attempt to prevent the passage of undesirable impulses would result only in short-circuiting and grounding the wiring system of the car. For this particular purpose interference eliminators are introduced into the circuit.

Electromagnetic Induction.

At this time it becomes necessary to describe the theory involved whereby the magnetic field surrounding the high tension wires of the distributor and ignition systems is carried to the receiver by means of the various pipes and wires running

through the engine partition. In engineering parlance this transfer of energy is described as Electromagnetic Induction. It may be defined as the process by which electrical energy is transferred from one circuit to another by means of electromagnetic lines of force of varying density or changing strength. To the layman, it is only necessary to state that when the current in one conductor is changing at a unit rate per second, it induces similar currents in wires or conductors which are in close relation to its magnetic field.

The Isolation of High-Tension Wires.

It will be seen from the above that the most convenient and effective method of preventing the transfer of energy from the motor compartment to the receiver is to separate all the low-tension wires of the car as far as possible from the high-tension wires of the ignition system. Many car manufacturers utilize the high-tension manifold as a convenient place in which to run the horn wire and the low-voltage lead extending from the primary winding of the ignition coil to the distributor. The close proximity of these leads will cause the condition described in the preceding paragraph. The lines of force surrounding the high-tension plug wire will induce a corresponding intermittent pulsation in the low-tension wire of the coil which will in turn induce similar pulsations into the receiver by means of the wire which extends from the coils to the ignition lock. The horn wire extending to the button on the steering column may contribute to the disturbance, although not to as great a degree, as this wire is usually located at a considerable distance from the receiver.

The High-Tension Manifold.

The obvious remedy in cases of this kind is to remove the horn and low-tension ignition leads from the high-tension manifold.

Suggested Remedy.

If necessary, these wires must be lengthened and relocated at a position which will remove them from the limit of the magnetic field.

The Low-Tension Distributor Wires.

Another serious source of disturbance is caused by the fluctuating magnetic field which surrounds the wires associated with the low-tension side of the distribution system. These wires which run from the ignition switch to the coil and to the breaker-points in the distributor-head, carry a low-tension current of an intermittent character. As the breaker-points open and close, the magnetic field surrounding these wires builds up to maximum and then suddenly collapses, at which time the collapsing field induces a back or counter-electromotive force which may build up to infinity. This intermittent characteristic of the current flowing through the wires, together with the fluctuating field surrounding the same, may cause considerable disturbance in the reproduction of the broadcast program.

Function of the Interference Eliminator and Method of Application.

It will be seen, therefore, that in order to secure reception which is free from interference, it will be necessary to filter or smooth out the fluctuations or pulsations of the current flowing in these wires. This is accomplished by means of the interference eliminators which may be mounted in a convenient position on the engine partition or instrument board of the car. These must be connected by short leads. One terminal of the eliminator should be connected to the wire causing the disturbance and the other terminal to the metallic structure of the car.

Locating the Offending Wires.

This is accomplished by using an interference filter unit as an exploring unit. Flexible leads about five or six inches in length are attached to the terminals of the unit. It may be desirable to fasten clips to the ends of the leads to afford a convenient temporary connection. To detect the offending wire it is only necessary to progressively connect one lead of the exploring unit to every accessible wiring terminal that can be located underneath the cowl or at the engine partition. The other terminal of the unit is connected to the metallic structure of the car. When the interfering lead is located, the spark disturbance will disappear entirely or be considerably reduced. This experiment must be conducted while the receiver is in operation and tuned to a relatively short wave-length, and the car motor is running, with the hood down.

Location of Interference Filter Units.

For the information of the operator or the radio man who is called upon to test the receiver at the completion of the installation, it may be well to designate the places where interference filter units are most frequently required. It must be understood, however, that the use of these units is the exception rather than the rule. In the average installation the standard elimination system successfully overcomes the disturbances of the generator and ignition systems of the car.

The Ammeter.

The most usual location for the interference filter

unit is at the ammeter. The interference filter unit should be connected to the terminal which affords the greatest reduction of the disturbance and mounted on the back of the instrument board.

The Cigar Lighter.

The cigar lighter is another point at which an interference filter unit is frequently needed. This is due to the fact that in some cars the connection leading to the dome light is taken off the terminal of the cigar lighter. The filter unit is to prevent the passage of energy to the antenna screen which may be induced in the lighter circuit by a stray magnetic field underneath the cowl. In testing the receiver, care should be taken that the dome light is turned on and off. In some cases where no spark disturbance is present, completing the circuit to the dome light by turning on the switch will cause the spark to appear.

The Ignition Switch.

The ignition switch is another location where an interference filter unit is sometimes necessary. This is used to smooth out the fluctuations of current due to the interruption of the circuit by the breaker-points.

NOTE: *Considerable caution* should be exercised in attaching filter units to any part of the low-tension side of the ignition system. The introduction of a unit at the wrong point in the system may slow up the motor.

Horns, Fans, and Windshield Wipers.

There are other electrical disturbances originating from entirely different sources which may be desirable to eliminate. These may be caused by motor-driven horns, windshield wipers, electric fans, etc. The elimination principle in these cases is similar in every respect to the above. The interference filter unit is mounted close to the disturbing accessory and connected between it and the ground. In these cases, however, the terminal leading to the accessory must be connected to the wire leading to the battery or ammeter.

NOTE: *It must be understood* that all of the above mentioned interference elimination requirements are never needed for any one motor car. The mechanical and electrical design of the car will determine the number of units which must be used.

The Ignition Coil on the Instrument Board.

Mention has been made of the ignition coil which in some cases is mounted on the instrument board side of the engine partition or on the instrument panel. This particular mounting arrangement calls for a slight deviation from the accepted method of interference elimination. It will be seen that in cases of this kind the magnetic field is not confined entirely to the engine compartment. A considerable field surrounds the exposed high-tension lead which runs in the immediate vicinity of the receiver and the various connecting wires. In order to overcome the disturbing effect of this magnetic field, certain additional requirements are necessary.

In many of the cars in this class, foremost of which are the Packard, Franklin, Oldsmobile, Marquette, De Soto, Viking, Dodge, and Chrysler, it will be necessary to enclose the high-tension lead which extends from the center tap of the ignition coil to the distributor-head in a copper braid. This effectively confines the magnetic field and prevents any transfer of energy to the receiver or associate wires. The braid must extend from the ignition coil to the motor side of the engine partition and be grounded to the car structure at both ends. In some cases, where the ignition switch and coil are not made up in an integral unit, the coil may be re-located on the motor side of the engine partition.

Wooden Engine Partitions.

It must be observed that in some of the cars the engine partition is constructed of wood. In these particular cases the partition must be covered with galvanized sheet-iron and be grounded to the chassis in several places. This may most conveniently be done on the instrument board side of the engine partition. The Nash and Auburn afford the most common examples of this body construction.

The Distributor and Breaker-Points.

It is not unusual, especially in the case of cars which have been on the road for a considerable length of time, to find that the interference elimination methods thus far outlined do not reduce the disturbance below an objectionable level. The noise usually manifests itself in intermittent surges or crackling sounds resembling static which bear no relation to the uniform discharge of the spark plugs.

This disturbance is usually caused by a dirty condition of the distributor. Examination will show that in many cases the breaker-points are dirty and pitted, that the distributing arm and stationary electrodes are oxidized, and that the entire assembly is covered with a film of oil. This unhealthy condition offers a path of leakage for the high-tension currents and prevents the immediate quenching of the low-tension spark which takes place when the breaker-points are opened. It is necessary therefore that the distributor be wiped clean of oil and the electrical members which comprise the unit be placed in a perfect condition.

In some particularly stubborn cases where the intermittent character of the disturbance indicates that the trouble is caused by the distributor, a generator

interference filter unit connected across the breaker-points may overcome the disturbance. At other times the introduction of the unit at this point may intensify the volume. It has been found in cases of this kind that an additional unit located at the ammeter may reduce the disturbance to zero.

This last illustrates one of the peculiarities of interference elimination. No set rule may be designated which will eliminate the disturbing interference in every case. The system whereby the disturbance may be overcome in one case may serve to intensify the condition when applied to another. It is only necessary, however, to know that the aforementioned elimination methods, when intelligently applied, will successfully overcome the ignition disturbances in any type of car.

GENERAL TESTS FOR AUTO RECEIVERS

Power Supply ("A" and "B" Batteries and Connections).

(A). Check connections at the storage battery. Make sure that there is no looseness or corrosion present at the terminals. Note that the polarity of the filament leads is correct.

(B). Check voltage of the storage battery with the set turned on, motor not running, and the car lights off. The correct reading should be 6 volts. A reading of less than 5.6 volts indicates a discharged battery or faulty connection.

(C). Check voltage of the "B" batteries. Each 45 volt unit that shows a terminal voltage of less than 35 volts should be discarded.

Input System (Antenna in Car Roof).

(A). Test for shorts between antenna and the metal body of the car.

(B). Test for open in the lead from the antenna in roof of car to set.

Input System (Capacitor Plate Method).

(A). Check connection of the shielded lead to capacitor plate.

(B). Check capacitor plate for grounds against car frame. Make sure that the shielding of the input cable does not touch the capacitor plate. Clean off any mud or dirt which may collect on the capacitor plate insulators.

(C). Check condition of tubes by using an analyzer to make the "tube test" or substitute tubes known to be good. Use standard tube checker if handy.

Chassis.

Check R.F., Det. and A.F. tubes with set analyzer. Proceed in the manner of checking the various circuits as explained in the section devoted to servicing radio receivers.

WEAK RECEPTION

Low "B" Battery Voltage.

As the "B" batteries drop in voltage a slight falling off in the sensitivity of the receiver will be noticed. Batteries as low as 35 volts must be replaced or noisy reception and poor tone will result.

Occasionally, due to some defect or misuse, one battery may drop excessively in voltage. While the total "B" supply may be between the correct limits, the extremely poor condition of the one battery may cause poor reception. In such an extreme case it is necessary to measure the voltage of each individual battery to locate this defect, and, of course, replace the defective battery.

Low "A" Battery Voltage.

This source of trouble is uncommon due to the fact that it seriously affects the operation of the car and is, therefore, immediately noticed and corrected. However, there may be difficulty due to a poor connection at the battery causing low voltage at the receiver. Make sure that all "A" connections are clean and tight.

Capacitor Plate or Antenna Disconnected.

The shielded lead from the receiver may be broken or disconnected at either end. Weak reception will result if the capacitor plate is grounded at any point. Make sure that the shielding of the "lead-in" cable is not touching the plate, and that the insulators are not broken.

Condenser Misalignment.

Poor condenser alignment may be caused by lengthwise movement of the rotor assembly or one of the stator plates. The setting of the alignment condensers may also have been altered. Make sure that the rotor plates are accurately spaced between the stator plates and that they have not become bent or damaged. The alignment condensers may generally be checked or adjusted without disturbing the set. The receiver should be tuned preferably to a station coming in from 20 to 50 on the dial. Do not, however, attempt to make this adjustment until every other possible source of trouble has been carefully checked.

Speaker Adjustment.

Very weak reception will result if the speaker is enough out of adjustment to allow the armature to rest against the pole pieces. A broken joint in the

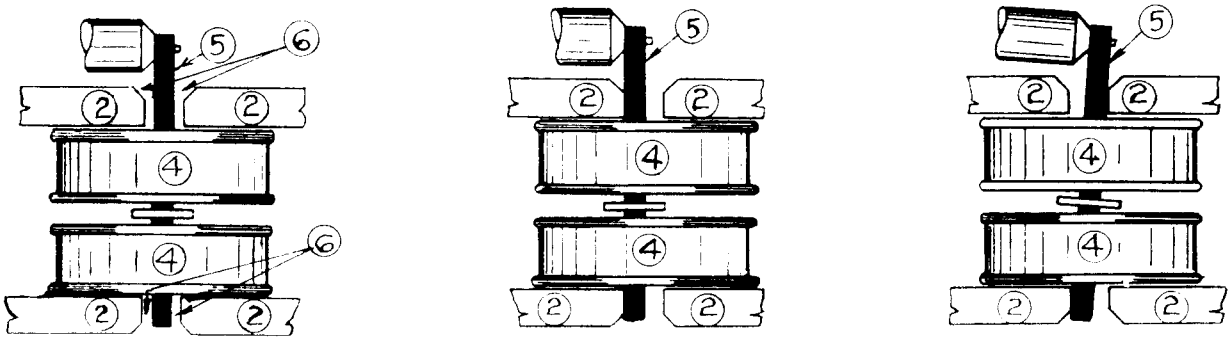


FIG. 182

linkage between the armature and the actuating pin will produce the same effect. Fig. 182 shows correct armature position for no signal condition.

Chassis Defects.

Poor reception may be caused by certain defects in the chassis which can best be located by checking socket voltages with the set analyzer as outlined under "General Test."

NO RECEPTION

No. "A" Voltage.

This condition is obviously indicated by the fact that the tubes and dial light do not light. Battery switch defective. Battery cable open.

Open "B" Connection.

Measure "B" voltages and inspect the "B" connection as outlined under "General Test."

Defective Tubes.

Inspect the tubes for burn-outs or poor contact in the socket. Test the tubes as previously explained under the heading "General Test."

Speaker.

Check the loud speaker on another set or touch its terminals across a radio "C" battery. A click indicates that the speaker is not "open."

Defect in Chassis.

See "General Test" for method of completely checking chassis circuits.

POOR TONE QUALITY

Low or Open "B" Battery.

When "B" batteries are allowed to drop below 35 volts per unit before being replaced there is likelihood of poor tone resulting, accompanied sometimes by a slight whistle. Check voltages as outlined under "General Test."

Defective Tubes.

A defective tube, particularly in the detector or audio stage, will cause very poor tone. This condition can be checked by means of the set analyzer or by substituting tubes known to be good.

Speaker Out of Adjustment.

Rattles in the speaker are caused by loose parts or by the armature striking the pole pieces. Refer to the section on the "Loud Speaker."

Defect in Chassis.

There are certain defects in the chassis which may cause poor tone. Open "C" bias resistors will cause weak and distorted reception. Use the set analyzer to check all socket voltages as outlined under "General Test."

NOISE OR INTERFERENCE

Defective Tube or Socket.

Poor welds or loose elements in the tubes themselves may cause intermittent noise due to the vibration of the car. Poor contact in the sockets will also produce the same result. To locate this trouble, remove the tube shield and jar the tubes vigorously while the set is operating. The detective socket or tube will immediately become apparent through the noise produced.

Loose Connection in Radio Installation.

A loose connection or partial "Ground" in the radio installation will cause irregular interference

and noise. The trouble can best be located by inspecting all wiring and connections, particularly at the capacitor plate and batteries.

Ignition Interference.

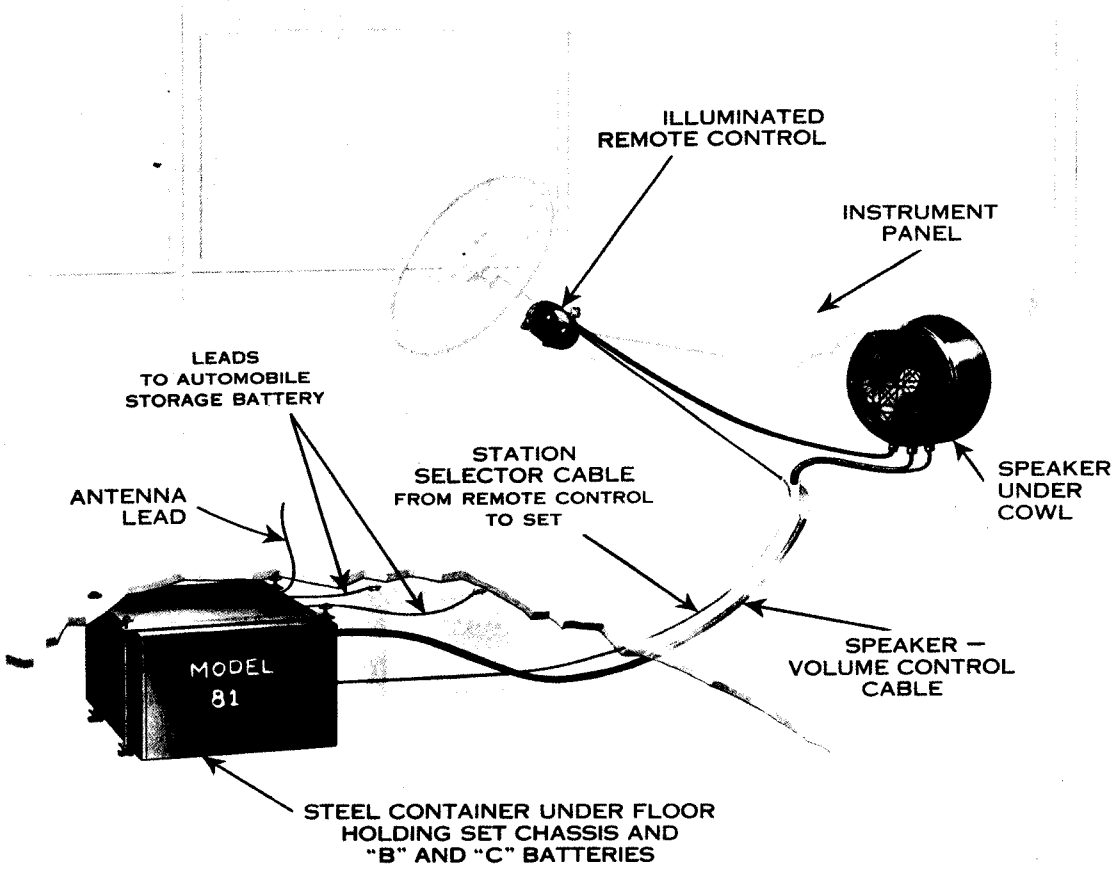
This type of interference is a regular succession of popping noises, especially evident when the motor is idling. The resistance in the spark coil and spark plug leads, as already mentioned, will eliminate this interference except in special cases. As a remedy a 1.0 microfarad condenser may be connected from one of the ignition switch terminals to "ground" or from one of the low tension terminals of the ignition coil to "ground." The proper terminal is best determined by actual trial.

Generator Interference.

A one microfarad condenser connected from the generator terminal to "ground" will eliminate ordinary generator interference. A dirty commutator or worn brushes may cause an excessive amount of interference which can only be eliminated by repairing the generator.

Acknowledgement and thanks are hereby expressed to the following for their kind permission to publish in whole or in part material from their files:

Automobile Radio Corp., N. Y.
Transitone Corp. (Philco)
United American Bosch Corp.



8

The new Atwater Kent automobile receiver can be easily installed in any automobile. It has a specially developed tuned radio frequency circuit employing seven tubes, with push-pull amplification, one bank of three condensers, automatic volume control, illuminated remote control, and a large-size improved electro-dynamic speaker.

SOUND PICTURES AND THE SERVICEMAN

TRAINED men capable of servicing "Talkie" equipment are finding this field a profitable one. The larger manufacturers of this type of equipment maintain large service organization for the theater owners and, of course, prefer to have their units serviced by their own men. Many small houses use less costly equipment and, of course, furnish their own service. This is the best point of attack for the independent service man. In many small cities, one man services all the theaters. Some theater owners "chip in" and employ a man to service two or more theaters, thus reducing their individual service expense.

The following paragraphs offer a brief explanation of the principles involved in the recording and reproduction of sound and a general discussion covering the troubles encountered in servicing the equipment. No attempt has been made to make this section anything more than an outline, because space will not permit the inclusion of everything that could be said on the subject.

Sound.

Sound may be considered as a series of vibrations of the air of such frequency or pitch, that it creates the sensation of hearing to the human ear. When the air is set in motion by any means whatsoever sound is produced, provided that the frequency of the vibrations are audible. An interesting chart is shown in Fig. 183 indicating the frequency range of various sounds and noises and their relation to the musical notes of the piano for comparison.

Sound Recording On Film by the Variable Density Method.

There are two methods in common use in recording the sound on the film. The method called "variable density" recording has the entire sound track exposed, and the amount of light passed through it is varied by regulating the amount of exposure. The voice or sound causes a variation of the electric current flowing in the microphone circuit. These variations are magnified by the amplifier and operate a shutter or "light valve" in the recorder to permit more or less light to fall on the sound track.

For each electrical impulse the shutter will open in proportion to the strength of the impulse and then close. This results in a series of lines entirely

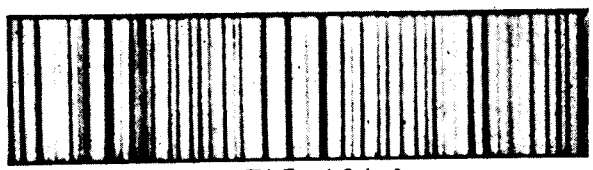


FIG. 184 A

across the sound track, the darkness of the lines corresponding to the volume of the recorded sound and the number of lines per inch corresponding to the pitch. This system is used by the Western Electric Co. and its licensees. Fig. 184A is an example of this method of recording.

Sound Recording on Film by the Variable Area Method.

In this method of recording, the electrical vibrations from the amplifier are changed into correspond-

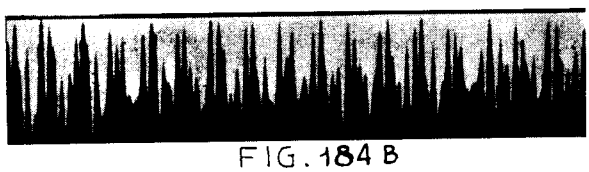


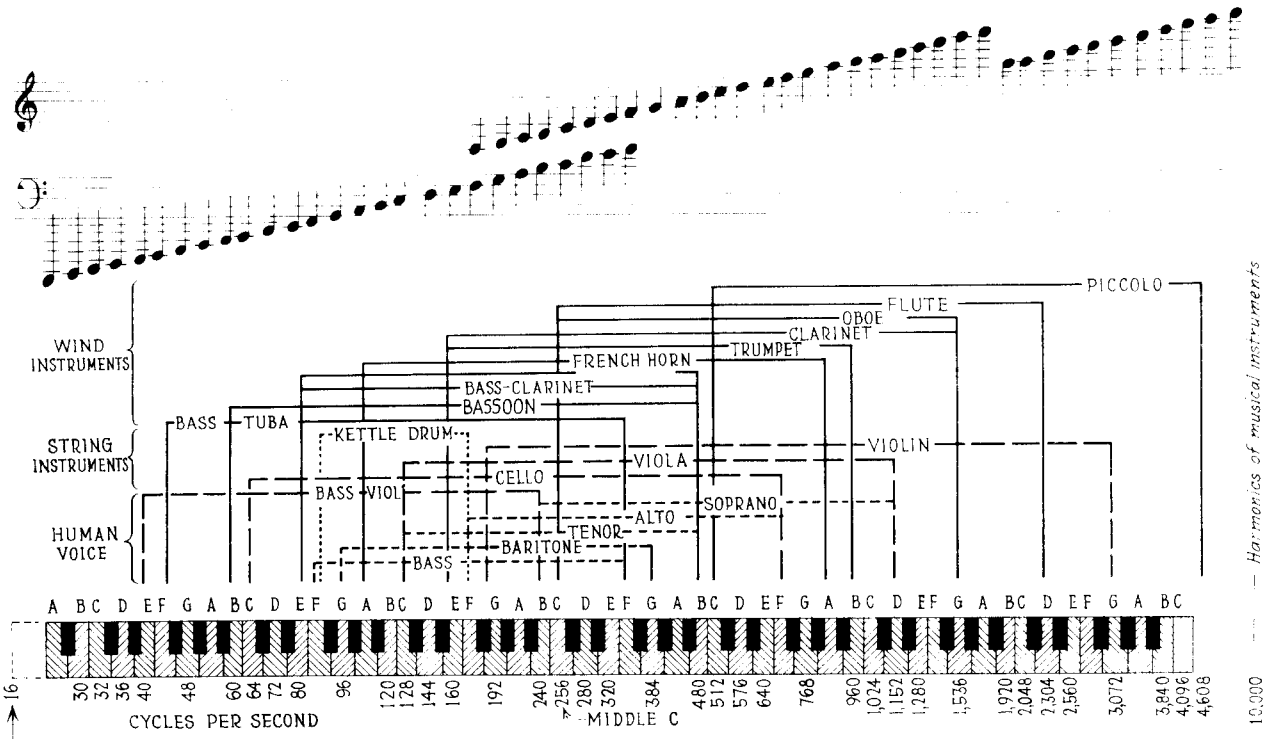
FIG. 184 B

ing variations in the movement of a narrow beam of light focused on the sound track of the unexposed film as the film moves past the recording optical system.

This sound track appears as a series of dips and peaks, the height of the peaks corresponding to the loudness of the sound recorded and the number of peaks per inch corresponding to the pitch. The peaks will be of the same darkness (that of completely exposed film) and will pass the minimum

Electronics' Chart of

Sound Frequency Characteristics



Point at which sense of feeling begins, before sense of hearing

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WIRE TRANSMISSION CIRCUITS

- Television wire circuit (20 to 18,000 cycles per second)
- Highest-class wire line for broadcasting (50 to 8,000)
- Ordinary wire circuit for broadcasting (50 to 5,000)
- Ordinary telephone talking circuit (250 to 2,750)
- Trans-oceanic telephonic cable (300 to 2,500)
- Standard telephone instrument (300 to 1,800)
- Early telephone lines (500 to 1,800)

Door squeak

RADIO BROADCASTING AND RECEPTION

- Modern broadcasting transmitter (30 to 7,500)
- Broadcasting station transmitting chain program (90 to 5,000)
- High-quality radio set (50 to 5,500)
- Obsolete or poor radio set (256 to 2,200)

Chirp of insects

SOUND REPRODUCERS

- Public-address system (60 to 5,500)
- Dynamic loud-speaker (40 to 5,500)
- Exponential loud-speaker (70 to 5,500)
- Electro-magnetic pickup (60 to 5,500)

SOUND RECORDINGS FOR RADIO AND FILMS

- Highest type electrical trancriptions for radio ("Hill & dale" cut) 30 to 10,000)
- Sound-picture film sound track recording (0 to 8,500)
- Sound-picture disc record 33⅓ r.p.m., lateral cut (60 to 6,000)

HOME PHONOGRAPHS

- Modern electric recorded home phonograph (60 to 5,000)
- Recent acoustic phonograph (90 to 4,500)
- Old fashioned phonograph (256 to 3,000)
- Office dictating machines (350 to 2,000)

MISCELLANEOUS

Niagara Falls 40 to 50

Thunder 20 to 40

Distant gunfire

60-cycle A.C.

Average man's speaking voice Av. 128

Average woman's speaking voice Av. 256

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amount of light. It will be noted that the amount of light passing through the sound track will depend upon the area of the unexposed portion. Fig. 184B.

"AEO" Light Recording.

Another system of recording is used by Fox Movietone. In this system, the electrical pulsations from the amplifier are used to vary the brilliancy of a lamp instead of opening and closing a "light valve." The lamp used for this purpose is called an "AEO" light.

General Requirements for Good Reproduction from Film Recordings.

We have seen that the aim, in all types of recording on film, is to create a photographic record in the form of a narrow sound track which would vary the amount of light through it (from a steady source of illumination) in proportion to the sound pressures on the diaphragm of the microphone.

Sound reproduction from film recordings requires that the variations of the amount of light transmitted through the photographic record be accurately translated into sound. To accomplish this, a thin beam of intense light, the width of which is equal to the width of the sound track, is focused on the sound track. The varying light which passes through the sound track affects a sensitive photo-electric cell so as to cause a varying electric current to pass through it. In the RCA Photophone system, this varying current is passed through a transformer primary. The voltage generated in the secondary of the transformer is amplified in the vacuum tube amplifier, the output of which is used to operate loud-speakers.

The Western Electric Co. feeds the output of the photo-electric cell into an amplifier unit mounted in the same compartment with the cell; the output of this so-called "head amplifier" being fed to the voltage amplifiers, power amplifiers, and then to the speakers.

The source of the light (exciter lamp) which shines through the film must be steady, that is, there must be no fluctuations in the amount of light. The beam of light must be nearly as thin as the beam used in recording, and exactly as wide as the sound track. The beam should not be more than 0.001 of an inch thick and should be exactly 0.084 of an inch wide.

The speed of the film passing the light beam must be the same as the film speed of recording and must be absolutely constant. Variations in speed would cause variations of pitch which would be recognized as "wows." This speed is 90 ft. per minute.

Reproduction from Variable Density and Variable Area Recordings.

Although the sound tracks of the variable area and variable density recordings do not look alike, the variations of the light transmitted through them are the same. Reproducing equipment which is suitable for reproducing from one type of recording is equally capable of reproducing from the other. All producers of standard sound recordings on film use the same width of sound track, and use a light beam of approximately the same thickness.

Exciter Lamps.

These lamps should not be operated at a higher current than that for which they are rated. As the lamp becomes old a dark coating inside the lamp materially decreases its efficiency. For this reason exciter lamps should not be used until burned out,

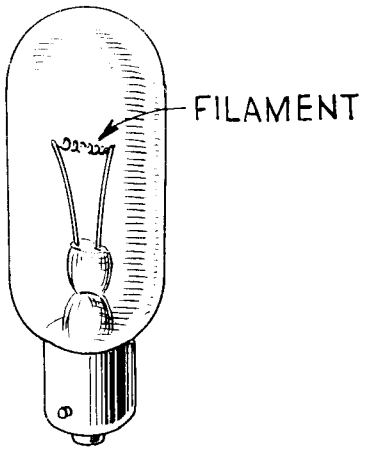


FIG.185

but should be replaced when the coating reduces the efficiency of the lamp to a point where satisfactory results cannot be obtained when the lamp is drawing its rated current. The exciter lamp is illustrated in Fig. 185.

Photo-Electric Cells.

A photo-electric cell is a device which varies in electrical resistance in proportion to the amount of light falling upon it. Therefore, a varying amount of light falling on its internal elements will cause a varying current in the external circuit. A standard photo-electric cell is shown in Fig. 186.

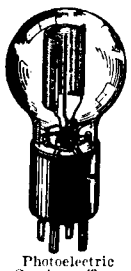
VACUUM TUBES

In many of the sound systems, standard tubes such as '24, '27, '50, '80, and '81 tubes are used. These tubes are covered in the section of this manual devoted to "Vacuum Tubes and Their Operation."

AMPLIFIERS

In general, the amplifiers used in "talkie" systems

are divided into two classifications. The output stage is termed the "power amplifier" as it furnishes the power to operate the speakers. The preceding stages are termed the "voltage amplifiers." Some models combine these two sections into one unit being entirely self-contained and A.C. operated.



Photoelectric Caesium Type cell.

TROUBLES IN SOUND SYSTEMS

Even with the best of care, troubles can develop which require immediate attention and correction. It is important that the operator or service man be ready to meet them with a definite idea as to what is to be done.

The troubles which may be experienced with sound reproducing equipments depend upon the type of equipment used. These are discussed in this section and more detailed discussion of troubles for a particular type equipment can be found in the instruction book which is sent along with the apparatus.

Probably the most common of the troubles experienced are those which are due to "slip-ups" in operation. It is important to check over the operating procedure before looking elsewhere.

If the trouble is not due to a "slip-up" in operation, then the portion of the equipment causing the trouble should be isolated by systematic tests. The instruction books sent out with equipment should be studied and the service man should familiarize himself with the individual peculiarities of the equipment.

When the fault has been discovered, it is usually a fairly simple matter to remedy the condition. The more probable causes of trouble in the various portions of the equipment are discussed in the manufacturers' service books.

Checking for Errors in Operation.

If no sound is obtained when starting, or when "changing-over" from one projector to the other, check for any of the following errors:

(a) Switches or other controls set incorrectly anywhere in the equipment or in its power supply circuits. (While checking the controls of the amplifier, inspect the tubes of the voltage and power amplifiers to see that they are all lighted.)

(b) Fader switch set for the wrong projector, or fader set in the "Off" position or for the wrong projector.

(c) Loud speakers not plugged in at the stage. (If "no sound" is due to the stage speakers being disconnected, sound can still be heard at the monitor speaker.)

If in checking over the routine operation no error is noted, the trouble is probably due to some defective part, and the next thing to be done is to isolate that defective part.

Systematic Tests for Locating a Defective Part.

Usually the most effective method of locating a defective part is by determining to what extent the equipment is still operative. If no sound is obtained from the photo-cell circuit of one projector, the other projector should be "faded in" and tested. If sound can be obtained from one projector and not from the other, the indication is that the defect may be in the fader circuit or in the sound head from which no sound can be obtained.

If it is found that sound cannot be obtained from either projector, the indication is that the trouble is in the amplifier equipment. If a non-synchronous phonograph attachment is available, the amplifier can be checked by plugging the non-synchronous phonograph input plug into the jack provided, and listening for sound while tapping the pick-up needle of the phonograph. If sound can be obtained from the non-synchronous phonograph and not from the projectors, the indication is that the amplifiers are O.K. and the defect is in the fader photo-cell units.

If no sound can be obtained from either of the projectors or from the non-synchronous phonograph, the indication is that the trouble is in the amplifier rack equipment or in its power supply circuit

No Sound From the Stage Speaker.

In case no sound is obtained at the stage and the sound is O.K. at the monitor speaker, the trouble must be somewhere in the line leading from the amplifier rack to the stage speakers.

Low Volume.

Low volume when using sound-on-film may be due to any of the following:—incorrect exciter lamp current, dirty or old exciter lamp, exciter lamp out of focus, sound gate aperture partly clogged, a defective photo-cell, or defective tubes.

Unequal Volume from Projectors.

If unequal volume is obtained from the two projectors when using sound film, the projector giving the lowest volume should be checked for trouble. If no cause is found for low volume the output of the projectors should be balanced by following

the directions in the manufacturers' service sheets furnished with the equipment.

Poor Quality.

Poor quality of sound from sound film may be due to any of the following causes:—poor sound film, dirty sound gate, dirty film, dirty constant speed sprocket, a defective photo-cell, an out-of-focus optical system, or defective tubes.

Poor quality of sound is often blamed on the equipment when the fault is in the film itself. On the other hand, dirt on the film or on the sound gate will ruin the quality of sound from a good recording.

A defective photo-cell can spoil the quality of the reproduced sound.

A photo-cell can be spoiled by misuse. It is important that the photo-cell should not be exposed to strong light at any time, whether the polarizing voltage is applied or not. They should be handled gently and not jarred. When no film is in the projector, the circle of light from the exciter lamp can be seen on the photo-cell. This circle should be located at the exact center of the plate of the photo-cell. Dirty prongs on the photo-cell may also cause trouble. These can be readily cleaned with fine sandpaper.

Exciter Lamps.

It is very important that the adjustment of the exciter lamps be checked by the projectionist before beginning the show at least once a day, as a loss of volume will be the result of any defect in their adjustment.

Exciter lamps should not be used after they have become excessively dark, but should be replaced.

All finger marks should be wiped off the lamp immediately. If the lamp becomes hot while greasy finger marks are upon it, the marks will be hard to remove later. The condensing lens on the optical system should be kept clean at all times.

The socket in which the exciter lamp is mounted should not be allowed to become loose. If the exciter lamp is loose it will be difficult, if not impossible, to keep the exciter lamp focused during the operation of the machine.

Amplifier Tubes Fail to Light.

If some of the voltage or power tubes fail to light while others in the same unit do light, the indication is that the unlighted tubes are burned out, and should be replaced; but if none of the tubes of a unit light when the amplifier is turned on, the indication is that the fuse is burned out or that there is something at fault in the power supply feeding the amplifier unit. As soon as it is noticed that none of the tubes light, the equipment should be turned off and all fuses and circuits checked.

Noise and "Motorboating."

Noise and "motorboating" when using sound film may be due to any of the following reasons:

Poor ground connections on the projectors. Clean and tighten.

Optical systems out of adjustment in such a way that the light ray passes through the sprocket holes of the film, or through the frame lines of the picture.

Guide rollers out of adjustment. The guide rollers in the sound gate should rotate freely. There should not be side play in the outside roller, but it should not bind on the gate shoe. If the guide roller is loose or out of position, the film will weave in and out through the gate, thereby causing "flutter" or "film noise," and the reproduction will be poor.

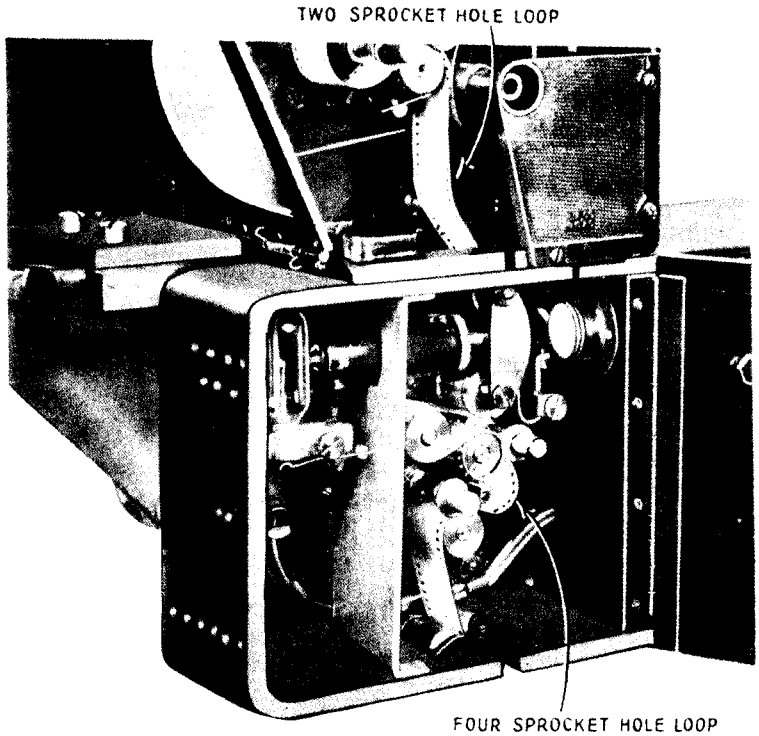
"Putting" noise in amplifier. In cases where the amplifier "motorboats" it is necessary to check over the tubes, and if batteries are used test them, because as the batteries age, they generally offer a common path of high impedance to the various tube circuits.

Reverberation and Its Elimination.

Reverberation can be stated as the persistence of sound in an enclosed space. When a sound wave is created in an enclosed room and strikes one of the walls, part of the sound is reflected, part transmitted, and part absorbed. It will be noted that an echo is simply a sound wave which is reflected back to the ear after the original impulse has died out. If two sounds strike the ear with a shorter period of time than one-tenth of a second, the ear cannot recognize them as separate sounds. As sound travels 1100 feet per second, we cannot receive an echo from an object that is closer than about 55 feet.

If a hall or auditorium uses hard materials for the floors, walls and ceilings, and the distance which the sound travels is less than 55 feet, the repeated reflections from the various surfaces bound back on the original sound and interfere with it to such an extent that a condition called reverberation is brought about resulting in "garbled" speech and music. The cure for this condition is to cover the floors, walls, and perhaps the ceiling, with some material capable of absorbing the excess sound that is represented by reflection.

One way to do this is to break the reflecting surfaces up into small sections so that the sound reflections by colliding with each other, will waste their energy and quickly die out. This is done in modern theater design. In old buildings, the established practice is to line the walls with sound absorbing material, using as much material as is necessary to reduce the period of reverberation to a satisfactory value.



Film side of PS-16 sound head RCA Photophone, Inc.

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Reverberation Time.

Professor Wallace C. Sabine found that a definite relation exists between the time of reverberation in seconds (t), the volume of the room in cubic feet (V), and the absorbing effect of the various materials present per square foot (A).

$$t = \frac{0.05V}{A}$$

Sound-Absorbing Coefficients for Pitch 512

Material	Coefficient per sq. ft.
Open Window	1.00
Acoustex 1 in. thick	0.37
Balsam Wool, bare, 1 in. thick, 0.26 lb. per sq. ft.	0.44
Brick wall	0.032
Brick wall, painted	0.017
Carpet, unlined	0.15
Carpet, lined	0.20
Carpet, with ½ in. Ozite hairfelt	0.25
Celotex, unperforated, 7/16 in. thick	0.20
Acousti-Celotex, type BB, painted or unpainted	0.70
Cork tile	0.03
Curtains in heavy folds	0.40-0
Flaxlinum Acoustic Tile, ½ in. thick, with wooden casing and metal screen	0.42
Glass (single thickness)	0.027
Hairfelt, bare, 1 in. thick, 0.75 lb. per sq. ft.	0.58
Oil painting, per sq. ft.	0.28
Linoleum	0.03
Marble	0.01
Plaster on wood lath	0.034
Plaster on metal lath	0.033
Plaster on tile	0.025
Sabinite Acoustical Plaster	0.21
Stage opening, depending on stage furnishings	0.25-0.40
Ventilators	0.75
Wood, plain	0.06
Wood, varnished	0.03
Adult person	4.7
Plain wood seats	0.15
Church pews, per seat	0.2
Seat cushions, per seat	1.00-2.00
Opera chairs.	
(a) plywood seat and back, no upholstery	0.24
(b) padded seat and back, covered with pantasote (imitation leather)	1.6
(c) various paddings, covered with velour or mohair	2.3-3.5
Piano	.6
Table	.2

Trade Name	Fire	Thickness	Coeff. per sq. ft.
Acousta-Zenitherm	Inflammable	1¼″	.33
Acoustex	Fireproof	1″	.54
Acousti-Celotex B	Inflammable	¾″	.43
Acousti-Celotex BB	Inflammable	1¼″	.63
Acousti-Celotex C	Inflammable	⅜″	.28
Acoustile	Inflammable	¾″	.37
Acoustolic	Inflammable	½″	.37
Akoustolith	Fireproof	½″	.29
Akoustolith Sound Abs. Stone	Fireproof	1″	.32
Ambler Plaster	Fireproof	¼″	.08
Asbestos Akoustikos Felt	Flameproof	½″	.31
		¾″	.45
		1″	.59
		1½″	.73
		2″	.79
		3″	.79
Balsam Wool	Flameproof	1″	.56
		½″	.41
Blast Hair Blanket	Inflammable	2″	.76
Celotex Building Board	Inflammable	7/16″	.22
Corkoustic	Inflammable	1″	.30
		1½″	.32
		2″	.35
Flaxlinum	Inflammable	½″	.34
		1″	.61
Gimco Acoustic Flexfelt	Fireproof	1″	.56
		1½″	.61
Insulite Building Board	Inflammable	½″	.30
Macoustic Plaster	Fireproof	½″	.08
Masonite Building Board	Inflammable	7/16″	.28
Nashkote A Perforated	Flameproof	½″	.43
		¾″	.53
		1″	.67
Nashkote AX	Flameproof	½″	.34
		¾″	.38
		1″	.43
Nashkote A-1-S, A-C-S	Flameproof	½″	.31
		¾″	.38
		1″	.46
Nashkote B-045	Flameproof	½″	.39
		¾″	.49
		1″	.64
Nashkote F	Flameproof	½″	.35
		¾″	.49
		1″	.65
		1½″	.72
		2″	.76
		3″	.77
Nashkote O-M-C	Flameproof	½″	.34
		¾″	.47
		1″	.67
Nashtile	Inflammable	¾″	.38
Nephi	Fireproof	¾″	.16
No-Echo Acoustical Tiles	Fireproof	⅞″	.35
Ozite Carpet Cushion	Inflammable	¼″	.13
		⅜″	.17
		½″	.20
		¾″	.28
Penn Acoustic Felt	Inflammable	½″	.31
Sabinite Plaster	Fireproof	½″	.29
Sanacoustic Tile	Fireproof	1¼″	.71
Spray-Acoustic	Flameproof	½″	45
		¾″	.61
		1″	.70
U. S. G. Acoustical Tile	Fireproof	½″	.47
		¾″	.56
		1″	.61
Westfelt	Flameproof	¼″	.19
		½″	.32

Acceptable Limits of Reverberation.

The figures given in the table are not to be regarded as absolute. Many rooms have values which exceed these mentioned in either direction by tenths of a second but are still satisfactory acoustically.

VOLUME OF ROOM IN CU. FT.	ACCEPTABLE REVERBERATION TIME IN SECONDS	
	Half audience	Full audience
10,000	0.9-1.2	0.6-0.8
25,000	1.0-1.3	0.8-1.1
50,000	1.2-1.5	0.9-1.3
100,000	1.5-1.8	1.2-1.5
200,000	1.8-2.0	1.4-1.7
400,000	2.1-2.3	1.7-2.0
600,000	2.3-2.6	1.8-2.2
800,000	2.5-2.8	1.9-2.3
1,000,000	2.6-2.9	2.1-2.5

Sabine's formula can be rearranged so that it states that the absorption units required to reduce reverberation to a certain period are equal to 0.05 times the cubic feet volume of the room divided by the reverberation period; thus simplifying the mathematics necessary for the proper selection of absorbing materials.

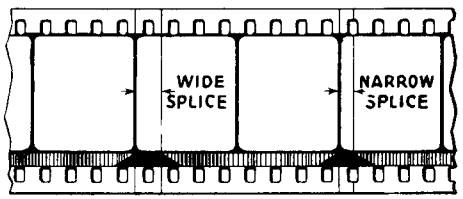


FIG. 187 A

Phasing Speakers.

In installations using more than one speaker it is necessary that the movements of the voice-coils be in phase. This is accomplished by connecting a small 4.5-volt flashlight battery with a circuit-closing arrangement to the speaker voice-coil lines. One man should stand in front of the speakers and closely observe the motion of the cone on the speaker. Close the battery circuit and note the direction of motion of the cone. The cone will move either in or out from the starting position. Check all of the speakers, one at a time, noting the direction of movement of each.

If one of the speakers' voice coils moves in while another moves out, it is necessary to reverse the voice

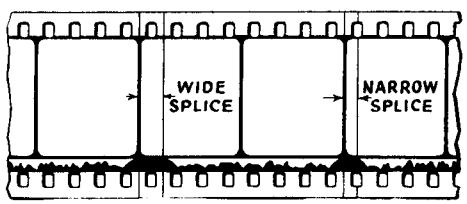
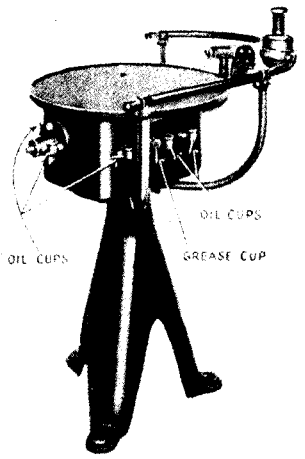


FIG. 187-B



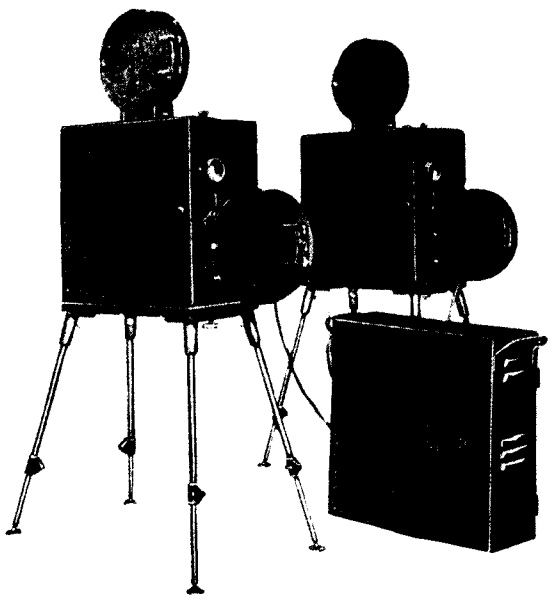
Type PT-7 synchronous turntable (Used in PG-10 equipments)

RCA Photophone, Inc.

coil connections of one of the speakers. All of the voice cones should move in or out in unison as the battery circuit is closed and opened.

Patching.

When a break occurs in a sound film it should be patched in the usual manner, but the sound track requires special treatment. The sound track should be painted as shown in Figs. 187A and B. Paint a half-moon over the sound track if the recording is variable area, and a blunt apex if the recording is variable density. Use Zapon concentrated Black Lacquer No. 2002-2.



The projectors and amplifier used with the PG-5 portable equipment

RCA Photophone, Inc.

ERECTING AERIAL AND INSTALLING SET

Although complex antenna systems have been used in transmission to good effect, it will be noted by those of you who reside in maritime ports that the big liners now employ a simple single wire antenna of heavy wire. Cages and fancy "gadgets" may present a pleasing appearance but add little to the collecting properties of the system.

The "doo-dads" and "gadgets" in various forms offered as "staticless" by certain advertisers have little merit save in locations where it is impossible to install a flat-top antenna of sizable proportions. Here these devices are sometimes able to give good accounts of themselves.

In installing the antenna it should be kept high and wide from all obstructions—particularly from structural steel formations. The "L" antenna shown in Fig. 188 is the usual type and although its directional properties are not pronounced, it is slightly more sensitive in the direction of the tap off. It is therefore, wasteful to tap off an "L" type antenna in the direction from which little of entertainment value can be expected.

How Long?

Many times the question is propounded—how long an antenna should be used? With the modern and highly sensitive receivers of today, the answer is to the effect that the antenna should be just as short as is compatible with the reception of distant signals. In rural districts where there are no locals to produce interference, a long antenna may be used to increase the sensitivity during daylight hours—for in many such localities, the nearest broadcaster may be a hundred or more miles away and a high degree of sensitivity is required if satisfactory daylight service is to be obtained.

The flat-top portion of the antenna may vary from twenty to a hundred feet in length, therefore, as a longer antenna might possibly result in upsetting the ganging of the tuned circuits.

The lead-in should run as directly to the receiver as possible. This lead wire should be kept clear of the building by at least six or eight inches. Unless the customer seriously objects, the receiver should be placed in such a manner as to make both the lead-in from the antenna and the ground lead as short as possible.

For the antenna itself, any good grade of antenna wire may be used although due care should be given to its tensile strength. Stranded phosphor-bronze wire has the best all-round characteristics and the enameled wire now on the market aids materially in reception as the enameled covering prevents oxidation of the wire and consequent increase in its radio frequency resistance.

In certain locations, the interference picked up by the down-lead running close to the building is great due to the presence of elevators and what-not in the building. In these locations a shielded wire may be used to advantage. This wire resembles BX cable on a diminutive scale and the sheathing should be grounded at the lightning arrester.

Contrary to belief in some circles, the lightning arrester is a decidedly important piece of apparatus. Not only is it necessary to use an arrester of high quality for the protection it affords, but for the assurance that the arrester will not short-circuit and cause a total loss of signals which condition is difficult to diagnose.

The arrester does not protect one materially from a direct stroke of lightning—neither does the antenna provide a hazard in this respect. The arrester does protect the set from the ravages of heavy static discharges such as may readily burn out the input coils of the receiver.

In some locations this occurs to every receiver at least once in its life-time. Arresters approved by the Underwriters are satisfactory for use and care should be taken that an approved model is employed.

In the country, it is possible to keep the arrester out of doors as shown in the figure, but in the city the best form of installation is the mere placement of the device across the antenna and ground leads at a point as near their entry to the house as possible. By all means, do not skimp on the lightning arrester

as you may be held responsible for any damage to the receiver resulting from such neglect.

In cities, the ground may be a water pipe (preferably "cold") or a radiator—but by no means should a gas pipe be taken as the ground.

There are many forms of ground clamps for making this connection and much time may be saved in the installation of a receiver by using a clamp which is readily attached. In country districts, it is sometimes impossible to ground the receiver to a pipe and in these cases some sort of manufactured ground is necessary.

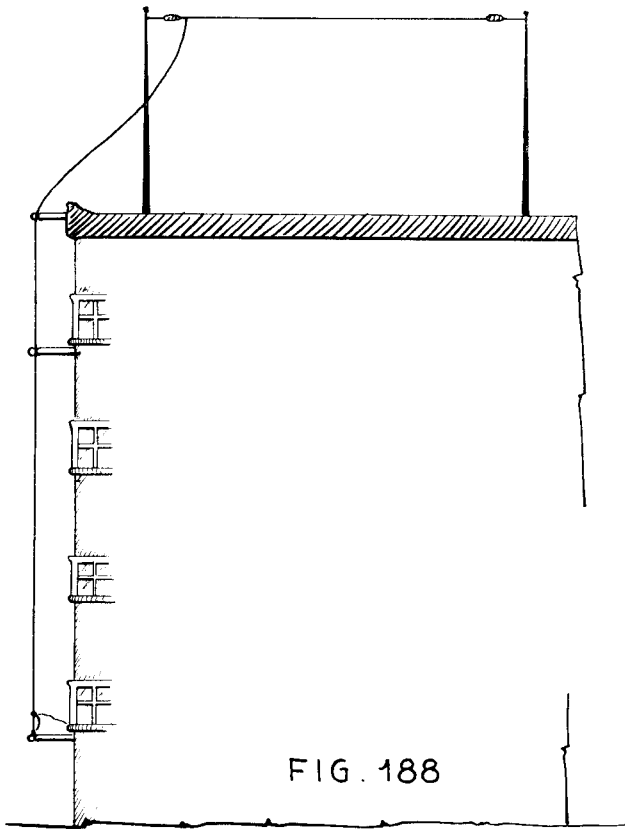


FIG. 188

The best manner of grounding the receiver in such locations is by digging a number of shallow trenches fan-wise under the antenna and burying wires in them. These wires may be as long or a bit longer than the antenna itself. An alternative method is to bury a bucket to which a connecting wire has been soldered, several feet in the moist earth. If the earth is naturally dry, some means should be provided for periodically moistening the surrounding earth.

A Good Ground Is Essential on Modern Receivers If Oscillation Is To Be Avoided.

The antenna lead-in and the lead-in from an external ground of the type just described may be by means of the familiar window strips. It is preferable that the connecting wires be soldered firmly to these strips and the joints taped. The interior wiring should be done with silk covered wire which matches the wood work as closely as possible. There is no excuse for a sloppy interior job and the customer has every right to kick if a job of this nature is turned out. In wiring the interior, care should be taken that the lead wire does not traverse the back of the receiver cabinet as undesirable coupling may result.

Bring the antenna and ground lead wires up to the receiver on the back side near the "A" and "G" terminal posts. This is usually on the left as we face the front of the receiver.

In installing a new receiver, make sure that all packing strips, etc., have been removed and that the receiver and speaker are bolted down securely in the cabinet. If cushions are provided to be placed under the receiver or speaker to avoid acoustic feed-back and howl, make sure that these are in place so that future trouble may be avoided.

Extraneous Noise.

In many cases it is found that noise cannot be eliminated by servicing the receiver. Noise may enter the home from outside via the electric light lines or through the antenna. In such cases, the only way in which you can check the source is to turn off—one after the other—all electrical apparatus in the near vicinity. First make sure that the noise is not due to a loose antenna connection or to some fault in the receiver which you have slipped over without recognizing it.

Where it is impossible to get at the source of the interference, a shielded antenna down-lead may be employed and an interference filter of one of the commercial types may be inserted in the power supply circuit. These may be obtained from most radio jobbing houses and are not economical to construct at home.

When the interference source can be located, it is possible that—in the case of motors, etc.—the trouble can be remedied by merely cleaning the brushes.

X-ray machines and other electro-medical apparatus rarely yield to any form of treatment.

If the trouble cannot be remedied through the servicing of the appliance in question, a filter system of large current-carrying capacity can be inserted between the interfering equipment and the supply line. Such apparatus is readily obtainable from many manufacturers who specialize in this class of equipment.

Where the interference is picked up in the antenna it may often be remedied by shielding the antenna down-lead. This is done by using lead-covered cable for the lead-in and grounding the lead casing at one or both ends. While this does not seem a particularly efficient form of coupling, it is in reality quite effective in achieving the desired end. When using a shielded lead-in of this type it is often necessary

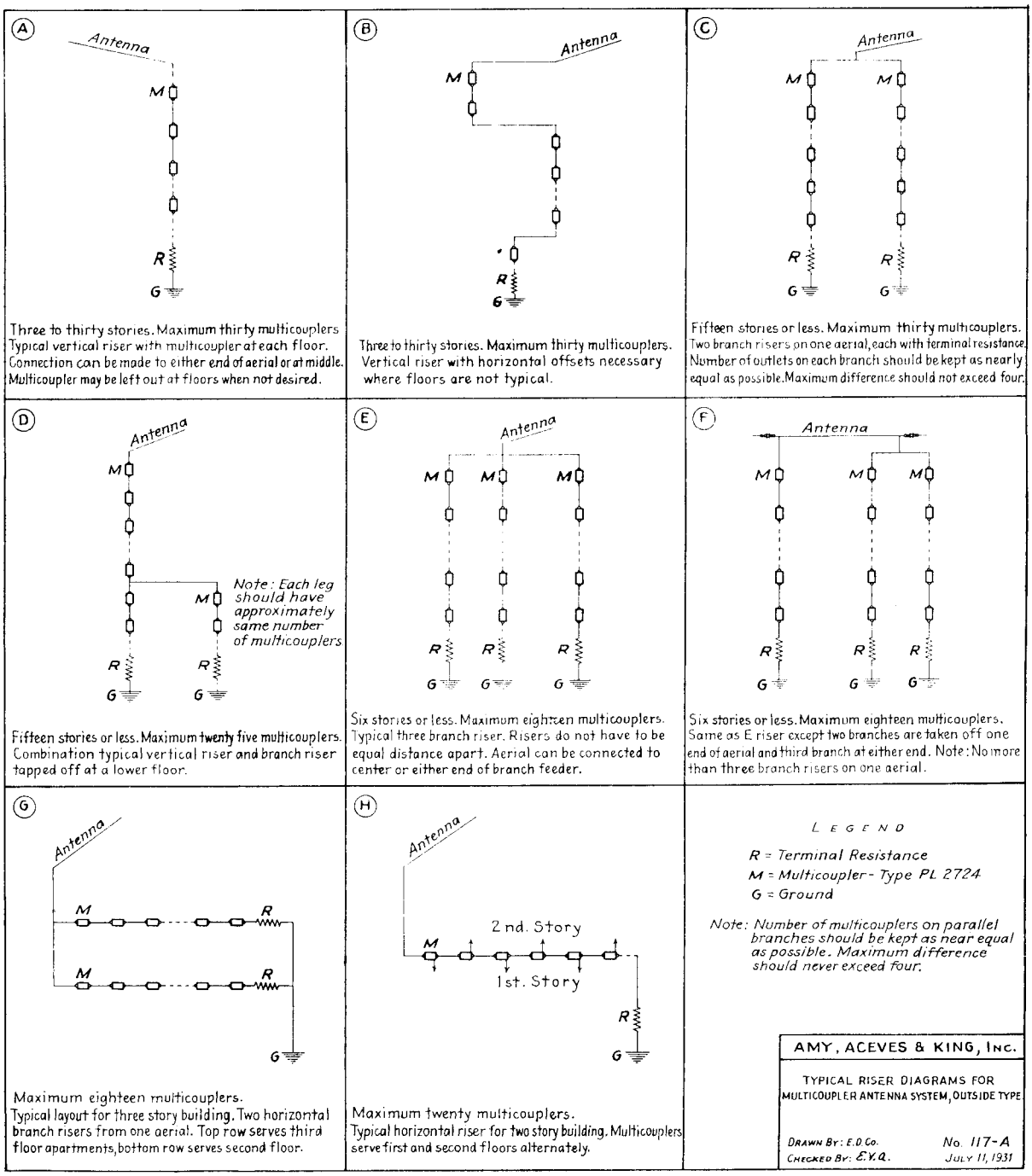
to increase the effective length of the antenna. This is due to the fact that the shielded lead-in is no longer an efficient collector of energy.

Some of the classes of equipment likely to cause interference are as follows:

Vacuum cleaners
Dial telephones
Electric sewing machines
Door bells
Motors of all kinds
Sign flashers
Traffic signals
Electric refrigerators
Oil burners
Electric fans
Electrically operated cash registers
Dental equipment
All types of electro-medical equipment

Defective power equipment—transformers, street lighting sockets, etc.—may cause bad interference to radio programs. In most instances, when such disturbances are suspected the power company in your community will be glad to aid in their solution.

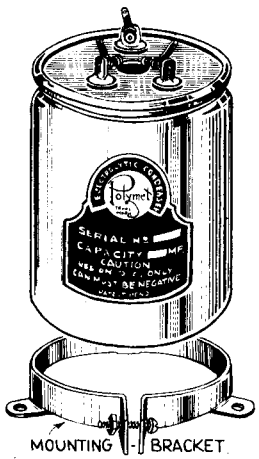
TYPICAL RISER DIAGRAMS *for* MULTICOUPLER ANTENNA SYSTEM



ELECTROLYTIC CONDENSERS

A great majority of present day receivers employ the electrolytic type of filter condenser. These are obtainable with a dry electrolyte or with liquid. It is not the present writer's task to glorify the one at the expense of the other and we will leave all discussion of the relative merits to salesmen and the like.

While the majority of set analyzers provide for the measurement of condenser capacitance by means of the A.C. meters with which they are furnished, these tests hold good only for paper condensers. Bridge methods or other methods where A.C. is involved are also unsuited to measurements of the capacitance



of electrolytic condensers.

The only methods by which these measurements can be made involve the use of direct current and a rapid make and break switch—such as a rotating commutator. The writer doubts the advisability of such equipment for the service laboratory as the different units on the market are readily distinguishable as to capacitance and the sole tests of actual interest to the service technician are those of operation.

The dielectric in an electrolytic condenser consists of a thin film on the surface of the plates and, under certain conditions, this film will break down—conditions not always due to excessive voltage. The leakage current through an electrolytic condenser should not exceed 5 milliamperes per section of 8 microfarads—this permits of a leakage of 20 ma. for a 32 mf. section—at a terminal voltage of 350, the correct polarity being, of course, observed. Fig. 189 shows test circuit.

In measuring the leakage through a condenser, do not place the milliammeter directly in the circuit but allow it to be shunted by a relatively low resistance during the first period of operation gradually increasing the resistance across the meter until it is entirely removed from the circuit.

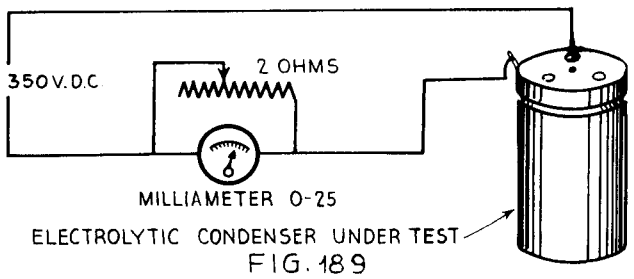


FIG. 189

After a long period of inoperation, an electrolytic unit will be found to have a greatly increased leakage. To "form" the plates, the condenser should be left across a voltage almost equal to its maximum safe value for a period of from ten to fifteen minutes. At the end of this time the leakage will be reduced to its allowable value.

Electrolyte escaping from the vent due to breakdown should be wiped away as its presence across the terminals will greatly increase the leakage.

Electrolytic condensers begin to jell at about 29° F. and freeze solid at 18° F., but they will return to normal operation after a brief period at normal room temperature. This precludes the possibility of using electrolytic condensers in portable apparatus to be operated at low temperature in the open.

Re-forming of the condensers may be carried out in the receiver by removing all tubes but the rectifier and allowing the receiver to run idle in this condition for a short period of time—any excess hum due to de-forming of the condenser plates will be found to have disappeared after about 15 minutes of such operation.

A MODULATED TEST OSCILLATOR

The oscillator shown in Fig. 190 employs a separate oscillating tube for modulation. The frequency of modulation may be altered by adjusting the value of the capacitance across the iron cored coil.

It is possible to shift from the broadcast range to the range between 115 and 200 kc. for lining up intermediate amplifiers in superheterodyne receivers by a single switching arrangement.

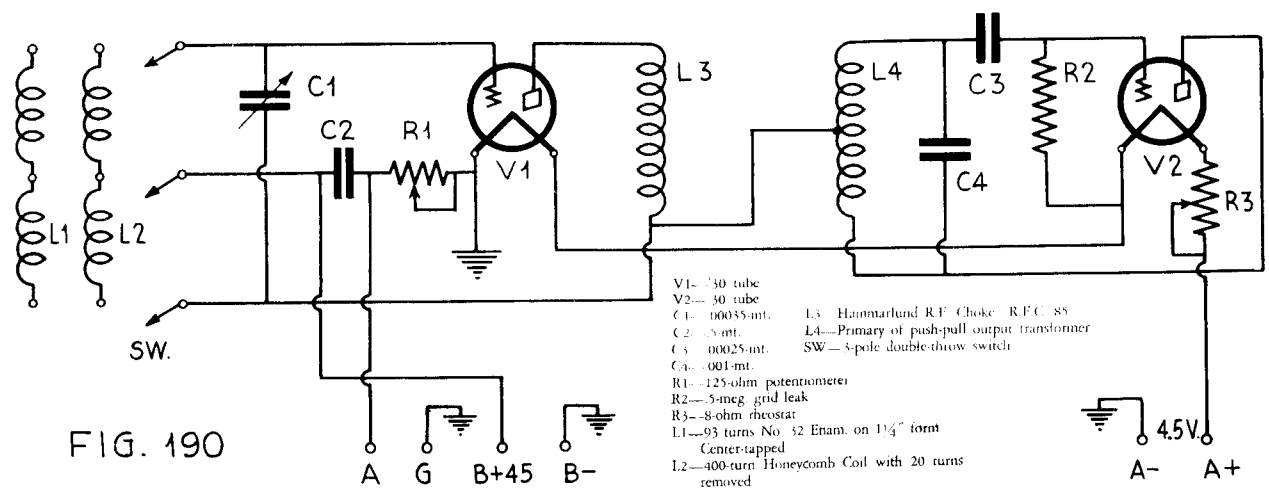
In calibrating the oscillator in the broadcast band, it is only necessary to tune in a number of broadcasters of known frequency; beating the output of the oscillator against the broadcast carrier gives an accurate knowledge of the frequency to which the oscillator is tuned. The oscillator is in tune with the incoming signal when the output of the radio set, which is used for the calibration, delivers a low-pitched growl along with the music. If the signal of the oscillator is high in pitch, then the oscillator is not in absolute resonance with the incoming signal.

In calibrating the low frequency range, a more difficult procedure is required. All oscillators are generators of harmonics of higher frequency than the basic carrier. Ours is no exception to this rule. The harmonics of various frequencies in this range are as follows:

Harmonic	200 kc.	175 kc.	150 kc.	120 kc.
2nd	400	350	300	240
3rd	600	525	450	360
4th	800	700	600	480
5th	1000	875	750	600
6th				720

Note that many of these values lie in the broadcast band.

The procedure in calibration is to hook up the oscillator operating in the low frequency range to the receiver through the dummy antenna described. With the oscillator condenser almost closed, it should be oscillating in the neighborhood of 120 kc. The sixth harmonic of 120 kc. is at 720 kc. and if we tone our receiver to this point and move the oscillator condenser slowly, we should find a weak signal when the oscillator passes through the 120 kc. mark. Mark the oscillator dial setting at this point and tune the receiver to 750 kc. which is the 5th harmonic of 150 kc. Repeat the first procedure and mark the oscillator setting as 150 kc. Check this reading by adjusting the receiver to 600 kc. where the 4th harmonic of 150 kc. should appear. If this is not in evidence, it is possible that your oscillator is not tuned to 150 kc. but to some other frequency of which 750 kc. is also a harmonic. If you get signals at 600,800, and 1000 kc., your oscillator is tuned to 200 kc. and you are getting the 3rd, 4th, and 5th harmonics, respectively. If you find a signal at 600 and 720 kc., you are tuned to 120 kc. and are picking up the 5th and 6th harmonics thereof. It is easy to identify the frequency to which you are tuned by calculating the intervals between the harmonics received. An extremely accurate calibration curve can be plotted in this manner if reasonable care is taken.



V1—'30 tube
V2—'30 tube
C1—.00035-mf.
C2—.5-mf.
C3—.00025-mf.
C4—.001-mf.
R1—125-ohm potentiometer
R2—.5-meg. grid leak
R3—8-ohm rheostat
L1—93 turns No. 32 Enam. on 1¼" form Center-tapped
L2—400-turn Honeycomb Coil with 20 turns removed
L3—Hammarlund R.F. Choke—R.F.C.-85
L4—Primary of push-pull output transformer
SW—3-pole double-throw switch

FIG. 190

POTENTIOMETERS

Many experimenters find some difficulty in applying potentiometer arrangements in radio circuits. Much has been written on the more complex theories of radio, but in most cases the practical application of potentiometers has been obscured in a mass of other explanations, it being assumed that potentiometers are so simple as to require no explanation.

The difficulty is that the mere buying of a unit labeled "potentiometer, so and so many ohms," is not all that is necessary. There is no mystery about a potentiometer as sold; it is only an electrical resistance with a tapping, or, if it is variable, it has a rotatable contact just the same as a filament rheostat, the only difference being the provision of an additional terminal to enable the resistance to be connected as a shunt across the circuit instead of two terminals for enabling the contact and part of the resistance to be connected in series in the circuit. Fig.

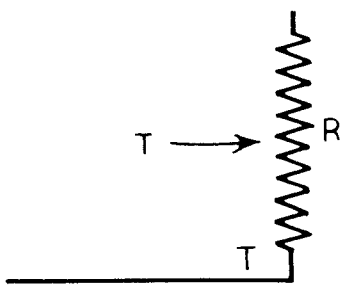


FIG. 191

191 illustrates a filament resistance and Fig. 192 illustrates a potentiometer, the terminals being marked T in each case.

Many service men fail to consider the effect of the resistance in the external circuit altogether, and as a consequence obtain results seemingly incongruous with theory. The division of potential calls for a particular electrical circuit and the potentiometer as sold is only a convenient unit for use in such a circuit; the circuit is of paramount importance.

All radio men know that potential is always dropped across an electrical resistance when current flows and the drop in voltage is dependent upon the resistance in accordance with Ohm's Law: E= IR; when E is the voltage, R the resistance, and I the current flowing.

If an electrical circuit is arranged as illustrated in Fig. 193, in which a resistance R is connected across the supply voltage, and if such resistance is divided

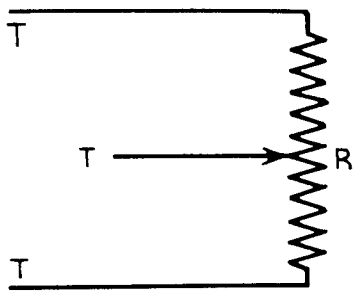


FIG. 192

into ten equal parts, so that the electrical resistance in ohms between the first contact and contact 1, is equal to the number of ohms between the contacts 1 and 2 and so on, then any proportion in tenths of the voltage between the positive and negative leads can be obtained by placing the arm B on a suitable con-

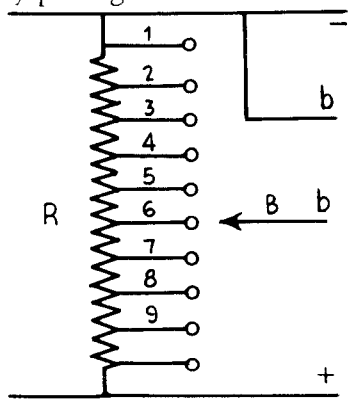


FIG. 193

tact provided no appreciable current flows through B. For example, if the potential difference between positive and negative is 10 volts, then the potential at stud 1 will be one volt, at stud 2 will be two volts, and so on if no current flows in the external circuit through B, that is to say, only a state of electrostatic tension occurs at b—b. This condition of affairs

exists when variable grid bias is provided for by means of a potentiometer, and in such a case the potential values will be substantially the obvious division of the potential, as all that is required is an electrostatic condition. The circuit of Fig. 194 shows a common application of this. In this arrangement the value of R has no bearing on the potential and a value can be selected to economize in current flow. The same condition exists when a potentiometer is used in leaky grid detectors.

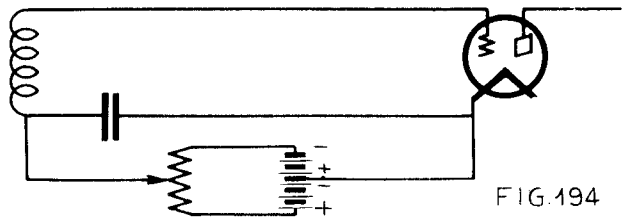


FIG. 194

When a current flows in the external circuit then the conditions are altered and the values of the potential at the contacts 1, 2, etc., are quite different. Fig. 195 illustrates diagrammatically the new conditions in the circuit; here r represents the electrical resistance in the external circuit, and owing to the flow of current through r, the potential at the stud 5 will

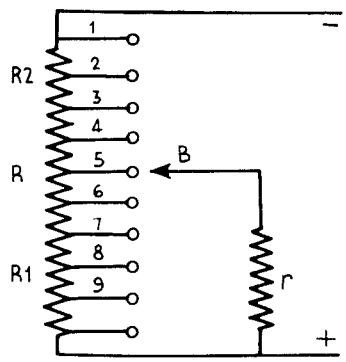


FIG. 195

not be half the potential difference across the positive and negative mains. It will be seen that r and the portion R_1 of the resistance R are in parallel, and the equivalent resistance will be

$$\frac{R_1 \times r}{R_1 + r}$$

Incidentally, the value of the resistance across the positive and negative has changed from R to

$$R_2 + \frac{R_1 \times r}{R_1 + r}$$

but that is by the way. Fig. 196 exhibits a family of curves showing how the value of the potential across r varies when the value of r changes. In these graphs, the potential difference across positive and negative has been taken as E=100 volts, and the resistance of R is 1000 ohms. Consider the tapping at R_2=500 ohms, when r is infinitely great then the voltage Er is 50; when r is 1000 ohms the voltage Er is 40; when r is 300 ohms the voltage Er is about 27; when r is 100 ohms, the voltage Er is about 13. and when r is only 50 ohms, then the voltage Er falls to about 8. From the above it will be clear that if a drop of 50 volts is required across r for some reason, it will be useless to use the tapping R_2=500 ohms regardless of the value of r.

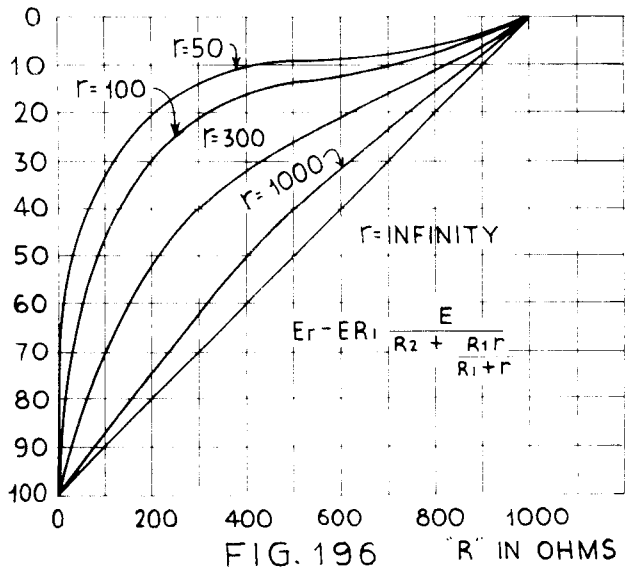


FIG. 196

This is of great importance today especially when we use a portion of the voltage divider to furnish the biasing potentials for the new variable-mu tubes as indicated in Fig. 197.

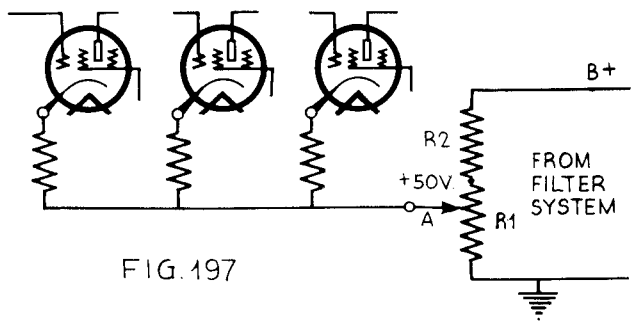


FIG. 197

The points to be considered in calculating the value of the resistance R1 are as follows:

What voltage drop is necessary? How much current will flow through the resistor? What should the watts rating of the resistor be?

When the contact A is turned to B—the current through the resistor is the bleed current consumed by R_1 and R_2. The bias on the tubes being furnished by the resistors in the cathode leads. If the contact A is moved up to the point +50 then the currents from the plate and screen circuits of the tubes have to flow through the resistor R1 as well as the current consumed by R_1 and R_2. To be sure, the current which flows in resistor R1 will always be the bleed current consumed by the resistors but as the arm A moves up it increases the value of the negative bias on the grids of the tube which in turn causes an increase in the voltages applied to the plates of the tubes due to the decrease in plate current caused by the additional grid bias. Thus the current through the resistor R1 should be so large that the addition of the currents flowing through the arm A will be but

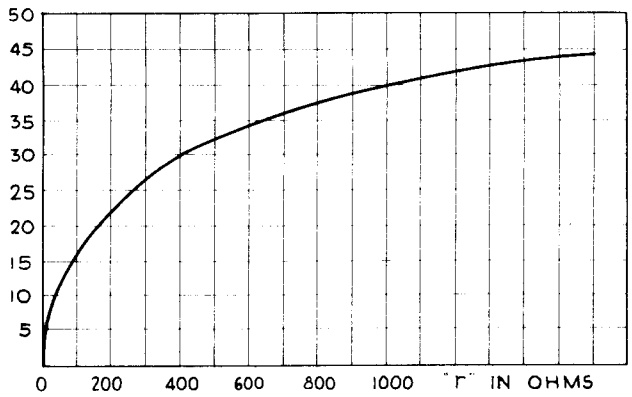
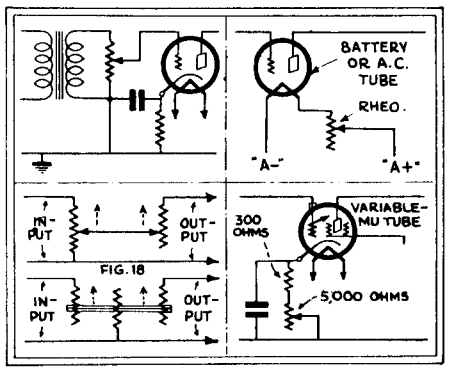


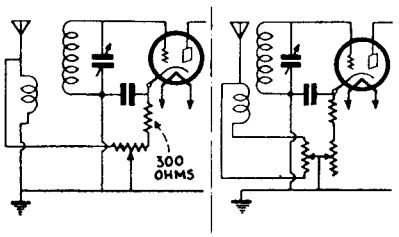
FIG. 198

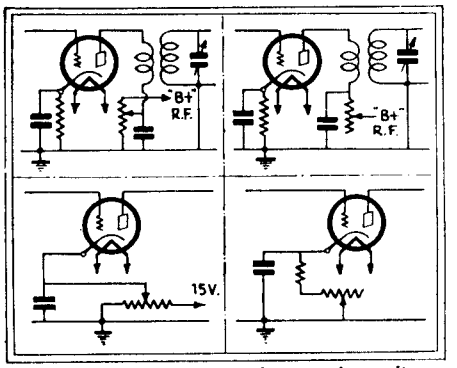
a small portion of the total current in R1 so that the volume control will operate smoothly without jumps or drops in the volume level as the arm is turned.

Many failures are due to no other cause than lack of proper appreciation of the conditions and values in the external circuit. Fig. 198 shows how the voltage across r varies with the value of r assuming R=1000 ohms and E is 100 volts, the tapping located so that $R_1=R_2=500$ ohms.

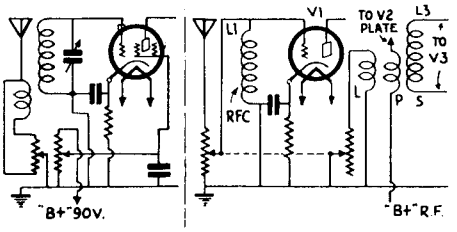


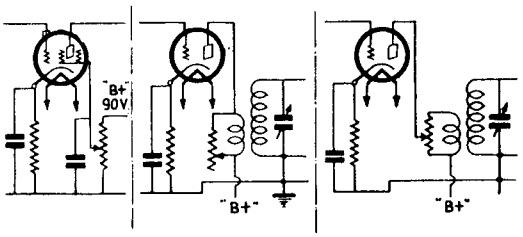
Above, old methods of volume control; below, two of the latest systems.

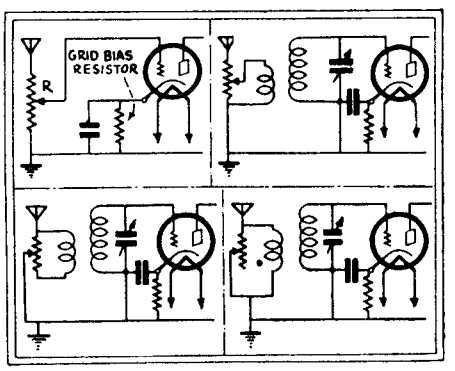




Above, potentiometer and rheostat plate-voltage control. Below, potentiometer and rheostat control of cathode bias. The fixed resistance sets a minimum negative bias.







Four types of antenna volume control.

R.M.A. COLOR CODE

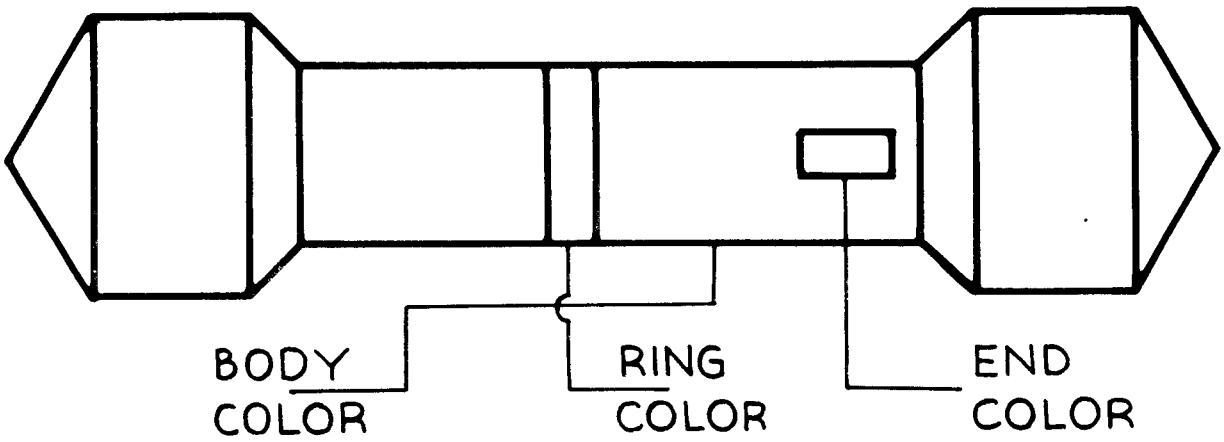


FIG. 199

Body Color indicates first significant figure.
End Color indicates second significant figure.
Band Color indicates third significant figure.

Body Color	*End Color*	*Band Color*
1.....brown	0.....black	.0 .....black
2.....red	1.....brown	0. .....brown
3.....orange	2.....red	00. .....red
4.....yellow	3.....orange	000. .....orange
5.....green	4.....yellow	0000. .....yellow
6.....blue	5.....green	00000. .....green
7.....violet	6.....blue	000000. .....blue
8.....gray	7.....violet	
9.....white	8.....gray	
0.....black	9.....white	

For example, a Resistor has a blue body, a yellow end color and a red band color. What is the resistance in ohms? Answer, 6400 ohms. Fig. 199 shows position of identifying colors and bands. (*Courtesy International Resistance Co.*)

BALLAST RESISTOR CALCULATION

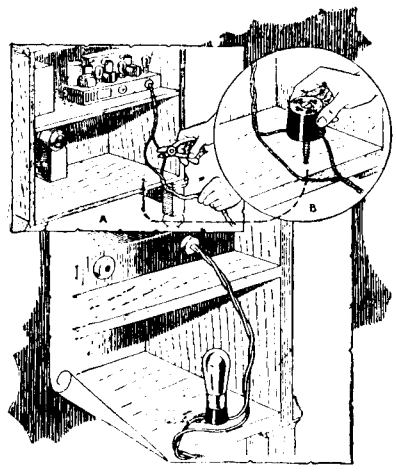
HOW TO DETERMINE THE PROPER AMPERITE

The service man is often called upon to install a voltage regulating device but is at a loss as to the proper type to use. The following tables cover practically every combination of current drains which can exist and it surely is a time saver.

Tubes of the '24, '26, '27, and '35 class, consume approximately 5 watts of the power line load.

Output tubes such as the '45 and '47 consume approximately 30 watts—6 times that of the tubes mentioned above.

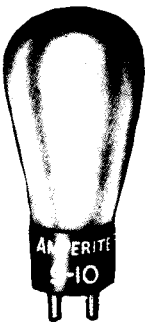
Thus, the output tube practically determines the wattage of the set and the proper Amperite for any 110-120 volt A.C. set can be approximated from the following chart:

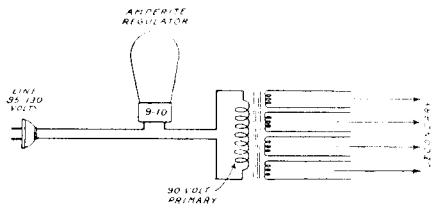


Output tubes in set	Total No. in set	Use Amperite
2-'45's (or Pent)	7 to 10	9-A-5
1-'45 "	5 to 8	7-A-5
1-'45 "	3 and 4	5-A-5
1 or 2-'12A ('71A)	6 to 9	7-A-5
1 210	6 to 8	9-A-5
2 250	7 to 10	9-A-5 (use 2)

When operating, the Amperite will get warm. It should not operate above a very dull red glow. If the Amperite burns higher than a dull red glow —use the next larger size, e.g., if 7-A-5 is too bright, use 8-A-5, etc.

Some sets are wound with a special 90-volt primary and require an Amperite of -10 or -20 series as e.g.





Victor R-32, R-52, RE-45	10-V-10
Victor R-35, R-39, R-57	9-V-10
General Electric 31, 51, 71	9-V-10
Radiola 80, 82, 86	9-V-10
Westinghouse WR-5, WR-6, WR-7	9-V-10
Peerless models 21 to 25	11-20
Kylectron K-71, K-72	11-20
Hi-Q 30	11-20
Brunswick 14, 21, 31	9-20
Silver Marshall, 20, 20-B, 60, 75, 95	10-25
Special mounting adapter used on	9-V-10
Special mounting adapter used on	10-V-10

REPLACEMENT CONDENSER NOTES

The service man is at a loss as to the proper value of a fixed condenser which, when burnt out, has to be replaced in order that the set will be operative.

Of course, if the circuits of the receiver are available and the value of the condenser is marked on the diagram, it is a simple matter to obtain a condenser of the same value and mechanical size and substitute it for the defective unit. Sadly enough, this information is never at hand when it is desired.

Modern radio receivers are so designed today that each tube must work at the greatest possible efficiency, thus any change in the electrical values may seriously affect the operation of the receiver.

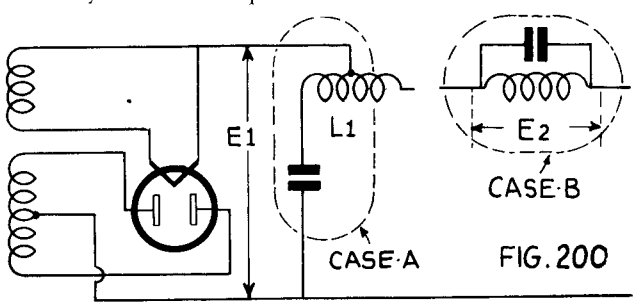


FIG. 200

Some manufacturers use filter systems as shown in Fig. 200, and, due to the resonant condition which exists in circuits of this type, condensers are known to puncture, placing a short on the rectifier in case A and shorting the filter choke in case B with a large increase in the hum output.

If the value of the condenser is not known, it is a difficult job to guess as to its capacity. If the inductance of the choke is known, and that means with the normal current consumed by the set flowing through the choke, the value of the condenser can be found. This applies to case B, as the current flowing through L1 in case A is not a direct current but a pulsating one and large currents appear only at the resonant frequency. The resonant frequency for full-wave operation would be at 120 cycles and for half-wave, 60 cycles.

For those interested in the solution of problems of this kind, the procedure noted in the following can be used. The first thing that should be known is the LC constant which is derived from the equation below.

$$LC = \frac{1}{4\pi^2 f^2}$$

$$LC = \frac{25300}{f^2}$$

$$LC = \frac{25300}{60\,(\text{Cycles})^2} = 7.02+$$

$$LC = \frac{25300}{120\,(\text{Cycles})^2} = 1.7+$$

Thus we find that the LC constant for 60 and 120 cycles is respectively 7.02 and 1.7. That is, the product of the capacity and the inductance will determine the resonant frequency. If the capacity is known, the inductance can be determined by simple division; for example, the capacity is .2 mf., what inductance is necessary for resonance at L1 for 60 cycles? for 120 cycles?

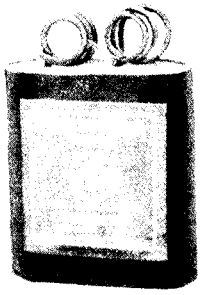
$$L = \frac{7.02}{.2\text{-MF.}} = 35.1\ \text{h. Approx.}$$

$$L = \frac{1.7}{.2\text{-MF.}} = 8.5\ \text{h. Approx.}$$

$$X_C = \frac{1{,}000{,}000}{6.28 \times 120 \times .2} = 6635\ \Omega$$

$$X_L = 6.28 \times 120 \times 8.5 = 6405\ \Omega$$

The best way from the service angle to find the proper value of capacity is by actual test, the value of capacity which permits of the least amount of hum in the speaker being the value to be used as the replacement unit.



UNCASED REPLACEMENT CONDENSER

The replacement capacity should be rated at a much greater voltage than the apparent voltage in the circuit. This will be noticed when the fact that voltages which appear across the condenser can be greater than the applied voltage as shown below. Fig. 201 shows the circuit in case A reduced to its simple form.

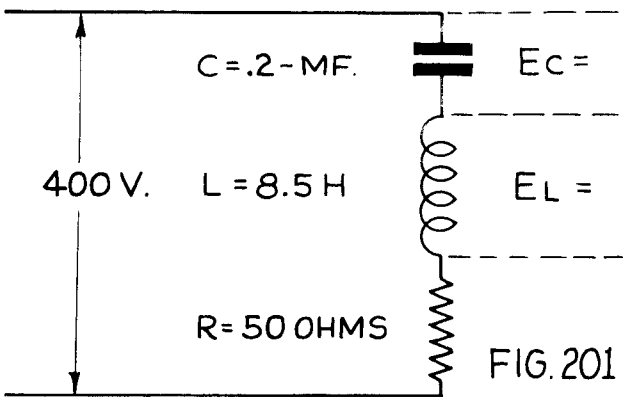


FIG. 201

Therefore, care must be exercised not only in selecting the condenser of the right capacity but, as shown in the above example, the voltage rating of the substituted condenser must be such that it can be used without danger of break down. A 1500-volt working voltage type condenser should be used in this case.

$$Z = \sqrt{50^2 + (X_L - X_C)^2} = 236\ \Omega$$

$$i = \frac{E}{Z} = \frac{400}{254} = 1.7 \text{ AMPS.}$$

$$E_C = i \times X_C = 1125 \text{ V.+}$$

$$E_L = i \times X_L = 1090 \text{ V.+}$$

When filter condensers are used in so-called brute-force filters, the danger of resonant conditions is more or less minimized due to the fact that resonance generally appears below 60 cycles and the individual units have a comparatively high impedance at 60 to 120 cycles. The voltage rating of the capacity should be such as to be greater than the peak value of the voltage output of the transformer which is 1.4 times the value indicated on the transformer data plate.

The selection of capacity values for use in audio frequency amplifiers can be simplified a great deal by making the reactance of the condenser about one-tenth the reactance of the choke or resistor which is in the circuit and which the condenser is supposed to

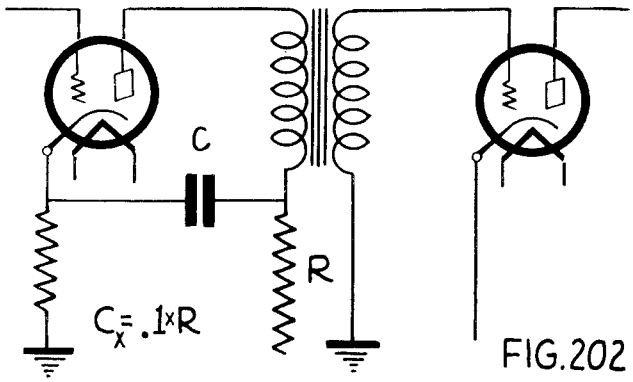


FIG. 202

by-pass. The reactance of the condenser employed should be of the required value at the lowest audio frequency which the amplifier will pass. Fig. 202 is an example of this type circuit.

The average value of condenser used in circuits of this type is one mf. or larger.

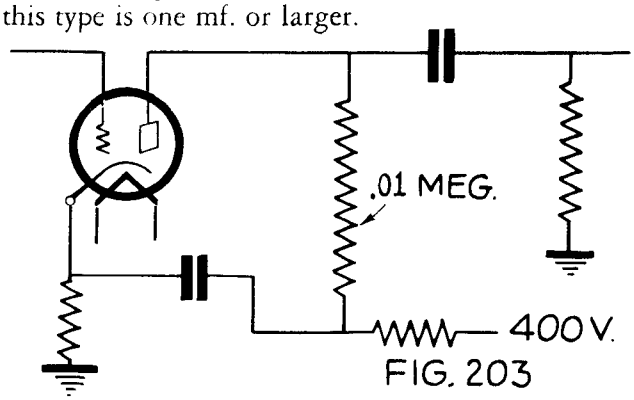
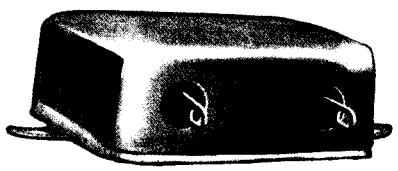


FIG. 203

Radio frequency circuits, due to the fact that the reactance of a condenser is extremely low at the higher frequencies, will not have as great a value as at audio frequencies. This results in a cost and space saving condition but does not mean that the value of the voltage appearing across the condenser can be ignored. The majority of receiver manufac-



SHIELDED BY-PASS CONDENSER

A. M. FLECHTHEIM & CO., INC.

turers use .1-mf. condensers as by-pass units and, in most cases, this value is satisfactory for radio frequency replacement work.

In cases where the condenser is used as part of an isolator circuit a ratio of ten to one as stated above should be used.

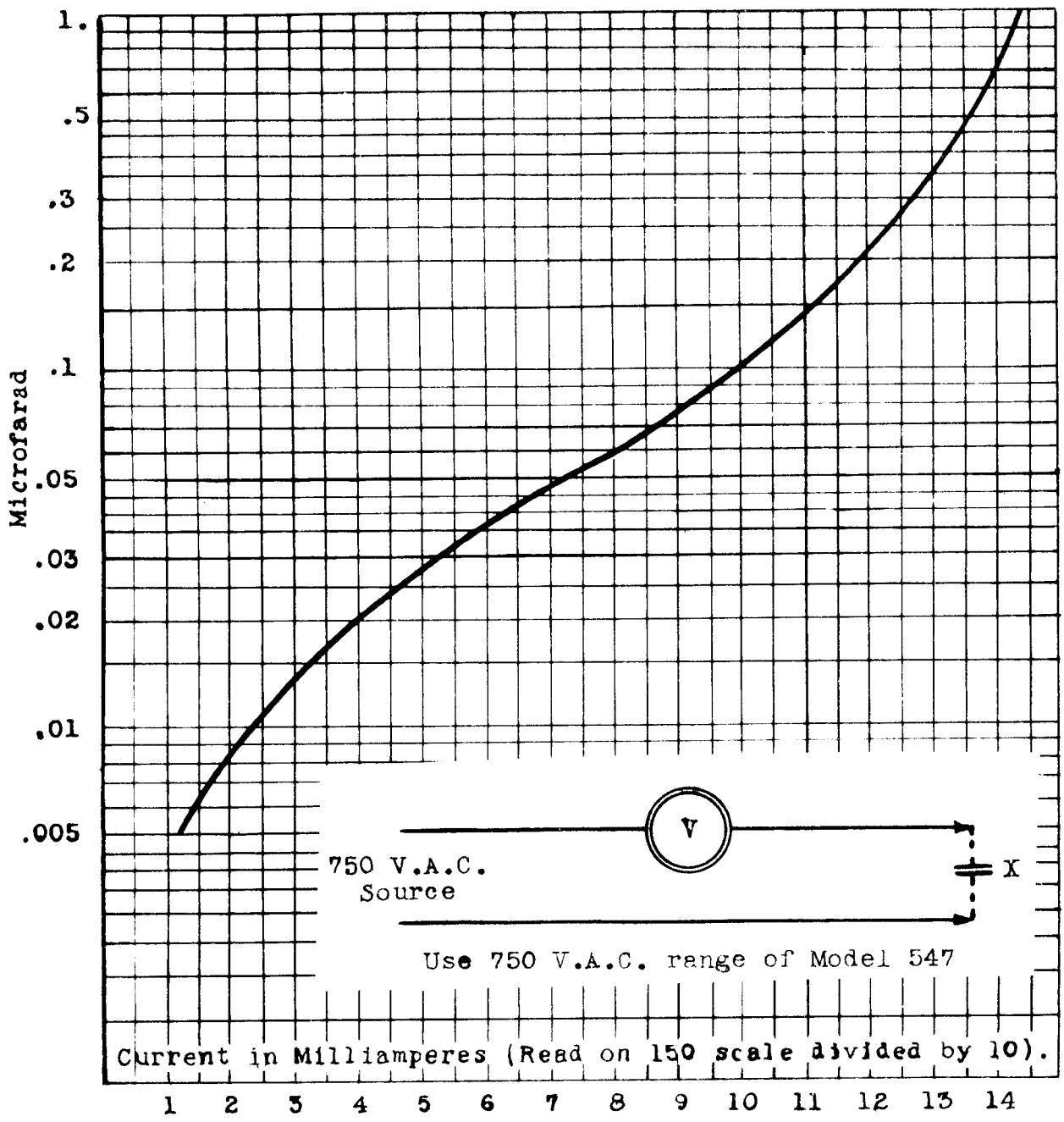
Many condensers are used in circuits as shown in C_1, Fig. 203; in this case, until the tube warms up, the total voltage will be applied across the condenser and after the tube heats to the normal operating condition, we find that the voltage has dropped across the condenser due to the voltage drop across the resistor. The condenser should be rated at the voltage which will appear across the condenser while the tube is heating. In this circuit the voltage rating of the condenser should be at least 400 volts.

In the final analysis, the substitution of a condenser should be made with the idea of using one of the specified value if such information is obtainable. When in doubt, try several and replace with the value which gives the best results and be sure that the condenser is rated above the voltage requirements of the circuit.

To Measure Small Capacities

With

Weston Model 547 Set Tester



SHORT-WAVE RECEIVERS AND CONVERTERS

IN the belief that a continued and increasing interest in the short waves and their entertainment value prevails throughout the industry, the editors have included in this Manual a large number of short-wave and all-wave receivers and the schematic circuits of many of the converters available on the market. The technician will note that a great many different forms of design are presented. Within the past year, marked advances have been made in the way of the complete elimination of plug-in coils. This has presented a serious problem and the manufacturers who have succeeded in this work are to be congratulated on their technical aptitude as well as upon their commercial acumen.

Perhaps a few notes on short-wave reception—on what may and what may not be expected—would be in order. It is true that, with very simple equipment, it is possible to receive foreign transmitters at great distances. It is also true—alas and alack—that the short waves suffer greatly from astronomical and meteorological conditions from which the broadcast band is quite free.

The radio wave as emitted from the transmitter consists in the main of two components—the ground wave and the sky wave. The ground wave in the broadcast bands is apparent at a considerable distance from the transmitter—but the sky wave continues onward for a much farther distance. As the waves become shorter, the distance at which the ground wave is apparent decreases, and even at short distances from the transmitter, the sky wave is predominant. But the real difficulty now enters into the picture. High above the earth is an ionized layer or barrier from which these waves are reflected—the angle of reflection being dependent upon the frequency of the wave. This results in a phenomenon known as "skip-distance"—the wave receivable close to the transmitter may not be found to be receivable again until a point many miles from the transmitter is reached. The height of this layer above the earth is at all times changing—its height and density being dependent upon the time of day or night, upon the season of the year, and upon certain astronomical and meteorological conditions as yet

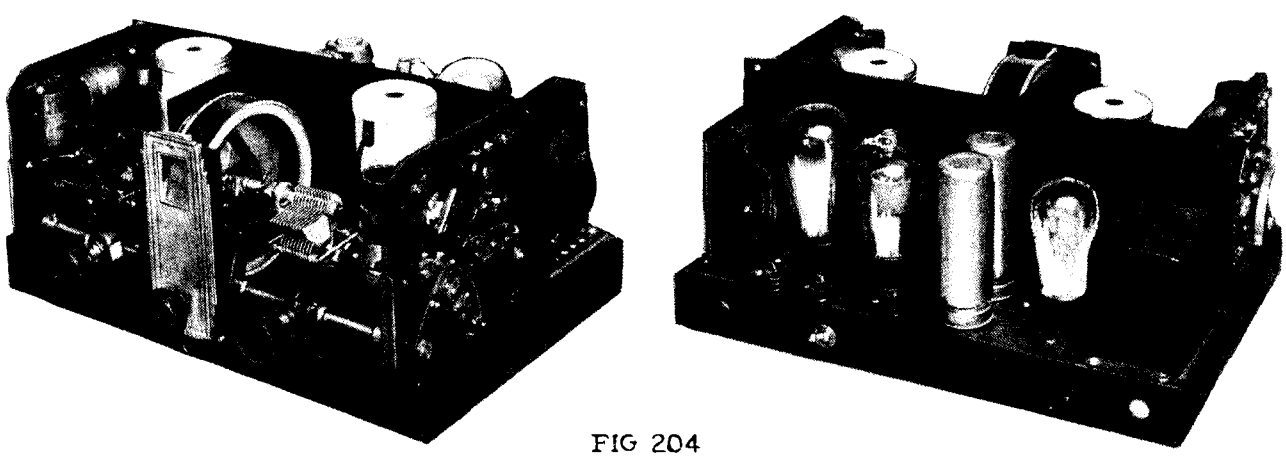


FIG 204

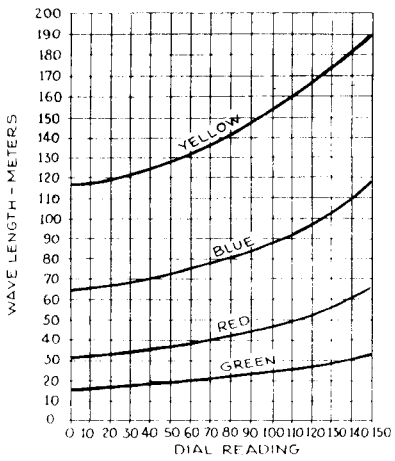


FIG. 205

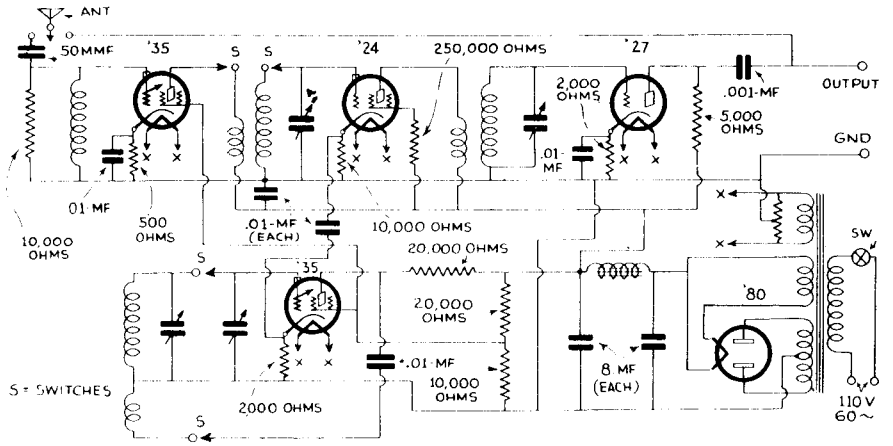


FIG. 206

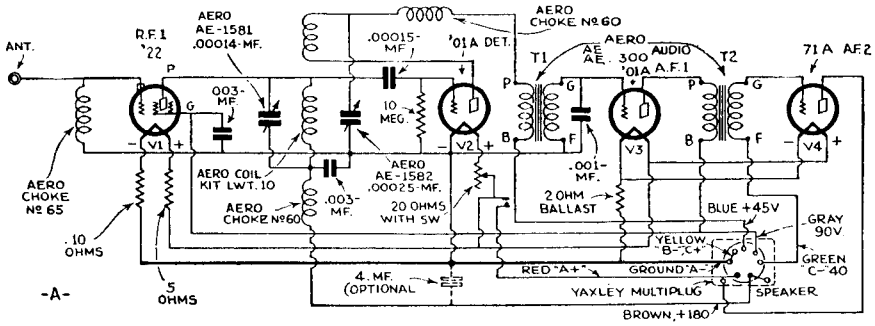


FIG. 207 A

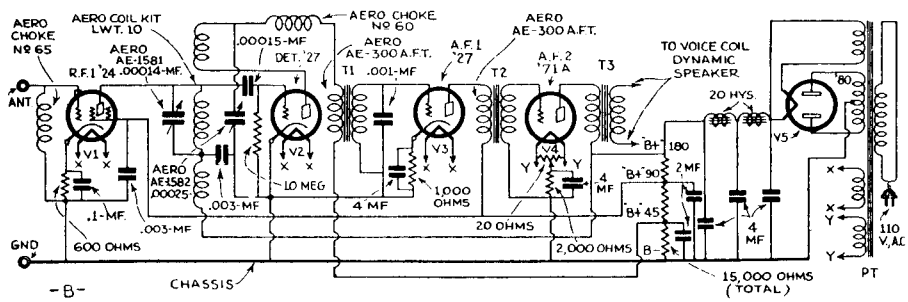


FIG. 207 B

not pronounceable in elementary terms. This results in a condition which is not entirely unsatisfactory where point to point communication is concerned, but which is a decided detriment to short-wave broadcasting. In point to point services, it is possible to use directional antennas which will pre-determine the angle at which the wave strikes the *Heaviside* layer and will, in a measure, control the effects of skip-distance. Even then, however, the frequency most favorable to laying down a strong signal in Buenos Aires tonight at eight o'clock will not be the frequency most favorable to the same tomorrow morning, and the engineers engaged in this development of trans-oceanic telephone services are at a loss to explain some of the phenomena encountered.

Thus, it may be seen that the reception of short-wave programs is not all a "bed of roses" and that one cannot expect to get foreign stations at all hours of the day and night. It is not our place here to give accurate data on these effects but merely to elucidate some of the problems encountered so that the service technician will be on his guard at all times and will not expect too much either for himself or for his customers. Many magazines—SHORT WAVE CRAFT for an example—carry much data on the reception of the short waves and on how and at what time they are best received. Another point of importance is that, in order to achieve success in short-wave reception, extreme patience is necessary—for with a one-tube regenerative short-wave receiver and a large supply of "stick-to-it-iveness" the "fan" can line up an incredible list of "stations

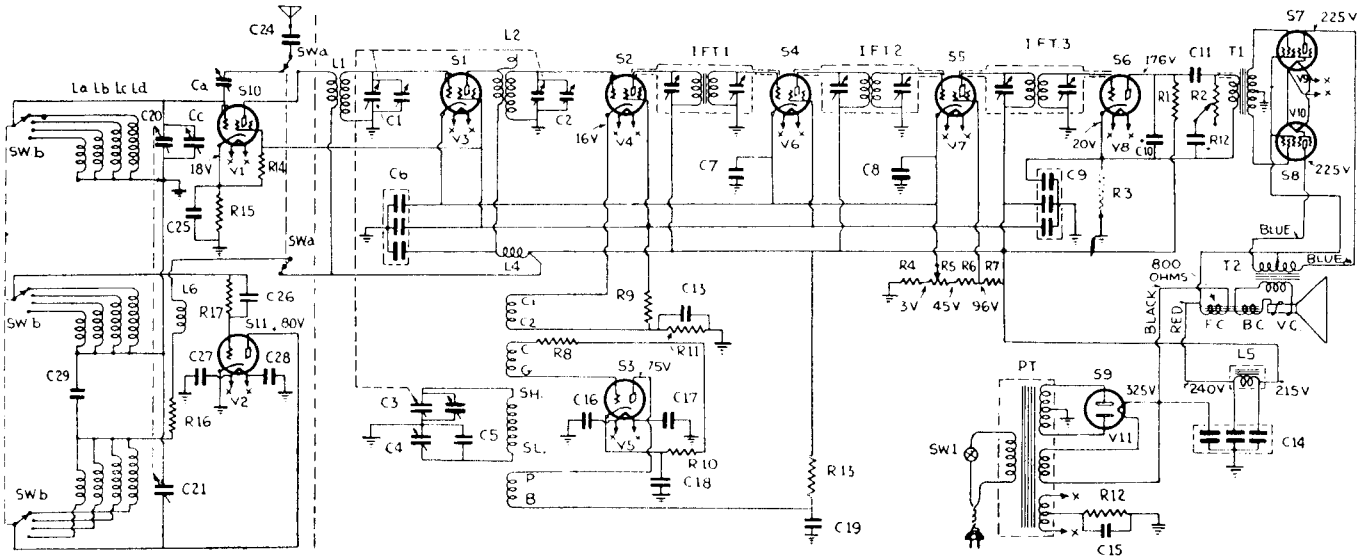


FIG. 208 SM 726 SW

received."

The new short-wave receivers brought out for the present season are examples of the tendency to do away with plug-in coils. The picture of the latest National receiver shows the use of switches for changing from one band to another. The changes are made by the simple manipulation of the control knob mounted on the right, facing the set. The tuning chart in Fig. 205 shows how the various ranges are covered with the minimum of over-lapping.

The ease of tuning, wave-band coverage, simplicity of design, and A.C. operation make the latest developments in short-wave receivers appealing to the ordinary user of radio receivers and open a new avenue of profitable sales to the wide-awake service man.

The complete electrical circuit of the receiver with the values of the components is shown in Fig. 206.

One of the most popular receivers was the old Aero Short-Wave job, the circuit of which is shown in Fig. 207A. As so many letters have been received for information on an A.C. version of this receiver, the circuit is shown in Fig. 207B.

The present season has witnessed the introduction by practically all of the receiver manufacturers, of broadcast "super-het" models which can be readily converted into short-wave receivers by the addition of so-called converters, an example of which is shown in Fig. 208. Here the short waves are beat against the local oscillator V2 and the resultant output of the detector tube V1 is fed to the conventional input circuit of the super.

The characteristics of simplicity of control, lack of plug-in coils, and satisfactory sensitivity play an important part in the public acceptance of these receivers.

PUBLIC ADDRESS AND CENTRALIZED RADIO SYSTEMS

ALTHOUGH the amplifiers employed in Public Address and Centralized Radio Systems are not altogether different from those employed in commercial radio receivers, there are some interesting points regarding their operation which are worthy of mention. In the first place, it is probable that in all instances these amplifiers will be designed for use with microphone, radio or phonograph pick-up. These three services require widely different gain characteristics since the output of the microphone is far below that possibly obtainable from the output of the average detector tube, and still further below that obtained from a phonograph pick-up of standard design. It is necessary then that this fact be taken into account in the design of a system for such mutiple service if the minimum labor is to be involved in the change-over from one form of reproduction to the other. In the typical systems shown in Figs. 211 to 216, it will be seen that individual volume controls are employed in the input circuit of the amplifier so that the average levels may be adjusted in such a manner that, in the changing-over process, no great difference in the relative output volume will be observed.

Impedance Matching.

In all systems of this character, the impedance of various components should be matched by the use of appropriate transformers. While—as we have seen before—the maximum undistorted power output of a vacuum tube is achieved when the load impedance is twice that of the tube itself, the maximum quality and efficiency is achieved in other circuits when impedances are identically matched. In doing this, it is necessary to employ a transformer which will make the load "look" like the desired impedance insofar as all electrical characteristics are to be considered. This effect is achieved by employing transformers having turns ratios which are the square roots of the impedance ratios. Let us suppose that we wish to match the impedance of a 500-ohm pick-up to the input of a tube (which may be considered as having an impedance of 250,000 ohms). The impedance ratio is 500:1 and the required turns ratio would be approximately 22.5:1. Since the tube is purely a voltage-operated device and consumes very little power, this gives us a gain of 22.5 in the transformer alone. It is usual to construct amplifiers in such a manner that their input and output

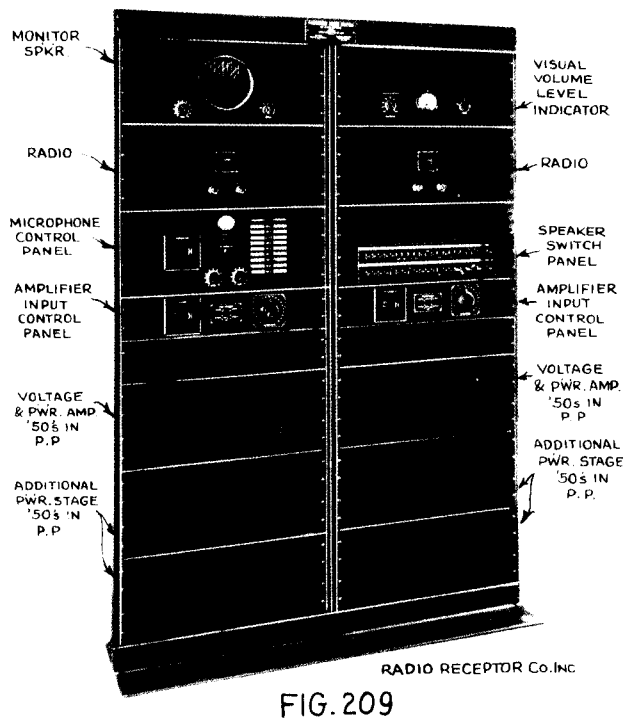


FIG. 209

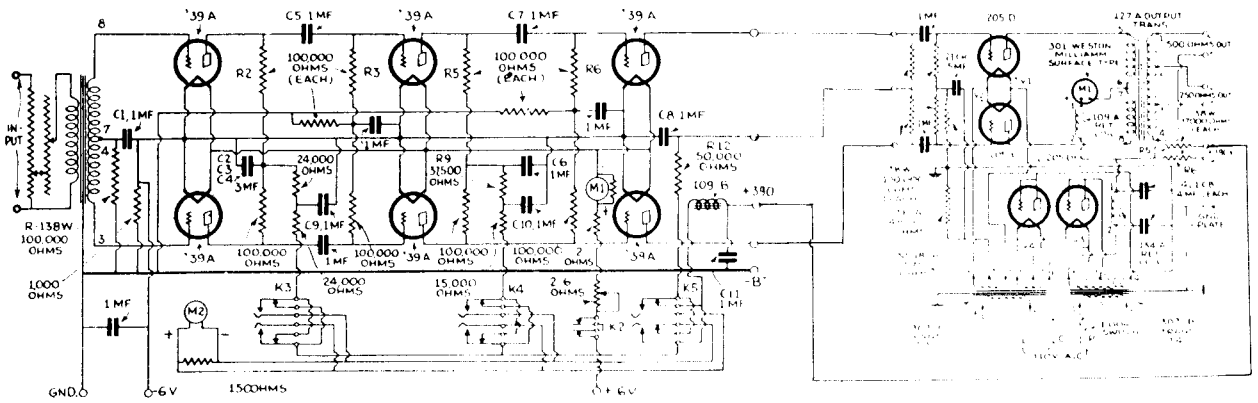
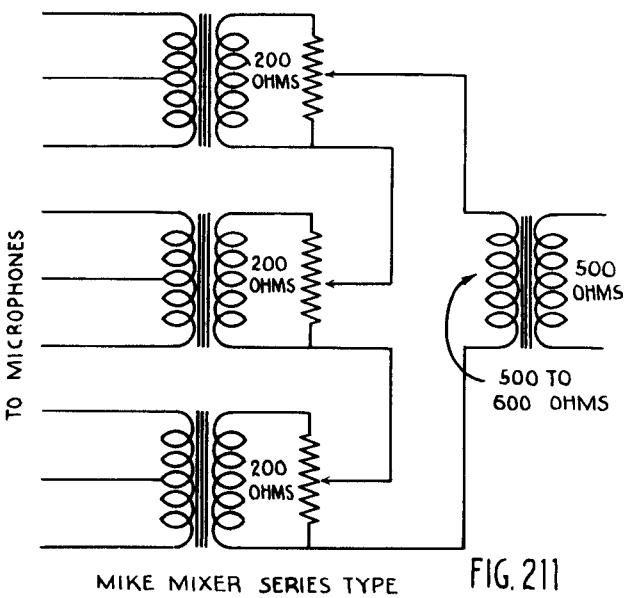


FIG. 210

impedances are equal. This impedance value may be either 200 or 500 ohms—the latter being the more usual. In working into the 500-ohm amplifier input from the detector tube of the radio receiver, it is necessary to employ a step-down transformer to match the relatively high impedance of the detector tube to the 500-ohm circuit.

All the various components employed are available on the open market and the characteristics and specifications are given in the circuit diagram. Note that the output transformer has two windings, one of which feeds a 500-ohm transmission line terminated in an audio-transformer designed to match the impedance of the line to any number of dynamic moving coils. Remember that the current is high in low impedance circuits such as dynamic moving coils and the voltage drop in the interconnecting wires must be guarded against. Do not use long lengths of wire in connecting up multiple-speaker arrangements of this type and be sure to use nothing smaller than No. 12 wire in the connections. The correct tap to employ on the auto-transformer depends upon the number of speakers used and whether they are connected in series, parallel, or series-parallel. The resultant impedance may be calculated in the same manner as in the case of series or parallel resistances.

In centralized radio systems, a great number of small magnetic or dynamic speakers are employed in a similar series-parallel arrangement. It is best to utilize the high-impedance transformer winding when the small dynamics are employed in this arrangement. The impedance of such a winding is in the neighborhood of 2500 ohms and they should be



MIKE MIXER SERIES TYPE FIG. 211

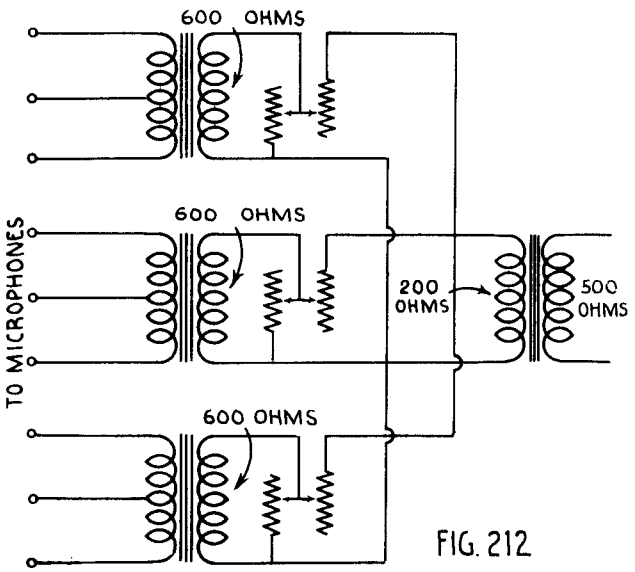


FIG. 212

MIKE MIXER
PARALLEL CONSTANT OUTPUT TYPE

so connected as to approximately match the 500-ohm output winding of the amplifier itself. The output transformer also has as a monitor a small 15-ohm winding designed to feed the moving coil of a monitoring speaker.

Power Output Requirements.

In calculating the power output requirements of systems, there is no set rule to follow. We may, however, assume that the larger dynamic speakers and dynamic horn units require an output of about two watts while the small speakers used in hotel systems do not require more than ¼ watt for good

results. We are able to calculate from this data the requirements for operation of most systems. The tubes necessary for the output stage in any system may be chosen from the tube data available in this book. Remember that tubes in parallel give double the output of a single tube while tubes in push-pull may be relied upon to give about 2.4 times the output of the single tube. The range available is all the way from the output obtainable from a single '71 up to the output of 60 watts available from two '45's in push-pull. Tubes of a special character capable of an output in excess of one kilowatt are obtainable in special cases and there is no reason why large power requirements should baffle the accomplished service technician.

In Fig. 209, a commercial type or a centralized system mounted in rack form is shown. The various panels and their use are indicated in the figure. The system offers a complete microphone control unit, voltage amplifier, and a 50-watt push-pull output stage for use with as many groups of speakers as desired. The change from "mike" to broadcast reproduction is accomplished by throwing the switches on the control panel. The circuits of the units which are incorporated in this unit are to be found

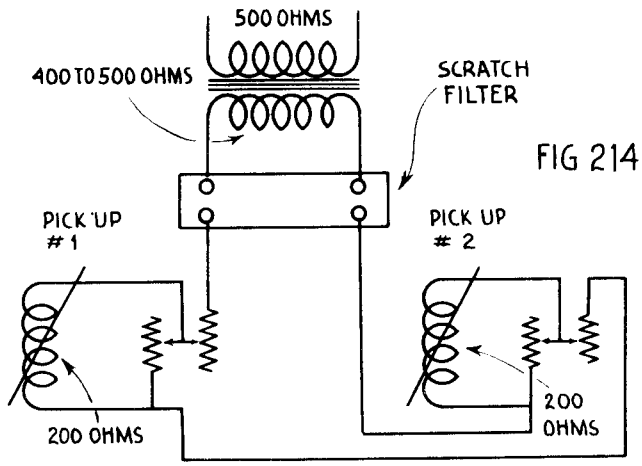


FIG 214

PHONOGRAPH PICK UP CONNECTIONS
DOUBLE TURNTABLE TYPE

in detail in the section of the Manual devoted to sound-system circuit diagrams.

A typical circuit diagram of a W.E. Co. 41A speech amplifier unit is shown in Fig. 210 and is an example of excellent design. The service man can build a real recording or public-address amplifier by following the information given in the drawing.

The necessity of proper impedance matching as stated above is an important consideration and it will be noted that the circuits shown in Figs. 211 to 216 are designed with this consideration in mind.

Mixers.

The simple series type of mixer is shown in Fig. 211. While it has the advantage of simplicity, it has the disadvantage of not being constant in its impedance of the operating range. The circuit of

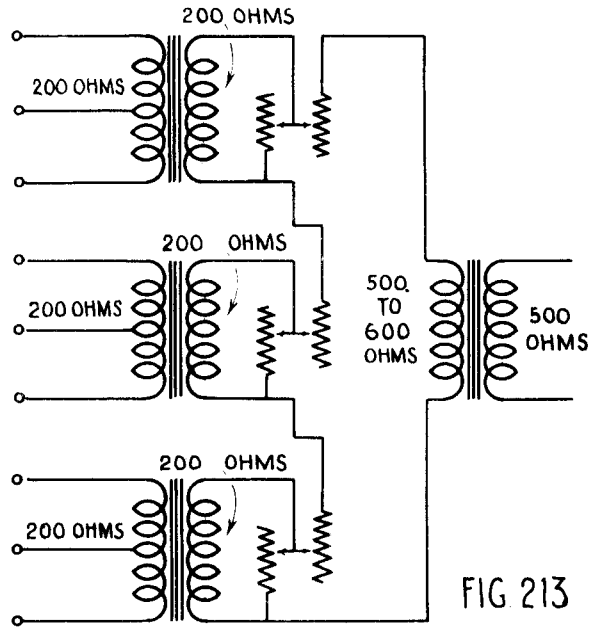


FIG 213

MIKE MIXER
CONSTANT OUTPUT TYPE

Fig. 212 is better as the type of control is practically constant-impedance and is superior to the method shown in Fig. 211. The most generally used type of control found in the better type of installation is indicated in Fig. 213. This system gives practically constant impedance with the various settings of the controls and is an important part of a first-class installation.

The use of phonograph records and electrical pick-ups for entertainment purposes in place of radio programs has become commonplace and the average system must include at least one electric turntable for record reproduction. The circuit shown in Fig. 214 indicates individual control of output of the two pick-ups so that the output of one can be faded into the output of the other so that the musical program can be continued without interruption.

The average radio detector-plate circuit has a very high impedance which must be matched to the 500-ohm line by means of a step-down transformer. See Fig. 215. The primary of the matching transformer for use with a '27 type tube used as a detector should have an inductance of about 250 henries to

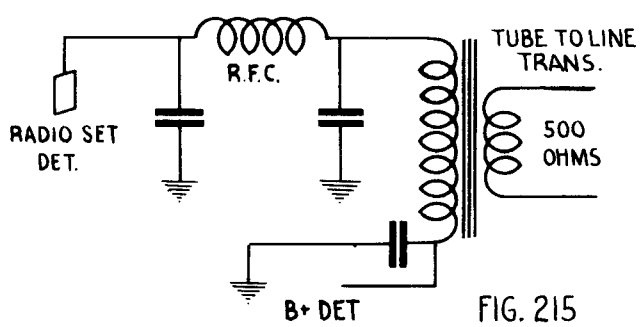


FIG. 215

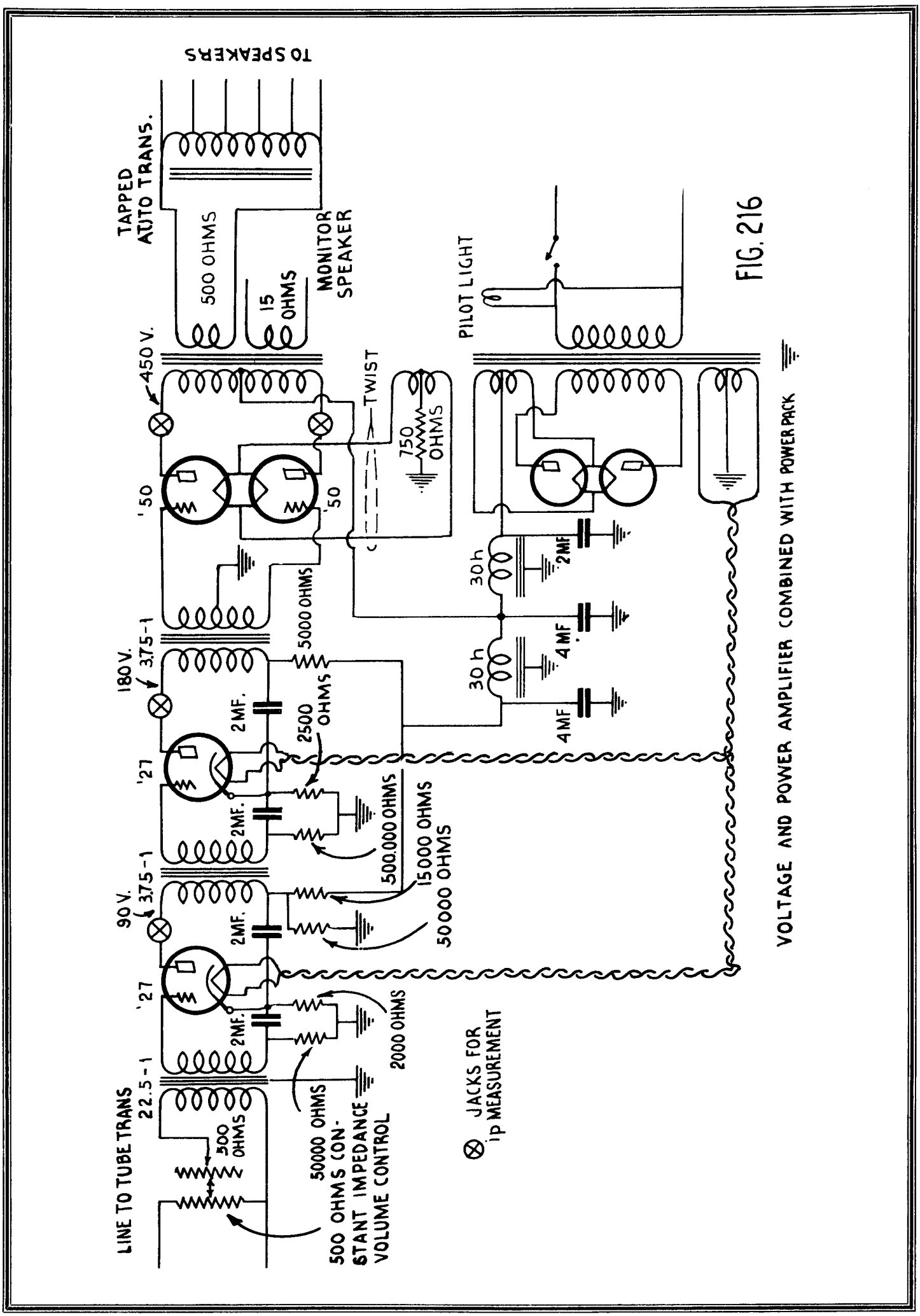

TO SPEAKERS
TAPPED AUTO TRANS.
500 OHMS
15 OHMS
MONITOR SPEAKER
PILOT LIGHT
450 V.
'50
'50
TWIST
750 OHMS
5000 OHMS
180 V.
3.75-1
2MF.
2500 OHMS
'27
2MF.
500,000 OHMS
15000 OHMS
50000 OHMS
90 V.
3.75-1
2MF.
'27
2MF.
2000 OHMS
22.5-1
LINE TO TUBE TRANS
500 OHMS
500 OHMS CONSTANT IMPEDANCE VOLUME CONTROL
50000 OHMS
JACKS FOR Ip MEASUREMENT
30h
30h
2MF
4MF
4MF
VOLTAGE AND POWER AMPLIFIER COMBINED WITH POWER PACK

FIG. 216

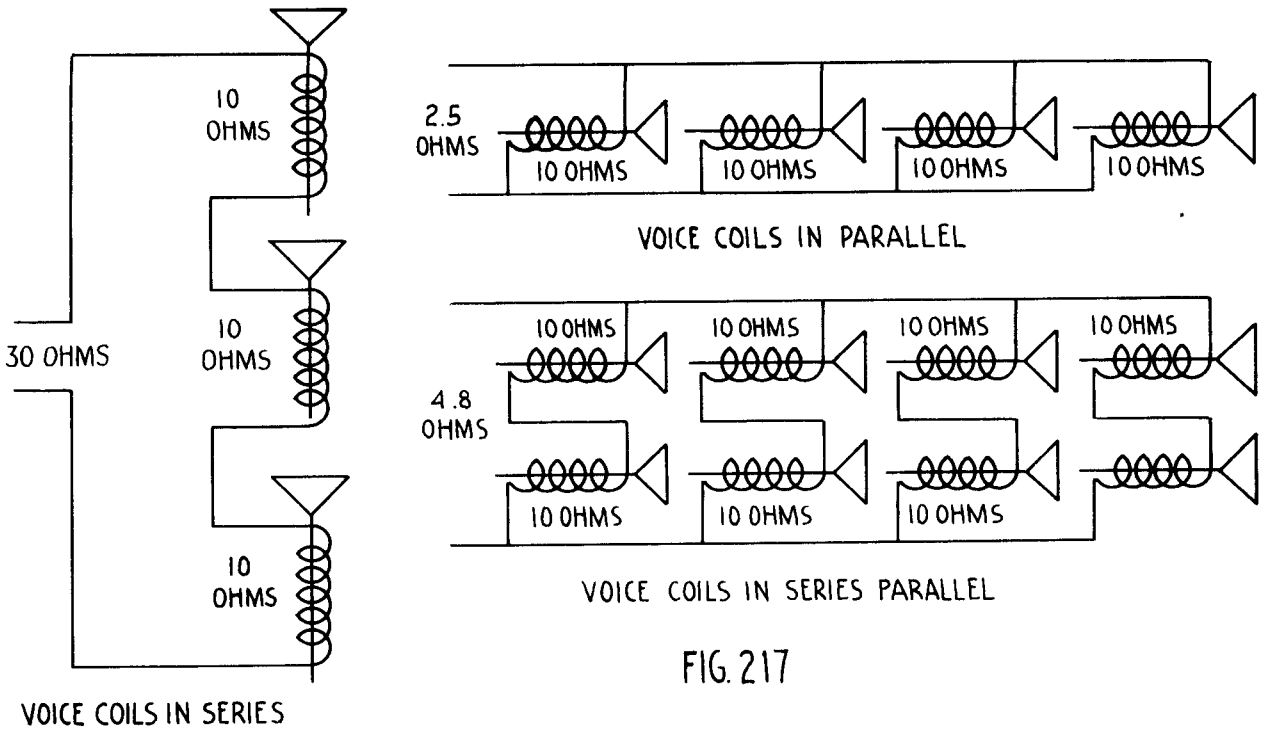


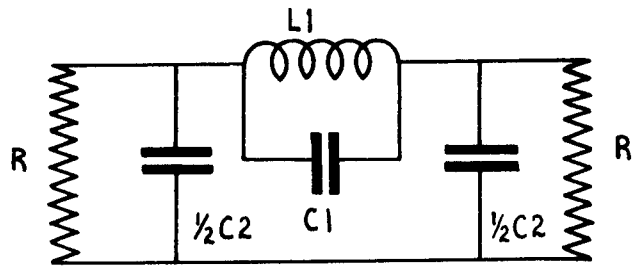
FIG. 217

afford ample bass frequency response. It is important that the direct current flowing in the plate circuit of the detector tube does not cause a drop in the inductance of the transformer primary. It is fortunate that the tubes used as detectors with the present systems of detection seldom require more than 1 to 1.5 ma., thus reducing the possibility of a serious drop in the inductance of the primary of the detector output matching transformer.

In Fig. 216, a more or less standardized circuit of a combined voltage and power amplifier circuit complete with its power supply is shown. It will be noticed that the input circuit and the output circuit both terminate with impedances of 500 ohms. The special output transformer, called an auto-transformer, is used for the purpose of matching the 500-ohm line to the speakers. The use of a device of this type is absolutely necessary if quality reproduction is to be obtained.

Jacks are included in the plate circuits of the various tubes so that an accurate check can be made on the plate current flowing. In the '50 stage, it is convenient to have some method whereby the two tubes can be matched as closely as possible. Tubes should be selected for their equality in plate-current drain under actual operating conditions.

In public address systems, the speakers are generally operated in banks of 25 or more and, to enable the designer to establish a low impedance line between the output transformer and the speakers, the voice-coils are connected in series or parallel, as the case may be. Fig. 217 shows the connections of speakers in series, in parallel, and in series-parallel with the effective of the resultant load when each voice-coil has an impedance of 10 ohms.



$$L_K = \frac{R}{\pi f_2} \qquad L_1 = mL_K$$

$$C_K = \frac{1}{\pi f_2 R} \qquad C_1 = \frac{1-m^2}{4m} \times C_K$$

$$m = .6 \qquad C_2 = mC_K$$

L = in henrys. C_2 = in microfarads.
f_2 = CUT OFF FREQUENCY.

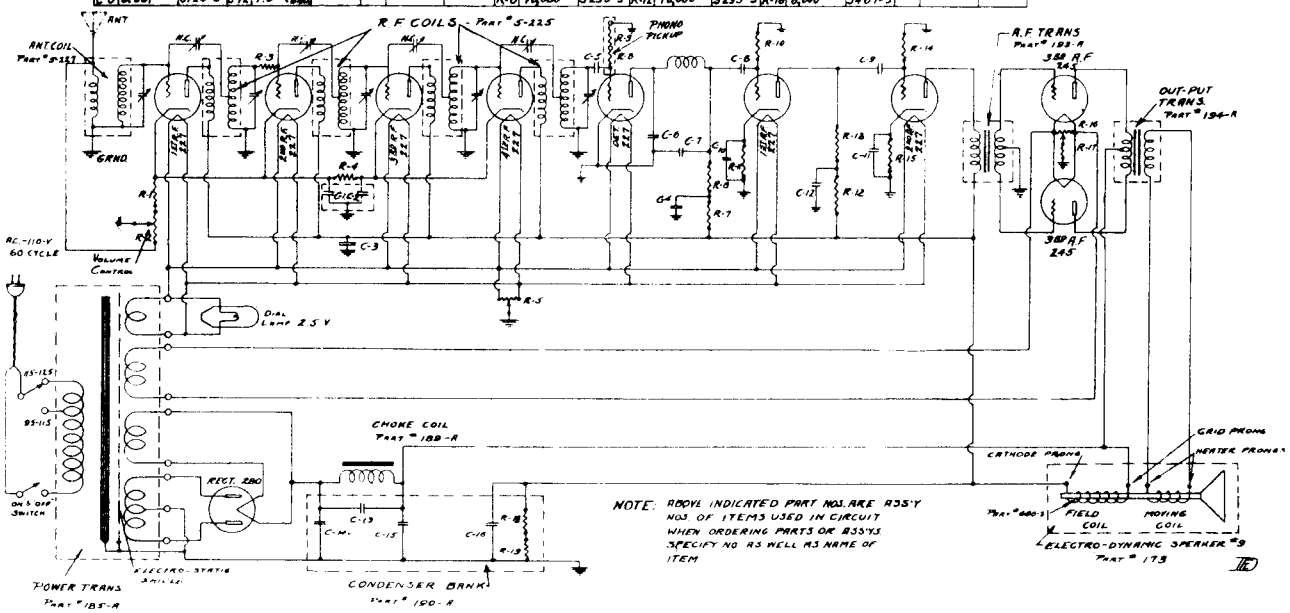
FIG. 218

Many times the service man is called upon to install a scratch-filter which is used to reduce the surface noise present in all phonograph records. Fig. 218 gives all the information for the computation of the necessary values of inductance and capacity for such devices. The cut-off frequency should generally be computed for frequencies of 3000 cycles or higher.

ALL-AMERICAN MOHAWK CORP.

VALUE AND PART NUMBER OF CIRCUIT ELEMENTS

UNIT	CAP IN M/F D	PART Nº	UNIT	CAP IN M F D	PART Nº	UNIT	CAP M F D	PART Nº	UNIT	RES IN OHMS	PART Nº	UNIT	RES IN OHMS	PART Nº	UNIT	RES IN OHMS	PART Nº	UNIT	RES IN OHMS	PART Nº
C-1	0.1 one unit	5593-5	C-7	0.001	5124-5	C-13	0.1	190-A	R-1	380	5520-5	R-7	70,000	5295-5	R-13	25,000	5172-5	R-19	6,000	5407-5
C-2	0.1	5593-5	C-8	0.01	5603-5	C-14	20		R-2	10,000	731-5	R-8	2 Megohms	5001-5	R-14	0.5 Megohm	5221-5			
C-3	0.5 one unit	5592-5	C-9	0.01	5603-5	C-15	20		R-3	1500	6004-5	R-9	0.5 "	5221-5	R-15	2,400	5274-5			
C-4	0.5	5592-5	C-10	0.5		C-16	20		R-4	100	5594-5	R-10	0.5 "	5221-5	R-16	20	5277-5			
C-5	0.00025	5125-5	C-11	0.5					R-5	80	5277-5	R-11	2,400	5274-5	R-17	1,000	5559-5			
C-6	0.001	5124-5	C-12	1.0					R-6	70,000	5295-5	R-12	70,000	5295-5	R-18	6,000	5407-5			

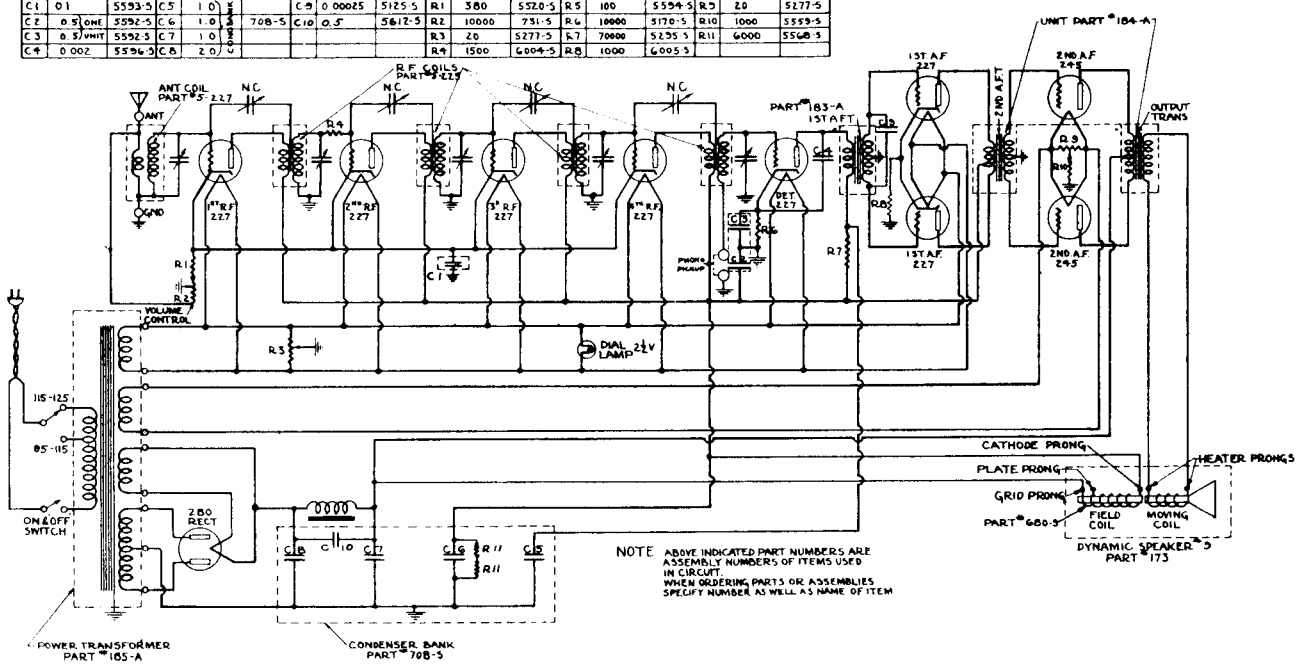


NOTE: ABOVE INDICATED PART NOS. ARE ASS'Y NOS OF ITEMS USED IN CIRCUIT WHEN ORDERING PARTS OR ASS'YS SPECIFY NO AS WELL AS NAME OF ITEM

CIRCUIT DIAGRAM NO. 90 CHASSIS
60 CYCLE

VALUE AND PART Nº OF CIRCUIT ELEMENTS

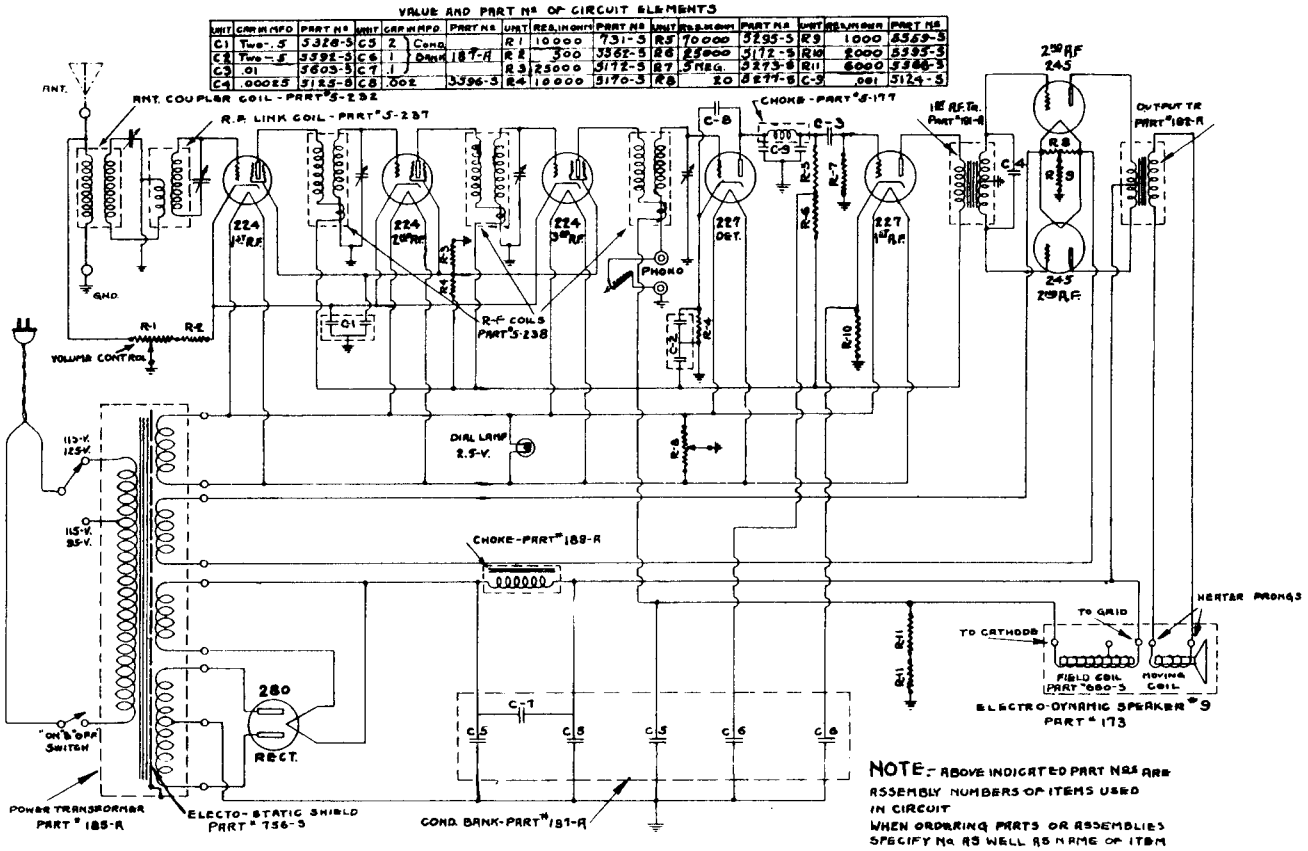
UNIT	CAP IN M/F D	PART Nº	UNIT	CAP IN M F D	PART Nº	UNIT	CAP IN M F D	PART Nº	UNIT	RES IN OHMS	PART Nº	UNIT	RES IN OHMS	PART Nº	UNIT	RES IN OHMS	PART Nº
C1	0.1	5593-5	C5	1.0		C9	0.00025	5125-5	R1	380	5520-5	R5	100	5594-5	R9	20	5277-5
C2	0.1 one unit	5592-5	C6	1.0	708-5	C10	0.5	5612-5	R2	10000	731-5	R6	10000	5170-5	R10	1000	5559-5
C3	0.5 unit	5592-5	C7	1.0					R3	20	5277-5	R7	70000	5295-5	R11	6000	5568-5
C4	0.002	5596-5	C8	2.0					R4	1500	6004-5	R8	1000	6005-5			



NOTE ABOVE INDICATED PART NUMBERS ARE ASSEMBLY NUMBERS OF ITEMS USED IN CIRCUIT. WHEN ORDERING PARTS OR ASSEMBLIES SPECIFY NUMBER AS WELL AS NAME OF ITEM

CIRCUIT DIAGRAM NO. 90 CHASSIS
25 CYCLE

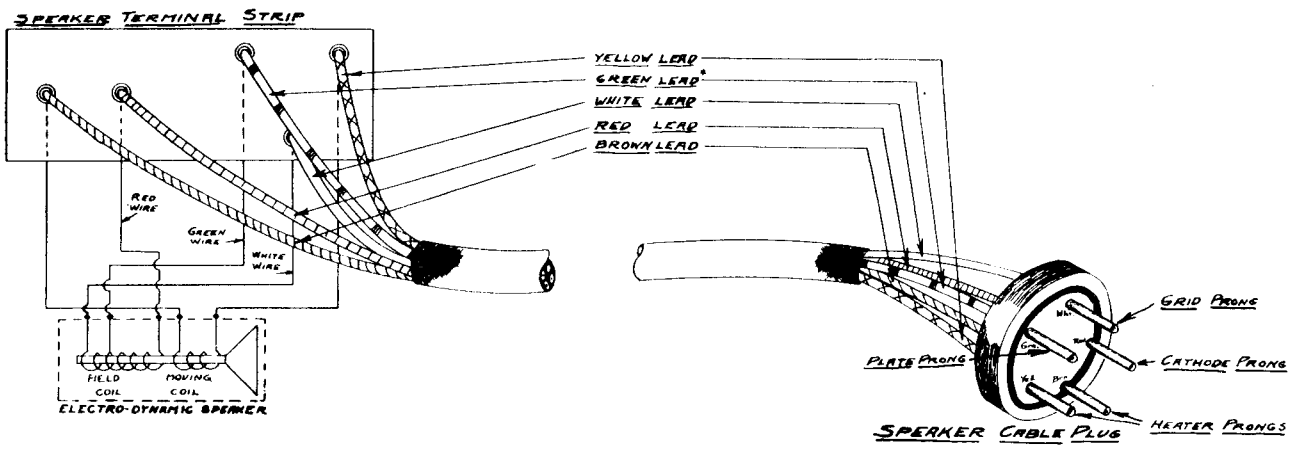
ALL-AMERICAN MOHAWK CORP.



UNIT	CAPACITY	PART No	UNIT	CAPACITY	PART No	UNIT	RESISTANCE	PART No	UNIT	RESISTANCE	PART No
C1	Two-.5	5328-S	C5	2 Cond. Bank 181-A		R1	10000	731-S	R5	70000	5295-S
C2	Two-.5	5592-S	C6			R2	300	5362-S	R6	25000	5272-S
C3	.01	5603-S	C7			R3	25000	5172-S	R7	.5 Meg.	5273-S
C4	.00025	5185-S	C8	.002	5396-S	R4	10000	5170-S	R8	20	5277-S

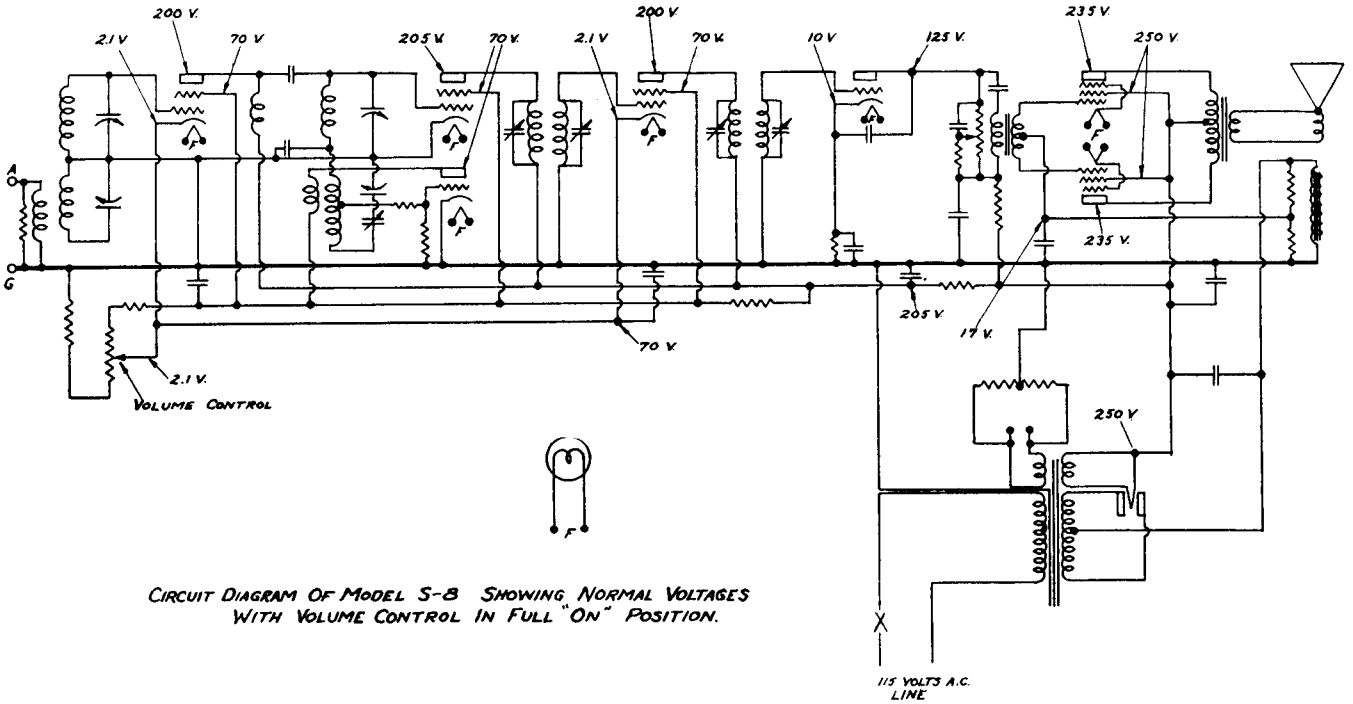
UNIT	RESISTANCE	PART No
R9	1000	5369-S
R10	2000	5393-S
R11	6000	5386-S
C-9	.001	5124-S

CIRCUIT DIAGRAM NO. 96 CHASSIS
60 CYCLE

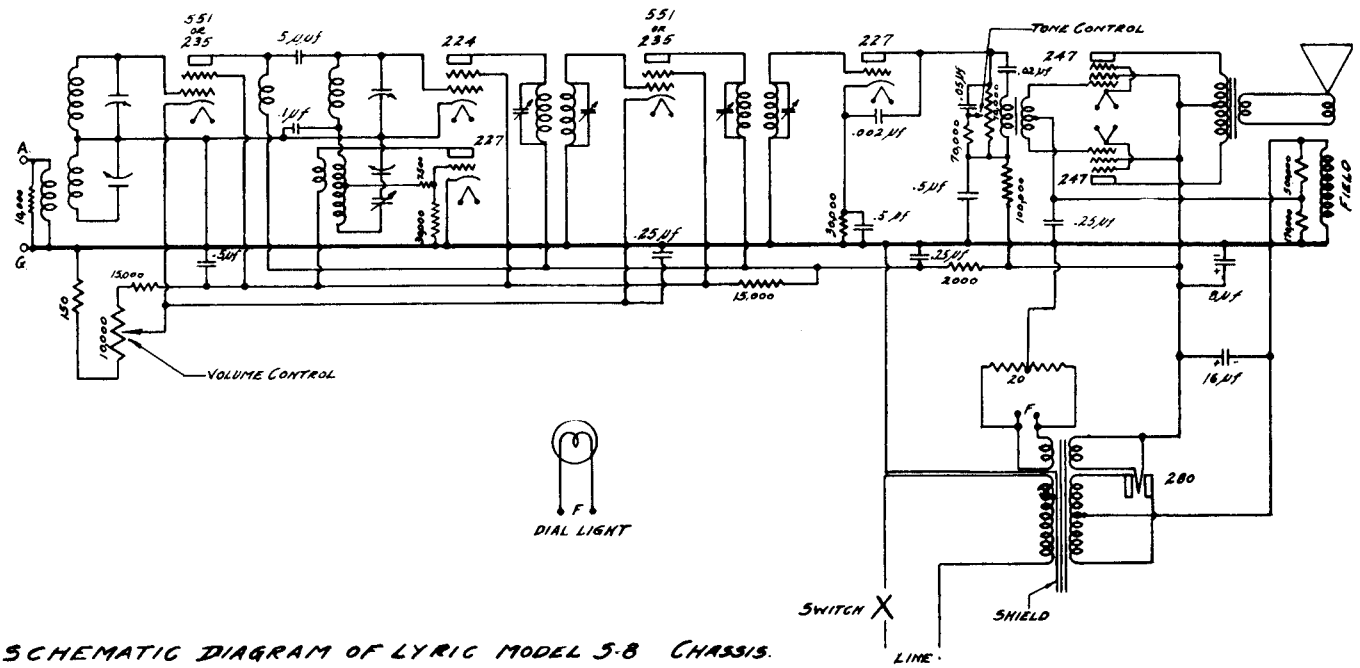


LOUDSPEAKER AND PLUG
CIRCUIT DIAGRAM NO. 90 CHASSIS

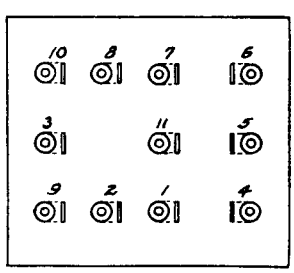
ALL-AMERICAN MOHAWK CORP.



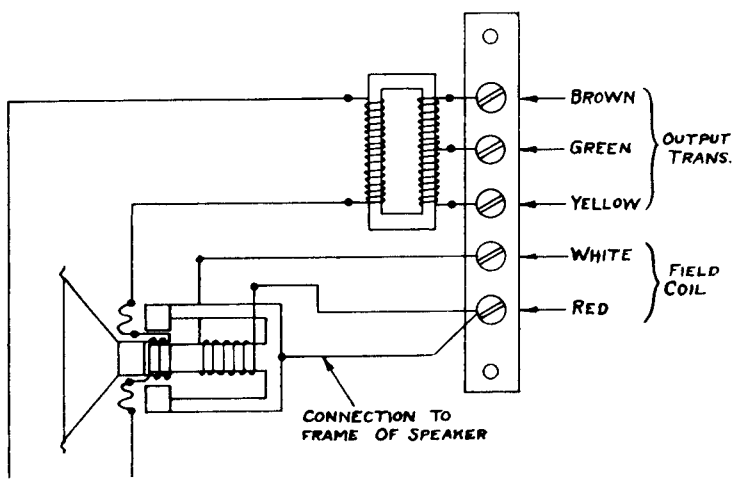
CIRCUIT DIAGRAM OF MODEL S-8 SHOWING NORMAL VOLTAGES WITH VOLUME CONTROL IN FULL "ON" POSITION.



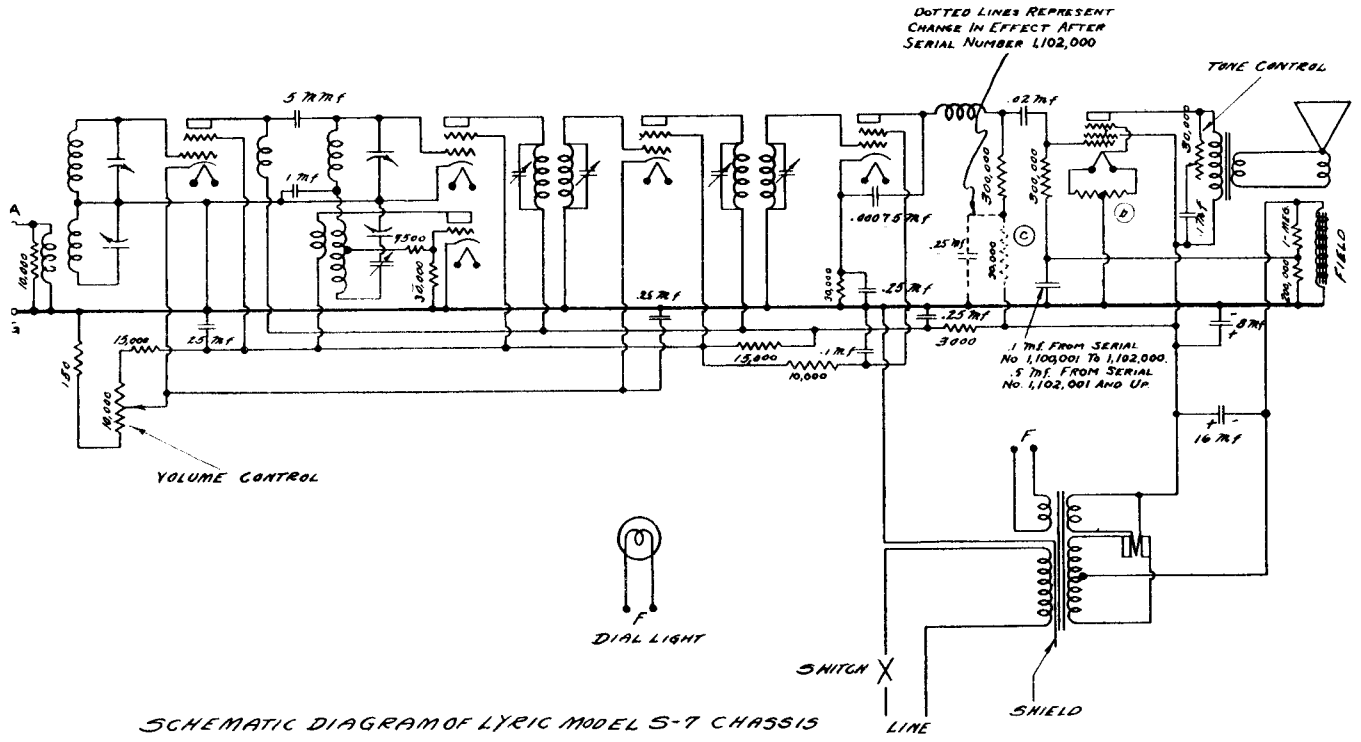
SCHEMATIC DIAGRAM OF LYRIC MODEL S-8 CHASSIS.



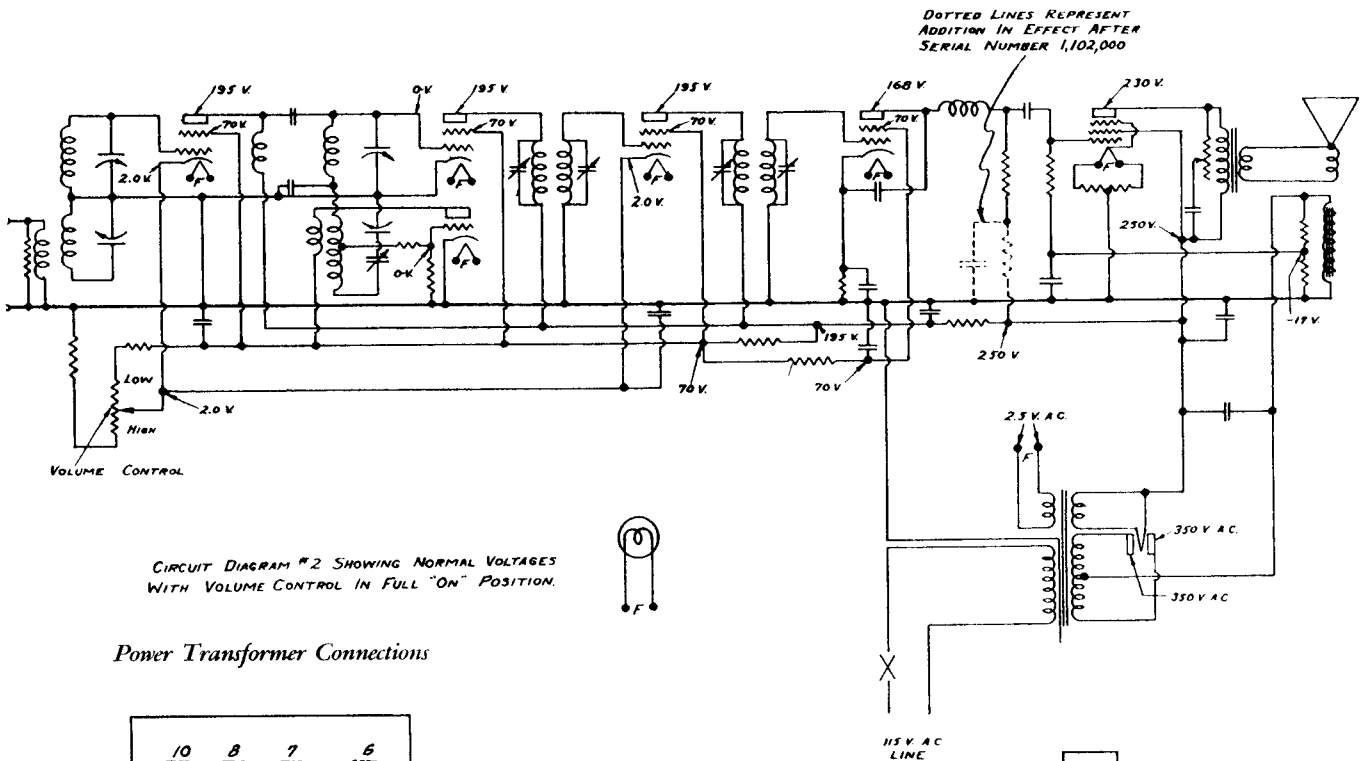
1—110 volt Primary Start
2—110 volt Primary Finish
3—Shield
4—High Voltage Secondary Start
5—High Voltage Secondary Tap
6—High Voltage Secondary Finish
7—'80 Filament Winding Start
8—'80 Filament Winding Finish
9—Heater and '47 Filament Winding Start
10—Heater and '47 Filament Winding Finish
11—No Connection



ALL-AMERICAN MOHAWK CORP.

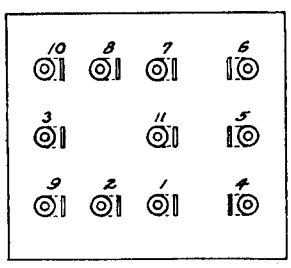


SCHEMATIC DIAGRAM OF LYRIC MODEL S-7 CHASSIS

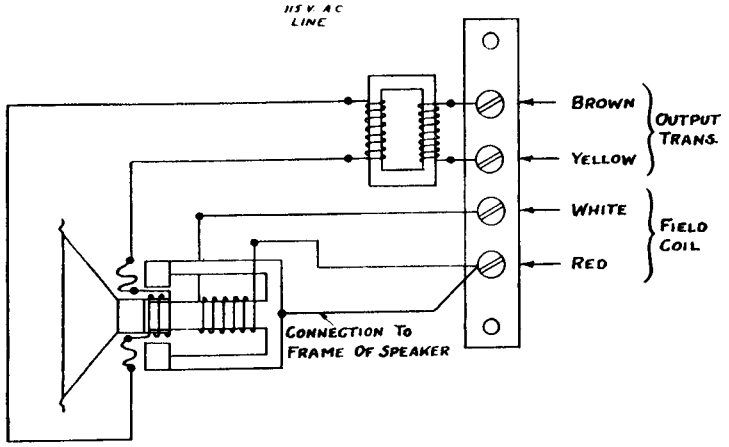


CIRCUIT DIAGRAM #2 SHOWING NORMAL VOLTAGES WITH VOLUME CONTROL IN FULL "ON" POSITION.

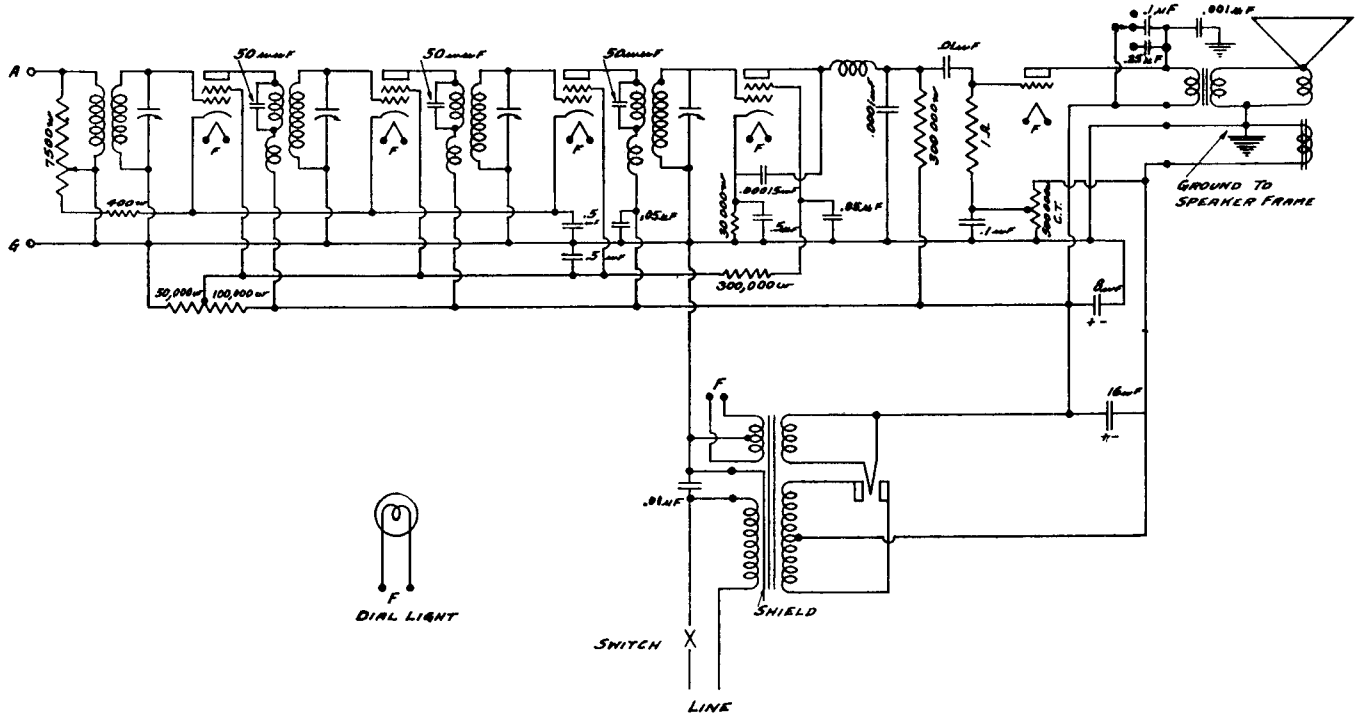
Power Transformer Connections



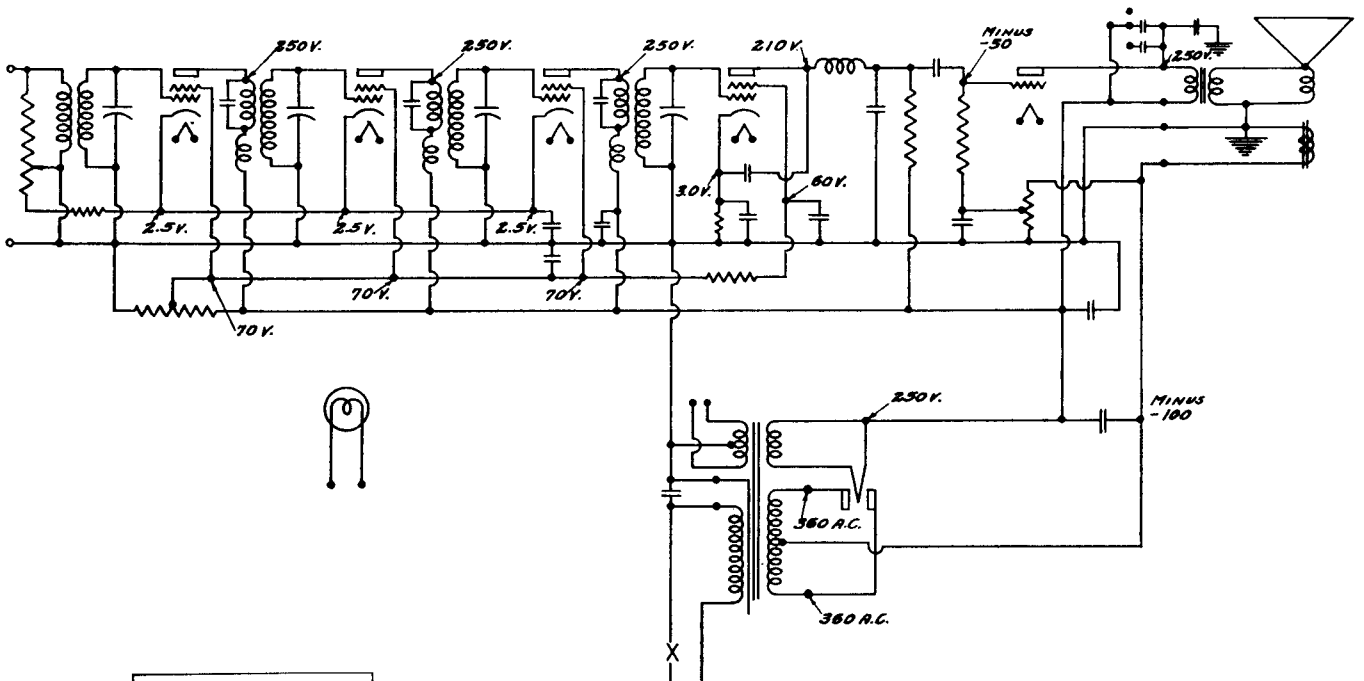
1—110 volt Primary Start
2—110 volt Primary Finish
3—Shield
4—High Voltage Secondary Start
5—High Voltage Secondary Tap
6—High Voltage Secondary Finish
7—'80 Filament Winding Start
8—'80 Filament Winding Finish
9—Heater and '47 Filament Winding Start
10—Heater and '47 Filament Winding Finish
11—No Connection



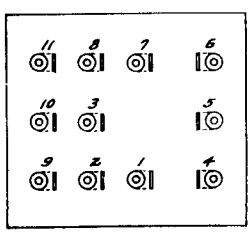
ALL-AMERICAN MOHAWK CORP.

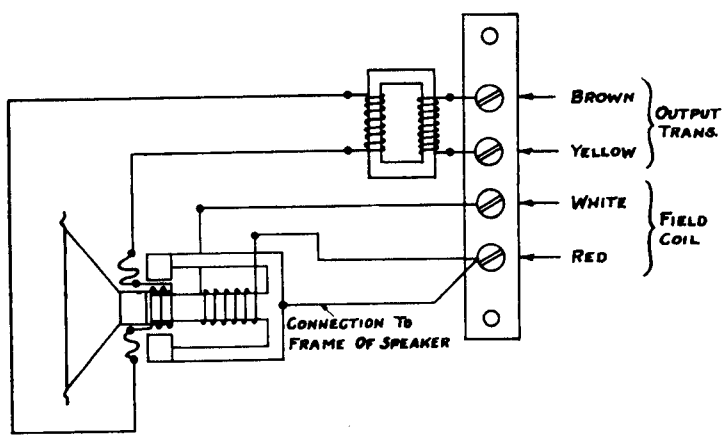


SCHEMATIC DIAGRAM OF LYRIC MODEL "J" CHASSIS



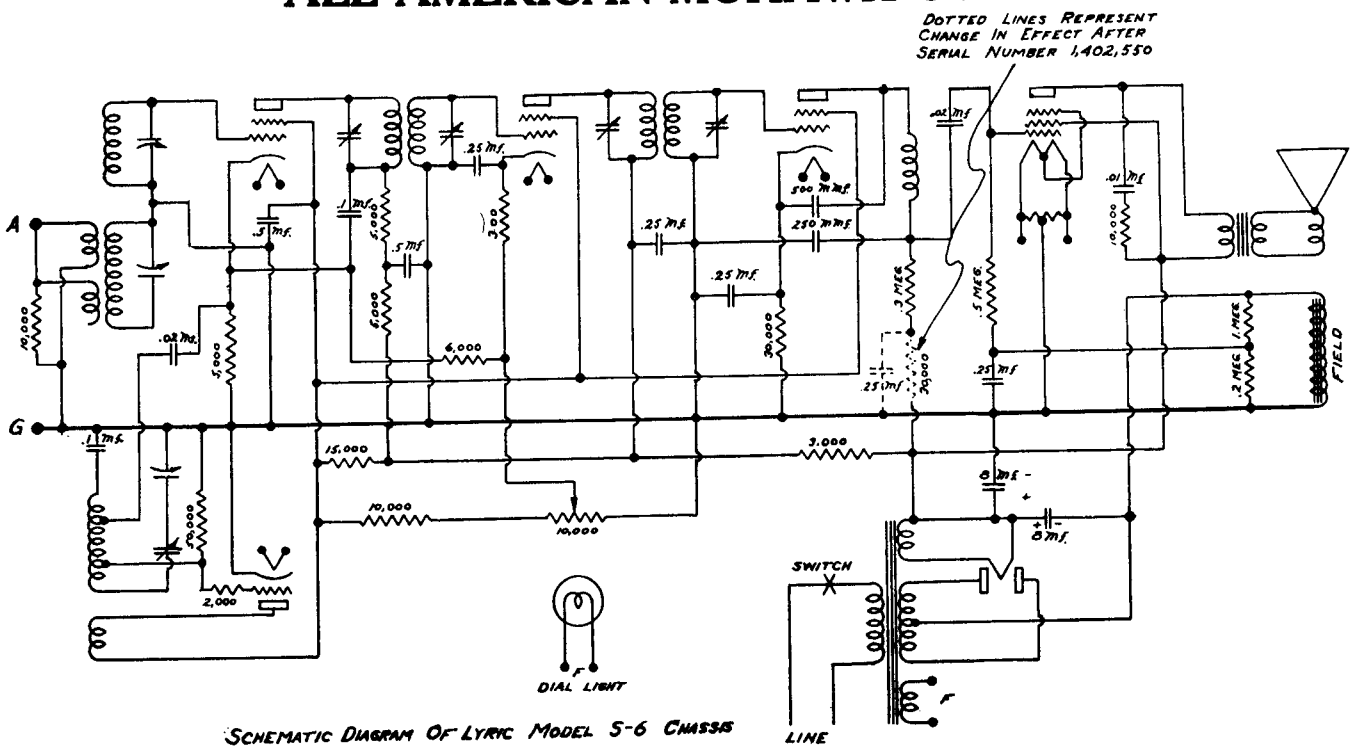
NOMINAL VOLTAGE CHART OF LYRIC MODEL "J" CHASSIS



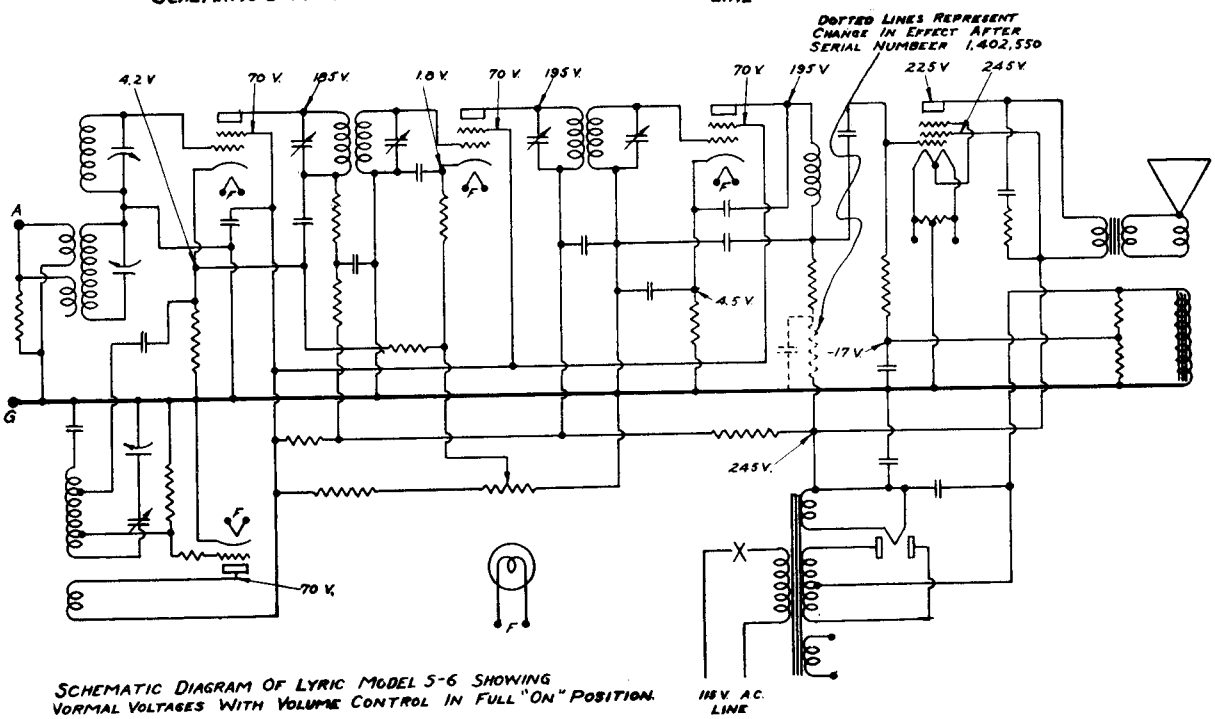


1—110 Volt Primary Start.
2—110 Volt Primary Finish.
3—Shield.
4—High Voltage Secondary Start.
5—High Voltage Secondary Tap.
6—High Voltage Secondary Finish.
7—'80 Filament Winding Start.
8—'80 Filament Winding Finish.
9—'24 and '45 Filament Winding Start.
10—'24 and '45 Filament Winding Tap.
11—'24 and '45 Filament Winding Finish.

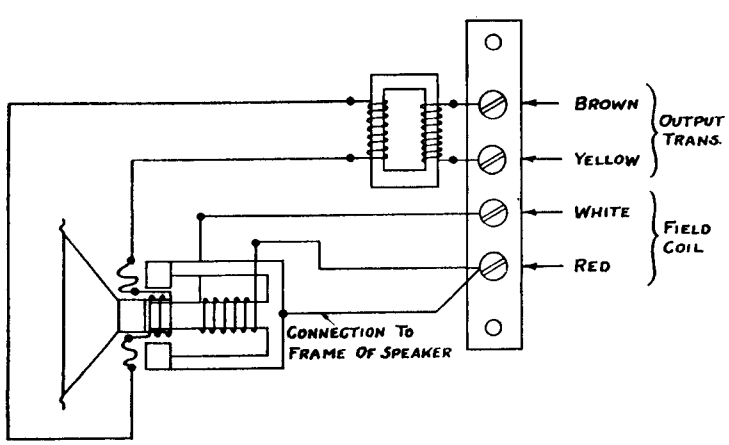
ALL-AMERICAN MOHAWK CORP.

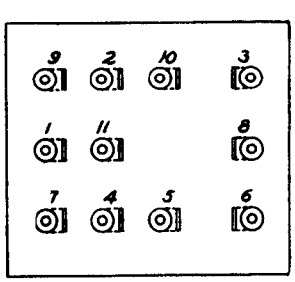


SCHEMATIC DIAGRAM OF LYRIC MODEL 5-6 CHASSIS



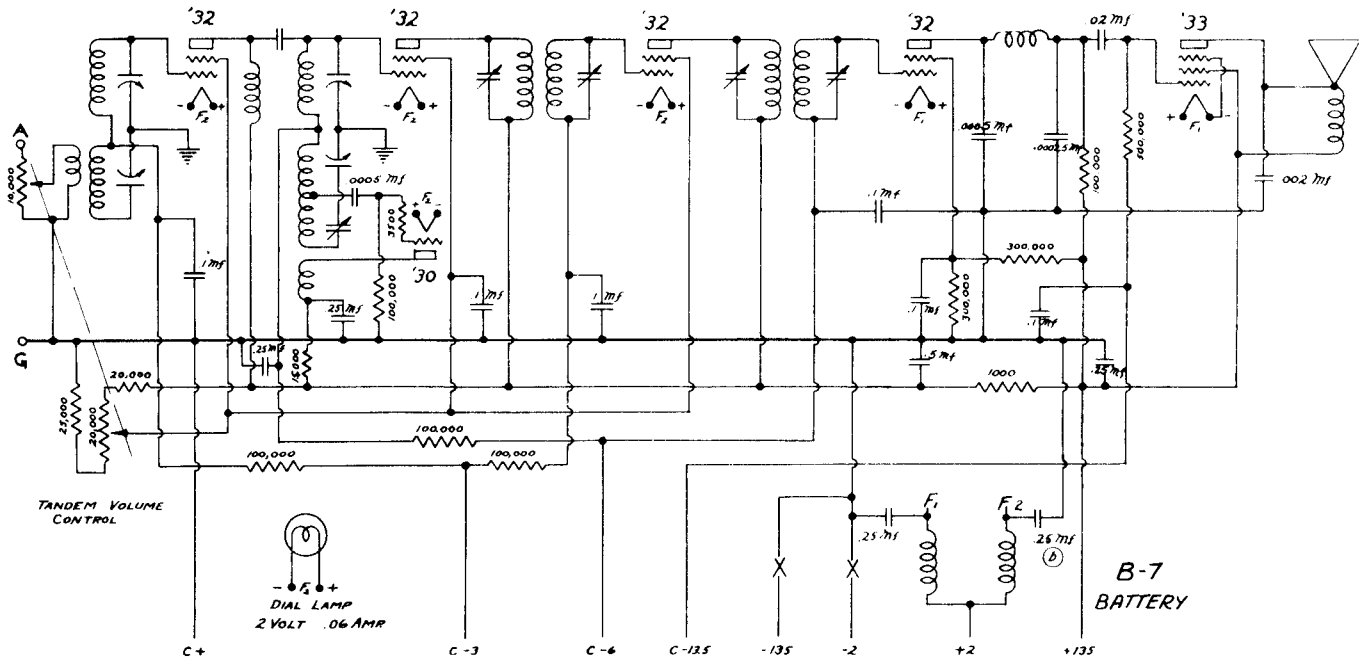
SCHEMATIC DIAGRAM OF LYRIC MODEL 5-6 SHOWING NORMAL VOLTAGES WITH VOLUME CONTROL IN FULL "ON" POSITION.

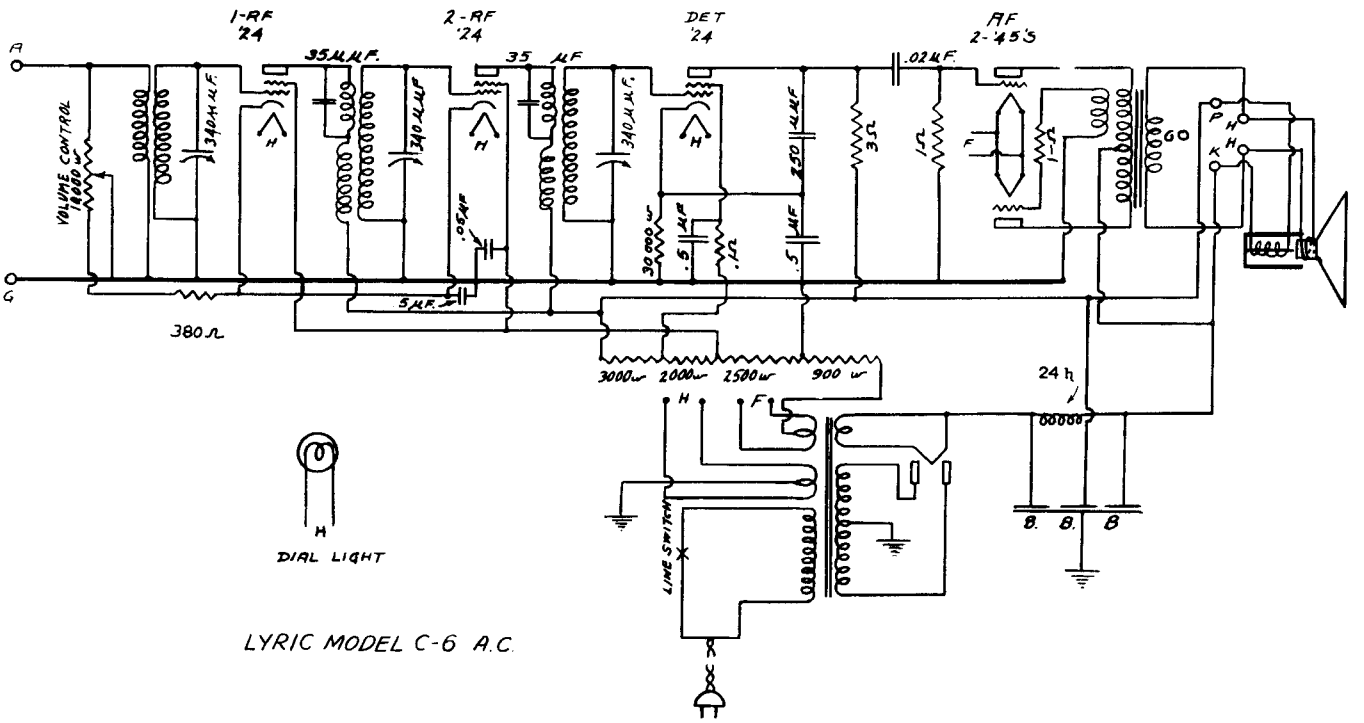




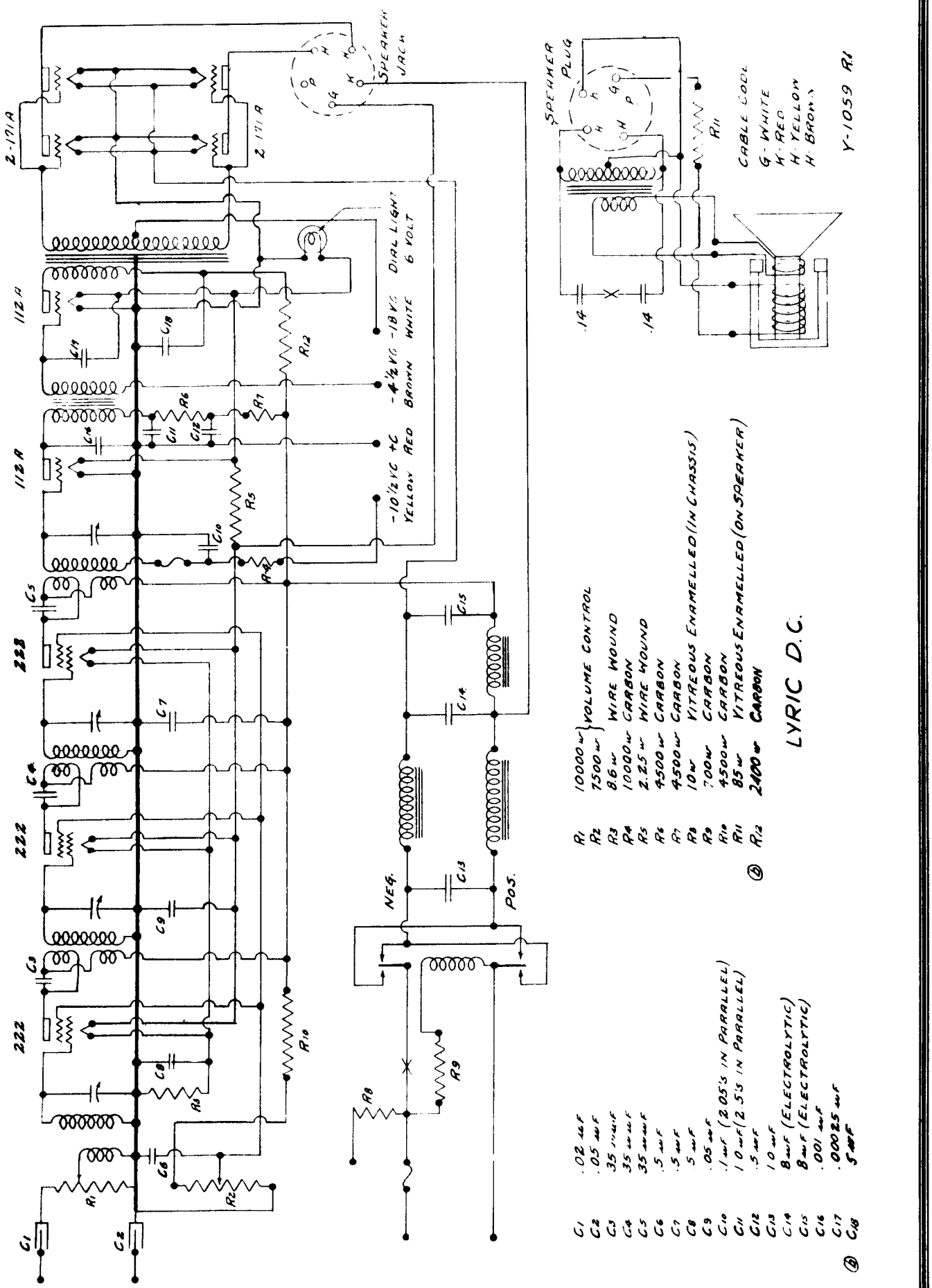
1—110 volt Primary Start
2—110 volt Primary Finish
3—Shield
4—High Voltage Secondary Start
5—High Voltage Secondary Tap
6—High Voltage Secondary Finish
7—'80 Filament Winding Start
8—'80 Filament Winding Finish
9—Heater Winding Start
10—Heater Winding Finish
11—No Connection

ALL-AMERICAN MOHAWK CORP.

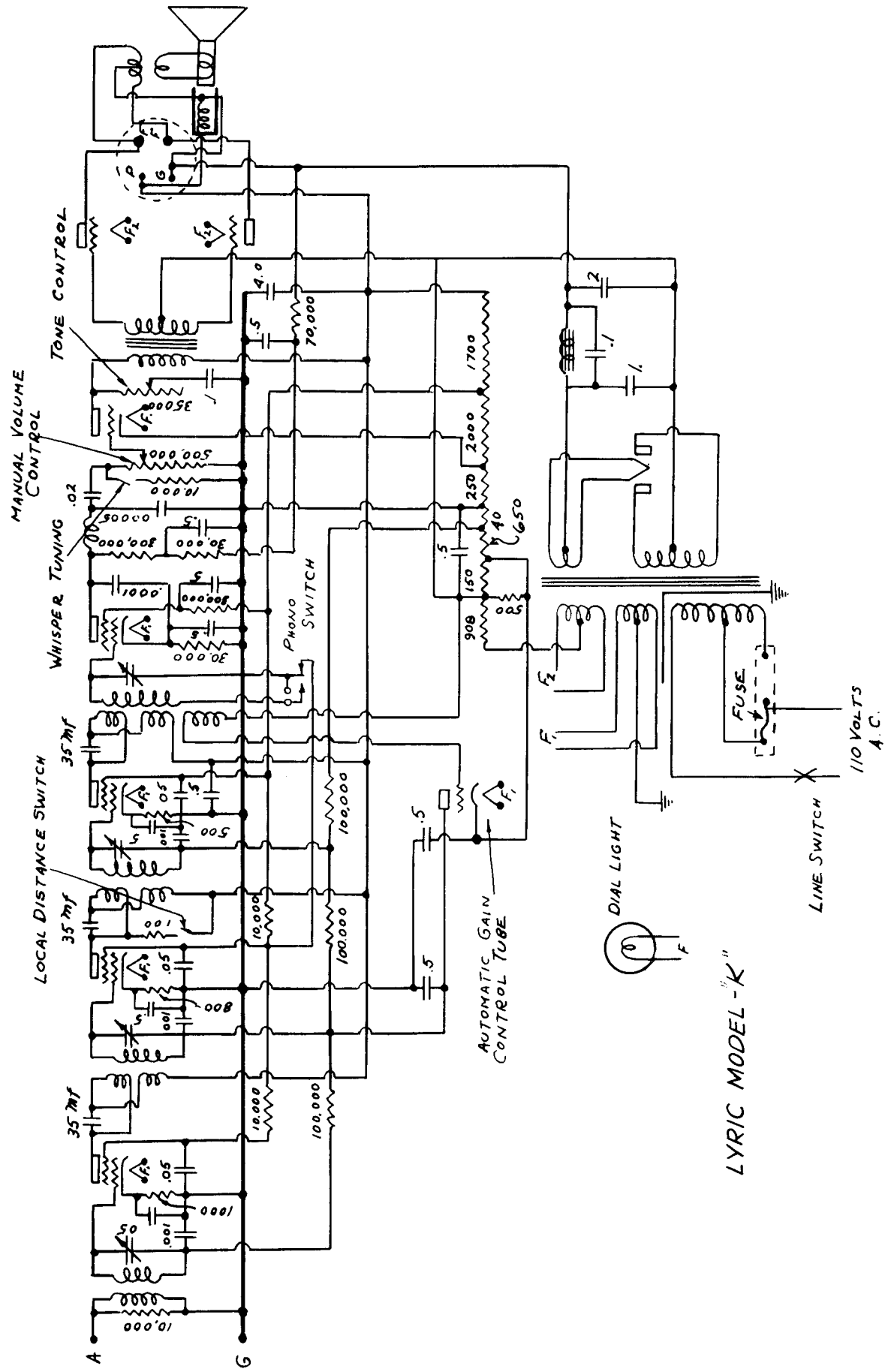




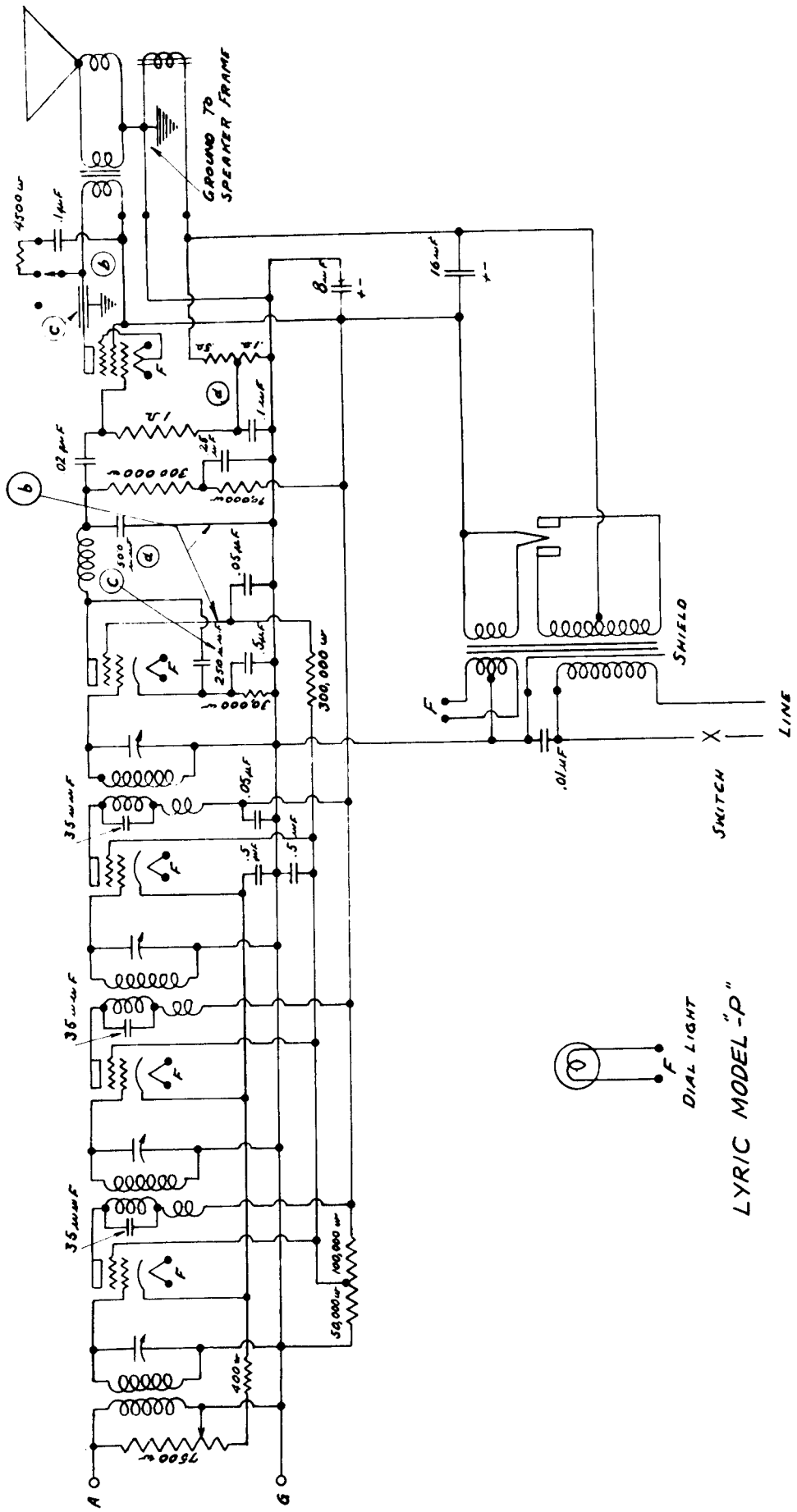
ALL-AMERICAN MOHAWK CORP.



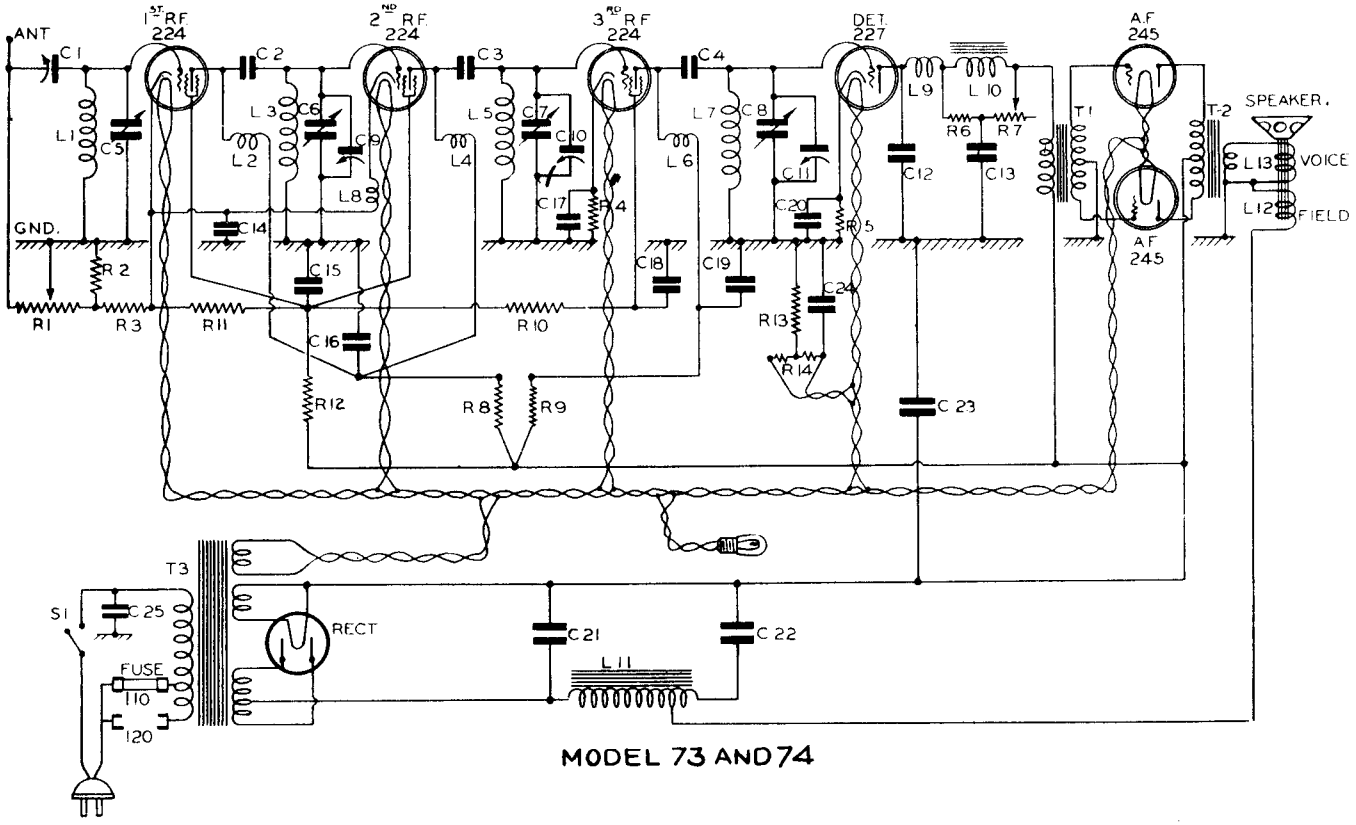
ALL-AMERICAN MOHAWK CORP.



ALL-AMERICAN MOHAWK CORP.



AMERICAN BOSCH MAGNETO CORP.



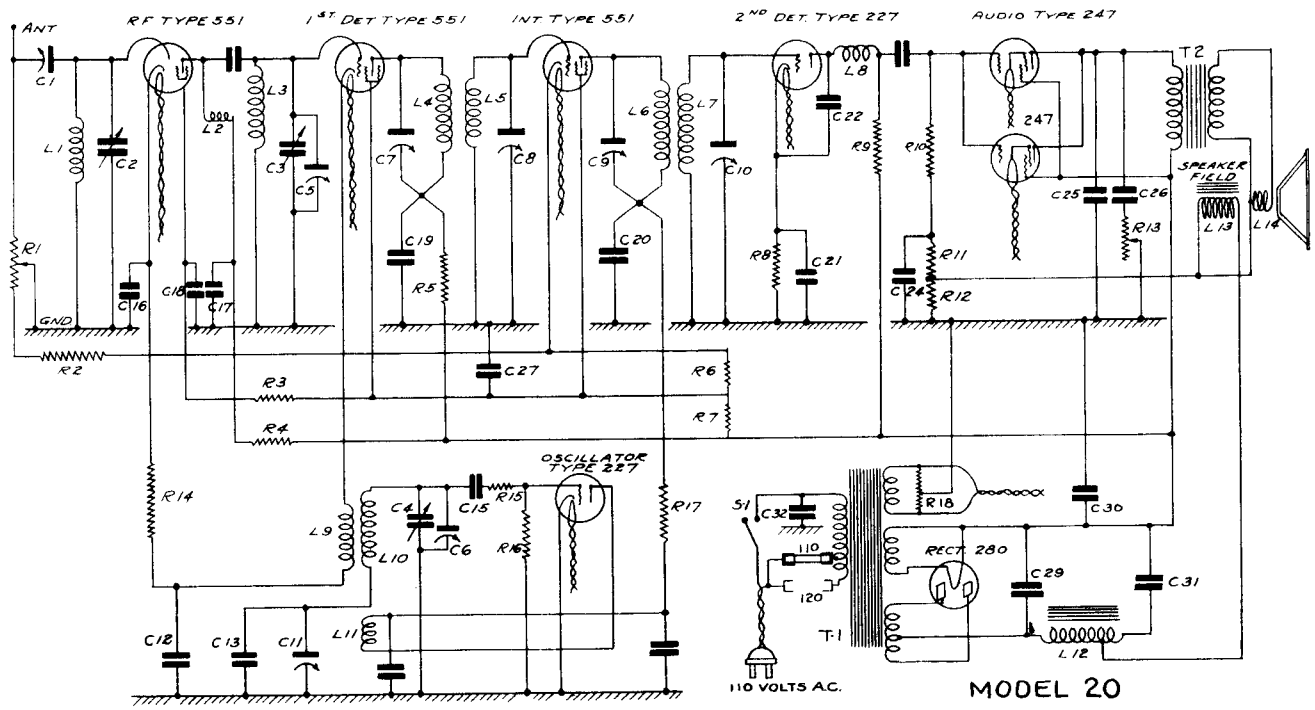
MODEL 73 AND 74

R 1—Volume Control 10,000 ohms
R 2—2750 ohms } Tapped unit
R 3— 250 ohms }
R 4—Cathode Resistor 750 ohms
R 5—Cathode Resistor 25,000 ohms
R 6—50,000 ohms
R 7—Tone Control 50,000 ohms
R 8—Plate Supply Resistor 5,000 ohms
R 9—Plate Supply Resistor 10,000 ohms
R 10—Screen Supply Resistor 750 ohms
R 11—Cathode Resistor 25,000 ohms
R 12—Screen Supply Resistor 30,000 ohms
R 13—Audio Bias Resistor 800 ohms
R 14—Center Tap Resistor 4.1 ohms

C 14—Cathode By-pass .05 mfd.
C 15—Screen By-pass .05 mfd.
C 16—Plate By-pass .05 mfd.
C 17—Cathode By-pass .05 mfd.
C 18—Screen By-pass .05 mfd.
C 19—Plate By-pass .05 mfd.
C 20—Det. Cathode By-pass .25 mfd.
C 21—Filter Condenser 2. mfd. } top unit
C 22—Filter Condenser 2. mfd. }
C 23—Filter Condenser 4. mfd. }
C 24—Audio Bias By-pass .05 mfd.
C 25—Buffer Condenser .1 mfd. (top unit)

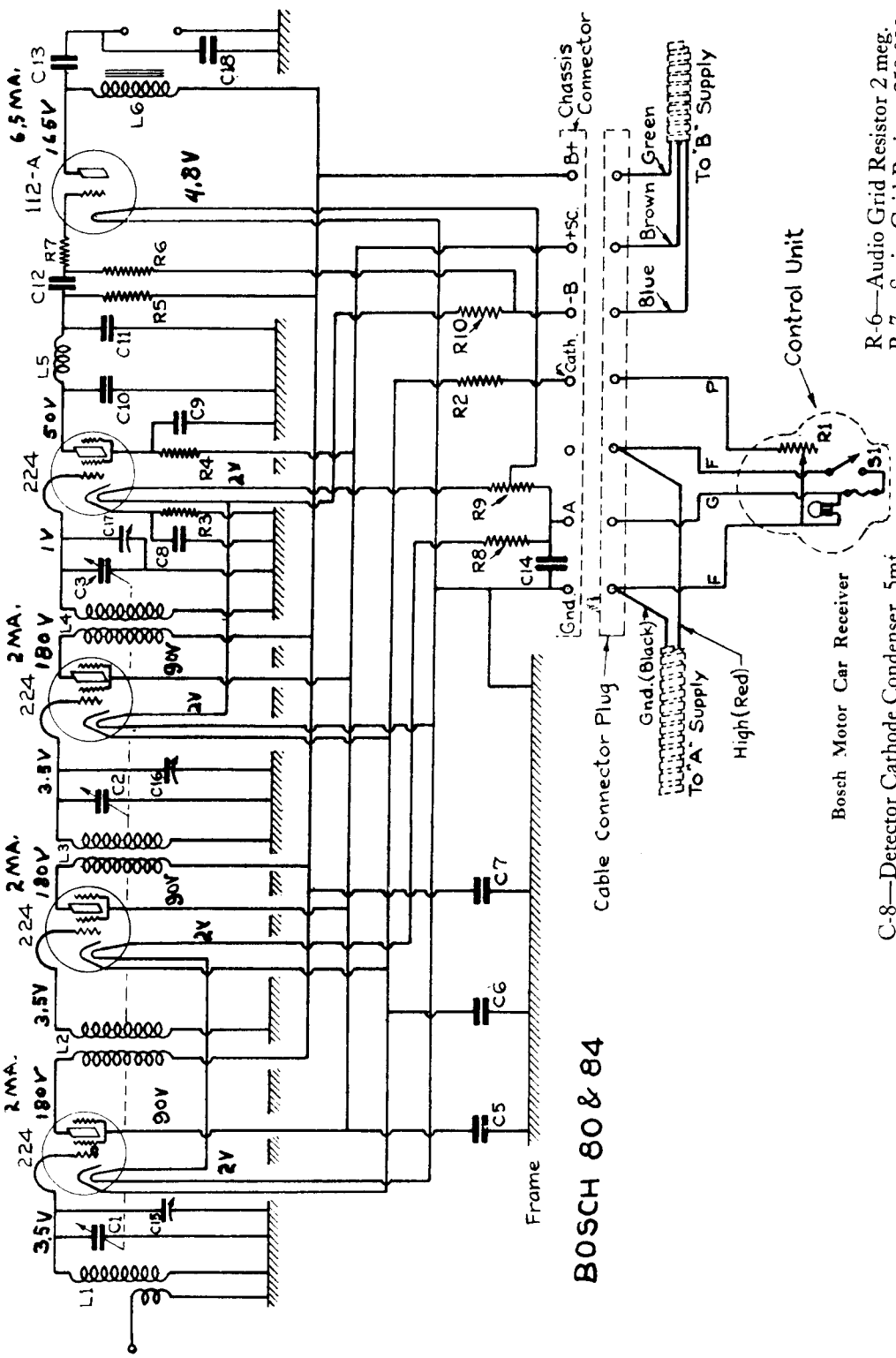
Stage	Tube	Plate	Screen	Cathode	Grid	Fil.	Plate Current
1st RF	224	240	90	44	3	2.2	4
2nd RF	224	240	90	44	3	2.2	4
3rd RF	224	240	90	44	3	2.2	4
Det.	227	250	....	20	25	2.2	1
Audio	245	230	....	....	44	2.3	25
Audio	245	230	....	....	44	2.3	25
Rect.	280	.....	....	....	....	4.8	30-30

AMERICAN BOSCH MAGNETO CORP.



Stage	Tube	Plate	Screen	Cathode	Grid	Fil.	Plate	Current
RF	551	225	90	18	3	2.2	3.5	MA
Oscillator	227	60	.....	0	0	2.2	5	MA
1st Det.	551	225	80	8	7	2.2	2	MA
I.F.	551	240	80	4	3	2.2	4	MA
2nd Det.	227	130	.....	0	15	2.2	1	MA
Audio	247	240	240	.....	16	2.2	30	MA
Audio	247	240	240	.....	16	2.2	30	MA
Rectifier	280	.....	.....	.....	.....	5	38	MA

AMERICAN BOSCH MAGNETO CORP.



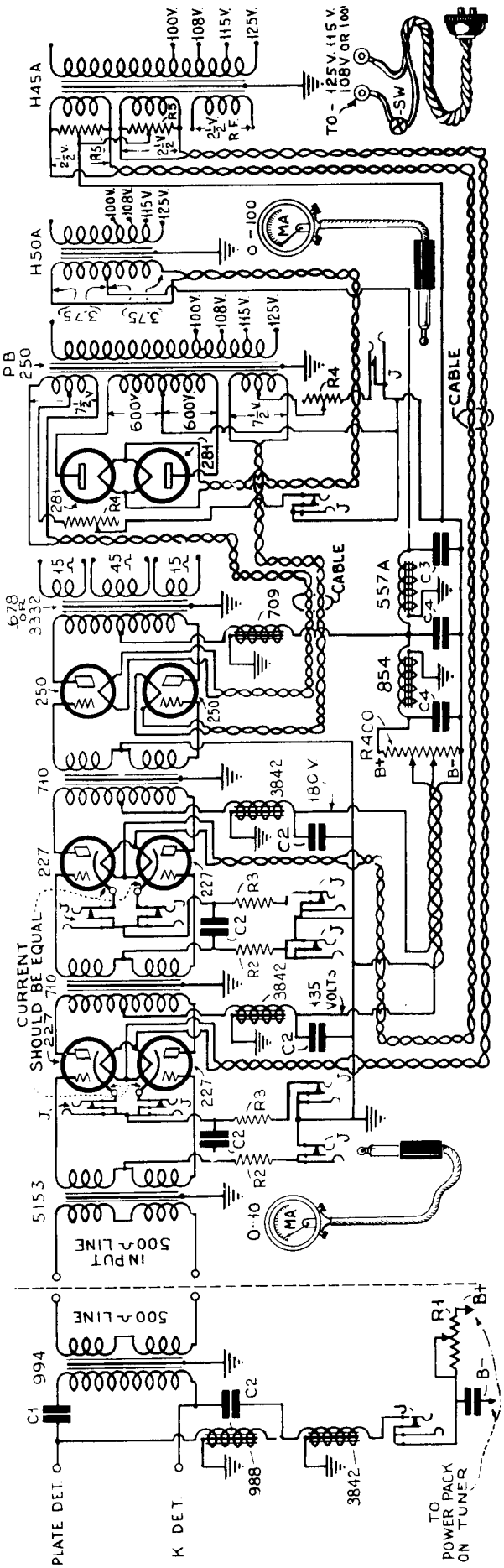
R-1—Volume Control 18,000 ohms
R-2—1st RF Bias Resistor 500 ohms
R-3—Detector Bias Resistor 25,000 ohms
R-4—Detector Screen Resistor 500,000 ohms
R-5—Detector Plate Resistor 500,000 ohms

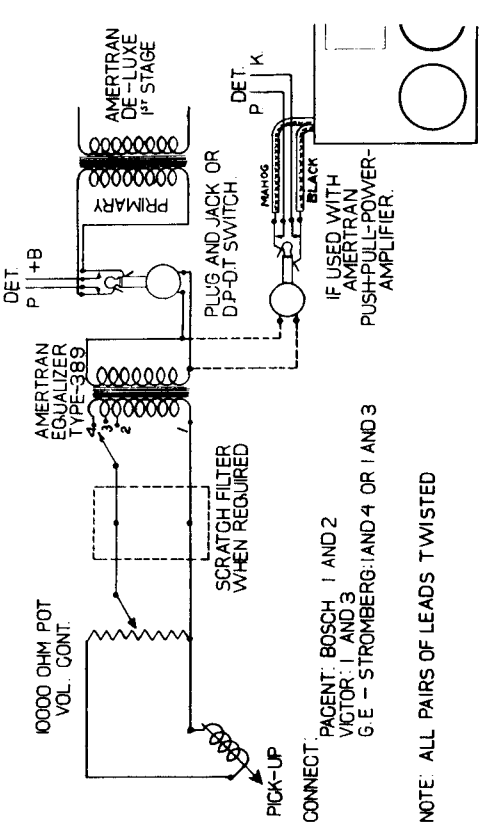
R-6—Audio Grid Resistor 2 meg.
R-7—Series Grid Resistor 250,000 ohms
R-8—Filament Resistor 1.3 ohms
R-9—Filament Resistor 1.1 ohms
R-10—Audio Bias Resistor 900 ohms

C-1—1st RF Tuning Condenser
C-2—2nd RF Tuning Condenser
C-3—3rd RF Tuning Condenser
C-5—Screen By-pass Condenser .5mf.
C-6—Cathode By-pass Condenser .5mf.
C-7—Plate By-pass Condenser 1.mf.

C-8—Detector Cathode Condenser .5mf.
C-9—Detector Screen Condenser .5mf.
C-10—Detector Plate Condenser .0001mf.
C-11—Detector Plate Condenser .0001mf.
C-12—Coupling Condenser .002mf.
C-13—Output Condenser 1.mf.
C-14—Filament By-pass Condenser
C-15—1st RF Alignment Condenser
C-16—3rd RF Alignment Condenser
C-17—Det. Alignment Condenser
C-18—Speaker Condenser

AMERICAN TRANSFORMER CO. (AMERTRAN)

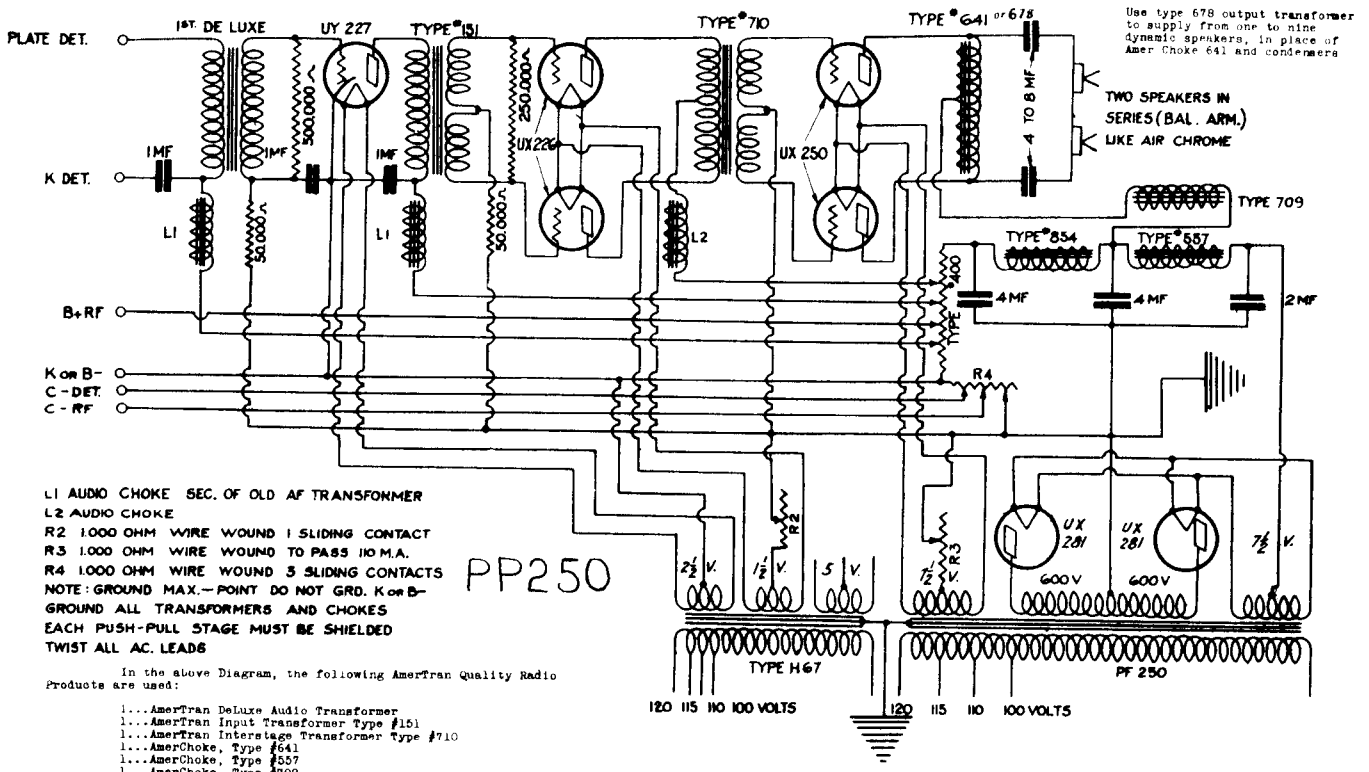




PHONOGRAPH-PICK-UP- CIRCUIT DIAGRAM

I...	994	AMERTRAN TRANSFORMER FROM DETECTOR TO 500 OHM LINE
I...	5153	AMERTRAN TRANSFORMER FROM 500 OHM LINE TO GRIDS OF TUBES
2...	710	AMERTRAN TRANSFORMER BETWEEN OUTPUT OF 2 TUBES AND 2 GRIDS
I...	678	AMERTRAN TRANSFORMER TO 200 OHM LINE OR TO 9 I5-OHM VOICE COILS
	OR	
I...	3332	AMERTRAN TRANSFORMER TO 500 OHM LINE AND I5 OHM MONITOR
I...	988	AMERTRAN PARALLEL FEED ALLOY CORE CHOKE
3...	3842	AMERTRAN ALLOY CORE AUDIO CHOKES
I...	577A	AMERTRAN FILTER CHOKE
I...	250A	AMERTRAN POWER BLOCK; 709,854 FILTER CHOKES INCLUDED
I...	H50A	AMERTRAN 7½ VOLT FILAMENT TRANSFORMER
I...	H45A	AMERTRAN 2½ VOLT FILAMENT TRANSFORMER
CI	R400	AMERTRAN VOLTAGE DIVIDER
C2	½MFD	AEROVOX 307 TYPE CONDENSER
C3	2MFD	AEROVOX 307 TYPE CONDENSER
C4	2MFD	AEROVOX I002TYPE CONDENSER
	4MFD	AEROVOX 802 TYPE CONDENSER
	OR	
C2,	C3, C4,	IN AEROVOX B-I000 CONDENSER BLOCK
RI		I00,000 OHM VARIABLE, ELECTRAD OR CENTRALAB
R2		50,000 OHM DURHAM, AEROVOX OR EL-MENCO 3 WATT RATING
R3		I000 OHM VARIABLE, CENTRALAB
R4		2000 OHM VARIABLE WARD LEONARD ADJUSTAT
R5		20 OHM CENTER TAPPED AEROVOX OR CLAROSTAT HUMDINGER
J		CLOSED CIRCUIT JACKS

AMERICAN TRANSFORMER CO. (AMERTRAN)

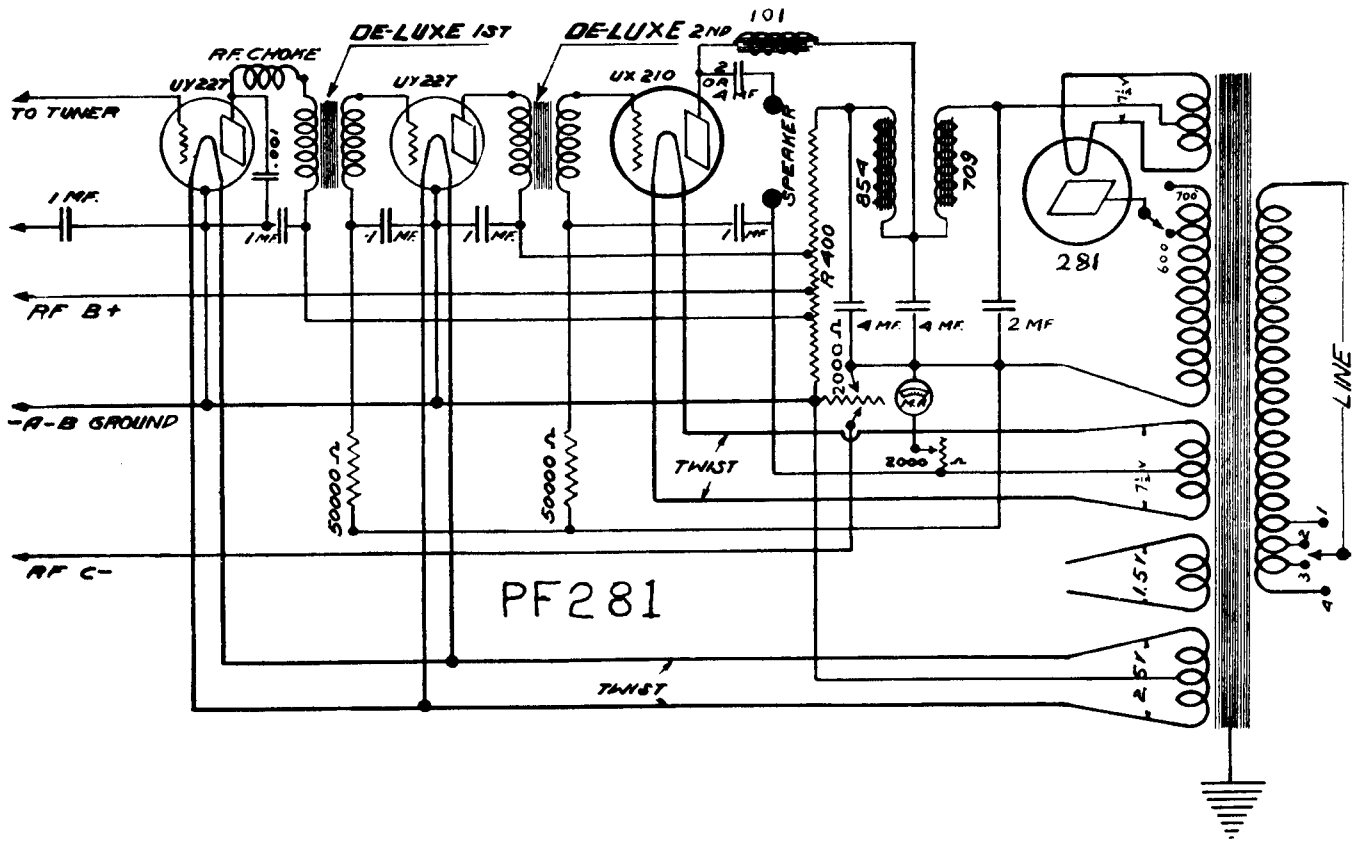


In the above Diagram, the following AmerTran Quality Radio Products are used:

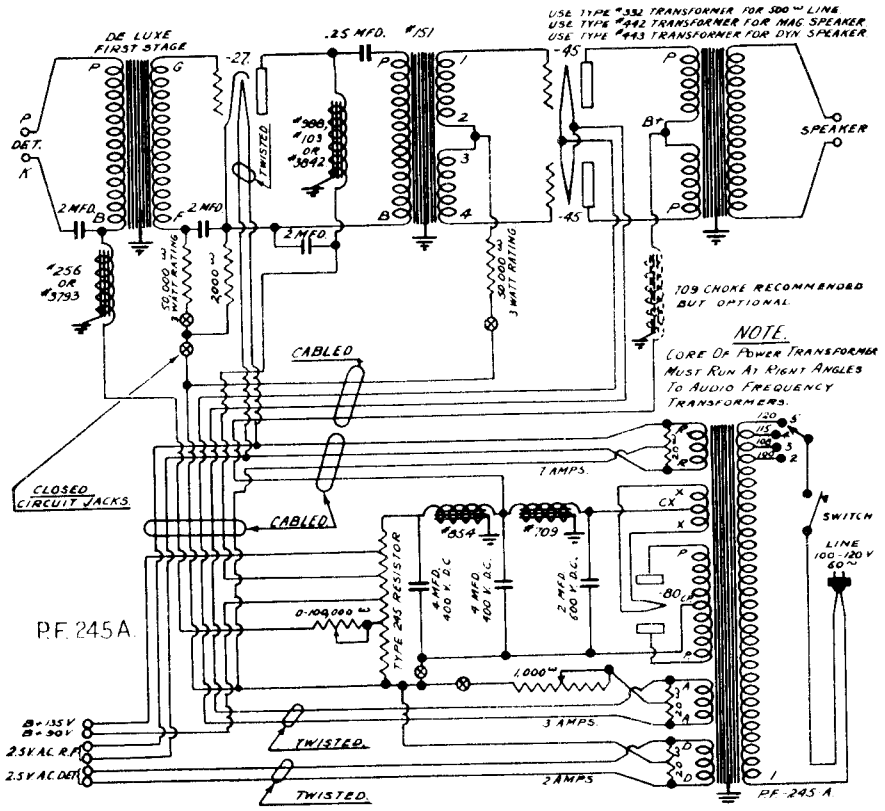
1...AmerTran DeLuxe Audio Transformer
1...AmerTran Input Transformer Type #151
1...AmerTran Interstage Transformer Type #710
1...AmerChoke, Type #641
1...AmerChoke, Type #557
1...AmerChoke, Type #709
1...AmerChoke, Type #854
1...AmerTran Voltage Divider, Type R400
1...AmerTran Power Transformer, Type PF 250
1...AmerTran Heater Transformer, Type H 67

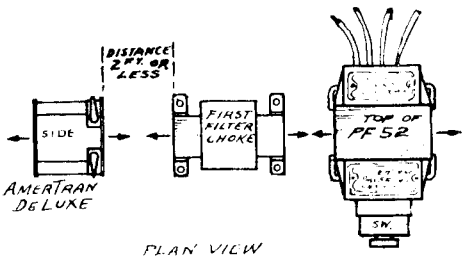
The Output from the two UX 250 tubes to dynamic type speakers should be through an AmerTran special output transformer designed to operate the type and number of speakers to be used.

Further information on request.



AMERICAN TRANSFORMER CO. (AMERTRAN)



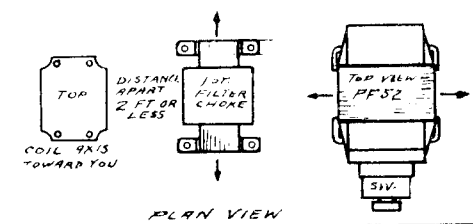


PLAN VIEW

INCORRECT
(THIS IS POSITION OF MAXIMUM COUPLING AND HUM

AXES OF ALL COILS COINCIDE

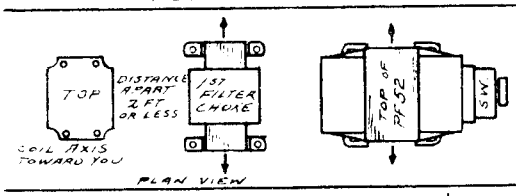
ARROWS SHOW DIRECTION OF MAGNETIC FIELD.



PLAN VIEW

INCORRECT BUT BETTER THAN ABOVE

AXIS OF COIL IN PF52 IS STILL POINTING TOWARD DE LUXE, ALTHO DE LUXE AXIS VERTICAL AND AT RIGHT ANGLES.

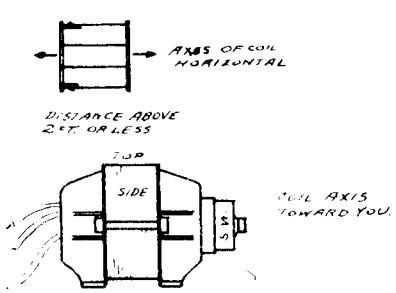


PLAN VIEW

CORRECT

POSITION OF LEAST COUPLING. LITTLE OR NO HUM

AXIS OF PF52 COIL AND CHOKE ARE BOTH AT RIGHT ANGLES TO DE LUXE COIL FROM ALL VIEW POINTS



ELEVATION VIEW

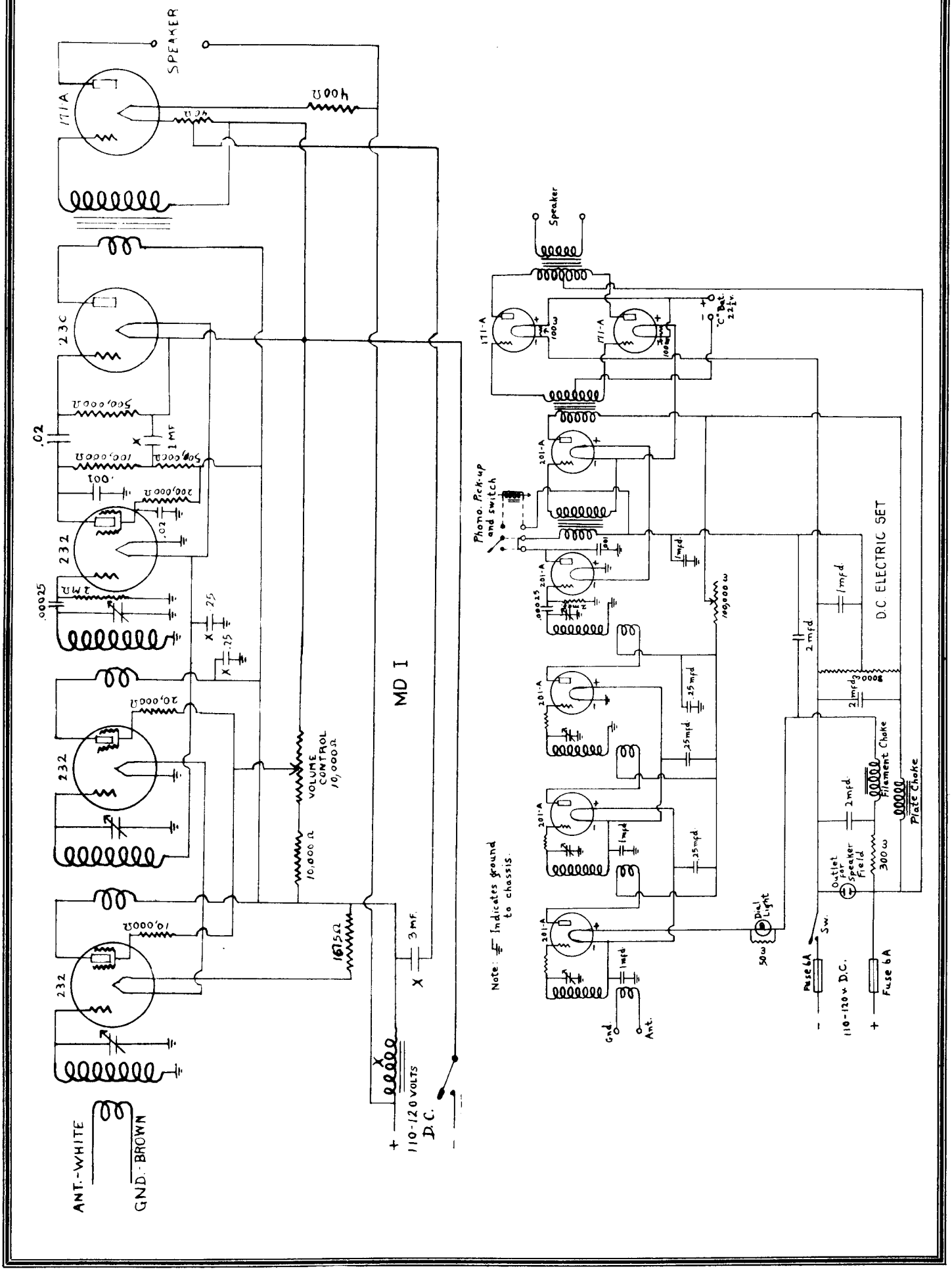
CORRECT POSITION IF AMPLIFIER MOUNTED DIRECTLY ABOVE PF52

ELIMINATION OF HUM CAUSED BY 60 CYCLE MAGNETIC FIELD FROM POWER TRANSFORMER AND FIRST FILTER CHOKE.

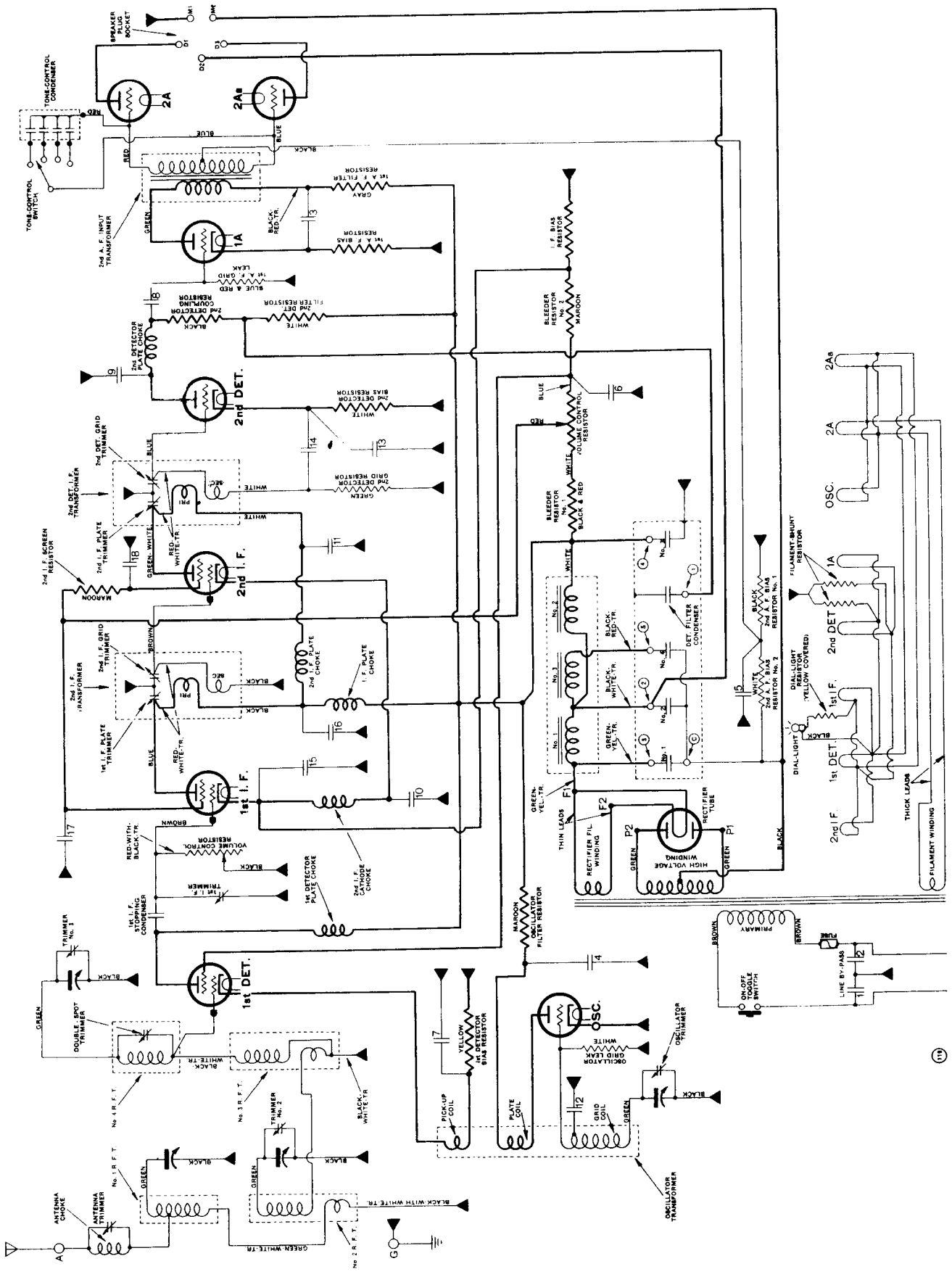
THE MOST EFFECTIVE SHIELDING IS THAT PRODUCED BY A HEAVY COPPER OR BRASS BOX AROUND THE POWER TRANSFORMER AND FIRST FILTER CHOKE. THE SECOND CHOKE SHOULD BE OUTSIDE OF THIS BOX. THE DISTANCE APART OF CHOKES AND BETWEEN FIRST CHOKE AND POWER TRANS. SHOULD NOT BE LESS THAN $1\frac{1}{2}$" TO 2"

HUM MAY ALSO BE CAUSED BY INTERSTAGE COUPLING IN THE AUDIO AMPLIFIER, DEFECTIVE TUBES, IMPROPER GAPS IN CHOKES, AND MUST NOT BE CONFUSED WITH HUM FROM FIELD SURROUNDING POWER TRANSFORMER

ANSLEY RADIO LABORATORIES

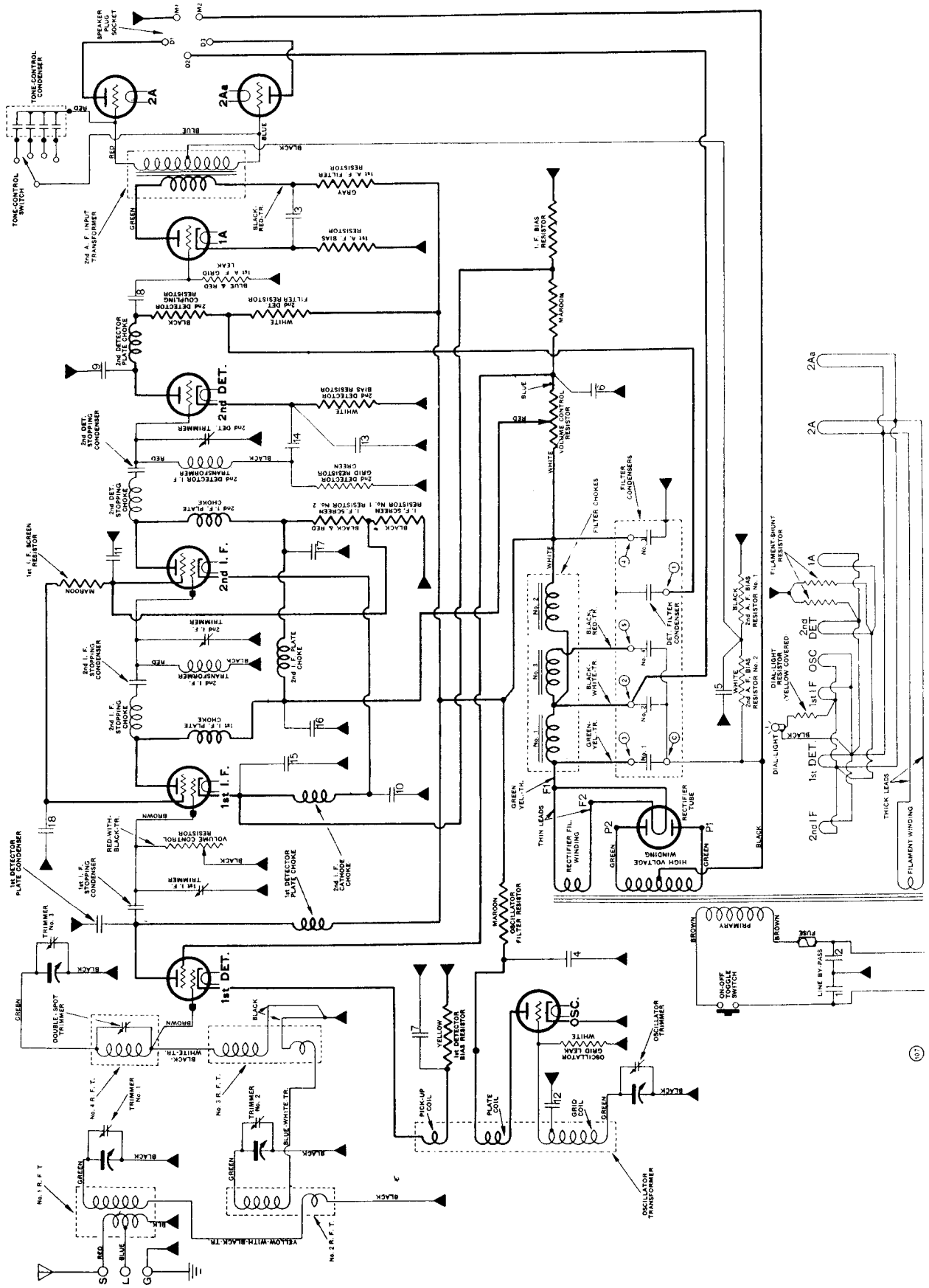


ATWATER KENT MANUFACTURING CO.



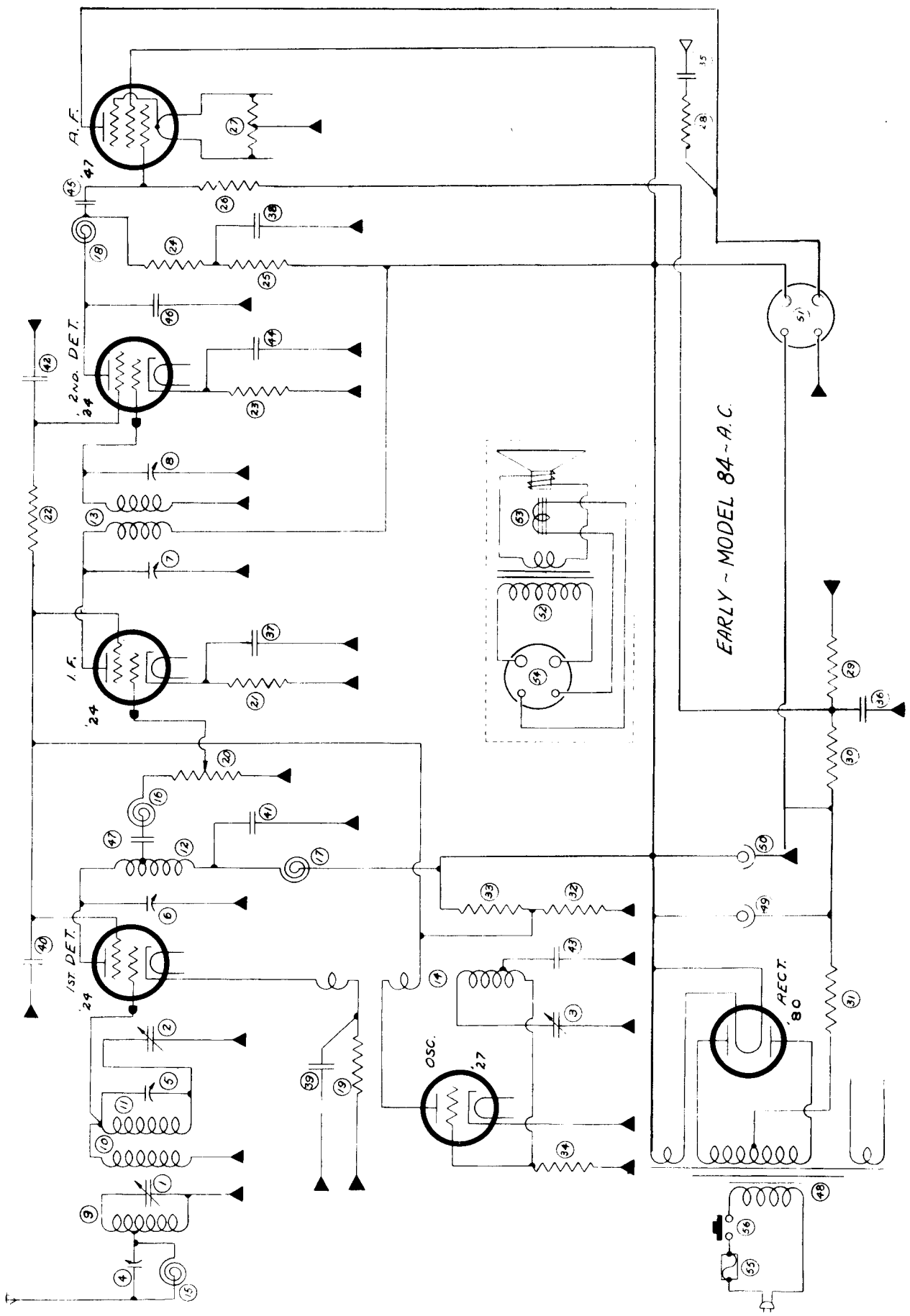
SCHEMATIC DIAGRAM OF TYPE H-2 CHASSIS

ATWATER KENT MANUFACTURING CO.

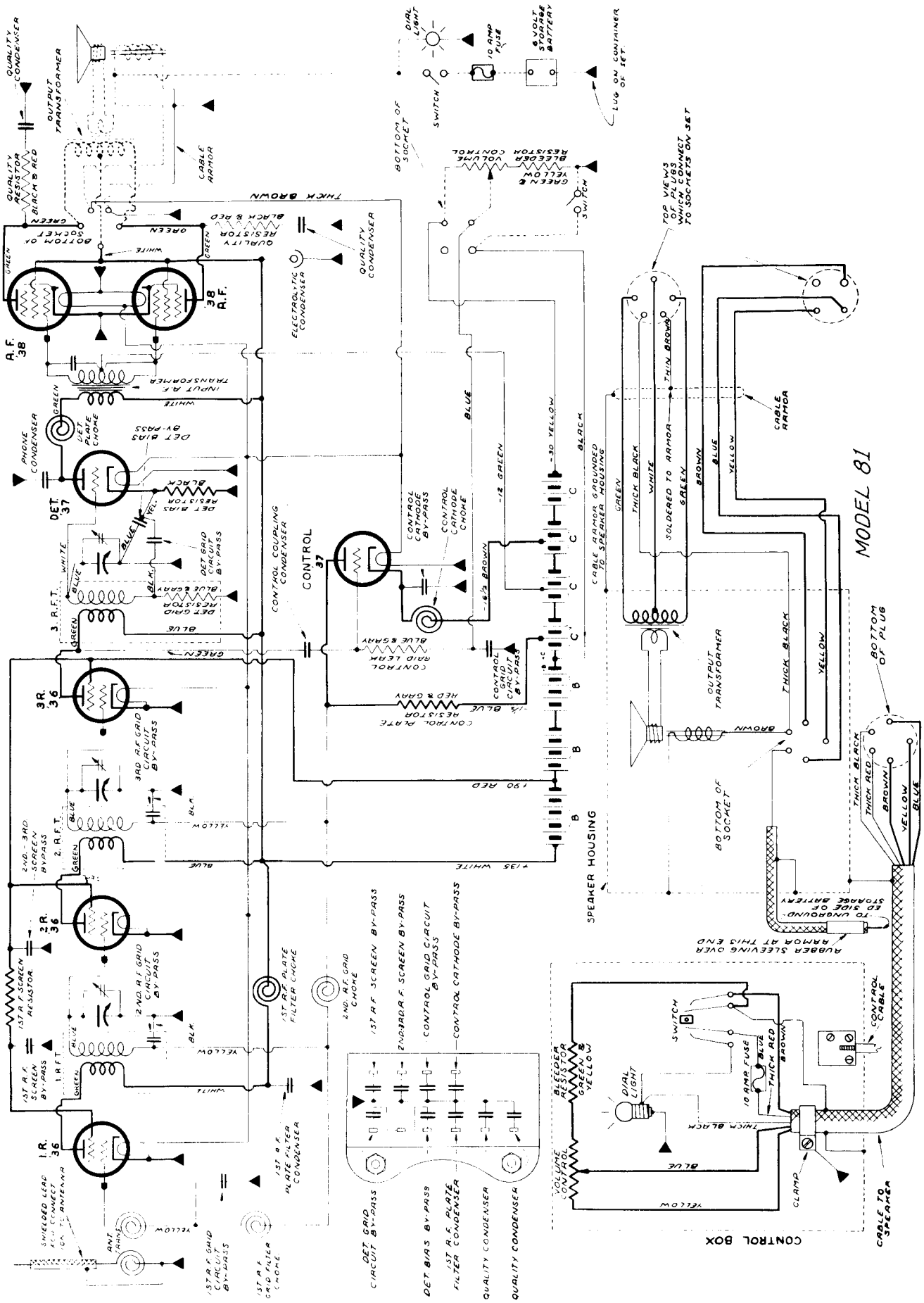


SCHEMATIC DIAGRAM OF TYPE H-1 CHASSIS

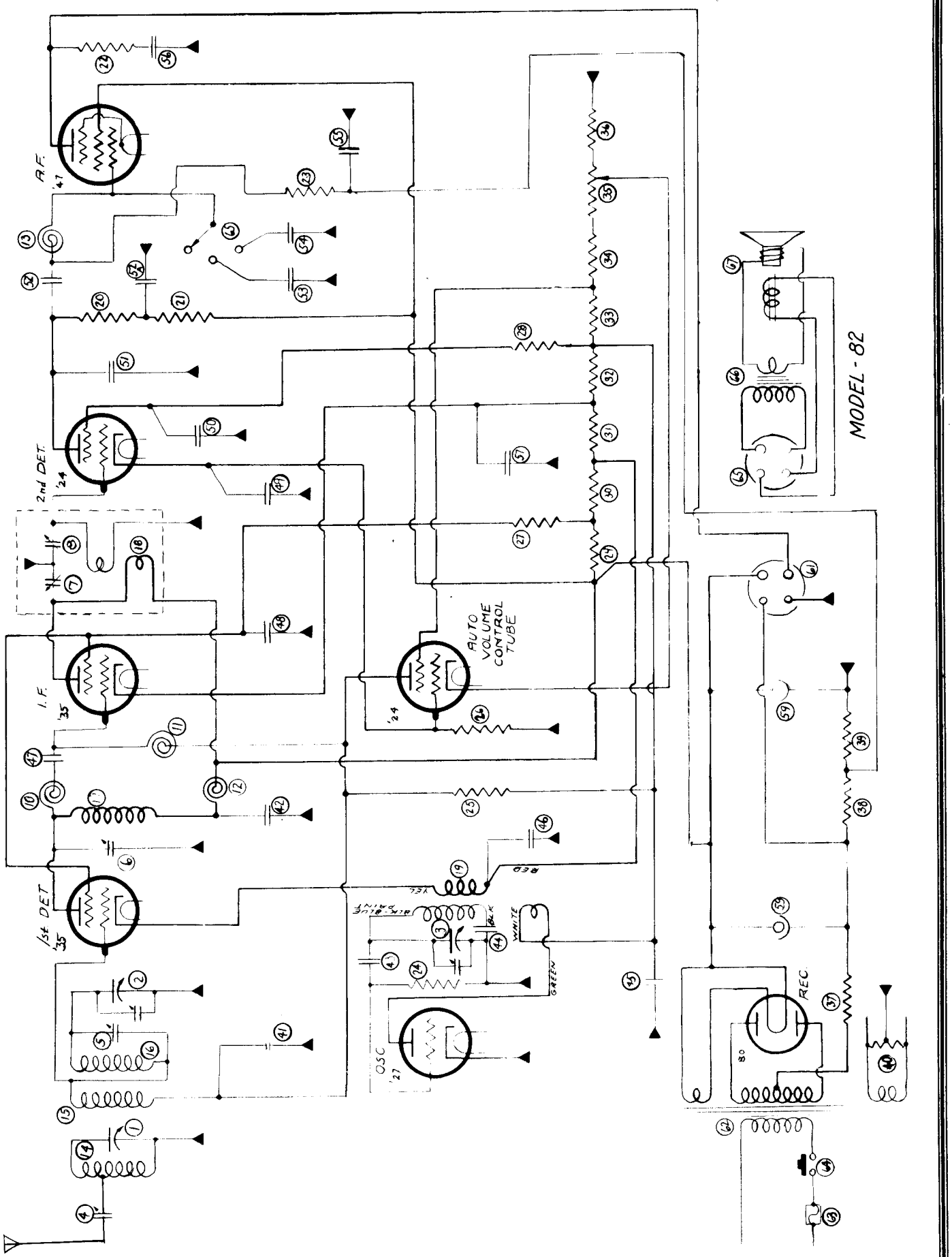
ATWATER KENT MANUFACTURING CO.



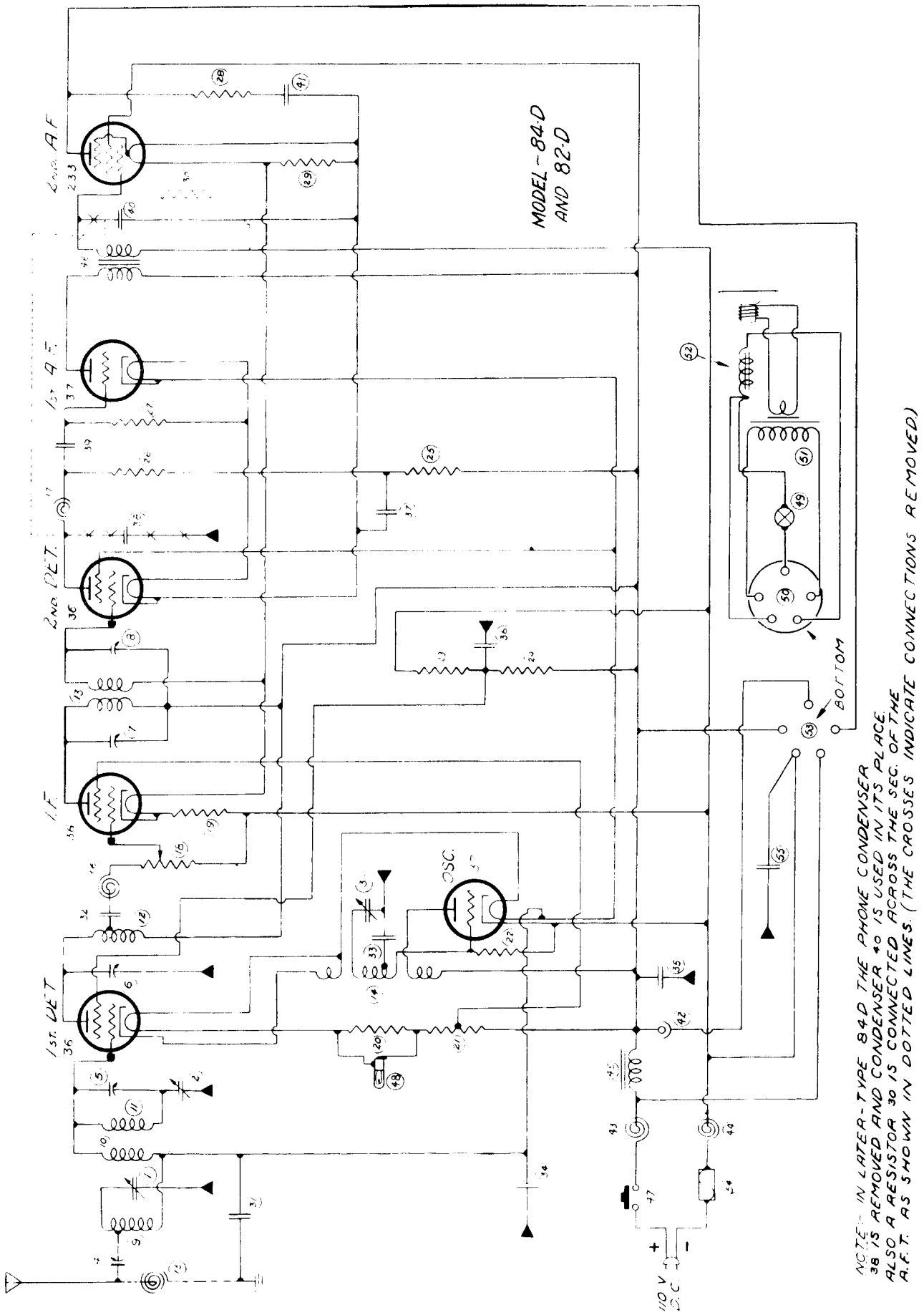
ATWATER KENT MANUFACTURING CO.



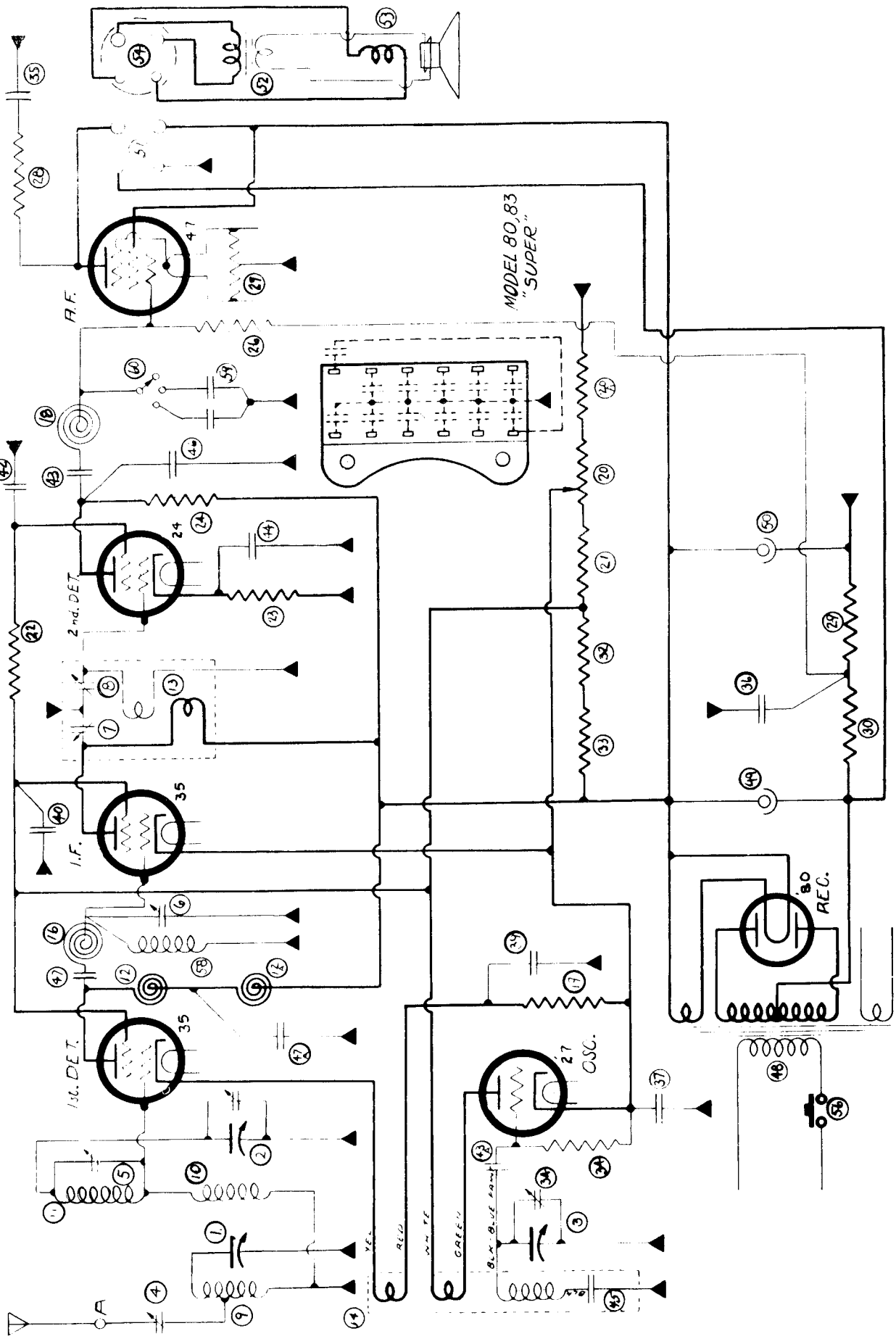
ATWATER KENT MANUFACTURING CO.



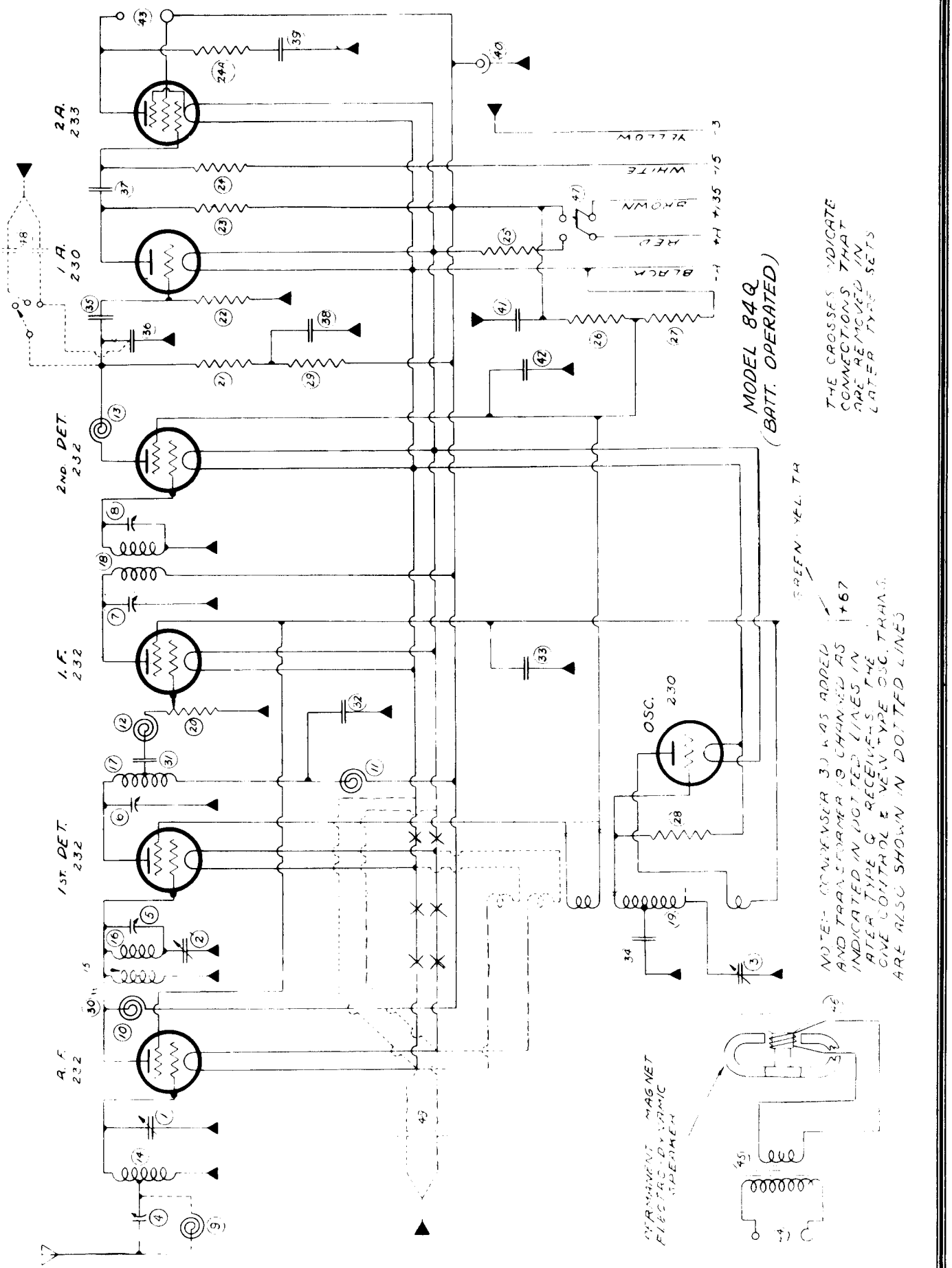
ATWATER KENT MANUFACTURING CO.



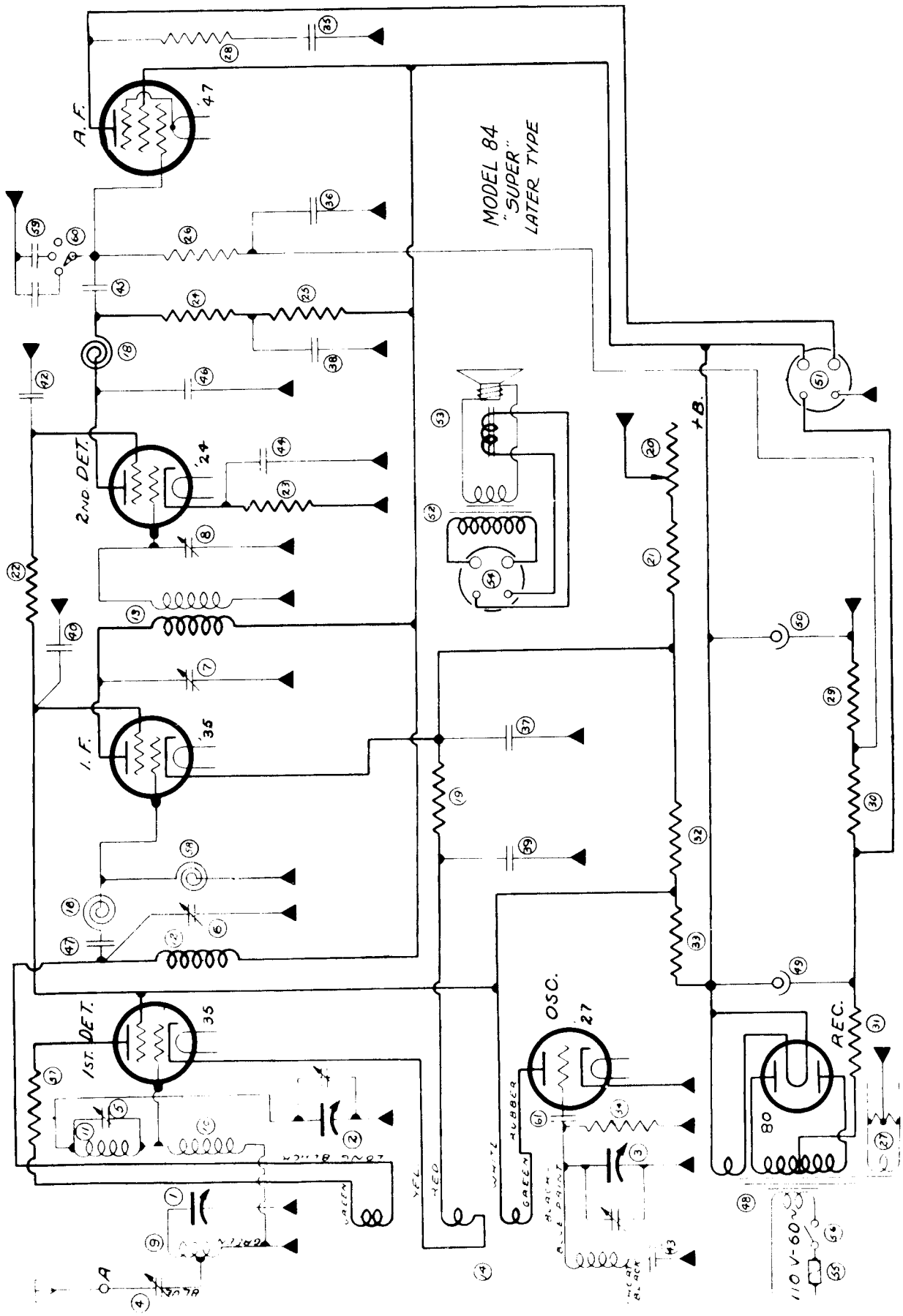
ATWATER KENT MANUFACTURING CO.



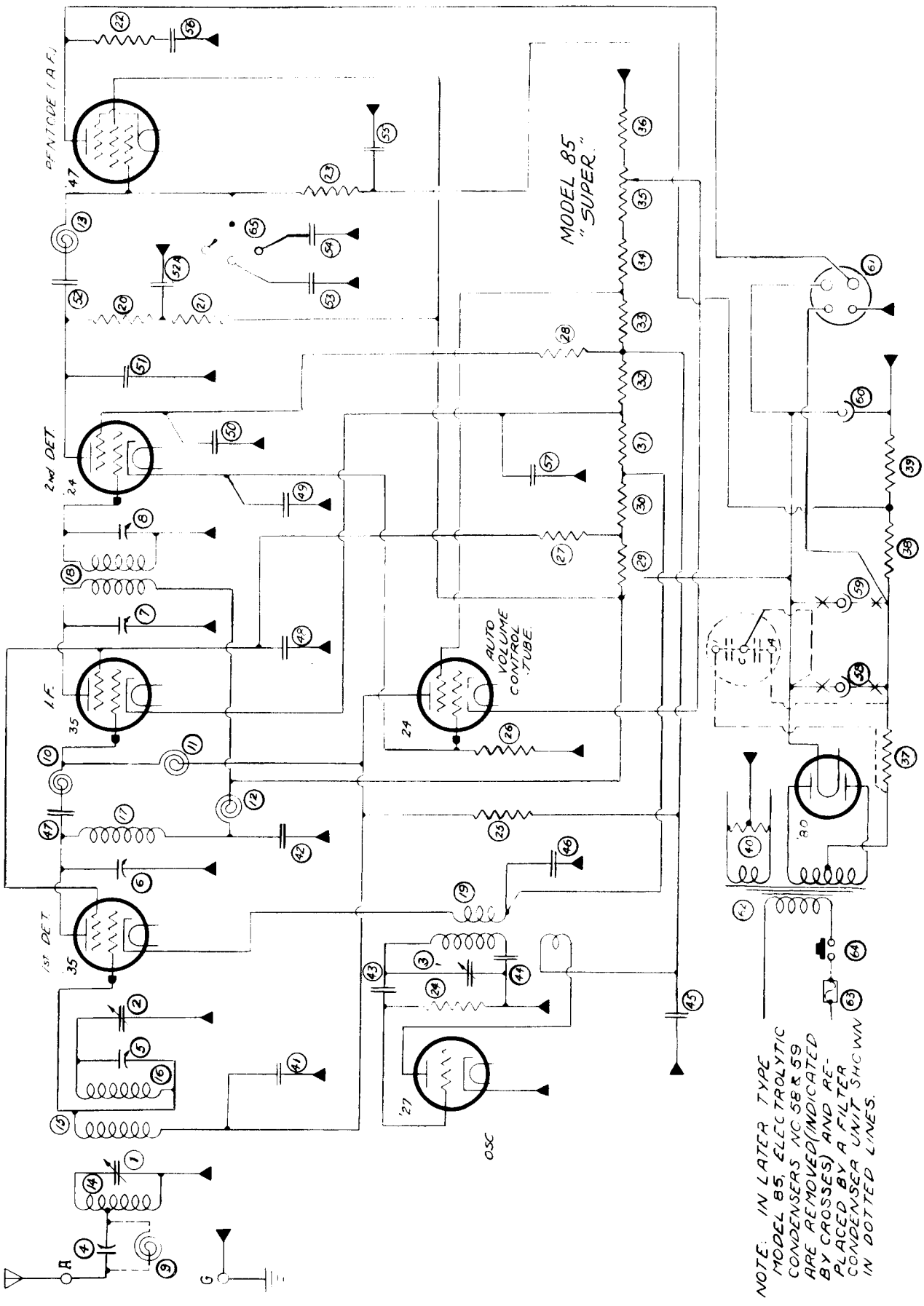
ATWATER KENT MANUFACTURING CO.



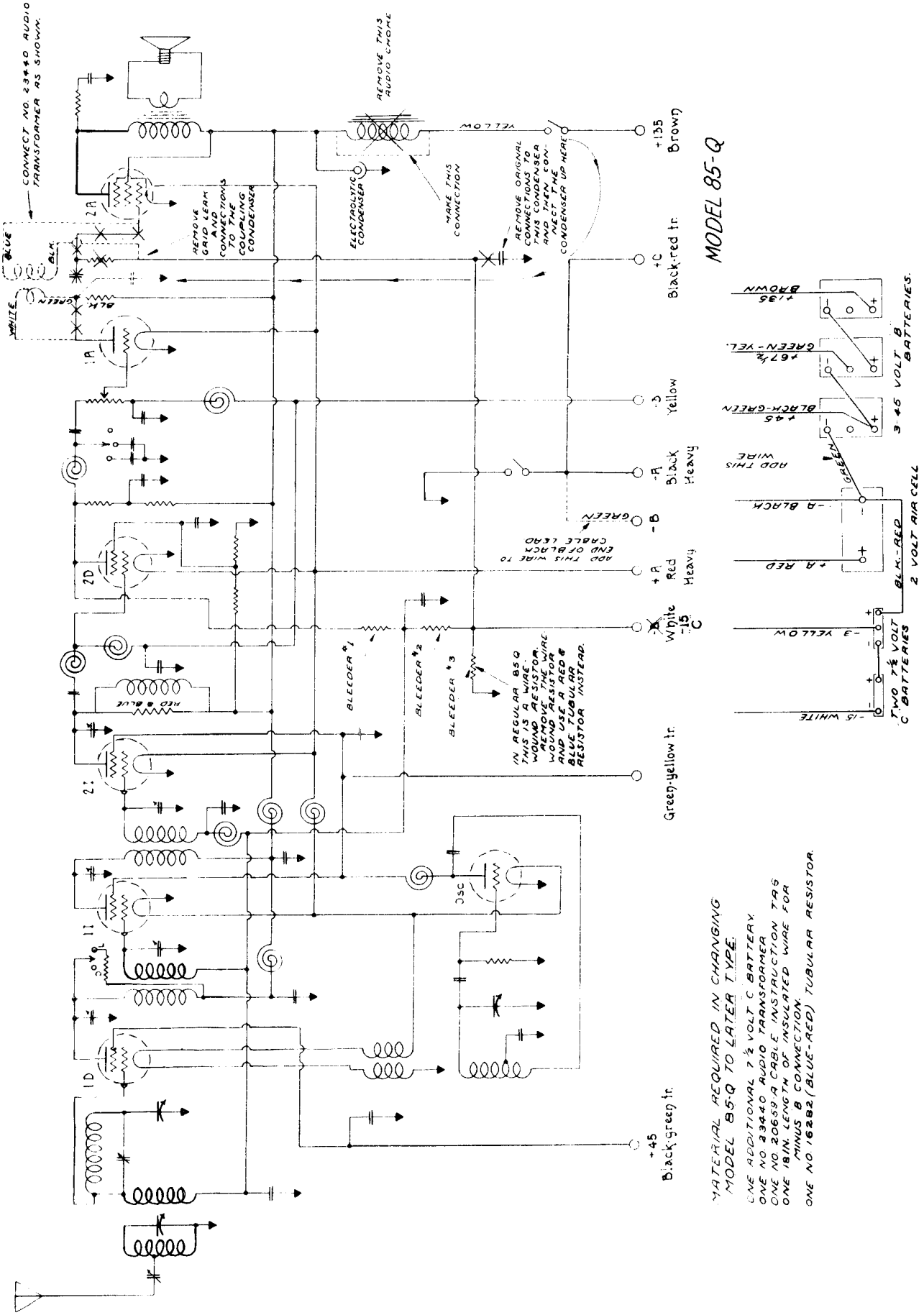
ATWATER KENT MANUFACTURING CO.



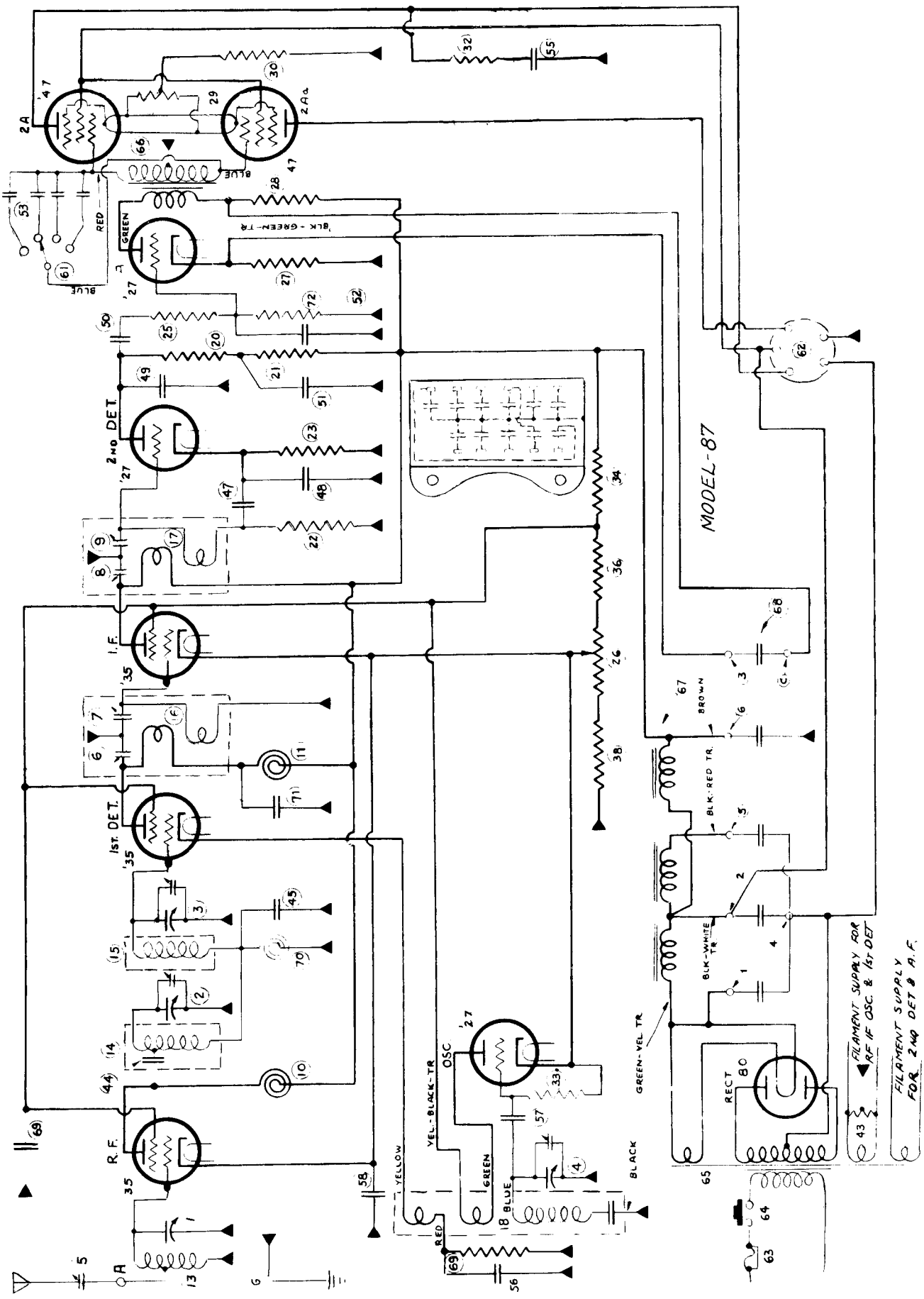
ATWATER KENT MANUFACTURING CO.



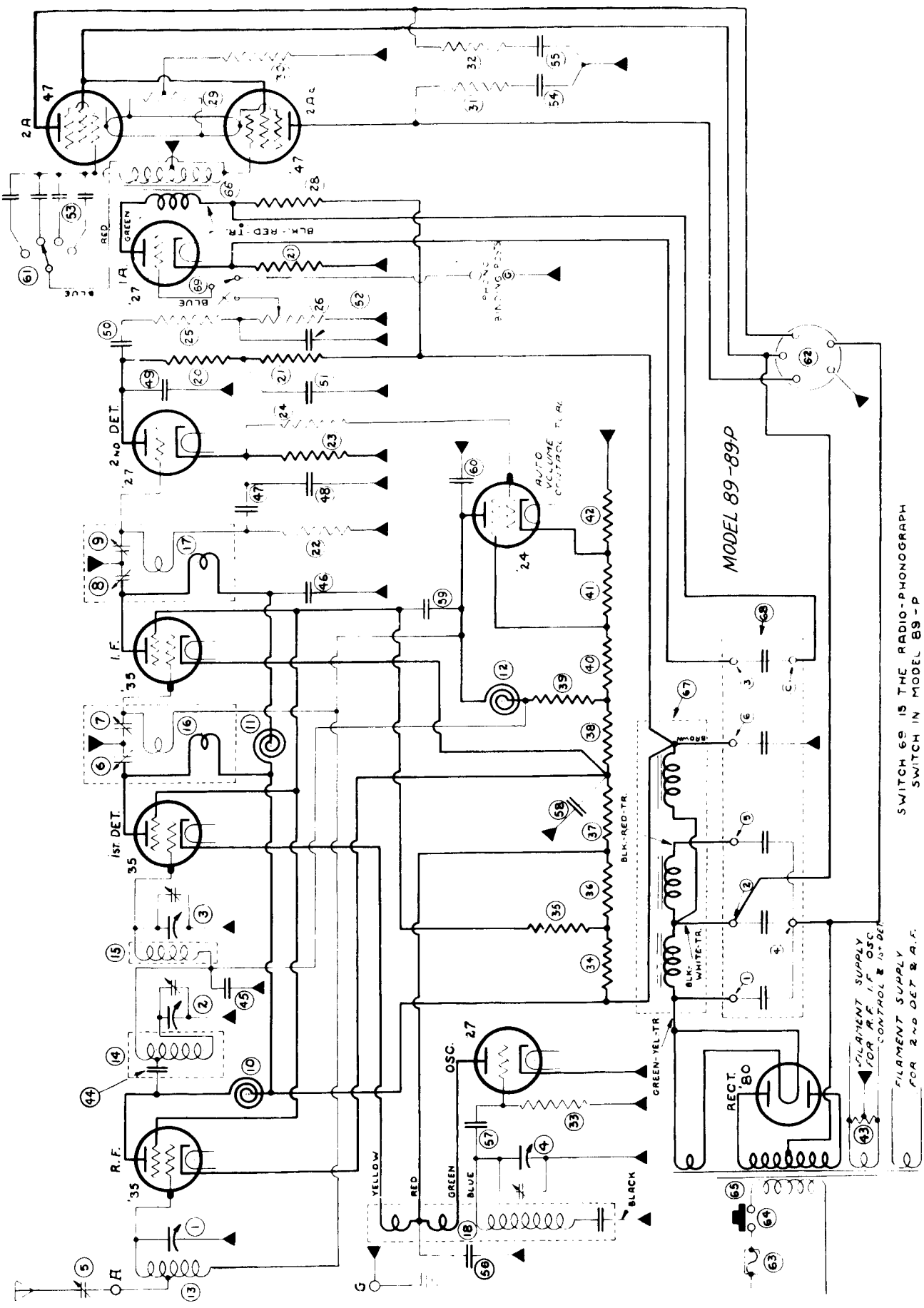
ATWATER KENT MANUFACTURING CO.



ATWATER KENT MANUFACTURING CO.



ATWATER KENT MANUFACTURING CO.



ATWATER KENT MANUFACTURING CO.

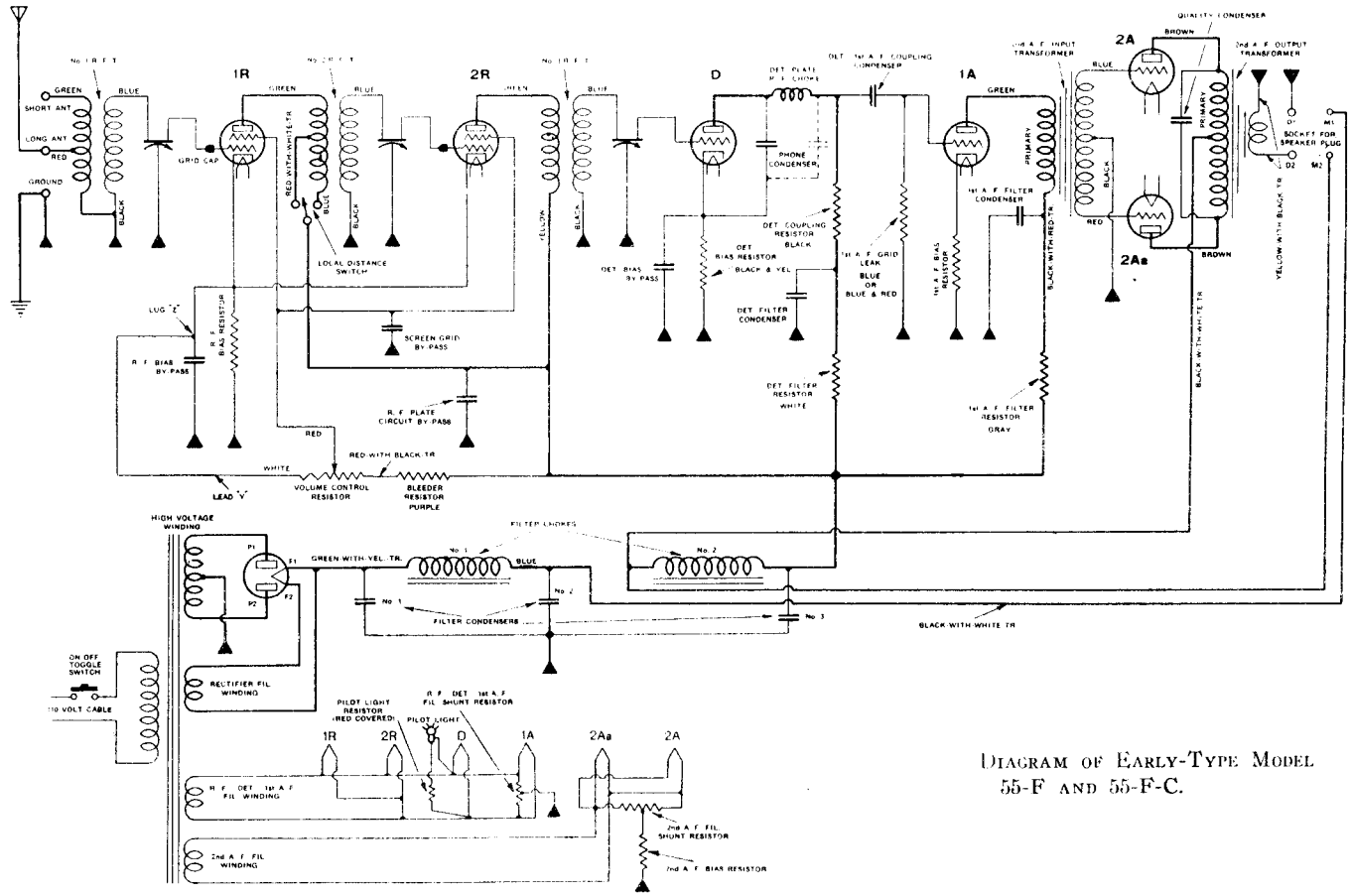


DIAGRAM OF EARLY-TYPE MODEL 55-F AND 55-F-C.

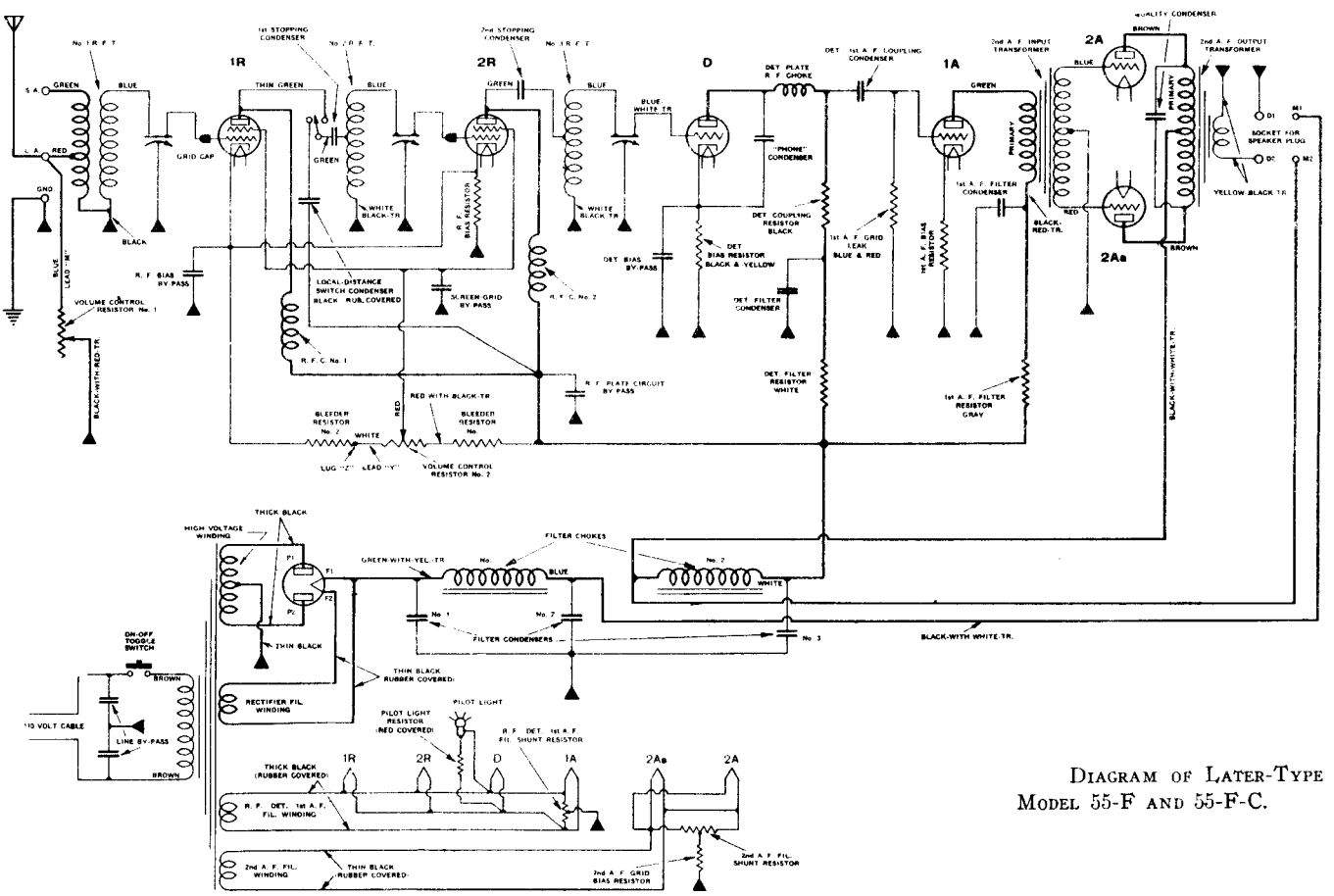


DIAGRAM OF LATER-TYPE MODEL 55-F AND 55-F-C.

ATWATER KENT MANUFACTURING CO.

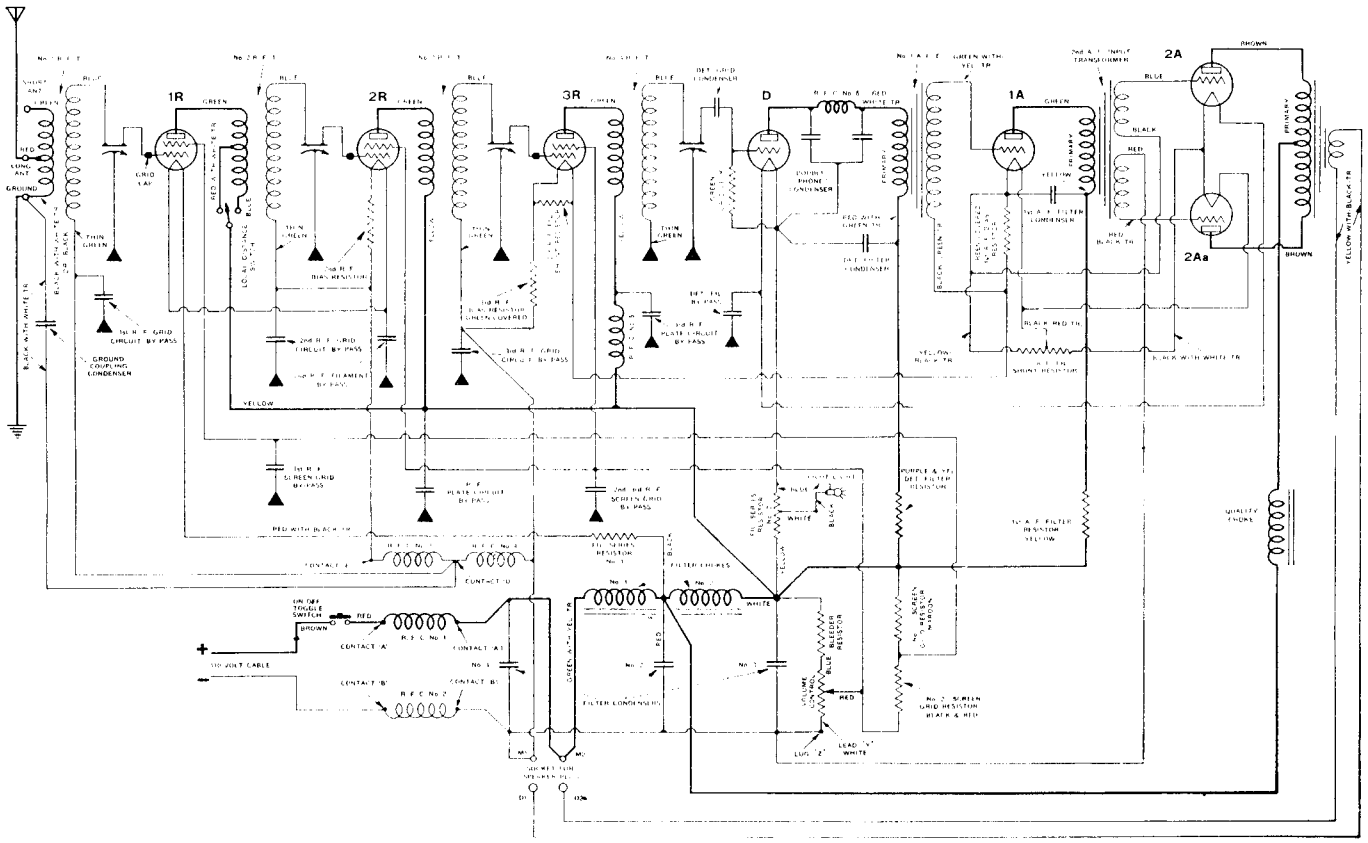
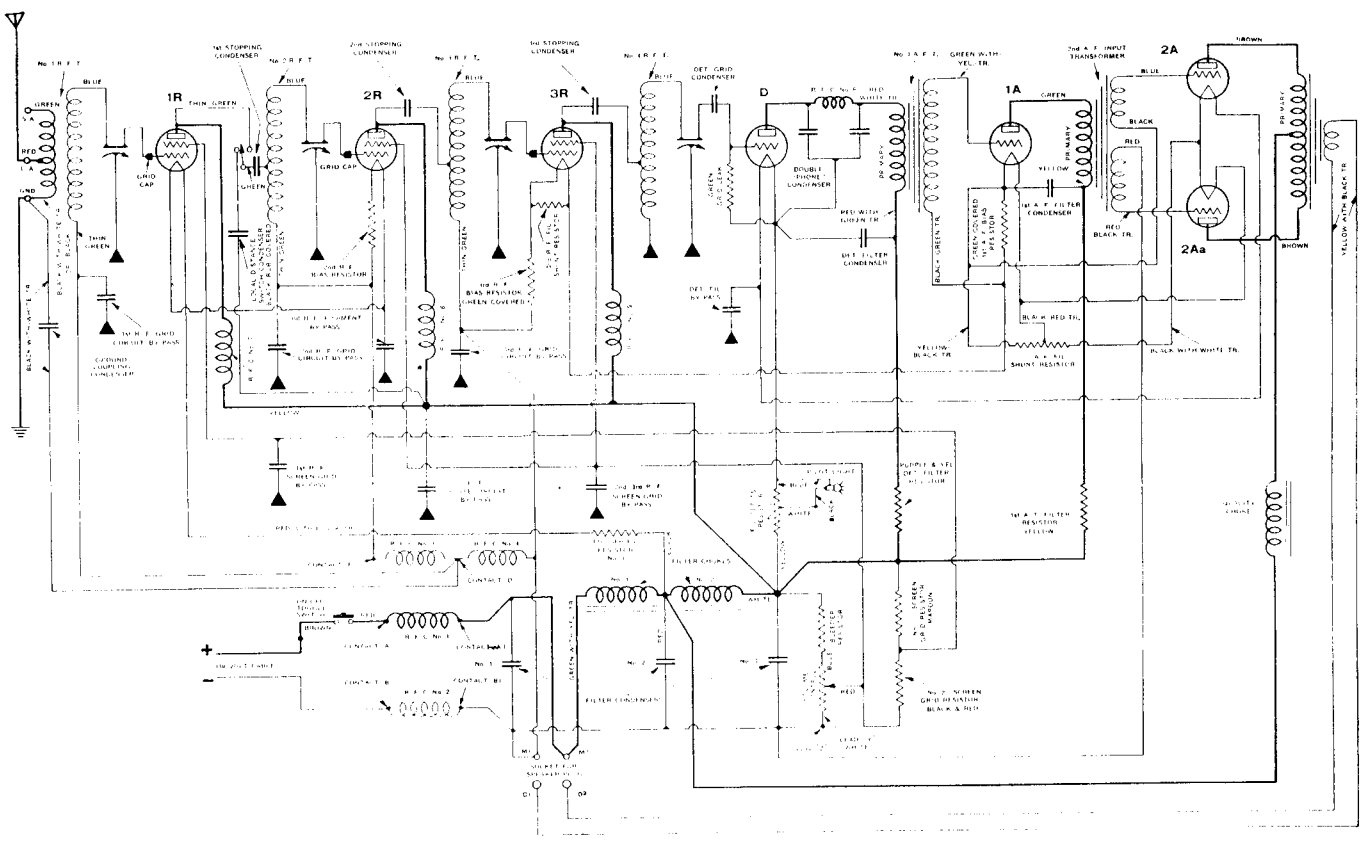
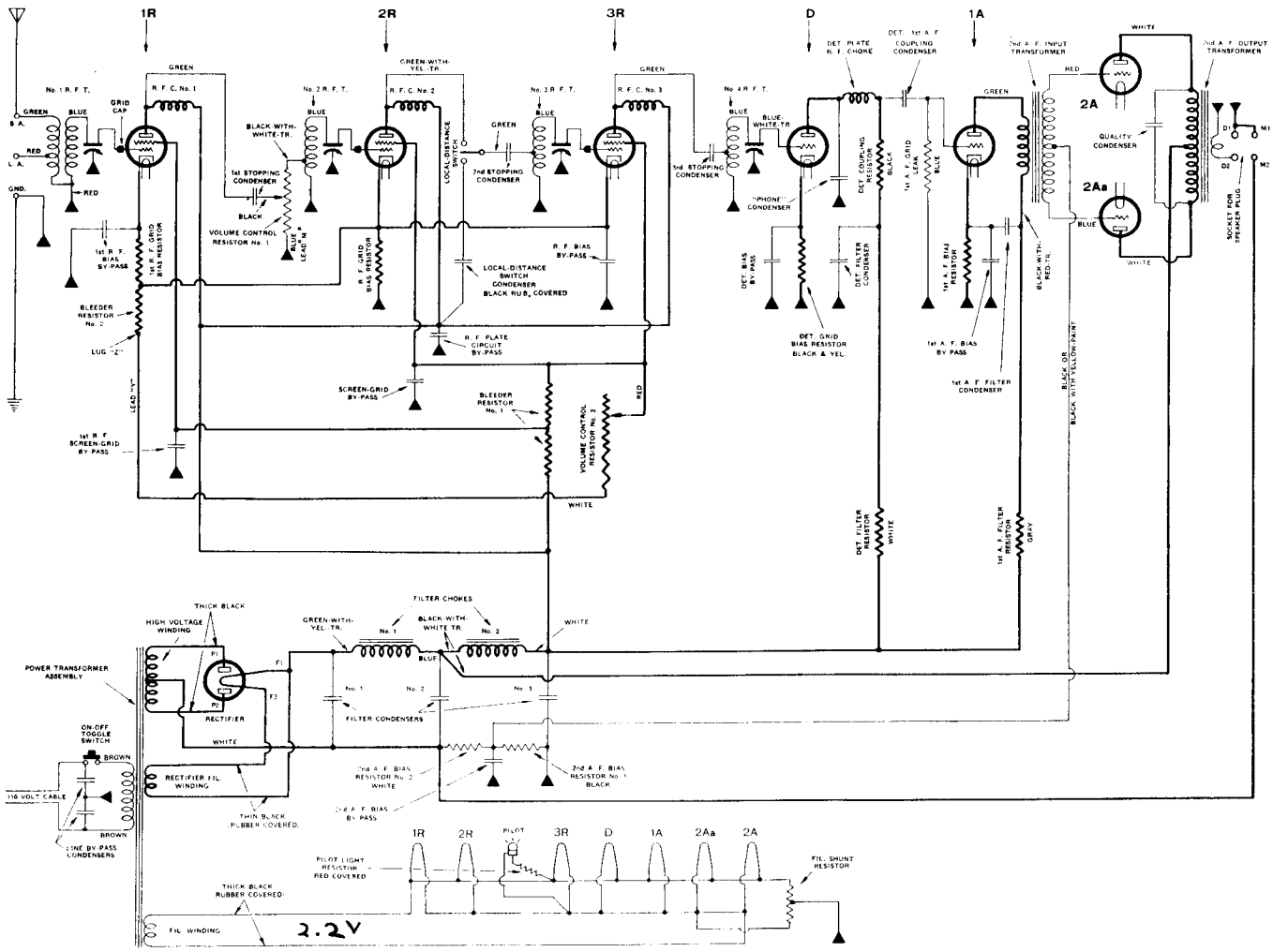


Diagram of Early Model 61 and 61-C (Direct Current).



Schematic Diagram of Later Model 61 and 61-C (Direct Current).

ATWATER KENT MANUFACTURING CO.



CIRCUIT OF LATER MODEL 60 AND 60-C.

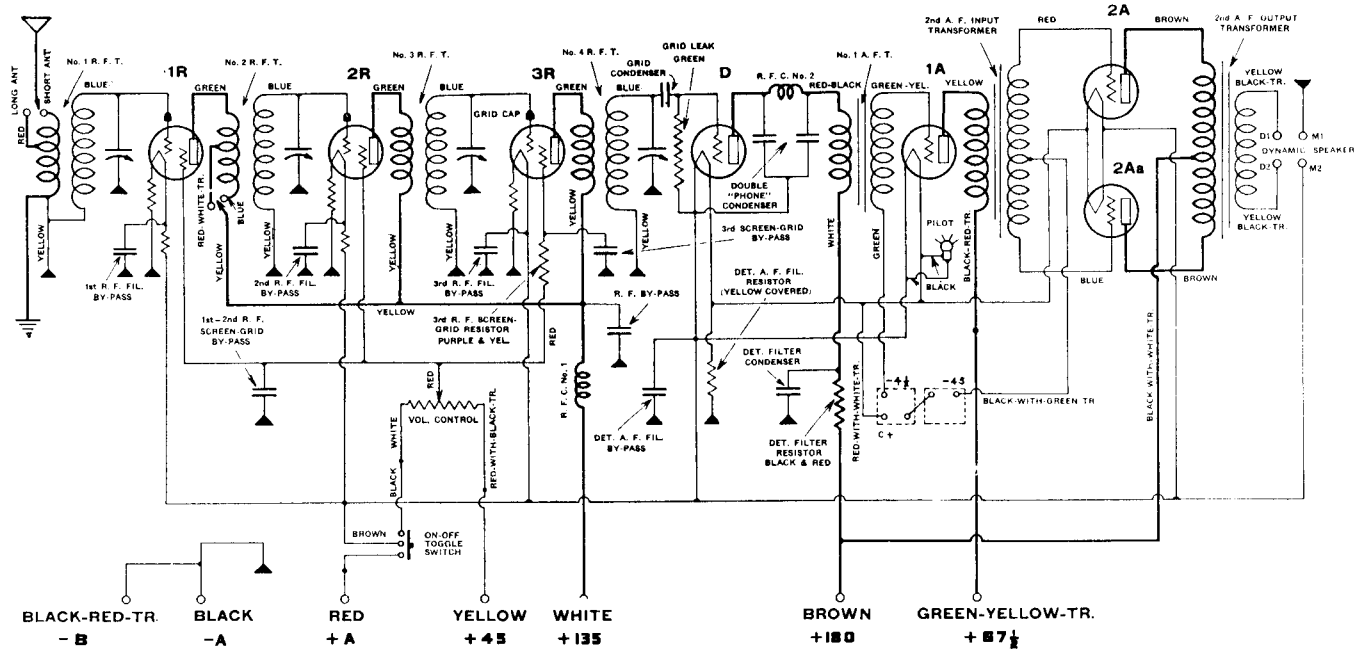
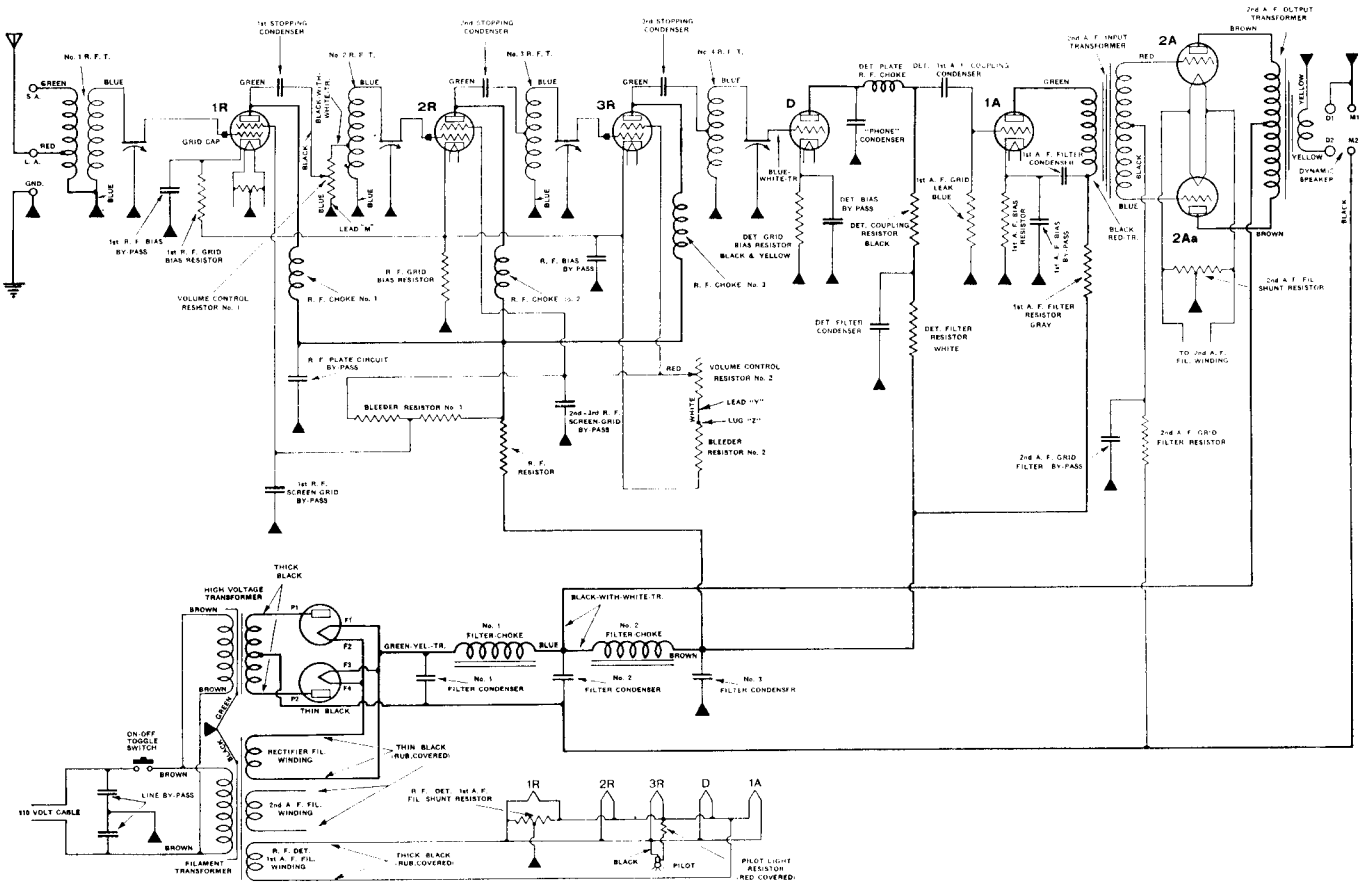


DIAGRAM OF EARLY MODEL 67 AND 67-C (BATTERY OPERATED).

ATWATER KENT MANUFACTURING CO.



CIRCUIT OF MODEL 66.

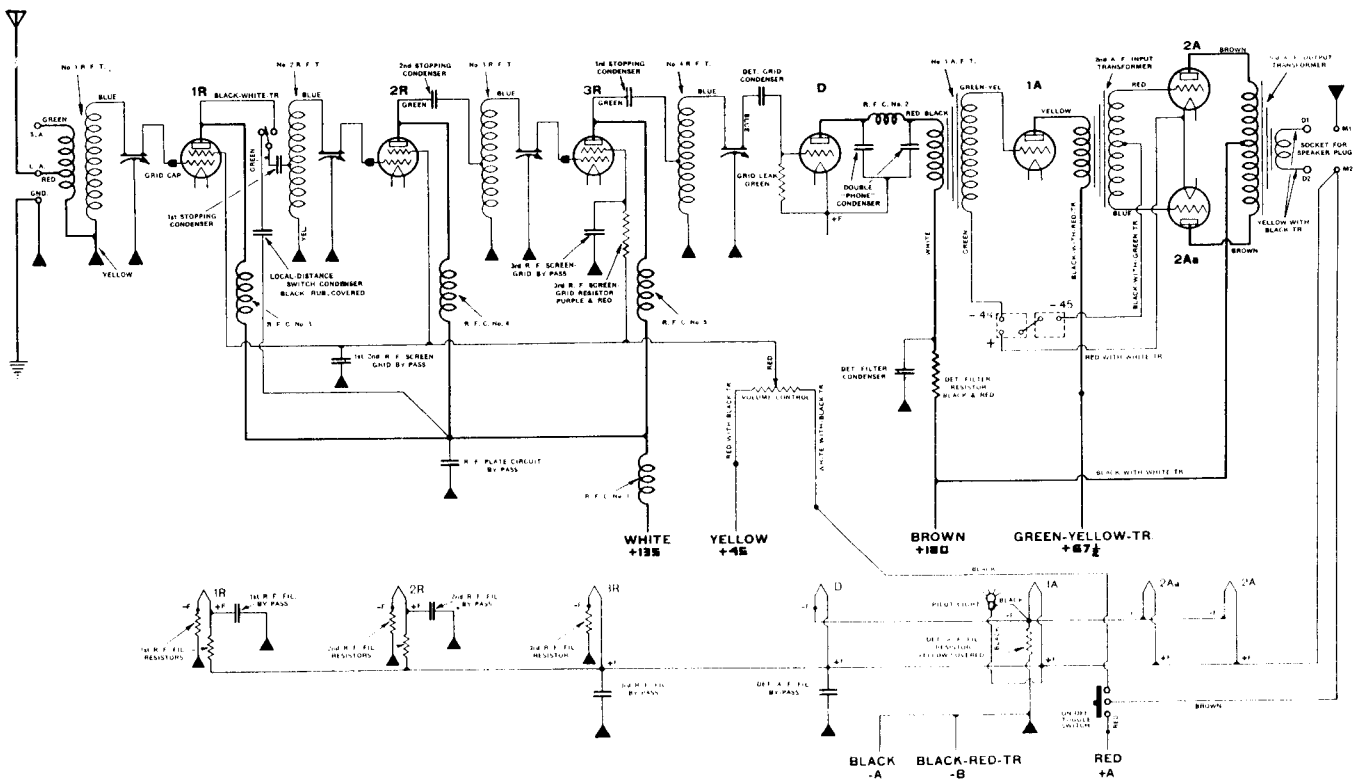


DIAGRAM OF LATER MODEL 67 AND 67-C (BATTERY OPERATED).

ATWATER KENT MANUFACTURING CO.

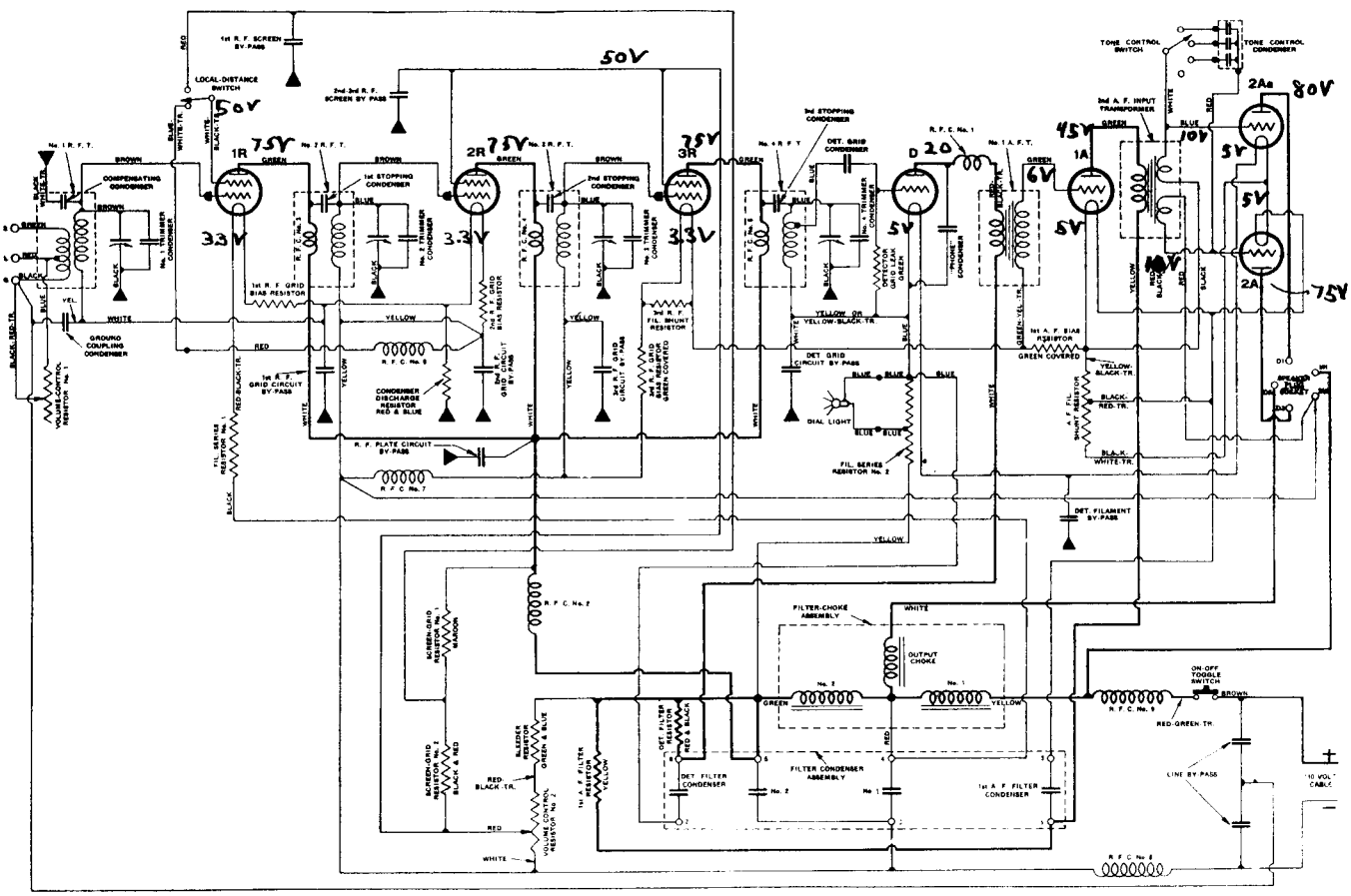


DIAGRAM OF D-1 CHASSIS.

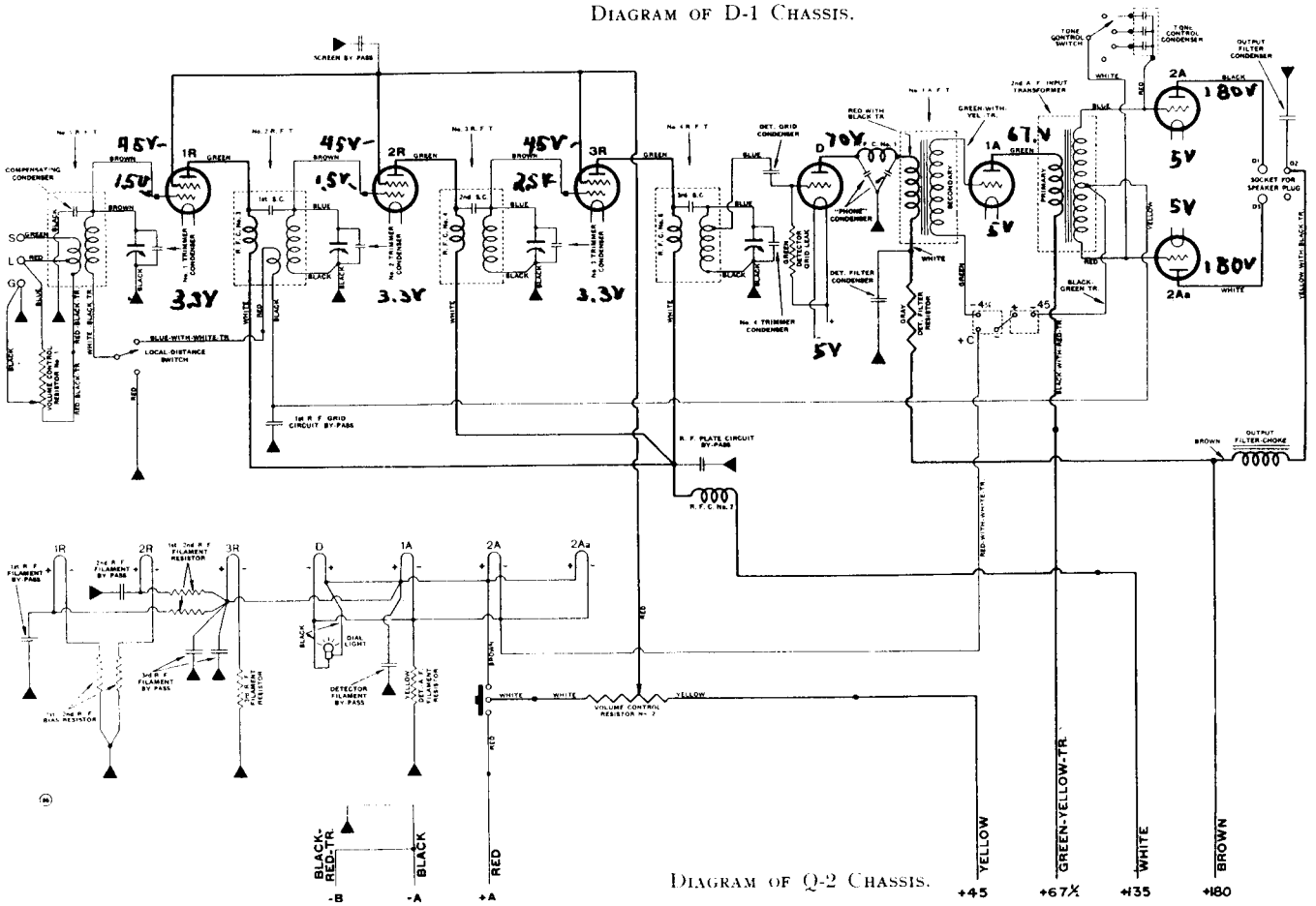


DIAGRAM OF Q-2 CHASSIS.

ATWATER KENT MANUFACTURING CO.

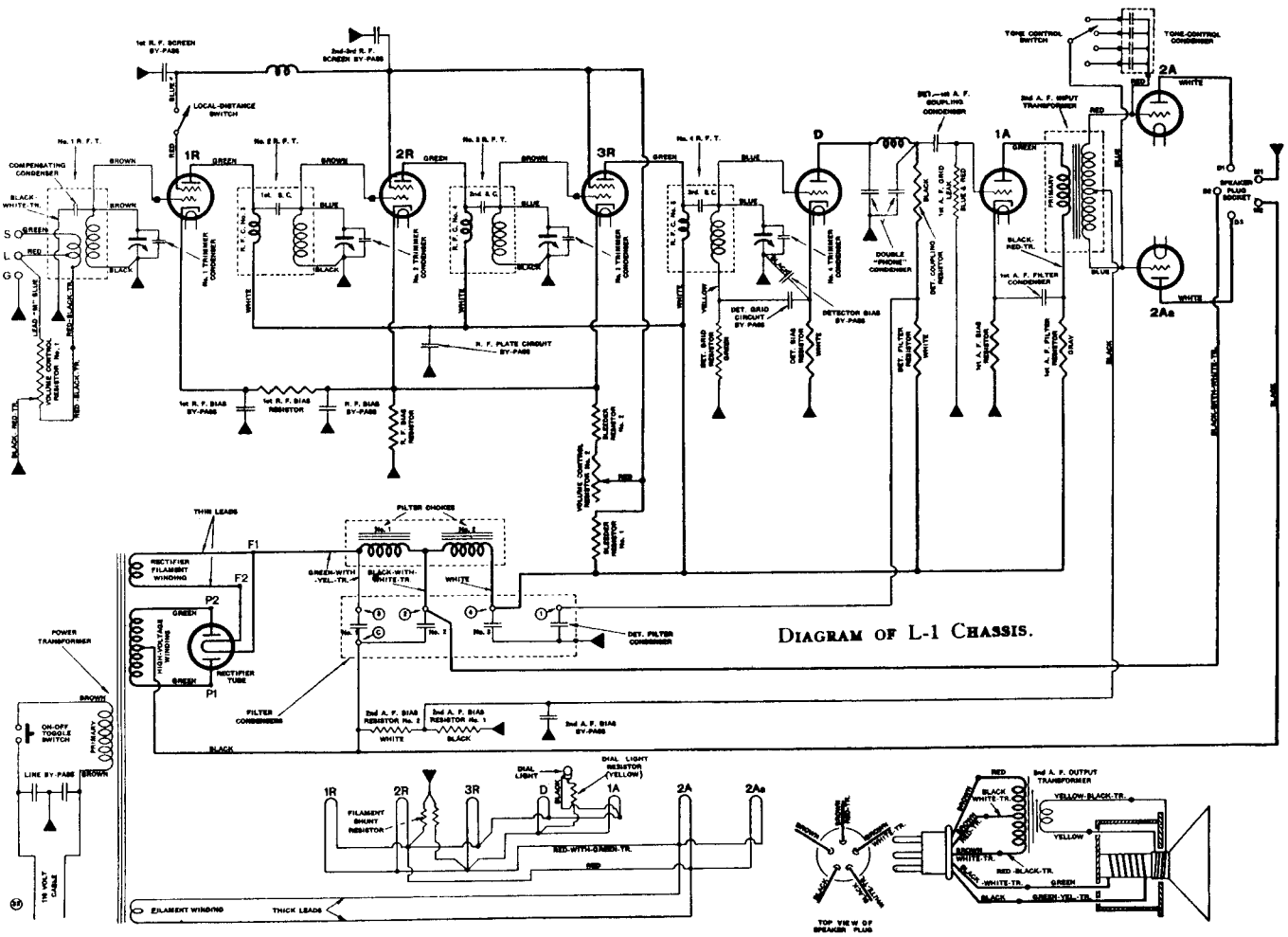
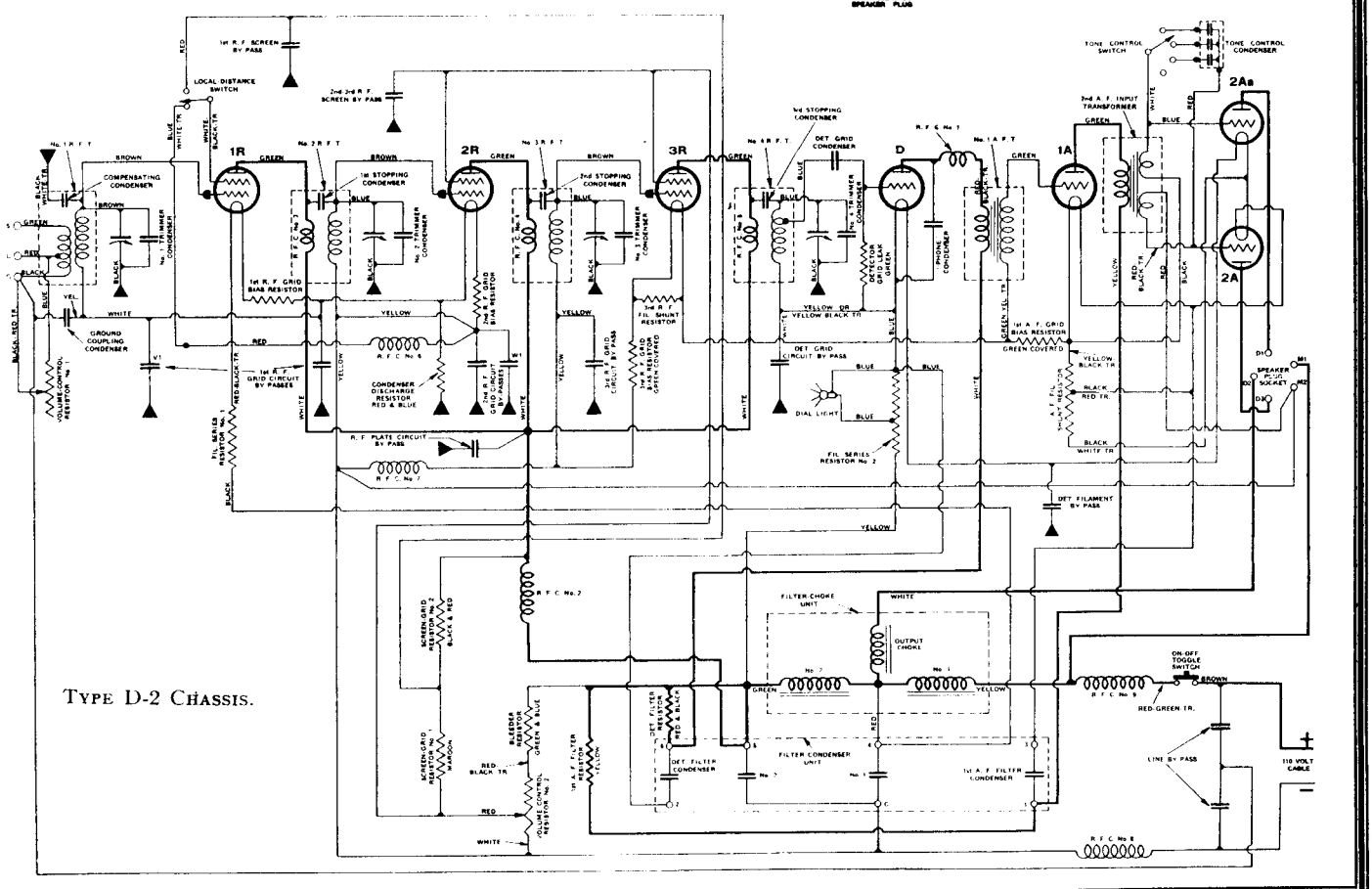
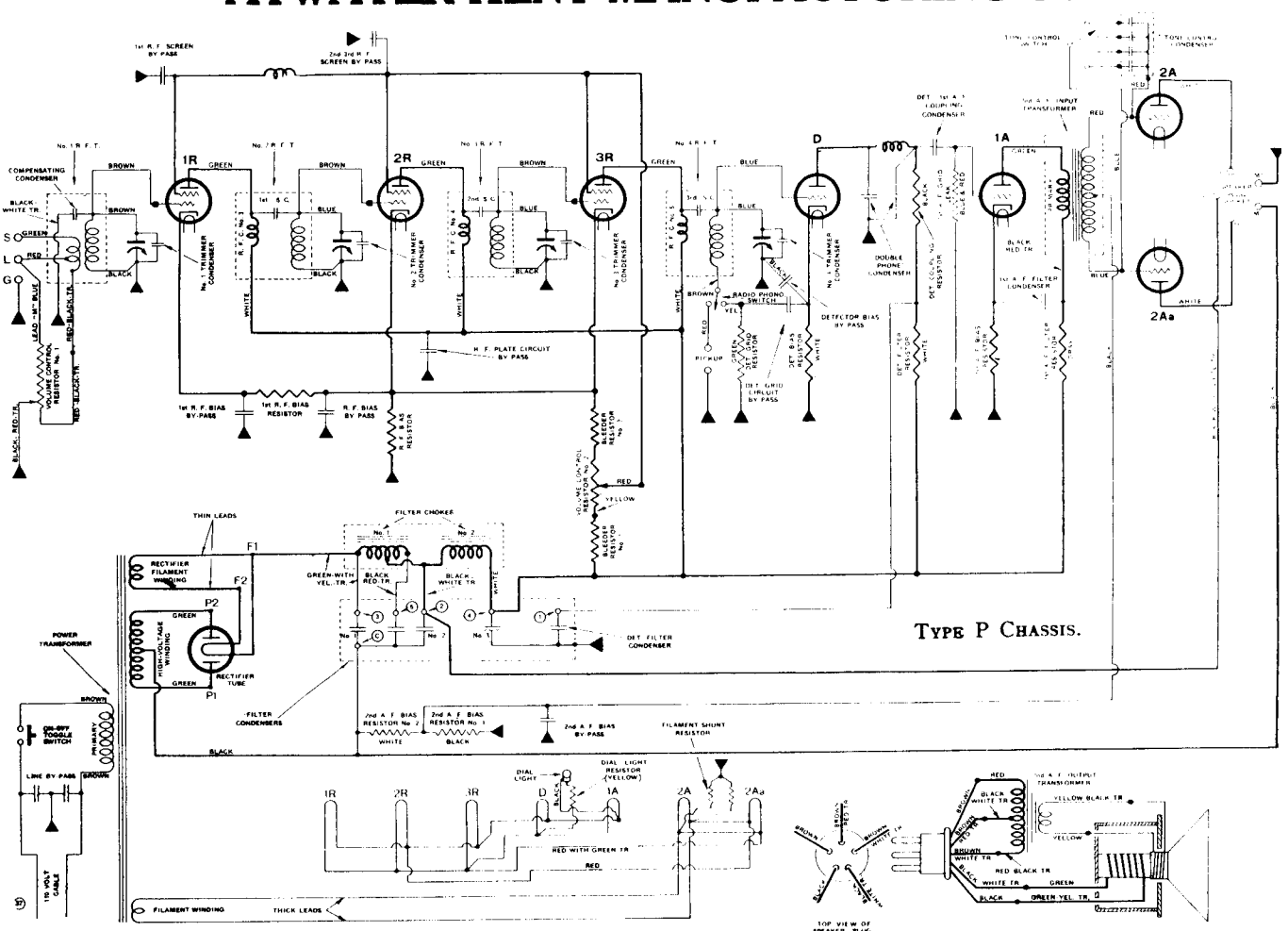


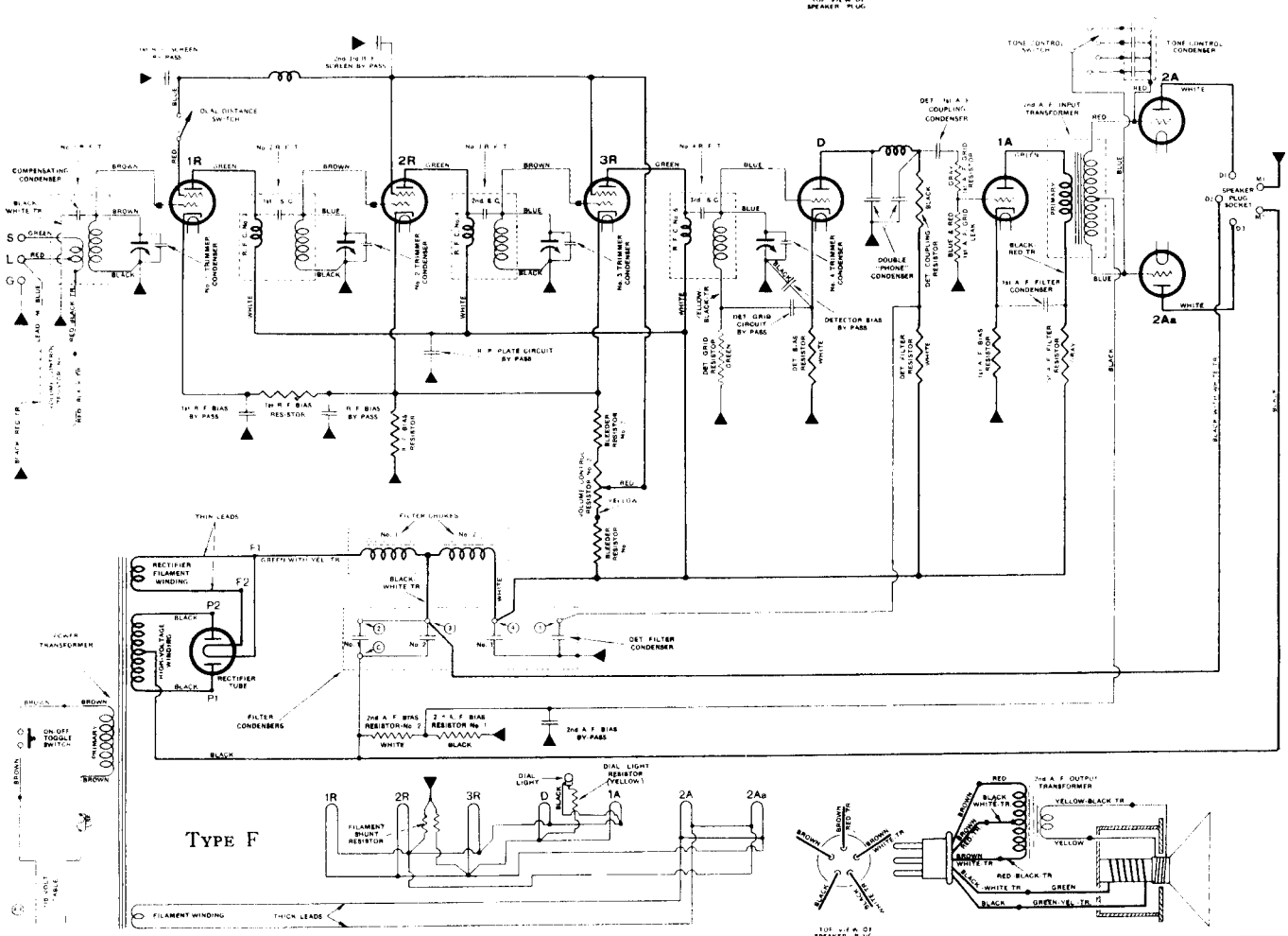
DIAGRAM OF L-1 CHASSIS.



TYPE D-2 CHASSIS.

ATWATER KENT MANUFACTURING CO.





ATWATER KENT MANUFACTURING CO.

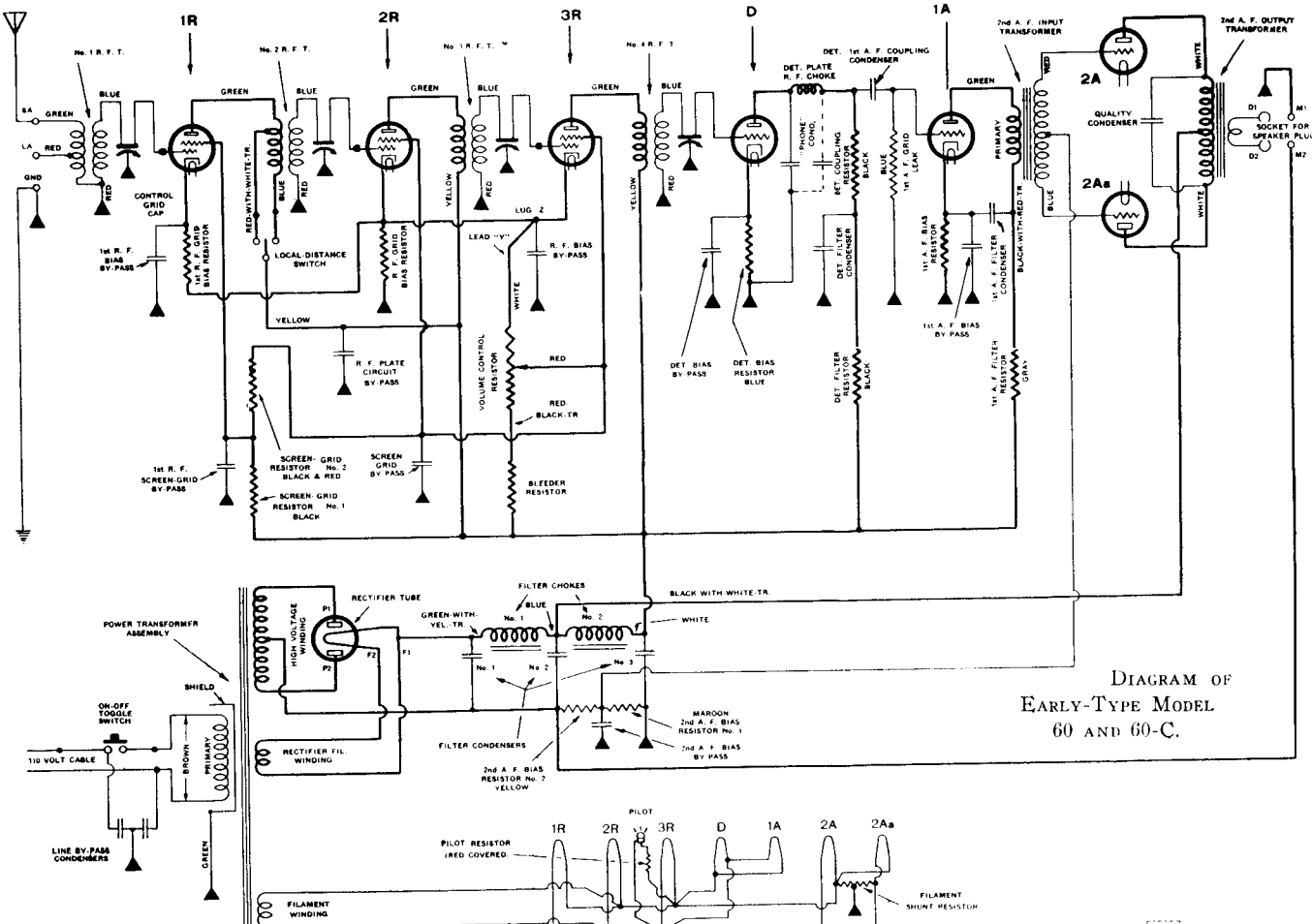


DIAGRAM OF EARLY-TYPE MODEL 60 AND 60-C.

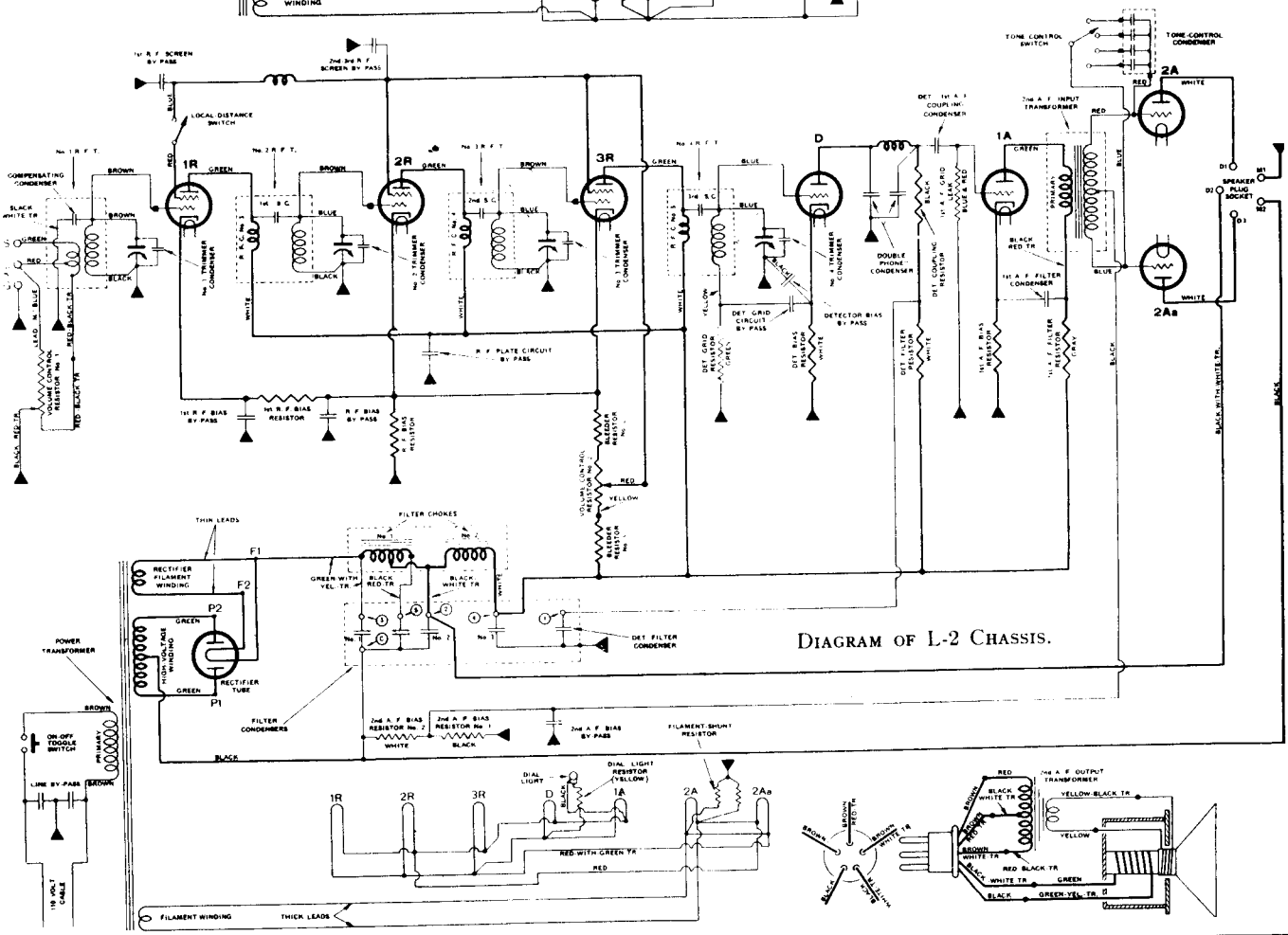
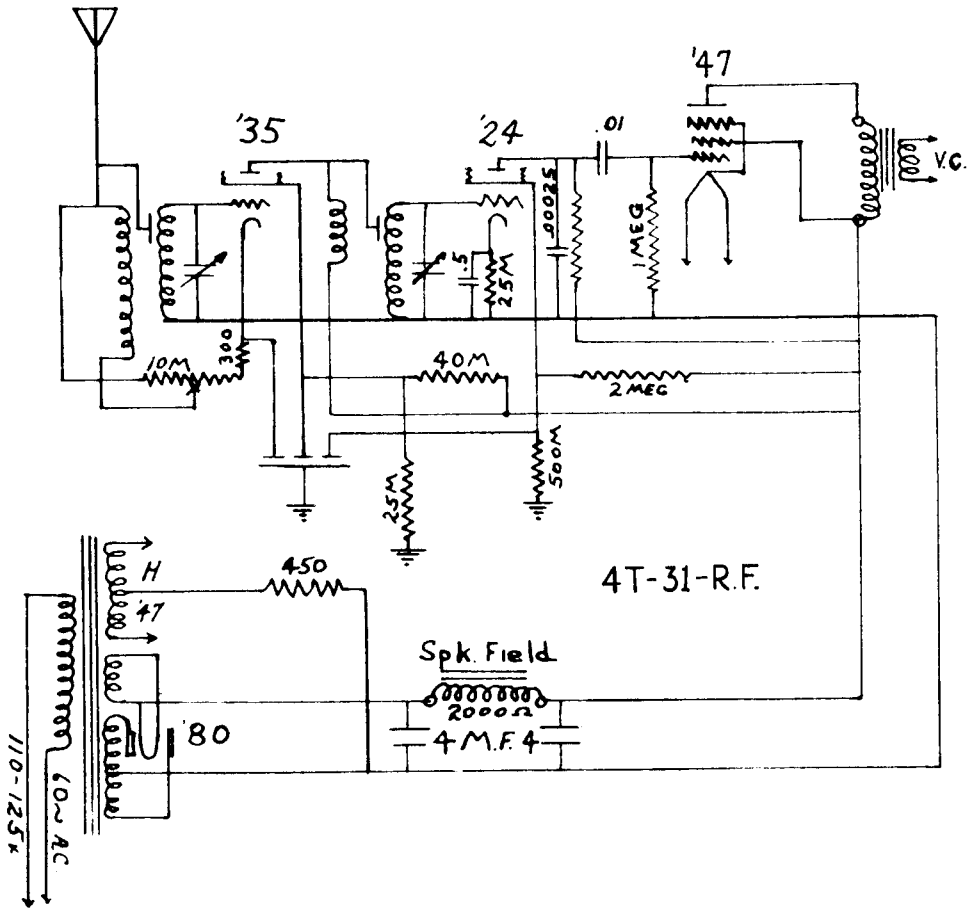
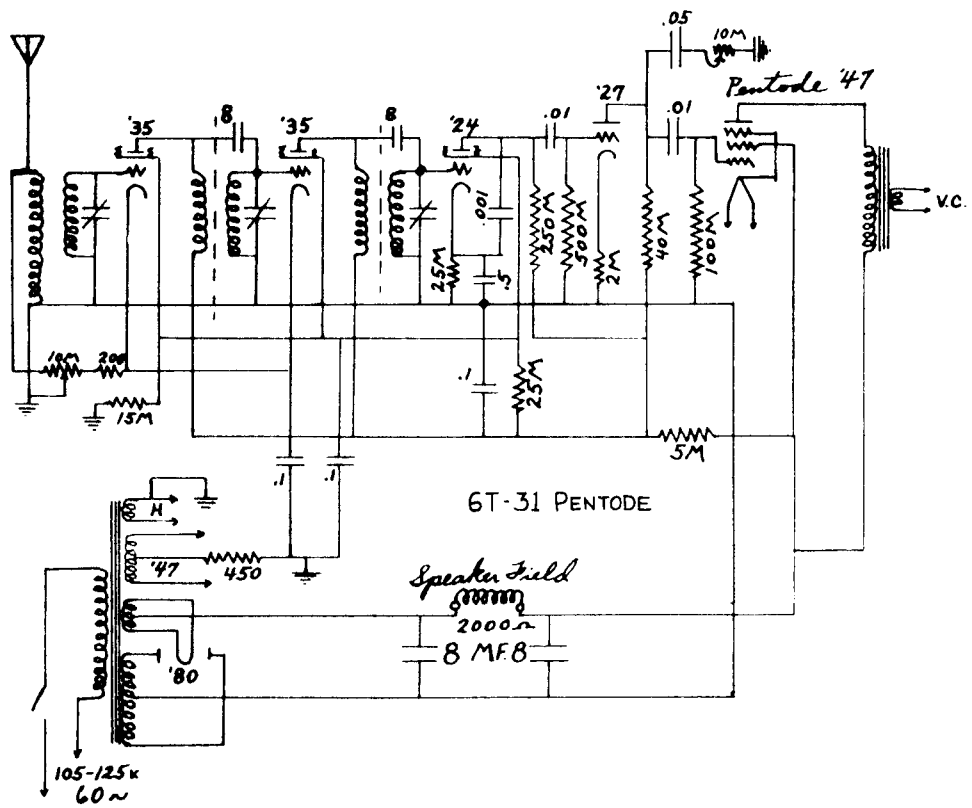


DIAGRAM OF L-2 CHASSIS.

AUDIOLA RADIO CO.





ATWATER KENT RADIO

ELECTRICAL VALUES OF RESISTORS and CONDENSERS IN ALL RECEIVERS 1924—1932 INCLUSIVE

This Service Manual supplement contains a numerical list, with values, of all Atwater Kent condensers and resistors in receivers produced up to and including 1932.

It also includes simplified parts-list tables, with values, for each model. In using these tables, please note the following:

1— The value of each part is printed in **heavy type** under the part number. The value is given in ohms unless otherwise specified. In cases where a resistor is tapped, the total over-all resistance is given. This also applies to tapped windings on audio transformers.

2 - Tubular resistors are not listed in the table for each model. To find the value of a tubular resistor it is necessary to refer to page 7, which contains a complete list of tubular resistors with resistance values and identifying color.

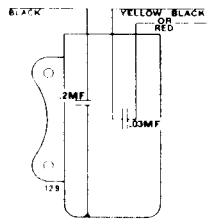
3 In these tables we give only the part number and code marking of by-pass and filter condensers. To find the values inside these condensers, it is necessary to refer to pages 2, 3 and 5. Owing to production changes, there are a few exceptions to the listing of by-pass condensers in the tables.

4 —In the list of flexible and wire-wound resistors, we show illustrations of the early-style resistors that were actually used in the sets. In many cases the resistors supplied for replacement are of late-style with die-cast lugs. Replacement resistors are usually furnished without leads.

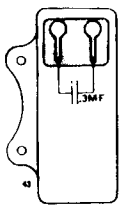
ATWATER KENT MFG. CO.

VALUES OF BY-PASS CONDENSERS

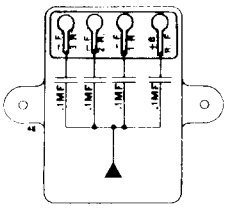
Numbers in circles refer to note on page 3.



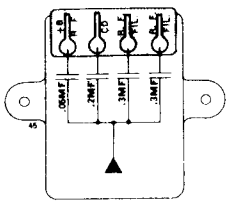
13956
200-Volts



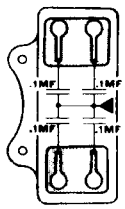
14902
450-Volts



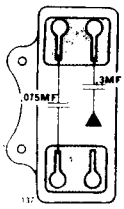
15157
450-Volts



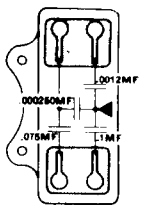
15158
.3MF, 200-Volts
.2 & .05, 400-Volts



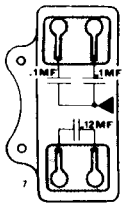
15262 ①
B-1, H-1
H-9, H-20



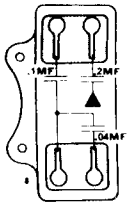
15263
B2-H-2
②



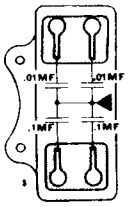
15640
H-16
400-Volts



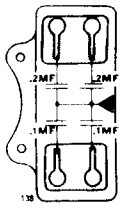
15770
H-15
③



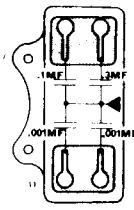
15780
H-17
④



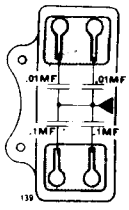
15790
H-18, H-21
400-Volts



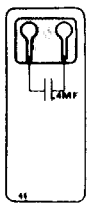
15837
B-3
Superseded by
16233



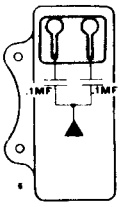
16060
H-24
Superseded by
18350



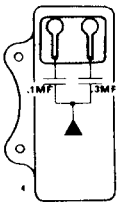
16233
H-4, H-10
⑥



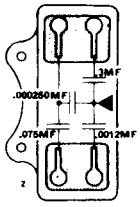
16318
450-Volts



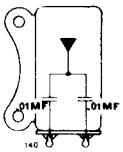
16461
H-6, H-12
400-Volts



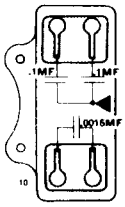
16462
H-5, H-11
400-Volts



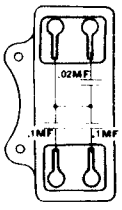
16745
H-7, H-8, H-13
⑥



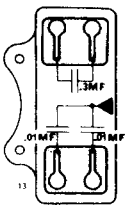
16828
B-5
450-Volts



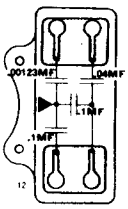
16880
H-23
400-Volts



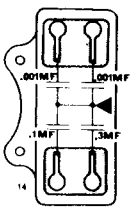
16940
H-22
400-Volts



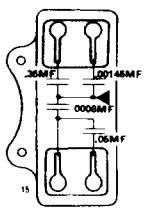
17360
H-27
400-Volts



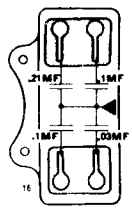
17370
H-25, H-26
400-Volts



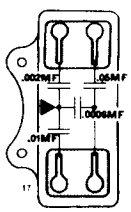
18350
H-28
⑦



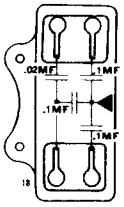
19150
H-29
400-Volts



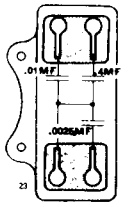
19160
H-30
400-Volts



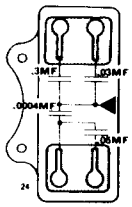
19560
H-31
400-Volts



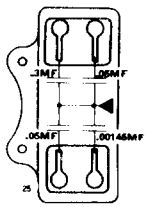
19690
H-32
400-Volts



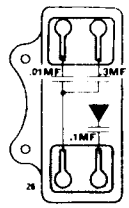
19710
H-33
400-Volts



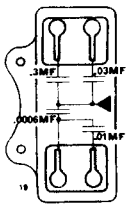
19980
H-34
400-Volts



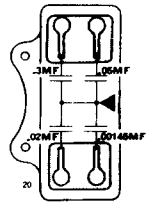
19990
H-35
400-Volts



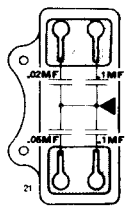
20350
H-36
400-Volts



21170
H-37
400-Volts



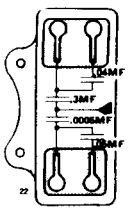
21180
H-38
400-Volts



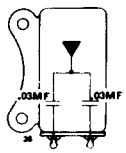
21430
H-39
400-Volts

ATWATER KENT MFG. CO.

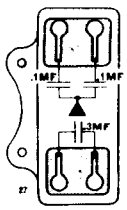
VALUES OF BY-PASS CONDENSERS (Continued)



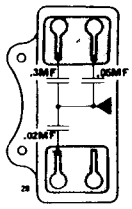
21440
H-40
400-Volts



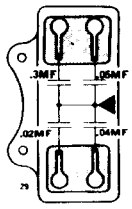
21450
B-10
450-Volts



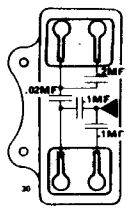
22050
H-41
200-Volts



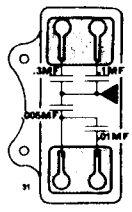
23310
H-42
Superseded by
21180



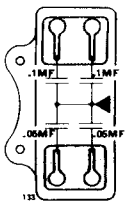
23330
H-43
200-Volts



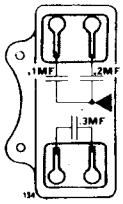
23590
H-44
200-Volts



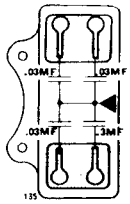
23610
H-45
400-Volts



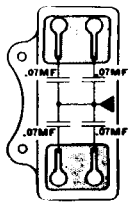
27120
H-46
400-Volts



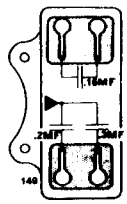
27140
H-47
200-Volts



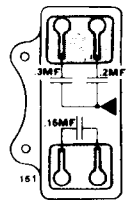
27580
H-48
200-Volts



29560
H-49
400-Volts



30290
H-50
Superseded by
30310

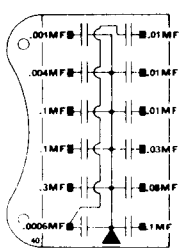


30310
H-51
200-Volts

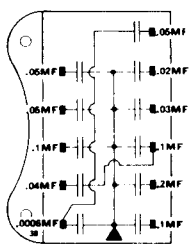
NOTES

1. In B-1, H-1, and H-9, the two top condensers are 150 volts; the two bottom condensers are 400-volts. In H-20, all four condensers are 400-volts. H-20 may be used in place of B-1, H-1, or H-9, but do not use B-1, H-1, or H-9 in place of H-20.
2. In 15263, the .3 MF condenser is 150-volts; the .075 MF is 400-volts.
3. In 15770, the .12 MF condenser is 400-volts; the others are 150-volts.
4. In 15780, the .2 MF condenser is 400-volts; the others are 150-volts.
5. In 16233, the .1 MF condensers are 150-volts; the others are 400-volts.
6. In 16745, the .3 MF condenser is 150-volts; the others are 400-volts.
7. In 18350, the top-right and lower-left condensers are 150-volts; the others are 400-volts.

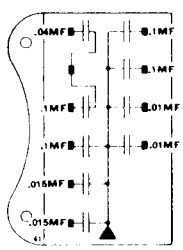
MULTIPLE TYPE BY-PASS CONDENSERS



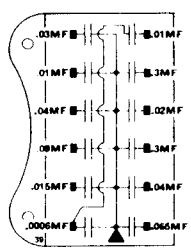
20830
J-1, J-2
200-Volts



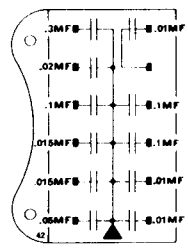
22570
J-3
200-Volts



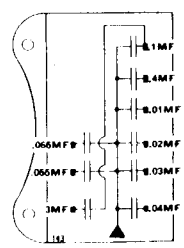
23140
J-4
200-Volts



24250
J-5
200-Volts

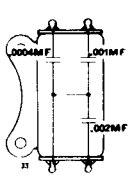


25690
J-6
200-Volts

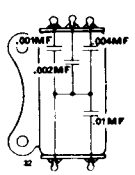


28140
J-7
200-Volts

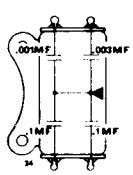
TONE CONTROL CONDENSERS



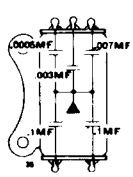
15870
B-7
100-Volts



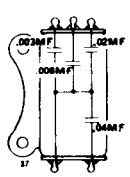
16490
B-6
100-Volts



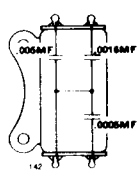
20010
B-8
100-Volts



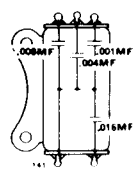
21250
B-9
200-Volts



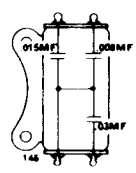
21530
B-11
200-Volts



27390
B-14
200-Volts



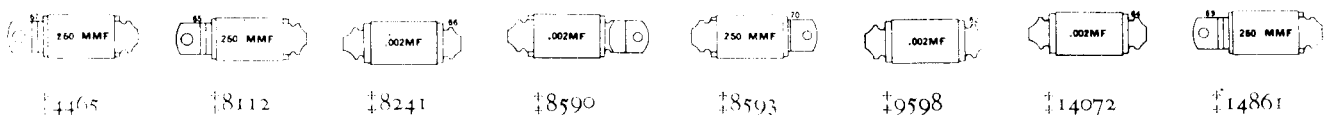
29690
B-15
200-Volts



30270
B-16
200-Volts

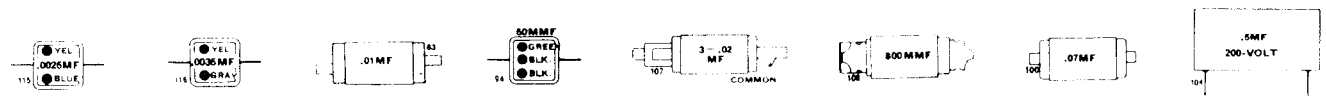
ATWATER KENT MFG. CO.

VALUES OF FIXED CONDENSERS AND DRY ELECTROLYTICS



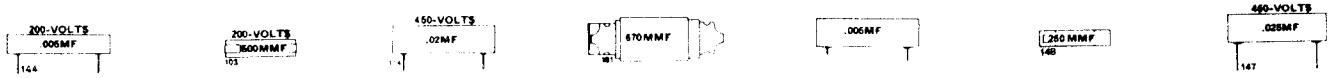
‡4465 ‡8112 ‡8241 ‡8590 ‡8593 ‡9598 ‡14072 ‡14861

‡15540 ‡15702 ‡15919 ‡16088 ‡16323 ‡16360 16788



†22365 †22366 †23250 †23282 §26040 26050 §26490 26550

26660 ‡26670 26690 26820 ‡27130 27630 ‡27640 ‡27650



28040 28130 29030 29360 ‡29800 §30240 30250

†17440
7 plates. Copper washers, or letter A.

† 17470
4 plates. "X" scratched on fibre, or letter F.

†17974
4 plates. Aluminum washers, or letter G.

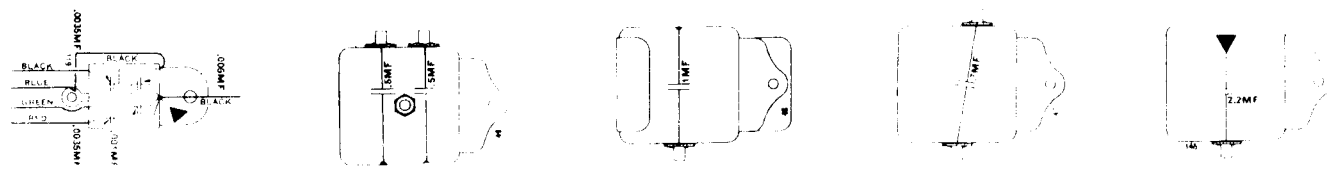
†21160
4 plates. Black washers, or letter B.

†22220
3 plates. Brass washers or letter C.

† 25650
6 plates. Black washers, or letter D.

†26440
4 plates. Black washers, or letter B.

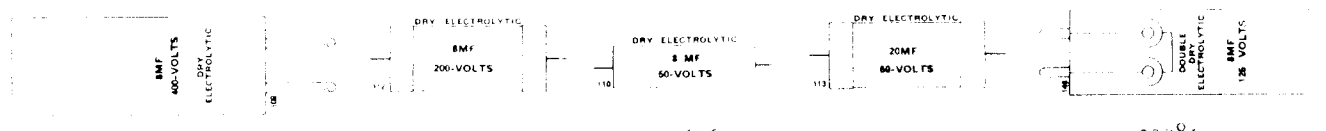
†30260
Letter E stamped on washer.



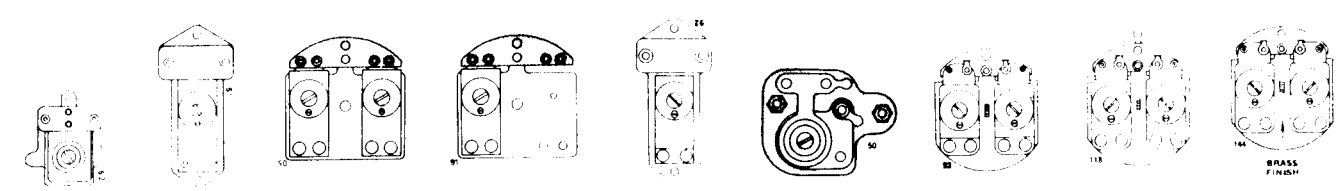
†23411 §21624 K-4 §23260 K-1 †26620 K-5 *29550 K-6

‡ 500-Volts.
† 450-Volts.
§ 200-Volts.
* 100-Volts.

DRY ELECTROLYTICS AND TRIMMERS



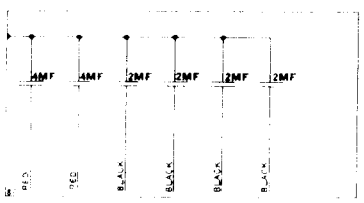
22397 22472 22646 23479 23981



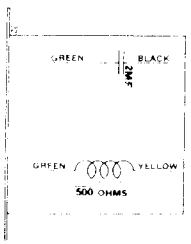
17230 ‡ to 85 MMF | 17240 70 to 225 MMF | 18150 45 to 115 MMF | 19330 25 to 150 MMF | 20100 25 to 100 MMF | 20340 30 to 250 MMF | 24760 30 to 125 MMF | 27860 30 to 140 MMF | 30110 20 to 130 MMF

ATWATER KENT MFG. CO.

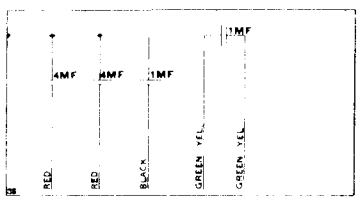
VALUES OF FILTER CONDENSER ASSEMBLIES



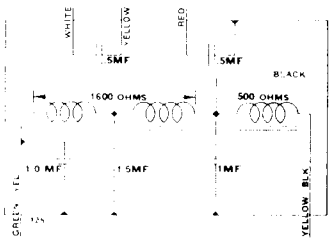
8875 and 9505



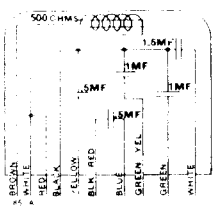
9511



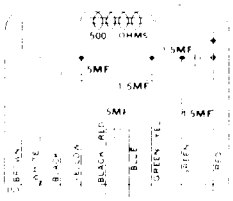
9704



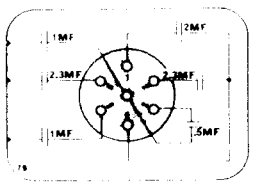
13315 (Late Type)



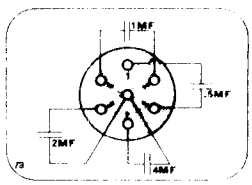
14247



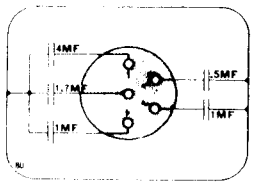
14256



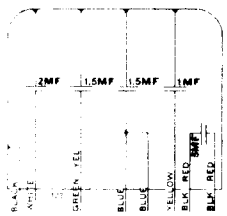
14340
A-3



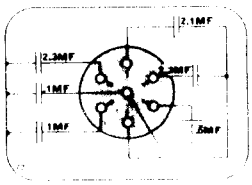
14710
C-1



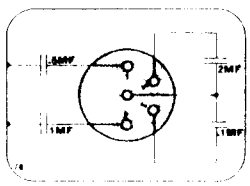
14720
D-2



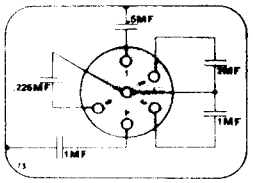
14743



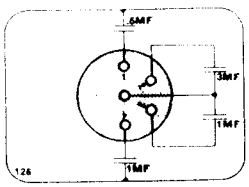
14880
E-1



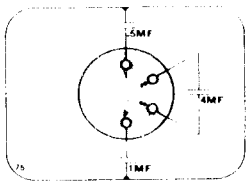
15480
A-5



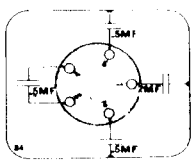
15850
C-7



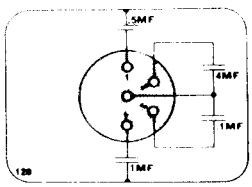
16520 (Early Type)
A-6



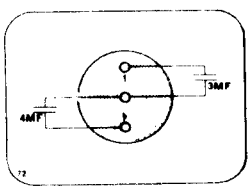
16520 (Late Type)
D-3



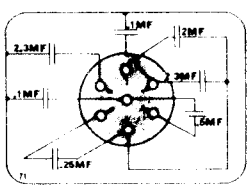
17159
C-6



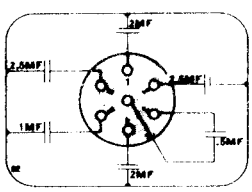
17480
E-3



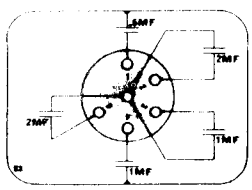
20370
F-1



21520
A-7



25130
F-3



25190
F-4

ATWATER KENT MFG. CO.

VALUES OF ELECTROLYTIC CONDENSERS

19060, superseded by 22538.

19728, superseded by 23146.

20049, 24MF, 120 volts.

22538, 8MF, 475 volts. Yellow paint.

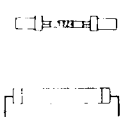
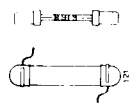
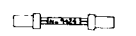
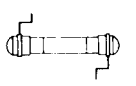
23146, 8MF, 475 volts. Yellow paint.

23394, superseded by 22538.

23498, 4MF, 475 volts. Green paint.

23481, 12MF, 475 volts. Red paint.

VALUES OF EARLY-TYPE TUBULAR RESISTORS

PART NO.	RESISTANCE	USED AS	USED IN MODELS	ILLUSTRATIONS (⅓ FULL SIZE)		SUPERSEDED BY
4782	2 megohms	Grid leak	20-4640 & 24	. . . . .	. . . . .	15892
4814	2 megohms	Grid leak	Board sets		YELLOW PAPER UNDER GLASS	15892
7639	2 megohms	Grid leak	20-7570 & 21		WHITE GLASS	15892
7724	.1 megohm	A.F. grid resistor	12-4910		BLUE PAPER UNDER GLASS	16282
8195	2 megohms	Grid leak	20-7960, 30, 32, 33, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 56 & 57			15892
8796	12,500 ohms	No. 1 R.F. resistor	50		YELLOW GLASS	———
8919	.1 megohm	Detector plate resistor	"B" power unit, 36, early 37 & 38		GREEN PAINT	———
9424	12,500 ohms	1st-A.F. plate resistor. Detector plate resistor.	36, 37, 38, 40, 42, 43, 44, 45, 52, 56 & 57 41			15941 or 16472
13047	65,000 ohms	Detector plate resistor	Late 37 & 38, 40, 42, 43, 44, 45, 52, 56 & 57			15592
13901	5000 ohms	1st-R.F. plate resistor	41			———
14565	65,000 ohms	Detector plate resistor	46, 47 & 53		BLACK PAINT	15592
14575	12,500 ohms	1st-A.F. plate resistor	46, 47 & 53		RED PAINT	15941 or 16472
15286A	6000 ohms	Bleeder resistor	Early 55		ALL PURPLE	16330
15286B	4000 ohms	Bleeder resistor	Early 55		PURPLE BAND	16295

ATWATER KENT MFG. CO.

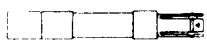
VALUES OF ½, 1, and 1½ WATT TUBULAR RESISTORS

(When replacing a tubular resistor, use a resistor of the same value and size.)

These three illustrations are full size.

RESISTANCE IN OHMS	RESISTANCE IN MEGOHMS	IDENTIFYING COLOR	½ WATT SIZE	1 WATT SIZE	1½ WATT SIZE
3,300	.0033	GREEN AND RED	26410	19346	——
4,000	.004	GREEN AND BLUE	——	18049	——
5,000	.005	BLUE AND YELLOW	28050	——	——
6,000	.006	PURPLE	——	20151	28770
7,500	.0075	YELLOW	——	15544	——
10,000	.01	MAROON	20950	15545	27210
12,500	.0125	PURPLE AND YELLOW	——	15941	——
		PURPLE AND RED	——	16472	——
		RED	——	15802	——
15,000	.015	GRAY AND YELLOW	20960	22211	27220
		GRAY AND GREEN	——	21784	——
20,000	.02	BLACK AND RED	23120	15891	28030
30,000	.03	GRAY	20970	15285	29710
40,000	.04	WHITE	26160	16724	28750
		BLACK AND YELLOW	——	16725	——
50,000	.05	BLACK, YELLOW AND RED	——	22407	——
65,000	.065	BLACK	21040	15592	——
		BLACK AND GREEN	——	17558	——
100,000	.1	BLUE	——	15287	——
		RED AND BLUE	20980	16282	28760
250,000	.25	RED AND YELLOW	20920	19581	——
500,000	.5	BLACK AND PURPLE	20930	19649	——
800,000	.8	RED AND GRAY	23130	20223	——
900,000	.9	GREEN AND YELLOW	23170	——	——
1,000,000	1	BLUE AND GRAY	21050	——	——
2,000,000	2	GREEN	20940	15892	——

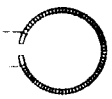
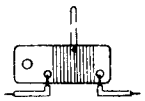
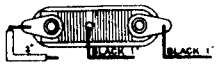
No. 21143 Plug suppressor
Used in Models 81 & 91
RESISTANCE 15,000 OHMS

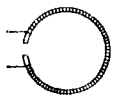
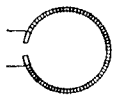
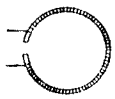
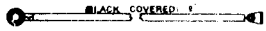
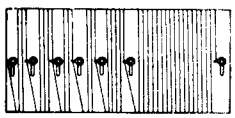
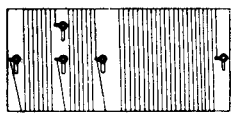
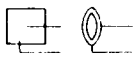
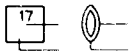


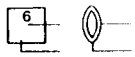
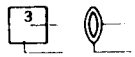
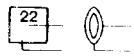
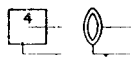
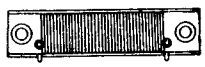
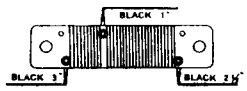
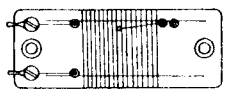
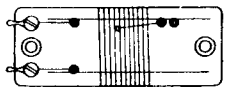
No. 21144 Distributor suppressor
Used in Models 81 & 91
RESISTANCE 15,000 OHMS

ATWATER KENT MFG. CO.

VALUES OF FLEXIBLE AND WIRE-WOUND RESISTORS

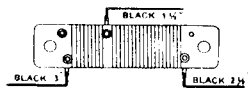
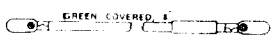
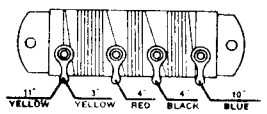
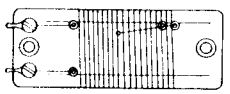
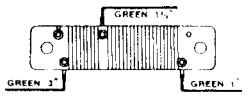
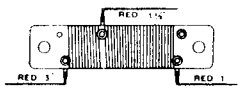
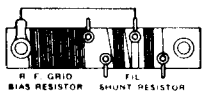
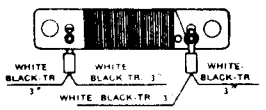
Part No. and Ohms	Illustrations ⅓ Full Size
3849 **4**	
4011 **200**	
4497 **10**	
4662 **20**	
4690 **10**	
4879 **600**	
4949 **600**	
4953 **10**	
4960 **2.5 & 2.5**	
4977 **600**	
8092 **500**	
8126 **1**	
8190 **180 & 270**	
8225 **500**	
8256 **1.5**	
8284 **865**	

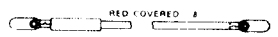
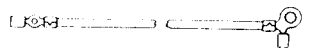
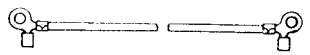
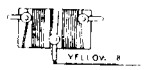
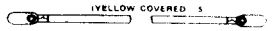
Part No. and Ohms	Illustrations ⅓ Full Size
8303 **1**	
8308 **5**	
8310 **20**	
8439 **350**	
8599 **5**	
8627 **1.5**	
8915 **800, 800, 800, 800, 1800&5000**	
8996 **800**	
9434 **10 & 10**	
9515 **1700, 1100, & 5000**	
9597 **25 & 25**	
9691 **1100**	
9692 **1750**	
9781 **425**	

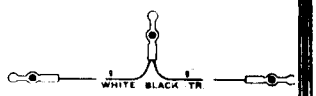
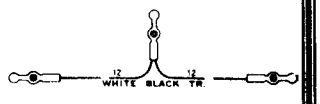
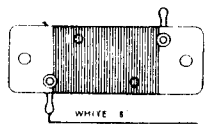
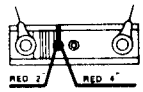
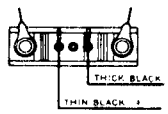
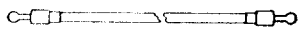
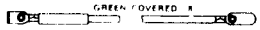
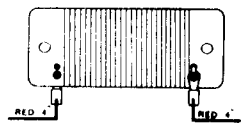
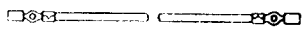
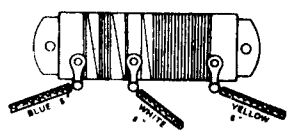
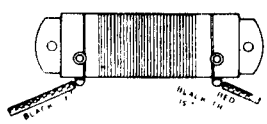
Part No. and Ohms	Illustrations ⅓ Full Size
9782 **425**	
9788 **400**	
(Superseded by 13604)	
13128 **625**	
13138 **550**	
13289 **2200**	
13296 **1500**	
(Superseded by 16253)	
13303 **550**	
13323 **0.3**	
13324 **0.05**	
13369 **3000**	
13383 **1500**	
(Superseded by 16253)	
13538 **625 and 2200**	
13604 **400**	
13645 **28**	
13755 **21**	

ATWATER KENT MFG. CO.

VALUES OF FLEXIBLE AND WIRE-WOUND RESISTORS (Continued)

Part No. and Ohms	Illustrations 1/3 Full Size
13756 **500 and 2200**	
13961 **4**	
14039 **235, 125 and 175**	
14041 **242**	
14427 **625 and 1000**	
15063 **550 and 1000**	
15272 **1050**	
(Superseded by 15660)	
15274 **160 & 30** (30-ohm has tap at 15)	
(Superseded by 16988 and 17077)	
15297, **6000 ohms**	
15547 **15 and 15**	
(Superseded by 17077)	
15660 **1050**	

Part No. and Ohms	Illustrations 1/3 Full Size
15670 **1050**	
(Superseded by 15660)	
15720 **425**	
(Superseded by 15830)	
15747 **2**	
15810 **1050**	
(Superseded by 16320)	
15820 **1050**	
(Superseded by 16320)	
15830 **425**	
15904 **160**	
(Superseded by 16988)	
16055 **1050**	
(Superseded by 15660)	
16056 **15 & 15**	
(Superseded by 17077)	
16077 **19**	
16081 **0.6**	
16175 **160**	
(Superseded by 16988)	
16176 **8.5 & 11.5**	
(Superseded by 16302)	

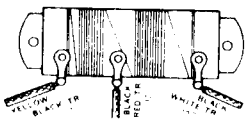
Part No. and Ohms	Illustrations 1/3 Full Size
16253 **1500**	
16280 **8 & 8**	
16290 **11 & 11**	
16295 **4000**	
16299 **11.5**	
16302 **8.5 & 11.5**	
16320 **1050**	
16322 **4**	
16330 **6000**	
16340 **850**	
16350 **200**	
16432 **35 & 250**	
16433 **680**	

ATWATER KENT MFG. CO.

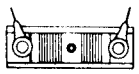
VALUES OF FLEXIBLE AND WIRE-WOUND RESISTORS (Continued)

Part No. and Ohms — **Illustrations ⅓ Full Size**

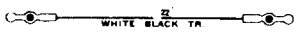
16434 **300 & 300**



16522 **22.5**



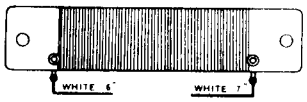
16610 **19**



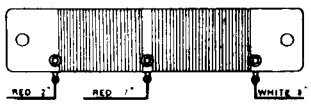
16638 **1050**

(Superseded by 15660)

16639 **8500**

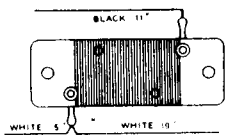


16641 **3000 & 4000**



16643 **2000**

16644 **4000**



(Superseded by 16295)

16759 **1050**

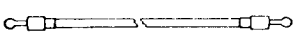
(Superseded by 15660)

16768 **115**

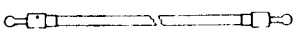
(Superseded by 16987)

16840 **22**

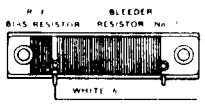
16850 **11**



16860 **35**



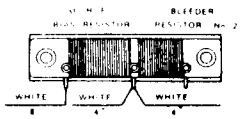
16868 **160 & 850**



(Superseded by 16988 and 16989)

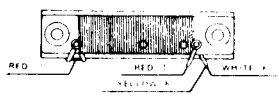
Part No. and Ohms — **Illustrations ⅓ Full Size**

16872 **1500 & 1050**



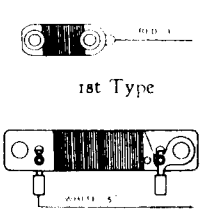
(Superseded by 16253 and 15660)

16905 **3000 & 3000**



(Superseded by 17041)

16987 **115**

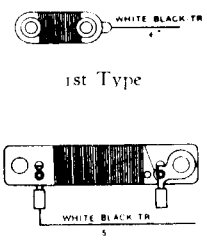


1st Type

2nd Type

16988 **160**

16988 was also made in flexible type, but only the 2nd type is now supplied.



1st Type

2nd Type

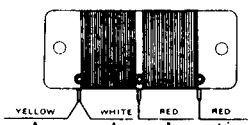
16989 **850**

(Superseded by 16340)

17016 **1050**

(Superseded by 15660)

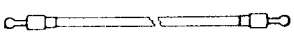
17041 **3000 & 3000**



17077 **5 & 5**

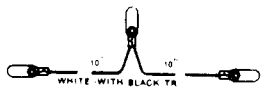
(Now Rubber Covered)

17090 **1200**



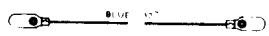
Part No. and Ohms — **Illustrations ⅓ Full Size**

17155 **7.5 & 7.5**

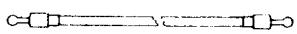


(Superseded by 17077)

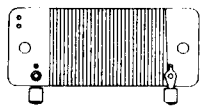
17299 **2**



17380 **425**

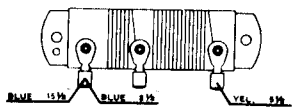


17610 **4000**

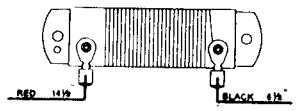


18236 **1**

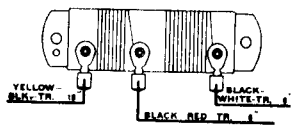
18354 **35 & 250**



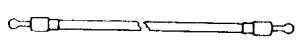
18355 **645**



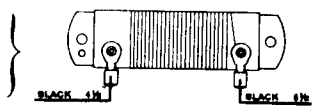
18356 **300 & 300**



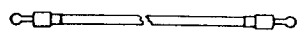
18520 **70**



19180 **1100**
19180X **600**



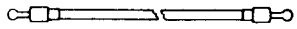
19190 **3300**



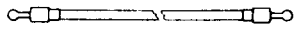
(Superseded by 19346 tubular)

19610 **.452**

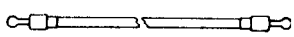
19820 **48**



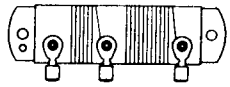
19830 **8**



19840 **35**



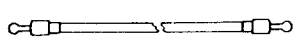
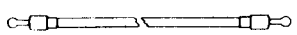
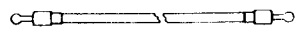
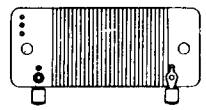
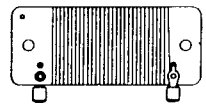
19850 **60 & 160**

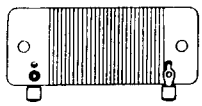
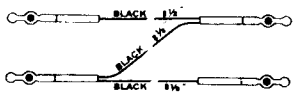


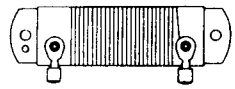
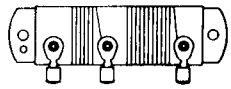
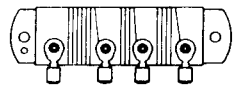
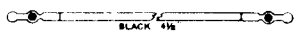
(Superseded by **25980** and **25990**)

ATWATER KENT MFG. CO.

VALUES OF FLEXIBLE AND WIRE-WOUND RESISTORS (Continued)

Part No. and Ohms	Illustrations ⅓ Full Size
20040 **100**	
20050 **355**	
20120 **800**	
20140 **6400**	
20150 **8000**	
20320 **200**	
20380 **1500**	
20520 **670**	
21030 **2000**	
21420 **250**	

Part No. and Ohms	Illustrations ⅓ Full Size
22660 **6000**	
23780 **550**	
23840 **8, 8 & 8**	
(Superseded by 26360)	
24340 **8000**	
24450 **6400**	
24470 **4000**	
24530 **2500**	
24980 **300**	
25720 **35**	
25840 **300**	

Part No. and Ohms	Illustrations ⅓ Full Size
25850 **2500**	
25950 **200**	
25980 **110**	
25990 **50 & 60**	
26360 **8, 8 & 8**	
27930 **500**	
28470 **3000**	
28950 **160**	
29220 **300**	
30030 **.352**	

INSULATORS FOR WIRE-WOUND RESISTORS

No. 13306 Fibre insulator

No. 16147 Fibre insulator

No. 17232 Fibre insulator

RESISTANCE VALUES OF R. F. AND I. F. CHOKES

8062, superseded by 8232.
8232, 35 ohms.
8660, 36 ohms.
13482, superseded by 13668.
13668, 25 ohms.
15271, 38 ohms.
16286, superseded by 17251.
16659, 70 ohms.
17015, 89 ohms.
17254, 1.4 ohms.
17390, 350 ohms.
17410, 46 ohms.
17420, superseded by 18220.
17820, superseded by 18220.
18160, 75 ohms.
18220, 70 ohms.
19210, 66 ohms.
19250, 130 ohms.
19571, 79 ohms.
20307, 84 ohms.
22494, 2.9 ohms.
26510, 2.7 ohms.

ATWATER KENT MFG. CO.

VALUES OF PARTS IN MODELS
20, 24, 30, 32, 33, 35, 48, 49 and 50

	20-4640 24-4920	20 No. 7570	20 No. 7960	Early 30	Late 30 and 48	32	33 and 49	Early 35	Late 35	50
RESISTORS										
R.F. rheostat resistor	4690 **10**	4690 **10**	4690 **10**	4690 **10**	4690 **10**	8308 **5**	4690 **10**	4690 **10**	4690 **10**	8599 **5**
Detector rheostat resistor	4690 **10**	4690 **10**	8310 **20**	8310 **20**	8310 **20**	8310 **20**	8310 **20**			8310 **20**
Fixed A.F. filament resistor			8303 **1**	8256 **1.5**	8256 **1.5**	8256 **1.5**	8256 **1.5**	8126 **1**	8126 **1**	8627 **1.5**
Detector grid bias resistor			8190 **450**	8190 **450**	8190 **450**	8190 **450**	8190 **450**	8190 **450**	8190 **450**	
Detector grid leak	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs.	15892 2 Megs
1st-R.F. plate resistor										8796 **12500**
No. 1 grid resistor	4949 **600**	4949 **600**	4949 **600**	8092 **500**	8439 **350**	8284 **865**	8996 **800**	8225 **500**	8439 **350**	
No. 2 grid resistor	4949 **600**	4949 **600**	4949 **600**	8092 **500**	8439 **350**	8284 **865**	8996 **800**	8225 **500**	8439 **350**	
No. 3 grid resistor						8284 **865**	8996 **800**			
Antenna Choke				8232 **35**	8232 **35**	8232 **35**		8232 **35**	8232 **35**	
A.F. TRANSFORMERS										
No. 1 A.F.T. Part No.	4779	7661	8060	8060	8060	8060	8060	8060	8060	8650
Primary Resistance	**1700**	**1700**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**
Secondary Resistance	**3250**	**3250**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**
No. 2 A.F.T. Part No.	4779	7661	7661	7661	7661	7661	7661	7661	7661	8940
Primary Resistance	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**1400**
Secondary Resistance	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**7000**
FIXED CONDENSERS										
"Single" By-pass	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**	14902 **.3 MF**
Phone Condenser	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8241 **.002 MF**	8590 **.002 MF**
Grid Condenser	4465 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8112 **250 MMF**	8593 **250 MMF**

VALUES OF CHASSIS PARTS IN MODELS
36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 52, 53, 56 and 57

	44 and 45	36	Early 37	Late 37	Early 38	Late 38	40, 42 52, 56 and 57	** 41	43	46 and 53	47
RESISTORS											
No. 1 grid resistor	8439 **350**	8996 **800**	8439 **350**	8439 **350**	8996 **800**	8996 **800**	8439 **350**	8439 **350**	8439 **350**	8439 **350**	8439 **350**
No. 2 grid resistor	8225 **500**	8996 **800**	8439 **350**	8439 **350**	8996 **800**	8996 **800**	8439 **350**	8439 **350**	8439 **350**	8439 **350**	8225 **500**
No. 3 grid resistor	8439 **350**	8996 **800**			8996 **800**	8996 **800**					8439 **350**
1st-R.F. plate resistor								13901 **5000**			
1st-R.F. bias resistor								13961 **4**			
R.F. plate resistor	16253 **1500**			13369 **3000**		16253 **1500**	13369 **3000**		13369 **3000**	13369 **3000**	16253 **1500**
Detector grid leak	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**	15892 **2 Megs**
Detector cathode resistor									13369 **3000**	13369 **3000**	13369 **3000**
Filament shunt resistor		9597 **50**	9597 **50**		9597 **50**			14039 **535**			
A.F. TRANSFORMERS											
No. 1 A.F.T.	8060	8060	8060	8060	8060	8060	8060	8060	14016	14721	14721
Primary resistance	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1800**	**1500**	**1500**
Secondary resistance	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**
No. 2 A.F.T.	7661	7661	7661	7661	7661	7661	7661	14015	14013	14722	14722
Primary resistance	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**1700**	**900**	**1300**	**1100**	**1100**
Secondary resistance	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**3250**	**7000**	**7000**	**7000**	**7000**

ATWATER KENT MFG. CO.

VALUES OF CHASSIS PARTS IN MODELS
36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 52, 53, 56 and 57 (Continued)

	44 and 45	36	Early 37	Late 37	Early 38	Late 38	40, 42 52, 56 and 57	** 41	43	46 and 53	47
FIXED CONDENSERS											
"Double" by-pass	15158	15158	15158	15158	15158	15158	15158	15157	15158	15158	15158
Speaker filter condenser	14902 .3 MF	14902 .3 MF	14902 .3 MF	14902 .3 MF	14902 .3 MF	14902 .3 MF	14902 .3 MF				
Phone condenser	9598 .002 MF	9598 .002 MF	9598 .002 MF	9598 .002 MF	9598 .002 MF	9598 .002 MF	9598 .002 MF	14072 .002 MF	9598 .002 MF	9598 .002 MF	9598 .002 MF
Grid condenser	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	8112 250 MMF	14861 250 MMF	14861 250 MMF
VOLUME CONTROL	13320	9490	9510	13020	13020	13020		13550	13320		13320
Volume control resistor	13604 400	*	13604 400	13604 400	13604 400	13604 400	13604 400	13604 400	13604 400	13604 400	13604 400

*Early 36 used a condenser type volume control No. 9561. In late 36, the volume control has two resistors, No. 9781 and 9782, each 425 ohms.

**In Model 41, the detector filament by-pass and the volume control condenser is No. 13956.

VALUES OF PARTS IN POWER UNITS FOR MODELS
36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 52, 53, 56 and 57

FOR VALUES IN BY-PASS AND FILTER CONDENSERS, SEE PAGES 2 AND 5

	Type "R" B Power Unit	Early 36	Late 36	Early 37	Late 37	Early 38	Late 38	40, 42, 52, 56 and 57	41	44 and 45	43	46 and 53	47
RESISTORS													
Detector plate resistor	8919 .1 Meg	8919 .1 Meg	8919 .1 Meg	8919 .1 Meg	15592 65000	8919 .1 Meg	15592 65000	15592 65000	15941 12500	15592 65000	15592 65000	15592 65000	15592 65000
1st-A.F. plate resistor	15941	15941 12500	15941 12500	15941 12500	15941 12500	15941 12500	15941 12500	15941 12500		15941 12500	15941 12500	15941 12500	15941 12500
R.F.-1st-A.F. bias	9515	9691 1100	9691 1100	13128 625	13138 550	13303 550	13538 625			13756 500	14427 625	14427 625	15063 550
2nd-A.F. bias	9515 ②	9692 1700	9692 1750	13289 1750	9692 2200	13289 1750	13538 ③ 2200			13756 ③ 2200	14427 ③ 1000	14427 ③ 1000	15063 ③ 1000
Load resistor	8915 ①	9515 5000											
Line voltage regulator							13645 ④ 28	14041 242	13755 ⑤ 21	13645 28			
Filament shunt resistor		9434 20	9434 20	9434 20	9434 20	9434 20	9434 20			9434 20	9434 20	9434 20	9434 20
Filament shunt potentiometer		9486 20											
Detector filament series res.		13323 .3											
R.F.-1st-A.F. filament series res.		13324 .05											
FILTER CHOKES													
No. 1 choke ohms	400	400	400	1600	1600	1600	1600	1350	90	1400	300	300	300
No. 2 choke ohms	400	400											
Speaker choke ohms		500	500	500	500	500	500	550	550 ⑥	500			
FILTER CONDENSER (Replaceable type only)	8875	9505	9704	13315	13315	13315	13315	17159 ⑧		14247		14743	14743
OUTPUT TRANSFORMER													
Primary resistance											1000	900	900
Secondary resistance											.7	.4	.4
SPEAKER FIELD COIL										14361		15629	15629
Speaker field resistance											2500	1700 ⑦	1700

①—See drawing of 8915 on Page 8. ②—These three resistors are combined in one unit No. 9515. ③—The 2nd-A.F. bias and the R.F.-1st-A.F. bias are combined in one unit, and the number of the complete unit is listed. ④—Used only in Models 42 and 52 ⑤—Used only in Model 44. ⑥—This is the output choke in Model 41. ⑦ Early 53 uses No. 14361, 2500 ohms. Late 53 uses No. 15631, 1700 ohms. No. 15631 is long and narrow. ⑧—In 40-F, 42-F, and 44-F, the replaceable condenser unit is No. 14256.

ATWATER KENT MFG. CO.

VALUES OF PARTS IN MODELS 55, 55-F, 60, 61, 66, and 67

	Early 55	Late 55	Early 55-F	Late 55-F	Early 60	Late 60	Early 61	Late 61	66	Early 67	Late 67
RESISTORS											
Bleeder resistor	16330 **6000**		16330 **6000**		16295 **4000**		16295 **4000**	16295 **4000**			
Bleeder resistor No. 1		16295 **4000**		16295 **4000**		17041 **6000**			16641 **7000**		
Bleeder resistor No. 2		16989 **850**		16989 **850**		15660 **1050**			15660 **1050**		
1st-R.F. bias resistor					16253 **1500**	16253 **1500**			15660 **1050**		
2nd-R.F. bias resistor							16299 **11.5**	16299 **11.5**			
3rd-R.F. bias resistor							16322 **4**	16322 **4**			
R.F. bias resistor	16988 **160**	16988 **160**	16988 **160**	16988 **160**	16988 **160**	16988 **160**			16987 **115**		
R.F. resistor									16639 **8500**		
1st-A.F. bias resistor	15660 **1050**	15660 **1050**	15660 **1050**	15660 **1050**	15660 **1050**	15660 **1050**	16322 **4**	16322 **4**	16643 **2000**		
2nd-A.F. bias resistor			15660 **1050**	15660 **1050**							
2nd-A.F. grid filter resistor									16295 **4000**		
1st or 2nd-R.F. filament res.										16302 **20**	16302 **20**
Detector and A.F. filament res.										16081 **.6**	16081 **.6**
Filament series resistor No. 1							16433 **680**	16433 **680**			
Filament series resistor No. 2							16432 **285**	16432 **285**			
A.F. filament shunt resistor							16434 **600**	16434 **600**			
3rd Filament shunt resistor							16522 **22.5**	16522 **22.5**		16077 **19**	16077 **19**
Filament shunt resistor	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**			17077 **10**		
Dial-light resistor	15747 **2**	15747 **2**	15747 **2**	15747 **2**	15747 **2**	15747 **2**			15747 **2**		
VOLUME CONTROL	14250	15160	14250	15160	14250	15160	14250	14250	15160	14630	14630
Wire-wound section	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**		
Carbon section		**10000**		**10000**		**10000**			**10000**	**.1 Meg**	**.1 Meg**
CONDENSERS											
Double phone condenser	15792 **.002 MF**		15792 **.002 MF**		15792 **.002 MF**		16323 **.002 MF**			16082 **.002 MF**	16082 **.002 MF**
Detector grid condenser							16088 **250 MMF**	16088 **250 MMF**		16088 **250 MMF**	16088 **250 MMF**
Local-distance switch condenser		16788 **28 MMF**		16788 **28 MMF**		16788 **28 MMF**		16788 **28 MMF**			16788 **28 MMF**
Filter Condenser	14340	14340	14720	14720	14340	14340	14710	14710	14880		
R.F. by-pass	15262 H-1	15262 H-1	15262 H-1	15262 H-1							
R.F. by-pass No. 1					15262 H-1	15262 H-1	15262 H-1	15262 H-1	15262 H-1	15262 H-1	15262 H-1
R.F. by-pass No. 2					16233 H-4	16233 H-4	15262 H-1	15262 H-1	16233 H-4	16461 H-6	16461 H-6
Detector by-pass	15263 H-2	16745 H-7	15263 H-2	16745 H-7	15263 H-2	16745 H-7	15263 H-2	16745 H-7	16745 H-7	16462 H-5	16462 H-5
Line condenser		16828 B-5		16828 B-5							
NO. 1 A. F. T.											
Primary resistance							**1500**	**1500**		**1500**	**1500**
Secondary resistance							**7000**	**7000**		**7000**	**7000**
2nd A.F. Input Transformer											
Primary resistance	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**	**1100**
Secondary resistance	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**	**7000**
2nd A.F. Output Transformer											
Primary resistance	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**900**	**900**
Secondary resistance	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**	**.2**
FILTER CHOKES											
No. 1 choke	**300**	**300**	**300**	**300**	**300**	**300**	**45**	**45**	**250**		
No. 2 choke	**2500**	**2500**	**2500**	**2500**	**2500**	**2500**	**45**	**45**	**2500**		
Field Coil	15635	15635	15629	15629	15635	15635	15854	15854	15854	15863	15863
Field resistance	**1100**	**1100**	**1700**	**1700**	**1100**	**1100**	**700**	**700**	**700**	**8**	**8**

ATWATER KENT MFG. CO.

VALUES OF PARTS IN MODEL 60-C, 3rd TYPE

RESISTORS		
Volume control	17736	
Resistance of screen section		**6000**
Resistance of antenna section		**2500**
R.F. bias resistor	17380	**425**
1st-R.F. bias resistor	16320	**1050**
1st-A.F. bias resistor	16320	**1050**
Filament shunt resistor	17077	**10**
Dial light resistor	17299	**2**
AUDIO TRANSFORMERS		
Input A.F. transformer	15520	
Primary resistance		**2000**
Secondary resistance		**6000**
Output A.F. transformer	15530	
Primary resistance		**300**
Secondary resistance		**.1**
FILTER CHOKE		
Filter choke assembly	15450	
Resistance of No. 1 choke		**600**
Resistance of No. 2 choke		**6000**
FIELD COIL		
Speaker field coil	17551	**1100**
CONDENSERS		
Filter condenser assembly	15480	
R.F. by-pass No. 1	15790	(H-21)
R.F. by-pass No. 2	15770	(H-15)
R.F. by-pass No. 3	15780	(H-17)
Detector by-pass	15640	(H-16)
Stopping or compensating condenser	15540	**8 MMF**

VALUES OF PARTS IN MODELS 70, 72, 74, 75, and 76

(TYPE L, F, P, H, D, and Q CHASSIS)

	L, F, P	H	D	Q
RESISTORS				
Volume control	16270	17270	16630	16010
Resistance of screen section	**5600**	**.1 Meg****	**6000**	**.1 Meg**
Resistance of antenna section	**2500**	**.25 Meg**	**2500**	**2500**
Phonograph volume control (P)	19077 **500**			
Bleeder resistor No. 1	16330 **6000**			
Bleeder resistor No. 2	17090 **1200**			
R.F. bias resistor	16350 **200**			
1st-R.F. bias resistor	16320 **1050**		16860 **35**	
1st-2nd R.F. bias resistor				16290 **22**
1st-2nd R.F. filament resistor				16280 **16**
2nd-R.F. bias resistor			16850 **11**	
3rd-R.F. bias resistor			16322 **4**	16610 **19**
3rd R.F. filament shunt resistor			16840 **22**	
Detector-A.F. filament resistor				16081 **.6**
1st-A.F. bias resistor	16320 **1050**	16320 **1050**	16322 **4**	
I.F. bias resistor		17380 **425**		
Dial light resistor	18236 **1**	18236 **1**		
Filament shunt resistor	17077 **10**	17077 **10**		
Filament series resistor No. 1			18355 **645**	
Filament series resistor No. 2			18354 **285**	
A.F. filament shunt resistor			18356 **600**	
AUDIO TRANSFORMERS				
No. 1 A.F. transformer			17070	15960
Primary resistance			**1500**	**1600**
Secondary resistance			**6000**	**7000**
2nd-A.F. input transformer	15520	17280	16640	18020
Primary resistance	**2000**	**1900**	**1100**	**1000**
Secondary resistance	**6000**	**5500**	**7000**	**7000**
Output filter choke				**350**
Output transformer	16390	16390	16390	
Primary resistance	**300**	**300**	**300**	
Secondary resistance	**.1**	**.1**	**.1**	
FILTER CHOKE				
Filter choke assembly	16680*	17290	16890	
Resistance of No. 1 choke	**560**	**500**	**45**	
Resistance of No. 2 choke	**3000**	**6000**	**45**	
Resistance of No. 3 choke		**100**		
Resistance of output choke			**100**	
FIELD COIL	16410	16410	17020	
Speaker field coil	**1100**	**1100**	**650**	
CONDENSERS				
Filter condenser assembly	15850* 15790*	15850 17360	14710 16940	15262
R.F. by-pass No. 1	H-21 15770	H-27 15262	H-22 15262	H-20 18350
R.F. by-pass No. 2	H-15 15780	H-20 16745	H-20 16880	H-28 15262
R.F. by-pass No. 3	H-17	H-13 17370	H-23 15262	H-20
R.F. by-pass No. 4		H-26 15262	H-20	
R.F. by-pass No. 5	15640	H-20		
Detector by-pass	H-16			
Tone control condenser	16490 B-6	16490 B-6	15870 B-7	15870 B-7
Stopping or compensating condenser	15540 8 MMF		16360 **11 MMF**	16360 **11 MMF**
Detector grid condenser			16088 **250 MMF**	16088 **250 MMF**
1st-I.F. stopping condenser		17440 **500 MMF**		
1st-detector plate condenser		17470 **200 MMF**		
2nd-detector or 2nd-I.F. stopping cond.		17974 **200 MMF**		

*In type L chassis below 6234881, the filter condenser is No. 15480.
In type F chassis, the filter condenser is No. 16520, and filter choke is No. 16260.
In type F chassis above 5802566, R.F. by-pass No. 1 is No. 15262.

**In type H chassis, the .25 meg section of the control is in the grid circuit of the 1st-I.F. tube. In type H-1 chassis, the .1 meg section of the control is in the plate circuit of the I.F. tubes. In type H-2 chassis, the .1 meg section controls the screen voltage of the I.F. tubes.

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VALUES OF PARTS IN MODELS 82-D, 84-D, 87-D, and 228-D

	1st Type 82-D	228-D and 2nd Type 82-D	84-D	87-D
RESISTORS				
Volume control	23228 .5 MEG	23228 .5 MEG	23228†† .5 MEG	21816 *
Filament series resistor No. 1	25980 110	25980 110	25980 110	25980 110
Filament series resistor No. 1A	25990 110	25990 110	25990 110	25990 110
Filament series resistor No. 2	19840 35	19840 35	19840 35	19840 35
Filament series resistor No. 3				26360 24
2nd-A.F. filament shunt resistor	19820 48	19820 48	19820 48	19820 48
R.F.-I.F. bias resistor				23780 550
1st-detector bias resistor				21030 2000
I.F. bias resistor	19830 8	19830 8	19830 8	
1st-A.F. bias resistor				16320 1050
AUDIO TRANSFORMERS				
Audio input transformer	19870	19870	19870	23760
Primary resistance	1500	1500	1500	500
Secondary resistance	7000	7000	7000	1000
Audio output transformer	19697	19697	19697	24040
Primary resistance	500	500	500	450
Secondary resistance	.25	.25	.25	.04

	1st Type 82-D	228-D and 2nd Type 82-D	84-D	87-D
FILTER CHOKE				
Filter choke unit	19770 30	19770 30	19770 30	19770 30
FIELD COIL				
Field coil	19860 1200	19860 1200	19860 1200	19860 1200
CONDENSERS				
Electrolytic filter condenser	20049 24 MF	20049 24 MF	20049 24 MF	20049 24 MF
By-pass No. 1	19690 H-32	19690 H-32	19690 H-32	23590 H-44
By-pass No. 2	19150 H-29	15262 H-20	19150 H-29	15770 H-15
By-pass No. 3	20350 H-36	20350 H-36	20350** H-36	23610 H-45
By-pass No. 4				15262 H-20
Tone control condenser	16490 B-6	16490 B-6	16490† B-6	21530 B-11
R.F. screen by-pass				23250 .01 MF
I.F. stopping condenser	21160 200 MMF	21160 200 MMF	17440 500 MMF	21160 200 MMF
Phone condenser**			17440 500 MMF	
2nd-detector-1st A.F. coupling condenser		23250 .01 MF		
Oscillator grid condenser				21160 200 MMF

*The volume control in 87-D is a dual type. The wire-wound section is 5000 ohms and controls the screen voltage. The carbon section is 2500 ohms and controls the antenna input.

**The phone condenser is used only in early type 84-D and in these sets, by-pass No. 3 is 19710.

†The tone-control condenser is used only in late type 84-D.

††In early type 84-D, the volume control is No. 19040, .5 meg.

VALUES OF PARTS IN MODELS 81, 81-B, 81-C, 91, 91-B, and 91-C

	Model 81, 81-B, and 81-C	Model 91, 91-B, and 91-C
RESISTORS		
Volume control	21496 .65 MEG	21496 .65 MEG
Distributor suppressor (long)	21144 15000	21144 15000
Plug suppressor (short)	21143 15000	21143 15000
CONDENSERS		
Condenser for ignition filter	21624 (2) .5 MF	21624 (2) .5 MF
Generator condenser	23260 1 MF	23260 1 MF
Electrolytic condenser	22538 8 MF	22472 8 MF
Multiple by-pass condenser	23140 J-4	25690 J-6
R.F. by-pass condenser		26040 (3) .02 MF
1st-R.F. grid circuit by-pass	23250 .01 MF	
Phone condenser	21160 200 MMF	17440 500 MMF
Control coupling condenser	21160 200 MMF	26440 200 MMF
Tracking condenser		26050 800 MMF
Oscillator grid condenser		21160 200 MMF
Audio input transformer	22810	26280
Primary resistance	2000	300
Secondary resistance	6000	250
Audio output transformer	22830	22830
Primary resistance	450	450
Secondary resistance	.02	.02
Field coil	22440 3	22440 3

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VALUES OF PARTS IN MODELS 82-Q, 84-Q, 85-Q and 228-Q

	82-Q 1st Type	82-Q 2nd Type and 228-Q	84-Q	85-Q
	16122	16122	19040	16122
Volume control	.1 MEG.	.1 MEG.	.5 MEG.	.1 MEG.
Filament series resistor	19610 .452	19610 .425	19610 .452	19610 .452
AUDIO TRANSFORMERS				
Audio input transformer	23510	23510		23440
Primary resistance	1450	1450		1450
Secondary resistance	6000	6000		6000
Audio output transformer	19697	19697	19697	19697
Primary resistance	500	500	500	500
Secondary resistance	.25	.25	.25	.25
CONDENSERS				
Filter condenser (electrolytic)	23146 8 MF	23146 8 MF	23146 8 MF	22538 8 MF
	21170	15262	19560	19980**
R.F. by-pass No. 1	H-37	H-20	H-31	H-34
	15262	15262	19150	19150
R.F. by-pass No. 2	H-20	H-20	H-29	H-29
	19150	19160	15262	15262
R.F. by-pass No. 3	H-29	H-30	H-20	H-20
	15262		16461	15262
R.F. by-pass No. 4	H-20		H-12	H-20
R.F. by-pass No. 5				15262 H-20
Tone control condenser	16490 B-6	16490 B-6	16490* B-6*	16490 B-6
SMALL FIXED CONDENSERS				
R.F.-1st-detector stopping cond.	21160 200 MMF	21160 200 MMF	17974* 270 MMF	21160* 200 MMF
Oscillator grid condenser	21160 200 MMF	21160 200 MMF		21160 200 MMF
I.F. stopping condenser	21160 200 MMF	21160 200 MMF	17440 500 MMF	21160 200 MMF
Phone condenser	17440 500 MMF	17440 500 MMF	17440 500 MMF	17440 500 MMF
2nd-detector-1st-A.F. coupling cond.		23250 .01 MF		
Oscillator plate filter condenser		23250 .01 MF		

*Used only in late type sets.

**In late 85-Q, R. F. by-pass No. 1 is 21170, H-37.

VALUES OF PARTS IN MODEL 93 SHORT-WAVE CONVERTER

	Part No.	Value
RESISTORS		
Antenna resistor	25720	35
Bleeder resistor No. 1 or No. 2	24450	6400
Bleeder resistor No. 3	21030	2000
I.F. bias resistor	16320	1050
CONDENSERS		
Electrolytic condenser No. 1	22538	8 MF
Electrolytic condenser No. 2	23146	8 MF
R.F. by-pass	15262	——
Compensating condenser	16360	11 MMF
Oscillator tracking condenser No. 1	25650	300 MMF
Oscillator tracking condenser No. 2	22365	.0025MF
Oscillator tracking condenser No. 3	22366	.0035 MF
Antenna condenser	22220	100 MMF
S.W. detector grid condenser	22220	100 MMF
Detector-I.F. stopping condenser	21160	200 MMF
Oscillator plate condenser	17440	500 MMF
Converter coupling condenser	21160	200 MMF
FILTER CHOKE		
Filter choke unit	25810	180

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VALUES OF PARTS IN MODELS 80, 82, 83, 84, 85, 86, 87, and 89

	80	82	83	84 Early Type	84 Late Type	85 Early Type	85 Late Type	86	87	89
Volume control	20840 **6000**	20990 **550**	22330 **6000**	19040 **.5 MEG**	20180 **3500**	19040 **.5 MEG**	20030 **550**	23416 **550**	22650 **3500**	23228 **.5 MEG**
RESISTORS										
Bleeder resistor No. 1		20150 **8000**		16330 **6000**	16330 **6000**	16330 **6000**	20150 **8000**	20150 **8000**	22660 **6000**	20150 **8000**
Bleeder resistor No. 2		20140 **6400**		16330 **6000**	17610 **4000**	16330 **6000**	16330 **6000**	20140 **6400**	22660 **6000**	20150 **8000**
Bleeder resistor No. 3		20050 **355**			18520 **70**		20050 **355**	16320 **1050**	20040 **100**	21030 **2000**
Bleeder resistor No. 3A								23780 **550**	17380 **425**	16320 **1050**
Bleeder resistor No. 4	20040 **100**	20040 **100**	20040 **100**				20040 **100**	20050 **355**		17380 **425**
Bleeder resistor No. 5		20150 **8000**					20150 **8000**	20150 **8000**		20150 **8000**
Bleeder resistor No. 6		20120 **800**					20120 **800**	20120 **800**		20120 **800**
Bleeder resistor No. 7		20520 **670**					20520 **670**	20520 **670**		17610 **4000**
1st-detector bias resistor	21030 **2000**		21030 **2000**	19346 **3300**	20380 **1500**					
1st-detector plate resistor					20320 **200**					
I.F. bias resistor				16320 **1050**		16320 **1050**				
A.F. bias resistor									21420 **250**	21420 **250**
Filter resistor		19180 **1100**		19180 **1100**	19180 **1100**	19180 **1100**	19180 **1100**	19180 **1100**		
Filament shunt resistor	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**
Dial light resistor								18236 **1**	18236 **1**	18236 **1**
AUDIO TRANSFORMERS										
A.F. Input transformer									21670	21670
Primary resistance									**2000**	**2000**
Secondary resistance									**1800**	**1800**
A.F. output transformer*	19697	19697	19697	19697	19697	19697	19697	21672	21370	21370
Primary resistance	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**450**	**450**
Secondary resistance	**.25**	**.25**	**.25**	**.25**	**.25**	**.25**	**.25**	**.25**	**.05**	**.05**
FILTER CHOKE UNIT									21680	21680
No. 1 choke, ohms									**480**	**480**
No. 2 choke, ohms									**1500**	**1500**
No. 3 choke, ohms									**90**	**90**
FIELD COIL	18870	18870	18870	18870	18870	18870	18870	18870	21260	21260
Field coil resistance	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**1100**	**1100**
CONDENSERS										
Filter condenser unit, paper and foil type			20370 F-1				20370 F-1	20370 F-1	21520 A-7	21520 A-7
Filter condenser No. 1 (electrolytic)	23146 **8 MF**	23146 **8 MF**		23146 **8 MF**	23146 **8 MF**	23146 **8 MF**				
Filter condenser No. 2 (electrolytic)	22538 **8 MF**	22538 **8 MF**		22538 **8 MF**	22538 **8 MF**	23146 **8 MF**				

*In late type 83 and 85 the output transformer is enclosed in a metal case; part No., less case, is 21672.
In late type 87 and 89 the output transformer is enclosed in a metal case; part No., less case, is 21693.

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VALUES OF PARTS IN MODELS 80, 82, 83, 84, 85, 86, 87, and 89 (Continued)

	80	82	83	84 Early Type	84 Late Type	85 Early Type	85 Late Type	86	87	89
Filter condenser No. 3 (electrolytic)			22538 **8 MF**			22538 **8 MF**	22538 **8 MF**	22538 **8 MF**		
By-pass condenser No. 1		21180 H-38		19160 H-30	19160 H-30	19160 H-30	19980 H-34	21170 H-37		21440 H-40
By-pass condenser No. 2		15262 H-20		19150 H-29	19150 H-29	19150 H-29	19990 H-35	23330 H-43		22050 H-41
By-pass condenser No. 3		21170 H-37		15262 H-20	15262 H-20	15262 H-20	15262 H-20	15262 H-20		21430 H-39
Tone control condenser		21250 B-9			16490 B-6	16490 B-6	20010 B-8	20010 B-8	21530 B-11	21530 B-11
Quality condenser										21450 B-10
Multiple type by-pass	20830 J-1, J-2		20830 J-1, J-2						22570 J-3	
SMALL FIXED CONDENSERS										
Oscillator grid condenser	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**		17470 **200 MMF**		21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**
I.F. stopping condenser	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	17440 **500 MMF**	17440 **500 MMF**	17440 **500 MMF**	31160 **200 MMF**			
Phone condenser				17440 **500 MMF**	17440 **500 MMF**	17440 **500 MMF**	17440 **500 MMF**			
A.F. grid condenser									22220 **100 MMF**	22220 **100 MMF**

VALUES OF PARTS IN MODELS 90, 92, 94, 96, 99, 228, and 567

	90 and 567	92 and 228	94	96-F, 1st and 2nd Type 96	96 3rd Type	99 1st and 2nd Types	99-F and 3rd Type 99
Volume control	20840 **6000**	23228 **.5 MEG**	22650 **3500**	23228 **.5 MEG**	23228 **.5 MEG**	23228 **.5 MEG**	23228 **.5 MEG**
Tonebeam adjustment potentiometer				22152 **40000**	22345 **8000**	22152 **40000**	22344 **14000**
RESISTORS							
Bleeder resistor No. 1		24340 **8000**	24470 **4000**	24340 **8000**	24340 **8000**	24340 **8000**	24340 **8000**
Bleeder resistor No. 2		24450 **6400**	24450 **6400**	24450 **6400**	18520 **70**	24340 **8000**	
Bleeder resistor No. 3		23780 **550**	18520 **70**	17380 **425**	18520 **70**	24340 **8000**	16320 **1050**
Bleeder resistor No. 4	20040 **100**	20040 **100**		20050 **355**	21420 **250**	21030 **2000**	20040 **100**
Bleeder resistor No. 5		17380 **425**		20040 **100**	25850 **2500**	23780 **550**	20050 **355**
Bleeder resistor No. 6		24340 **8000**		24340 **8000**		20040 **100**	24470 **4000**
Bleeder resistor No. 7		21030 **2000**		21030 **2000**		24340 **8000**	25950 **200**
Bleeder resistor No. 8					24450 **6400**	20120 **800**	25840 **300**
Bleeder resistor No. 9						24530 **2500**	
1st-detector bias resistor	21030 **2000**		21030 **2000**		16320 **1050**		
R.F. bias resistor			19820 **48**				
1st-A.F. bias resistor							24470 **4000**
A.F. bias resistor				24980 **300**	25840 **300**	21420 **250**	

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VALUES OF PARTS IN MODELS 90, 92, 94, 96, 99, 228, and 567 (Continued)

	90 and 567	92 and 228	94	96-F, 1st and 2nd Type 96	96 3rd Type	99 1st and 2nd Types	99-F and 3rd Type
Filter resistor		19180 **1100**	19180 **1100**				
Filament shunt resistor	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**
AUDIO TRANSFORMERS							
Audio input transformer						21670	21670
Primary resistance						**2000**	**2000**
Secondary resistance						**1800**	**1800**
Audio output transformer	19697	19697	21672	21672	21672	21693	21693
Primary resistance	**500**	**500**	**500**	**500**	**500**	**450**	**450**
Secondary resistance	**.25**	**.25**	**.25**	**.25**	**.25**	**.07**	**.07**
FILTER CHOKE UNIT				24930	24930	21680	21680
No. 1 choke, ohms				**480**	**480**	**480**	**480**
No. 2 choke, ohms				**90**	**90**	**90**	**90**
No. 3 choke, ohms						**1500**	**1500**
FIELD COIL	18870	18870	18870	18870	18870	21260	18870*
Field coil resistance	**2000**	**2000**	**2000**	**2000**	**2000**	**1100**	**2000**
CONDENSERS							
Filter condenser unit, paper and foil type			20370 F-1	15850† C-7	15850 C-7	21520 A-7	21520** A-7
Filter condenser No. 1 (electrolytic)	23146 **8 MF**	23146 **8 MF**	22538 **8 MF**	22538 **8 MF**	22538 **8 MF**		
Filter condenser No. 2 (electrolytic)	22538 **8 MF**	22538 **8 MF**					
Dry electrolytic condenser		22397†† **8 MF**					22646 **8 MF**
By-pass condenser No. 1				15262 H-20	22050 H-41	21440 H-40	21440 H-40
By-pass condenser No. 2				23330 H-43	23330 H-43	22050 H-41	22050 H-41
By-pass condenser No. 3				21170 H-37	21170 H-37	15262 H-20	15262 H-20
By-pass condenser No. 4						21430 H-39	15262 H-20
Tone control condenser		20010 B-8	20010 B-8	20010 B-8	20010 B-8	21530 B-11	21530 B-11
Quality condenser						21450 B-10	21450 B-10
Multiple type by-pass	20830 J-1, J-2	24250 J-5	24250 J-5				
SMALL FIXED CONDENSERS							
R.F.-1st-detector stopping condenser				21160 **200 MMF**	21160 **200 MMF**		
Oscillator grid condenser	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**
I.F. stopping condenser	21160 **200 MMF**	21160 **200 MMF**	21160 **200 MMF**				
Phone condenser		17440 **500 MMF**		17440 **500 MMF**	17440 **500 MMF**		
A.F. grid condenser						22220 **100 MMF**	22220 **100 MMF**
Control grid condenser					22220 **100 MMF**		
Grid circuit by-pass condenser	26490 **.07 MF**		26490 **.07 MF**				
Control plate by-pass condenser		23250 **.01 MF**		23250 **.01 MF**	23250 **.01 MF**		

*Field coil in 99-F is 21260, 1100 ohms.
**Filter condenser for 99-F is 25130, F-3.

†Filter condenser for 96-F is 25190, F-4.
††22397 is used only in 92-F.

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VALUES OF PARTS IN MODELS

188, 260, 469, 469-D, 469-Q, 480, 558, 558-D, 558-Q, 612, 627, and 812

	1st Type 188	2nd Type 188	1st and 2nd Type 260	3rd Type 260	1st Type 469	2nd Type 469	469-D 558-D	469-Q 558-Q	480	558	612	627	812
CONTROLS													
Volume control	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23482 **.5 Meg.**	23376 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**	23228 **.5 Meg**
Tonebeam adjustment			26540 **15000**	29020 **20000**	27190 **8000**	29020 **20000**			27190 **8000**		29020 **20000**		29020 **20000**
Silencing adjustment		28220 **20000**		28220 **20000**		28220 **20000**	28220 **20000**			28220 **20000**	28220 **20000**		28220 **20000**
RESISTORS													
Bleeder resistor No. 1		24450 **6400**					29220 **300**			24450 **6400**			
Bleeder resistor No. 2						24470 **4000**							
Bleeder resistor No. 3					20520 **670**				20380 **1500**				
Bleeder resistor No. 4	20380 **1500**				20380 **1500**						20380 **1500**		
R.F.-I.F. bias resistor		28950 **160**				20040 **100**	20050 **355**			20040 **100**	21420 **250**		25950 **200**
R.F.-I.F. bias resistor No. 1	20040 **100**		17380 **425**	20040 **100**	20040 **100**				25950 **200**			20040 **100**	
R.F.-I.F. bias resistor No. 2	21030 **2000**		25950 **200**	20040 **100**					23780 **550**			20380 **1500**	
2nd-I.F. screen resistor													28470 **3000**
1st-detector bias resistor	16320 **1050**	16320 **1050**	20120 **800**	25950 **200**	16320 **1050**	16320 **1050**			16320 **1050**	16320 **1050**	25950 **200**	16320 **1050**	25950 **200**
2nd-I.F. bias resistor			20040 **100**								20040 **100**		20040 **100**
2nd-I.F. bias resistor No. 1									16320 **1050**				
2nd-I.F. bias resistor No. 2									24470 **4000**				
Oscillator plate resistor						23780 **550**							
Oscillator plate compensating resistor									23780 **550**				
Control bias resistor No. 1		21030 **2000**		20380 **1500**		16320 **1050**	19820 **48**			21030 **2000**	16320 **1050**		16320 **1050**
Control bias resistor No. 2		25850 **2500**				24470 **4000**	19820 **48**			25850 **2500**	24470 **4000**		
A.F. bias resistor	25840 **300**				25840 **300**				25840 **300**				
1st-A.F. bias resistor			21030 **2000**										
Driver bias resistor											16320 **1050**		20380 **1500**
2nd-A.F. bias resistor		21420 **250**	21420 **250**	25950 **200**		25950 **200**	28950 **160**						
Screen resistor		24470 **4000**								24470 **4000**			
Filter resistor	19180 **1100**	27930 **500**								27930 **500**		27930 **500**	
Filament shunt resistor	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**			17077 **10**	17077 **10**	17077 **10**	17077 **10**	17077 **10**
Filament series resistor								30030 **.352**					

ATWATER KENT MFG. CO.

VALUES OF PARTS IN MODELS

188, 260, 469, 469-D, 469-Q, 480, 558, 558-D, 558-Q, 612, 627, and 812 (Continued)

	1st Type 188	2nd Type 188	1st and 2nd Type 260	3rd Type 260	1st Type 469	2nd Type 469	469-D 558-D	469-Q 558-Q	480	558	612	627	812
AUDIO TRANSFORMERS													
Audio input transformer		28490	26940	26940	26950	26940	29380	29390	27760	28290	28670		29960
Primary resistance		**1900**	**1900**	**1900**	**2600**	**1900**	**2000**	**650**	**2500**	**1300**	**450**		**230**
Secondary resistance		**1700**	**1700**	**1700**	**6000**	**1700**	**6000**	**350**	**6000**	**1400**	**400**		**130**
Audio output transformer	21672	21672	21693	21693	21693	21693	30020	23701	21693	19697	28630	19697	28630
Primary resistance	**500**	**500**	**450**	**450**	**450**	**450**	**100**	**500**	**450**	**500**	**200**	**500**	**200**
Secondary resistance	**.25**	**.25**	**.05**	**.05**	**.05**	**.05**	**.08**	**.04**	**.05**	**.25**	**.03**	**.25**	**.03**
FILTER CHOKES			26960	26960	26970	26970	29370		26970		29410		28640
Resistance of 1st choke			**160**	**160**	**550**	**550**	**30**		**550**		**160**		**70**
Resistance of 2nd choke			**1500**	**1500**							**550**		**1500**
SPEAKER FIELD COIL	18870	18870	21260	21260	21260	21260	19860		21260	18870	*	18870	*
Speaker field resistance	**2000**	**2000**	**1100**	**1100**	**1100**	**1100**	**1200**		**1100**	**2000**	*	**2000**	*
FILTER CONDENSERS													
Electrolytic filter No. 1	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**			22538 **.8 MF**	22538 **.8 MF**	23498 **.4 MF**	22538 **.8 MF**	23498 **.4 MF**
Electrolytic filter No. 2	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**			22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**	22538 **.8 MF**
Electrolytic filter No. 3											22538 **8 MF**		23481 **12 MF**
Electrolytic filter No. 4											22538 **8 MF**		22538 **8 MF**
Filter condenser unit (paper and foil type)	26620 **.7 MF**	26620 **.7 MF**			26620 **.7 MF**	26620 **.7 MF**			26620 **.7 MF**				
Dry electrolytic condenser							23981 **8 MF**	22472 **8 MF**			23479 **20 MF**		23479 **20 MF**
BY-PASS CONDENSERS													
Multiple type by-pass	24250 J-5	28140 J-7					28140 J-7			28140 J-7		24250 J-5	
By-pass No. 1			23330 H-43	23330 H-43	23330 H-43	23330 H-43		15262 H-20	15262 H-20		15262 H-20		15262 H-20
By-pass No. 2			15262 H-20	15262 H-20	15262 H-20	15262 H-20			23330 H-43		23330 H-43		23330 H-43
By-pass No. 3			22050 H-41	27140 H-47	23330 H-43	22050 H-41			27580 H-48		27140 H-47		27140 H-47
By-pass No. 4			27120 H-46	27120 H-46	21450 B-10	21450 B-10			15262 H-20		27120 H-46		27120 H-46
By-pass No. 5											15262** H-20		15262** H-20
TONE CONTROL CONDENSER	20010 B-8	28040 **.005 MF**	21530 B-11	21530 B-11	27390 B-14	21530 B-11	27390 B-14	21530 B-11	27390 B-14	28040 **.005 MF**	30270 B-16	28040 **.005 MF**	30270 B-16
SMALL FIXED CONDENSERS													
Antenna condenser									27130 **500 MMF**				
R.F. bias by-pass										26660 **.1 MF**			
R.F. grid filter condenser		26820 **.05 MF**					26820 **.05 MF**	26820 **.05 MF**	27630 **.01 MF**	26820 **.05 MF**		26820 **.05 MF**	
R.F.-I.F. bias by-pass		26660 **.1 MF**										26660 **.1 MF**	

*The field coil of the 4-prong speaker is No. 18870, 2000 ohms. The field coil of the 5-prong speaker is No. 28550, 6500 ohms.

**By-pass No. 5 in late models is No. 29560, H-49.

ATWATER KENT MFG. CO.

VALUES OF PARTS IN MODELS

188, 260, 469, 469-D, 469-Q, 480, 558, 558-D, 558-Q, 612, 627, and 812 (Continued)

	1st Type 188	2nd Type 188	1st and 2nd Type 260	3rd Type 260	1st Type 469	2nd Type 469	469-D 558-D	469-Q 558-Q	480	558	612	627	812
SMALL FIXED CONDENSERS (Continued)													
1st-detector grid filter or screen by-pass				26660 .1 MF		26820 .05 MF			27630 .01 MF				
Oscillator-1st-detector coupling condenser									26670 125 MMF				
Oscillator grid condenser	26670 125 MMF	26670 125 MMF			26670 125 MMF					26670 125 MMF		26670 125 MMF	
Tracking condenser	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF		26690 1450 MMF	26690 1450 MMF	26690 1450 MMF	26690 1450 MMF
Tracking condenser No. 1									23411				
Tracking condenser No. 2									25650 300 MMF				
Oscillator plate filter condenser	26820 .05 MF				26820 .05 MF		26670 125 MMF						
2nd-detector plate-to grid condenser			26820 .05 MF										
2nd-detector-1st-A.F.-coupling condenser		23250 .01 MF	23250 .01 MF	23250 .01 MF		23250 .01 MF	23250 .01 MF	23250 .01 MF		27630 .01 MF	23250 .01 MF	27630 .01 MF	23250 .01 MF
Phone condenser	17440 500 MMF	17440 500 MMF	26670 125 MMF	17440 500 MMF	17440 500 MMF	17440 500 MMF	22220 100 MMF	21160 200 MMF	17440 500 MMF	17440 500 MMF	30260 45 MMF	17440 500 MMF	30260 45 MMF
Diode plate condenser		30240 250 MMF		30240 250 MMF		30240 250 MMF	30240 250 MMF			30240 250 MMF	30240 250 MMF	30240 250 MMF	30240 250 MMF
Control coupling condenser					16360 11 MMF			30240 250 MMF	27650 8 MMF				
Control plate by-pass or control bias by-pass	23250 .01 MF	26550 .5 MF			26820 .05 MF			26660 .1 MF	27630 .01 MF	26550 .5 MF		26550 .5 MF	
2nd-detector bias by-pass			26550 .5 MF										
Screen by-pass or 1st-A.F. screen by-pass	26660 .1 MF						26660 .1 MF	26660 .1 MF		26660 .1 MF			
Compensating or stopping condenser		16360 11 MMF							27650 8 MMF	16360 11 MMF		16360 11 MMF	
Stopping condenser (1 green dot, 2 black)									23282 50 MMF				
Quality condenser			21450 B-10	21450 B-10			26820 .05 MF	21450 B-10			30250 .025 MF		30250 .025 MF
110-volt line condenser							29550 2.2 MF						
R.F. or I.F. grid filter condenser, 1st-A.F.—driver coupling condenser, or control filter condenser								27630 .01 MF					
R.F. line by-pass							26660 .1 MF						
2nd-I.F. screen by-pass								29030 .02 MF					
1st-A.F. plate by-pass								22220 100 MMF					

In late type 612 and 812, the audio coupling unit between the 1st-A. F. and driver tubes consists of an audio choke (3000 ohms) in the plate circuit of the 1st-A. F. tube, a coupling condenser (.05 MF) and a driver grid leak (¼ MEG). These parts are all sealed inside the audio transformer unit together with the audio input transformer. In early type 612 and 812, an audio transformer is used to couple the 1st-A. F. and driver tubes. The primary resistance is 2000 ohms and the secondary is 1800 ohms.

ATWATER KENT MFG. CO.

RESISTANCE OF FIELD COILS IN ELECTRO-DYNAMIC SPEAKERS

Model Number of Set	Speaker Type Number	Speaker Part Number	Part No. of Field Coil	Resistance of Field Coil (Ohms)
43	F	9890	14361	2500
46, 47	F-2 F-2A F-2C	14200 14760 14300	15629	1700
53 (Early type)	F-3	13990	14361 (short)	2500
53 (Late type)	F-3	14190	15631 (long)	1700
55	F-4 F-4A	14380 14770	15635 15635	1100 1100
55-C	F-4C	14410	15635	1100
55-F	F-2 F-2A	14200 14760	15629 15629	1700 1700
55-F-C	F-2C	14300	15629	1700
60	F-4 F-4A	14380 14770	15635 15635	1100 1100
60-C	F-4C	14410	15635	1100
60-C, 3rd type	F-4C	14410	17551	1100
61	F-6 F-6A	14480 14780	15854 15854	700 700
61-C	F-6C	14490	15854	700
66 (made in console type only)	F-6C	14490	15854	700
67	F-7 F-7A	14510 14790	15863 15863	8 8
67-C	F-7C	14520	15863	8
70 with L chassis	N	16400	16410	1100
70 with F chassis	N	16400	16410	1100
70 with D chassis	N-3	16900	17020	650
70 with Q chassis	J*	15920	———	———
72 with H chassis	N	16400	16410	1100
74 with L chassis	N	16400	16410	1100
74 with F chassis	N	16400	16410	1100
74 with D chassis	N-3	16900	17020	650
75 with P chassis	N	16400	16410	1100
76 with L chassis	N	16400	16410	1100
76 with F chassis	N	16400	16410	1100
76 with D chassis	N-3	16900	17020	650
76 with Q chassis	J*	15920	———	———
80, 80-F	S	17300	18870	2000
81, 81-B, 81-C	—	22600	22440	3
82, 82-F	S	17300	18870	2000
82-D**	—	18600	19860	1200
82-Q***	—	18400	———	———
83, 83-F (early type)	—	18100	18870	2000
83, 83-F (late type)	—	24600	18870	2000
84, 84-F	S	17300	18870	2000
84-D**	—	18600	19860	1200
84-Q***	—	18400	———	———
85, 85-F (early type)	—	18100	18870	2000
85, 85-F (late type)	—	24600	18870	2000
85-Q***	—	19900	———	———
86, 86-F	—	24600	18870	2000
87	—	19800	21260	1100
87-D	—	25000	19860	1200
89, 89-F, 89-P	—	19800	21260	1100
90, 90-F	S	17300	18870	2000
91, 91-B, 91-C	—	27900	22440	3
92, 92-F	S	17300	18870	2000
94, 94-F	—	26300	18870	2000
96, 96-F	—	26300	18870	2000
99 below 4884901	—	26400	21260	1100
99 above 4884901	—	26400	18870	2000
99-F	—	26400	21260	1100
99-P	—	26400	18870	2000
188, 188-F	368	28700	18870	2000
228, 228-F	S	17300	18870	2000
228-D**	—	18600	19860	1200
228-Q***	—	18400	———	———
260, 260-F	380	28800	21260	1100
469, 469-F	380	28800	21260	1100
469-D	—	31600	19860	1200
469-Q***	—	31500	———	———
480, 480-F	380	28800	21260	1100
558, 558-F	S	17300	18870	2000
558-D	—	31800	19860	1200
558-Q***	—	31700	———	———
567, 567-F	S	17300	18870	2000
612	324† 326††	30200 30300	18870 28550	2000 6500
627, 627-F	S	17300	18870	2000
812	336 338††	30400 30600	18870 28550	2000 6500

*The J speaker is an inductor-dynamic with two coils connected in series; resistance of each coil is about 275 ohms. Only three prongs on the four-prong plug are used. See diagram on page 241.

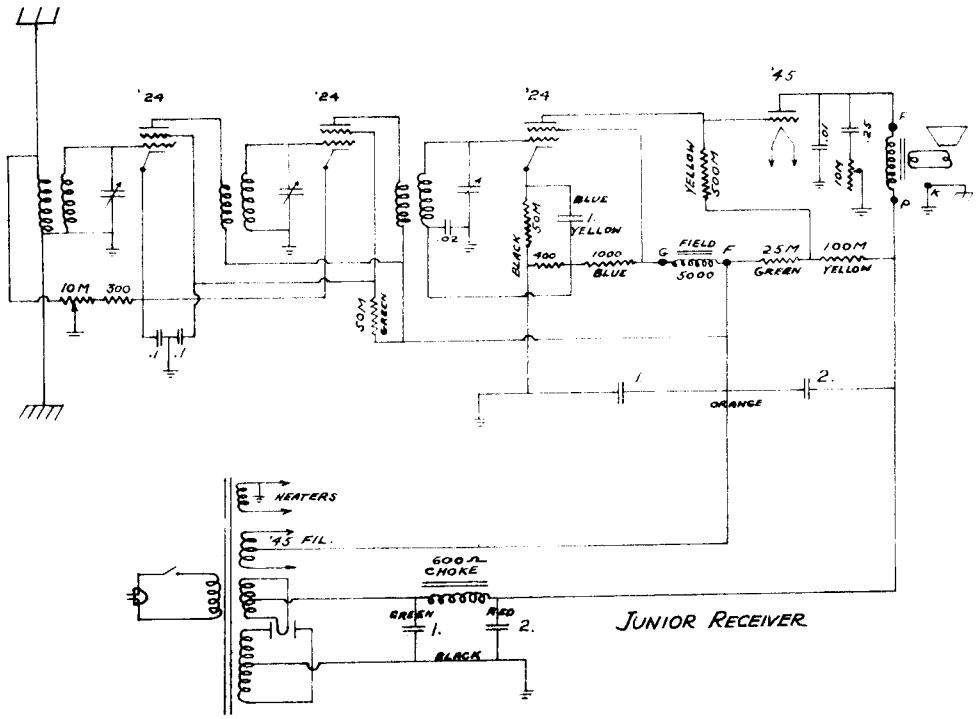
**The speakers in Models 82-D, 84-D and 228-D have a protective lamp mounted on the speaker housing. See diagram on page 307.

***The speakers in Models 82-Q, 84-Q, 85-Q, 228-Q, 469-Q and 558-Q are permanent-magnet electro-dynamics without field coils. In the 469-Q and 558-Q only three prongs on the four-prong plug are used.

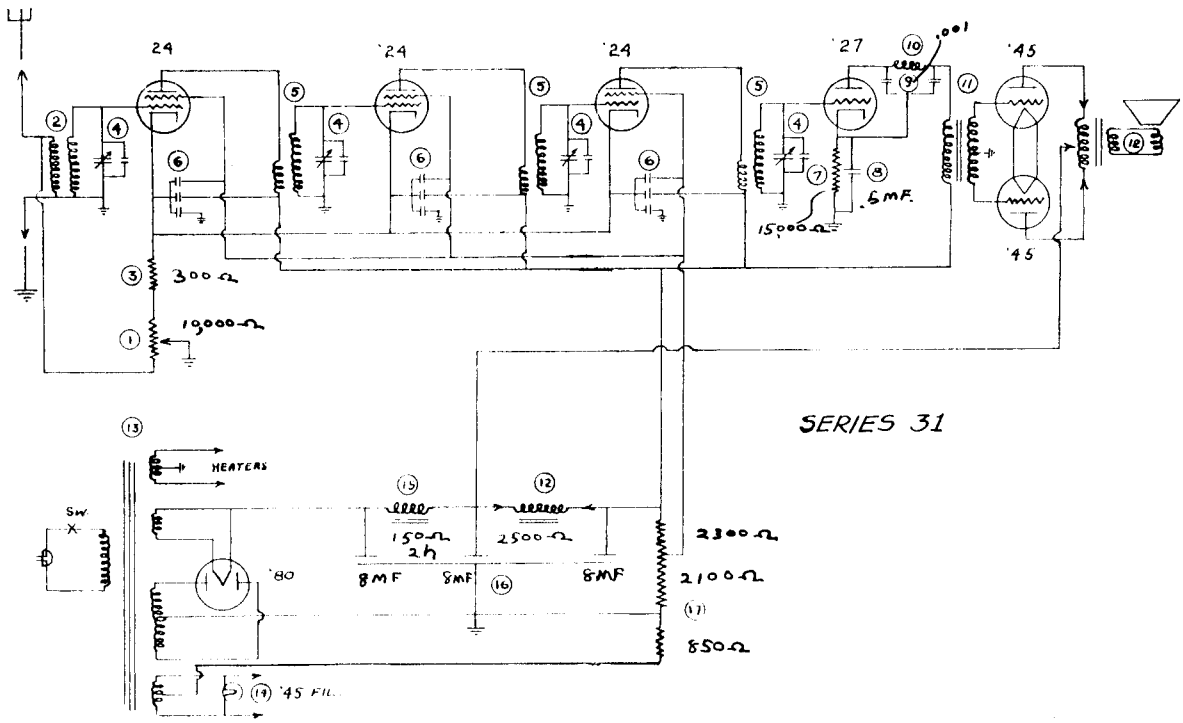
†Type 324 speaker has a hum-bucking coil connected in series with the voice coil.

††In type 326 and 338 speakers, only four prongs on the five-prong plug are used

AUDIOLA RADIO CO.

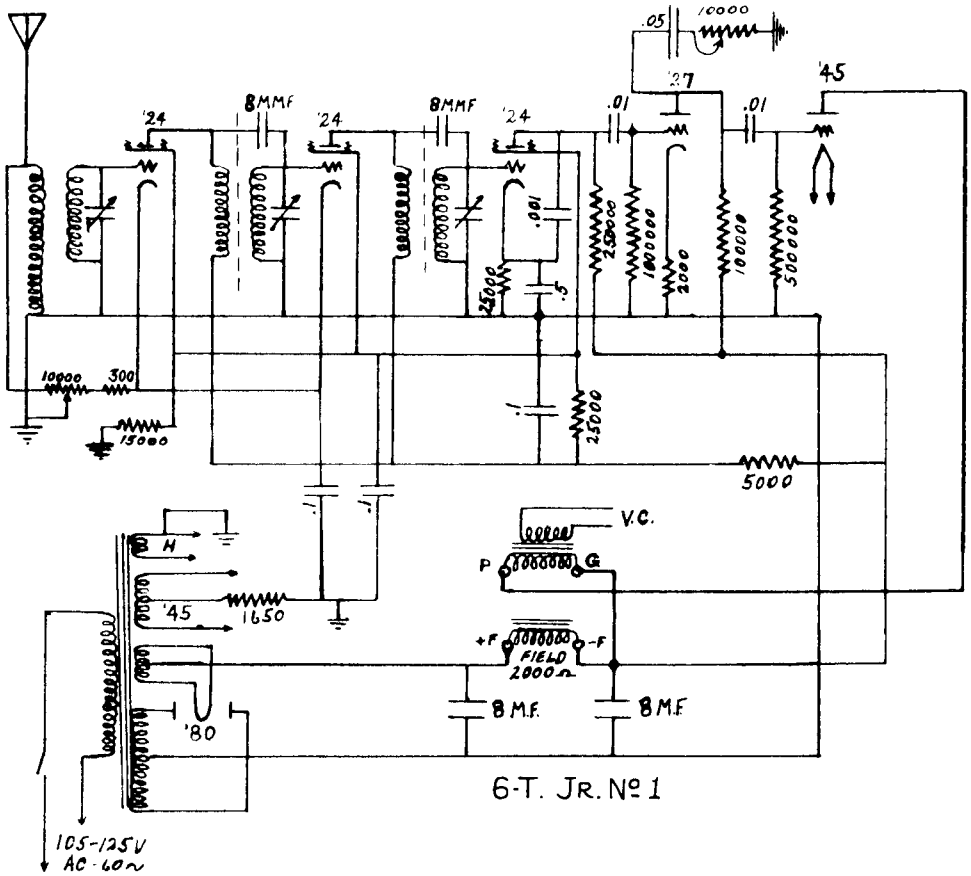


JUNIOR RECEIVER

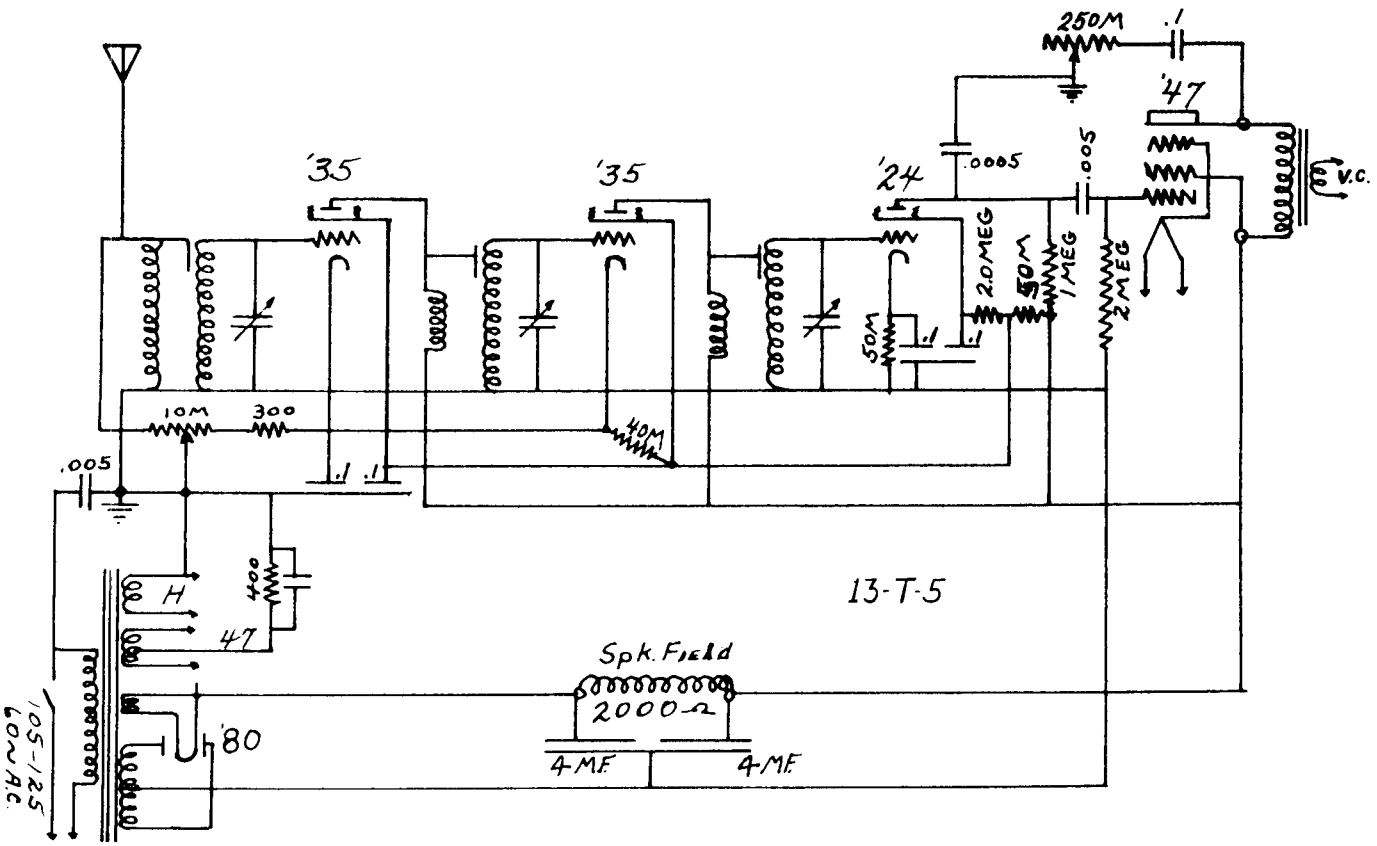


SERIES 31

AUDIOLA RADIO CO.



6-T. JR. Nº 1



13-T-5

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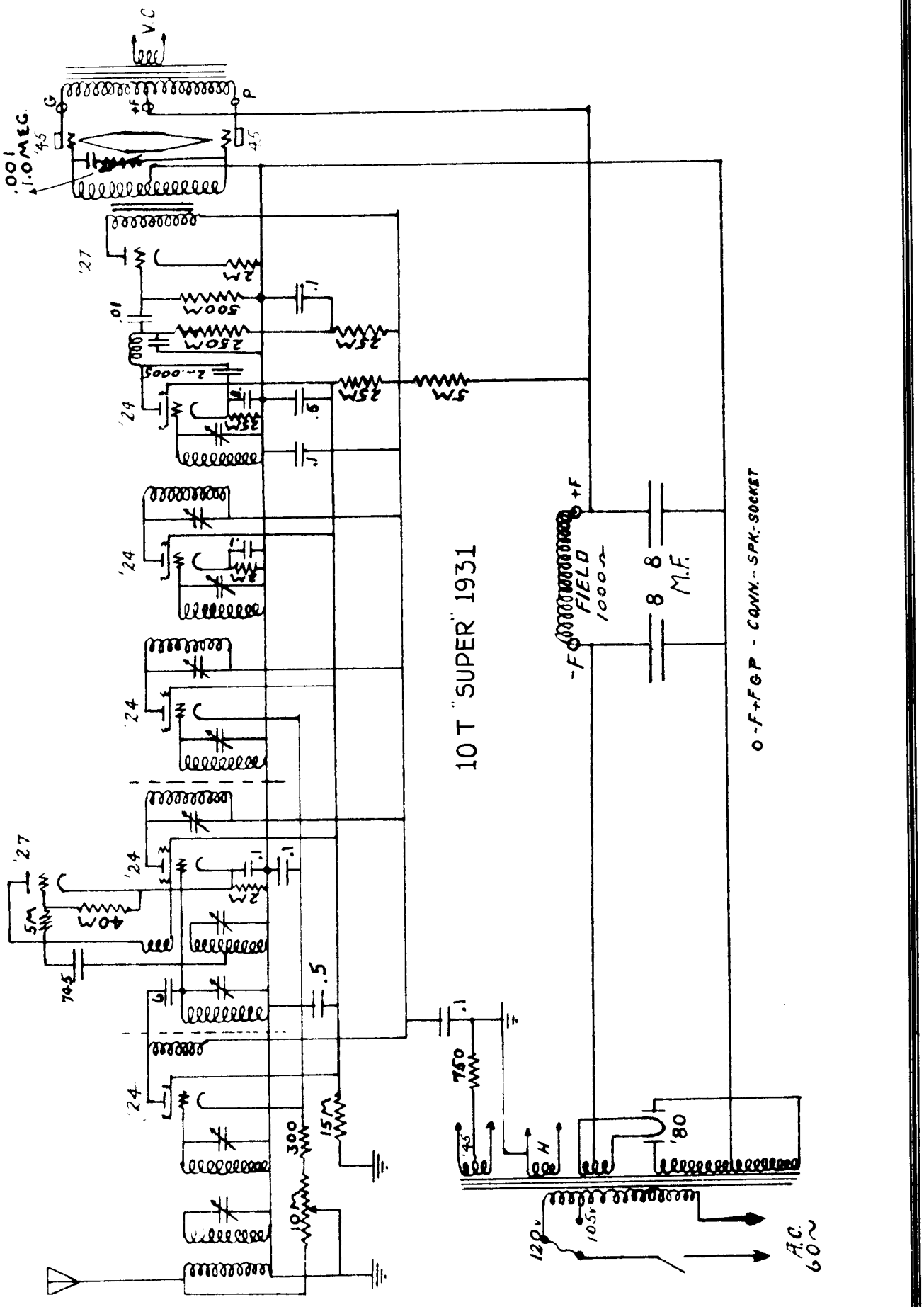

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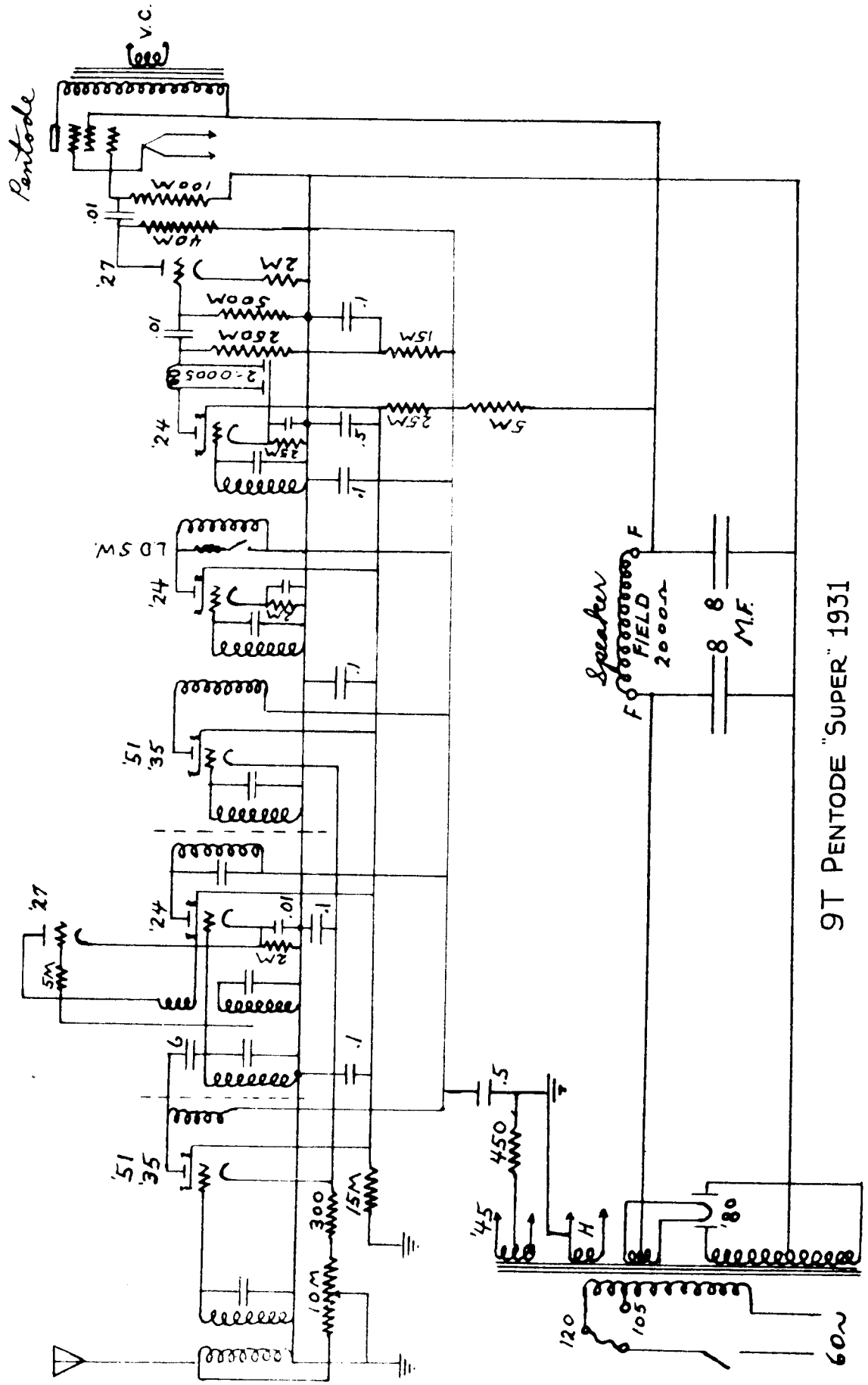

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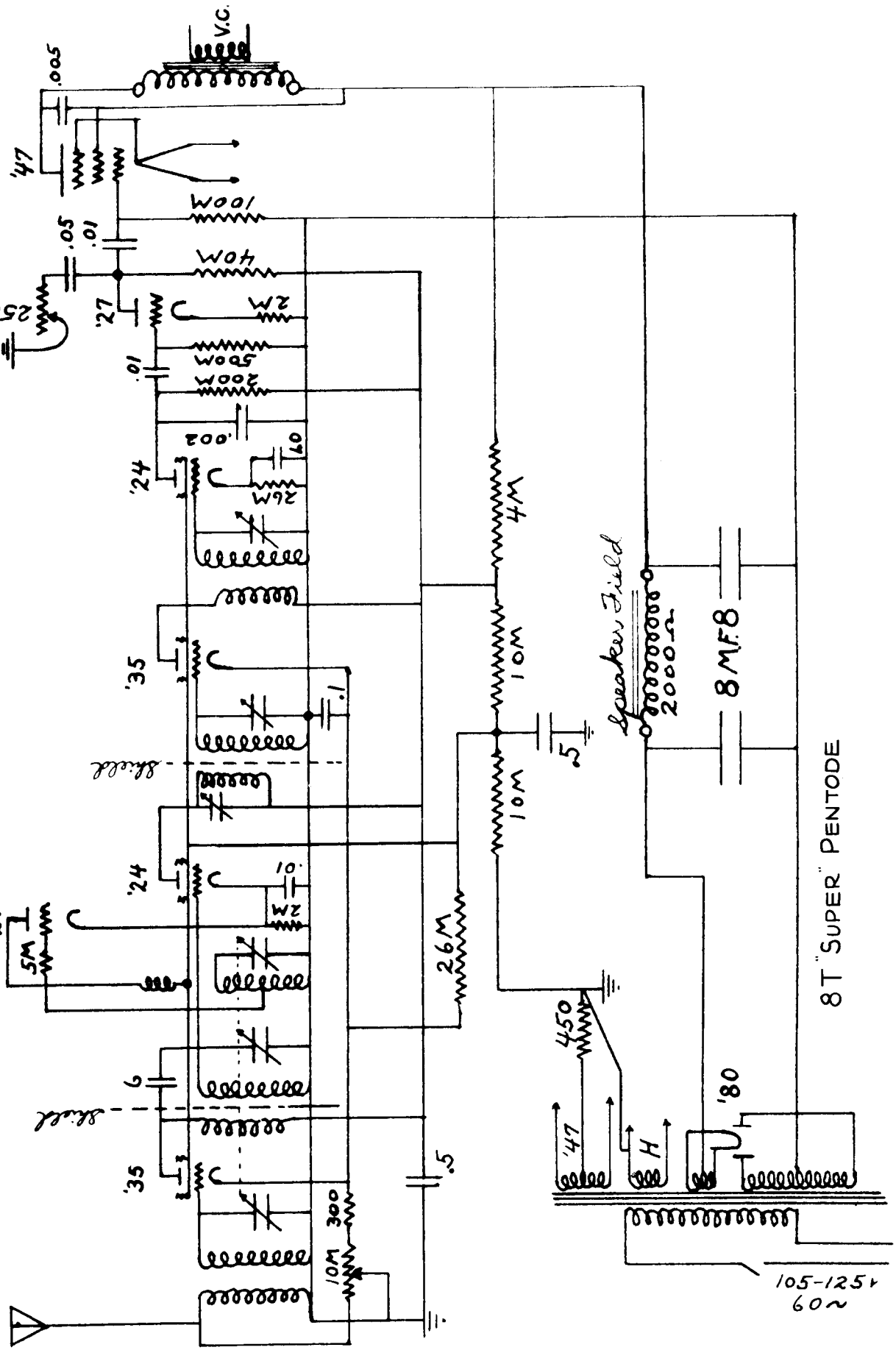

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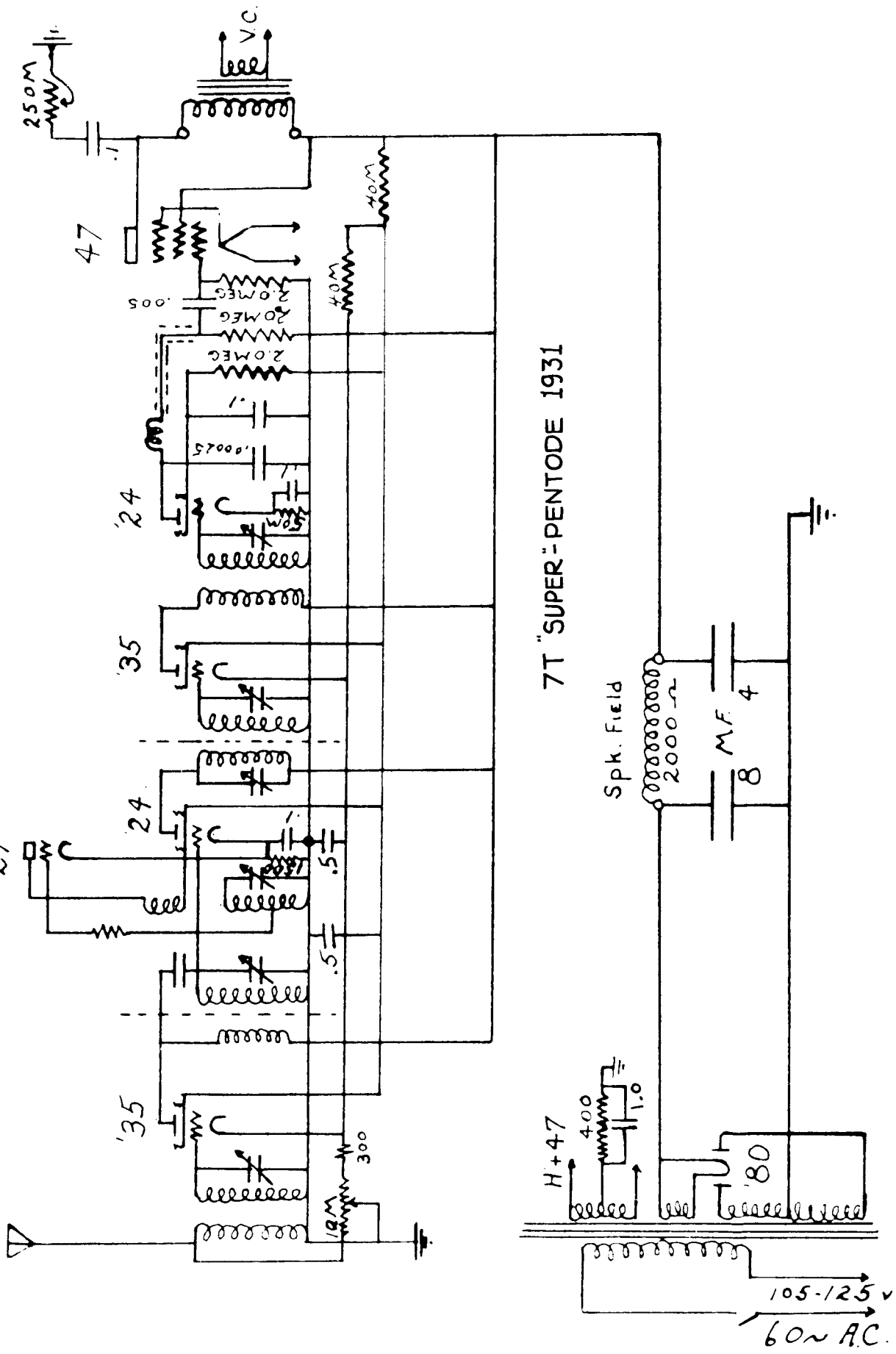

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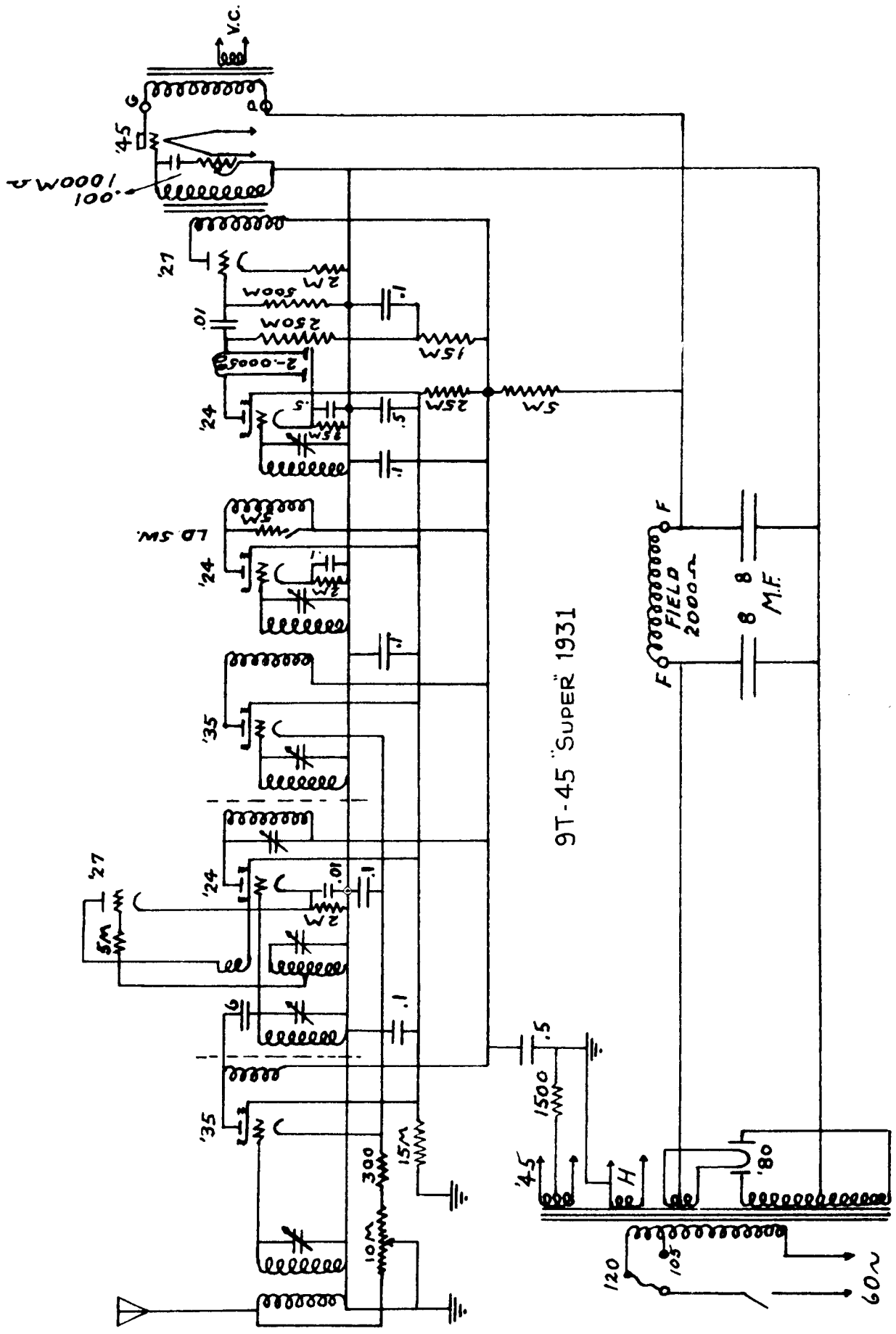

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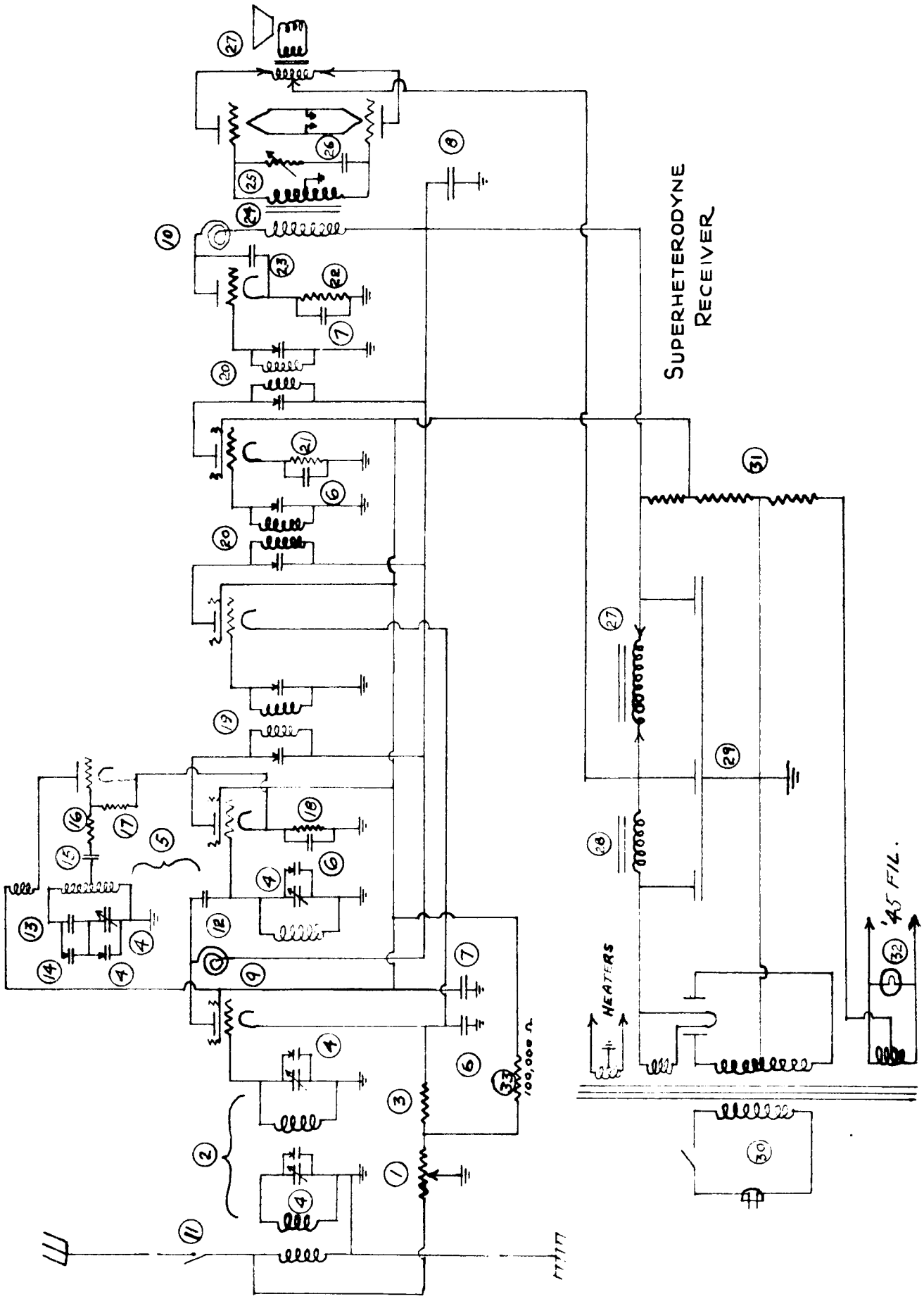

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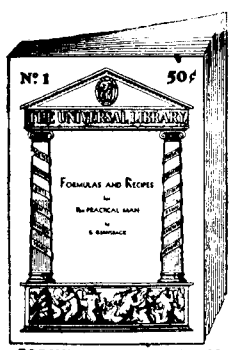

FORMULAS AND RECIPES For the PRACTICAL MAN

CONTENTS

1. Adhesives: Glues, Cements, Gums, Mucilages, Lubricants —2. Cleansing: Stain Removers, Bleaches, Cleaning Fluids —3. Metal Craft: Coloring, Oxydizing, Plating, Repairing, Welding, Polishes, Alloys, Solders—4. Paints: Colors, Stains, Varnishes, Enamels, Luminous Paint, Washable Paint, Paint-Removing, Waterproofing, Fireproofing—5. Glass-Working: Cutting, Drilling, Boring, Bending, Blowing, Etching, Engraving, Frosting, Silvering, etc.—6. Wood-Craft: Fillers, Fireproofing, Acid-proofing, Waterproofing, Furniture Polishes—7. Inks: Eradicators, Ink Stain Removers: Sympathetic, Invisible, Hectograph—8. Photography: Developers, Emulsions, Fixers, Sensitizing, Toning, Printing, Photographic Paper, Blueprint Paper—9. Antitodes for Poisons, Remedies for Burns and Scalds, Disinfectants, First-Aid in Accidents, Home Remedies — 10. Preparation, Manipulation, Handling, Mixing, Emulsifying; Use of Hydrometer, Use of Thermometer; Tables of Weights and Measures, Decimal System, Useful Tables.

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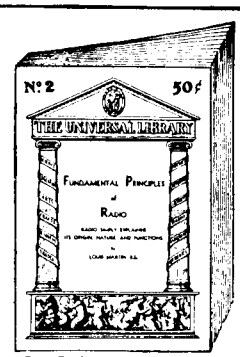

FUNDAMENTAL PRINCIPLES OF RADIO
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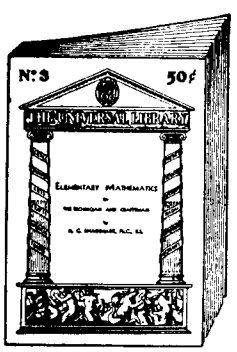
That is the object of this book. Mr. Shainmark, who is an instructor in practical sciences, knows how to explain things in plain English, and his one purpose in this book is to make clear, in terms of daily application, the important basic principles of mathematics which everyone ought to know, whether he be a working man, a merchant, or a professional man.

Special attention is devoted in this book to showing the man who is employed in industry or in technical work, how to apply the working rules of mathematics in his profession or business.



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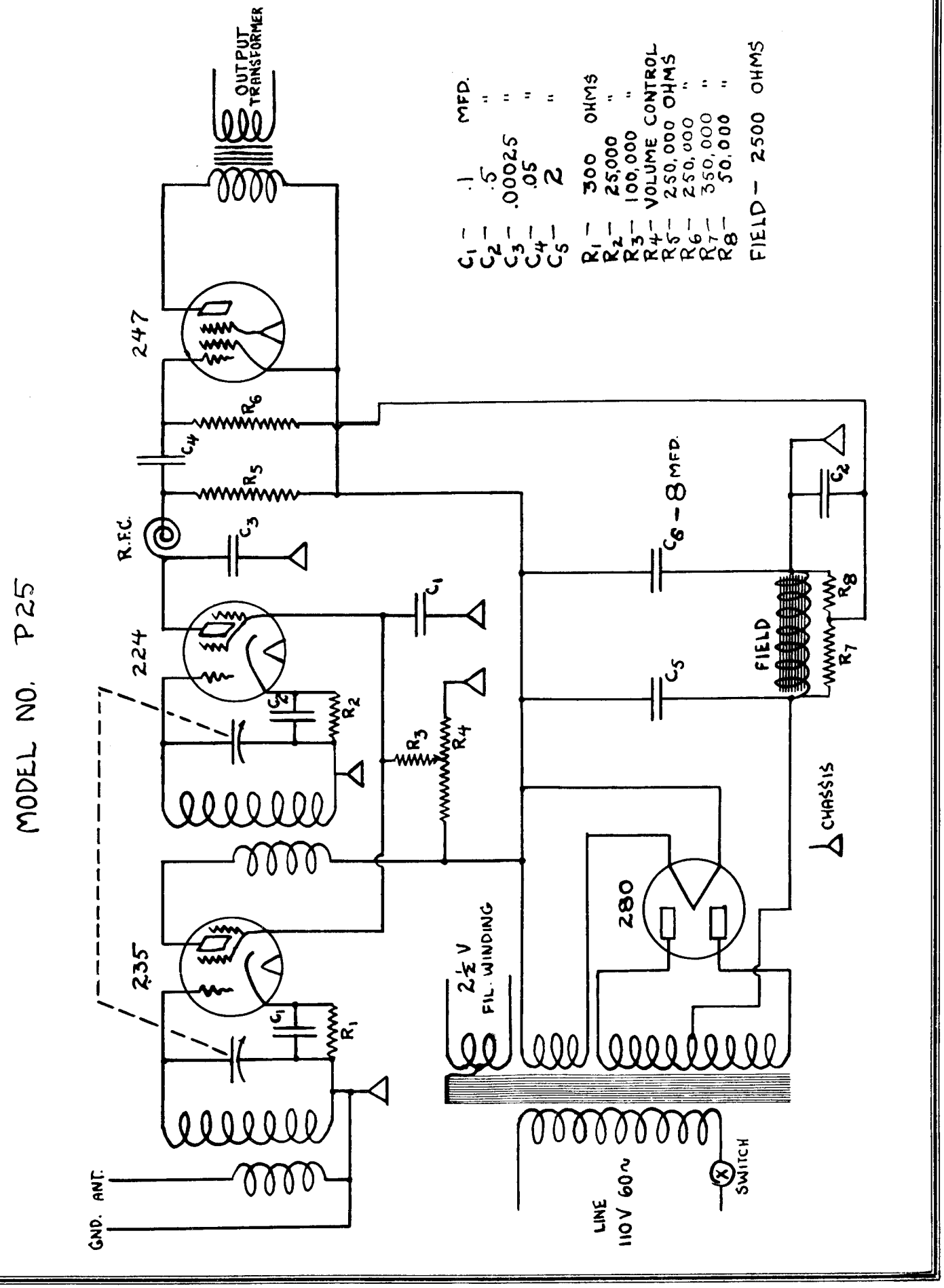

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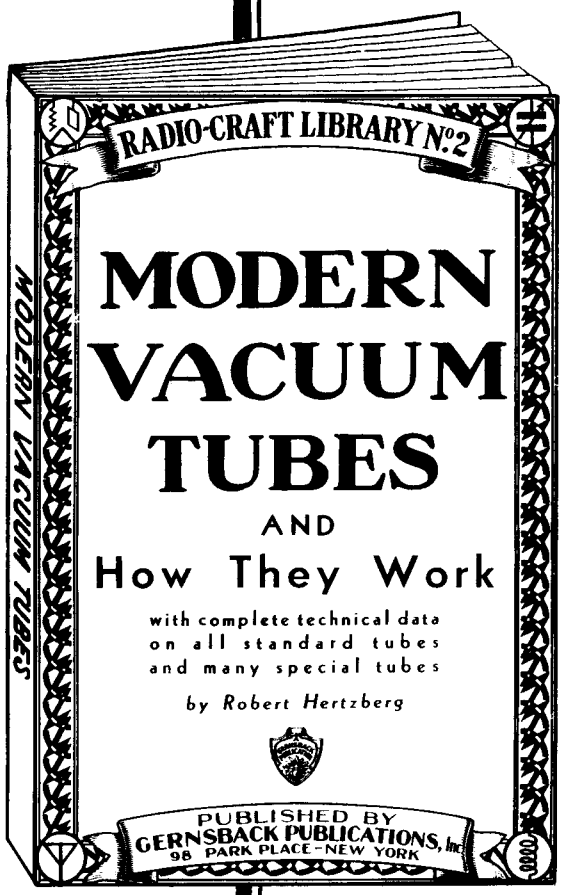

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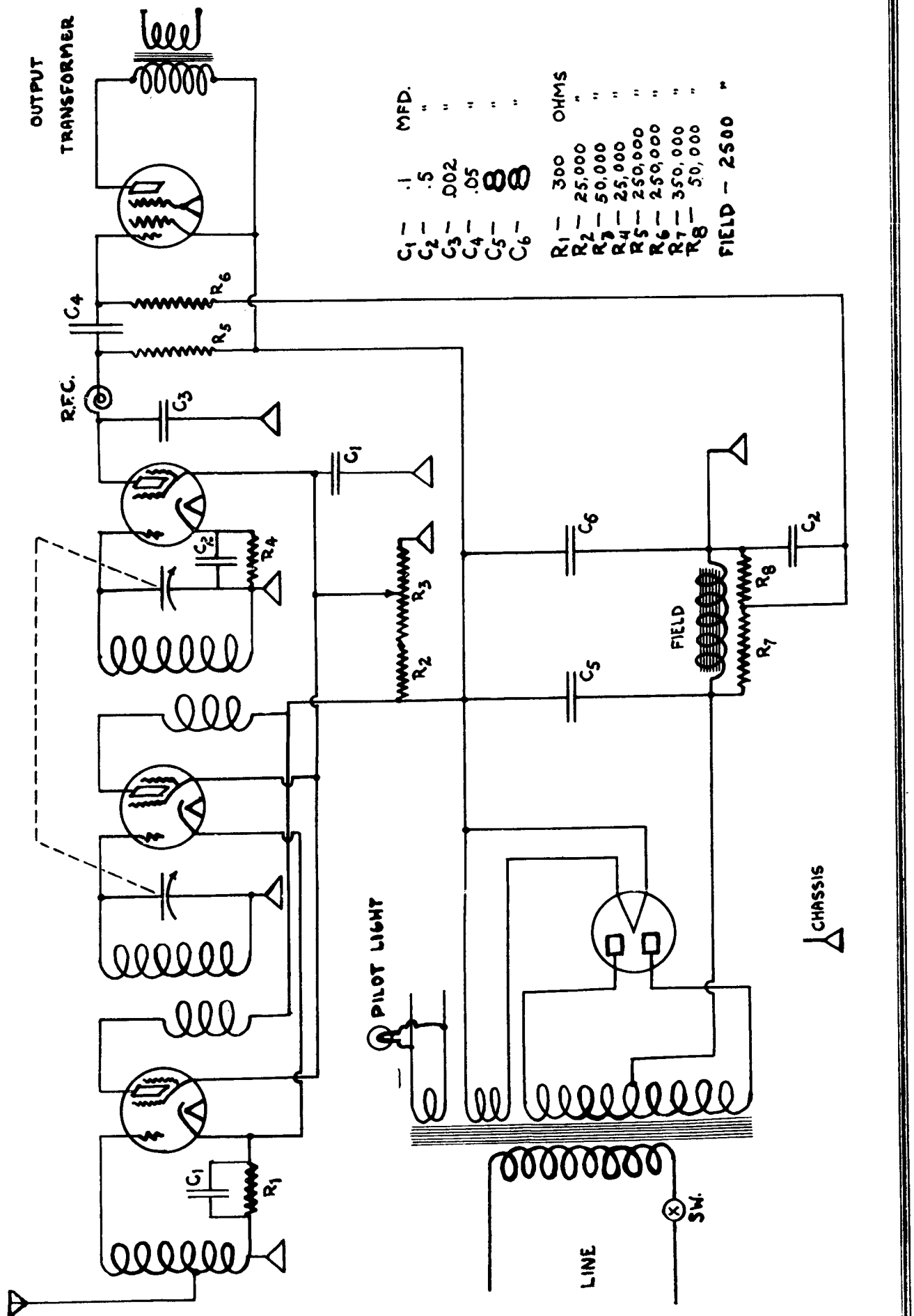
MODELS NO. P35, 34



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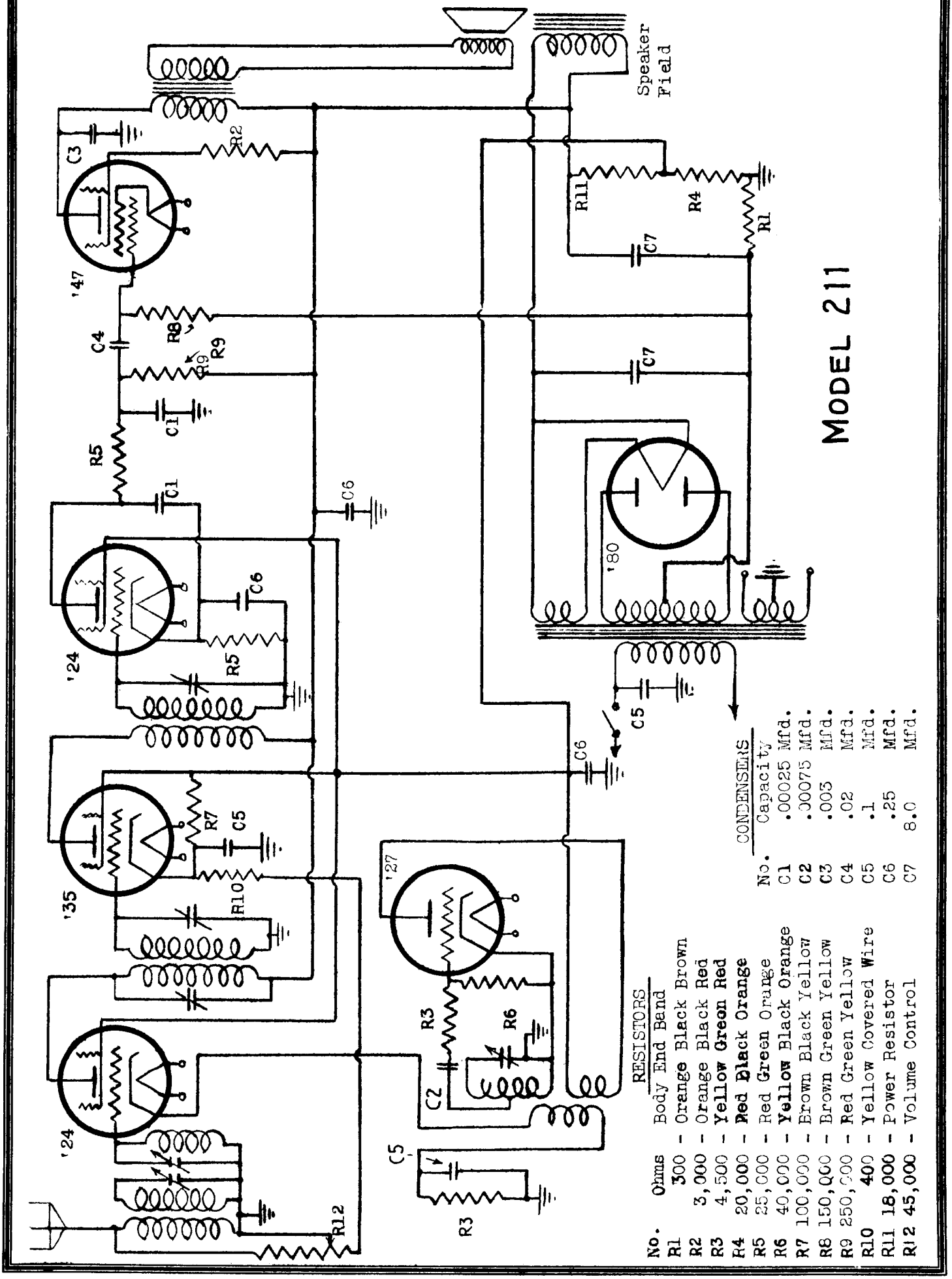


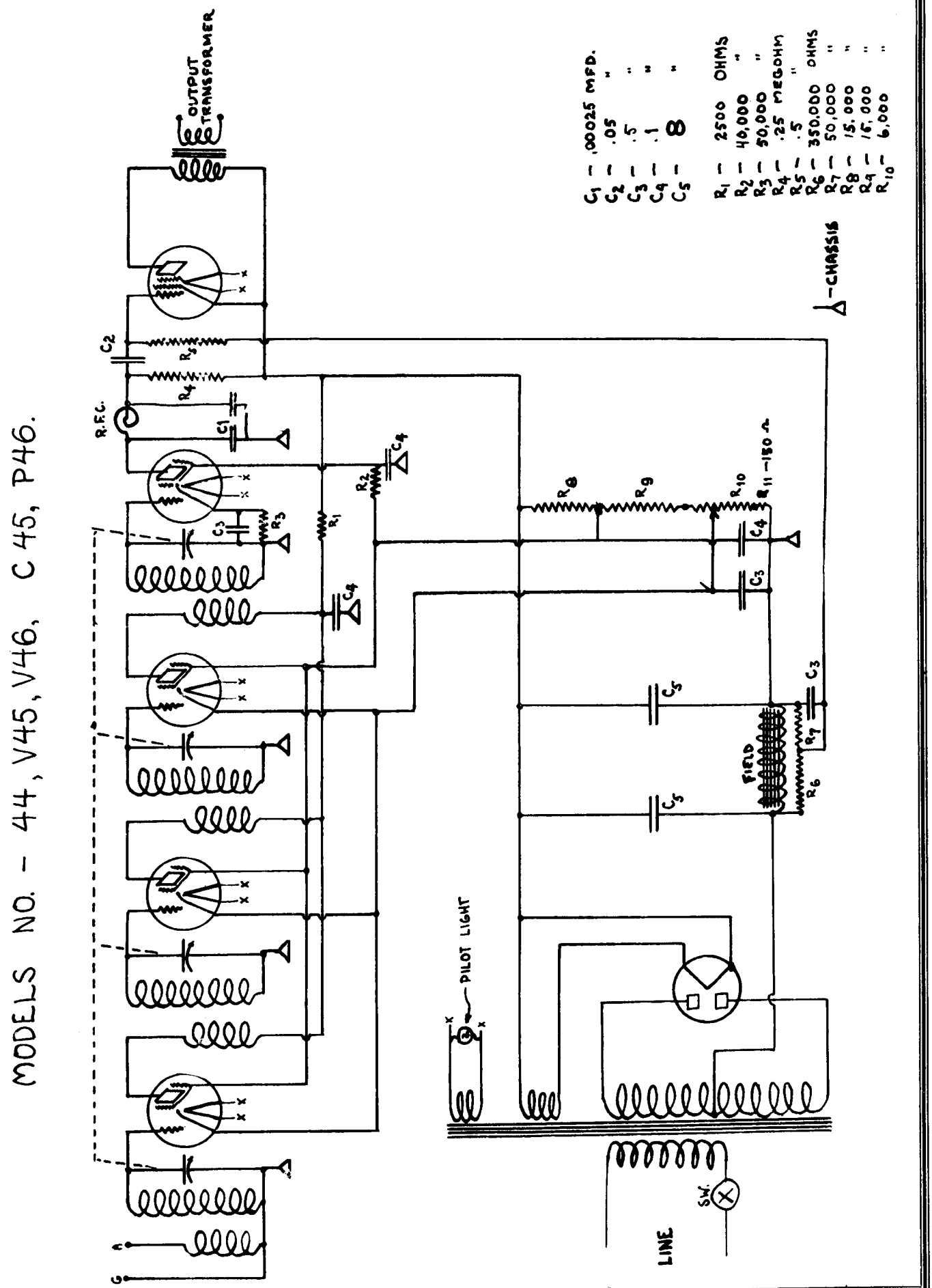
RESISTORS

No.	Ohms	Body End Band
R1	300	- Orange Black Brown
R2	3,000	- Orange Black Red
R3	4,500	- Yellow Green Red
R4	20,000	- Red Black Orange
R5	25,000	- Red Green Orange
R6	40,000	- Yellow Black Orange
R7	100,000	- Brown Black Yellow
R8	150,000	- Brown Green Yellow
R9	250,000	- Red Green Yellow
R10	400	- Yellow Covered Wire
R11	18,000	- Power Resistor
R12	45,000	- Volume Control

CONDENSERS

No.	Capacity
C1	.00025 Mfd.
C2	.00075 Mfd.
C3	.005 Mfd.
C4	.02 Mfd.
C5	.1 Mfd.
C6	.25 Mfd.
C7	8.0 Mfd.

AUTOMATIC RADIO COMPANY



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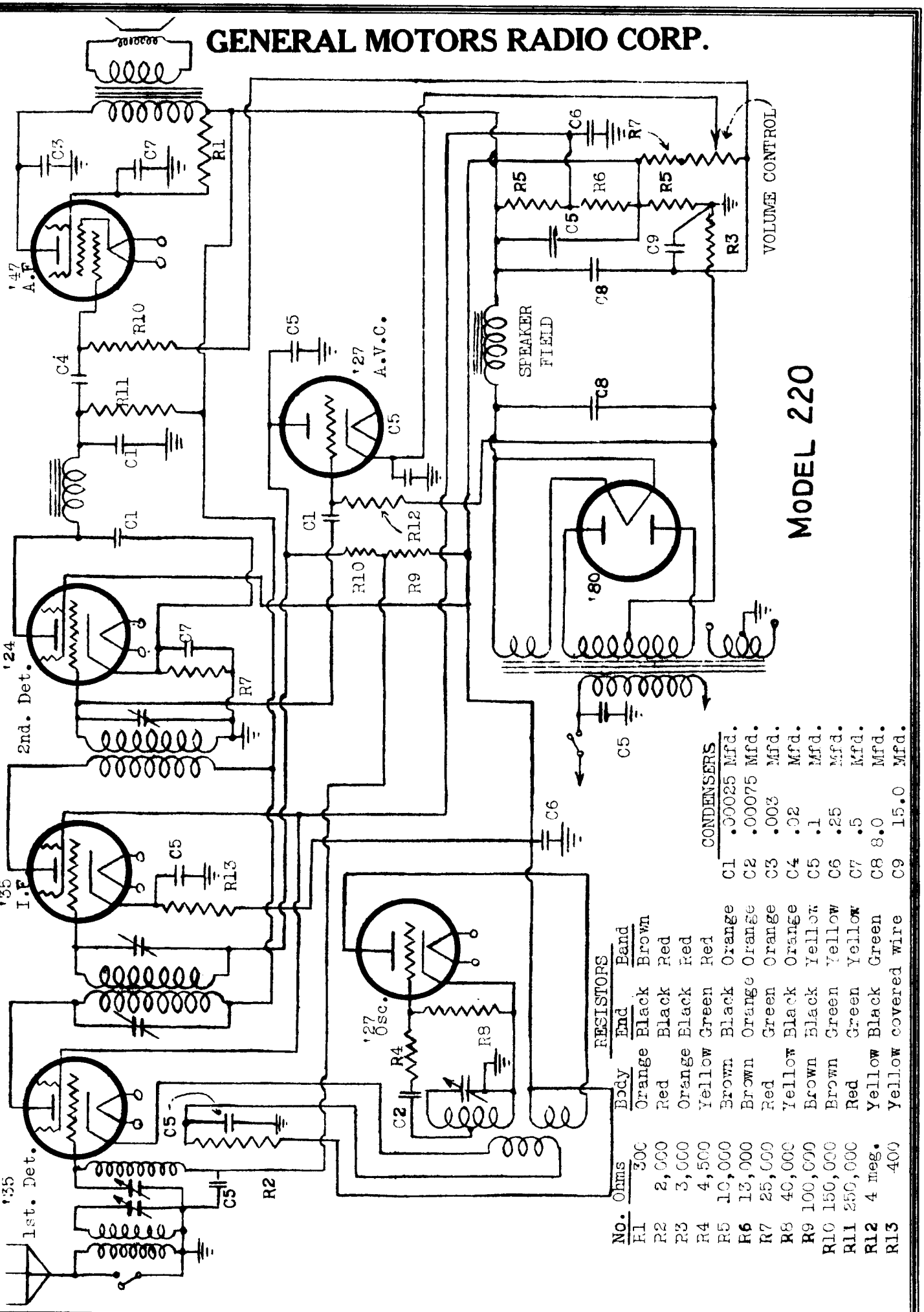

RESISTORS			
No.	Ohms	Body	End	Band
R1	300	Orange	Black	Brown
R2	2,000	Red	Black	Red
R3	3,000	Orange	Black	Red
R4	4,500	Yellow	Green	Red
R5	10,000	Brown	Black	Orange
R6	13,000	Brown	Orange	Orange
R7	25,000	Red	Green	Orange
R8	40,000	Yellow	Black	Orange
R9	100,000	Brown	Black	Yellow
R10	150,000	Brown	Green	Yellow
R11	250,000	Red	Green	Yellow
R12	4 meg.	Yellow	Black	Green
R13	400	Yellow	covered wire	

CONDENSERS		
C1	.00025	Mfd.
C2	.00075	Mfd.
C3	.003	Mfd.
C4	.02	Mfd.
C5	.1	Mfd.
C6	.25	Mfd.
C7	.5	Mfd.
C8	8.0	Mfd.
C9	15.0	Mfd.

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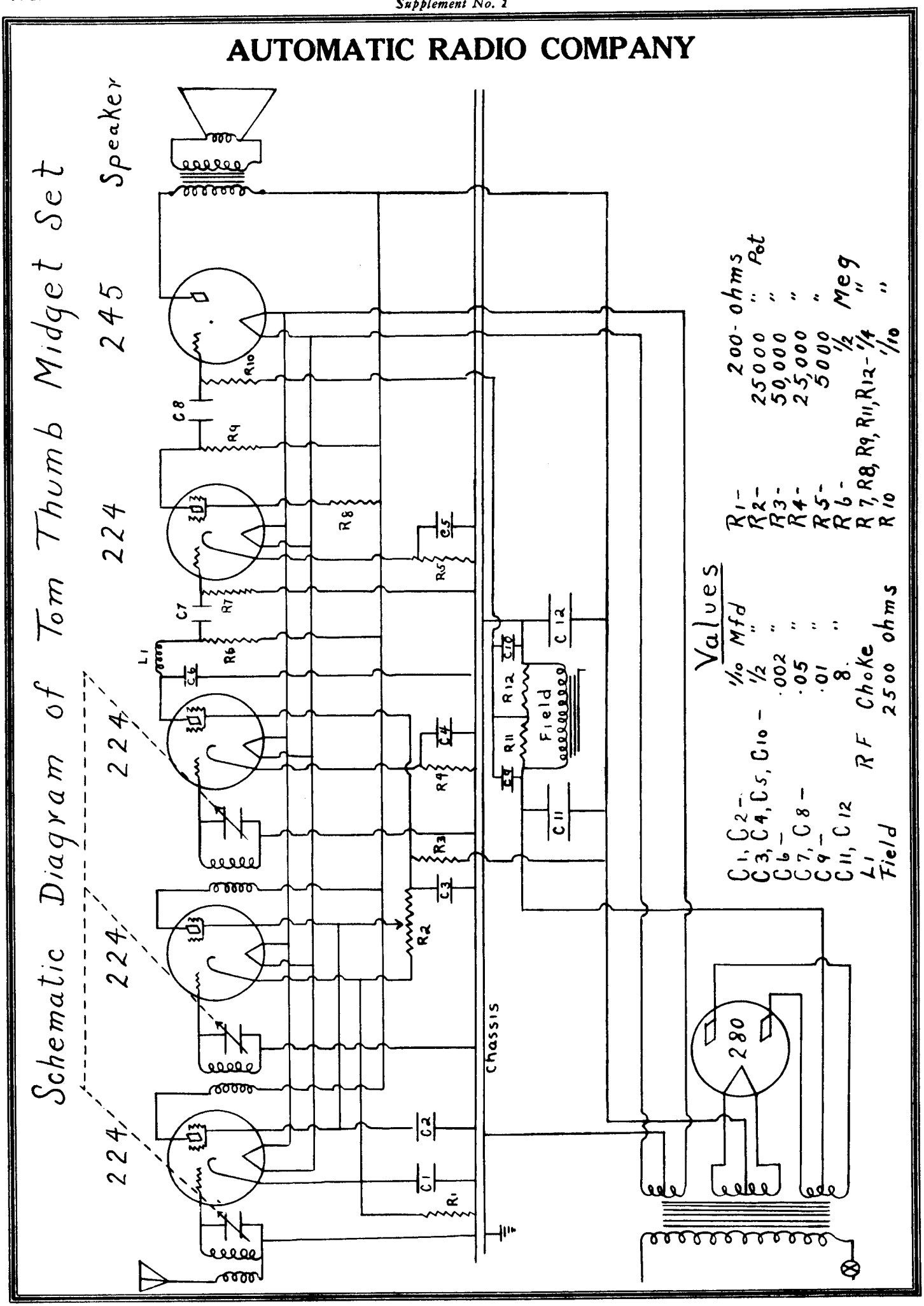
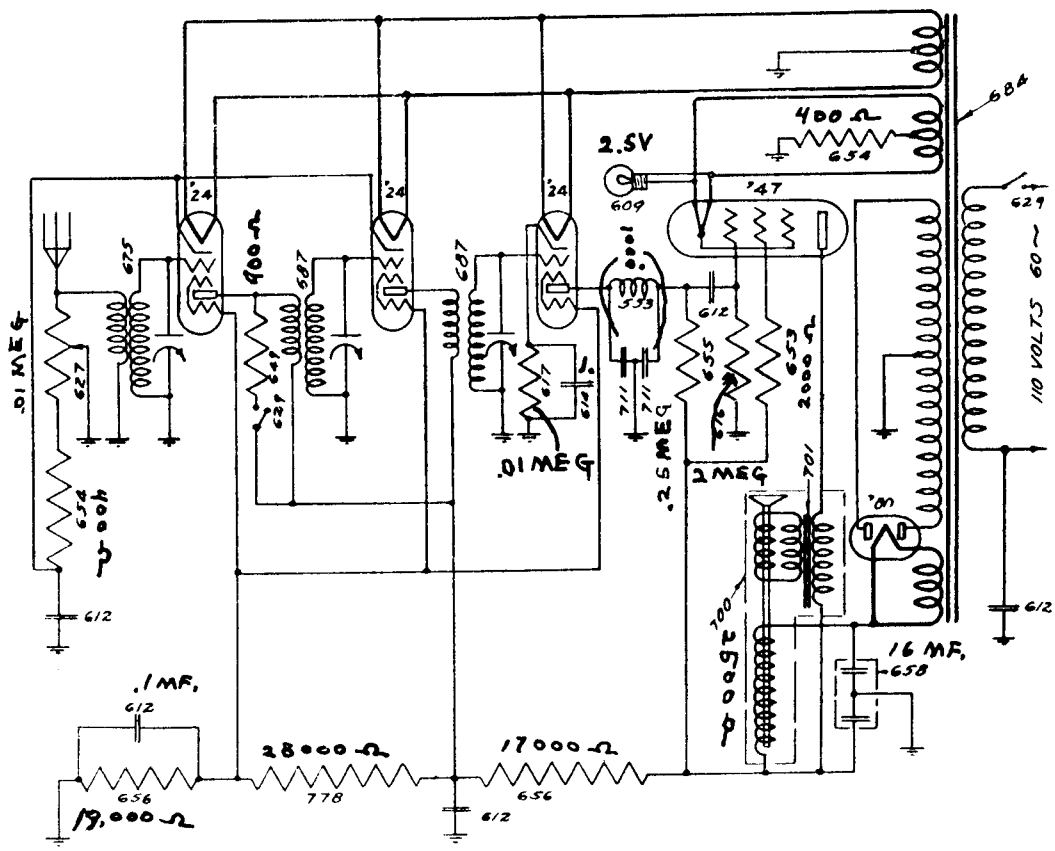


AZTEC RADIO CO.



D. C. Voltages

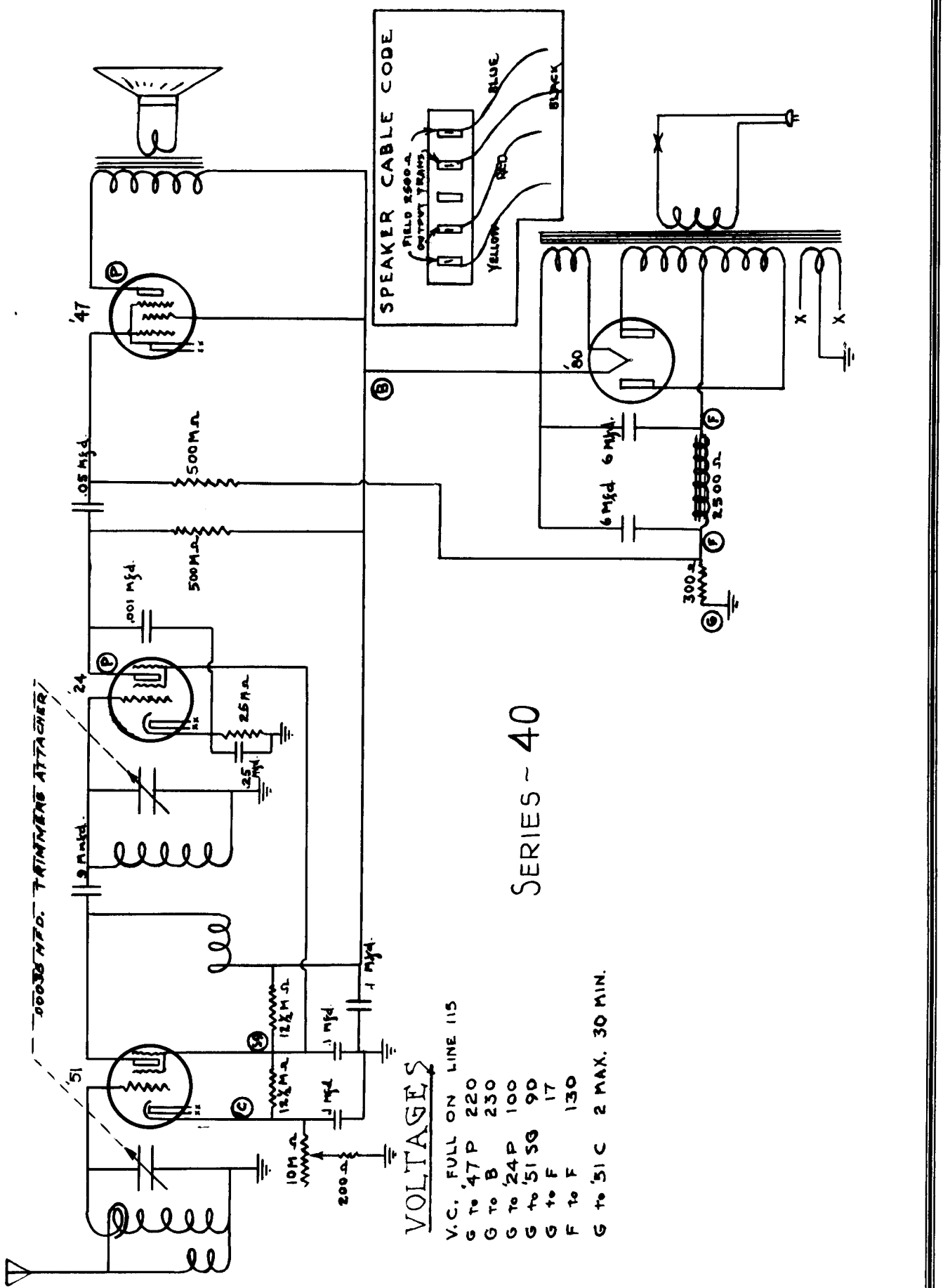
		READING FROM—	
Chassis	(ground)	to plates of R. F. tubes	130 to 150 volts
"	"	to plate of Detector	75 to 95 volts
"	"	to plate of Pentode	215 to 235 volts
"	"	to screen of R. F. tubes	45 to 65 volts
"	"	to screen of Detector	45 to 65 volts
"	"	to screen of Pentode	215 to 235 volts
"	"	to cathode of R. F. tubes	1.5 to 2.5 volts
"	"	to Cathode of Detector	4 to 6 volts
"	"	to pentode Filament Center Tap	14 to 18 volts

A. C. Voltages

1st R. F., 2nd R. F., Detector and Pentode Filaments	2.3 to 2.5 volts
Rectifier Filament	4.8 to 5.1 volts
Ground to plates of 280	approximately 375 volts

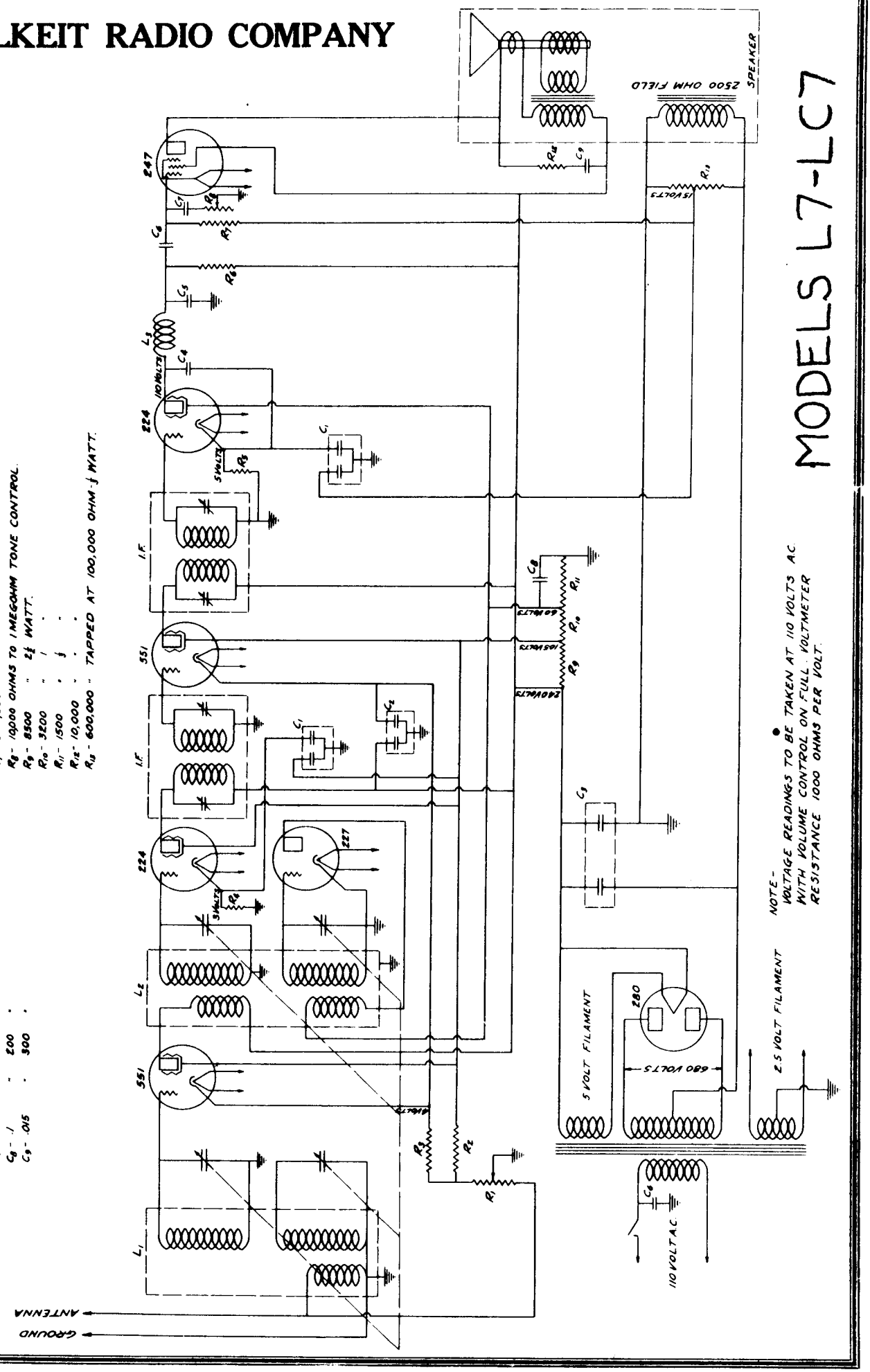
NOTE: Filament Voltages may be measured with a Weston Triple Range (0-4, 0-8, 0-150) Type 528 AC Voltmeter. The high voltage on the Rectifier Plates should be measured with a double range (300, 0-600) Type Weston AC Voltmeter.

BELMONT RADIO CORP.



BALKEIT RADIO COMPANY

MODELS L7-LC7



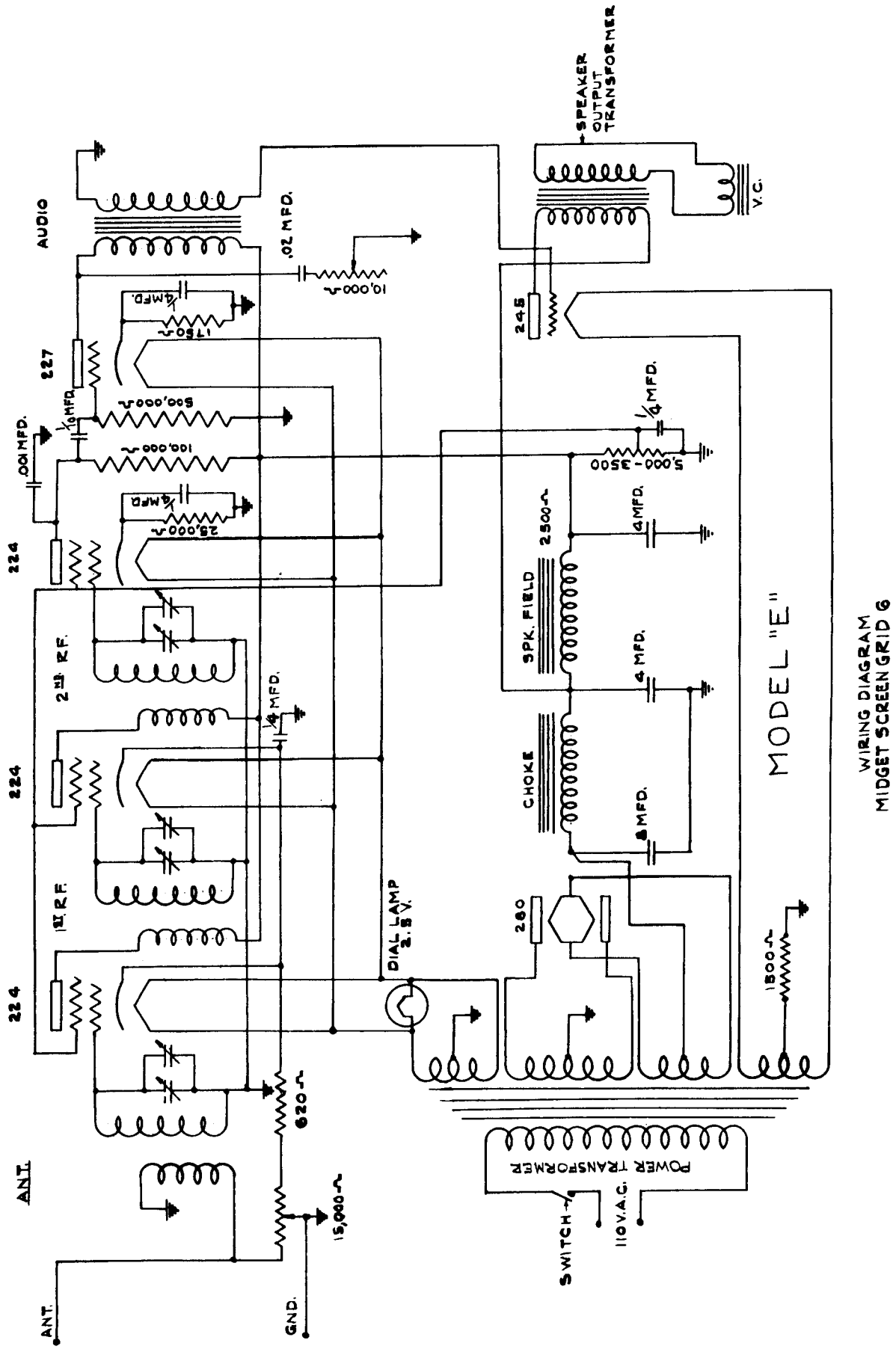
L_1 - ANTENNA AND R.F. COIL.
L_2 - DETECTOR AND OSC. COIL.
L_3 - R.F. CHOKE.
I.F. - INTERMEDIATE FREQUENCY TRANSFORMER ASSEMBLY.

C_1 - DUAL $\frac{1}{14}$ MFD. 200 VOLT.
C_2 - DUAL COND. $\frac{1}{4}$ MFD SEC. 200 V - $\frac{1}{4}$ MFD SEC. 300 V.
C_3 - DUAL 8 MFD. COND - 1 SEC. 350 V - 1 SEC 450 V.
C_4 - .00025 MFD.
C_5 - .0005 "
C_6 - .01 " 300 VOLTS.
C_7 - .004 " 200 "
C_8 - .1 " 200 "
C_9 - .015 " 300 "

R_1 - 15,000 OHM VOLUME CONTROL.
R_2 - 40,000 " $\frac{1}{2}$ WATT.
R_3 - 300 " " "
R_4 - 800 " " "
R_5 - 30,000 " " "
R_6 - 200,000 " " "
R_7 - 500,000 " " "
R_8 - 10,000 OHMS TO 1 MEGAHM TONE CONTROL.
R_9 - 8500 " 2$\frac{1}{2}$ WATT.
R_{10} - 3200 " 1 " "
R_{11} - 1500 " $\frac{1}{2}$ " "
R_{12} - 10,000 " " "
R_{13} - 600,000 " TAPPED AT 100,000 OHM - $\frac{1}{2}$ WATT.

NOTE -
VOLTAGE READINGS TO BE TAKEN AT 110 VOLTS A.C.
WITH VOLUME CONTROL ON FULL. VOLTMETER
RESISTANCE 1000 OHMS PER VOLT.

BALKEIT RADIO COMPANY



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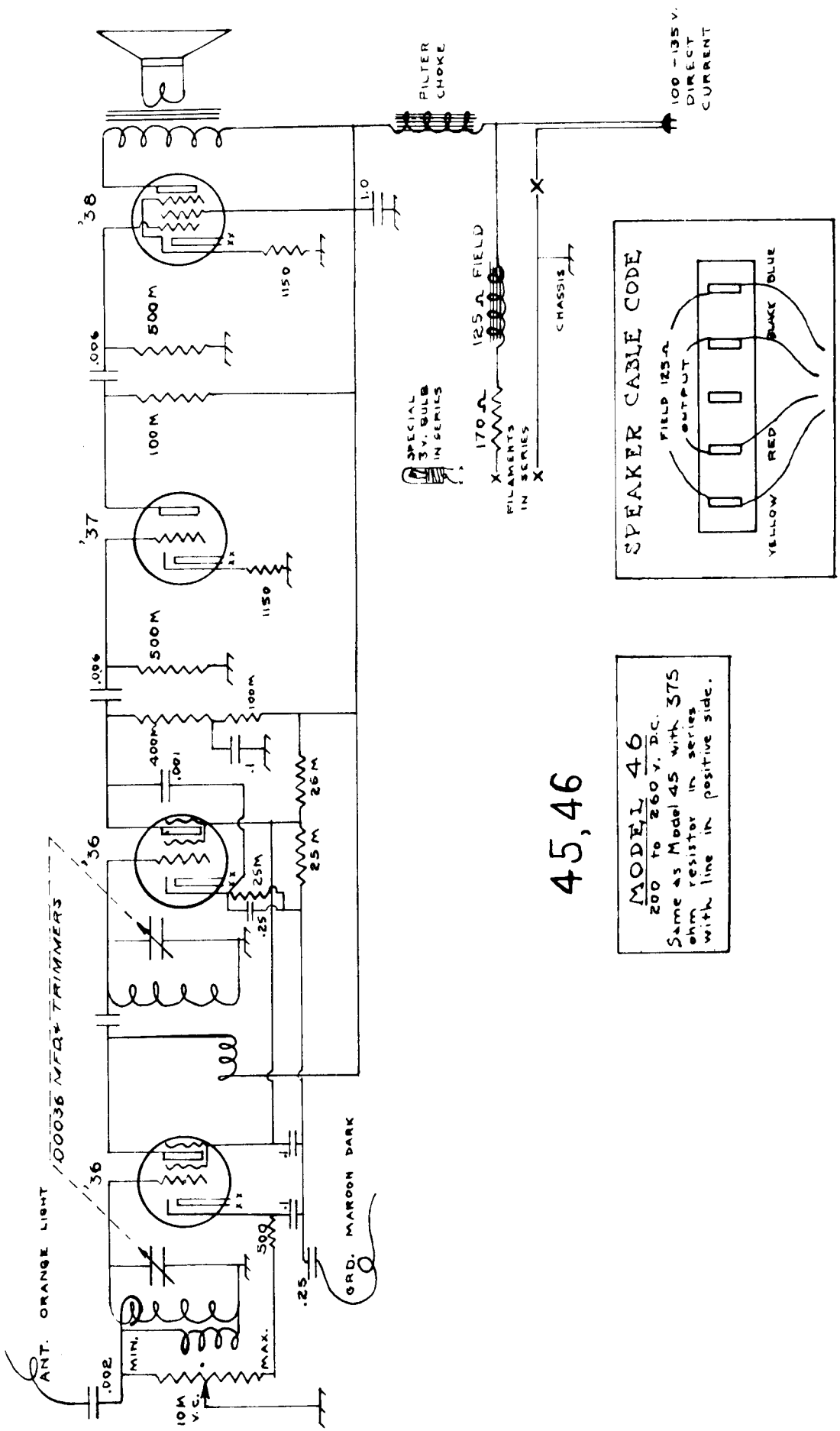

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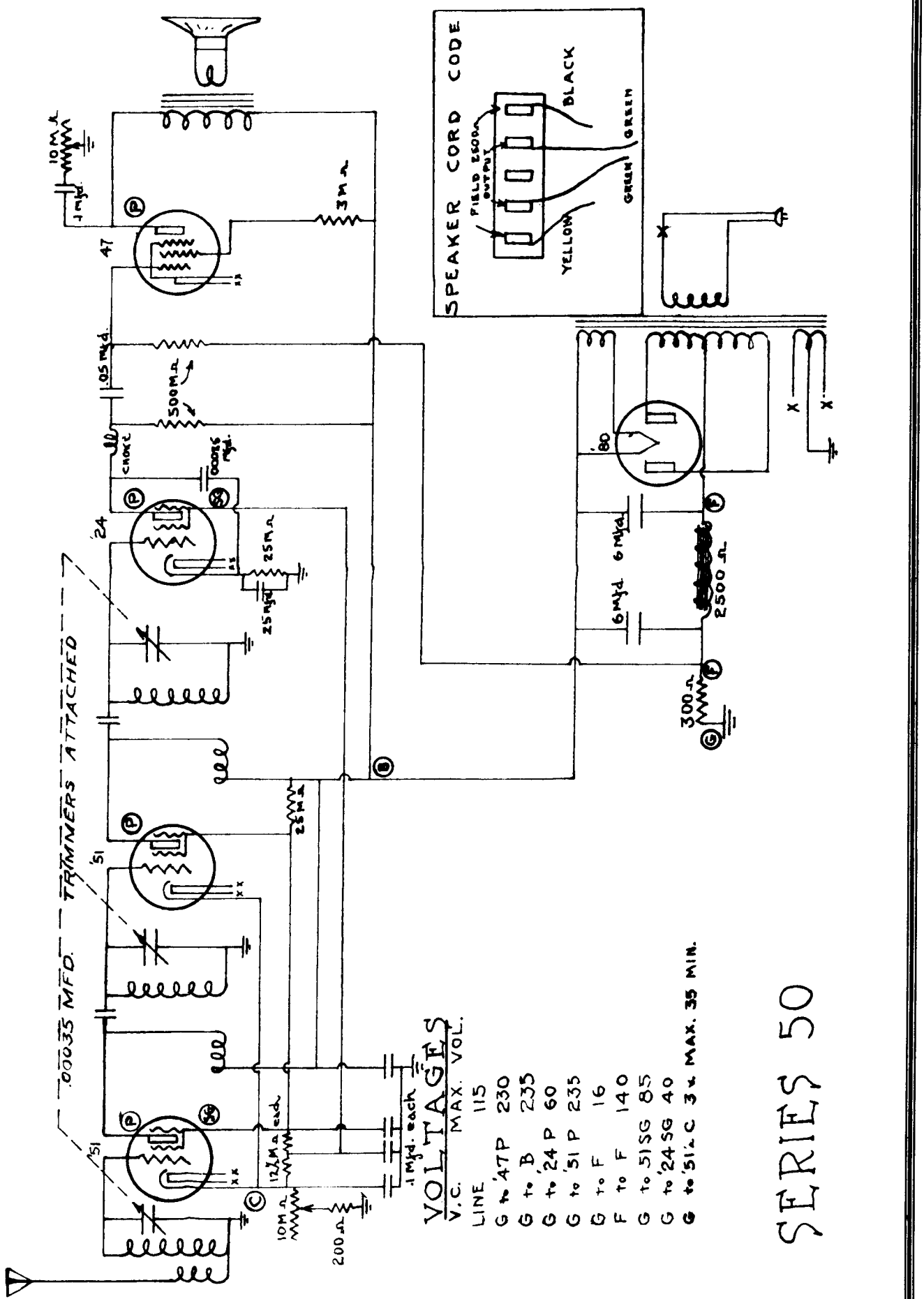
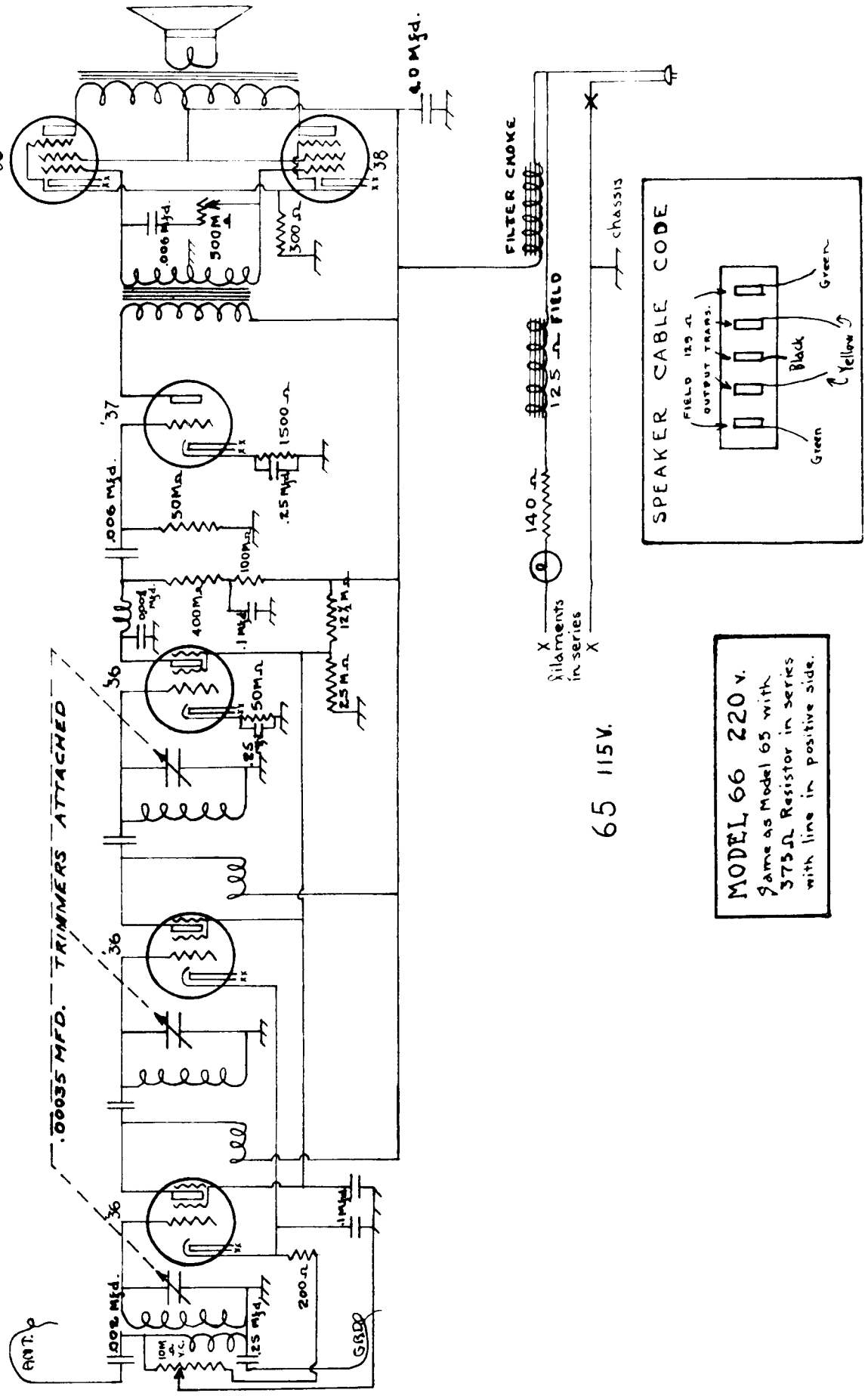


VOLTAGES

V.C.	MAX. VOL.
LINE	115
G to '47 P	230
G to B	235
G to '24 P	60
G to '51 P	235
G to F	16
F to F	140
G to 51 SG	85
G to '24 SG	40
G to '51 C	3 v. MAX. 35 MIN.

SERIES 50

BELMONT RADIO CORP.



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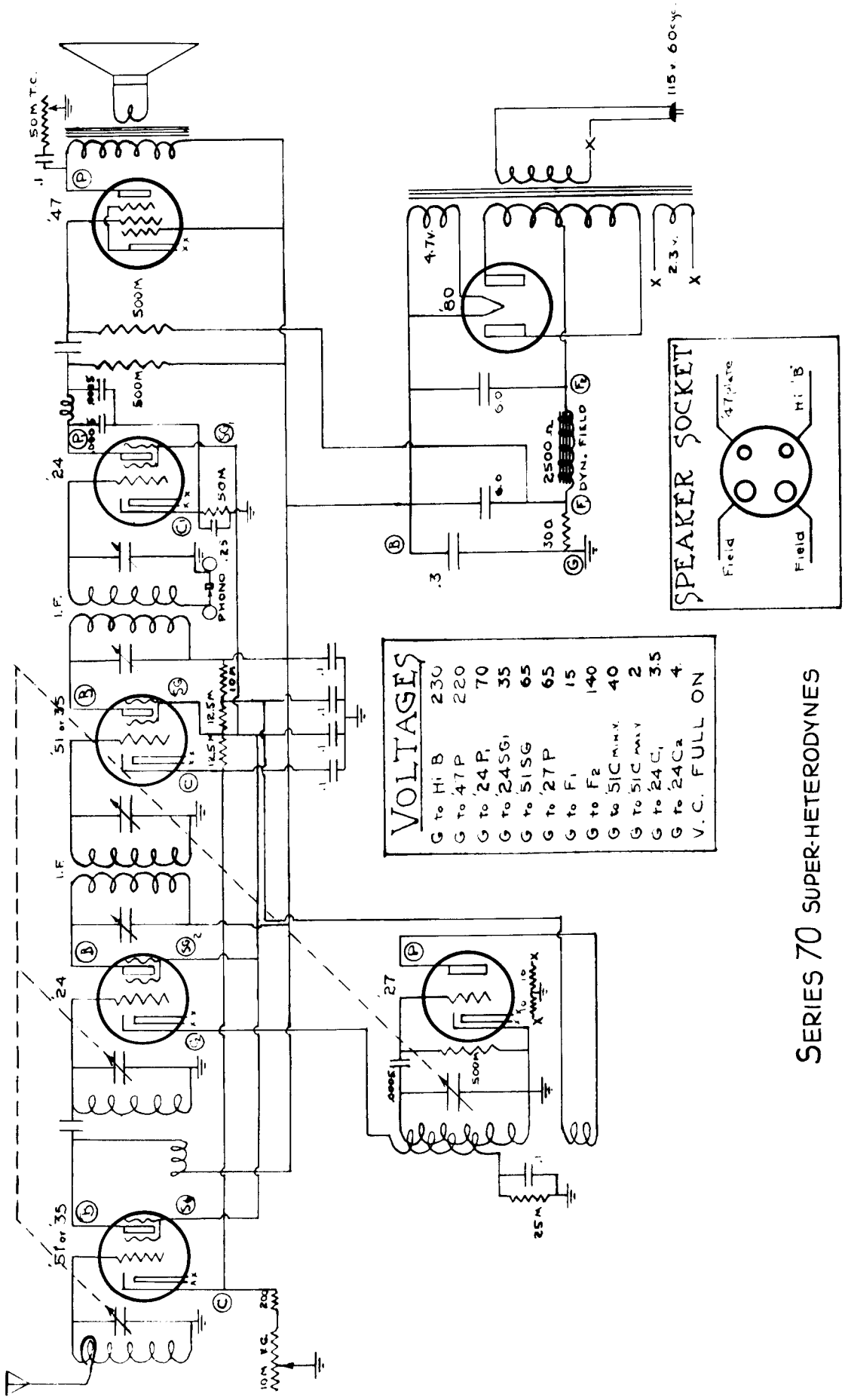
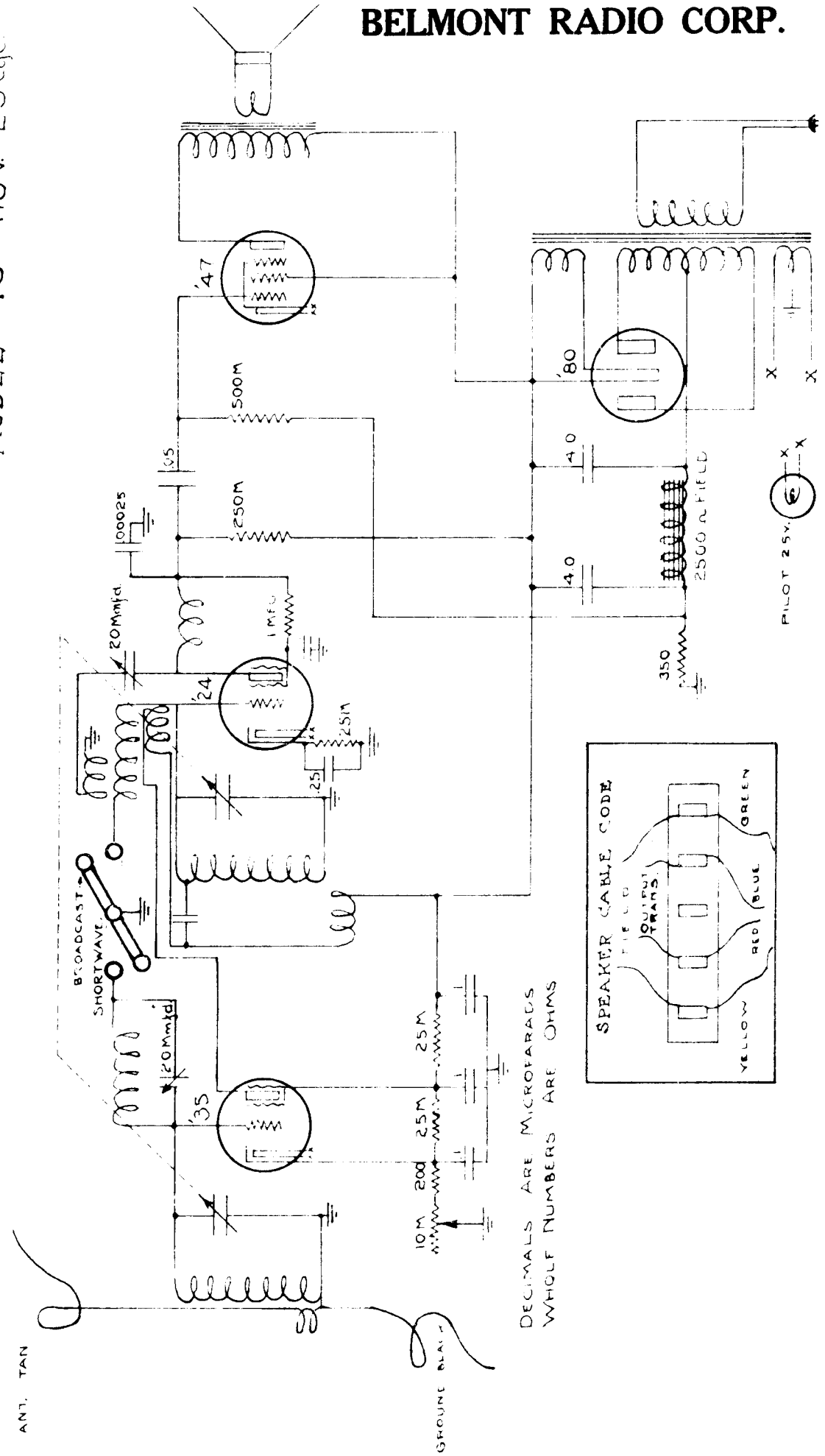


BELMONT RADIO CORP.

MODEL 47 110 v. 60 cyc.
MODEL 48 110 v. 25 cyc.

SERIES 40



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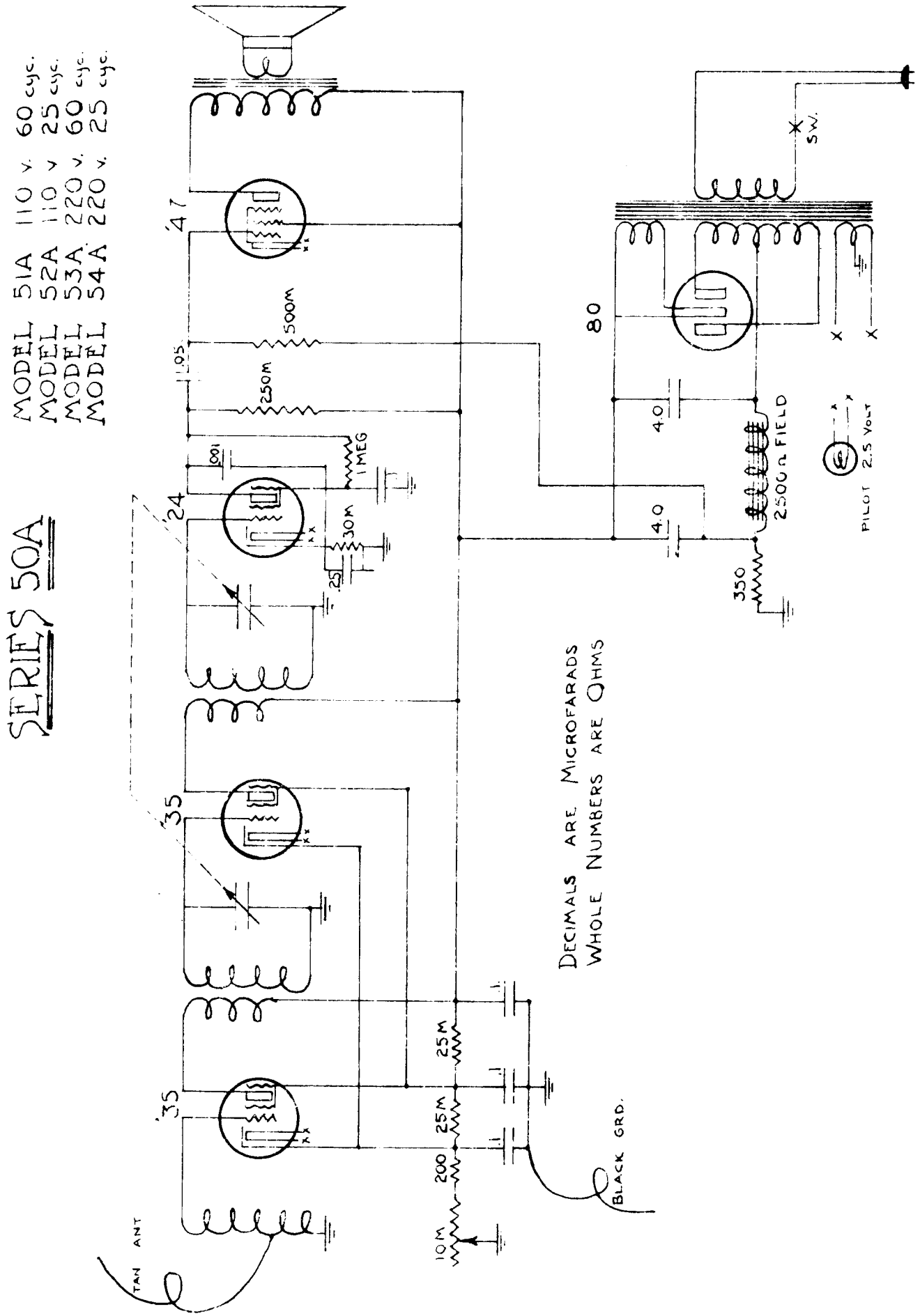
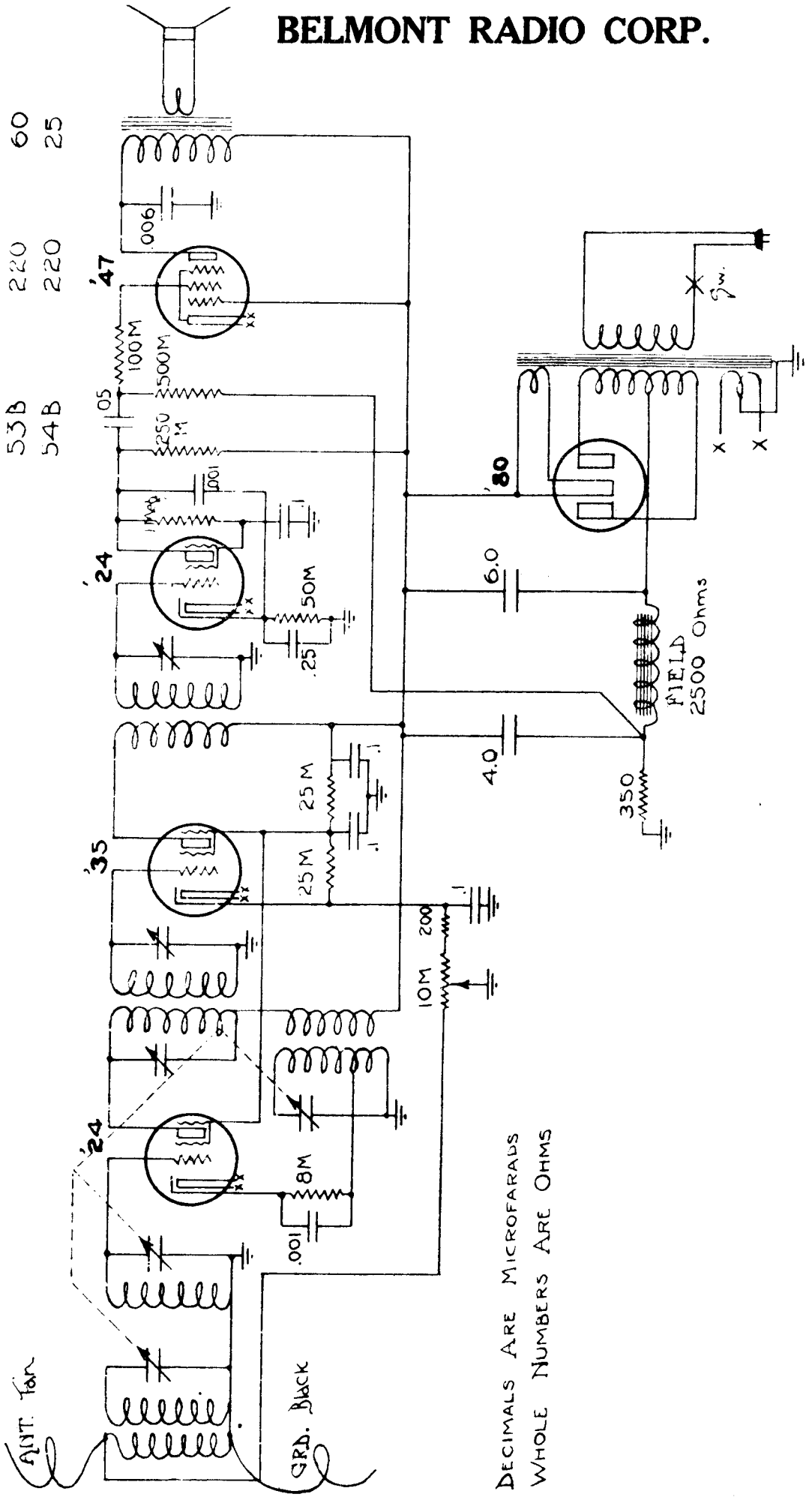


BELMONT RADIO CORP.

SERIES 50B

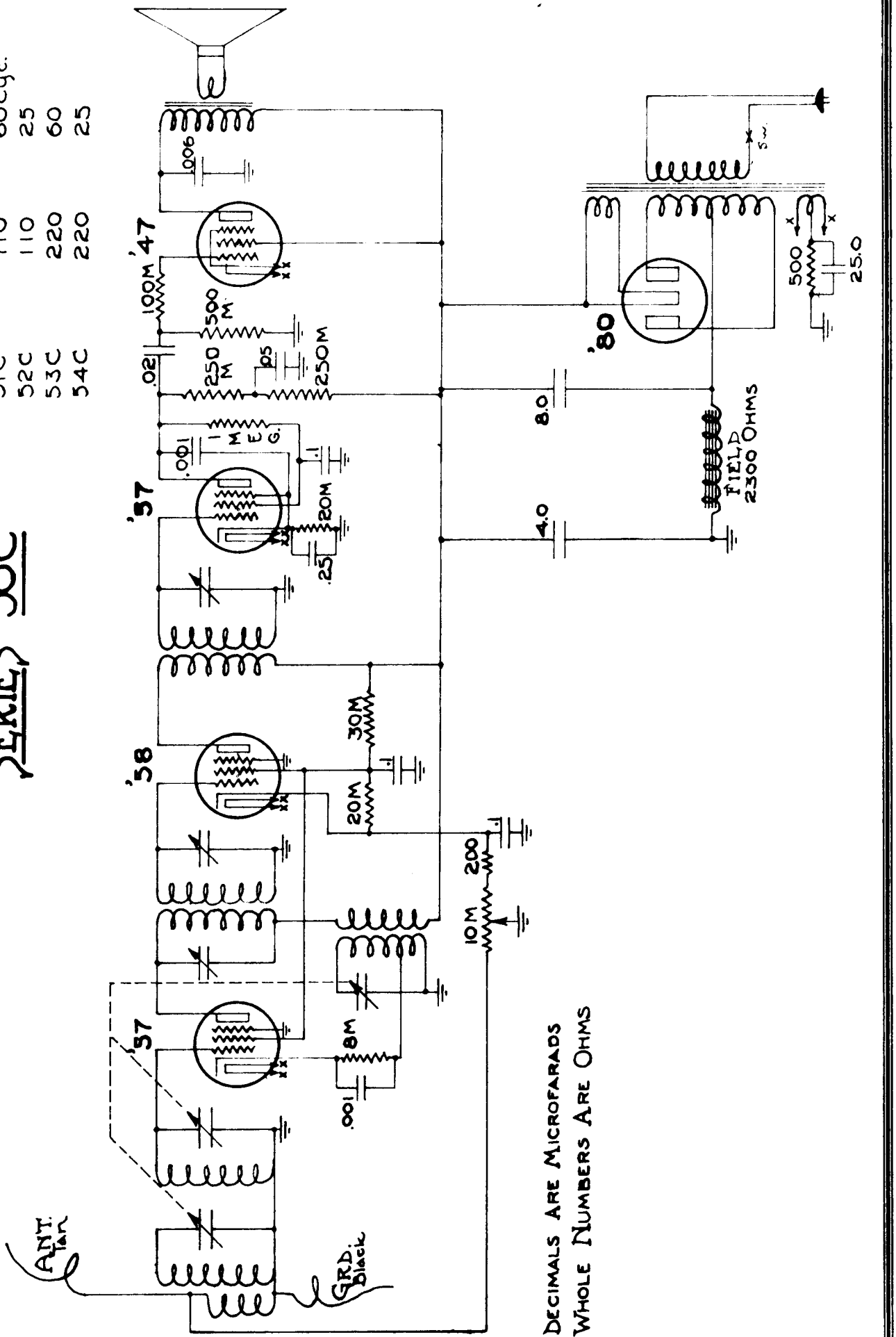
MODEL	VOLTS	FREQ.
51B	110	60 cyc.
52B	110	25
53B	220	60
54B	220	25



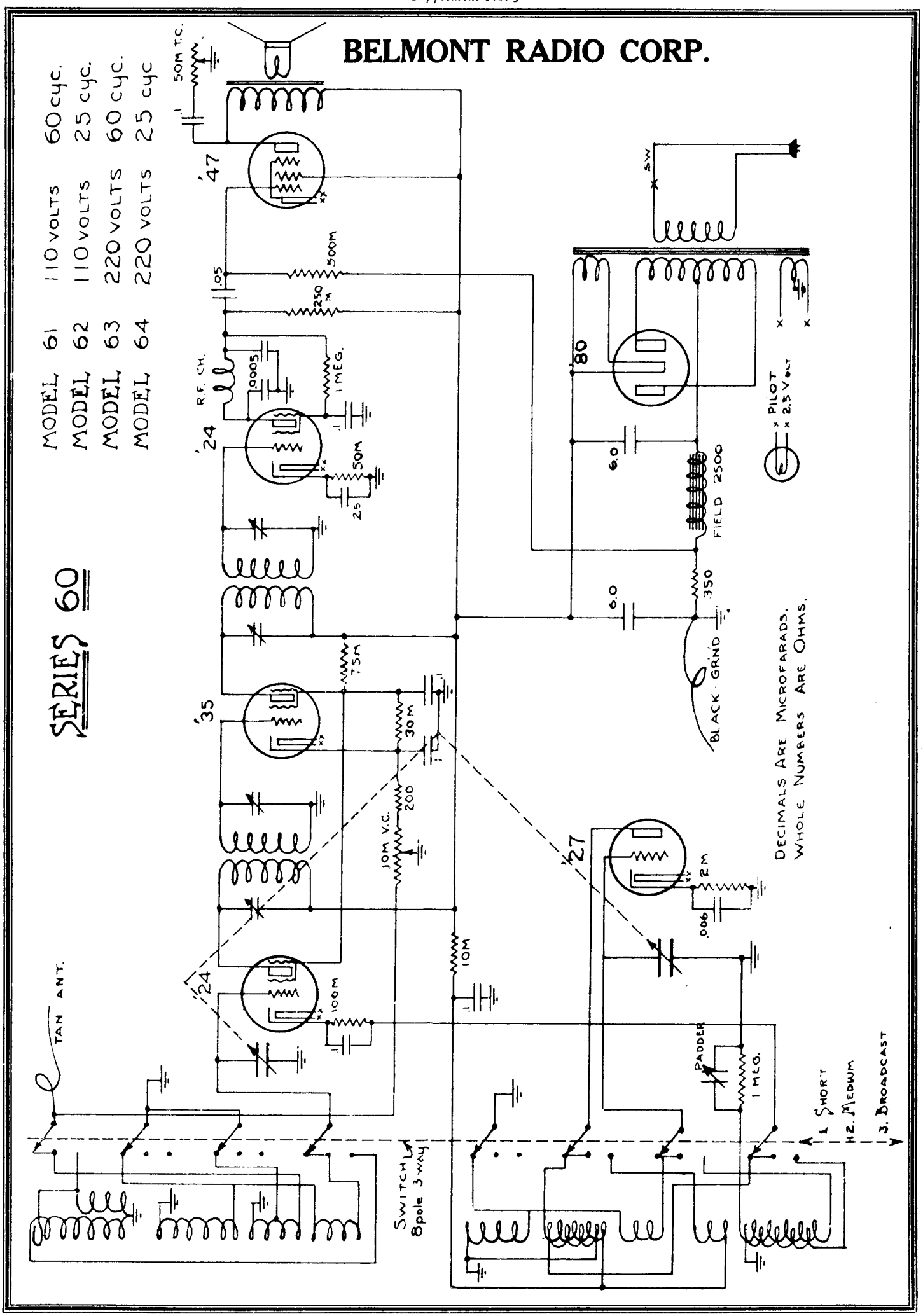
BELMONT RADIO CORP.

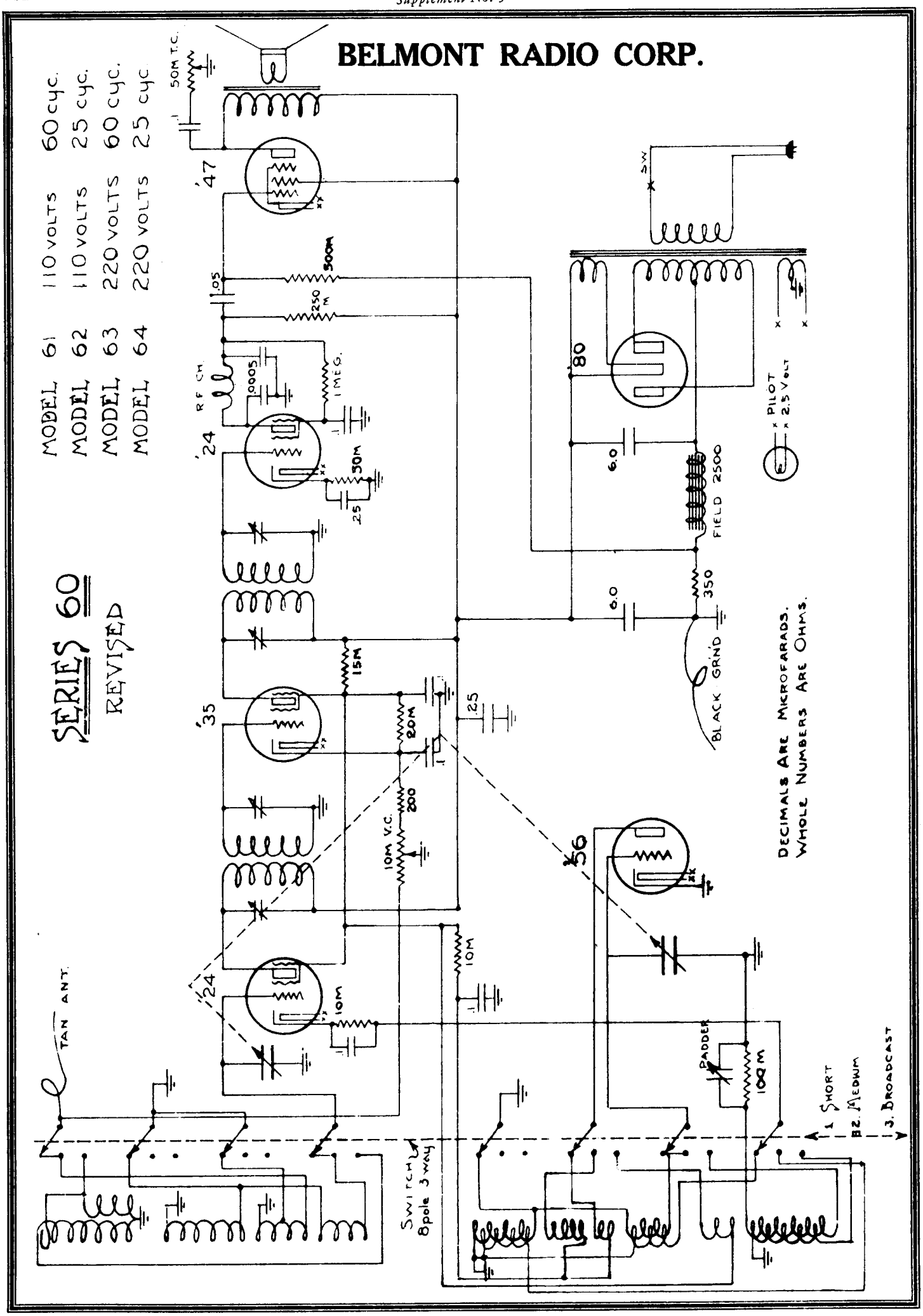
SERIES 50C

MODEL	VOLTS	FREQ.
51C	110	60 cyc.
52C	110	25
53C	220	60
54C	220	25



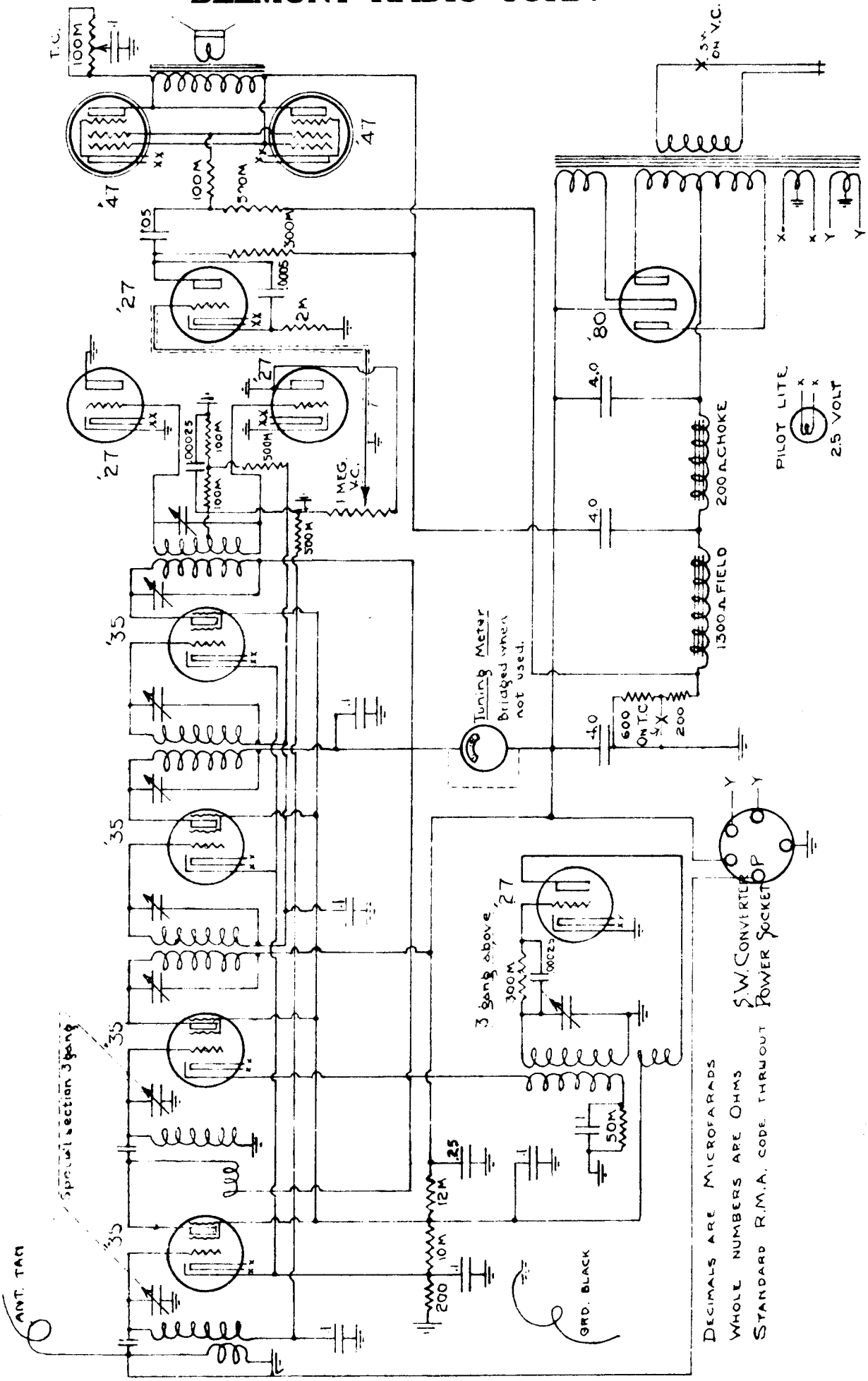
DECIMALS ARE MICROFARADS
WHOLE NUMBERS ARE OHMS


BELMONT RADIO CORP.
SERIES 60
MODEL 61 110 VOLTS 60 CYC.
MODEL 62 110 VOLTS 25 CYC.
MODEL 63 220 VOLTS 60 CYC.
MODEL 64 220 VOLTS 25 CYC.
'47
'24
'35
'24
'80
'27
50M T.C.
.05
500M
250 M
.0005
R.F. CH.
1 MEG.
50M
25
7.5M
30M
200
10M V.C.
100M
10M
6.0
FIELD 2500
350
BLACK GRID
PILOT 2.5 VOLT
SW
2M
.006
PADDER
1 MEG.
TAN ANT.
SWITCH 8 pole 3 way
1 SHORT
2. MEDIUM
3. BROADCAST
DECIMALS ARE MICROFARADS.
WHOLE NUMBERS ARE OHMS.


BELMONT RADIO CORP.
MODEL 61 110 VOLTS 60 CYC.
MODEL 62 110 VOLTS 25 CYC.
MODEL 63 220 VOLTS 60 CYC.
MODEL 64 220 VOLTS 25 CYC.
SERIES 60
REVISED
DECIMALS ARE MICROFARADS.
WHOLE NUMBERS ARE OHMS.
BLACK GRID
FIELD 2500
PILOT
2.5 VOLT
TAN ANT.
SWITCH
8 pole 3 way
1 SHORT
2 MEDIUM
3 BROADCAST
PADDER
100M
10M V.C.
50M T.C.
'47
'24
'35
'56
'80

BELMONT RADIO CORP.

SERIES 110



GRIGSBY-GRUNOW CO.

MAJESTIC MODEL 11 SHORT-WAVE CONVERTER (No. 10 CHASSIS)

(This chassis is incorporated in the Viking, Explorer and Number 11 all-wave receivers).

Short-wave reception has become the high-light of 1932 radio business; and among the foremost instrument designs with which the Service Man must familiarize himself are the Majestic models Viking, Explorer, and Number 11 all-wave receivers. These radio sets incorporate two chasses; one is a standard broadcast receiver, (No. 55 chassis), and the other is a short-wave converter (No. 10 chassis) whose output feeds into the broadcast receiver when it is tuned as an I.F. amplifier at 1,000 kc. (300 meters).

Volume is controlled by the volume control of the broadcast receiver operating in the usual manner.

The numbers on the dial of the converter give the frequency reading in "megacycles" (millions of cycles); therefore, to obtain a reading in "kilocycles" it is necessary to multiply the numbers on the dial by 1,000. The three sets of numbers on the dial of the converter indicate band frequencies as follows: outer circle, 37½ to 15 meters; center circle, 85 to 37½ meters; inner circle, 200 to 85 meters.

The values of the components of this converter are as follows: Condenser C1, 100 mmf.; C2, C3, C4, 0.1-mf.; C5, .01-mf.; C6, C7, 360 mmf.; C8, C9, 5 to 30 mmf.; C10, C11, 50 to 100 mmf.; C12, C15, 200 to 600 mmf.; C13, .001- to .0015-mf.; C14, .0041- to .0047-mf.; C16, C17, .03-mf.; C18, C19, 4 mf.

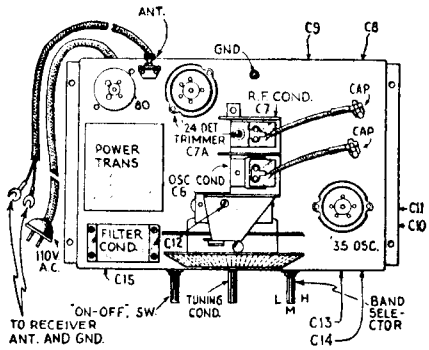
Resistors R1, R7, 20,000 ohms; R2, R4, R6, 10,000 ohms; R3, 1,000 ohms; R5, 30,000 ohms.

Operating voltages read to ground (except A.C. potentials), with a 115-volt line and band-selector switch in "medium" position, are as follows. Filament potential, V1, V2, 2.5 volts; V3, 5 volts. Plate potential, V1, 250 volts; V2, 170 volts. Plate current, V1, 0.1 ma.; V2, 7.5 ma.; V3, 20 ma. (total). Screen-grid potential, V1, 135 volts; V2, 75 volts. Screen-grid current, V1, .02-ma.; V2, 1. ma. Filament-to ground D.C., V3, 275 volts. Cathode-to-ground D.C., V1, V2, 8 volts.

For purposes of reference the variable condensers in the model 10 converter are given designations as follows: C6, oscillator tuning condenser; C7, R.F. tuning condenser; C7A, R.F. trimmer; C8, coil L1A "low frequency" padder; C9, L1B "medium frequency" padder; C10, coil L2A "low frequency" padder; C11, coil L2B "medium frequency" padder; V12, "low frequency" oscillator series-aligner; C13, "medium frequency" oscillator series-aligner; C14, "high frequency" oscillator series-aligner; C15, wavetrap tuning condenser.

If low sensitivity is encountered, check the condition of the tubes in the converter and the broadcast receiver. Do not realign the model 10 chassis except as a last resort; authorized Majestic dealers and distributors are best equipped for this service. Since the converter chassis does not in itself amplify, it is necessary to maintain the receiver chassis at maximum efficiency in order to realize the desired gain in signal strength. The model 10 chassis normally is selective.

In the model 10 converter chassis there are eight alignment adjustments; each of these must be made accurately in order to obtain maximum efficiency from the converter. To align these circuits it will be necessary to use two A.F. modulated service oscillators; one, the standard 550 to 1,500 kc. broadcast type of service oscillator, and the other a special 3,000 to 16,000 kc. "short-wave" type of service oscillator. If realignment becomes necessary, every circuit of the converter should be adjusted.



The first step in realignment is to tune the associated broadcast receiver (the I.F. amplifier portion of the complete short-wave superheterodyne) to 1,000 kc. and adjust the volume control to minimum position; then insert the receiver line plug into the receptacle provided on the converter chassis, and check the off-on switch to determine whether it correctly connects the antenna either to the receiver or the converter and at the same time controls the power line connection of the converter.

Now turn up the volume control on the broadcast receiver, adjust all the converter "padding" variable condensers C8, C9, C10, C11 and R.F. trimmer C7A to minimum position, and the series-aligners C12, C13, C14 to maximum position; then set the selector switch for "medium" range, adjust the converter tuning condenser for about 50% rotation, and connect to the input of the converter a broadcast service oscillator tuned to 1,000 kc. Turn this oscillator "on," and tune the wavetrap condenser C15 for minimum indication on an output meter.

Next, readjust the converter tuning gang to an extreme right position, loosen the set screws on the hub of the dial and adjust for alignment with the indicator and long line at the extreme left of the dial.

Except for the final step, the remaining adjustments will require the use of the short-wave service oscillator.

Set this oscillator at 16,000 kc. (modulation off), turn band-selector switch to "high frequency" position, and rotate the converter tuning control until a *beat note* is heard; then, turn the modulation "on" and adjust trimmer C7A for maximum output.

Proceed to tune the service oscillator to 9,000 kc. (modulation on), and tune the converter to this frequency. Turn the modulation "off" and adjust series-aligner C14 for *zero beat*.

Tune the service oscillator to 8,400 kc., place the band-selector switch in "medium" position (modulation on), and with the gang condenser on the converter turned all the way out first adjust padding condenser C11, and then padding condenser C9 for maximum output.

Next, tune the service oscillator to 7,400 kc. (modulation on), and tune in this signal; and then turn the modulation "off" and adjust padding condenser C11 for zero beat.

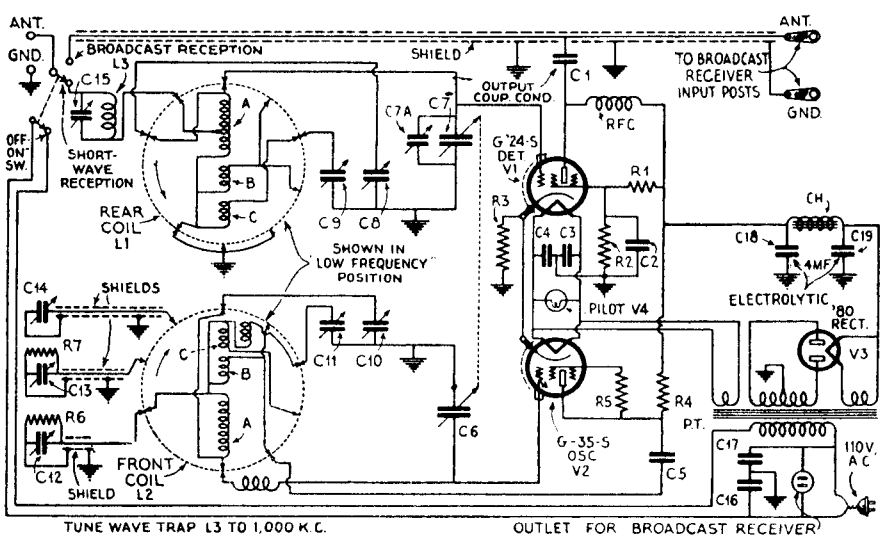
Tune the service oscillator to 4,900 kc. (modulation on), and tune in this signal; then, turn the modulation "off" and adjust series-aligner C13 for zero beat.

With the service oscillator tuned to 3,000 kc. (modulation on), and the band-selector switch in the "low" position, rotate the converter tuning condenser gang to the extreme left, and first adjust padding condenser C10 and then padding condenser C8 for maximum output.

The final adjustment requiring the short-wave service oscillator calls for a setting of 3,400 kc. (modulation on). Tune in this signal. Then, turn the modulation "off" and adjust padding condenser C10 for zero beat.

Finally, set the converter at 1.5, adjust the broadcast service oscillator for 1,500 kc. and start it operating, and adjust series-aligner C12 for maximum output.

Note that when adjusting for a peak with the modulation "on," the volume of the receiver (now the I.F. amplifier) should be kept low as possible—just enough to obtain a reading on the scale of the output meter. In this way the peak will be sharpest. Also, *it will help to determine whether the signal heard is a harmonic or the desired fundamental.*



GRIGSBY-GRUNOW CO.

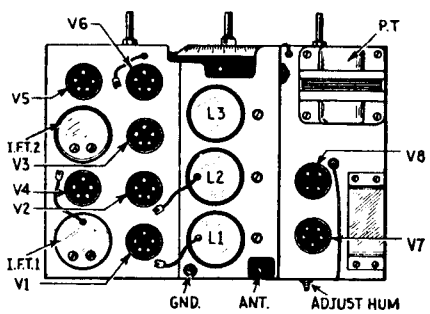
MAJESTIC MODELS FAIRFAX AND SHEFFIELD 8-TUBE SUPERHETERODYNES

(Model 200 Chassis; with automatic volume control and duodiode detector)

New radio receivers are adding responsibilities to the Service Man, but if he knows his business he will experience no difficulty in clearing the normal troubles he may find in such sets. He must merely acquaint himself with the design variations of each new model. For instance, the Grigsby-Grunow Company's Majestic Model 200 chassis uses a new type of tube in the dual role of second-detector and automatic volume control. This is indicated in the schematic circuit.

The parts values are: Resistor R1, 7,000 ohms; R2, 3,500 ohms; R3, 3,000 ohms; R4, 110 ohms; R5, 180 ohms; R6, R8, R13, 0.1-meg.; R7, R9, 0.25-meg.; R10, R11, R12, R18 (manual volume control), 0.5-meg.; R14, 0.3-meg.; R15, 1. meg.; R16, 0.2-meg.; R17 (hum balancer), 20 ohms; R19 (tone control), 50,000 ohms; R20, 700 ohms.

Condensers C1, C4, 0.1-mf.; C2, C3, C5, .25-mf.; C6, C11, .05-mf.; C7, C8, C12, C13, C14, C15, .01-mf.; C9, .03-mf.; C10, .005-mf.; C16, 50 mmf.; C17, C19, 4 mf.; C18, 500 mmf.; C20, 8 mf. Condenser C is the oscillator padding component.



The tubes specified for this receiver carry the following Majestic numbers: Type G-35-S spray shield multi-mu screen-grid tube, as R.F. amplifier V1; Type G-35-S spray shield multi-mu screen-grid tube as first-detector V2; Type G-27-S spray shield tube as oscillator V3; Type G-35-S spray shield multi-mu screen-grid tube as I.F. amplifier V4; Type G-2-S spray shield duodiode tube as second-detector and automatic volume control V5; Type G-35-S spray shield multi-mu screen-grid tube as first A.F. V6; Type G-47 pentode as second A.F. power tube V7.

To obtain correct balance in the filament circuit, to reduce hum, there is provided a hum balancing potentiometer R17. Adjust this, right or left, by means of a screwdriver, for minimum hum. It is seldom necessary to readjust this unit unless pentode V7 is replaced.

The length of the antenna recommended for various receivers varies with the design of each model; the Model 200 chassis is designed to work best with an antenna of about 30 to 40 feet, for normal urban localities, and a somewhat greater length, up to 100 feet, in rural sections.

Due to the fact that the diode second-detector V5 also forms part of an automatic volume-control circuit, the tube ordinarily required for this service is eliminated. Since there is an A.V.C. circuit in the Model 200 chassis, and a visual tuning meter has not been provided, it is *essential* that stations be tuned in for maximum volume and clarity; if the tuning is slightly off the correct point, noise and poor tone will result. In fact, it is best to carefully note the dial marking while tuning in a desired program, to rock the dial back and forth until the signal drops out at equal points on either side of good reception, and then to leave the dial at a position half-way between these two settings.

Looking at the front of the set, the knob on the left controls the combined tone control ("static modifier and acoustic control") R19 and off-on switch SW-1, and the one on the right varies the manual volume control, R18. Note that the automatic volume-control action is independent of the other portions of the circuit, being adjusted to operate at a volume level pre-determined in the design of the chassis. The manual volume control only varies the audio input to the voltage-amplifier V6, and the succeeding power-amplifier pentode V7.

The duodiode full-wave rectifier V5 is used specifically because of its increased sensitivity over the diode (or "two-element") half-wave connection ordinarily employed, its sturdier construction, better fidelity, better definition on the higher frequencies, and its ability to handle more power. The duodiode is a full-wave rectifier, as compared to the diode, which is a half-wave rectifier.

A tone control is included in the instrument, not as a means of correcting faults in the receiver design, but to accomodate variations in conditions external to the radio set. For instance, as a means of matching the acoustic properties of the room, in order to obtain the most realistic reproduction; also, to reduce the proportion of static and background noise during local electric storms or when receiving distant programs.

The output of the oscillator is coupled into the cathode circuit of first-detector V2 by means of a small coupling coil which forms part of inductnce L3.

The Model 200 chassis is used in the Sheffield Model 201 receiver and the Fairfax Model 203 receiver. The power consumption is 85 watts.

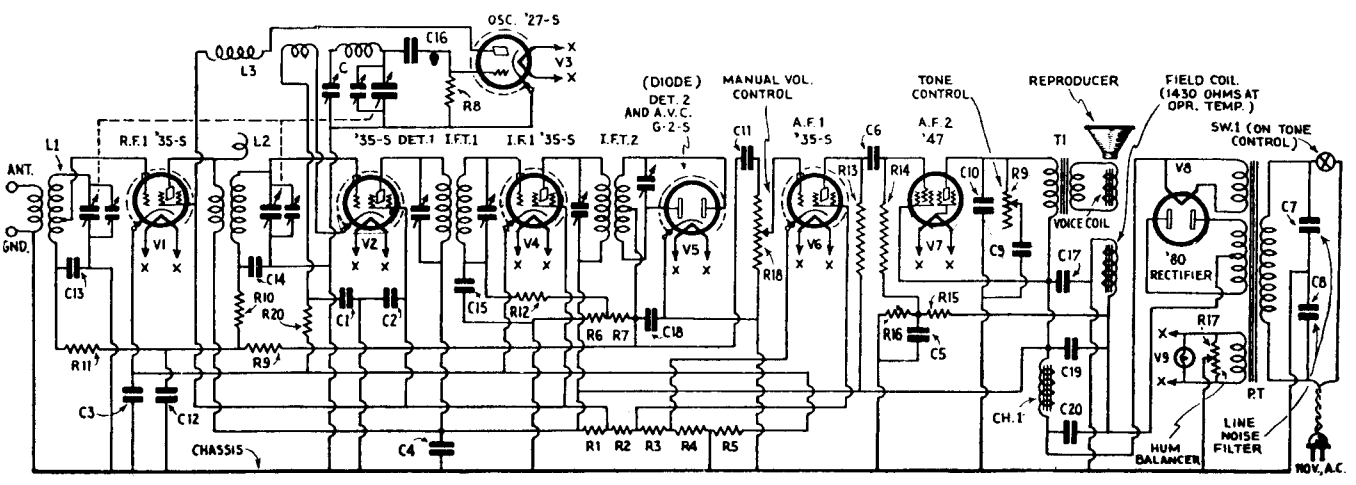
Line-filter condensers C7 and C8 prevent clicking sounds in the loud speaker when electric lights on the same circuit are turned on or off, and also reduce noises incidental to the operation of other electrical devices on the same line.

MODEL 200 CHASSIS

TABLE OF VOLTAGE AND CURRENT READINGS

All D.C. Voltage Readings are to Ground.

Tube Purpose	Type Tube	Filament Voltage A.C.	Plate Voltage D.C.	Filament To Ground D.C.	Cathode To Ground D.C.	Plate Current M.A. - D.C.	Screen Voltage D.C.	Screen Current M.A. - D.C
R.F. Amp.	G-35-S	2.5	255	.5	3	5.	96	1.
1st Det.	G-35-S	2.5	255	.5	11	4.	96	.4
Oscillator	G-27-S	2.5	98	.5	0	9.5	—	—
I.F. Amp.	G-35-S	2.5	255	.5	3	1.	96	.8
2nd Det.	G-2-S	2.5	0	.5	0	0	—	—
1st Audio	G-35-S	2.5	100	.5	2	2.	44	.4
Power Amp.	G-47	2.5	250	.5	—	25	260	6.
Rectifier	G-80	5.	—	290	—	75 Total	—	—



TRANSFORMER CORPORATION OF AMERICA

CLARION "REPLACEMENT" CHASSIS, MODEL AC-160 A.V.C. SUPERHETERODYNE

(Push-Pull Pentodes, Variable-Mu Tubes, Tone Control and A.V.C.)

Of the estimated 17 million radio sets now in use in the United States, the chasses of approximately 11 million are now obsolete, due to the rapid advance in receiver design. At the same time, the cabinets in which these chasses are housed are just as much in vogue as the day they were bought; and they still represent a considerable portion of the cost of the ensemble.

To offset this discrepancy, a western manufacturer has brought out a 10-tube superheterodyne receiver chassis, complete in every respect, and modern in design, which is to be used as "replacement" for the older set models. The diagram of this receiver, the model AC-160, is shown. The chassis is available without tubes.

The electrical values of the components are as follows: Resistor R1, volume control, 1,150 ohms; R2, tone control, 0.1-meg.; R3, 8,000 ohms; R4, 0.1-meg.; R5, 2,000 ohms; R6, 400 ohms; R7, 0.5-meg.; R8, 40,000 ohms; R9, R12, 10,000 ohms; R10, 30,000 ohms; R11, 0.2-meg.; R13, 300 ohms; R14, 700 ohms; R15, 175 ohms; R16, 2,900 ohms; R17, 4,300 ohms; R18, 3,800 ohms; R19, R20, 1,000 ohms.

Condensers C1, C2, C3, are tuning units; C4, C18, .0008-mf.; C5, C7, .02-mf.; C6, C12, C14, C21, C25, 0.1-mf.; C8, 0.7-mf.; C9, C10, C22, .05-mf.; C11, .00005-mf.; C13, .01-mf.; C16, C23, 8 mf.; C19, C20, 0.35-mf.; C24, 1. mf.

Operating voltage and current characteristics are taken with the volume control set "full on," and the "supersensitive" switch turned "to right."

Filament potential, V1, V2, V4, V9, 2.2 volts; V3, V5, V6, 2.1 volts; V7, V8, 2.3 volts; V10, 4.9 volts. Plate potential, V1, V4, 151 volts; V2, 140 volts; V3, 115 volts; V5, 192 volts; V6, 230 volts; V7, V8, 250 volts; V9, 15 volts; V10, zero. Control-grid potential, V1, V4, 0.2-volt; V2, 5.7 volts; V3, V5, V10, zero; V6, 8 volts; V7, V8, 16.5 volts; V9, 20 volts. Cathode potential, V1, V4, 3 volts; V2, 9 volts; V3, V5, V7, V8, V10, zero; V6, 15 volts; V9, 45 volts. Screen-grid potential, V1, V4, 75 volts; V2, 70 volts; V3, V5, V6, V9, V10, zero; V7, V8, 255 volts. Plate current, V1, 3 ma.; V2, 1.2 ma.; V3, 9.5 ma.; V4, 2.5 ma.; V5, 0.5-ma.; V6, 5.5 ma.; V7, V8, 27 ma.; V9, zero; V10, 47 ma.

plete in its action, even on very strong sig-

Do not connect the ground wire to the "Ant." post unless a fixed condenser is connected in series, to prevent a burnout of the antenna coil in the event that a ground may have occurred in the power transformer.

A good ground is *important* to satisfactory operation; selectivity and circuit stability depend upon this consideration. The ground connection is conveniently tested by grounding one side of a 110-volt lamp, noting the brilliancy when each side of the light-line is connected to the remaining lead of the lamp; a dim light indicates a poor radio ground. An entire absence of light in this test usually indicates a lack of ground at the main power transformer; in this case the local power company should be notified.

Switch SW.2 should not be thrown to the "Phono." position unless a pickup is in the circuit; otherwise, noise and fluttering will result.

Poor sensitivity *may* be due to mis-alignment of the tuning condensers, but *the trimmers of these units should not be adjusted except as a last resort.*

Since this receiver has automatic volume control, poor tone quality will result if the set is adjusted slightly off-tune. Therefore, it is recommended that the volume first be reduced to low audibility, the set tuned for a point mid-way between the two extreme dial points of reception, and then the volume brought up to normal.

Another method of checking tone quality at this point is to substitute for the regular antenna, a very short piece of wire, so that the volume control must be adjusted to the "full on" position, when the A.V.C. feature no longer holds, tuning being "peaked," as in the ordinary types of sets.

A poor type '27 tube used as the second-detector V5, or A.V.C. V9, will result in poor operation. Note that tubes unsuited to use in these positions may test "okay" on a tube checker.

In "noisy" localities it may be well to shunt the power line by a filter system of the usual type—two 0.1-mf. fixed condensers, connected in series, the two free ends connecting to the two line-leads, and the center-tap being grounded.

Due to the high audio gain of this receiver, special precautions in the design were taken to eliminate hum beyond the normal, slight degree existing in practically all sets. Consequently, should a complaint of hum arise, after eliminating the usual possible causes check the position of A.F. transformer T1. The angle of its mounting bracket has been carefully calculated to eliminate hum and if for any reason T1 must be replaced, be sure to retain the bracket and see that it is not accidentally twisted out of its original angle.

The tuning condenser nearest the front-panel is C1, followed by C2, and C3, (in this order); the trimmer for each of these circuits is located on top of the respective tuning unit. Padding condenser C4A is located on the front skirt of the chassis, alongside unit R1- SW.2. Trimmers of the I.F. circuits are located on the left-hand side of the respective I.F. transformers, the top adjusting screw of the two being the grid-circuit tuning control; I.F. transformer I.F.T. 1 is the one nearest the front-panel.

Connect the 175 kc. service oscillator to the control-grid cap of V2, and to ground. Do not remove any of the tubes from the sockets; also, it is unnecessary to disconnect the control-grid cap connection from V2.

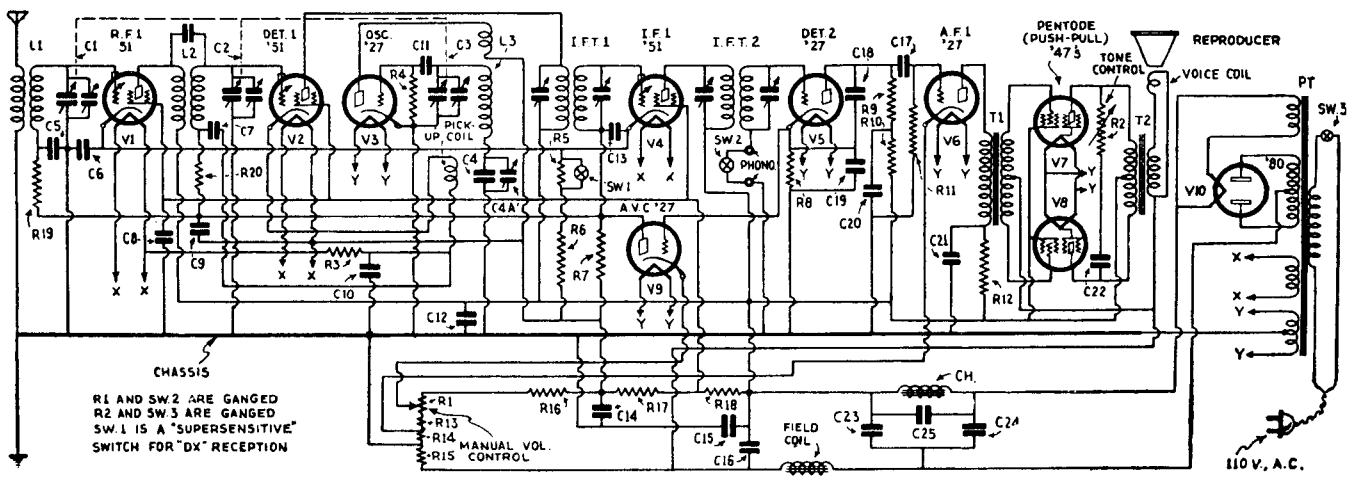
After adjusting the I.F. circuit, connect a broadcast-frequency service oscillator to the input posts of the radio set, and tune in its signal at 1400 kc. Now adjust the trimmers of C1 and C2, respectively, for maximum output.

To check the calibration of the receiver, whether it is high or low, the trimmer in shunt to C3 should be adjusted until a crystal-controlled station of known high frequency is brought in, *at the correct dial marking,* with peaked tuning and maximum volume. If the broadcast-frequency service oscillator is accurately calibrated, it might be used in place of the broadcast station's signal which, however, is held within about 50 cycles by reason of the crystal-control. In this adjustment a test frequency of 1400 kc. should be used. Note that at this frequency the setting of the trimmer of C3 will be exceedingly critical.

Now comes the problem of balancing the oscillator to the R.F. and detector circuits so that perfect tracking will be obtained over the entire tuning range.

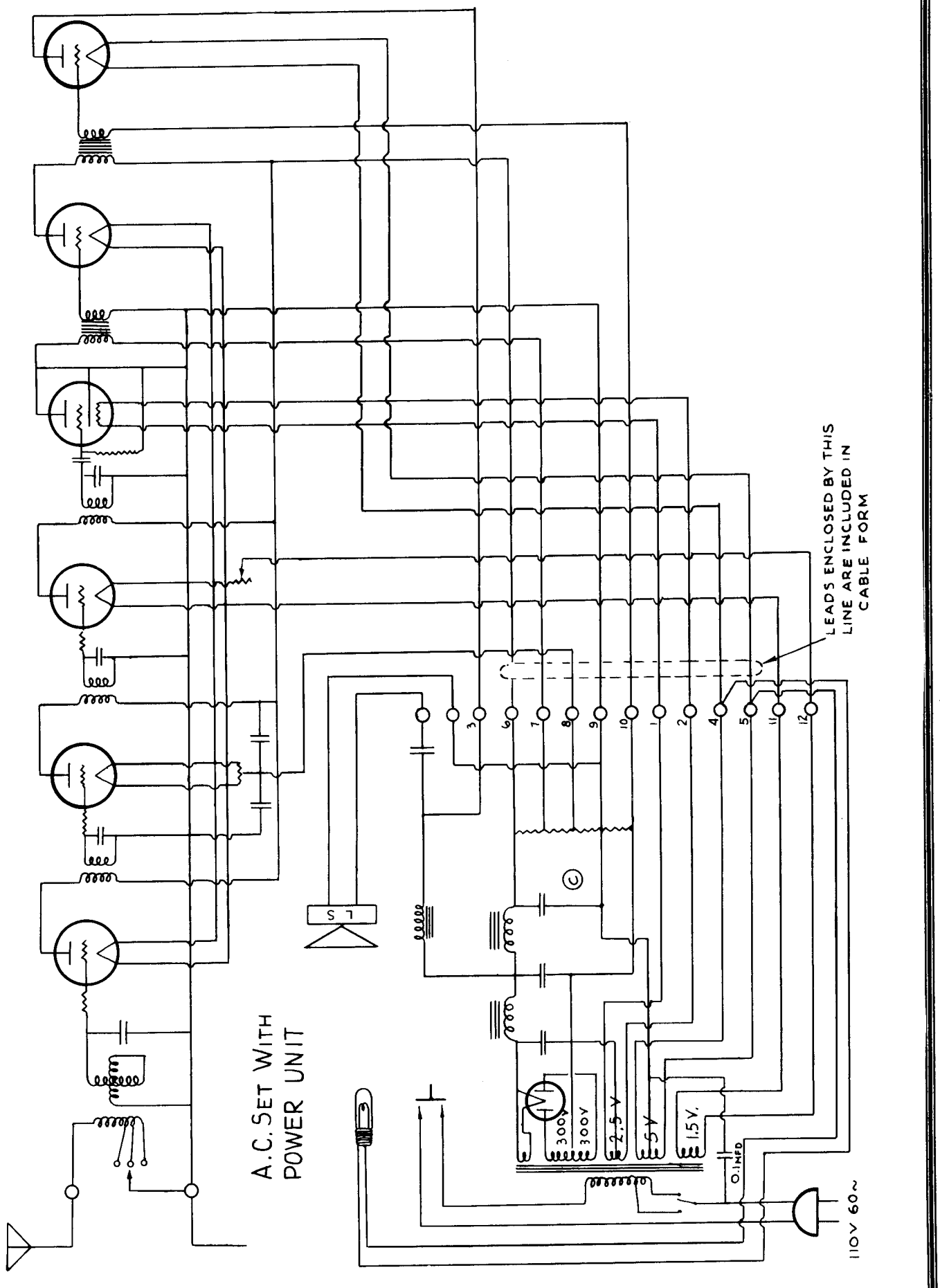
Tune the external broadcast-frequency test oscillator and the receiver both to 600 kc., then slowly increase or decrease the capacity of C4A, at the same time continuously tuning back and forth across the signal with the receiver tuning condenser gang. The output meter needle will now be swinging up and down in step with the variation in tuning. Watch the peak of this swinging closely and readjust C4A until the swinging needle reaches its highest peak.

Retune the receiver and broadcast-frequency service oscillator to 1400 kc. and re-check the trimmer of C3 to make sure that the adjustment of C4A has not thrown the receiver out of calibration. Should this have occurred, readjust the trimmer of C3 until the calibration is correct, and then check on the trimmers of C2 and C1 to make sure that the adjustment of C4A has not reduced the sensitivity.



Schematic circuit, Clarion "Replacement" Chassis, Model AC-160 A.V.C. Superheterodyne. Condenser C17 is .05-mf.

BRANDES PRODUCTS CORP.



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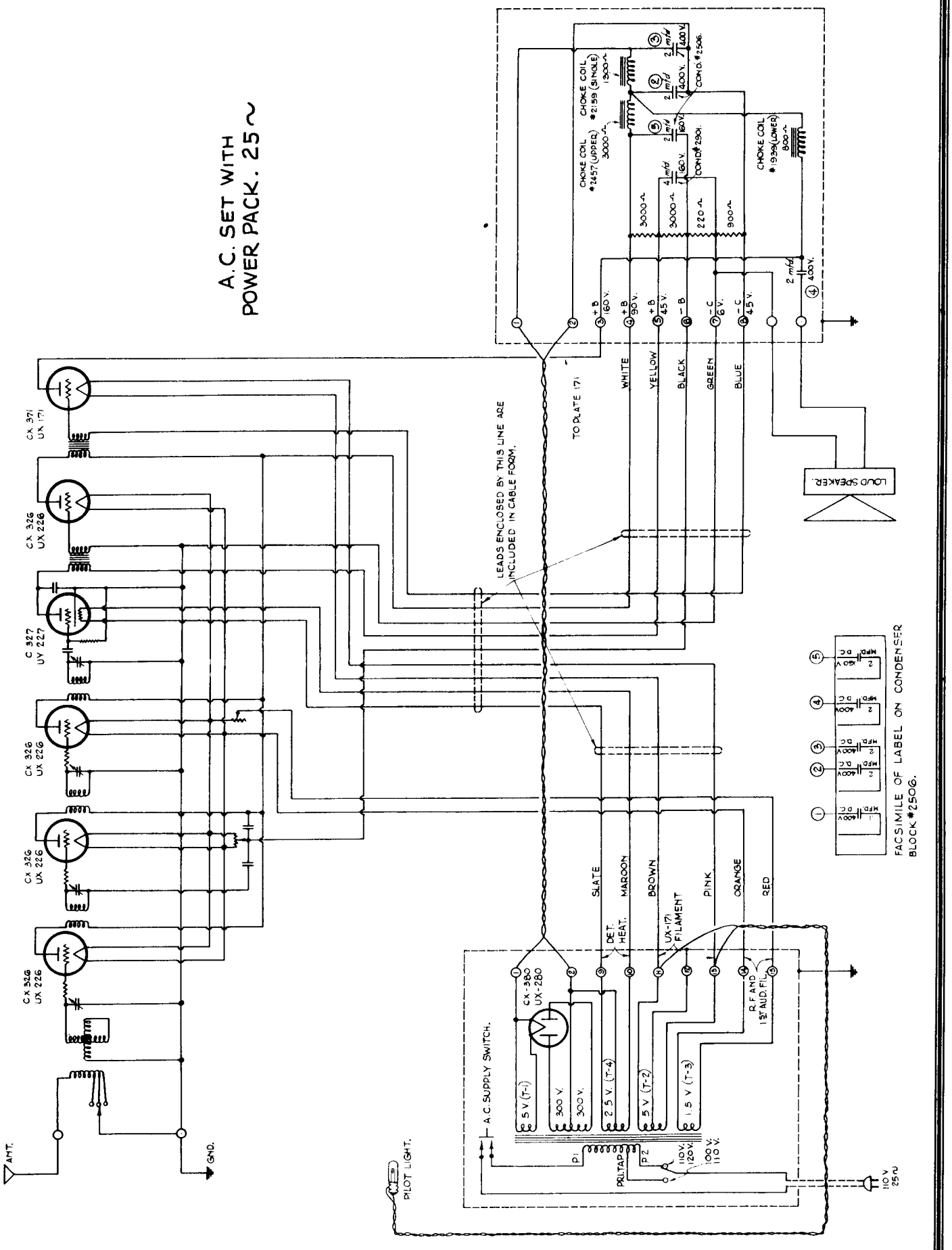

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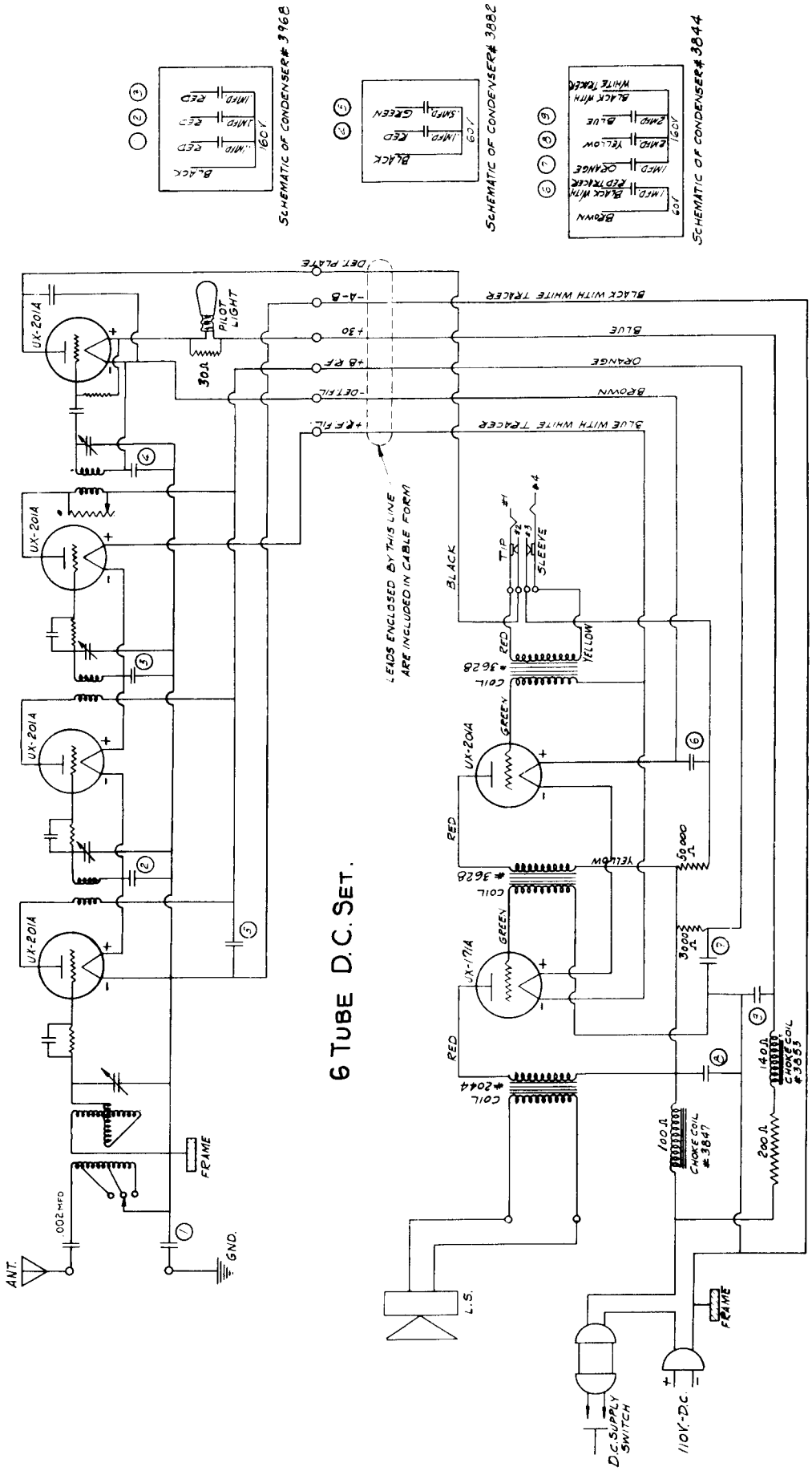

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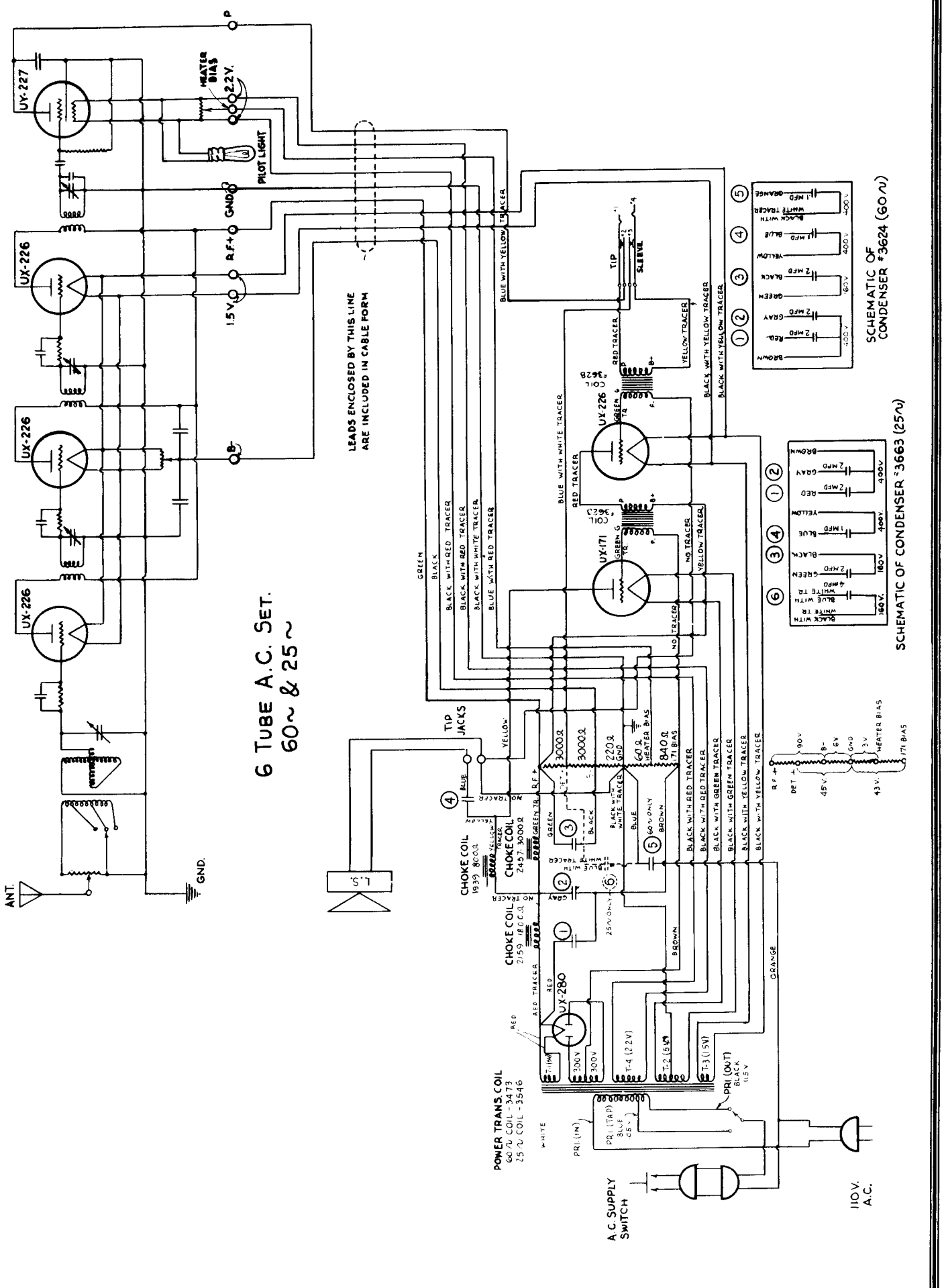

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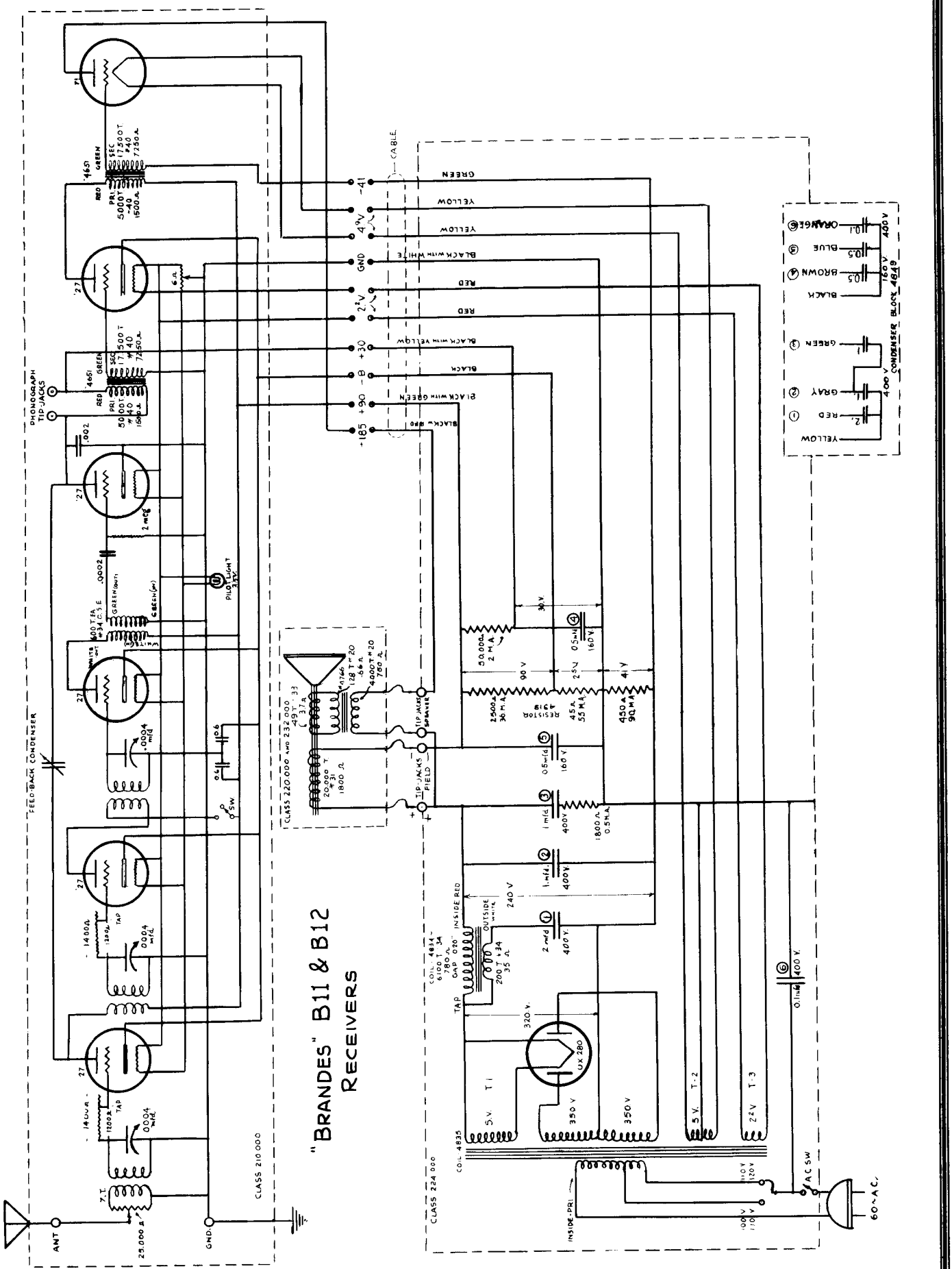

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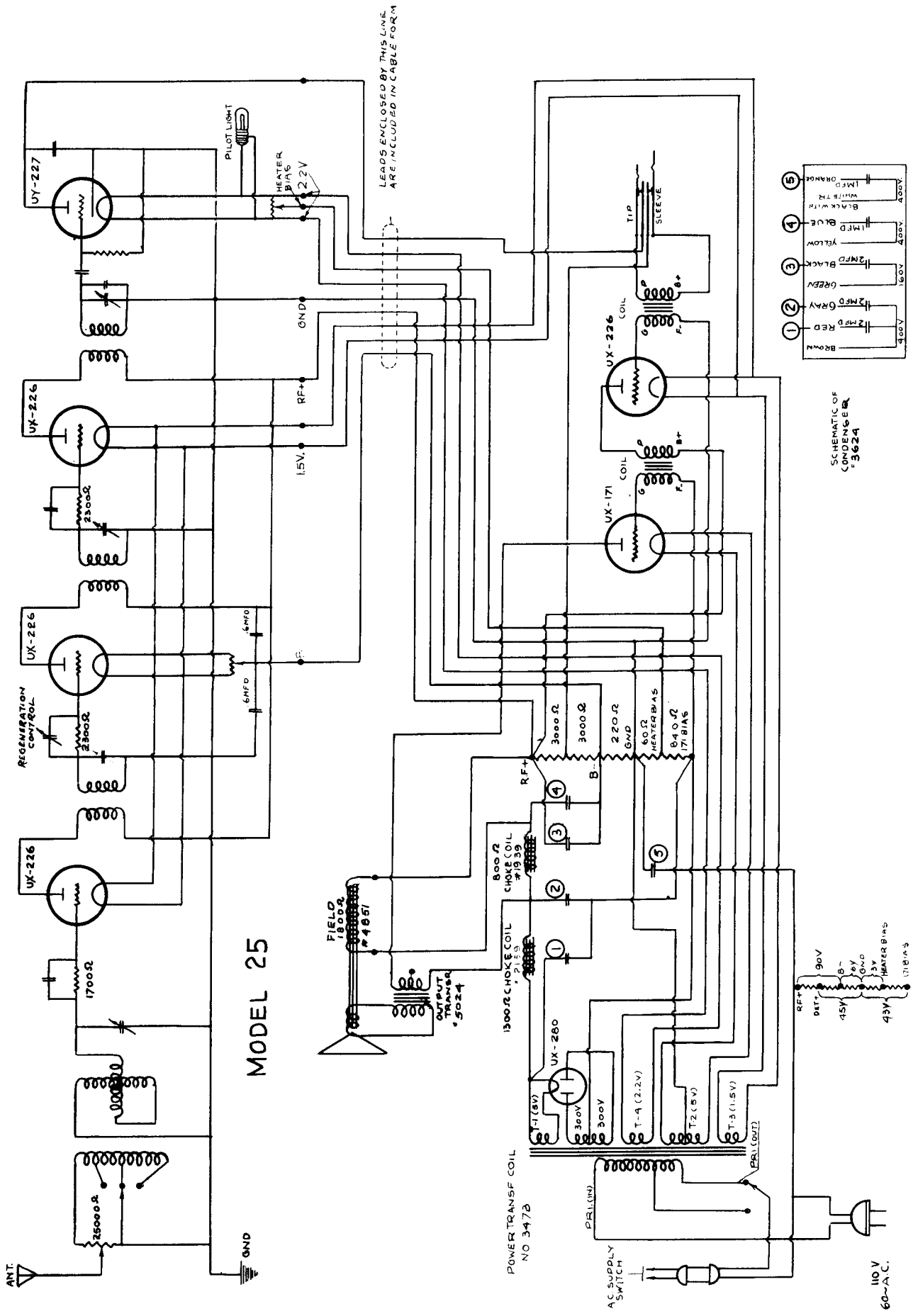

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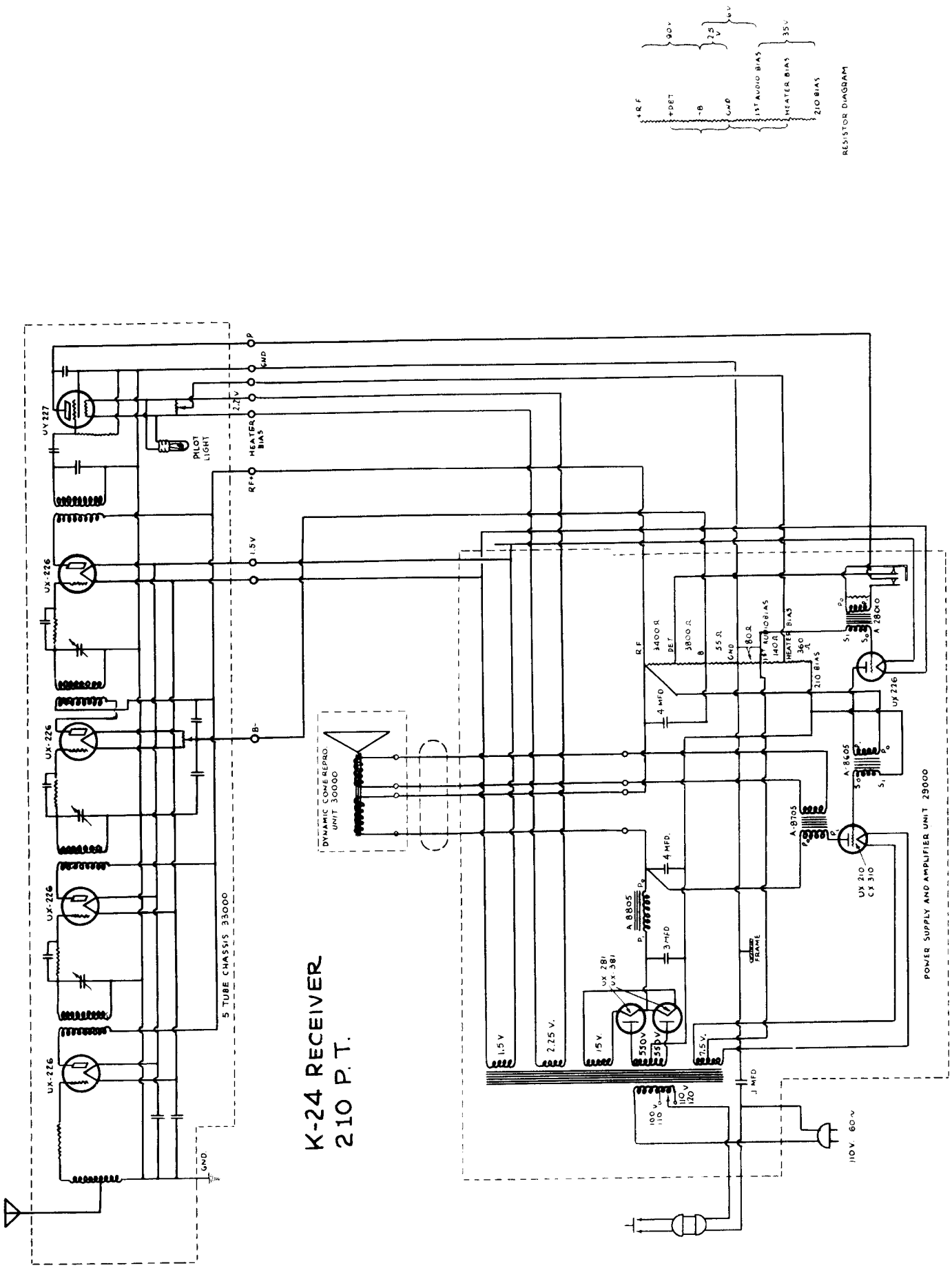

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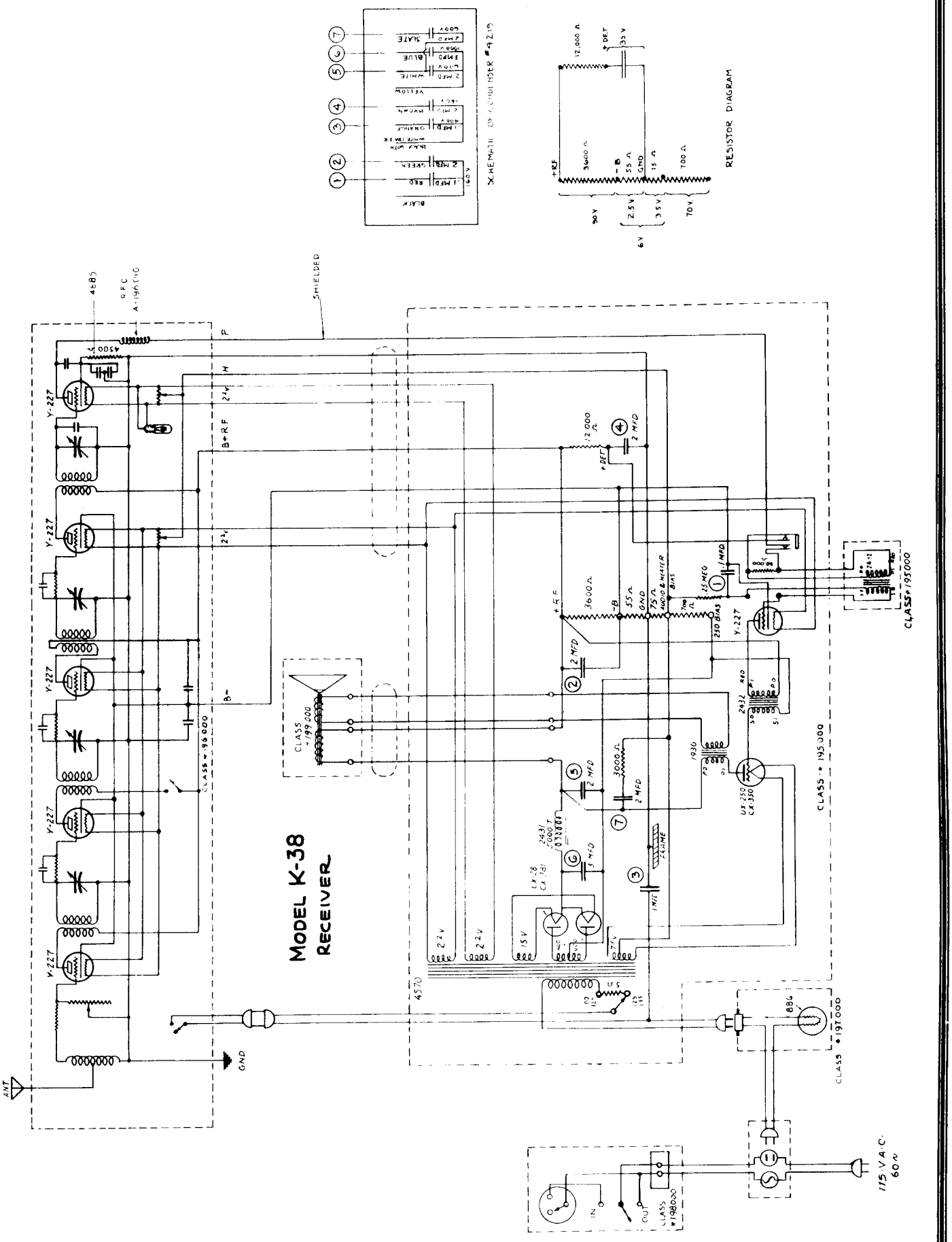

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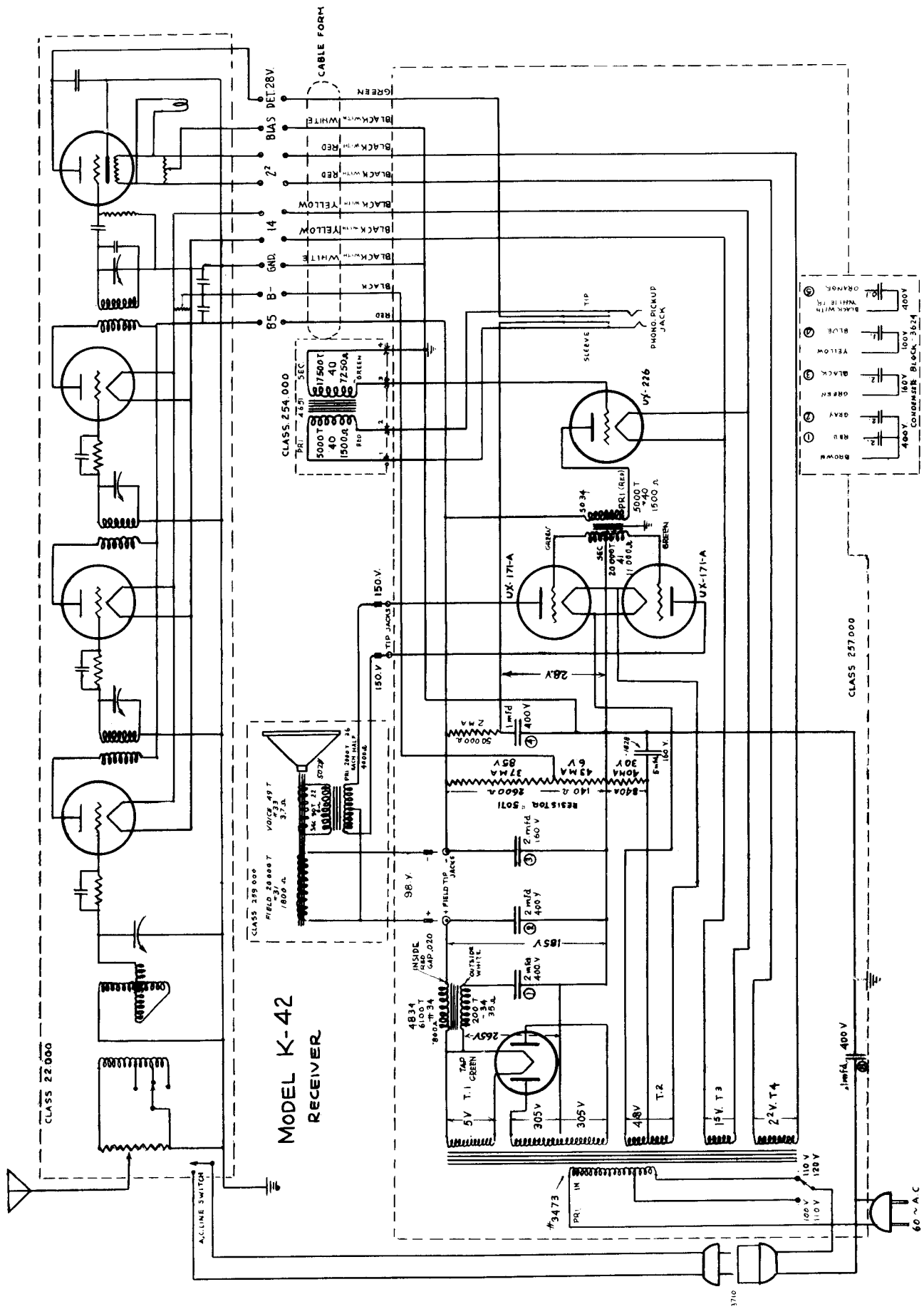

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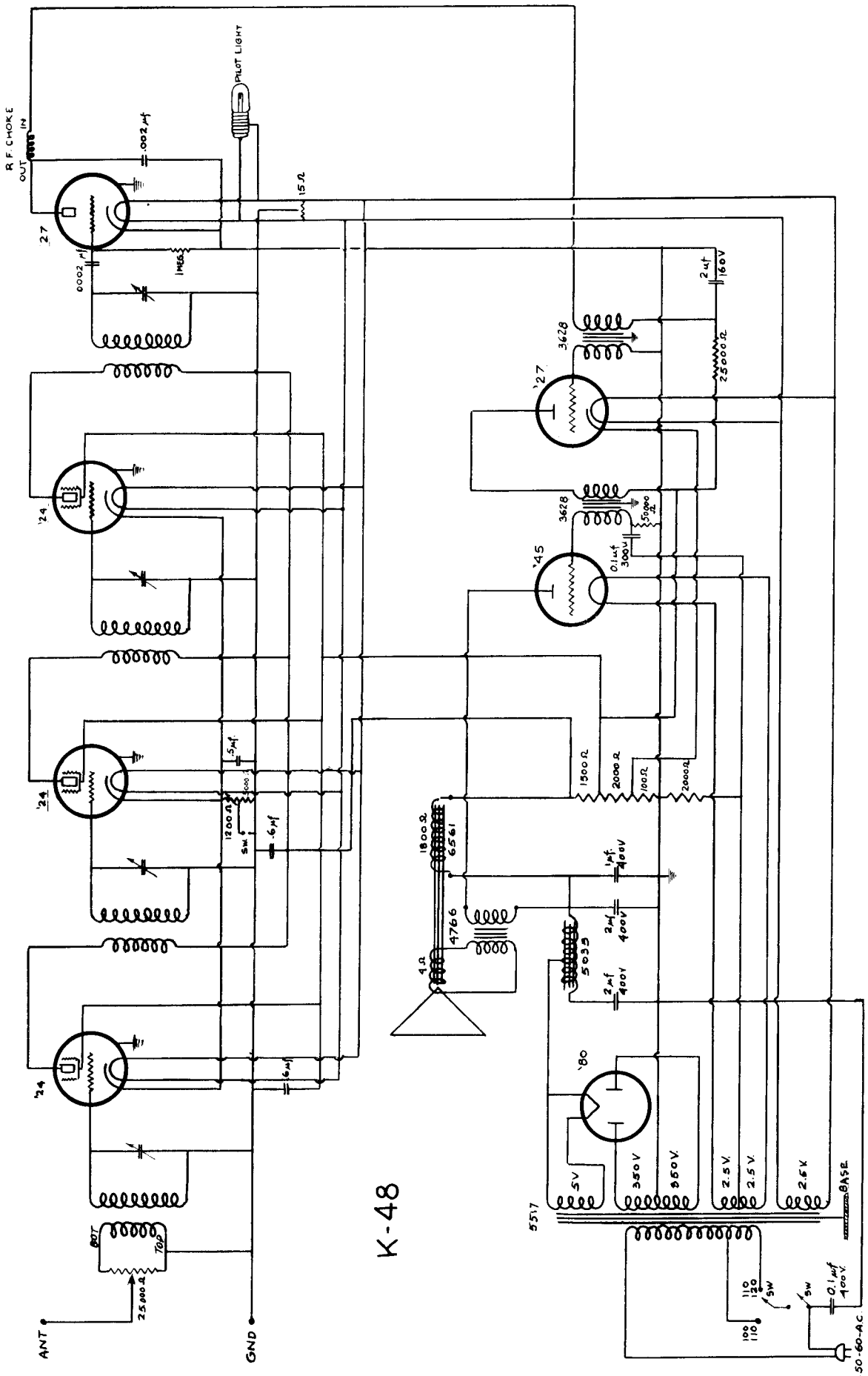

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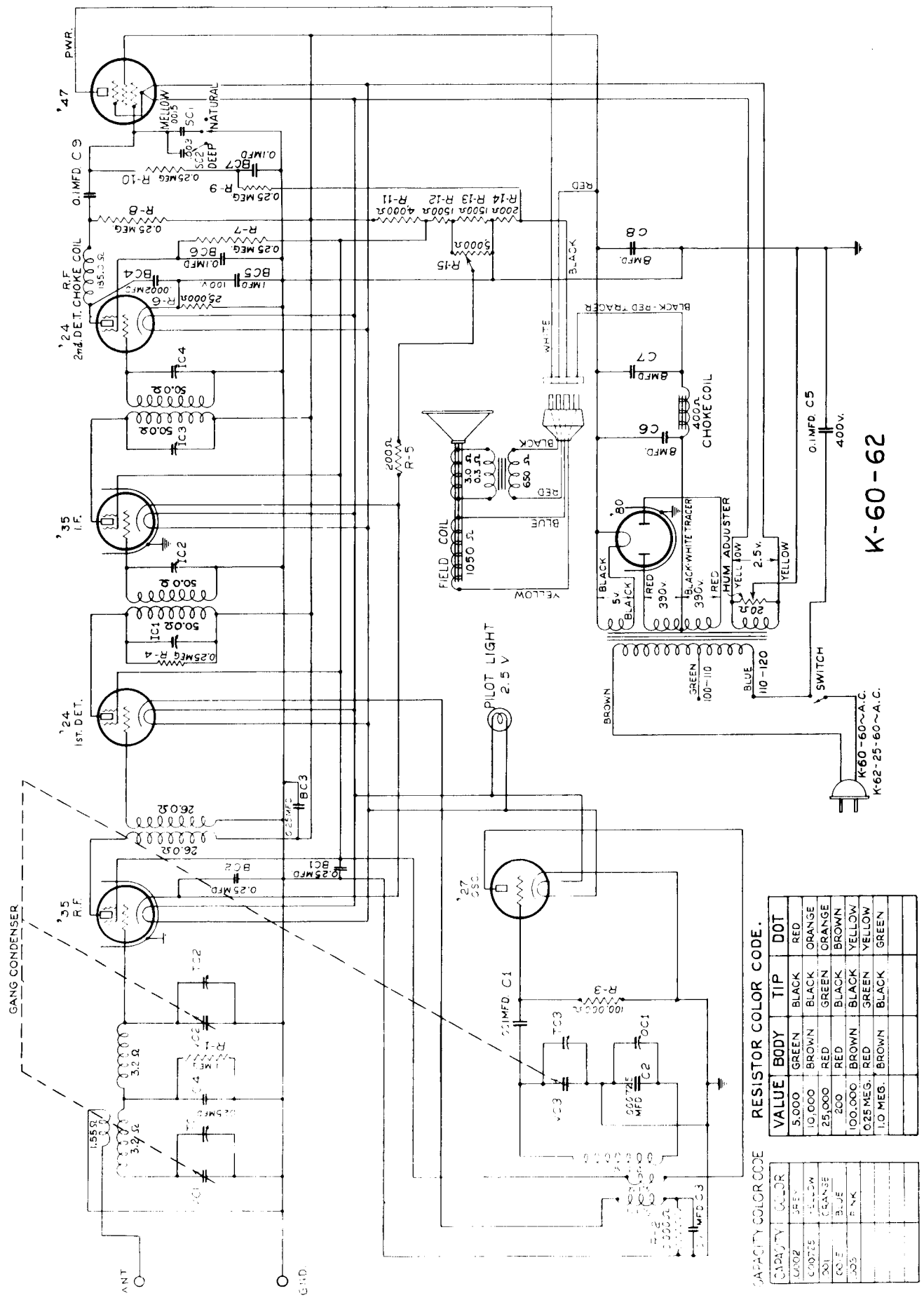

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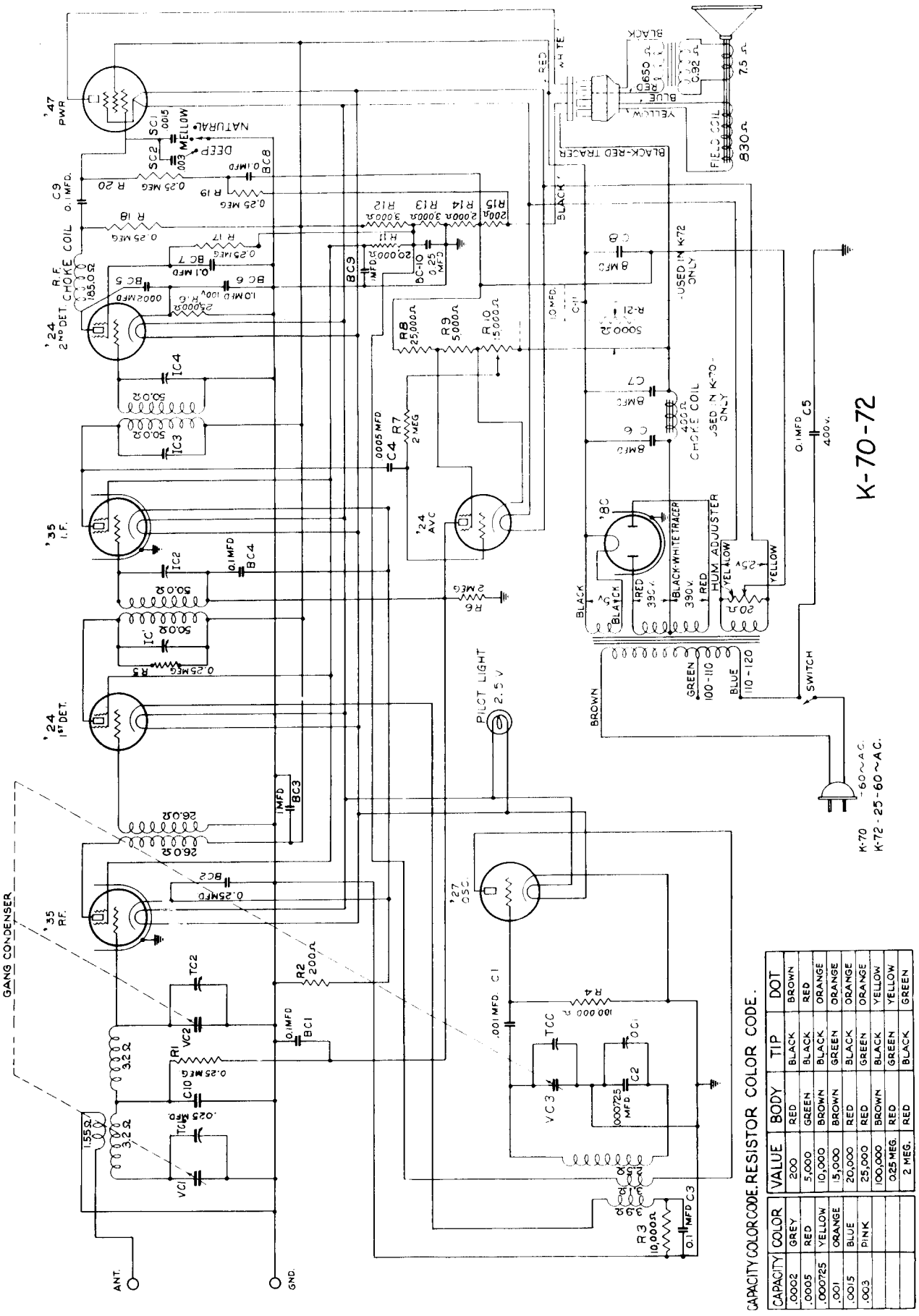


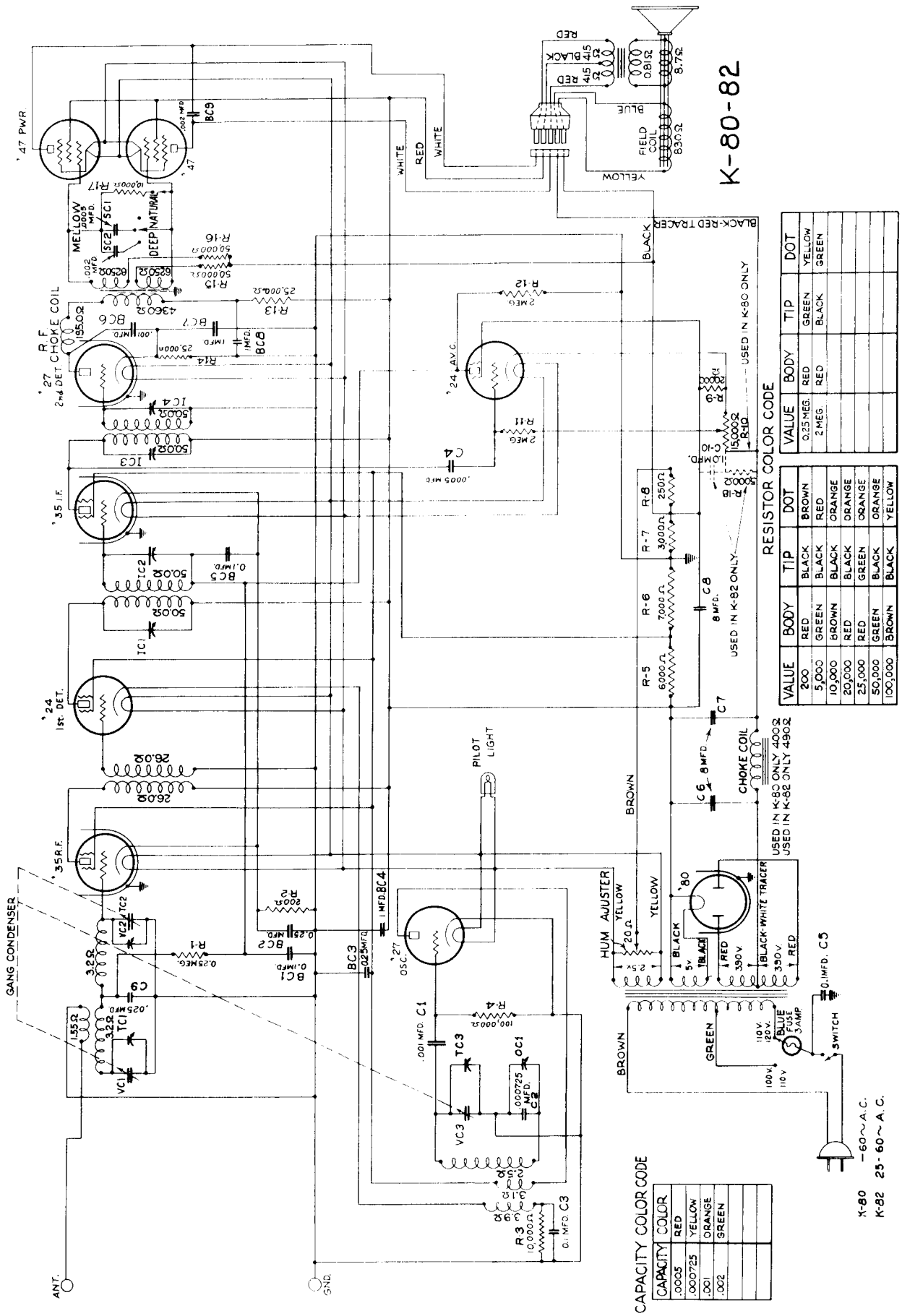
CAPACITY COLOR CODE.

CAPACITY	COLOR
.0002	GREY
.0005	RED
.000725	YELLOW
.001	ORANGE
.0015	BLUE
.003	PINK

RESISTOR COLOR CODE.

VALUE	BODY	TIP	DOT
200	RED	BLACK	BROWN
5,000	GREEN	BLACK	RED
10,000	BROWN	BLACK	ORANGE
15,000	BROWN	GREEN	ORANGE
20,000	RED	BLACK	ORANGE
25,000	RED	GREEN	ORANGE
100,000	BROWN	BLACK	YELLOW
0.25 MEG.	RED	GREEN	YELLOW
2 MEG.	RED	BLACK	GREEN

BRANDES PRODUCTS CORP.



RESISTOR COLOR CODE

VALUE	BODY	TIP	DOT
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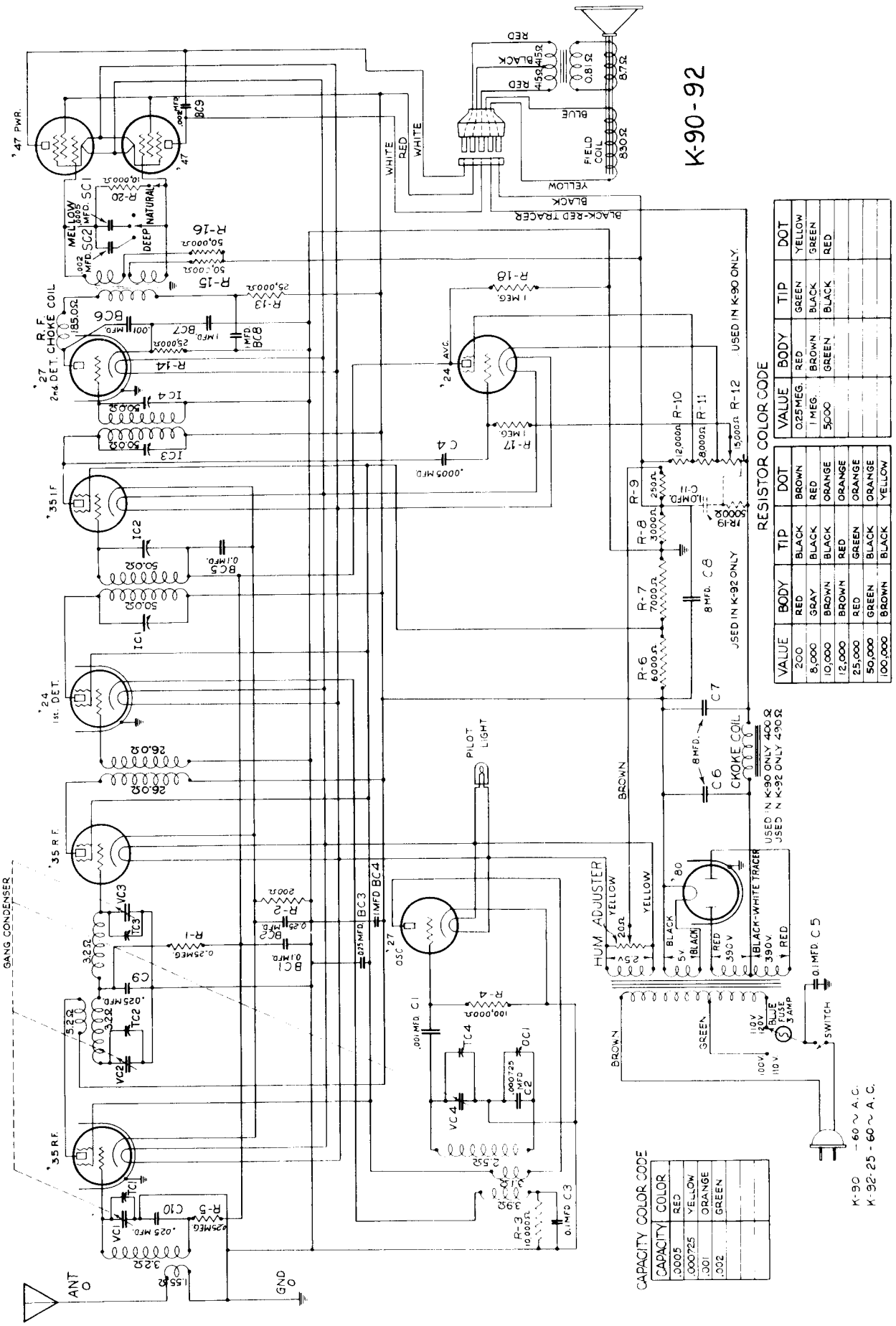
5,000	GREEN	BLACK	RED
10,000	BROWN	BLACK	ORANGE
20,000	RED	BLACK	ORANGE
25,000	RED	GREEN	ORANGE
50,000	GREEN	BLACK	ORANGE
100,000	BROWN	BLACK	YELLOW

VALUE	BODY	TIP	DOT
0.25 MEG.	RED	GREEN	YELLOW
2 MEG.	RED	BLACK	GREEN

CAPACITY COLOR CODE

CAPACITY	COLOR
.0005	RED
.000725	YELLOW
.001	ORANGE
.002	GREEN

BRANDES PRODUCTS CORP.



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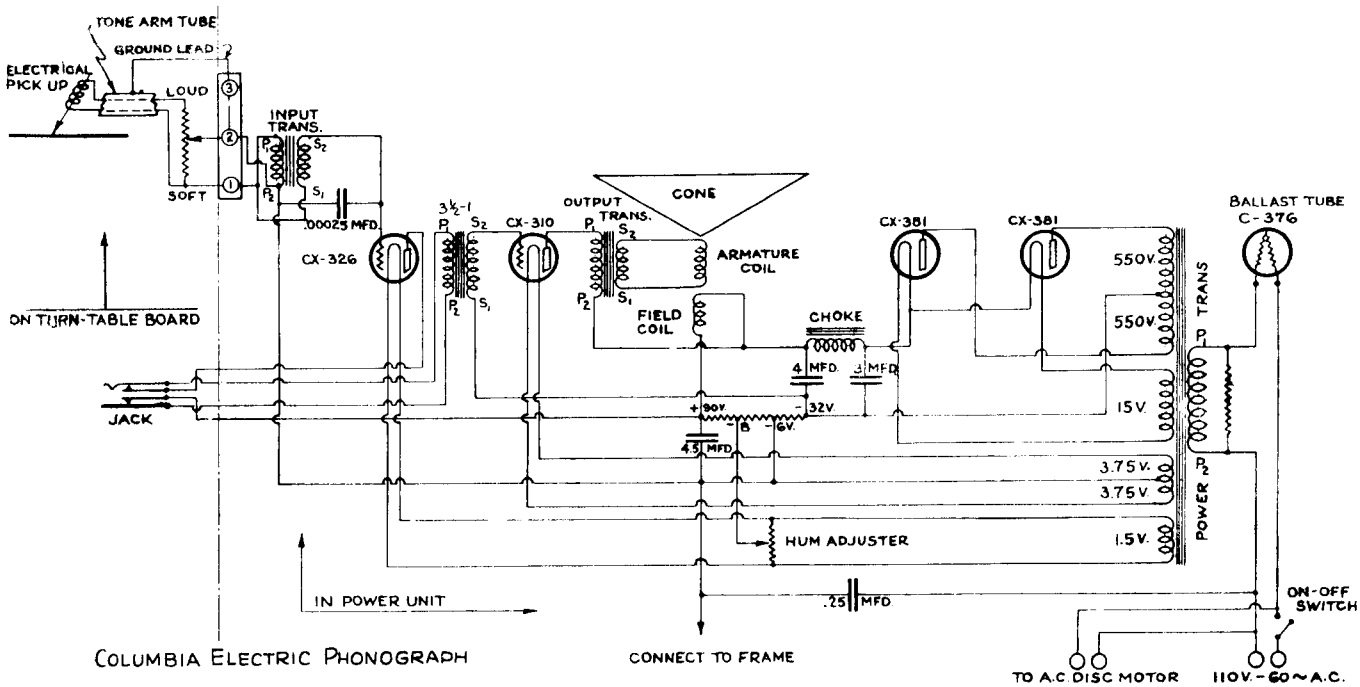
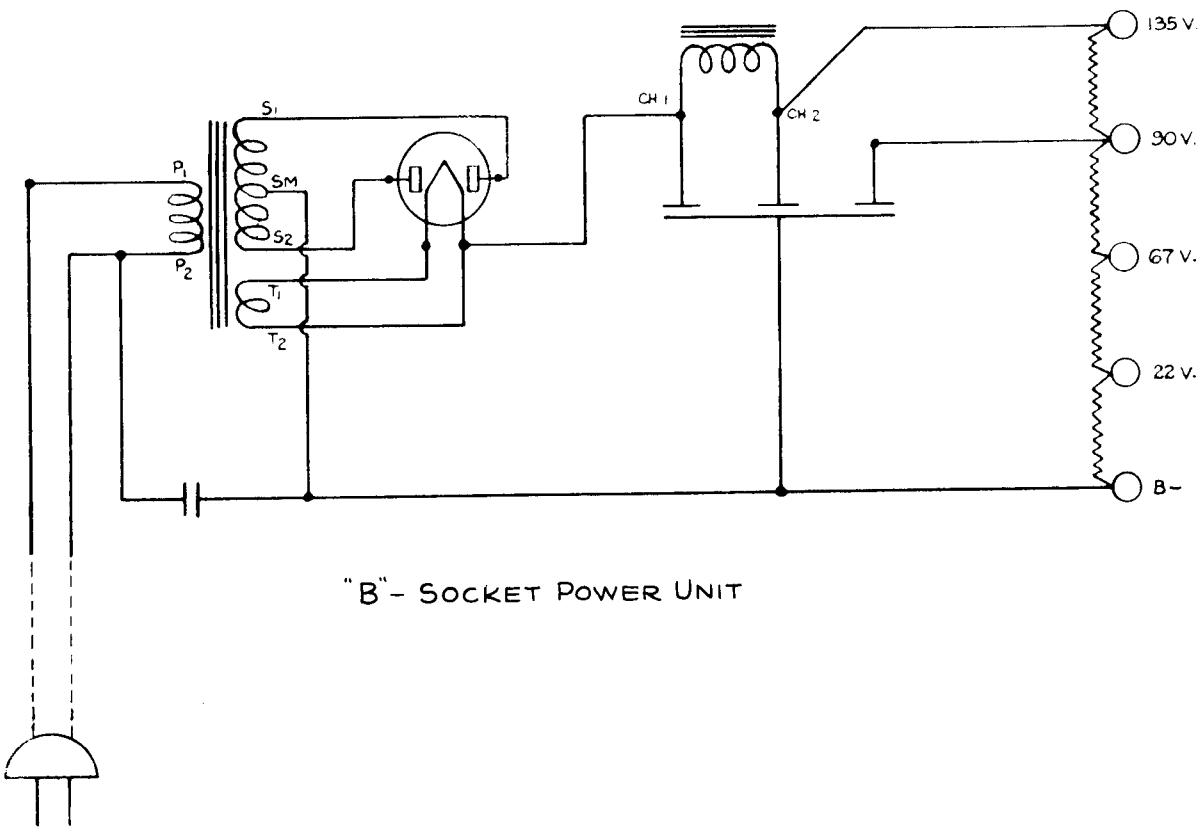
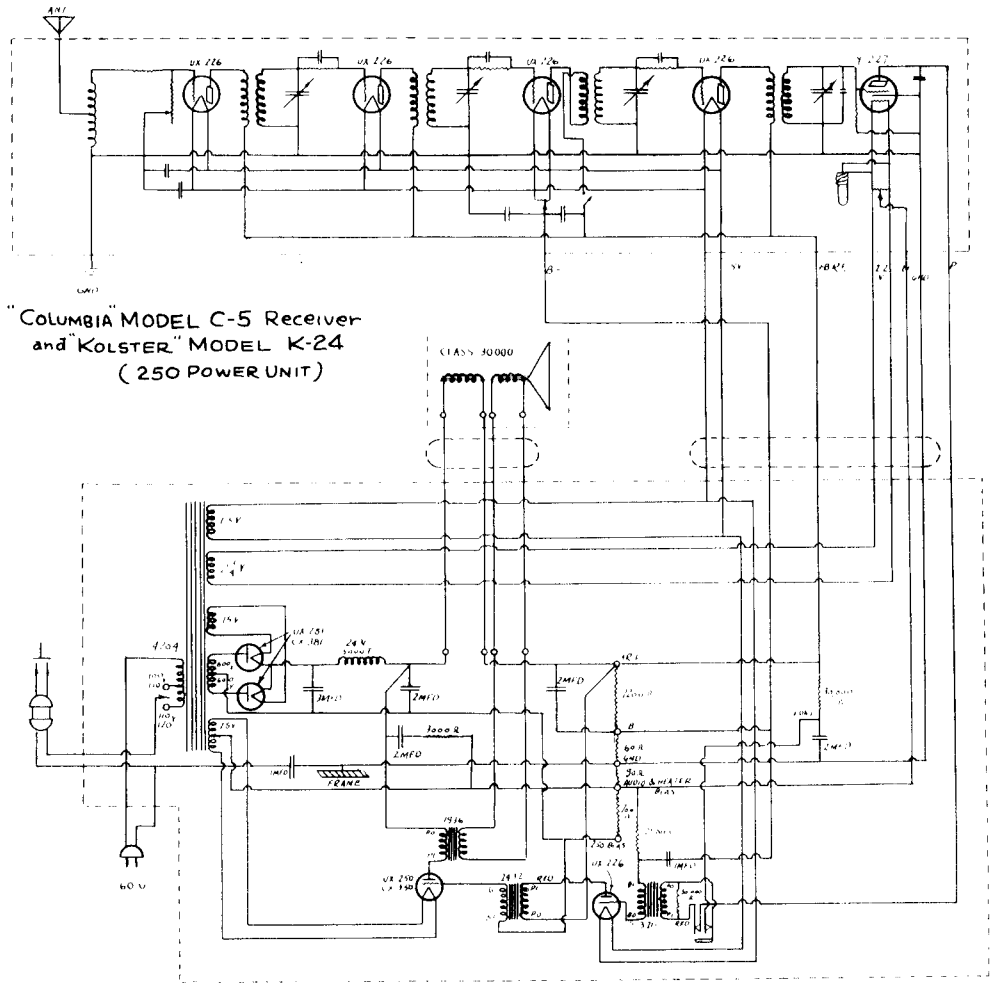


COLUMBIA ELECTRIC PHONOGRAPH

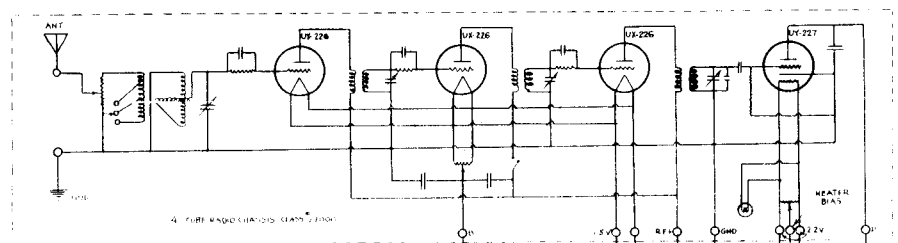


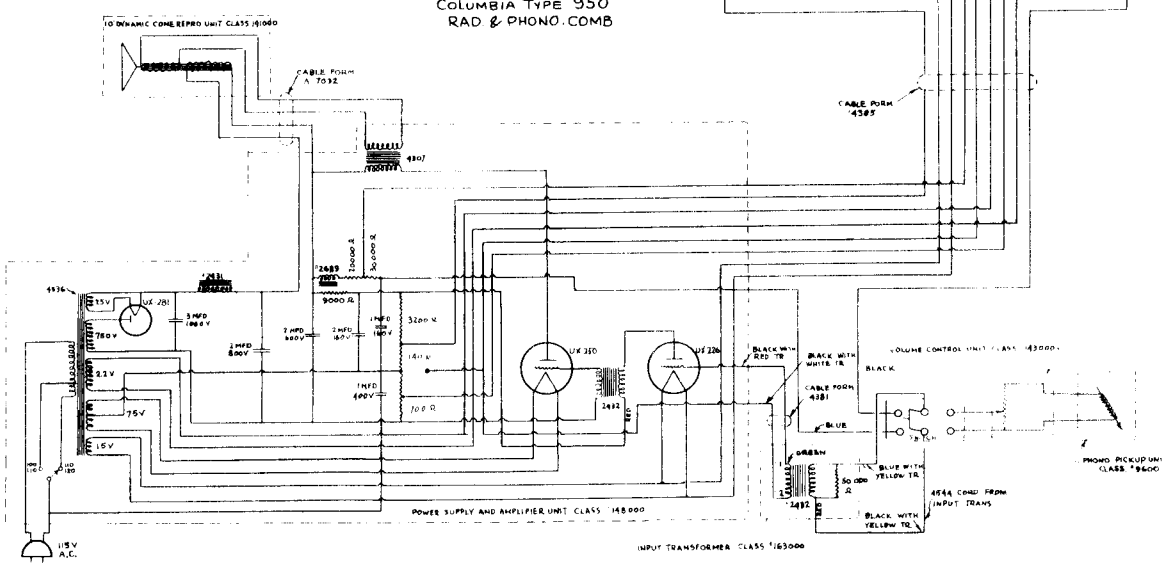
"B"- SOCKET POWER UNIT

BRANDES PRODUCTS CORP.



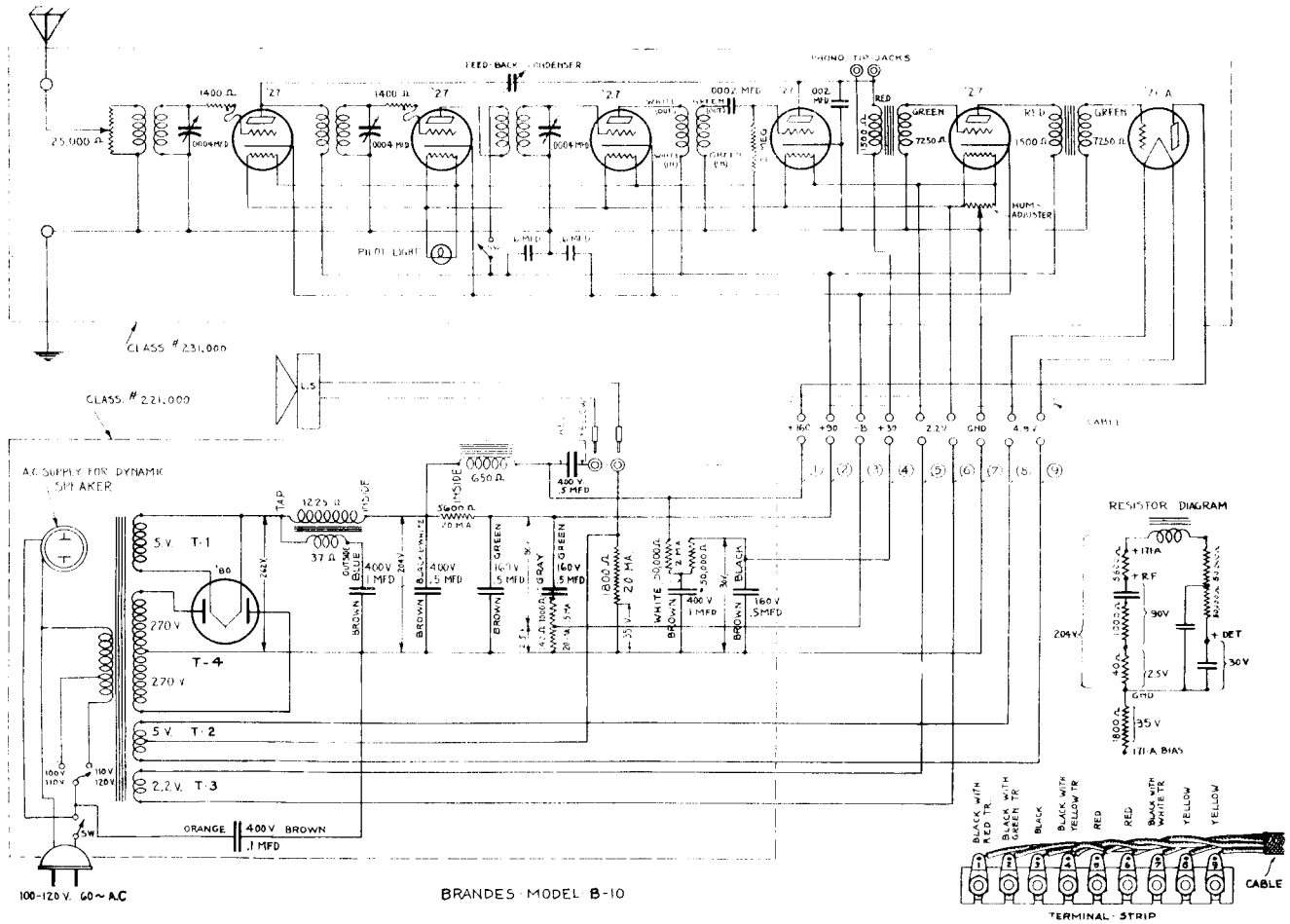
"COLUMBIA" MODEL C-5 Receiver
and "KOLSTER" MODEL K-24
(250 POWER UNIT)

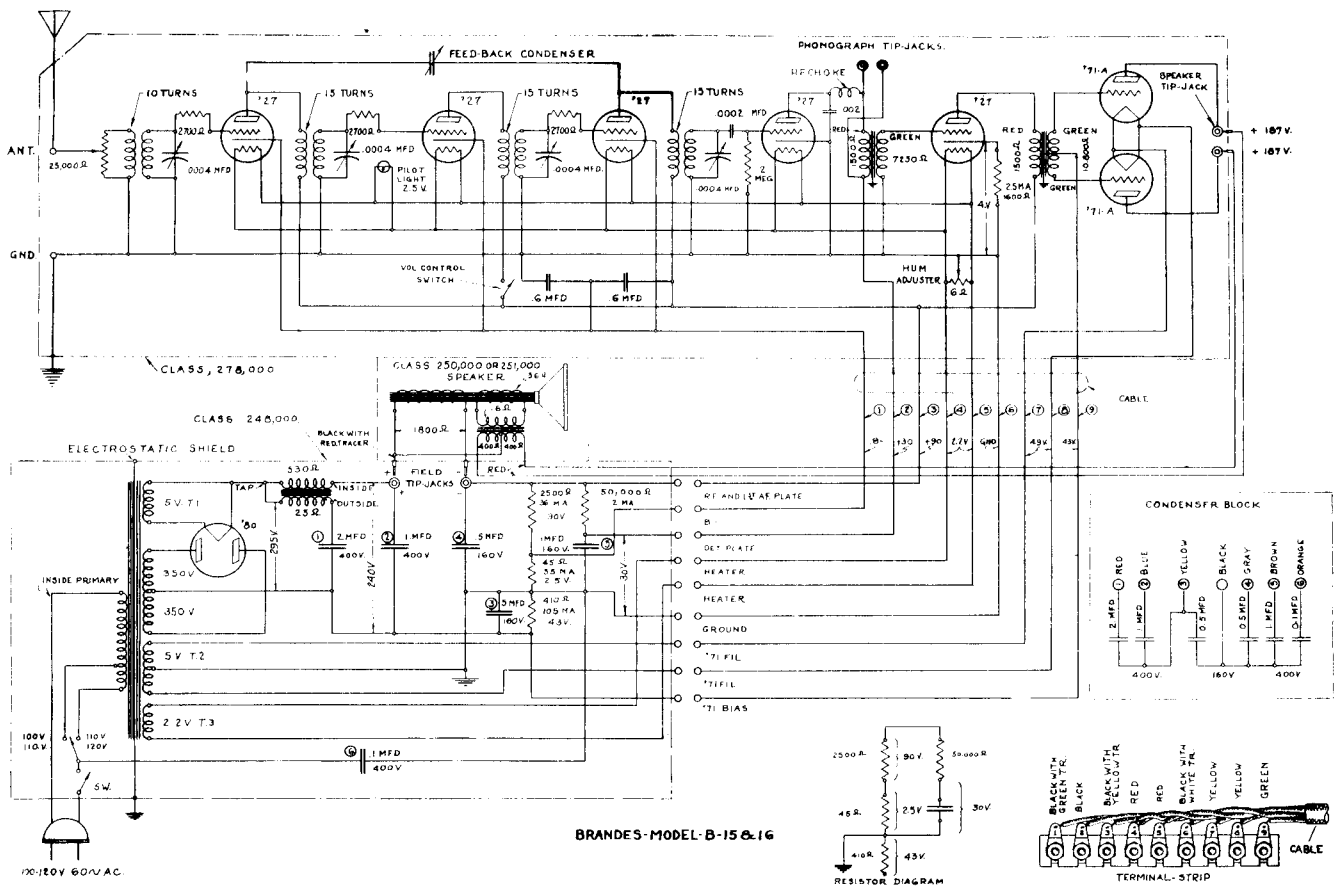




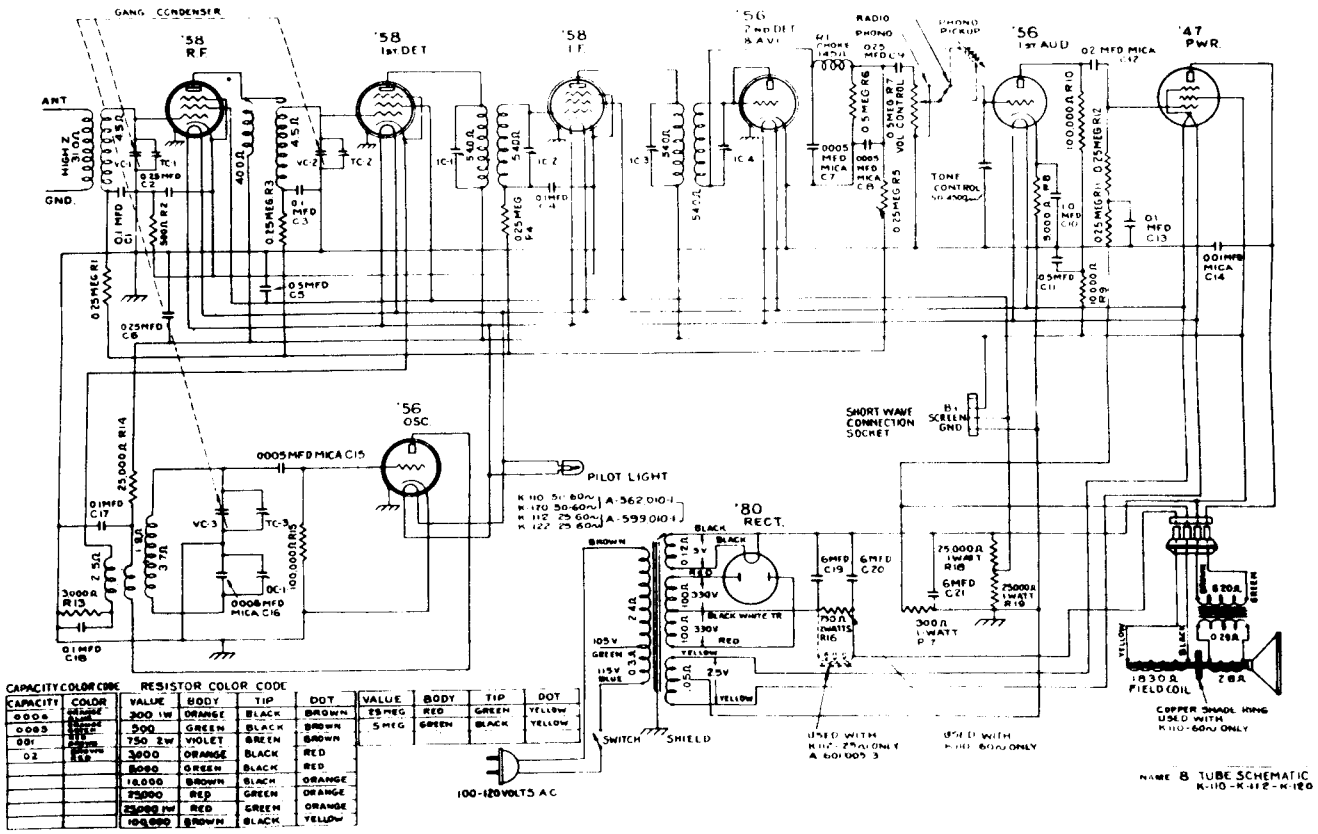
"COLUMBIA" TYPE 950
RAD & PHONO. COMB

BRANDES PRODUCTS CORP.





BRANDES PRODUCTS CORP.



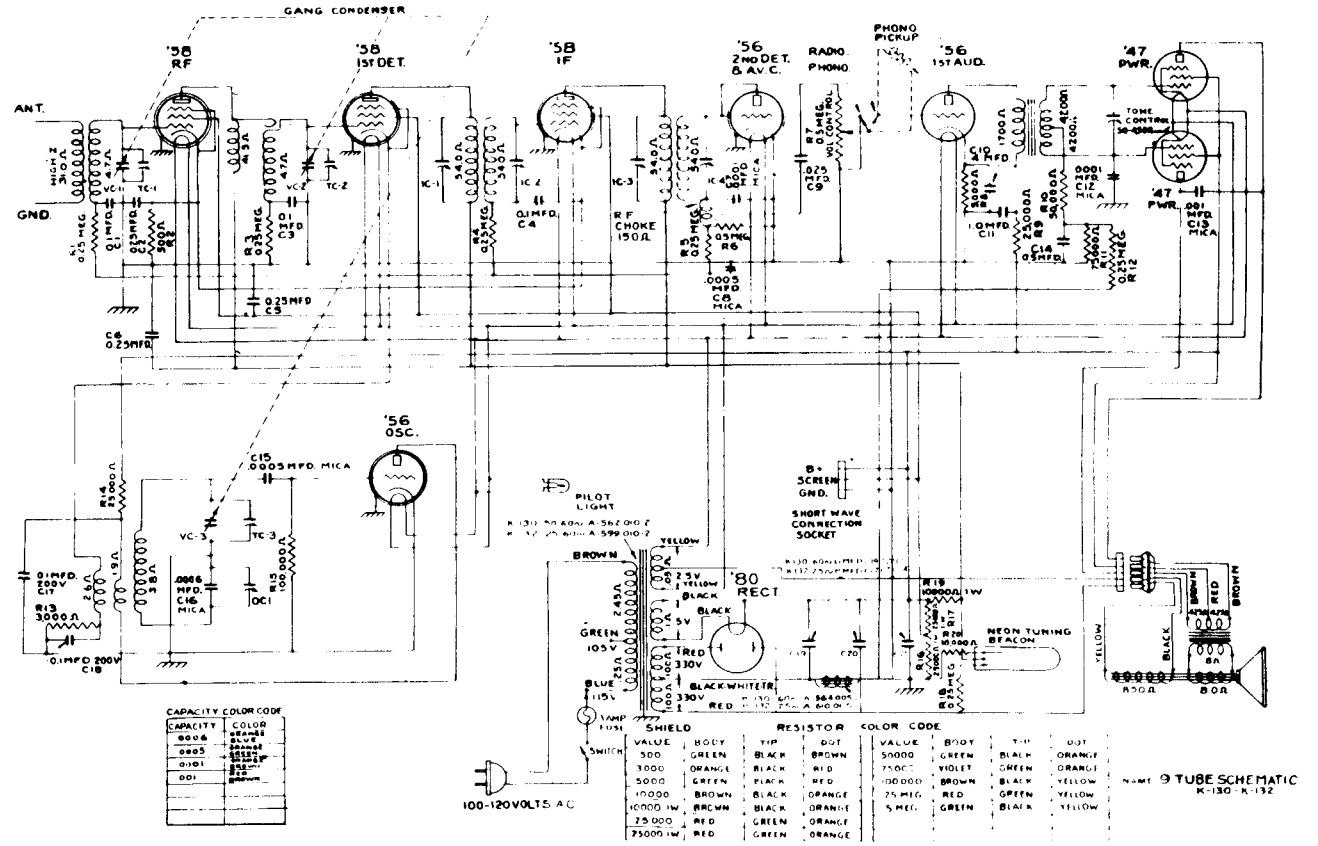
CAPACITY COLOR CODE

CAPACITY	COLOR
.0006	ORANGE
.0003	BLUE
.001	ORANGE
.02	BROWN

RESISTOR COLOR CODE

VALUE	BODY	TIP	DOT
300 1W	ORANGE	BLACK	BROWN
500	GREEN	BLACK	BROWN
750 2W	VIOLET	GREEN	BROWN
3000	ORANGE	BLACK	RED
5000	GREEN	BLACK	RED
10,000	BROWN	BLACK	ORANGE
25000	RED	GREEN	ORANGE
25,000 1W	RED	GREEN	ORANGE
100,000	BROWN	BLACK	YELLOW

VALUE	BODY	TIP	DOT
.25 MEG	RED	GREEN	YELLOW
.5 MEG	GREEN	BLACK	YELLOW



CAPACITY COLOR CODE

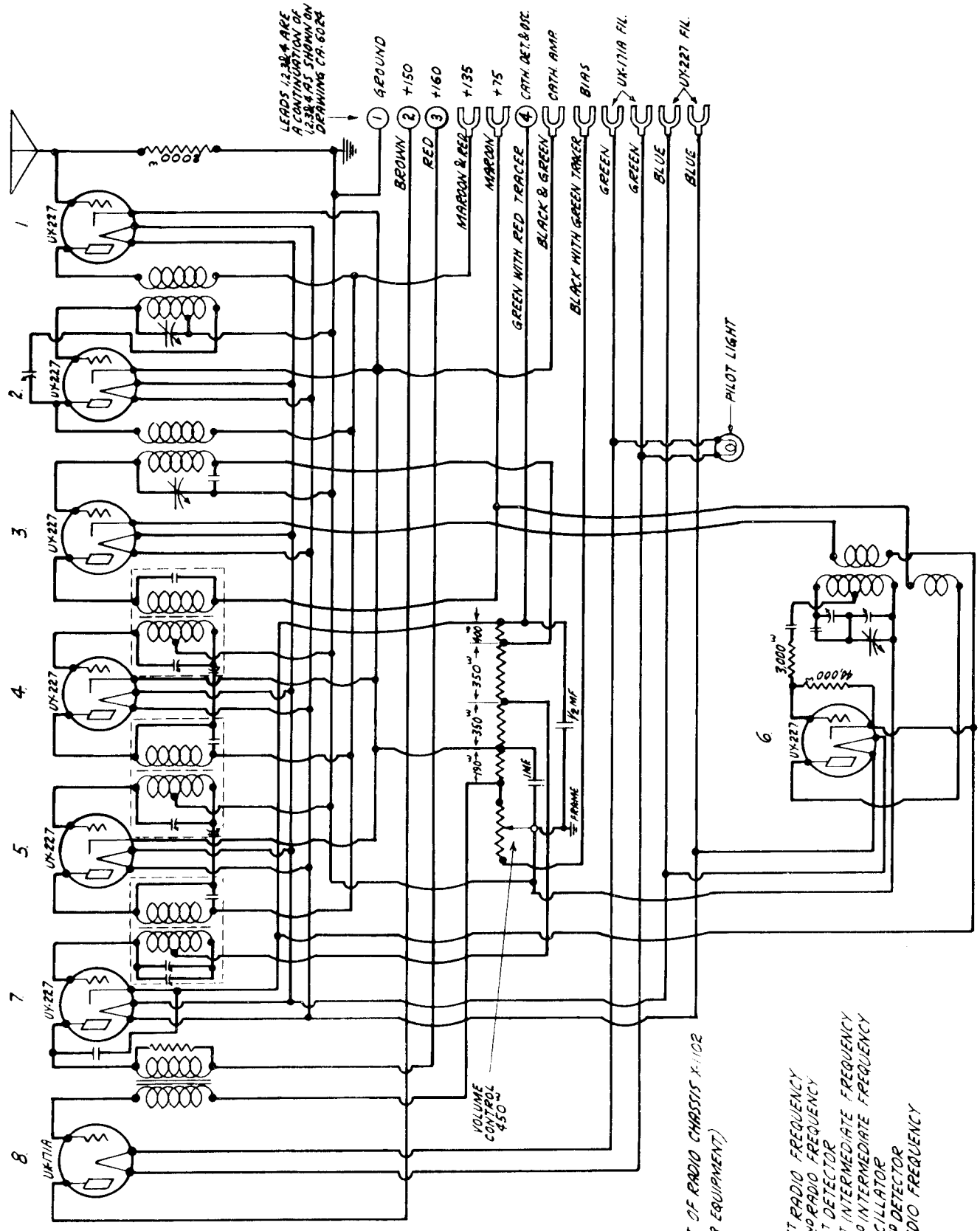
CAPACITY	COLOR
.0006	ORANGE
.0005	BLUE
.0001	ORANGE
.001	BROWN

RESISTOR COLOR CODE

VALUE	BODY	TIP	DOT
500	GREEN	BLACK	BROWN
3000	ORANGE	BLACK	RED
5000	GREEN	BLACK	RED
10000	BROWN	BLACK	ORANGE
10000 1W	BROWN	BLACK	ORANGE
25,000	RED	GREEN	ORANGE
25000 1W	RED	GREEN	ORANGE

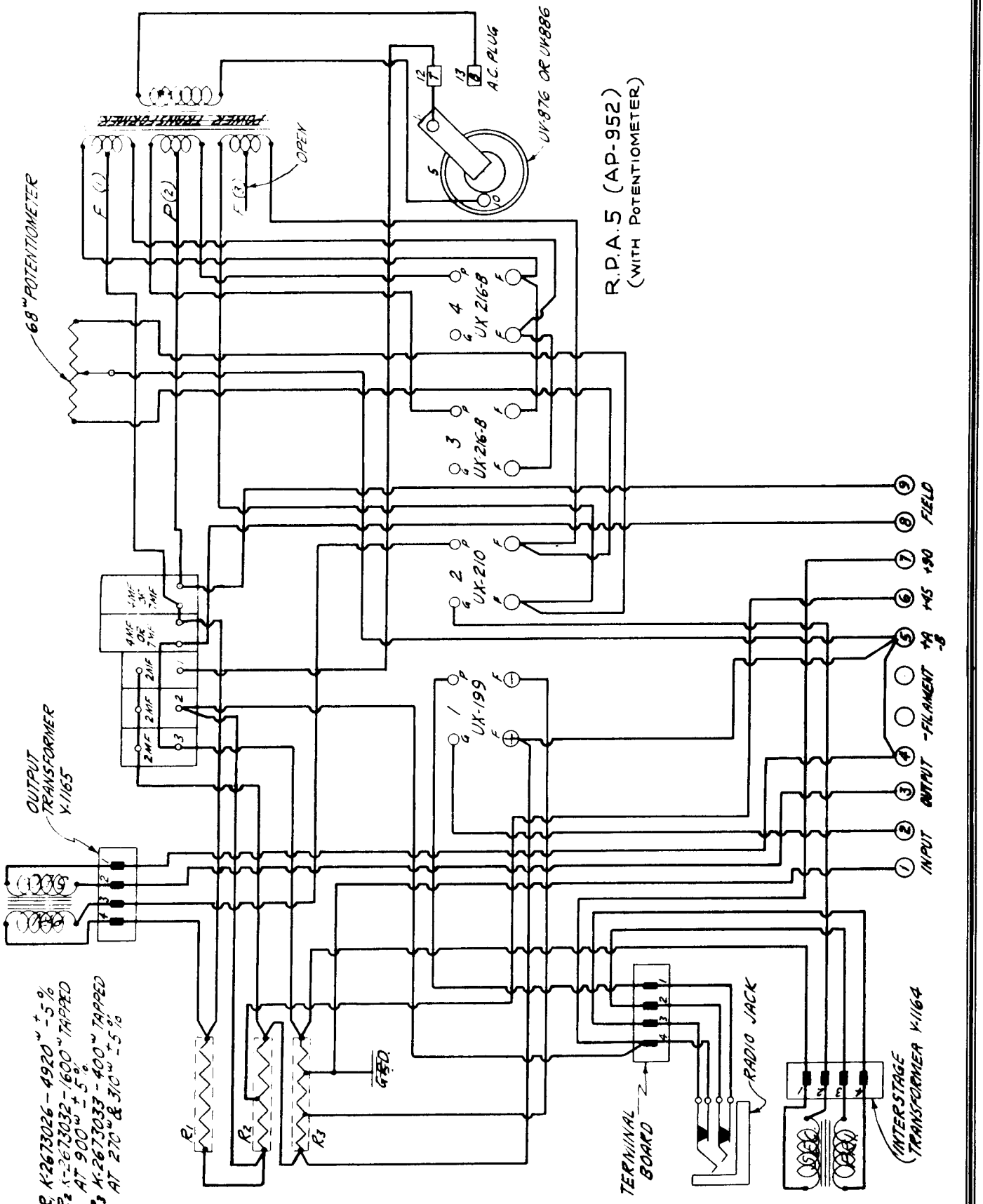
VALUE	BODY	TIP	DOT
50000	GREEN	BLACK	ORANGE
75000	VIOLET	GREEN	ORANGE
100000	BROWN	BLACK	YELLOW
.25 MEG	RED	GREEN	YELLOW
.5 MEG	GREEN	BLACK	YELLOW

BRUNSWICK-BALKE-COLLENDER CO.

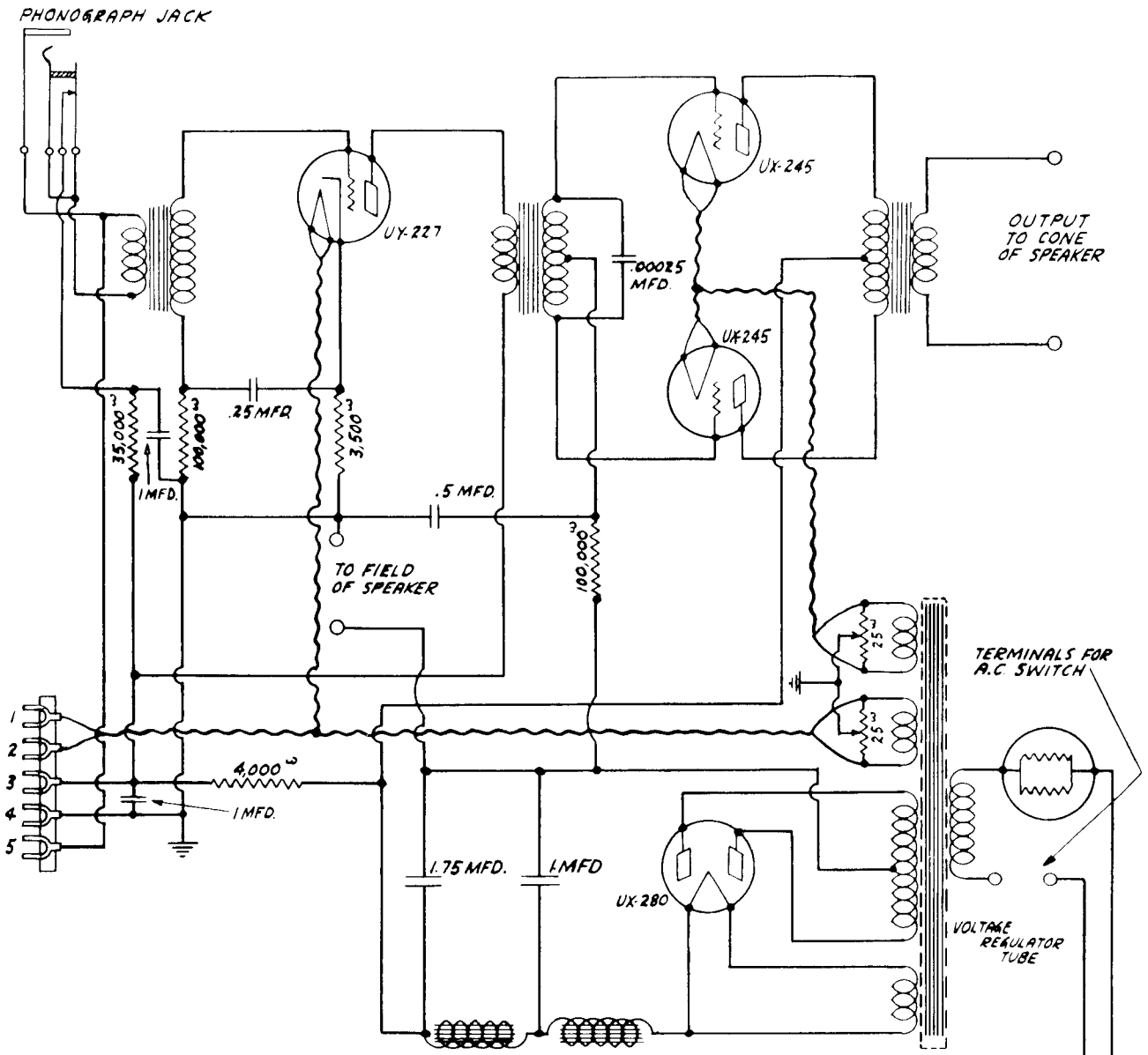


SCHEMATIC CIRCUIT OF RADIO CHASSIS X-1102
(USED WITH 5NC8 EQUIPMENT)

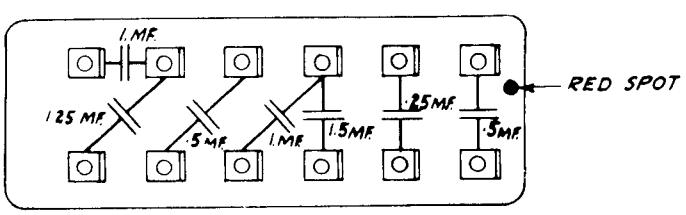
BRUNSWICK-BALKE-COLLENDER CO.



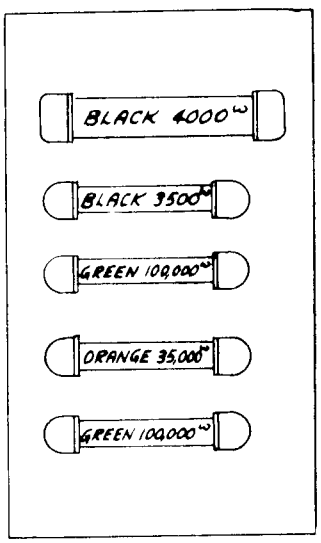
BRUNSWICK-BALKE-COLLENDER CO.



SCHEMATIC CIRCUIT OF SOCKET POWER UNIT
(USED ON #14 & #21 RADIOS)

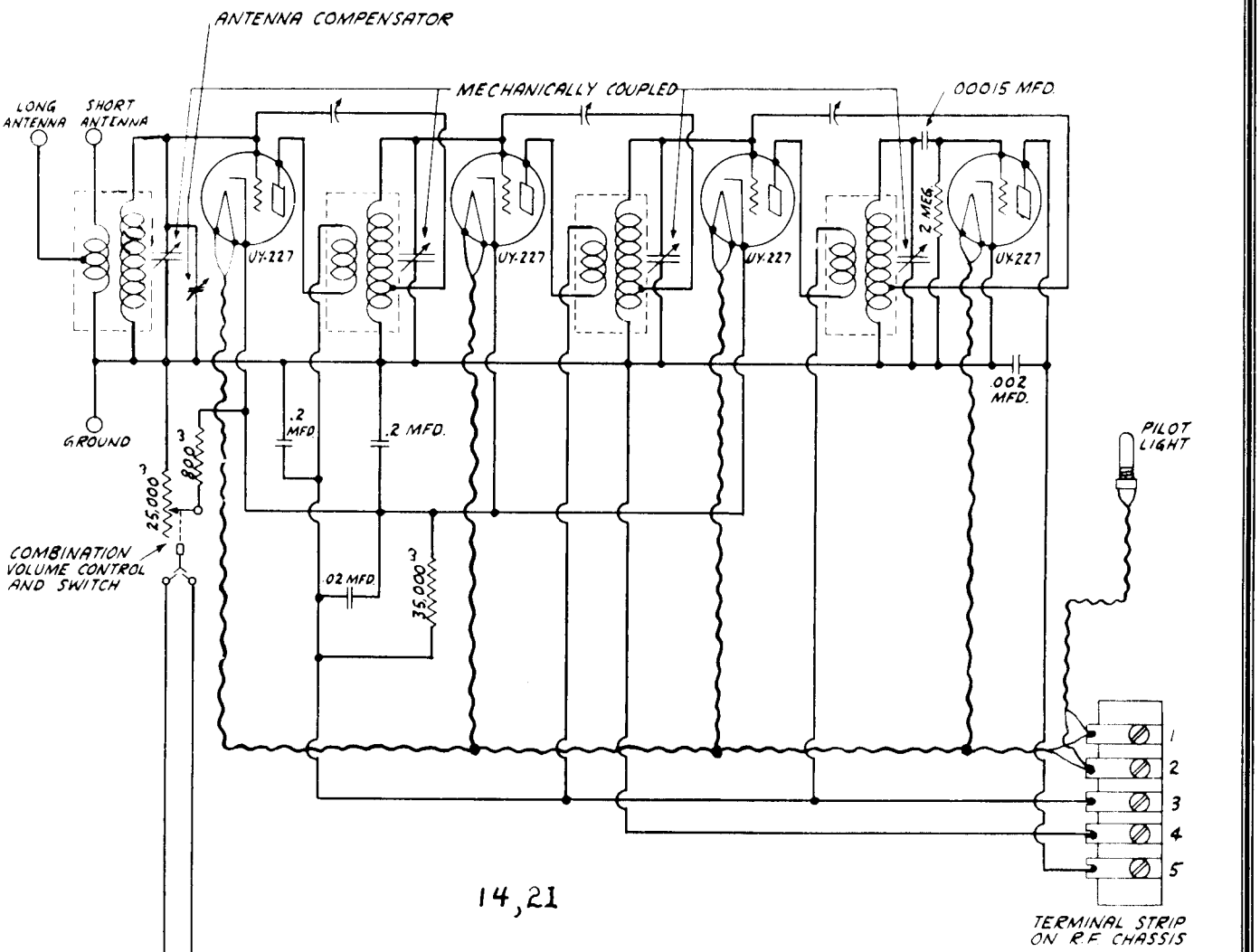


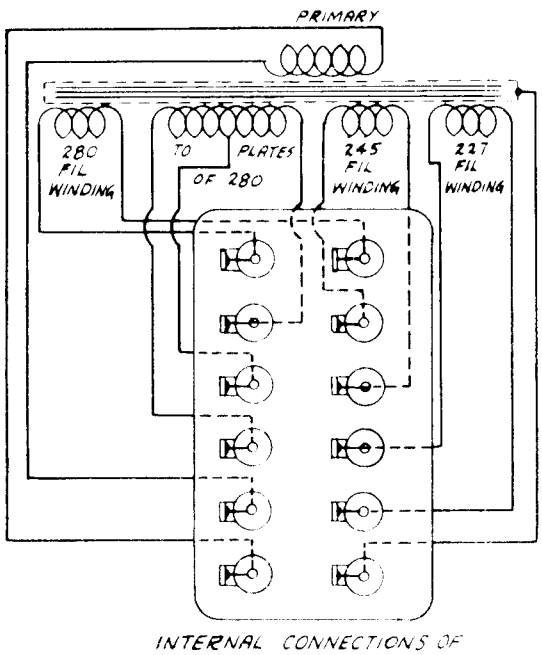
INTERNAL CONNECTIONS OF FILTER
AND BY-PASS CONDENSERS



ARRANGEMENT OF RESISTORS
ON TERMINAL BOARD

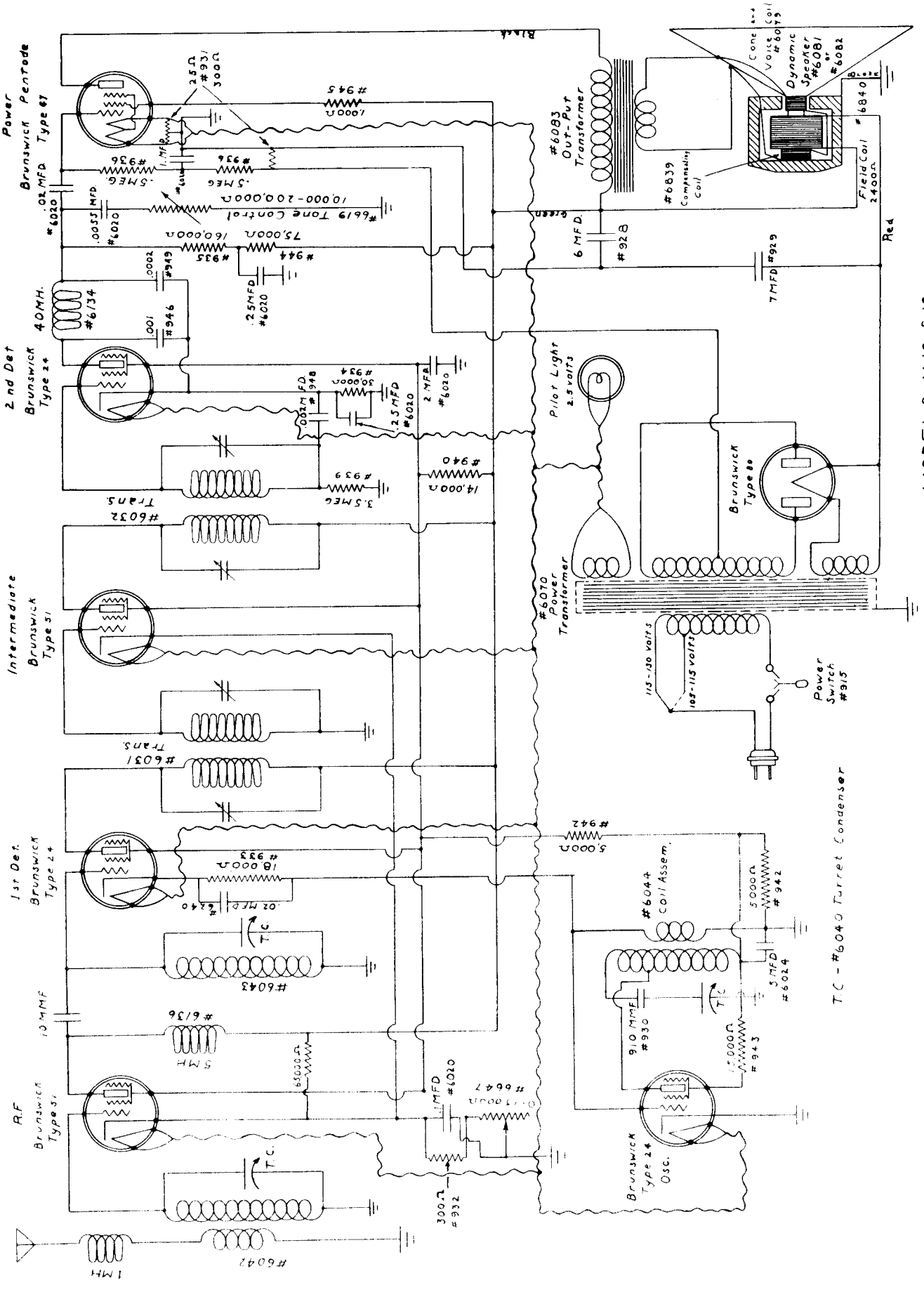
BRUNSWICK-BALKE-COLLENDER CO.





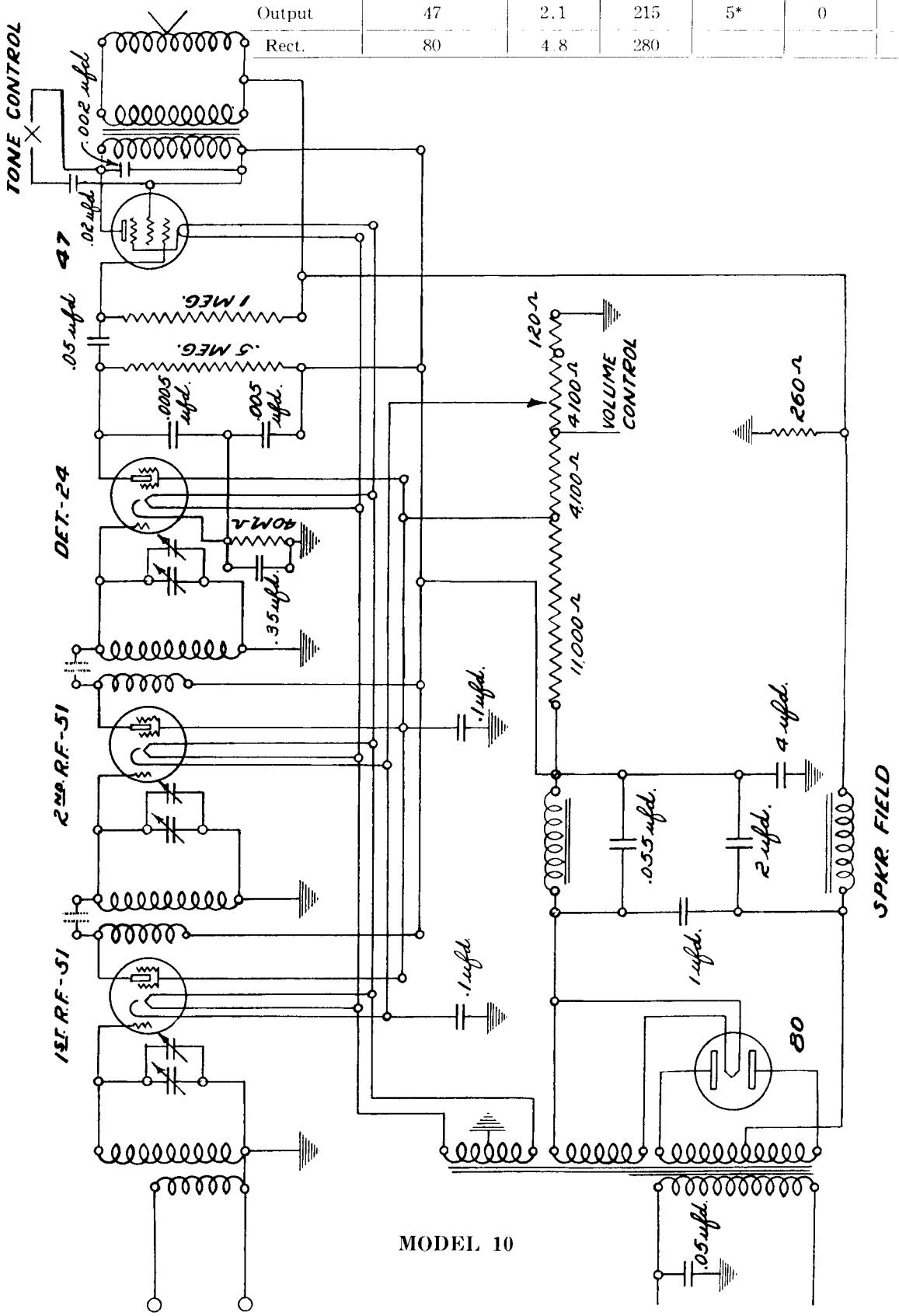
INTERNAL CONNECTIONS OF POWER TRANSFORMER

BRUNSWICK RADIO CORP.



BRUNSWICK RADIO CORP.

Stage	Type Tube	Fil. Volts	Plate Volts	Cont. Grid Volts	Cath. Volts	S. G. Volts	Ip. Normal
1st R. F.	51	2.1	225	2.1	2	75	5
2nd R. F.	51	2.1	230	2.2	2	75	4.5
Det.	24	2.1	160*	7	7.5	75	.02
Output	47	2.1	215	5*	0	225	26.5
Rect.	80	4.8	280				†30

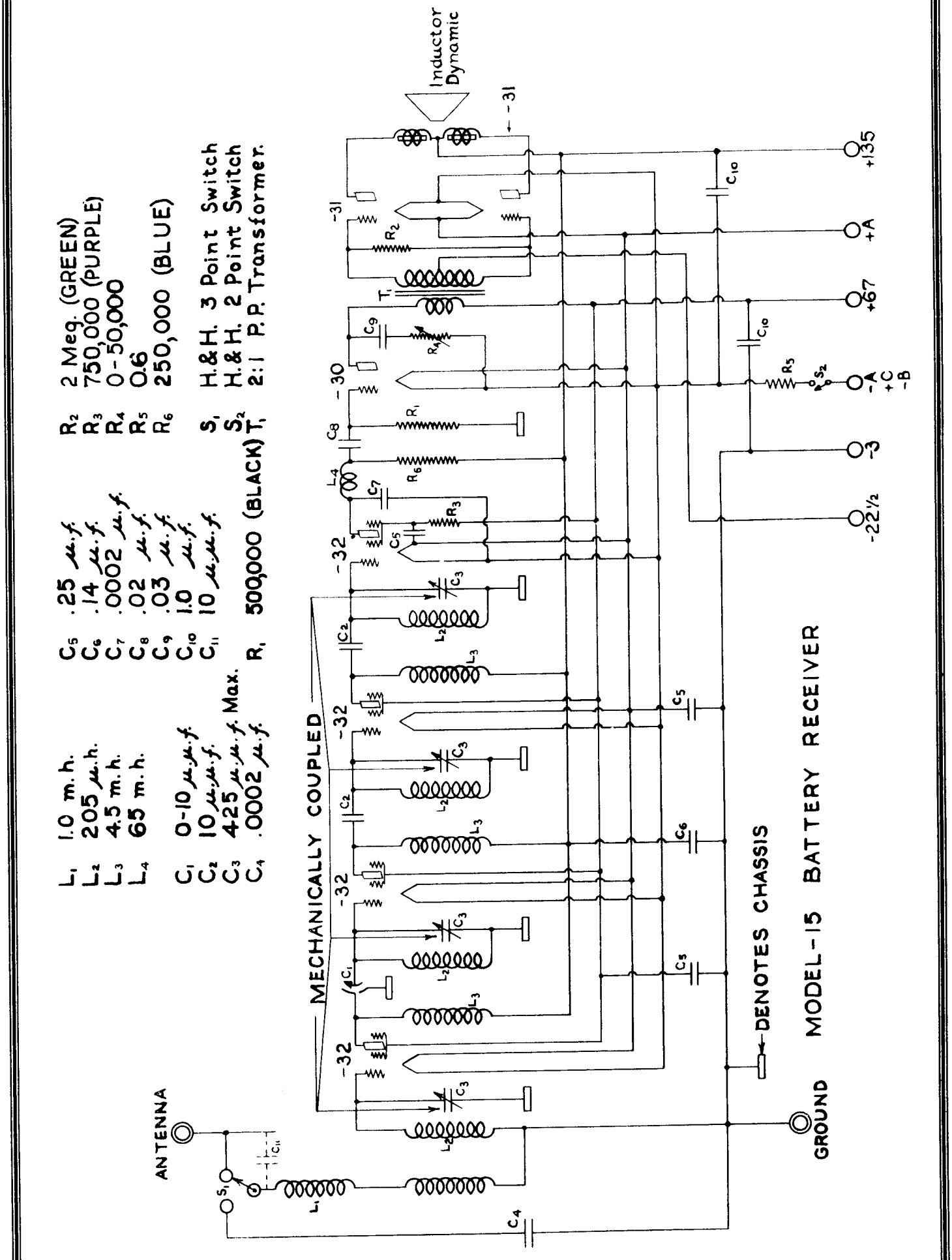


MODEL 10

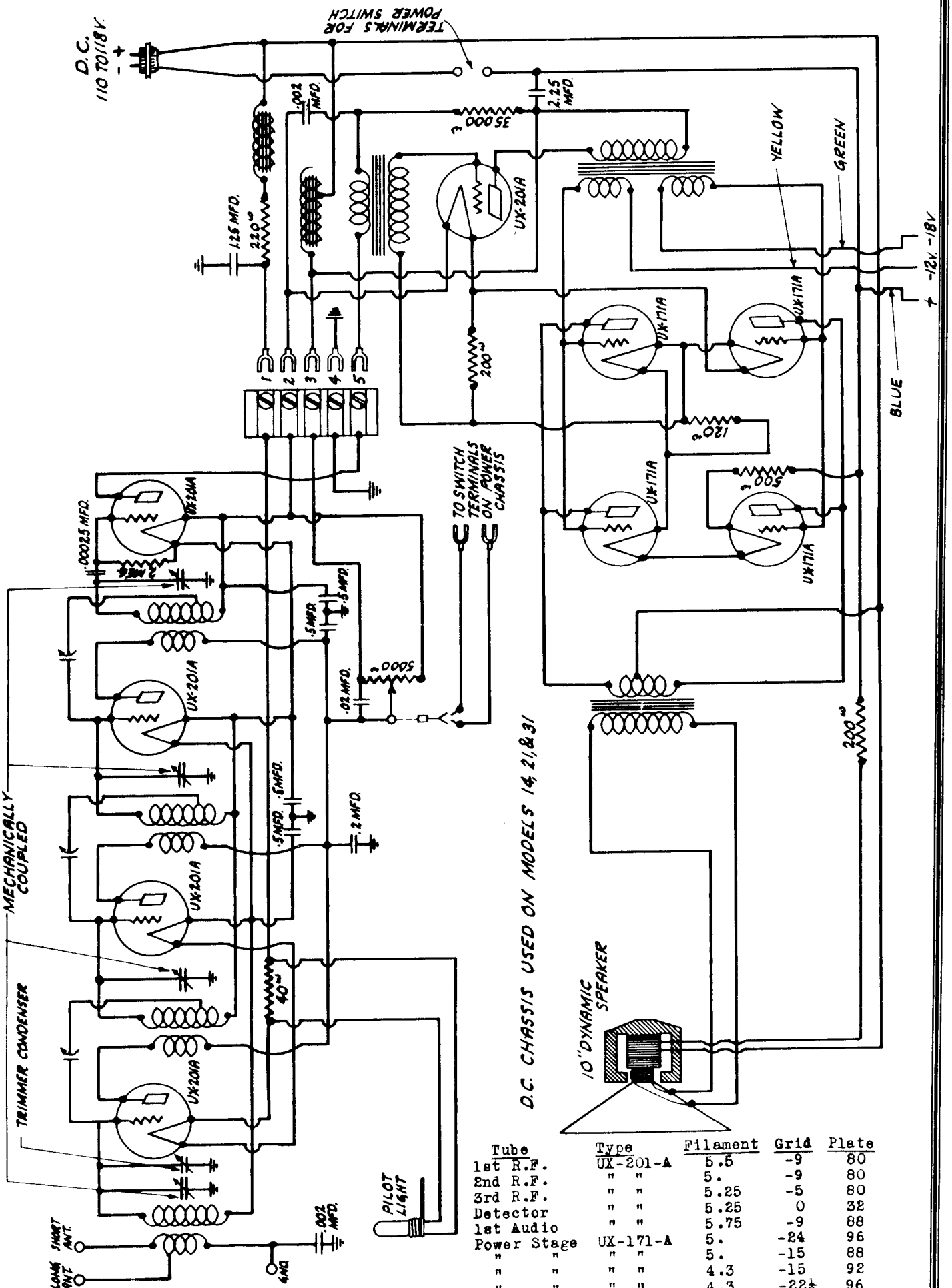
*Reading dependent upon resistance of meter.

†Reading taken for one anode only: 60 milliamperes would be about correct. Volume control position full. Line voltage 115—60 cycle.

BRUNSWICK RADIO CORP.

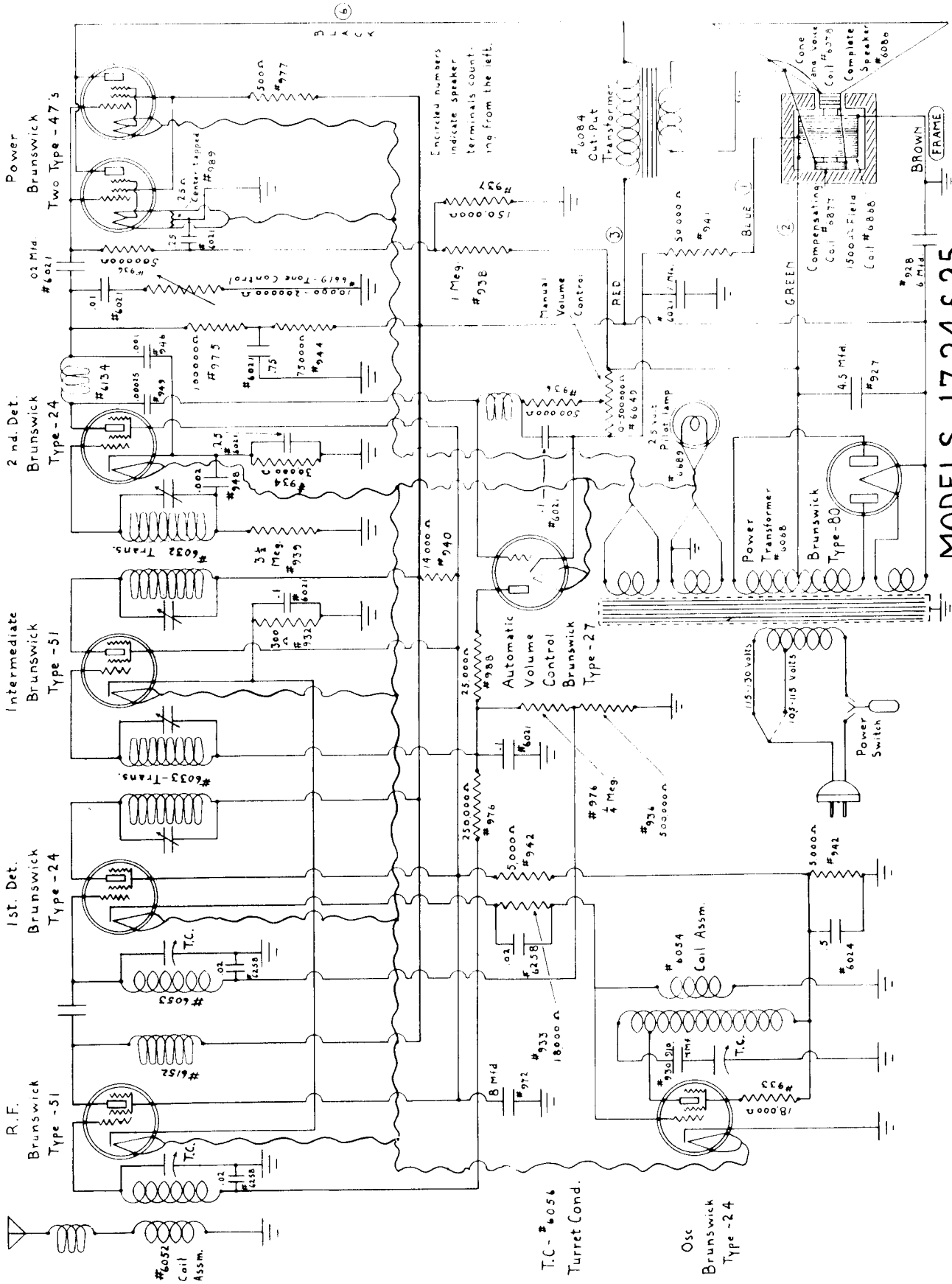


BRUNSWICK RADIO CORP.

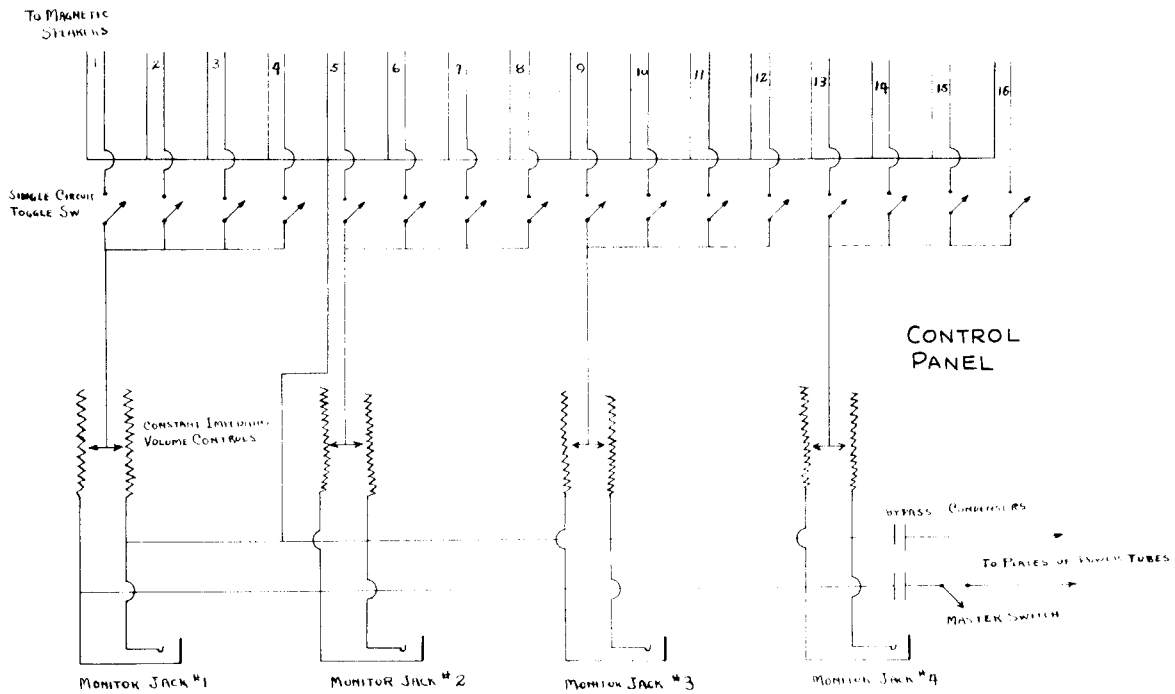


Tube	Type	Filament	Grid	Plate
1st R.F.	UX-201-A	5.5	-9	80
2nd R.F.	" "	5.	-9	80
3rd R.F.	" "	5.25	-5	80
Detector	" "	5.25	0	32
1st Audio	" "	5.75	-9	88
Power Stage	UX-171-A	5.	-24	96
" "	" "	5.	-15	88
" "	" "	4.3	-15	92
" "	" "	4.3	-22½	96

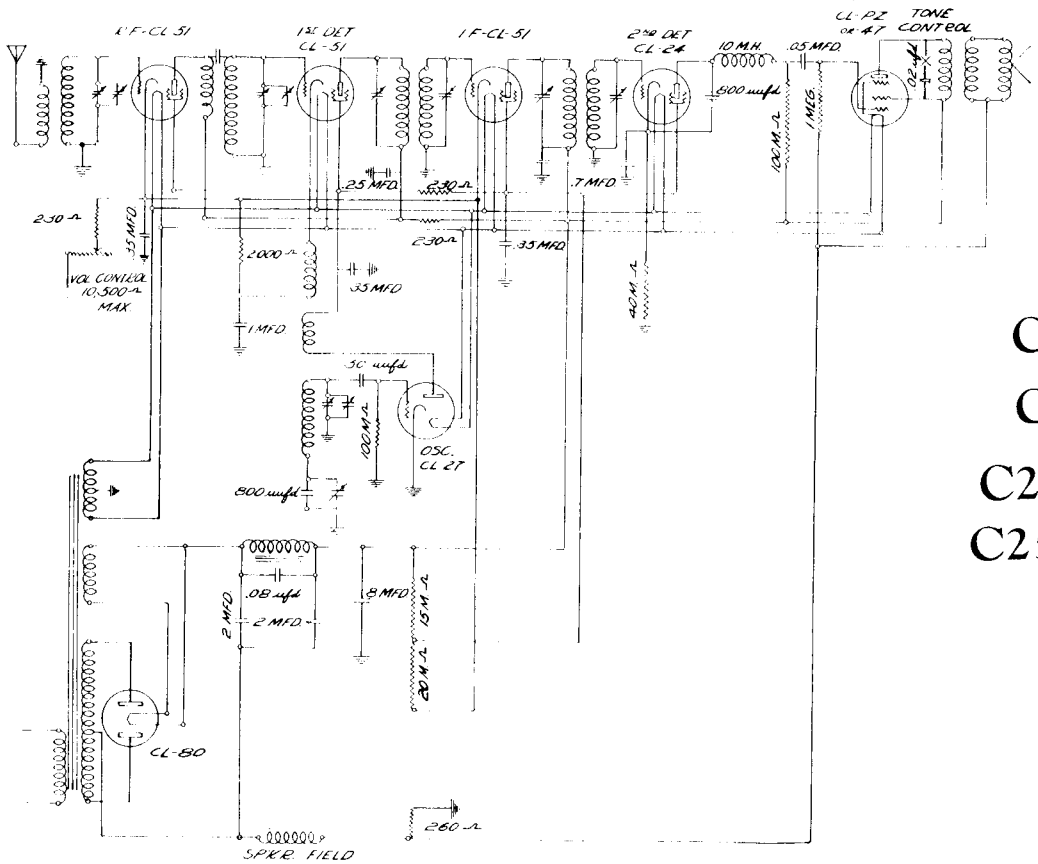
BRUNSWICK RADIO CORP.



BUD MANUFACTURING CO.



COLUMBIA PHONOGAPH CO., INC.



C33

C34

C25-33

C25-34

COLUMBIA PHONOGAPH CO., INC.

Stage	Type Tube	Fil. Volts	Plate Volts	Cont. Grid Volts	Cath. Volts	S. G. Volts	Ip. Normal
1st R. F.	51	2.1	225	2.1	2	75	5
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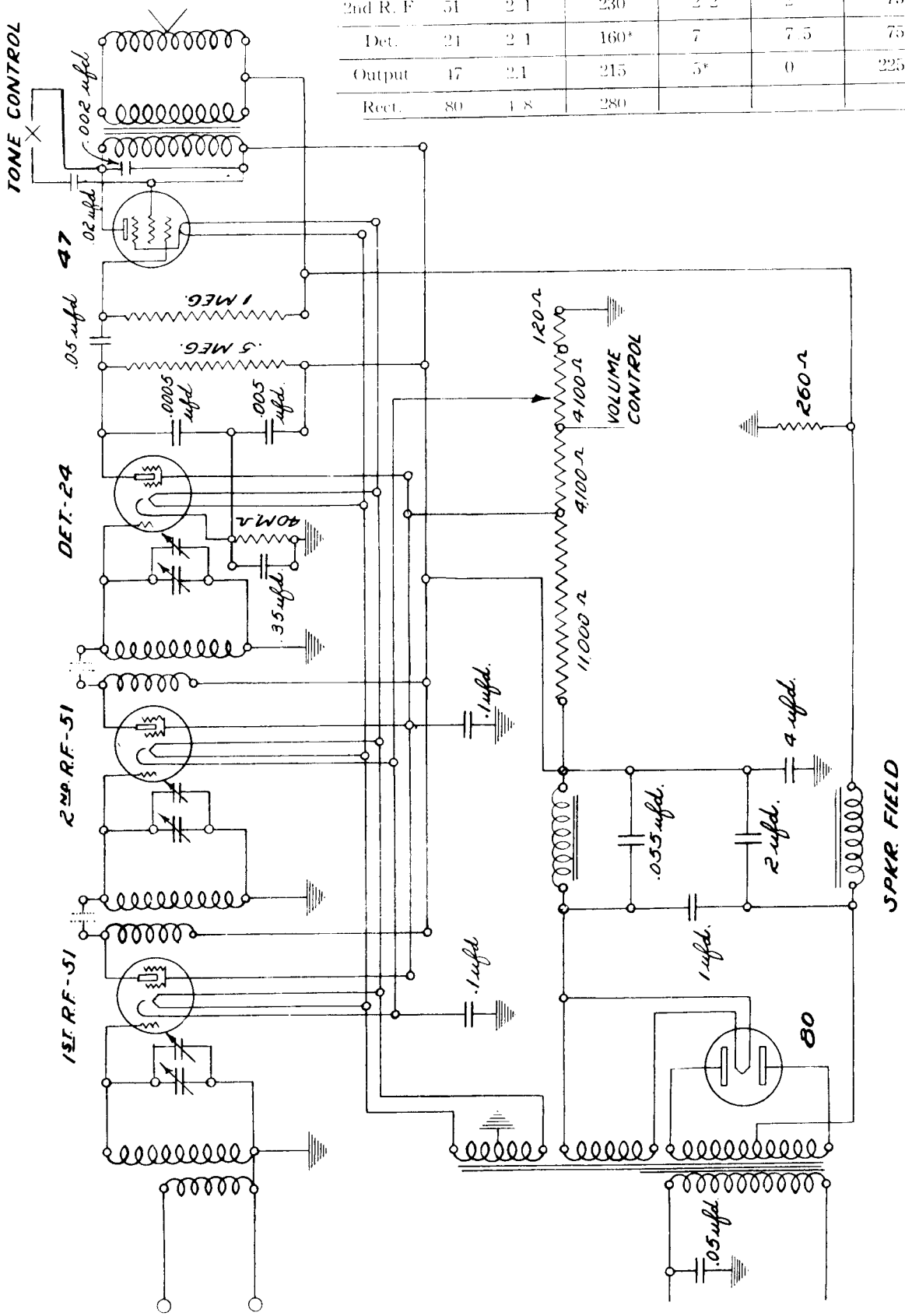
Det.	24	2.1	160*	7	7.5	75	.02
Output	47	2.1	215	5*	0	225	26.5
Rect.	80	4.8	280				‡30



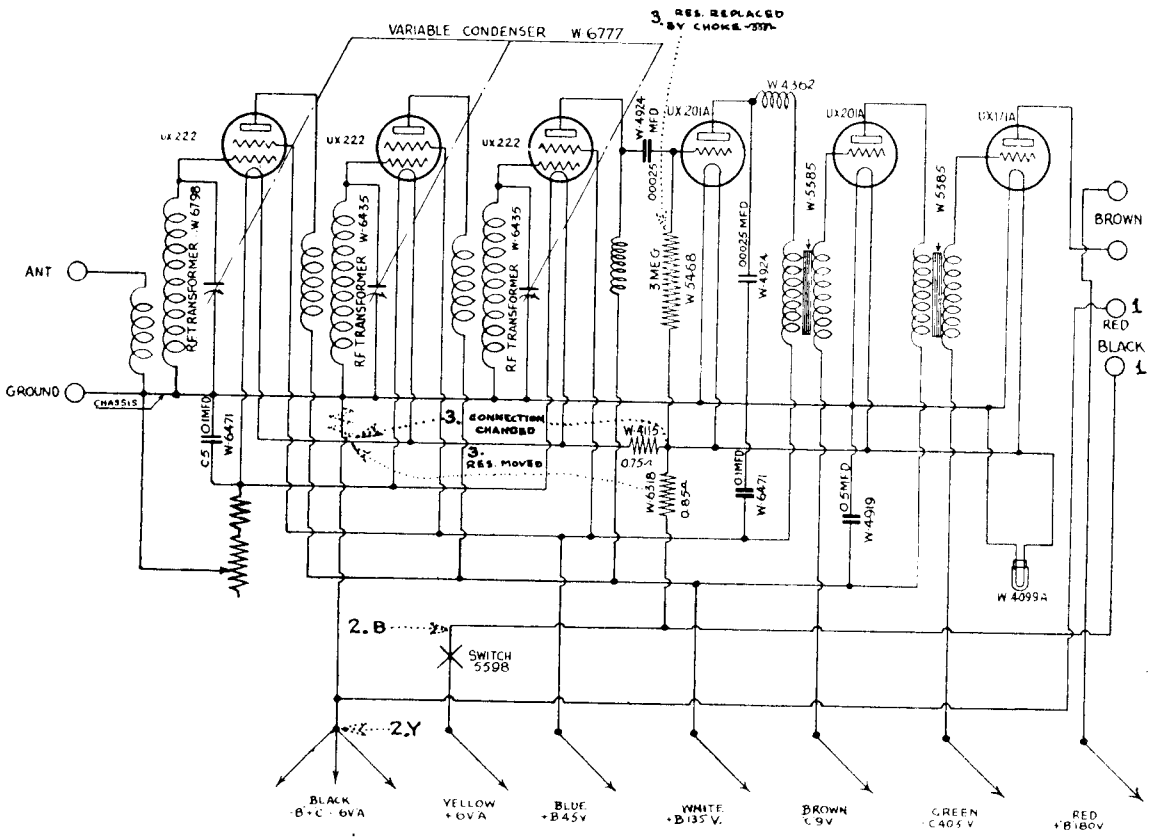
*Reading dependent upon resistance of meter.

‡Reading taken for one anode only: 60 milliamperes would be about correct.

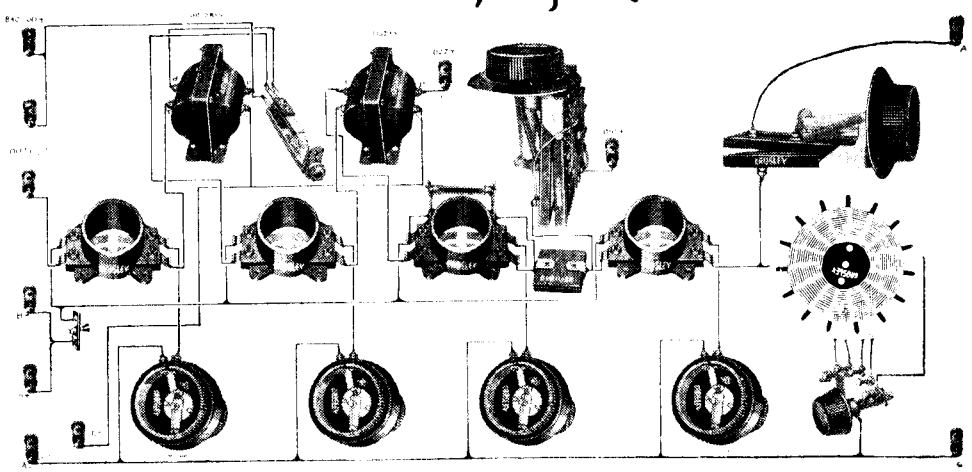
Volume control position full. Line voltage 115 60 cycle.

C-31, C32, C25-31, C25-32.

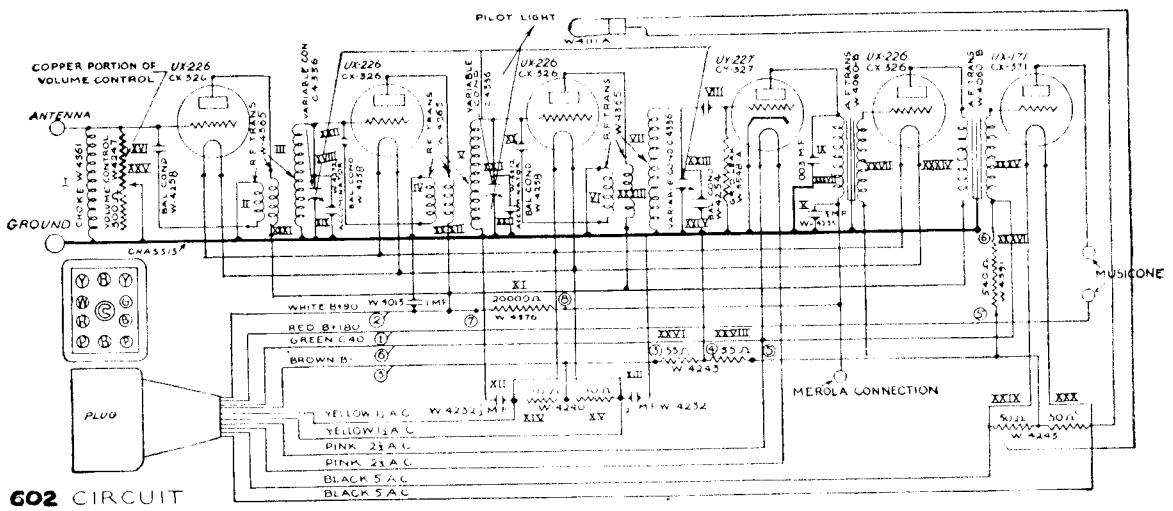
CROSLEY RADIO CORP.



20, 21, 22.



Crosley Models XJ and XL Circuit



602 CIRCUIT

CROSLEY RADIO CORP.

The Crosley Service Bulletin

The Crosley Radio Corporation, Cincinnati, Ohio

Model 47

Specifications

Model 47 is a midget receiver for operation from 110 volt, AC house lighting circuits.

Installation Notes

This receiver is designed primarily for the reception of nearby stations, and for that purpose an aerial 50 feet or more in length will usually be satisfactory. To increase the pick-up, aerials 75 to 100 feet or more in length should be used.

The earlier chasses do not have power switches. In installing them it is best to connect them, if possible, to a socket equipped with a switch. The later chasses are equipped with power switches.

Circuit

The circuit consists of a radio-frequency stage, a detector stage, and an audio stage. Type -24 tubes are used in the radio-frequency and detector stages, a type -45 tube in the audio stage, and a type -80 in the rectifier circuit.

The grid circuits of the radio-frequency and detector stages are tuned by separately-operated variable condensers. Since these condensers are not operated simultaneously, it is not necessary to equip them with aligning condensers.

An air-core auto-transformer couples the antenna circuit to the r. f. tube. An air-core radio-frequency transformer is used to couple the radio-frequency and detector tubes. Resistance coupling is used between the detector and audio tube.

The power supply for the various circuits is obtained from a transformer having an untapped primary and three secondaries. One secondary supplies the filament of the -80 type rectifier tube. A second secondary supplies the current for the filament of the audio tube and th heaters of the detector and radio-frequency tubes. The third secondary is the source of high voltage supply. It is connected to the plates of the rectifier tube. The middle of this secondary is grounded, and represents the negative side of the B supply circuit.

The positive B supply circuit is connected to one side of the rectifier tube filament. From this point it leads to the "Red" speaker terminal, and thence through the speaker field.

After passing through the speaker field, the B circuit branches, one branch connecting to the speaker voice coils and through them to the "Brown" speaker terminal on the receiver and the output tube plate. The other branch returns through the speaker lead with "Red Tracers" to the corresponding terminal on the receiver. From that point it continues through a 300,000 ohm detector plate coupling resistor to the detector plate, and through the primary of the inter-stage radio-frequency transformer to the plate of the radio-frequency tube.

A branch of the positive "B" circuit is connected through a 20,000 ohm resistor to the screen grids of the detector and radio-frequency tubes. The radio-frequency screen grid is connected to the heater circuit through a 11,000 ohm resistor. Bleeder current through these resistors maintains the screen grids at the appropriate potential. The detector screen grid is connected to the chassis through a 1-10 m. f. by-pass condenser.

The filter circuit consists of an 8 m. f. electrolytic condenser shunted across the B supply circuit, which, in conjunction with the choking effect of the speaker field, satisfactorily eliminates hum.

The output tube is biased by the previously mentioned 1100 ohm resistor connected from one side of the filament circuit to the chassis. Biasing of the detector and radio-frequency tubes is accomplished by a 40,000 ohm resistor in the detector emittor circuit, and a bias re-

Voltage Limits

	Volume Control On Full
Filament Voltages	
All Tubes but Rectifier	2.2 to 2.5
Rectifier Tube	4.5 to 5.0
Plate Voltages	
R. F. Tube	160 to 180
Detector Tube	100 to 120
Audio Tube	130 to 150
Control Grid Voltages	
R. F. Tube	1.8 to 2.2
Detector Tube	5.0 to 5.5
Screen Grid Voltages	
R. F. and Detector Tubes	60 to 80

The above readings are to be taken with the receiver in full operating condition, with the volume control on full, and with a line voltage of 117.5. Measure plate and grid voltages with a high-resistance D. C. voltmeter (at least 800 ohms per volt.) These voltages are to be measured from the plate or grid socket contact to the emitter contact or negative filament contact, unless otherwise noted in the table. The contacts must be reached from the bottom of the receiver (unless a set tester is used) with tubes, dial light, and speaker in place. Use a low-range A. C. voltmeter to measure the filament voltages.

CROSLEY RADIO CORP.

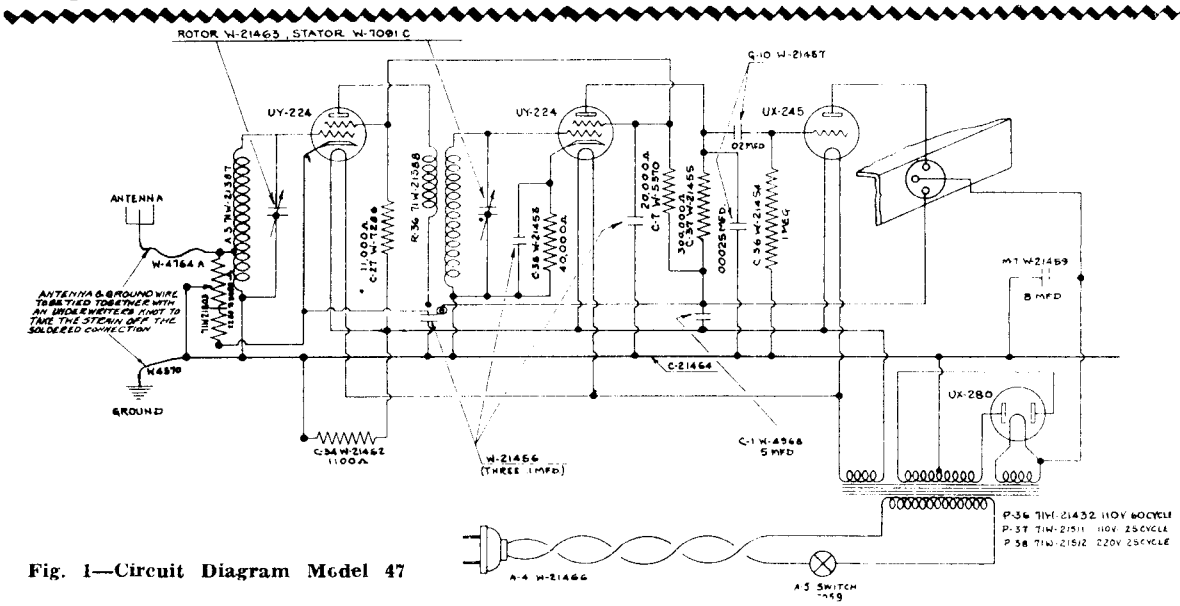


Fig. 1—Circuit Diagram Model 47

sistor and a portion of the volume control resistor in the radio-frequency emittor circuit.

Volume is controlled by a variable resistor, the fixed resistance unit of which is connected between the antenna lead and the radio-frequency bias resistor, and the variable contact of which is connected to ground. Variation in volume is thus accomplished by simultaneously changing the portion of the current in the antenna circuit shunted from the antenna lead to ground, and the biasing of the radio-frequency tubes.

Radio-frequency by-pass condensers of 0.1 m. f. capacity are connected from each cathode of the -24 tubes to ground and from the screen grids to ground. A 0.00025 m. f. r. f. by-pass condenser is connected from the detector plate to ground. A 0.02 m. f. coupling condenser is used between the detector plate circuit and the audio-frequency grid circuit.

Continuity Tests

NOTE—In order to make the test procedure as simple as possible, certain tests are omitted which are taken care of by the voltage limits in the accompanying table.

Circuit	Remarks	Correct Test	Incorrect Test Indicates
The following tests are to be made with a circuit tester consisting of a 45 volt "B" battery in series with a 50 volt, high-resistance voltmeter; a 1½ volt battery in series with a milliammeter of 1 m. a. range and a 1500 ohm resistor, or a similar arrangement.			
Antenna to Ground	Reading should vary with setting of volume control	Part Scale	No reading indicates open circuit. Full scale indicates short
Operating Grids R. F. and Detector Sockets to Ground (Chassis)		Practically Full Scale	Open circuit in r. f. transformer or faulty connections
Grid Audio Socket to Ground (Chassis)		Slight Deflection	No reading indicates open circuit in grid resistor or faulty connections. Full scale indicates short
Screen Grids R. F. and Detector Sockets to Filament, Rectifier Socket	Speaker Connected	Part Scale	No reading indicates open circuit in resistor, speaker field, etc. Full scale indicates short.
Plates R. F. and Audio Sockets to Filament, Rectifier Socket	Speaker Connected	Part Scale	No reading indicates open circuit in r. f. transformer primary, speaker, etc. Full scale indicates short.
Plate Detector Socket to Filament, Rectifier Socket	Speaker Connected	Slight Deflection	No reading indicates open circuit in plate coupling resistor, speaker, etc. Full scale indicates short

COLUMBIA PHONOGRAPH CO.

COLUMBIA MODELS C-90A (Single Reproducer) AND C-90B (Dual Reproducer) 11-TUBE SUPERHETERODYNES

(Incorporates A.V.C., phase-reversing tube, reactance resonance indicator, "silent tuning" tube.)

A number of unusual features recommend the Columbia Model C-90A and C-90B receiver chasses to the close attention of Service Men. To maintain these chasses at maximum efficiency it is essential that the technician be thoroughly familiar with their individual features.

Following are the values of the components: Condensers C1, C2, C3, tuning condenser gang, shunted by trimmers C1A, C2A, C3A; C4 to C7, I.F. trimmers; C8, C10, C11, C12, C17, 0.1-mf.; C9, C29, C30, 0.25-mf.; C13, .02-mf.; C14, C15, C16, C19, C20, C21, .01-mf.; C22, C23, 500 mmf.; C24, 32 mf.; C25, 16 mf.; C26, 10 mf.; C27, 7 mf.; C28, 20 mf. Condensers C24 to C28 are dry electrolytic units. Condensers C8 to C12, and C29, C30 are contained in one can; C13, C14, C15, C18, in another.

Resistor R1, hum control, 20 ohms; R2, "silent tuning" control, 20,000 ohms; R3, manual volume control, 0.2-meg.; R4, tone control, 0.25-meg.; R5, 180 ohms; R6, 700 ohms; R7, 400 ohms; R8, 0.5-meg.; R9, 50, 50,000 ohms; R10, R12, R14, R15, R18, R19, 0.3-meg.; R11, R13, R20, 0.1-meg.; R16, 30,000 ohms; R17, 2,000 ohms; R21, 230 ohms; R22, 6,700 ohms; R23, 2,400 ohms; R24, 18,000 ohms. Resistors R5, R6, R7, R21, R22, R23, R24, multiple wire-wound unit.

Following are the tube operating characteristics; at a line potential of 115 V. and the "synchro-silent tuner" all the way counter-clockwise, (all D.C. potentials are to ground): Filament potential, all tubes, 2.5 V. Plate potential, V1, V2, V4, 255 V.; V3, 75 V.; V6, 200 V.; V7, 116 V.; V8, V9, 240 V.; V10, too small to measure practically. Plate current, V1, V3, 4 ma.; V2, 2.6 ma.; V4, 4.4 ma.; V6, V10, too small to measure practically; V7, 1. ma.; V8, V9, 60 ma.; V11, 160 ma., total. Cathode potential, V1, V4, 2 V.; V2, 9 V.; V3, 12 V.; V5, V10, zero; V6, 75 V.; V7, 32 V. Screen-grid potential, V1, V2, V4, 75 V.; V6, 120 V.; V7, 116 V.; V8, V9, 255 V.; V10, 73 V. Screen-grid current, V1, V4, 1. ma.; V2, 0.6-ma.; V6, too small to measure practically; V7, 0.3-ma.; V8, V9, 6.6 ma.; V10, 3.8 ma.

Because of the elimination of noise between stations, by means of the synchro-silent tuning connection, it has been possible to improve the sensitivity of the C-90 chasses to several times that heretofore used. In cases where low sensitivity is encountered, the adjustment of the synchro-silent tuning control should be carefully checked, as well as all the tubes in the R.F. end of the chassis. This should always be done before attempting to increase sensitivity by re-aligning the condensers.

The function of the silent tuning" or "synchro-silent tuning control" is as follows: One of the type C-57-S tubes is used as V6 because of its sharp plate current cut-off characteristic. By inserting a high negative bias on the surpressor-grid of this tube, it is "blocked," and no signal will come through.

To obtain this action a type C-57-S tube is used as the "silent-tuning" tube, V10. Its plate current through resistor R8 develops a voltage drop which is applied to the suppressor-grid circuit of V6, to which it is common. Tube V10 obtains its control-grid potential from the A.V.C. circuit. When there is no station tuned in, there is no A.V.C. potential, and hence the control-grid of the silent-tuning tube V10 is approximately at zero bias. The resulting high plate current passes through R8 and develops the high blocking potential which is effective on V6.

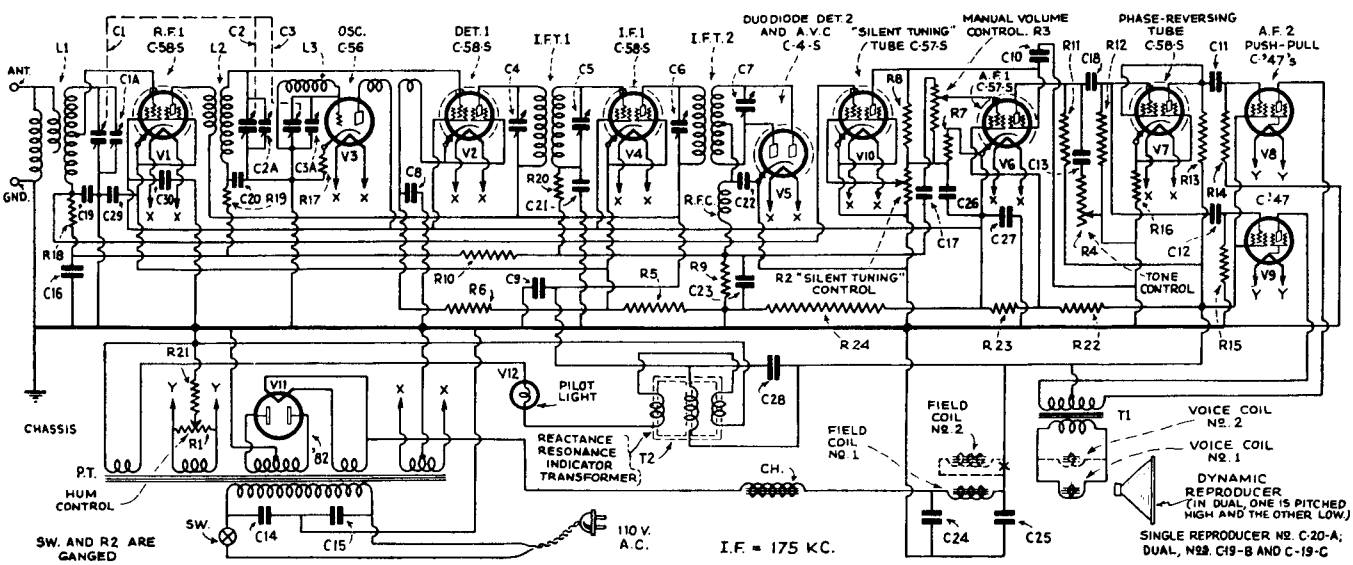
Now, when a station is tuned in, the A.V.C. potential develops across resistor R9 and is impressed on V10 in the form of a negative bias. The plate circuit of V10 therefore draws little or no current and hence the voltage drop across R8 disappears, leaving nothing but the normal operating bias on V6. In this condition the entire set is operative just as though there were no silent-tuning tube in the circuit. In fact, it is possible to tune in a station and remove V10 without any noticeable change. On the other hand, if V10 is removed when no station is tuned in, the customary background noises will be heard. Resistor R2 is provided to govern the point at which V10 "takes hold"; it compensates for local noise conditions and variations in individual antenna systems.

To obtain push-pull operation and yet retain resistance-capacity coupling, tube V7 is used to obtain a reverse-phase potential to actuate the control-grid of one power tube, V8. The circuit is carefully balanced to prevent a change in the magnitude of the voltage through V7.

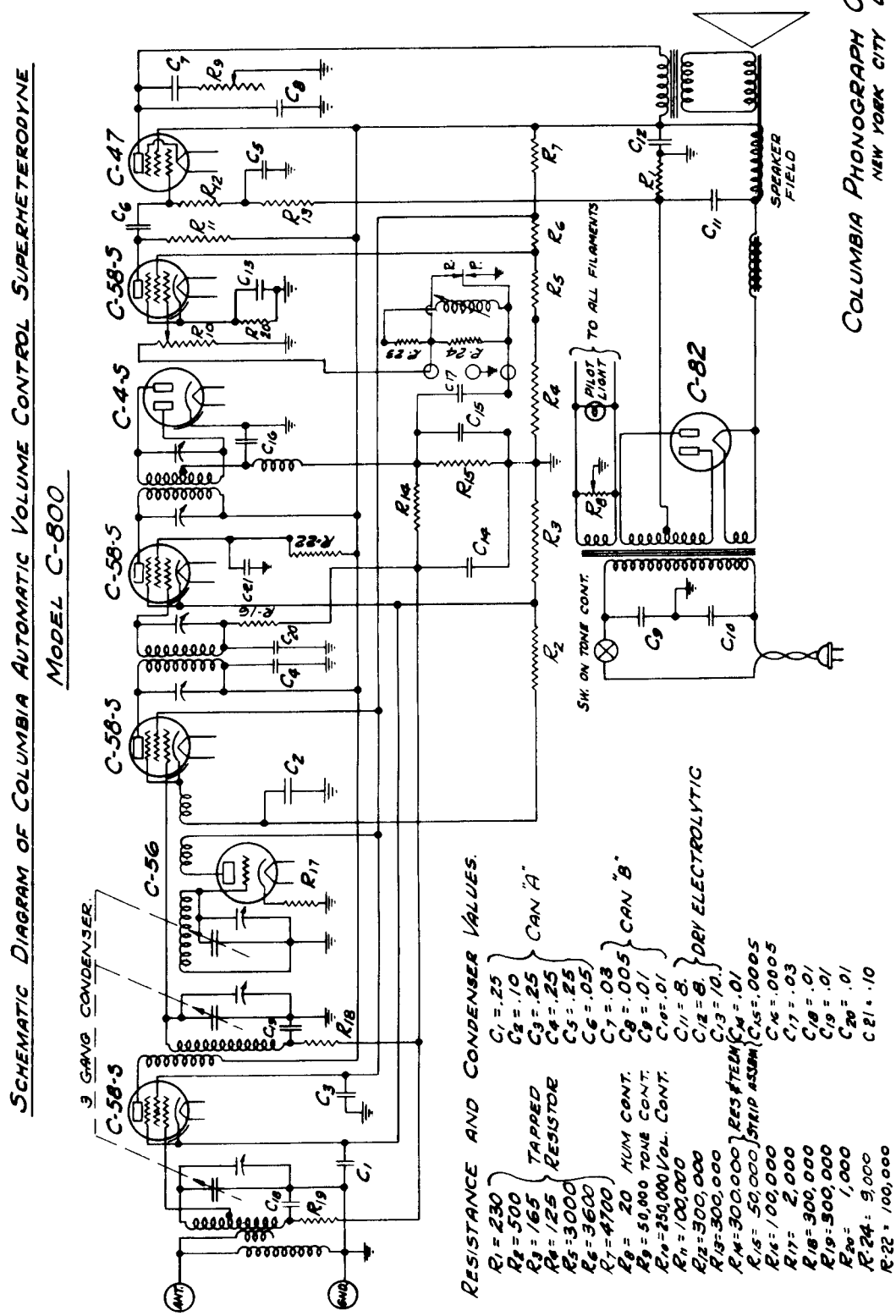
The operation of the "reactance resonance indicator" circuit, which centers around transformer T2(is as follows: When the set is turned on and the tube filaments warm up, but no station is tuned in, a relatively large plate current flows through the center winding. This saturates the iron core, reducing the reactance of the two outer windings to a very low figure, which causes considerable current to flow through the pilot light, V12. When a station is tuned in, it operates the duodiode, V5, so that an A.V.C. potential is built up across resistor R9. This bias voltage is in turn, impressed upon the control-grids of V1, V2 and V4. The result is normal A.V.C. operation—amplification is decreased. However, their plate current is decreased, due to the higher negative bias on their control-grids. This reduced plate current flowing through the center winding of the reactor relieves the saturated condition in the iron core so that the reactance of the outer windings increases and the current flowing through the pilot light current supply is therefore reduced, causing the pilot light to dim when a station is tuned in.

The two outer windings are connected so that they buck each other, insofar as the center leg of the core is concerned; hence, current is not induced into this center winding (which is in the plate circuit). Electrolytic condenser C28 compensates for slight unbalances.

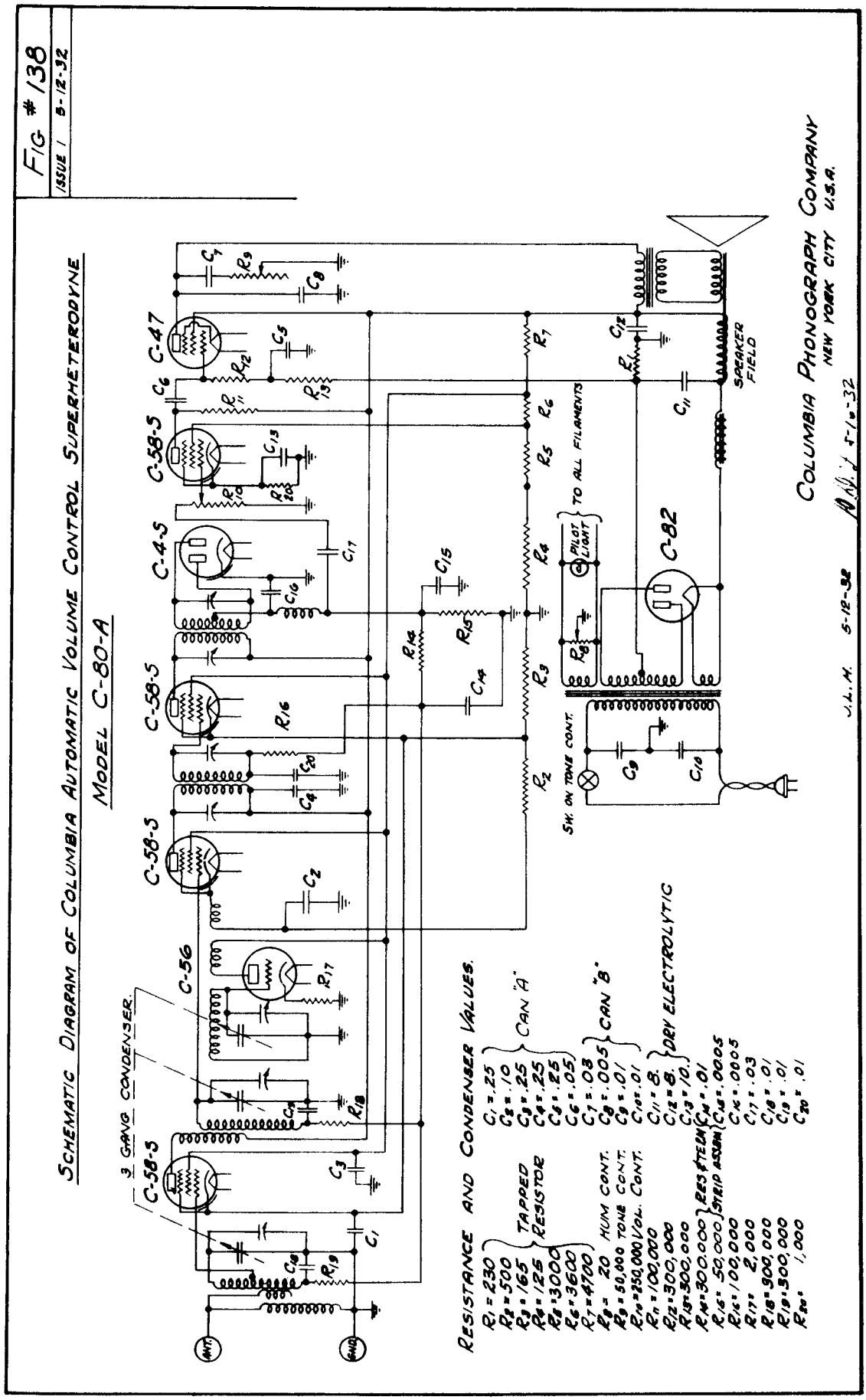
Field coil resistance, 1,000 ohms (single); or, 520 ohms each (dual).



COLUMBIA PHONOGRAPH CO.



COLUMBIA PHONOGRAPH CO.



COLUMBIA PHONOGRAPH CO.

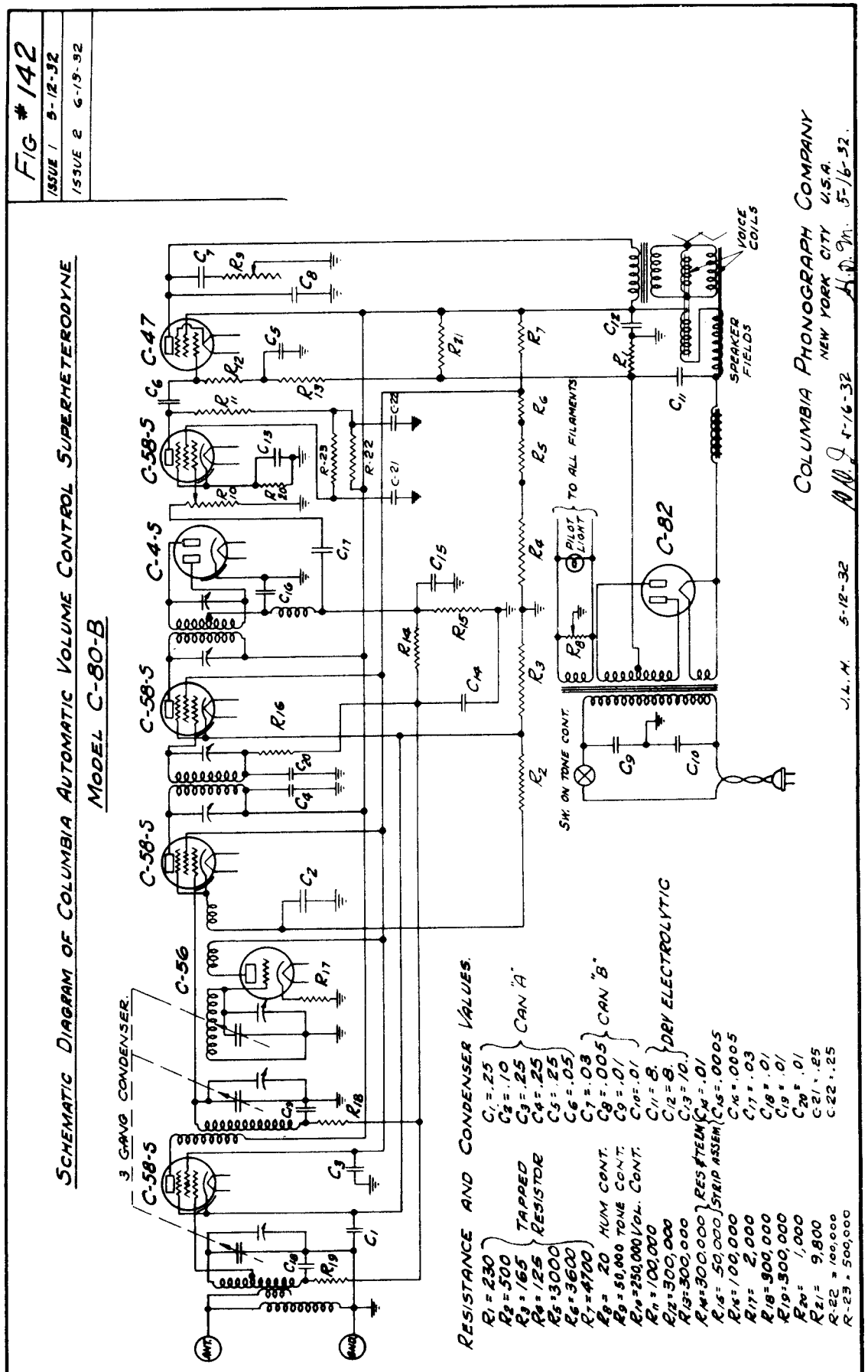
FIG #142

ISSUE 1 5-12-32

ISSUE 2 6-19-32

SCHEMATIC DIAGRAM OF COLUMBIA AUTOMATIC VOLUME CONTROL SUPERHETERODYNE

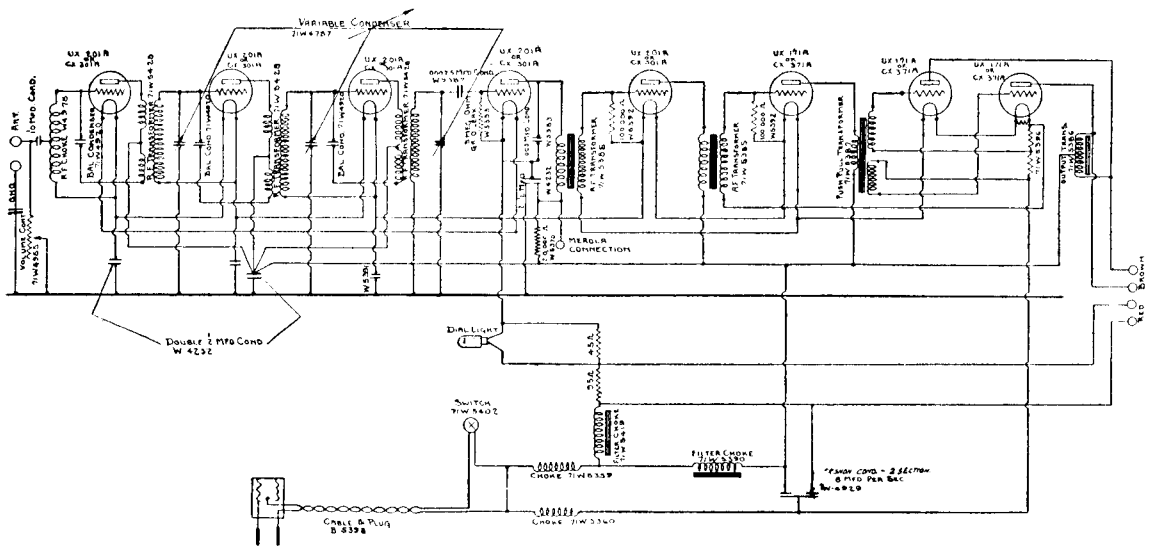
MODEL C-80-B



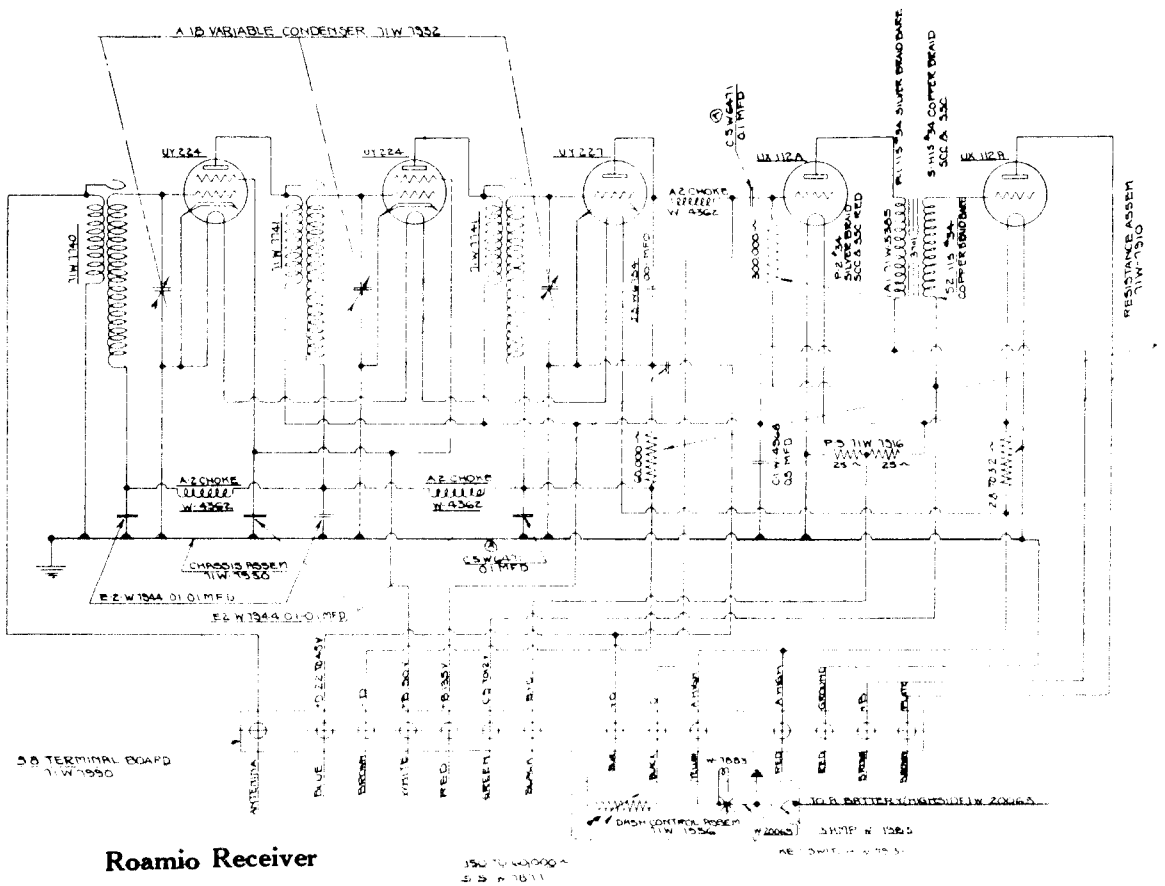
RESISTANCE AND CONDENSER VALUES.

R_1 = 230	TAPPED RESISTOR	C_1 = .25	CAN "A"
R_2 = 500		C_2 = .10	
R_3 = 165		C_3 = .25	
R_4 = 125		C_4 = .25	
R_5 = 3000		C_5 = .25	
R_6 = 3600		C_6 = .05	
R_7 = 4700		C_7 = .03	CAN "B"
R_8 = 20	HUM CONT.	C_8 = .005	
R_9 = 50,000	TONE CONT.	C_9 = .01	
R_{10} = 250,000	VOL. CONT.	C_{10} = .01	
R_{11} = 100,000		C_{11} = 8.	DRY ELECTROLYTIC
R_{12} = 300,000		C_{12} = 8.	
R_{13} = 300,000		C_{13} = 10.	
R_{14} = 300,000	RES. STRIP ASSEM.	C_{14} = .01	
R_{15} = 50,000		C_{15} = .0005	
R_{16} = 100,000		C_{16} = .0005	
R_{17} = 2,000		C_{17} = .03	
R_{18} = 300,000		C_{18} = .01	
R_{19} = 300,000		C_{19} = .01	
R_{20} = 1,000		C_{20} = .01	
R_{21} = 9,800		C_{21} = .25	
R_{22} = 100,000		C_{22} = .25	
R_{23} = 500,000			

CROSLEY RADIO CORP.

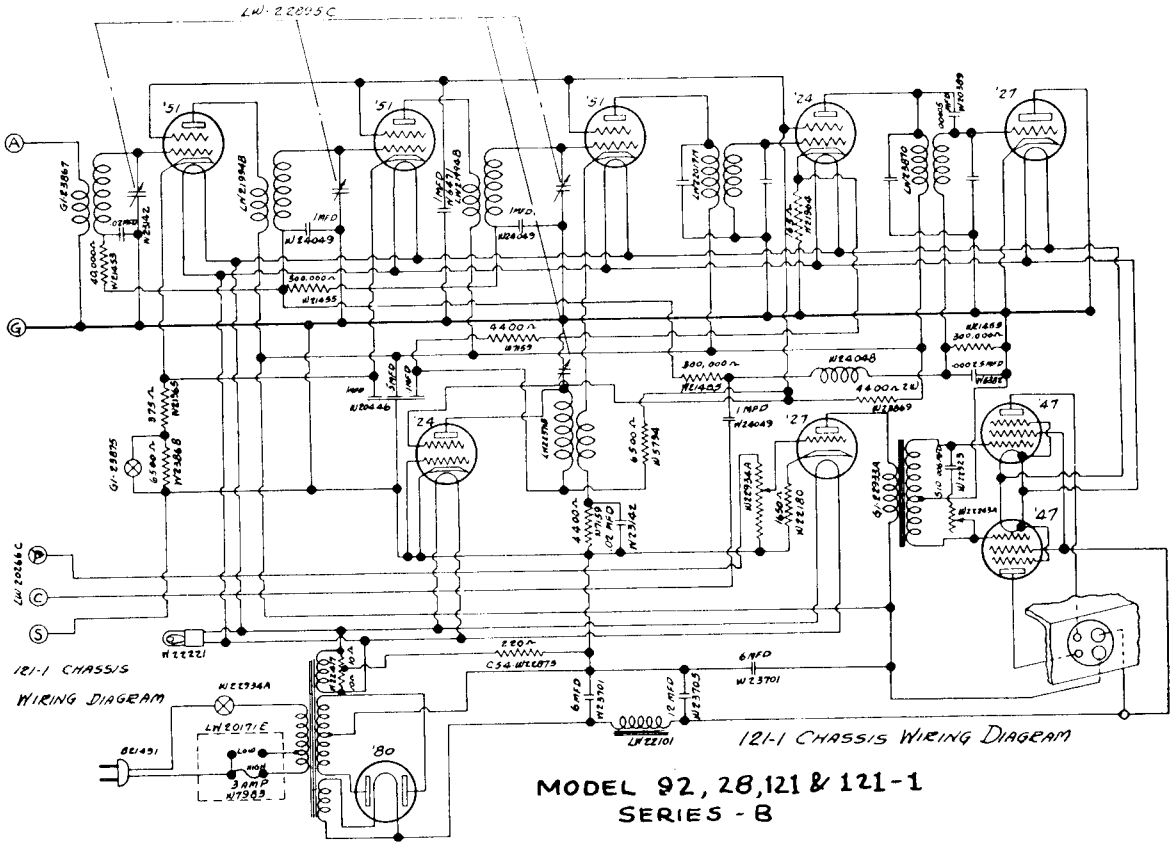


MODEL 705



Roamio Receiver

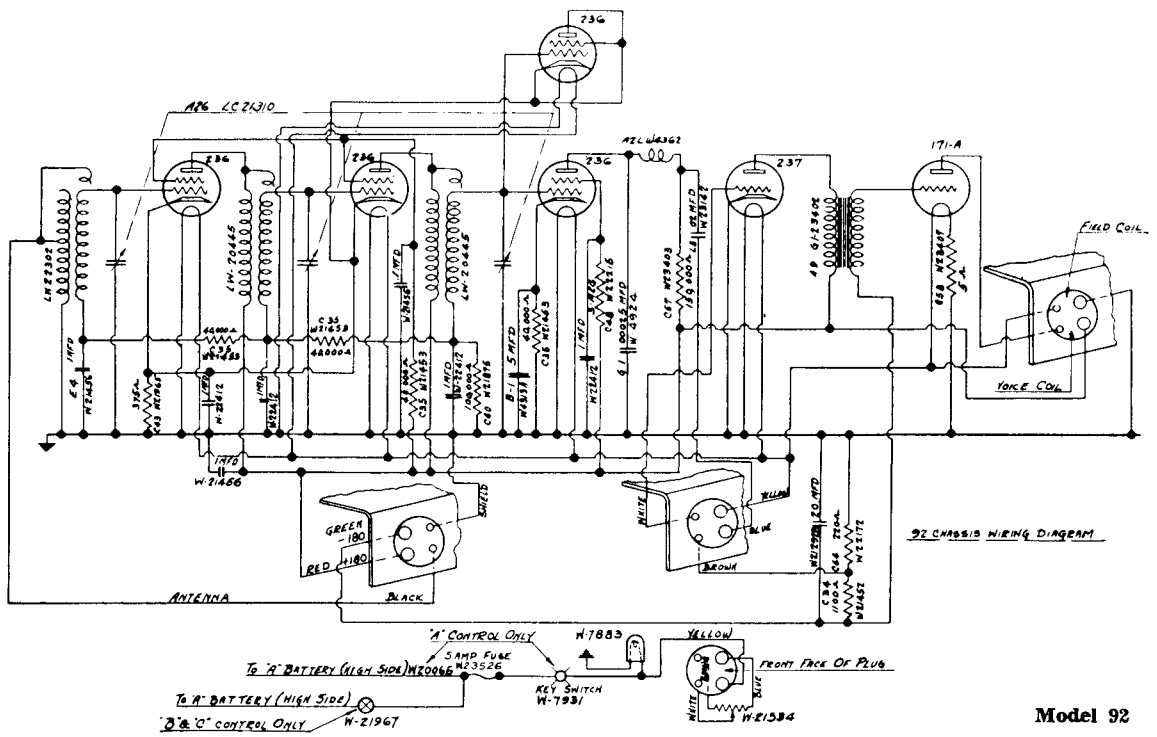
CROSLEY RADIO CORP.



121-1 CHASSIS WIRING DIAGRAM

MODEL 92, 28, 121 & 121-1
SERIES - B

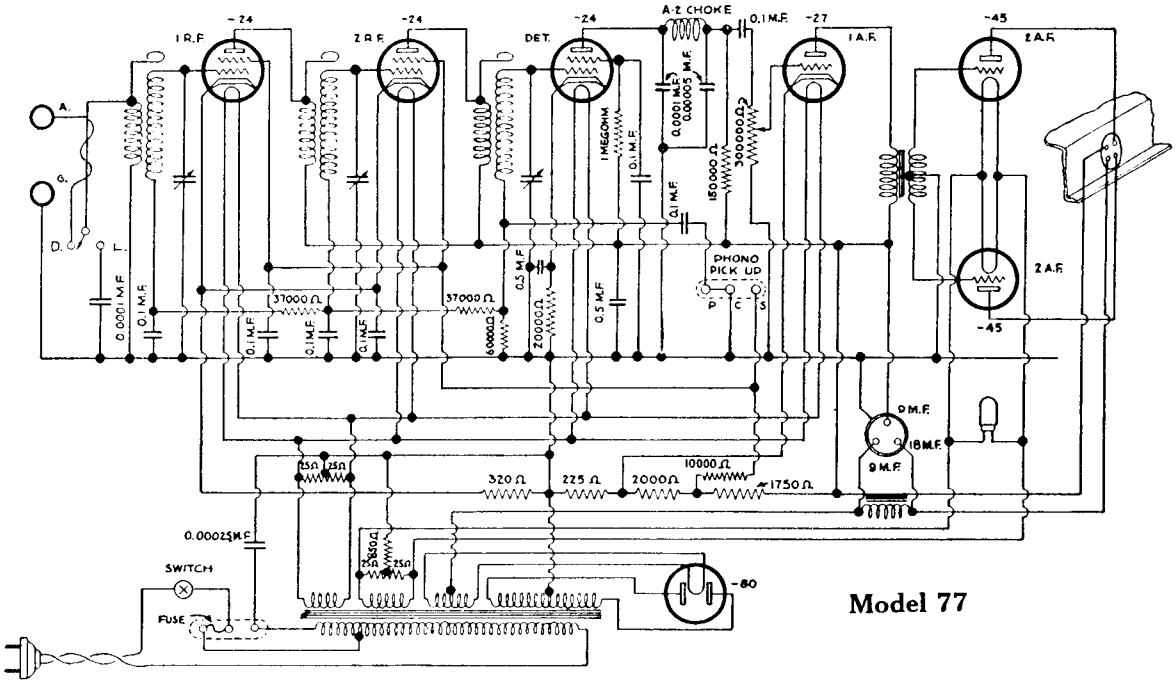
L 23960 60 - 110V
L 23962 25 - 110V
L 23964 25 - 220V



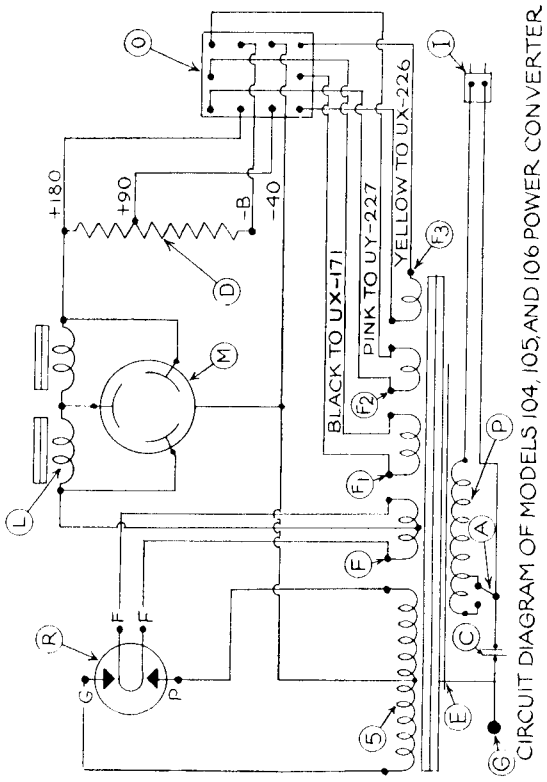
92 CHASSIS WIRING DIAGRAM

Model 92

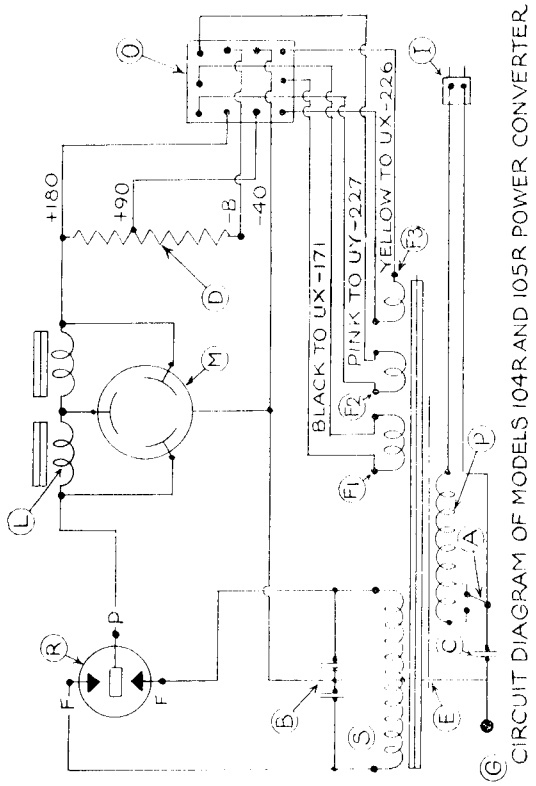
CROSLEY RADIO CORP.



Model 77

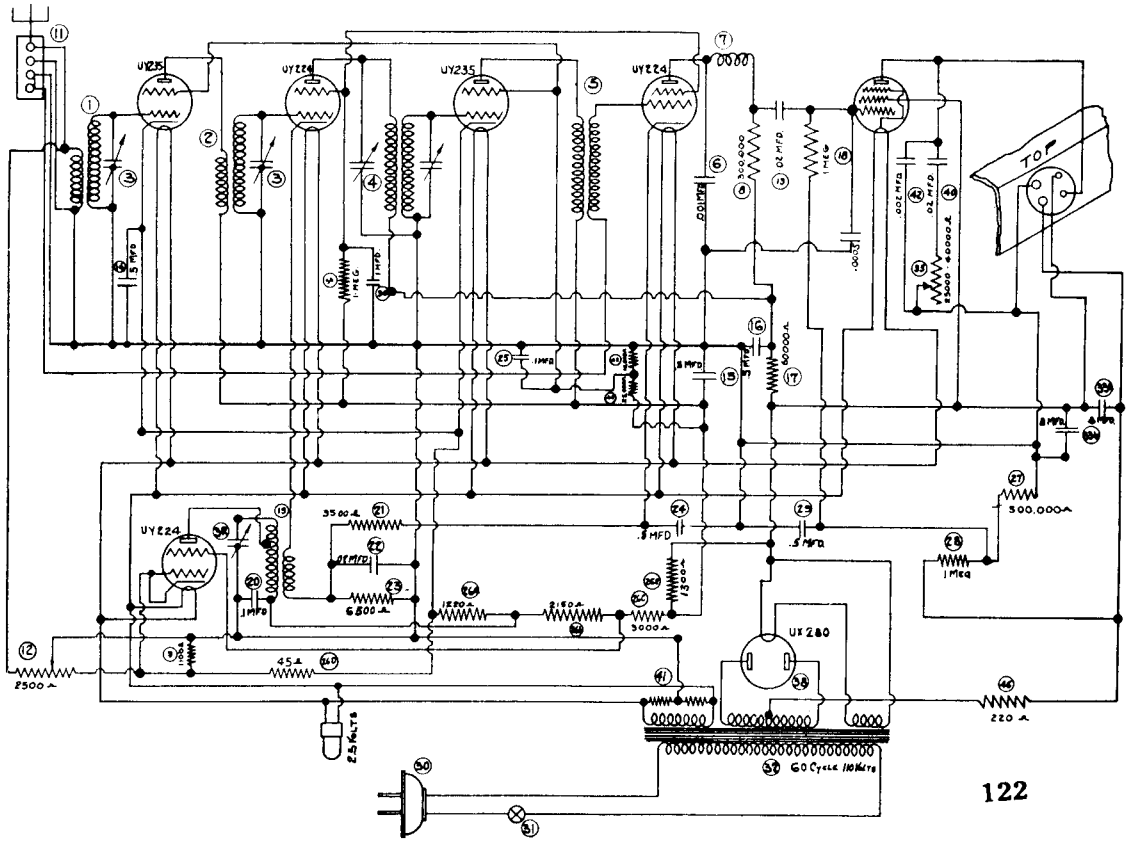


CIRCUIT DIAGRAM OF MODELS 104, 105, AND 106 POWER CONVERTER

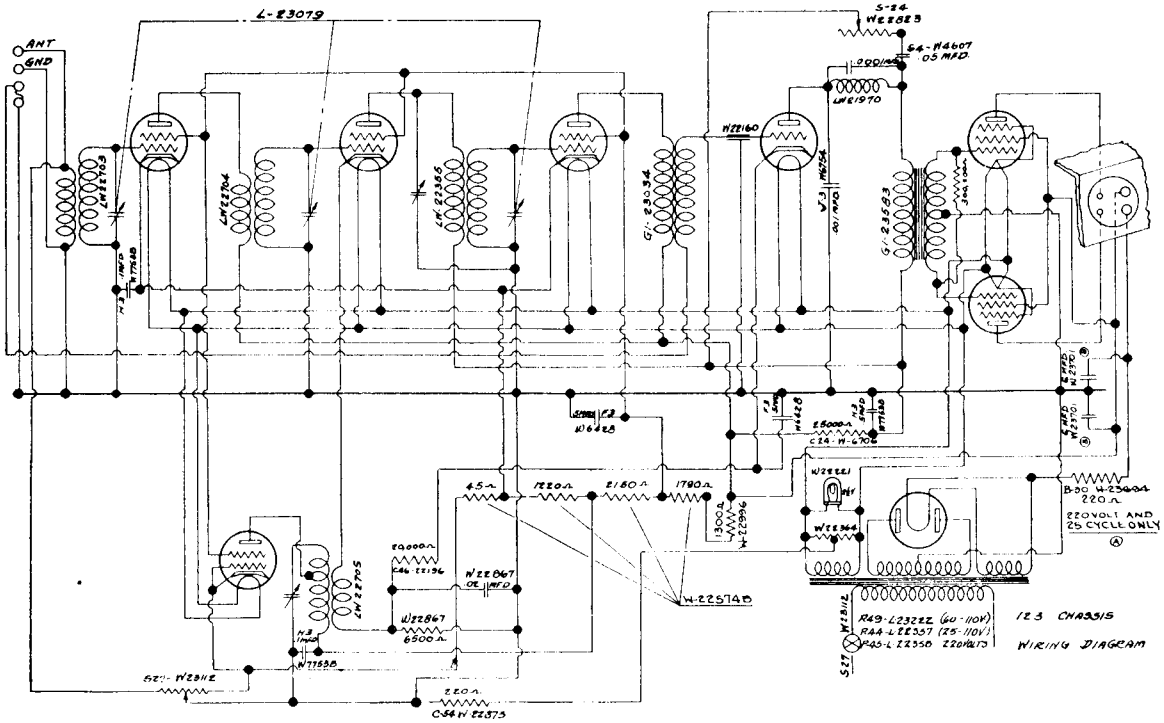


CIRCUIT DIAGRAM OF MODELS 104R AND 105R POWER CONVERTER

CROSLEY RADIO CORP.



122



Model 123

CROSLEY RADIO CORP.

CROSLEY ROAMIO AUTOMOTIVE T.R.F. RECEIVER MODELS 90, 91 AND 92

(The T.R.F. series of Crosley Roamio sets; Radio Service Data Sheet No. 88 describes the superheterodyne series.)

Model 90

Average operating potentials are given below. These values are measured with the reproducer connected and the tubes in place. For plate and grid voltages, use a high-resistance meter; measure from tube element to negative filament.

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts
V1	2.0	2.5	90	135
V2	2.0	2.5	90	135
V3	2.0	3.0	....	22.5
V4	4.7	12	....	135
V5	4.7	12	....	135

The A.V.C. potential is derived as the drop across R2. With increased signal, more current flows through the plate circuit of the combination detector and A.V.C. tube, V3, increasing the drop across R2 and thereby increasing the bias voltage applied to the control-grids of V1 and V2. This results in a reduction of the R.F. amplification, and thus maintains constant the A.F. output determined by the setting of R1.

Battery D supplies plate potential for V3. The negative "B" and positive "C" lead returns to the center-tap of two 25 ohm resistors, to secure the same plate potentials regardless of whether the car-battery positive or negative terminal is grounded.

Model 91

Average operating potentials are given in the tabulation below. Measure, with a high-resistance meter, to the negative filament contact.

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts
V1	2.0	1.5	100	170
V2	2.0	1.5	100	170
V3	2.0	2.5	7.5	45
V4	4.7	10*	.....	170
V5	4.7	10*	.....	170

*With volume control "off."

If a signal of sufficient strength is received to cause current to flow in the grid circuit of V3 (biased by R6), the resultant drop across R2 decreases the amplification of V1, V2. Resistors R3, R4, R5 are R.F. filters.

Manual volume control R1 determines the A.F. input to the control-grid of A.F. amplifier V4.

Model 92

Operating potentials appear in the table.

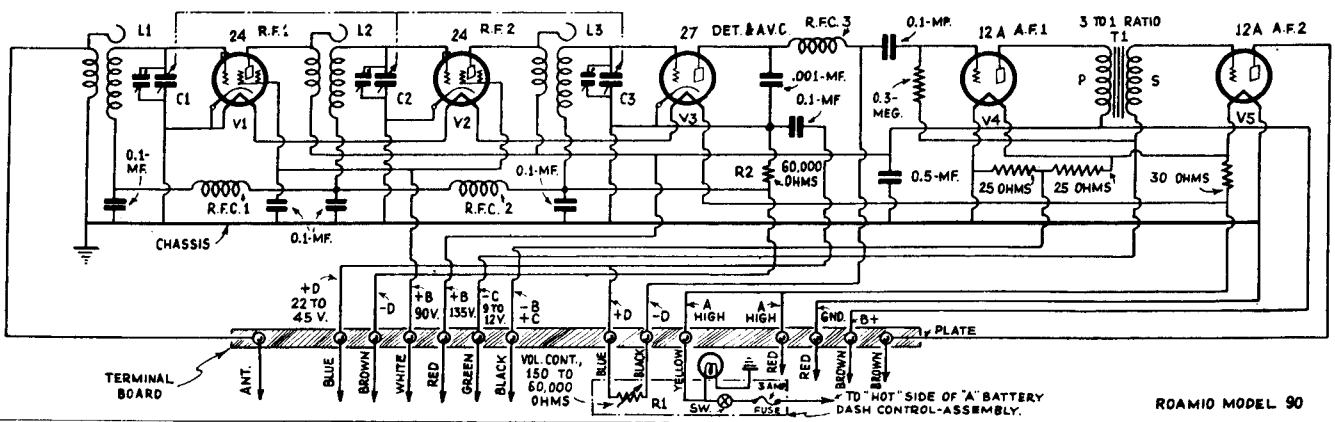
Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts
V1	5.9	3	75	170
V2	5.9	3	40	170
V3	5.9	3	40	45
V4	5.9	20	.....	170
V5	4.7	40	.....	170
V6	5.9	.....	.....	3

The circuit is adjusted for zero current flow in the circuit of A.V.C. tube V6, with normal signal input; at the same time resistor R3 establishes the normal bias required by the control-grids of V1, V2. Now, an incoming signal of increased strength causes diode V6, in conjunction with load-resistor R2, to develop across R2 an increased D.C. negative potential which reduces the amplification of V1, V2. Resistors R4, R5 are R.F. filters.

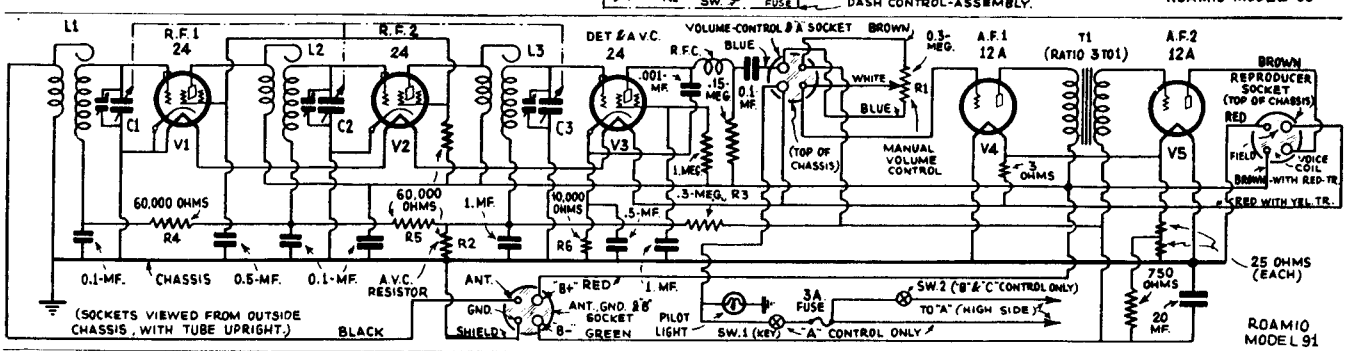
The A.F. input to the first-A.F. tube, V4, is determined by the setting of the manual volume control, R1.

Manual volume control resistor R1 has a value of 0.3-meg. Since Crosley Service Bulletin No. A8 does not include the tube operating voltages for the model 92, estimated values are given.

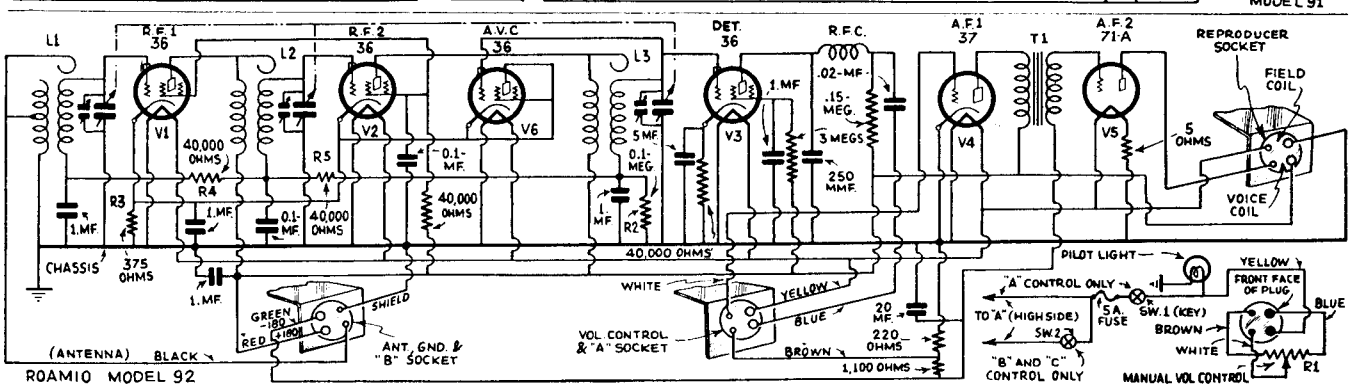
At the present time there are no Roamio models 93 or 94 receivers.



ROAMIO MODEL 90



ROAMIO MODEL 91



ROAMIO MODEL 92

CROSLEY RADIO CORP.

CROSLEY ROAMIO AUTOMOTIVE SUPERHETERODYNE MODELS 95 AND 96

(The superheterodyne series of Crosley Roamio sets; Radio Service Data Sheet No. 87 describes the T.R.F. series.)

Model 95

Average operating potentials are given in the following tabulation. These figures are measured with the speaker connected; a high-resistance meter will be required to obtain correct readings.

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts
V1	5.9	8	75	170
V2	5.9	*	75	170
V3	5.9	*	.....	170
V4	5.9	.....	.....	.....
V5	5.9	5.5		85
V6	5.9	17	170	160

*A. V. C. only.

The pole of the "A" battery which is not directly connected to the frame of the car connects through the insulated battery cable lead to the cable connector of the receiver, and thence to one pole of the power switch; this D. P. D. T. unit controls both the "A" and "B" circuits. After going through the switch, the "A" circuit branches, one branch going to the heaters (connected in parallel) and through them to the chassis, another going through the dial light to the chassis, and the third going through the speaker field, to the speaker cable shield, and then through the battery cable shield to the other side of the "A" battery which connects to the frame of the car.

Tube V1 incorporates the dual action of oscillator and first-detector. Tube V4 is connected as a diode and serves the dual functions of automatic volume control and A.V.C.

The grid of the output pentode, V6, is connected to the chassis through a grid leak of 0.3-meg. (in models using a type 38 pentode this resistor has a value of 0.5-meg.). The output volume is determined by the setting of the 3-meg, potentiometer, R1.

The A.V.C. potential is developed across resistors R2, R3, which connect to the plate of the second-detector, V4. The maximum negative potential (the total drop across R2, R3) is applied to the control-grid of the pentode I.F. amplifier, V2, through filter resistor R4. A lower potential is obtained at the center-tap of resistors R2, R3, and this voltage is applied to the control-grid of the screen-grid I.F. amplifier, V3, through filter resistor R5. Thus, resistors R2, R3 serve the dual functions of supplying A.V.C. potential, and at the same time acting as the load resistor combination across which is developed the A.F. potential which is applied to the .03-mf. coupling condenser and thence to the combination grid-leak and manual volume control potentiometer R1.

The two 8 mf. condensers are electrolytic units and are contained in one can.

To re-align the set, turn the station selector to 550 kc., and adjust the service oscillator to 181.5 kc., after first connecting it, through a condenser of 0.1-mf., to the control-grid of V1. Ground the other side of the service oscillator, and do not remove the control-grid clip-wire (of the set) from V1. Next, adjust the I.F. trimming condensers of I.F.T.1 for maximum reading, and then adjust the trimmers in shunt to the secondaries of I.F.T.2 and I.F.T.3, respectively, for maximum output-meter reading.

After this step has been completed, the antenna and oscillator circuits, respectively, may be aligned.

Police Roamio model 951 is the same as the model 95, except for the coils which are designed for the police band.

Model 96

Following are the average operating potentials to be measured with a high-resistance meter.

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts
V1	5.9	4	95	180
V2	5.5	7	95	180
V3	5.9	4	95	180
V4	5.9	2	95	180
V5	5.9	6		80
V6	5.9	14	180	170

The aligning procedure in connection with this receiver is the same as for the Model 95 chassis, except that the high side of the service oscillator connects through a condenser of 0.1-mf., not to the first tube in the set, V1, but to the first-detector, V2, for making the I.F. adjustments. After setting the station-selector dial to 550 kc., adjust the service oscillator to 181.5 kc., and proceed as previously described.

Then, tune the service oscillator to 1,400 kc., set the station-selector dial to 1,400 kc., and connect the high side of the service oscillator, through a condenser of 250 mmf., to the antenna lead of the receiver; the low side of the service oscillator connects to the chassis.

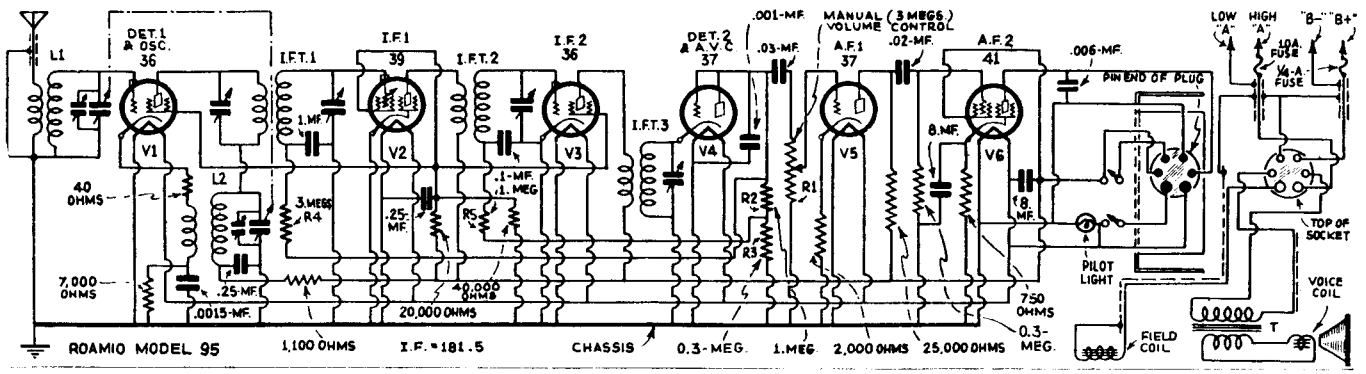
It is preferable to use a dummy antenna in making these adjustments. Align the I.F. and R.F. circuits for maximum reading on the output meter. The circuits of L1, L2 and L3 should not be adjusted until the I.F. circuits have been aligned.

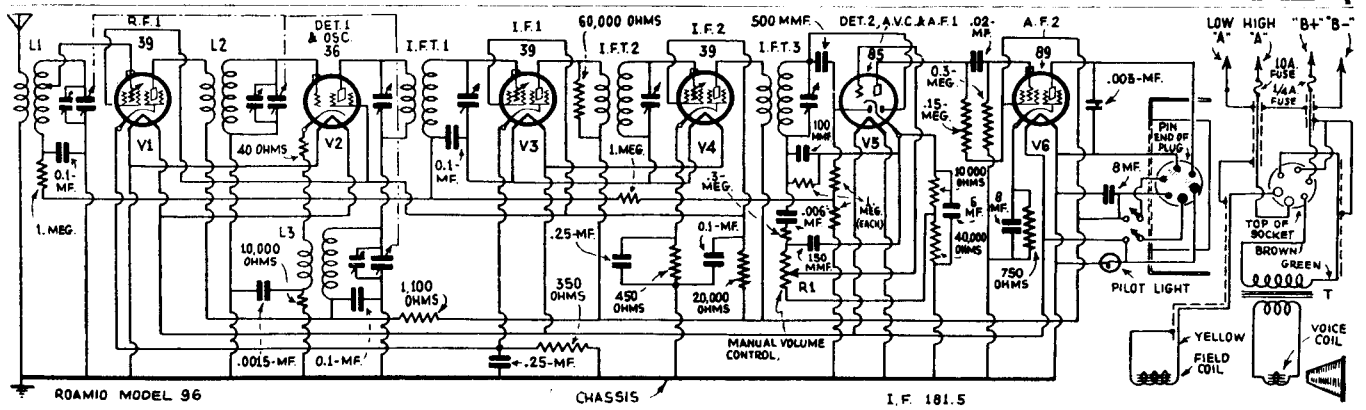
The action of the A.V.C. section of this receiver model is a bit more complicated than that of the previously described Roamio A.V.C. circuits. Consequently, the interested Service Man is referred to the September, 1932 issue of RADIO-CRAFT, which contains a lengthy description of the diode-triode tube, in the article: "Still More New Tubes"; fundamental data regarding A.V.C. circuits in general are discussed at considerable length in the article, "Operation and Service of Automatic Volume Control Systems" (in the same issue).

The manual volume control resistor, R1, has a value of 3 megs.

Variation in tube current supplied by the automobile storage battery, due to fluctuations caused by the generator and load on the battery, is a cause of so-called "interference" in many automobile receivers. Although these Roamio models are designed to eliminate this effect as much as possible, in order to insure the best reception it may be advisable to pay particular attention to the connection of the yellow "A" lead, running it *direct to the car battery* rather than to other possible locations to the "A" supply.

Whether filter condensers will be required in shunt to the electric horn, electric windshield wiper, electric fan, etc., may be determined by shunting these units with a test condenser of about 2 mf.





CROSLEY RADIO CORP.

CROSLEY "CHIEF" 12-TUBE MODEL 132-1 12-TUBE SUPERHETERODYNE

(Dual reproducers, class B push-push A.F. power output fed by a class A push-pull driver stage, meter tuning, A.V.C., tone control, static control.)

The Crosley Chief, 12-tube superheterodyne console model radio receiving set, is the most recent addition to the line. This receiver incorporates the model 132-1 chassis. Although incorporating a large number of tubes, the power line current consumption is held to a minimum by use of the new tubes which consume much less current than the older types.

Resistors R1A, R1B, 1.5 megs. (per section); R2, 0.4-meg.; R3, 80,000 ohms; R4, 0.15-meg.; R5, R6, 60,000 ohms; R7, 2,000 ohms; R8, 1. meg.; R9, 7,000 ohms; R10, 40 ohms; R11, 750 ohms; R12, R13, R24, 0.5-meg.; R-14, R23, 0.3-meg.; R15, 450 ohms; R16, 3 megs.; R17, 30,000 ohms; R18, 20 ohms center-tapped; R19, 3,500 ohms; R20, 6,000 ohms; R21, 10,000 ohms; R22, 5 megs.

Condensers C1 to C4, tuning units; C5 to C8, I. F. trimmers; C9, C25, C26, .02-mf.; C10, C11, C13, C14, C16, C30, C31, C32, 0.1-mf.; C17, C15, 4 mf.; C18, 150 mmf.; C19, 100 mmf.; C20, C23, .006-mf.; C21, C22, C28, 8 mf.; C24, .05-mf.; C27, .003-mf.; C29, 12 mf.

Tube Type	Fil. Volts	Bias Volts	S.-G. Volts	Plate Volts
V1	2.4	0.5	60	200
V2	2.4	2.5	60	200
V3	2.4	13.5	...	170
V4	2.4	0.5	60	200
V5	2.4	8	165	220
V6	2.4	—	...	...
V7	5.6	23.5	220	200
V8	5.6	23.5	220	200
V9	5.6	28.5	—	405
V10	5.6	28.5	...	405
V11	2.4	77.5	—	70
V12	2.5	...	...	415

With a line potential of 117.5 V. the above figures may be taken as average readings; for "220 V." sets a line voltage of 235 is taken as standard. Bias (unless otherwise stated), screen-grid, and plate readings are taken between these tube contacts and the emitter; bias for V3, V5, V7 to V11, cathode to chassis.

Late chasses of this model have a 1,400-ohm resistor shunted across the visual tuning meter. Also, these later chasses may have two 1. meg. resistors (total) in the manual volume control circuit, connected from the moving arms to the ground ends of R1A and R1B.

The tuning meter of this receiver has a resistance of approximately 440 ohms and the deflection is approximately 10 ma.

The A. F. output of V6 actuates tube V11 which, in turn, controls the bias on the amplifier tubes for A.V.C. operation. By manual adjustment of R2 the degree of background noise is controlled to suit individual preference of sensitivity.

Note that the transformer secondary supplying tubes V1, V2, V3 is bypassed by a dual-section condenser, C30-C31. Another unusual circuit arrangement is the use of a double choke coil arrangement comprising Ch1-Ch2. and field coils 1 and 2. The first two choke coils are connected in the positive high-voltage lead in the usual manner, while the second two chokes, the field coils of the dynamic reproducers, are connected as an "inductive voltage divider," one terminal of the two coils in series being connected to the positive output of the regular filter system, and the other end being grounded to the chassis; the center-tap of these field coils supplies voltage to the screen-grids of V1, V2, V4, and to the plate of V5.

The tone correction furnished by C25-C26 applies equally to V9 and V10, the center-tap of these two condensers being grounded to the chassis. If any portion of the tone control R3, C24, becomes grounded the A. F. portion of the receiver will become inoperative as the entire tone control operates at the potential of the plates of V7, V8.

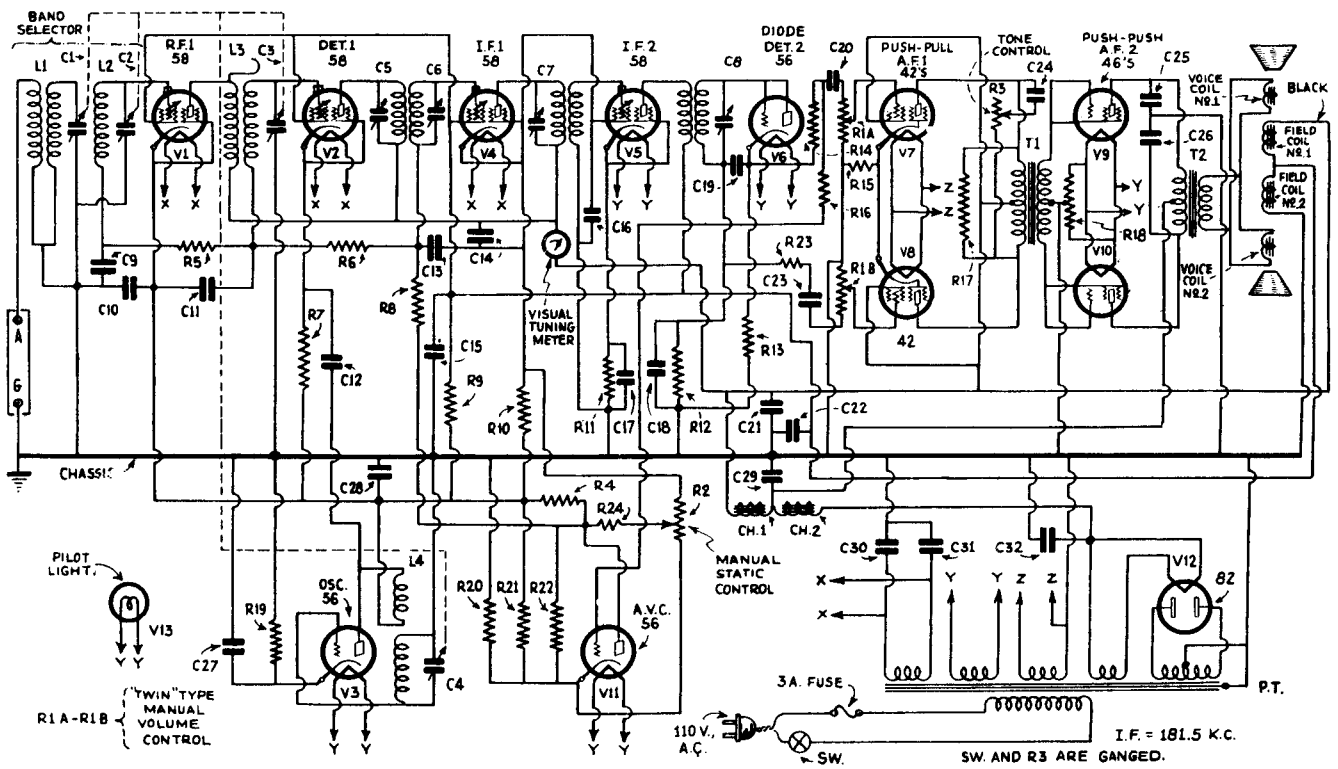
The manual volume control operates in the input circuit of the push-pull driver stage, V7-V8. The two sections of this volume control, R1A, R1B, operate simultaneously as a dual unit.

The first A.F. stage, V7, V8, is driven by a so-called split-diode circuit furnishing A.F. voltage from both the cathode and plate circuits, which are out of phase (in push-pull relationship).

The input circuit of V1 is preceded by a band-selector which must be carefully aligned in order to maintain the required degree of selectivity at all points in the tuning band.

The A.V.C. action is obtained through the voltage drop across resistor R4. There is an initial current flowing through this unit and the 5 meg. grid leak, R22, furnishing a normal bias for the R.F. and I.F. stages. The A.V.C. tube V11 is delayed by means of a positive potential on the cathode of about 60 V. When an R.F. signal of sufficient intensity is applied to make this A.V.C. tube (D.C. amplifier) draw plate current, its plate current also flows through R4 and furnishes an additional A.V.C. bias.

The "static" control is also connected to change the current flowing through R4, thus changing the initial bias on the controlled tubes, so that the overall sensitivity of the set is reduced.



Schematic circuit of the Crosley "Chief" model 132-1, 12-tube superheterodyne. Note the unusual arrangement of the circuits of V7-V8, and also V11.

RCA-VICTOR, INC.

R.C.A. VICTOR R-27 AND PHILCO 53 ULTRA-MIDGET A.C.-D.C. RADIO RECEIVERS

R.C.A. Victor R-27 Universal

This small radio set carries the following specifications: Line voltage rating, 105 to 120 V., D.C., or 25 to 133 cycles A.C. Power consumption, 40 W. A feature of this set is the extremely wide tuning range of 540 to 1,700 kc. Operating voltages at maximum volume, on a 115 V. A.C. line (on D.C., slightly less) are as follows:

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts	Plate Ma.
1	6.0	3.0	105	105	7
2	6.0	0.75*	11.0	60*	.025
3	6.0	11.0	100	95	5
4	6.0	.....	.....	115	15

*Impossible to measure on ordinary voltmeter.

The left-hand knob is a combined volume control and power switch; the station selector is at the right. If the set does not work within a minute, reverse the position of the line plug in the socket. This particular type of set should be so positioned as to permit full ventilation at all times.

The most satisfactory length of aerial for this set is to be determined by individual trial. In general, a length of about 20 ft. should be quite sufficient: this length is the dimension of the lead which is supplied with the set. If the antenna lead is bunched, or coiled, too near the set, circuit oscillation may occur. A similar effect may be produced if the volume control is advanced too far. When tuned to a local station with the volume control fully advanced, a condition may be observed where a certain amount of counter-clockwise rotation of the control will improve the quality of reproduction and actually increase the volume. This condition is caused by overloading and may be corrected simply by setting the volume control below the readily-apparent critical point.

Philco 53 Universal Compact

Operating voltages at a line potential of 120 V., D.C., are given below:

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Cath. Volts	Plate Volts
V1	*	8	93	7-14	95
V2	*	3	34	6-12	14
V3	*	4	100	3-26	94
V4	*	..	....	58-73	10

*The total voltage applied to the filaments is 51 V.

All of these readings were taken from the underside of the chassis, using test prods and leads with a suitable high resistance meter; the volume control is set at maximum and the station selector at 550 kc.

The following data concerning the operation of this set on 115 V. A.C. are furnished:

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Cath. Volts	Plate Volts
V1	*	7	94	18	95
V2	*	4	34	12	15
V3	*	4	102	10	94
V4	*	..	....	112	112

*The total voltage applied to the filaments is 49.9 V.

These readings are taken in the manner described for making D.C. tests.

To obtain maximum sensitivity through the use of the 30 ft. of antenna wire furnished with the set, it will be necessary to adjust the antenna compensating condenser, the L.F. compensating condenser and the sensitivity condenser in the following manner; unroll the 30 ft. of antenna wire to its full length (do not connect it to another aerial or ground while the following adjustments are being made). Tune to a station near the H.F. end of the dial (between 1400 and 1500 kc.). With a fibre adjusting wrench, adjust the antenna condenser for maximum volume. (This condenser is the second one from the front control.) After this is completed, tune to a station near the L.F. end of the dial (as near 600 kc. as possible) and then adjust the L.F. condenser for maximum volume (looking at the back of the set, this is the unit at the extreme left); retune to the H.F. station and do any necessary fine readjusting so as to bring in the station with maximum volume.

Now check the adjustment of the sensitivity condenser (at the immediate right of the L.F. condenser) with the receiver tuned to a station near the H.F. end of the dial; turn this condenser to the right as far as possible without causing circuit oscillation or a squeal. Repeat this adjustment on a station near the L.F. end of the dial; if circuit oscillation occurs, turn the condenser to the left until this disappears.

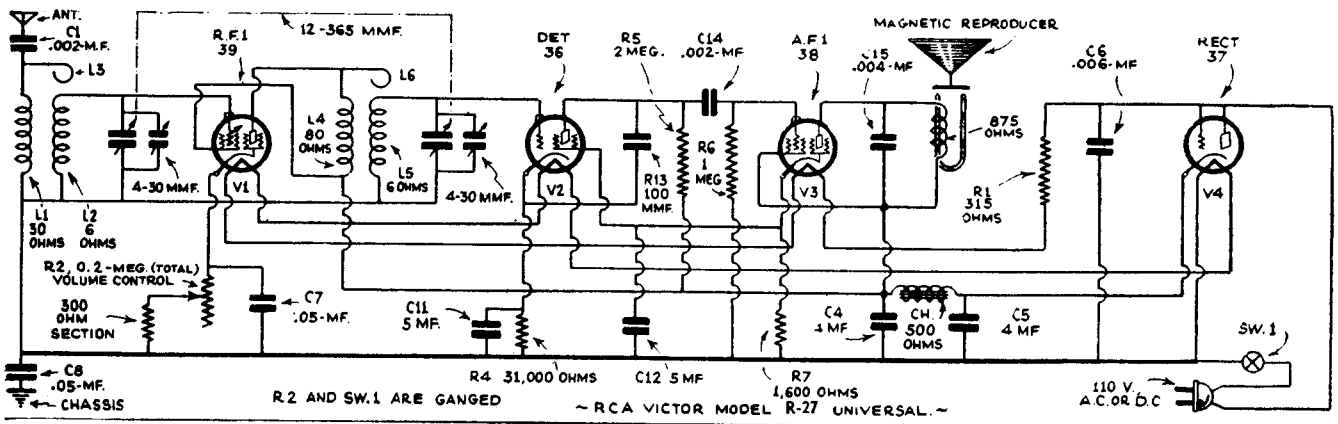
At the rear of the chassis are four condenser controls, as follows (starting from the left): L.F. condenser; sensitivity; I.F. primary, 450 kc.; and I.F. secondary, 450 kc.

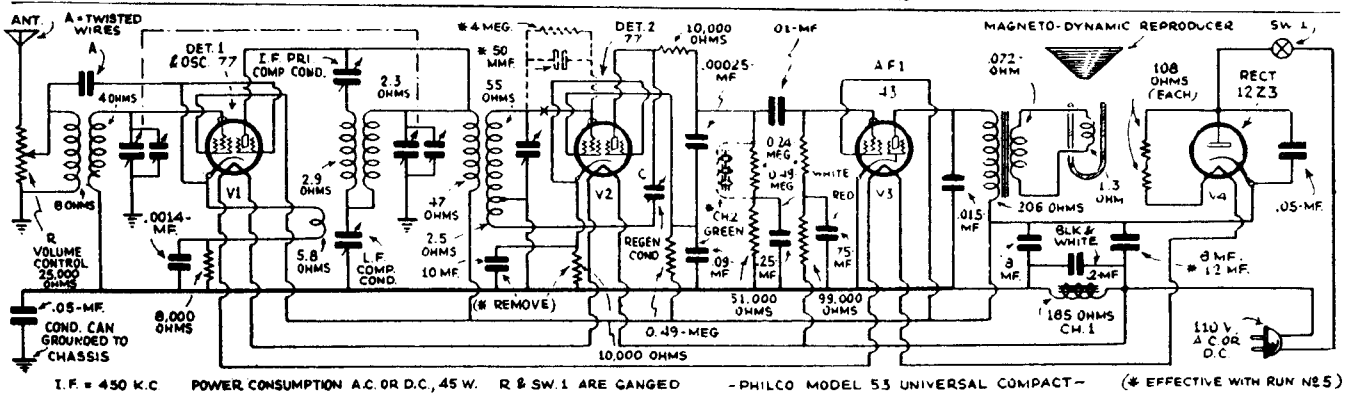
Of exceptional interest is the use of the new, type 77 tube, the externally-connected suppressor-grid 6.3 V. R.F. pentode. The type 12Z3 rectifier has a 12 V. filament. The second-detector, V2, is made slightly regenerative at the I.F. In order to secure adequate filtration on A.C. circuits, the single filter-choke has connected to it not only the usual input and output filter condensers, but also a shunt tuning condenser which, with the choke coil, forms a trap circuit. The chassis does not connect directly to the light line.

The filter condenser bank is color coded as follows: Black, common; green, .09-mf.; white, .25-mf.; red, .75-mf.; black and white, 0.2-mf.; the common lead connects to the shield can only through a condenser of .05-mf.

The fiber screw at the back of the chassis should be adjusted at the time of installation. Place the set in operation, tune in a station near the middle of the dial, and adjust this screw, which controls the regeneration condenser, C_4 until, by turning clockwise, a swishing sound is heard where different stations are tuned in. Now turn the screw counter-clockwise until the swishing sound just ceases. Continue to turn in the same direction about one-quarter turn. When correctly adjusted, the circuit will not break into oscillation at any point in the tuning range.

As indicated in the schematic circuit, several changes have been incorporated in models starting with run 5.





CANADIAN MARCONI CO.

MODELS 32-B, 33, 33-AW, 34, 35, 36, & 37

ALIGNMENT OF TRIMMING CONDENSERS

Before attempting to adjust the R.F. trimmers, be sure that the Intermediate Frequency trimmers are properly adjusted. The procedure is as follows:—

I.F. TRIMMERS:—(1) Connect the output meter to the voice coil terminals of the speaker.
(2) See that the receiver chassis is properly grounded.
(3) Remove the oscillator tube from the receiver.
(4) Connect the Test Oscillator to the grid of the 1st detector tube and the chassis.
(5) Turn the volume control on full and reduce the output of the test oscillator to give a low reading on the output meter.
(6) Adjust the I.F. Trimmers in the following order:—

Models 32-B, 33, 33-AW and 34:—(a) 2nd Det. Grid. (b) I.F. Plate. (c) I.F. Grid. (d) 1st Det. Plate.

Models 35-36-37:—(a) 2nd I.F. Transformer, Secondary. (b) 1st I.F. Transformer, Secondary. (c) 1st I.F. Transformer, Primary. (d) Band pass coil. The position of these trimmers is shown on the data sheet for each receiver.

Model 33-AW 175 KC Plate Coil:—In addition to the regular I.F. Transformers the oscillator plate coil is tuned to 175 KC. After aligning the I.F. Transformers, connect the 175 KC Oscillator to "A" and "G," switch to the 125 meter band (Mauve) and adjust the S/W I.F. trimmer for maximum output.

See that the output of the Test Oscillator is kept as low as possible at all times, in order to avoid overloading any of the tubes or causing the Automatic Volume Control to function.

R.F. TRIMMERS:—With all tubes in place and the receiver grounded, connect the output meter as above and proceed as follows:—(1) Connect the Test Oscillator to the aerial and ground terminals. (2) Set the oscillator at 1,400 KC and the dial of the receiver to the same frequency. (3) Reduce the output of the oscillator to give a low reading on the output meter with the volume control on full. (4) Adjust the R.F. trimmers in the following order:—(a) Oscillator, (b) 1st Detector, (c) R.F. Amplifier. Reduce the output of the Test Oscillator as the sensitivity of the receiver is increased. (5) Set Oscillator at 600 KC and tune the receiver to this frequency. (6) Adjust the Oscillator tracking condenser for maximum output while rocking the tuning condenser back and forth.

ALIGNMENT OF SHORT WAVE TRIMMERS

The "All Wave" A.C. Models may be tuned to any frequency from 1,500 KC to 26,000 KC, as well as the broadcast band. Incoming signals of these frequencies are heterodyned by the S/W Oscillator to produce a resultant frequency of 1,520 KC which is applied to the grid of the R.F. amplifier. In order that the circuits of the broadcast receiver may be at maximum efficiency at this frequency (1,520 KC), adjustable condensers are substituted for the three sections of the gang tuning condenser. These condensers are located alongside of the first three sections of the tuning condenser and may be adjusted with a long screw-driver through holes in the top of the condenser shield. The procedure is as follows:—

1,520 KC TRIMMERS:—(1) Turn the selector switch to the 60-200 meter (Green) band. See that the receiver is grounded. (2) Remove the S/W Oscillator tube and connect the Test Oscillator to the grid of the S/W Detector and to chassis. (3) Set the Test Oscillator at exactly 1,520 KC and adjust the trimmers in the following order:—(a) Oscillator, (b) 1st Det., (c) R.F. Amplifier. If the Test Oscillator will not tune to 1,520 KC, set it at exactly 760 KC, the second harmonic of this frequency is 1,520 KC.

S/W TRACKING CONDENSERS:—The S/W Oscillator circuit is provided with three adjustable tracking condensers, one for each of the three short wave bands. We do not advise attempting to adjust these unless a calibrated S/W Oscillator is available. The procedure is similar to adjusting the 600 KC Tracking condenser. With the S/W Test Oscillator connected to "A" and "G," adjust for maximum output while rocking the tuning condenser back and forth at the following frequencies:—

Band	Alignment Frequency	Dial Reading	Trimmer
(1) S. S/W Red	12,000 KC	81° Approx.	Left
(2) M. S/W Yellow	4,500 KC	93° "	Center
(3) L. S/W Green	1,650 KC	90° "	Right

Trimmer position shown when looking at back of chassis.

CANADIAN MARCONI CO.

MODELS 32-B, 33, 33 AW, 34, 35, 36 & 37

It is absolutely essential that both the receiver and the S/W Test Oscillator be properly grounded.

If no short wave oscillator is available it may be possible to pick up a harmonic of a broadcast band oscillator. At all times the signal should be kept as low as possible to avoid picking up the image frequency.

In order to obtain a sufficiently weak signal it may be necessary to remove the Oscillator to some distance from the receiver.

ACTION OF DIODE (2nd) DETECTOR—MODELS 35, 36 and 37

Half wave rectification of the signal takes place in this tube between the cathode and each of the three other elements (counting the screen and suppressor grids as one). This pulsating direct current flows from each of these elements to the cathode. The rectified signal current flowing to the grid is applied to the grid of the 1st Audio tube through condenser C28. The rectified current flowing to the plate produces a voltage drop in resistor R17 which increases the bias on the R.F. Amplifier tube and automatically controls the sensitivity of the receiver The current flowing to the screen and suppressor grids is used for Automatic Silent Tuning.

In **Model 34** a separate tube is used for automatic volume control. The grid of this tube is coupled to the 2nd Detector grid circuit by a small condenser (C17). The incoming signal causes the tube to draw more or less plate current which causes a voltage drop in resistor R14 which varies the bias on the grids of the R.F. and I.F. amplifiers, thus controlling the sensitivity of the receiver.

AUTOMATIC SILENT TUNING:—MODELS 35-37:—Silencing the receiver is accomplished by making the bias on the grid of the 1st Audio tube sufficiently negative to prevent this tube from operating. The action is as follows:—The grid of the Suppressor tube is at the same potential as the cathode due to the fact that it is connected to it through resistors R18 and R19, consequently, current flows to the plate through resistor R22. The voltage drop across this resistor produces the extra bias necessary to prevent the 1st Audio tube functioning and no sound is heard from the speaker. When a carrier wave is tuned in, current flows to the screen and suppressor grids of the detector through R19. The voltage drop across this resistor makes the grid of the Suppressor tube negative with respect to its cathode and prevents plate current from flowing, this in turn allows the bias on the 1st Audio grid to drop to normal and allows this tube to amplify the signal applied to its grid by the detector.

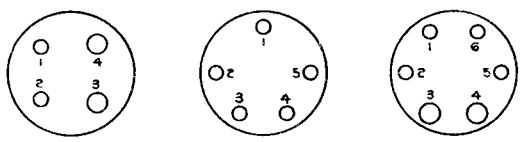
A three position switch is provided for controlling the action of this tube. In the FULL position the tube is actuated only by fairly powerful stations. In the MEDIUM position, stations of moderate power can be received. This position of the switch should be used wherever the noise level is sufficiently low to permit satisfactory reception.

Throwing the switch to the OFF position makes the grid of the Suppressor tube sufficiently negative to prevent plate current flowing at any time, consequently the bias on the 1st Audio tube remains normal and the receiver is not silenced.

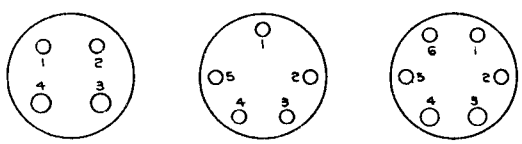
SPEAKERS:—A.C. MODELS. It is not feasible to replace the cone in these speakers, consequently, the entire head of the speaker must be replaced. In Model 37, twin speakers are used. These speakers are identical electrically but differ slightly in the construction of the cone and are therefore **not** interchangeable. The speakers are distinguished by marking one type with a Red spot.

In ordering speakers or cones, be sure to specify which type is required.

CAUTION:—Care should be taken not to turn on the Power switch (left hand knob) immediately after turning it off. Allow about twenty seconds for the tubes to cool off before turning the receiver on again in order to avoid possible damage to the Rectifier Tube.



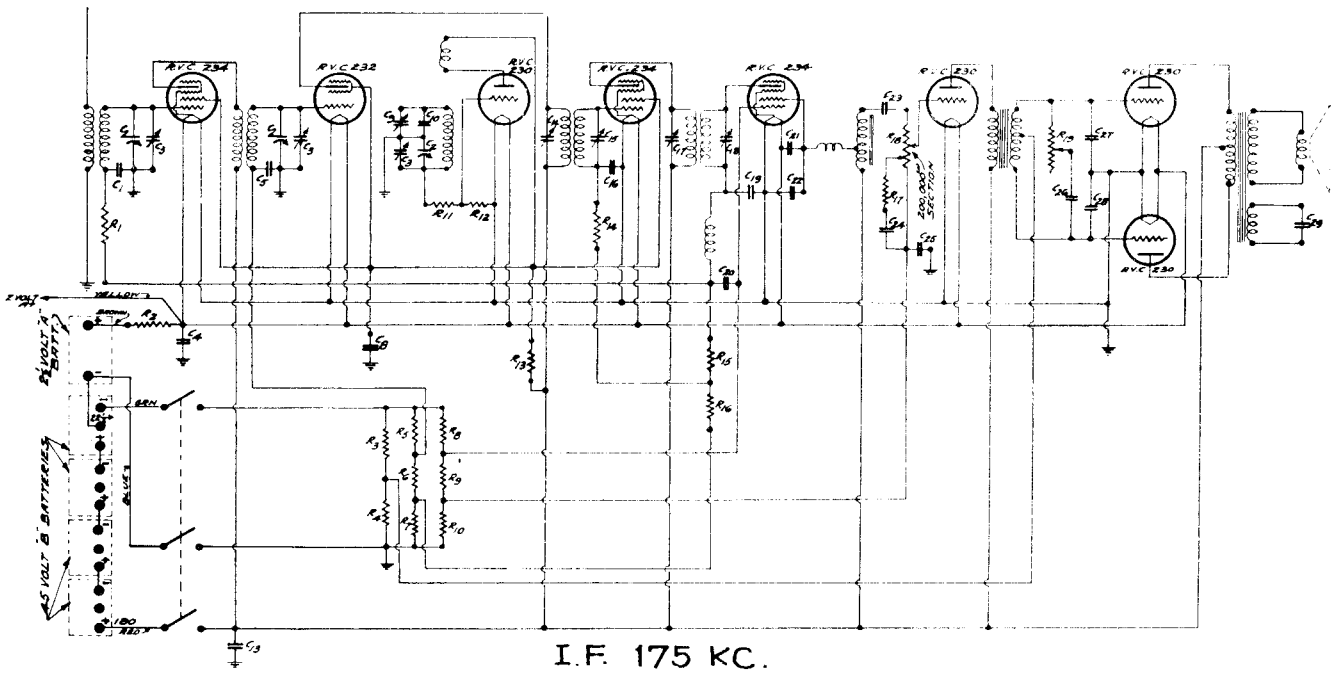
TUBE BASES (BOTTOM VIEW)



SOCKETS (TOP VIEW)

CANADIAN MARCONI CO.

32-B SET



CONDENSERS FOR MODEL 32-B

Ref. No.	Part No.	Capacity	Type	List Price
C1	1001	.05 Mf	6317	**1.20**
C2	1002	18–325 Mmf 3 gang	7501	**9.60**
C3		4–50 " Trimmer for C2		
C4	1003	.75 Mf Bypass block	7525	**10.00**
C5	1003	.1 " " "	"	**10.00**
C8	1003	.25 " " "	"	**10.00**
C9	1004	15–75 Mmf Osc. Tracking	7062	**1.20**
C10	1005	670 "	6320	**.90**
C13	1003	.8 Mf Bypass block	7525	**10.00**
C14 C15	1006	15–75 Mmf / 140–220 " I. F. Trimmers	7062	**1.20**
C16	1003	.05 Mf Bypass block	7525	**10.00**
C17 C18	1006	140–220 Mmf / 15–75 " I. F. Trimmers	7062	**1.20**
C19	1007	400 "	3085	**.75**
C20	1008	.005 Mf	2962	**1.25**
C21	1009	1200 Mmf	2012	**.85**
C22	1009	1200 "	2012	**.85**
C23	1008	.005 Mf	2962	**1.25**
C24	1003	.025 " Bypass block	7525	**10.00**
C25	1003	.5 " " "	7525	**10.00**
C26	1003	.025 " " "	"	**10.00**
C27	1003	.005 " " "	"	**10.00**
C28	1003	.005 " " "	"	**10.00**
C29	1010	2400 Mmf	2749	**1.80**

RESISTORS FOR MODEL 32-B

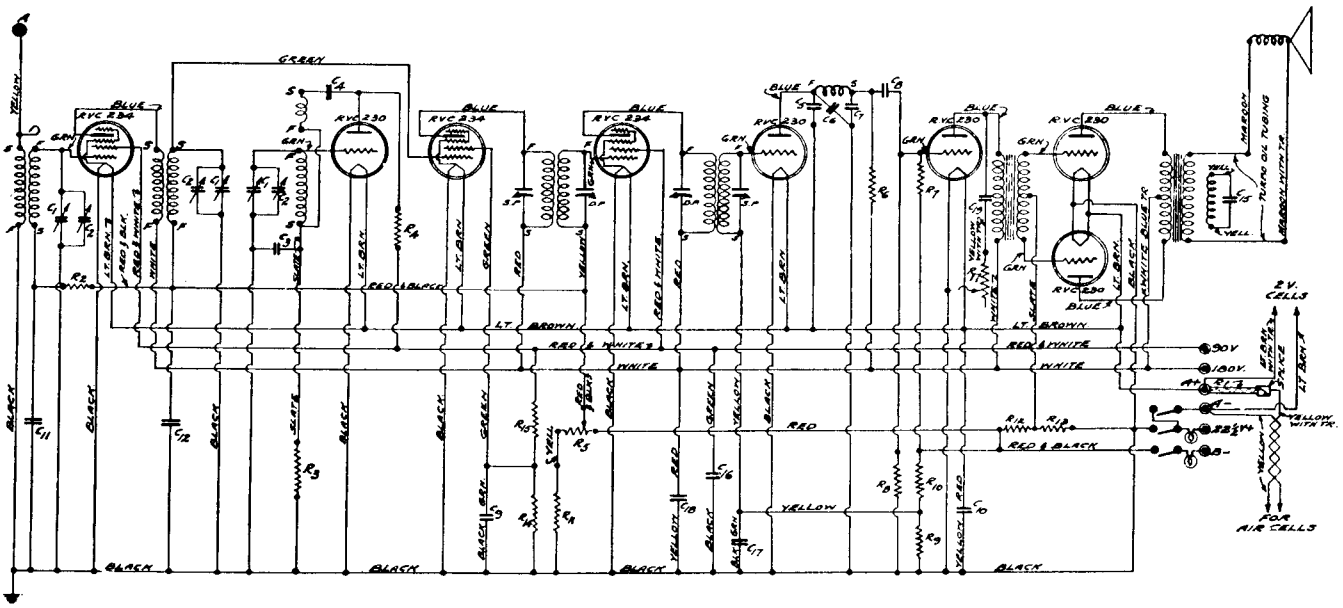
Ref.	Part No.	Resistance	Type No.	List Price
R1	1011	500,000 Ohms ¼ Watt	S–1067	**.60**
R2	1012	.8 " Wire Wound	3043	**.80**
R3	1013	500 " ½ Watt	3383	**.70**
R4	1014	750 " ½ "	3382	**.70**
R5	1015	700,000 " ¼ "	6244	**.60**
R6	1016	140,000 " ¼ "	6241	**.60**
R7	1017	65,000 " ¼ "	3245	**.60**
R8	1018	1 Meg. " ¼ "	3033	**.60**
R9	1018	1 " " ¼ "	"	**.60**
R10	1019	2 " " ¼ "	6242	**.60**
R11	1020	3,000 " ½ "	3358	**.70**
R12	1021	40,000 " ¼ "		**.60**
R13	1022	15,000 " ½ "	S–1116	**.60**
R14	1011	500,000 " ¼ "	S–1067	**.60**
R15	1011	500,000 " ¼ "	"	**.60**
R16	1011	500,000 " ¼ "	"	**.60**
R17	1023	10,000 " ¾ "	3381	**.60**
R18	1056	1 Meg. " Vol. Control	6328	**2.75**
R19	1055	150,000 " Tone "	6329	**3.50**

VOLTAGE READINGS—MODEL 32-B

Radiotron No.	Control Grid to Filament Volts	Screen Grid to Filament Volts.	Plate to Filament Volts	Screen Current M.A.	Plate Current M.A.	Filament Volts
1. R.F.	0.2	65	157	1.0	3.0	2.0
2. 1st Detector	0.5	65	157	0.1	0.2	2.0
3. Oscillator	1.0	..	65	..	4.0	2.0
4. I.F.	0.5	65	157	1.0	3.0	2.0
5. 2nd Detector	2.0	155	0	4.0	0	2.0
6. 1st A.F.	1.0	..	155	..	2.5	2.0
7. Power	14.0	..	155	..	1.2	2.0
8. Power	14.0	..	155	..	1.2	2.0

CANADIAN MARCONI CO.

MODEL 33



TRIMMER ADJUSTMENTS—MODEL 33

I.F.—175 K.C. adjust in order—No. 1, No. 2, No. 3, No. 4
R.F.—Trim at 1,400 K.C. in order—Osc., Det., R.F.
Oscillator Tracking Condenser—Adjust at 600 K.C.

CONDENSERS FOR MODEL 33

Ref.	Part No.	Capacity	Type	List Price
C1	1101	17–360 Mmf 3 gang	32948	5.00
C2	...	Trimmer for C1	....	....
C3	1102	950 Mmf Osc. Tracking	36078	.75
C4	1103	.002 Mf Mica		.50
C5	1104	.001 " "		.50
C6	1105	.001 " "		.50
C7	1106	.00025 " "		.50
C8	1107	.02 " "		.50
C9	1108	.3 " Bypass block	36109	3.50
C10	1108	1 " " "	36109	3.50
C11	1109	.1 " 200v. Tubular		.50
C12	1110	.1 " " "		.50
C15	1113	.002 " Mica		.50
C16	1108	.3 " Bypass block	36109	3.50
C17	1108	.3 " " "	36109	3.50
C18	1108	1 " " "	36109	3.50
C19	1114	.04 " 200v. Tubular		.50

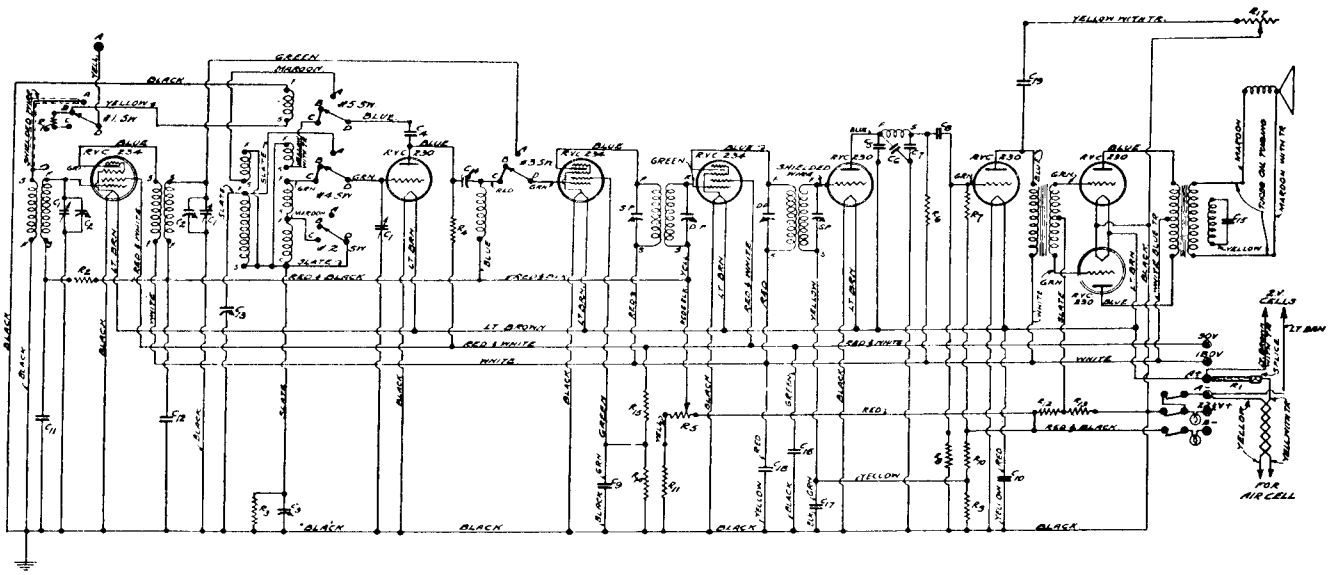
NOTE:—Bypass block Part No. 1108 contains condensers C9, C10, C16 and C17.

RESISTORS FOR MODEL 33

Ref.	Part No.	Resistance	Type	List Price
R1	1116	.525 Ohms	36112	.50
R2	1117	1,000 " ½ Watt	..	.50
R3	1118	500,000 " ½ "	..	.50
R4	1119	10,000 " ½ "	..	.50
R5	1189	50,000 " Vol. Control	..	1.20
R6	1120	450,000 " ½ Watt	..	.50
R7	1118	500,000 " ½ "	..	.50
R8	1118	500,000 " ½ "	..	.50
R9	1121	350,000 " ½ "	..	.50
R10	1122	600,000 " ½ "	..	.50
R11	1124	7,700 " ½ "	..	.90
R12	1125	650 " ½ "	..	.50
R13	1126	1,300 " ½ "	..	.50
R14	1127	34,000 " ½ "	..	.50
R15	1128	16,500 " ½ "	..	.50
R17	1188	250,000 " Tone Control	..	1.20

CANADIAN MARCONI CO.

MODEL 33-AW



TRIMMER ADJUSTMENTS—MODEL 33-AW

I.F.-175 K.C. adjust in order—No. 1, No. 2, No. 3, No. 4.
R.F. Trim at 1,400 K.C. in order—Osc., Det., R.F.
Oscillator Tracking Condenser—Adjust at 600 K.C.
S/W I.F. Trimmer—Switch to 125 meter band, connect 175 K.C. oscillator to A. & G., adjust for maximum output.

CONDENSERS FOR MODEL 33-AW

Ref.	Part No.	Capacity	Type No.	List Price
C1	1201	17 -360 Mmf 3 gang	32948	5.00
C2	..	Trimmer for C1	..	..
C3	1202	950 Mmf Osc. Tracking	36078	.75
C4	1203	.002 Mf Mica		.50
C5	1204	.001 " "		.50
C6	1205	.001 " "		.50
C7	1206	.00025 " "		.50
C8	1207	.02 " "		.50
C9	1208	.3 " Bypass block	36109	3.50
C10	1208	1. " " "	"	3.50
C11	1209	.1 " 200v. Tubular		.50
C12	1210	.1 " " "		.50
C13	1211	4-20 Mmf Osc. Trimmer	36123	.60
C14	1212	60-140 Mmf S/W.I.F. Trim	36161	.60
C15	1213	.002 Mf Mica		.50
C16	1208	.3 " Bypass block	36109	3.50
C17	1208	.3 " " "	"	3.50
C18	1208	1. " " "	"	3.50
C19	1214	.04 " 200v. Tubular		.50

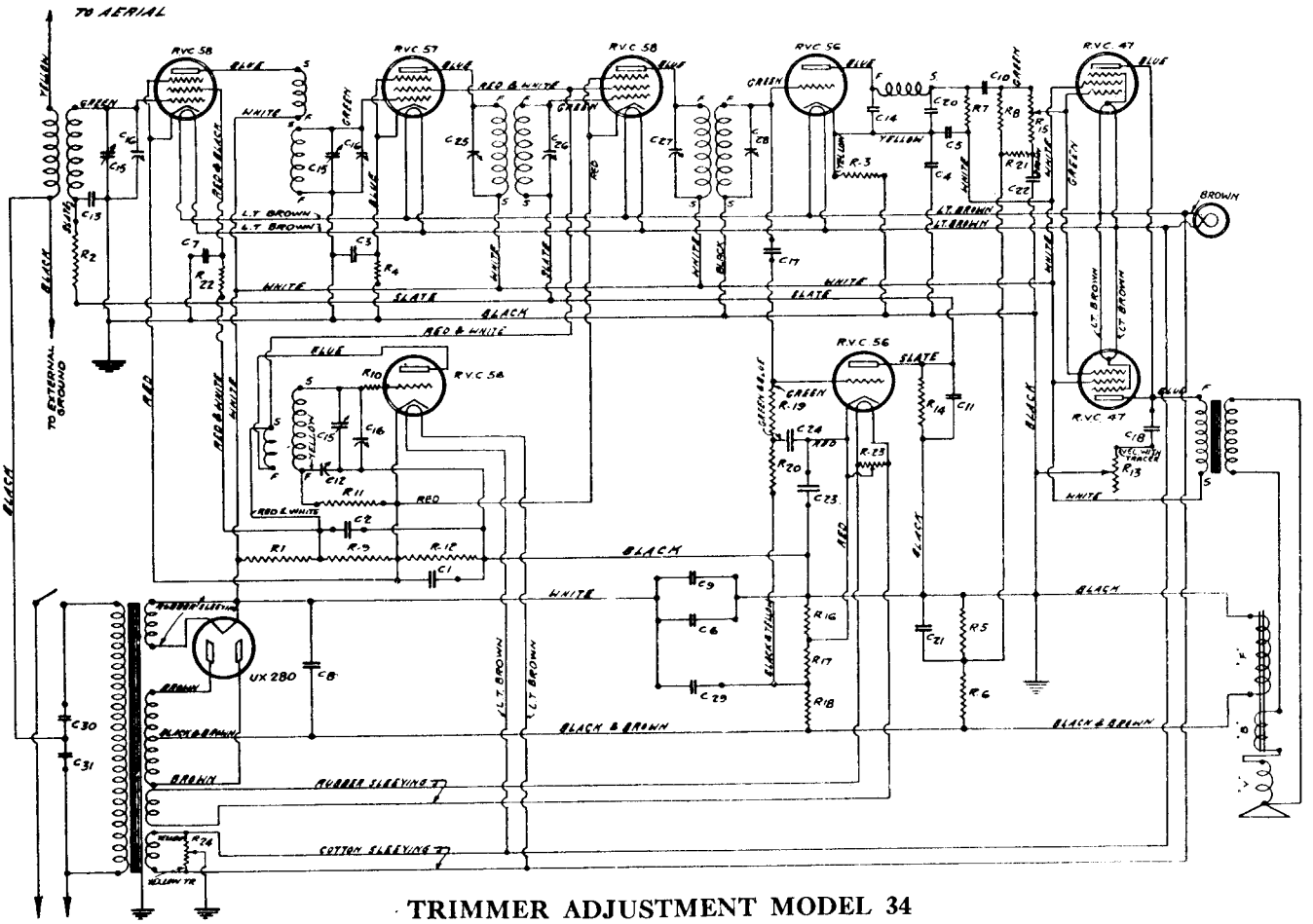
NOTE:—Bypass block Part No. 1208 contains condensers C9, C10, C16 and C17.

RESISTORS FOR MODEL 33-AW

Ref.	Part No.	Resistance	Type No.	List Price
R1	1216	.525 Ohms	36112	.50
R2	1217	1,000 " ½ Watt	..	.50
R3	1218	500,000 " ½ "	..	.50
R4	1219	10,000 " ½ "	..	.50
R5	1289	50,000 " Volume Control	..	1.20
R6	1220	450,000 " ½ Watt	..	.50
R7	1218	500,000 " ½ "	..	.50
R8	1218	500,000 " ½ "	..	.50
R9	1221	350,000 " ½ "	..	.50
R10	1222	600,000 " ½ "	..	.50
R11	1224	7,700 " ½ "	..	.50
R12	1225	650 " ½ "	..	.50
R13	1226	1,300 " ½ "	..	.50
R14	1227	34,000 " ½ "	..	.50
R15	1228	16,500 " ½ "	..	.50
R16	1229	400 " ½ "	..	.50
R17	1288	250,000 " Tone Control	..	1.20

CANADIAN MARCONI CO.

MODEL 34



TRIMMER ADJUSTMENT MODEL 34

I.F.—175 K.C. Adjust in order No. 1, No. 2, No. 3, No. 4.
R.F.—Trim at 1,400 K.C. in order—Osc., Det., and R.F.
Oscillator Tracking Condenser—Adjust at 600 K.C.

CONDENSERS FOR MODEL 34 RECEIVER

Ref.	Part No.	Capacity	Type No.	List Price
C1	1301	.5 Mf 200 Volt Bypass Block	35942	5.00
C2	1301	1. " " " " " "	"	5.00
C3	1302	.1 " " " Tubular		.50
C4	1301	1. " " " Bypass Block	35942	5.00
C5	1301	.25 " 400 " " " "	"	5.00
C6	1301	.5 " " " " " "	"	5.00
C7	1301	.1 " 200 " " " "	"	5.00
C8	1303	8. " 400 " Electrolytic		1.50
C9	1304	6. " 250 " "		1.50
C10	1305	.006 " Mica		.50
C11	1301	.04 " 200 " Bypass Block	35942	5.00
C12	1306	850 Mmf Osc. Tracking	34517	.80
C13	1307	.04 Mf 200 " Tubular		.50
C14	1308	.001 " Mica		.50
C15	1309	21–325 Mmf 3 gang	35533	5.00
C16		60 Mmf Trimmer for C15		
C17	1310	100 " Mica		.50
C18	1311	.15 Mf 400 " Tubular		.50
C20	1312	250 Mmf Mica		.50
C21	1313	.03 Mf 200 " Tubular		.50
C22	1301	.25 " 200 " Bypass Block	35942	5.00
C23	1301	.1 " " " " " "	"	5.00
C24	1301	.1 " " " " " "	"	5.00
C25	1314	6-70 Mmf I.F. Trimmer No. 4		..
C26	1314	70–140 " " " No. 3		
C27	1315	70–140 " " " No. 2		..
C28	1315	6-70 " " " No. 1		
C29	1301	.25 Mf Bypass Block	35942	5.00
C30	1316	.02 " Line Filter	35248	1.00
C31	1316	.02 " " "	"	

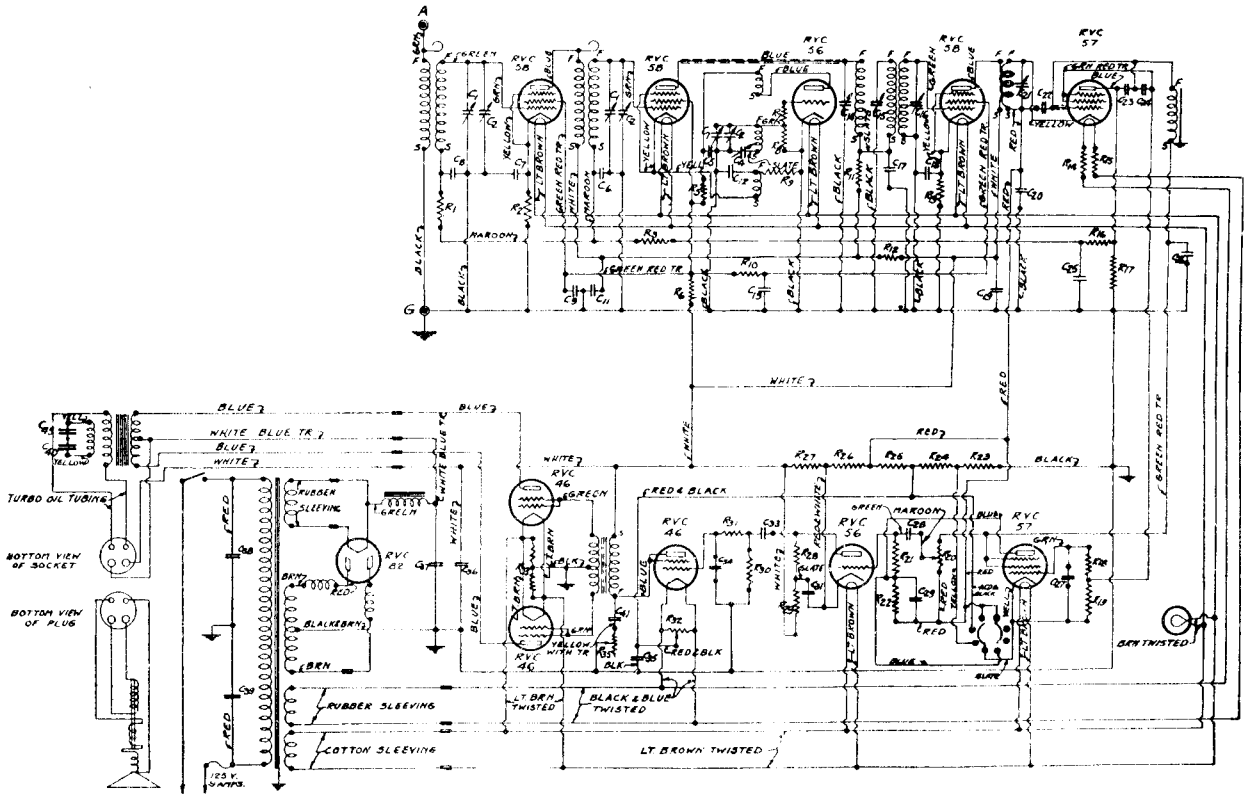
NOTE:—Bypass block, Part No. 1301, contains condensers C1, C2, C4, C5, C6, C7, C11, C22, C23, C24 and C29.

RESISTORS FOR MODEL 34 RECEIVER

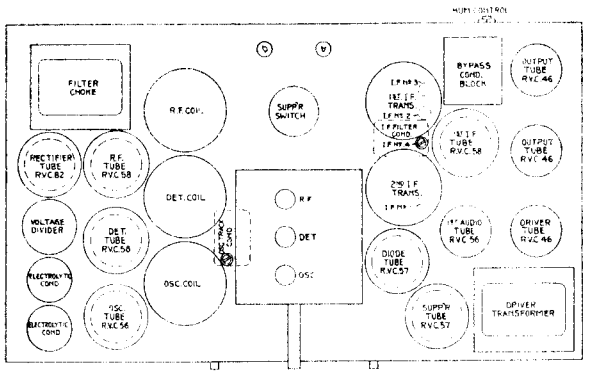
Ref.	Part No.	Resistance	Type No.	List Price
R1	1318	16,000 Ohms 3 Watt		.75
R2	1319	25,000 " ½ "		.50
R3	1320	50,000 " ½ "		.50
R4	1321	10,000 " ½ "		.50
R5	1320	50,000 " ½ "		.50
R6	1322	380,000 " ½ "		.50
R7	1323	100,000 " ½ "		.50
R8	1324	750,000 " ½ "		.50
R9	1325	15,000 " 1 "		.50
R10	1326	2,500 " ½ "		.50
R11	1327	40,000 " ½ "		.50
R12	1328	300 " ½ "		.50
R13	1390	100,000 " Tone Control	35926	1.75
R14	1329	1 Meg. " ½ Watt		.50
R15	1391	800,000 " Volume Control	35927	1.20
R16	1330	525,000 " ½ Watt		.50
R17	1323	100,000 " ½ "		.50
R18	1323	100,000 " ½ "		.50
R19	1331	2 Meg. " ½ "		.50
R20	1329	1 Meg. " ½ "		.50
R21	1332	200,000 " ½ "		.50
R22	1326	2,500 " ½ "		.50
R23	1333	20 " Center Tapped		.50
R24	1334	6 " " "		.50

CANADIAN MARCONI CO.

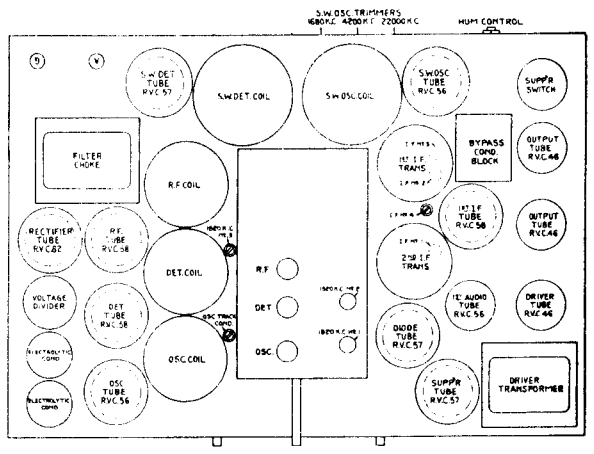
SERVICE DATA—MODELS 35, 36-37



Model 35



Model 35



Model 36 and 37

VOLTAGE READINGS—MODELS 35, 36-37

	VOLTAGES to Cathode			VOLTAGES to Chassis				VOLTAGES to Cathode or Fil.			
	Grid	Pl.	Scr.	Sup.	Catn.	Htr.		Grid	Pl.	Scr.	Sup.
B.C.-R.F.	0	215	90	0	..	..	*S/W R.F.	.5	230	30	0
1st Det.	0	185	85	0	6	..	*S/W Osc.	25	165	..	..
B.C. Osc.	0	90	..	..	..	..	Driver	18	230	225	..
I.F.	0	230	90	0	3	..	Power	0	380	0	..
Diode	+13	−18	−18	−18	40	25	Rect.	..	420	..	..
Suppressor	0	9	9	9	15						
1st. A.F.	.1	130	..	..	44	.1					

*Models 36-37 only.

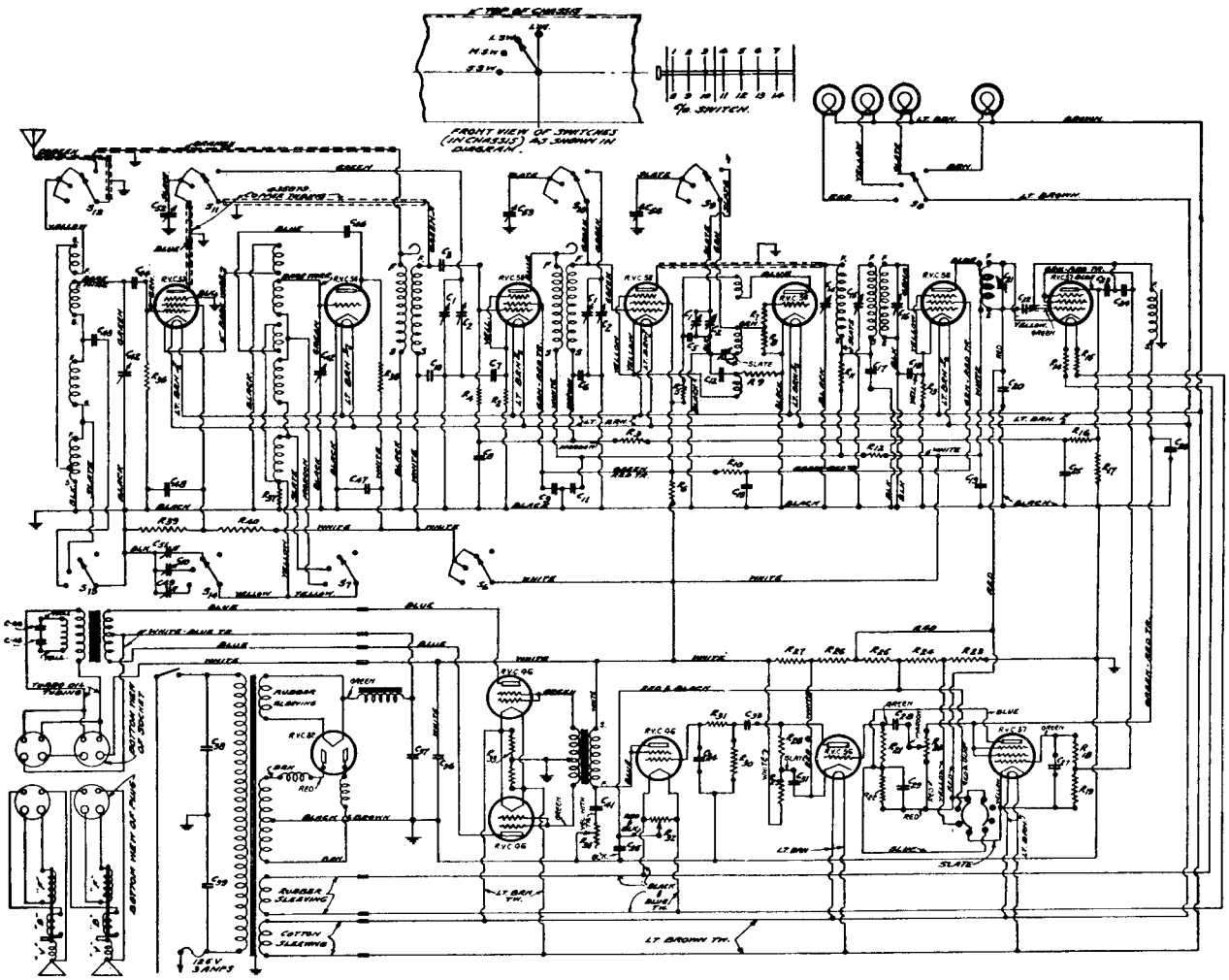
TRIMMER ADJUSTMENTS—MODELS 35, 36-37

I.F.—175 K.C. Adjust in order—No. 1, No. 2, No. 3, No. 4.
R.F.—Trim at 1400 K.C. in order—Osc., Det., and R.F.
Oscillator Tracking Condenser—Adjust at 600 K.C.

(MODELS 36-37 ONLY)

S/W I.F.—1520 K.C. Adjust in order—No. 1, No. 2, No. 3.
S/W Oscillator Tracking Condensers. Adjust at following frequencies—(1) Red Band—12,000 K.C. (Approx. 81° on dial) (2) Yellow band—4,500 K.C.(Approx. 93° on dial) (3) Green Band—1,650 K.C. (Approx. 90° on dial).

CANADIAN MARCONI CO.



MODEL 37

Model 36 is identical except for output transformer and speaker connections which are as in Model 35.

CONTINUITY TESTS—MODELS 35, 36-37

Resistance from Socket Pins to Chassis with Speaker connected

SOCKET	PIN	No.	OHMS	SWITCH
*SW-DET 57	g	C	1,000,000	
	g_1	1	29,000	
	g_2	6	0	
	p	2	Open	B.C.
	p	2	6,500	S.W.
	k	5	0	
*SW-OSC. 56	g	1	250,000	
	p	2	12,500	S.W.
	p	2	239,000	B.C.
	k	5	0	
BC-R.F. 58	g	C	6,600,000	
	g_1	1	22,585	B.C.
	g_1	1	20,000	S.W.
	g_2	6	400	
	k	5	400	
	p	2	21,000	
BC-1st. Det. 58	g	C	1,600,000	
	g_1	1	22,585	
	g_2	6	2,500	
	k	5	2,500	
	p	2	18,585	
BC-OSC. 56	g	1	42,500	
	p	2	23,585	
	k	5	0	
I.F. 58	g	C	130	
	g_1	1	23,585	
	g_2	6	400	
	p	2	7,585	
	k	5	400	

SOCKET	PIN	No.	OHMS	SUPPRESSOR SWITCH
DIODE DET. 57	g	C	101,000	
	g_1	1	2,000,000	
	g_2	6	2,000,000	
	p	2	1,000,000	
	k	5	1,050	
	h	3	500	
SUPPRESSOR 57	g	C	3,000,000	
	g_1	1	100,000	
	g_2	6	100,000	
	p	2	1,000,000	Full and Med.
	p	2	900	Off
	k	5	275	Full
	k	5	800	Med.
	k	5	900	Off
1st A.F. 56	g	1	2,000,000	
	p	2	27,585	
	k	5	1,235	
DRIVER 46	g_1	1	250,000	
	g_2	5	7,585	
	p_2	2	7,585	
	f	3	525	
POWER 46	g_1	1	100	
	g_2	5	100	
	p	2	9,500	
	f	3	10	
	p to p		400	
RECT. 82	p	1	75	
	f	3	9,000	
	p to p		150	
SPEAKER FIELD	M-36		1,500	
	M-37		750	Each

*Models 36 and 37 only.

g=Control Grid, g_1=Screen Grid, g_2=Suppressor Grid, C=Cap.

CANADIAN MARCONI CO.

CONDENSERS FOR MODELS 35, 36-37

Ref.	Part No.	Capacity	Type No.	List Price
C1	1401	21–370 Mmf, 5 Gang Tuning	*35122	7.00
C1	1402	21–370 " 3 " "	†35193	5.00
C2		60 " Trimmer for C1		
C3	1403	250 " Mica	*	.50
C4	1404	850 " Osc. Tracking	35681	.75
C5	1405	.1 Mf 300 V. Tubular		.50
C6	1406	.05 " 200 V. "		.50
C7	1407	.1 " 200 V. "		.50
C8	1406	.05 " 200 V. "		.50
C9	1408	.1 " 300 V. "		.50
C10	1408	.1 " 300 V. "	*	.50
C11	1408	.1 " 300 V. "		.50
C12	1407	.1 " 200 V. "		.50
C13	1408	.1 " 300 V. "		.50
C14	1409	6–70 Mmf I.F. Trimmer No. 4	35233	.60
C15	1410	6–70 " " " No. 3	35217	.75
C16	1411	6–70 " " " No. 2	35217	.75
C17	1412	.004 Mf 300 V. Tubular		.50
C18	1413	.1 " 200 V. Bypass block	35699	2.50
C19	1408	.1 " 300 V. Tubular		.50
C20	1406	.05 " 200 V. "		.50
C21	1414	6–70 Mmf I.F. Trimmer No. 1	35700	.75
C22	1403	250 " Mica		.50
C23	1414	.01 Mf 200 V. Tubular		.50
C24	1414	.01 " 200 V. "		.50
C25	1415	.001 " Mica		.50
C26	1403	250 Mmf "		.50
C27	1414	.01 Mf 200 V. Tubular		.50
C28	1415	.02 " Mica		.75
C29	1416	.05 " 300 V. Tubular		.50
C31	1413	1. " 300 V. Bypass block	35699	2.50
C33	1415	.02 " Mica		.50
C34	1417	500 Mmf "		.50
C35	1413	1. Mf 200 V. Bypass block	35699	2.50
C36	1418	8 " 450 V. Electrolytic	2251	1.50
C37	1418	8 " 450 V. "	2251	1.50
C38, C39	1419	.02 " Line filter .02 " "	35248	1.00
C40	1420	.004 " Mica		.50
C41	1421	.2 " 300 V. Tubular		.50
C42	1401	13–268 Mmf 5 gang tuning	*35122	7.00
C43	1422	360 " Mica	*	.50
C44	1403	250 " "	*	.50
C45	1423	.004 Mf "		.50
C46	1424	.002 " "	*	.50
C47	1408	.1 " 300 V. Tubular	*	.50
C48	1408	.1 " " "	*	.50
C49	1425	308 Mmf 22,000 K.C. Tracking	*	.75
C50	1426	665 " 4,200 K.C. "	*	.75
C51	1427	248 " 1,680 K.C. "	*	.75
C52	1428	4–20 " 1,520 Trimmer No. 1	*36241	.60
C53	1429	6–70 " 1,520 " No. 2	*35844	.75
C54	1430	6–70 " 1,520 " No. 3	*35844	.75

Bypass block, Part No. 1413, contains condensers C18, C31, C35. *Models 36, 37 only. †Model 35 only.

RESISTORS FOR MODELS 35, 36-37

Ref.	Part No.	Resistance	Type No.	List Price
R1	1441	100,000 Ohms ½ Watt	Model 35 only	.50
R2	1442	400 " ½ "		.50
R3	1441	100,000 " ½ "		.50
R4	1443	5 Meg. " ½ "	Models 36-37 only	.50
R5	1444	1,000 " ½ "		.50
R6	1445	15,000 " 1 "		.50
R7	1446	25,000 " ½ "		.50
R8	1447	40,000 " ½ "		.50
R9	1448	2,500 " ½ "		.50
R10	1444	1,000 " ½ "		.50
R11	1449	10,000 " ½ "		.50
R12	1444	1,000 " ½ "		.50
R13	1442	400 " ½ "		.50
R14	1450	.525 "	35841	.60
R15	1450	.525 "	35841	.60
R16	1451	500,000 " ½ "		.50
R17	1452	1 Meg. " ½ "		.50
R18	1452	1 Meg. " ½ "		.50
R19	1453	2 " " ½ "		.50
R20	1589	100,000 "	Vol. Control	1.20
R21	1452	1 Meg. Ohms ½ Watt		.50
R21	1452	1 " " ½ "		.50
R23	1454	315 " 1 "		.50
R24	1455	210 " 1 "		.50
R25	1456	485 " 1 "		.50
R26	1457	225 " 1 "		.50
R27	1525	6,350 "	Pot. Divider	1.00
R28	1449	10,000 " ½ "		.50
R29	1449	10,000 " ½ "		.50
R30	1458	200,000 " ½ "		.50
R31	1459	50,000 " ½ "		.50
R32	1531	6 "	Hum Control	1.00
R33	1460	20 "	Center tapped	.50
R35	1588	100,000 "	Tone control	1.75
R36	1452	1 Meg. " ½ "	Models 36-37 only	.50
R37	1461	250,000 " ½ "	" " "	.50
R38	1449	10,000 " ½ "	" " "	.50
R39	1462	29,000 " ½ "	" " "	.50
R40	1458	200,000 " ½ "	" " "	.50

FADA RADIO & ELECTRIC CORP.

FADA 103 FADALETTE, STEWART-WARNER SERIES 108, AND DE WALD 54 DYNETTE SETS

Fada 103 Fadalette

A tabulation of voltages in this set on D.C.:

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts	Plate Ma.
V1	6.3	2.5	97.5	97.5	4.5
V2	6.3	....	7.5	....	....
V3	6.3	7.5	92.5	95.5	4.8
V4	2.5	....	....	....	37

A set of figures for A.C. line operation:

Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts	Plate Ma.
V1	6.3	2.6	110	110	6
V2	6.3	....	9	....	....
V3	6.3	9	104	102	7
V4	6.3	....	....	....	40

The D.C. and A.C. readings are for a 110 V. line. Bias readings are taken across respective bias resistors. The D.C. input is 34 W., and the A.C., 36 W.

Stewart-Warner Companion Chassis Series 108 and 108-X, Models 10 to 20

With the volume control tuned full on, the following approximate voltages should be read to the frame of unit C. (using a high resistance voltmeter).

Tube Type	Fil. Volts	Cath. Volts	S.G. Volts	Plate Volts
V1	6.3	1.5	107	107
V2	6.3	1.3	9	1.3
V3	6.3	9	107	103
V4	12.6	122	....	....

These figures are for a 115 v., A.C. line; on D.C., the values will be slightly lower.

Circuit oscillation may be due to the antenna being too close to the set; oscillation at low signal volume with maximum set sensitivity is normal. The power cord is naturally warm. Do not force V4 into its socket. This set is designed to be operated on 110, 32, 12, or 6 V. current-supply systems.

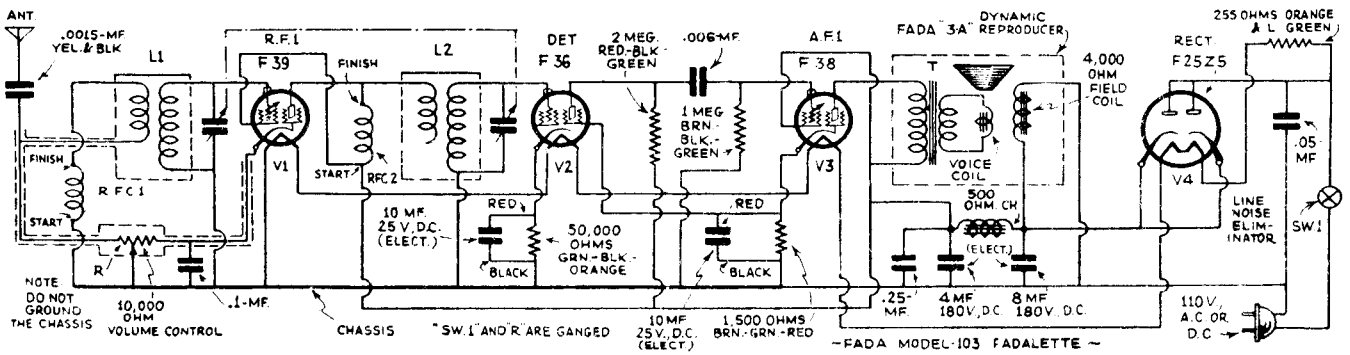
Pierce-Airo De Wald Model 54 Dynette

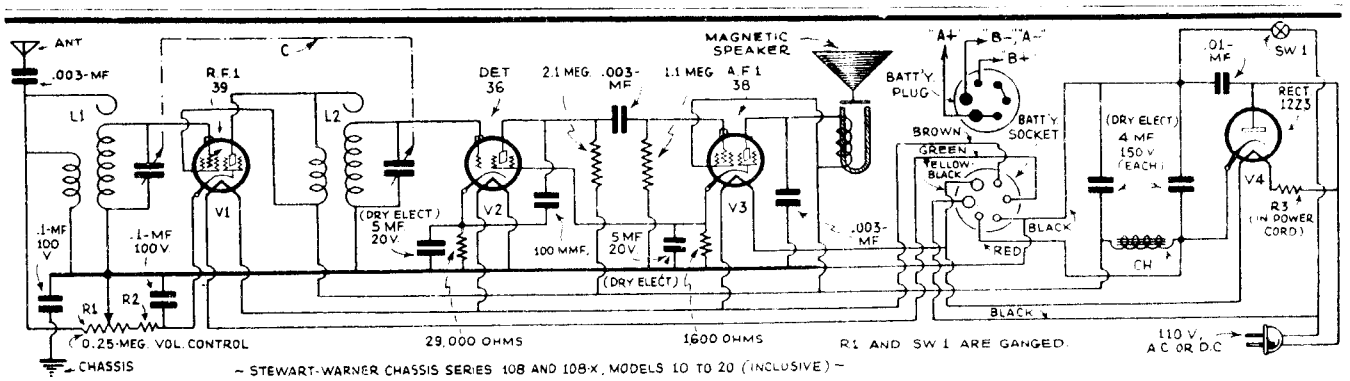
The following tabulation of operating voltages is furnished by the manufacturer:

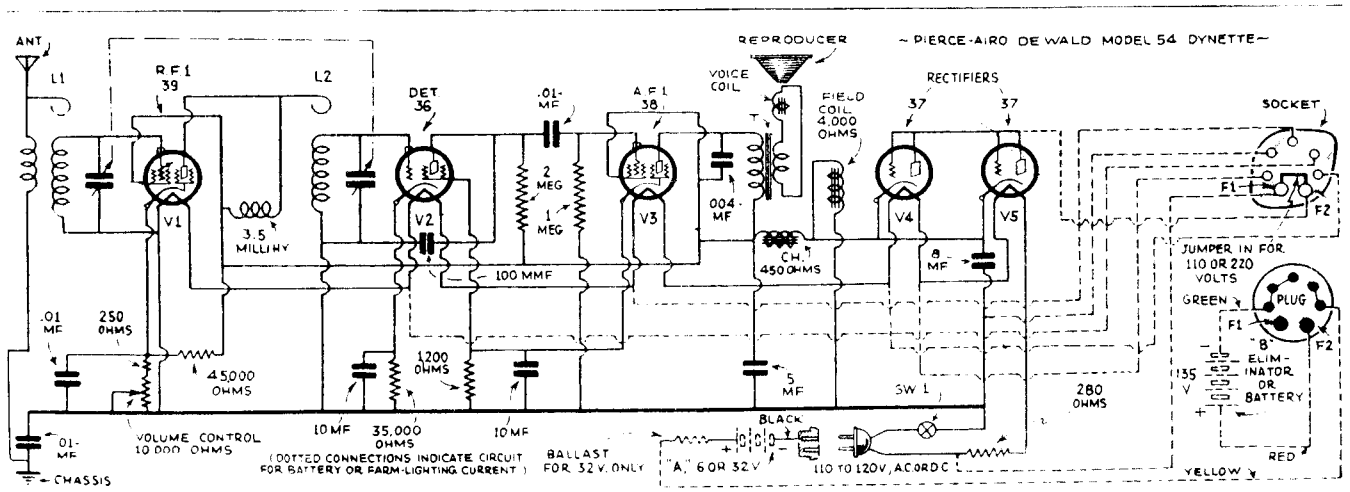
Tube Type	Fil. Volts	C.-G. Volts	S.-G. Volts	Plate Volts	Plate Ma.
V1	6.3	2.15	103	103	2
V2	6.3	3	9	39	.1
V3	6.3	9	103	98	10
V4, V5	6.3	....	....	....	15

By means of suitable line resistors, or adapters, this set may be operated on light-line or battery power.

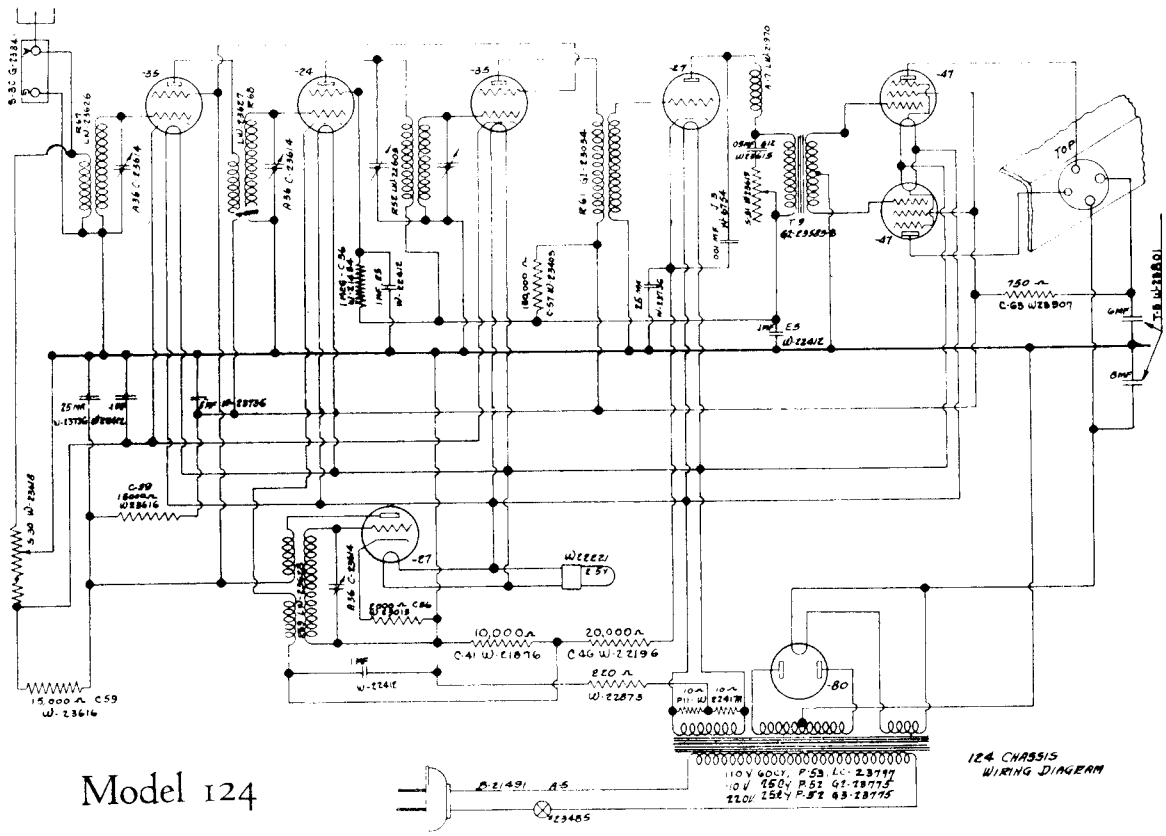
All sets of the "universal current" type now on the market require that the Service Man check the position of the power plug in its socket to determine whether it is correctly poled. It is seldom that the chassis frame connects directly to the power line. Circuit oscillation at the high-sensitivity setting of the volume control is normal in many models. The results obtained with ultra-midget sets will greatly depend upon local reception conditions.





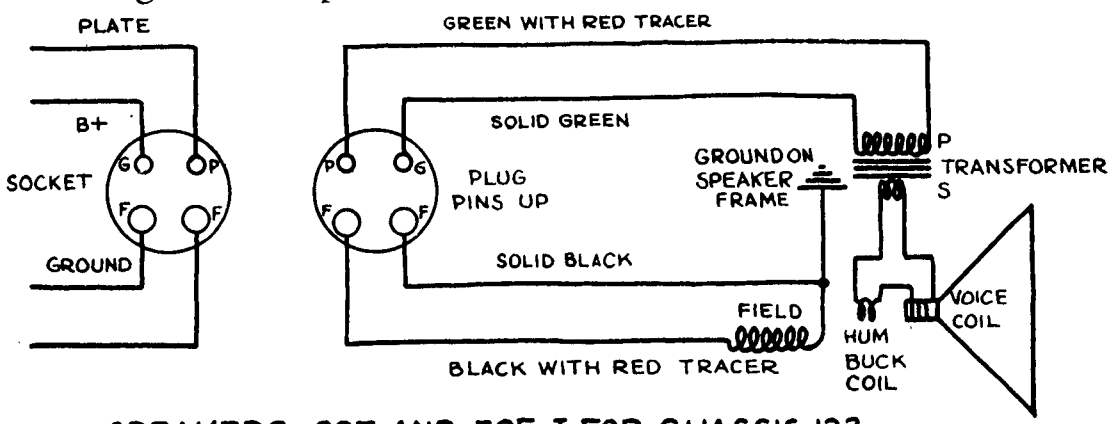


CROSLEY RADIO CORP.

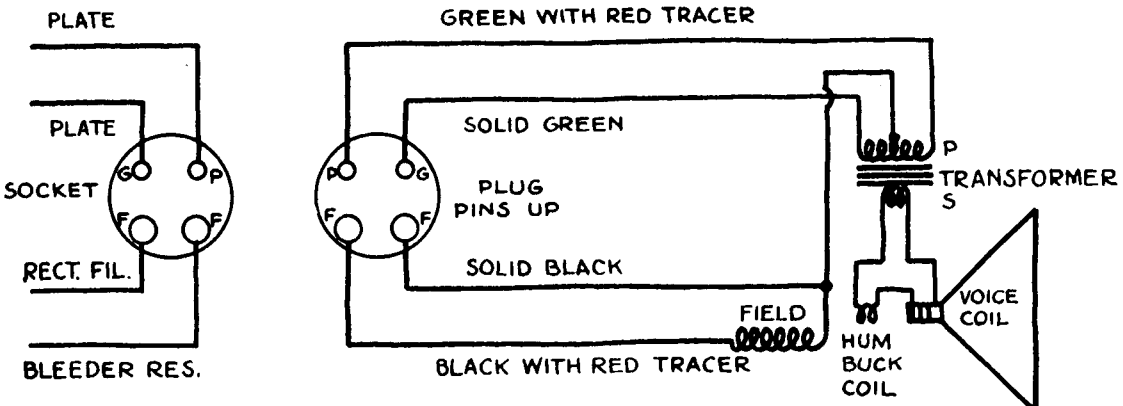


Model 124

Diagrams of Speaker Connections Models 122, 123, 124

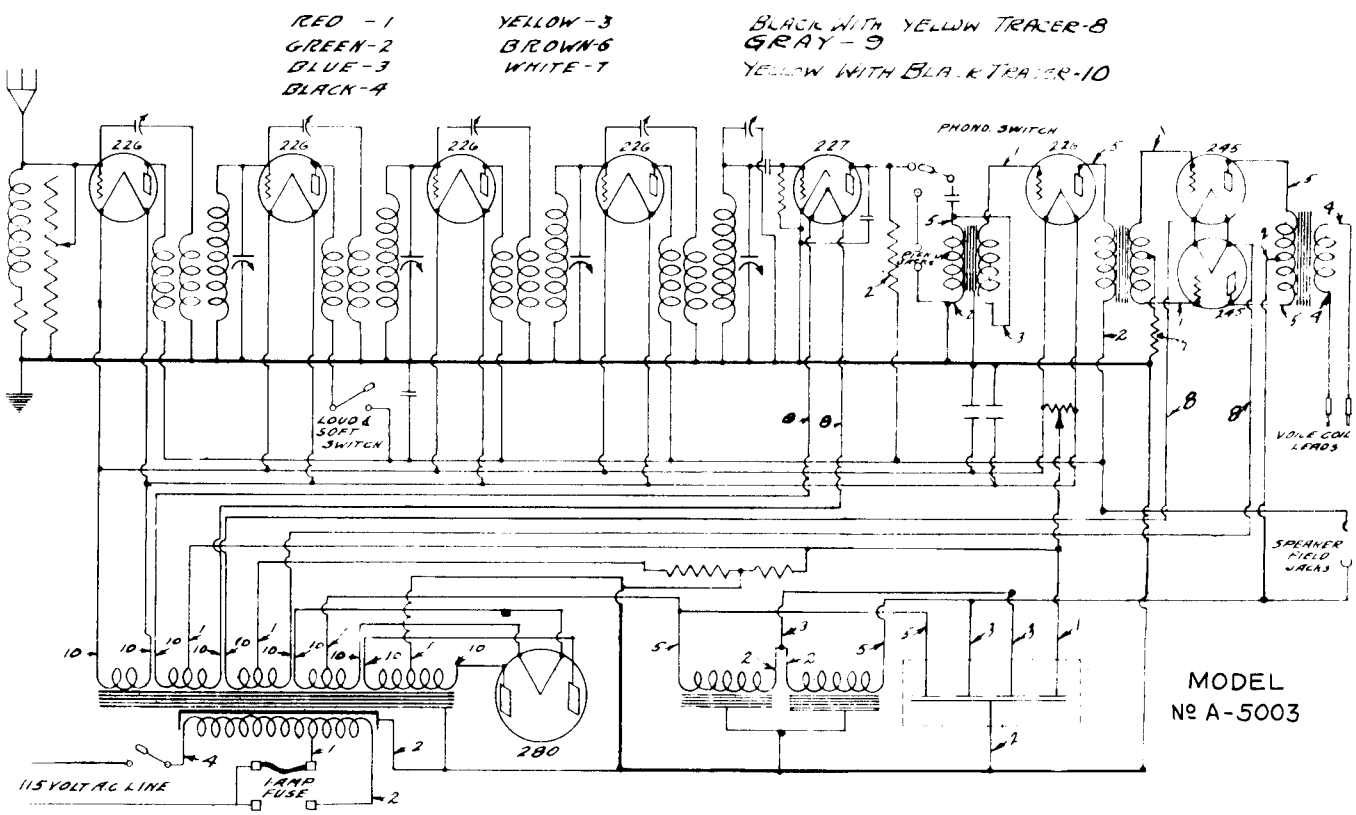


SPEAKERS 297 AND 305-J FOR CHASSIS 122

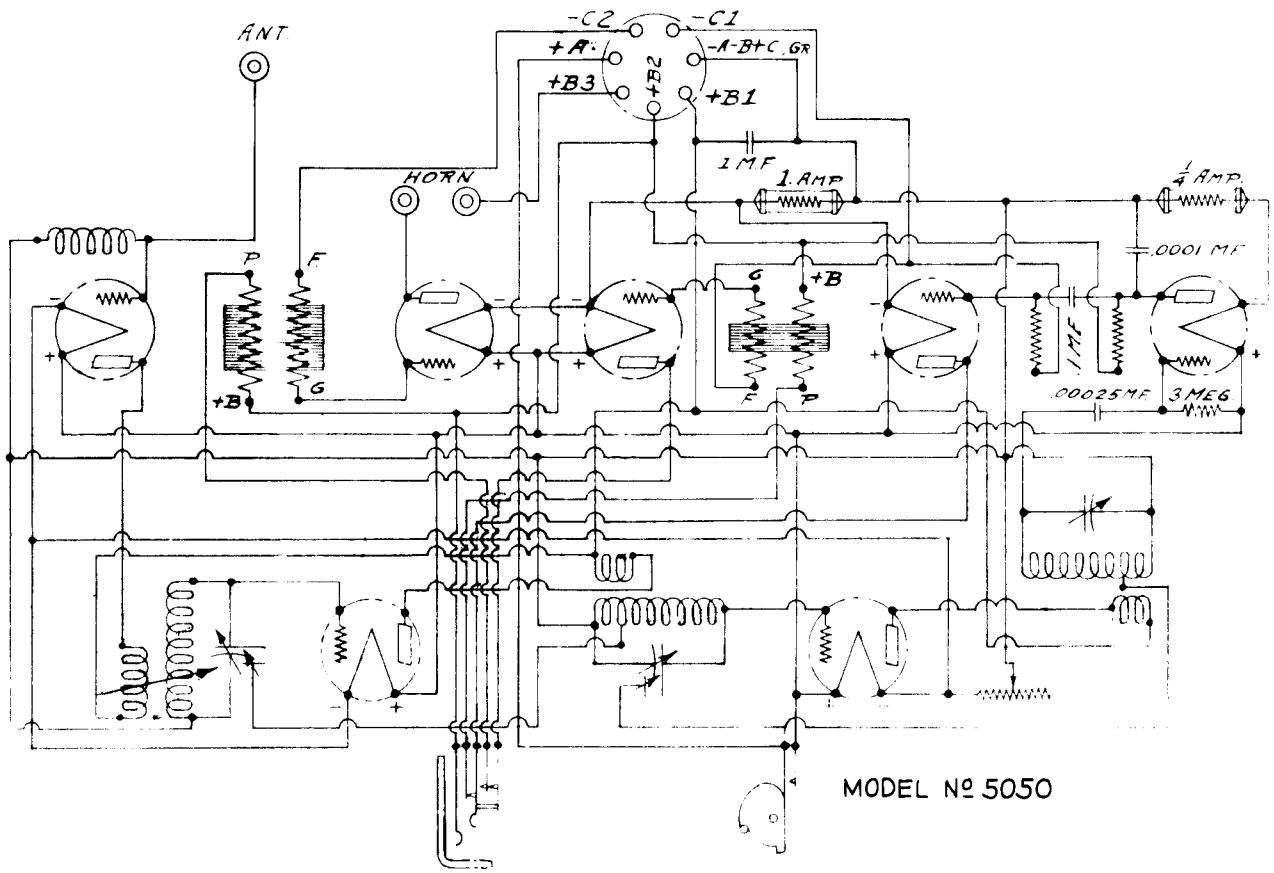


SPEAKER 287 FOR CHASSIS 123; SPEAKERS 306-J AND 306-M FOR CHASSIS 124

DAY-FAN ELECTRIC CO.

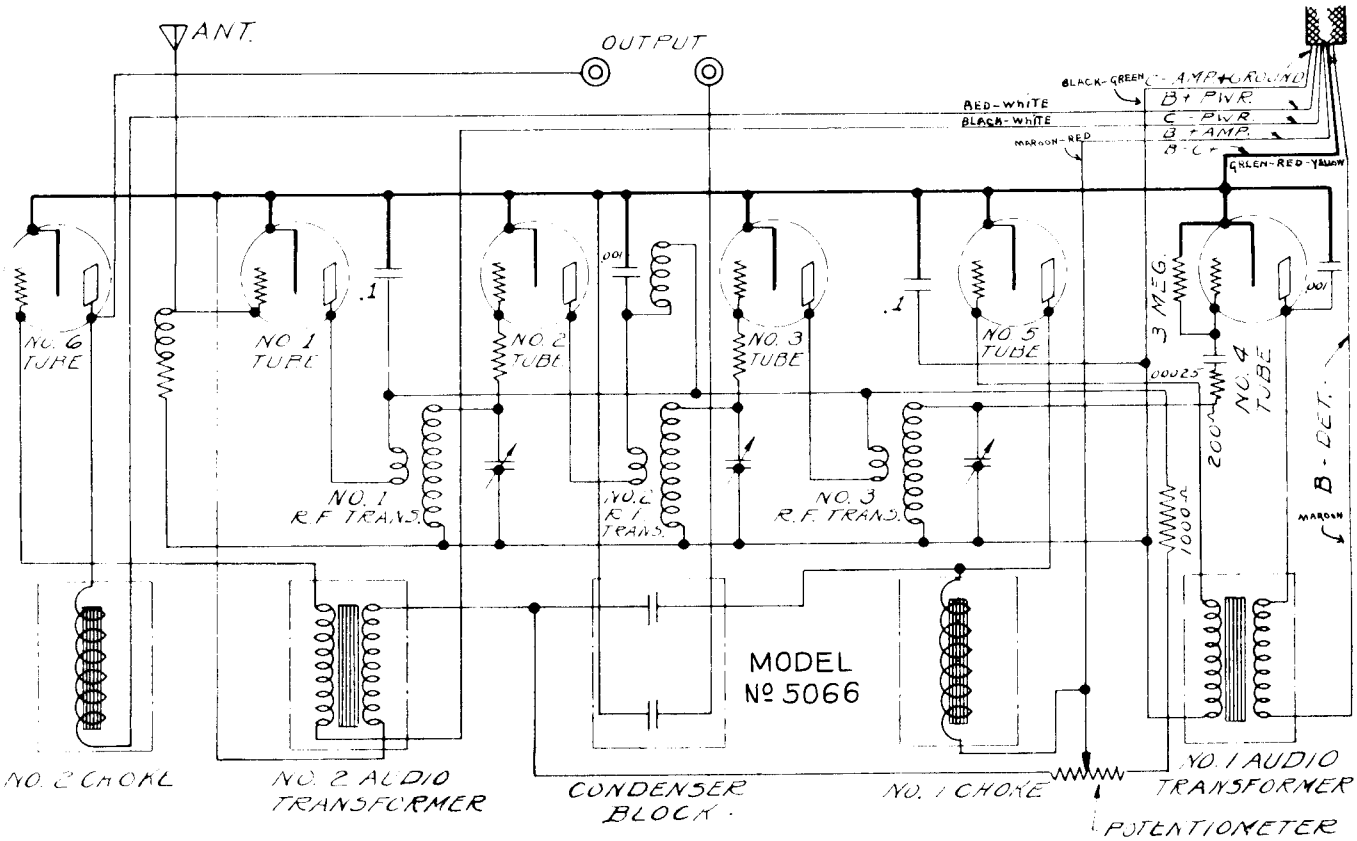


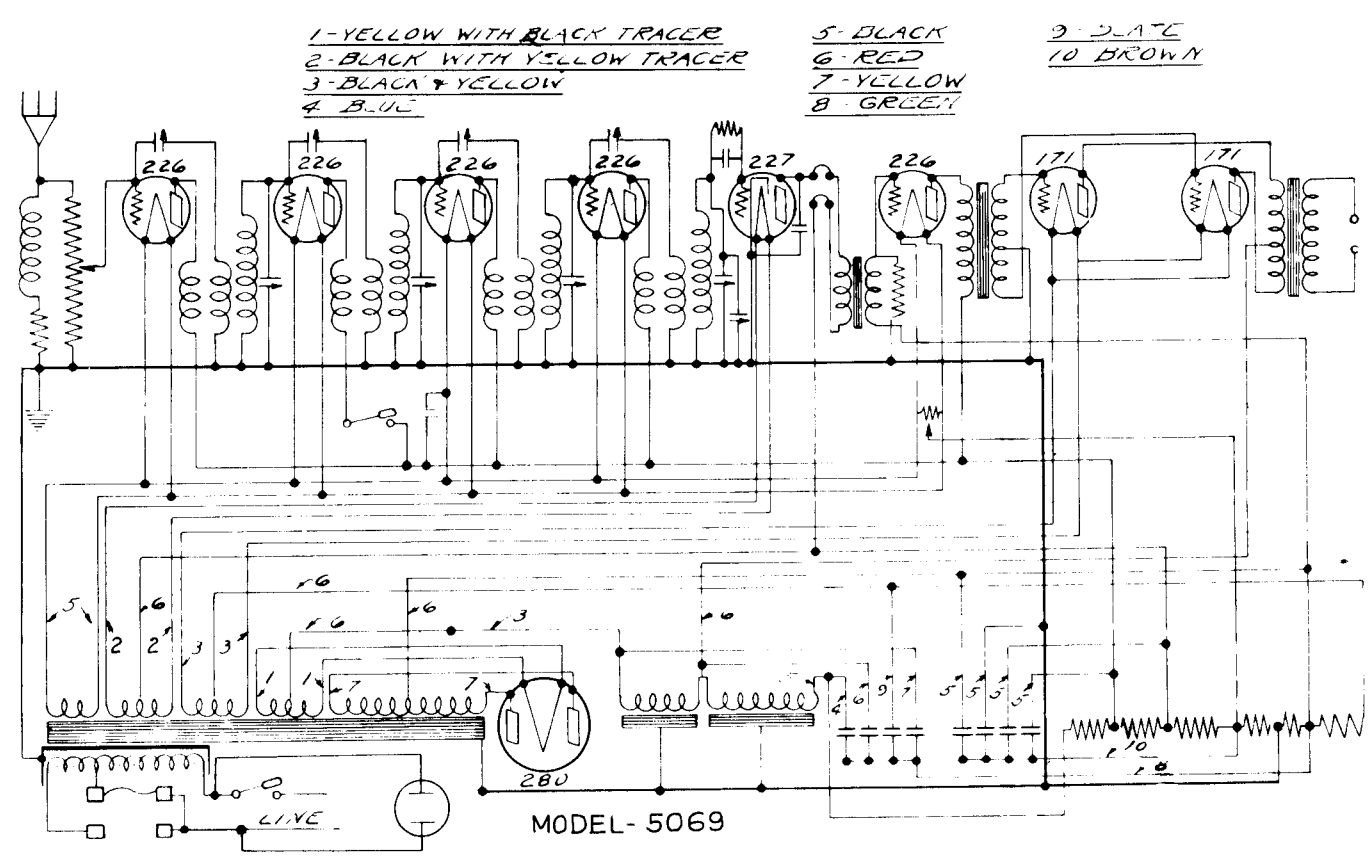
MODEL
Nº A-5003



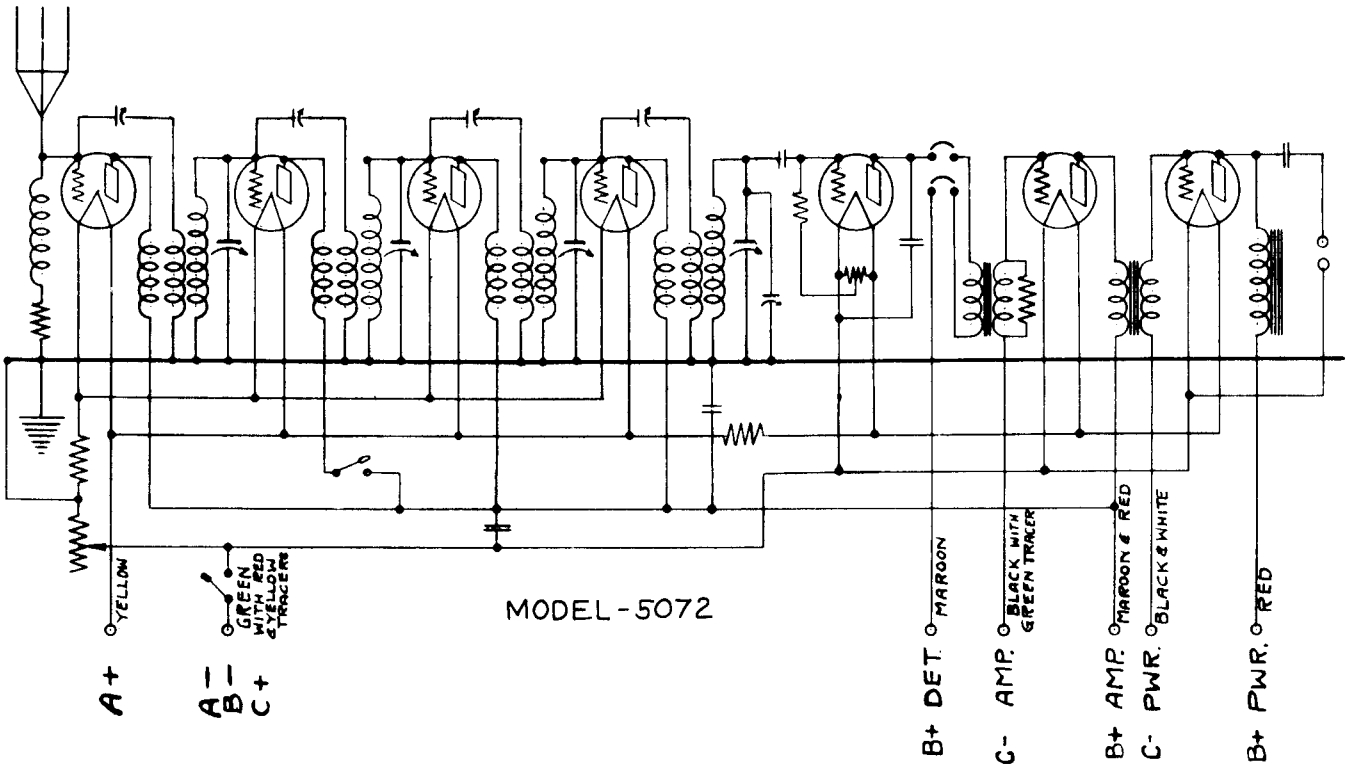
MODEL Nº 5050

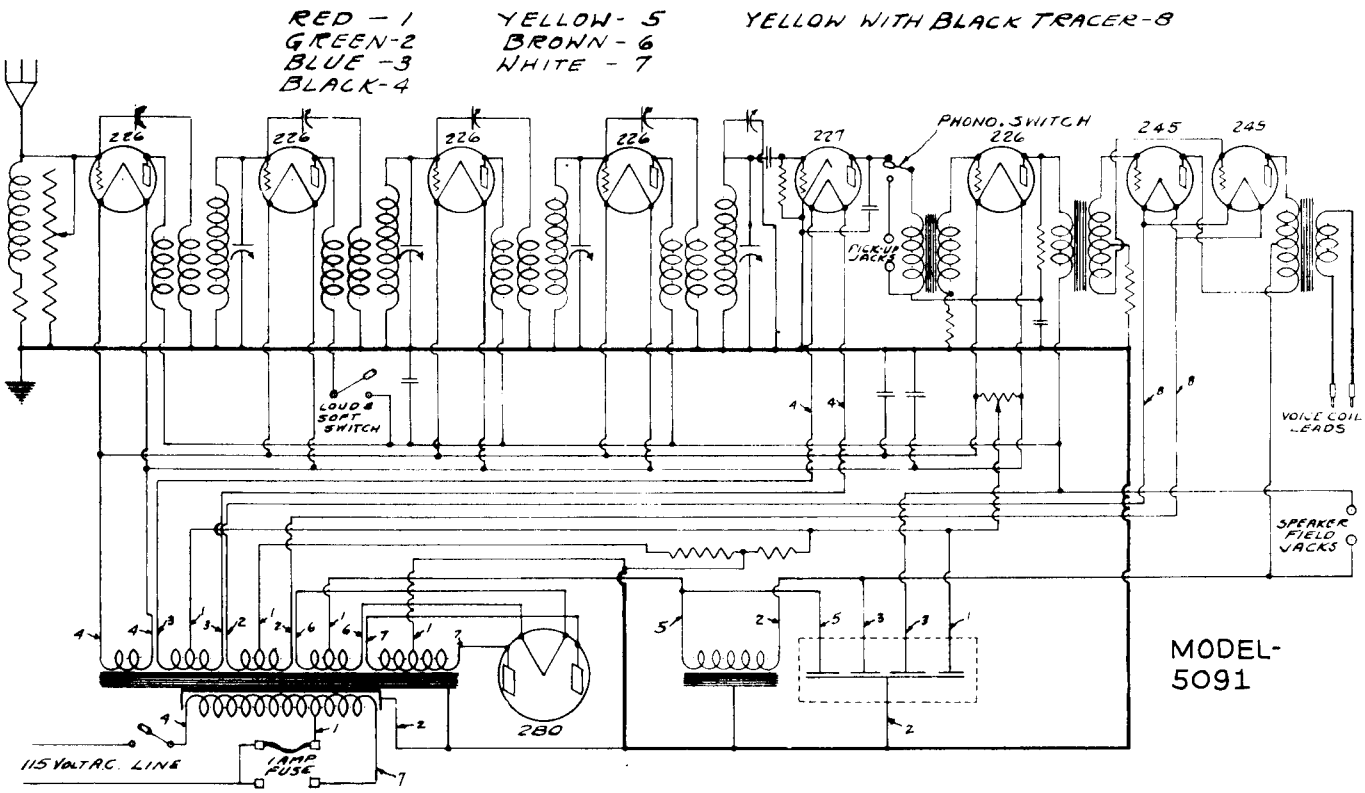
DAY-FAN ELECTRIC CO.





DAY-FAN ELECTRIC CO.





DE FOREST CROSLEY, Ltd.

902 A-B-F

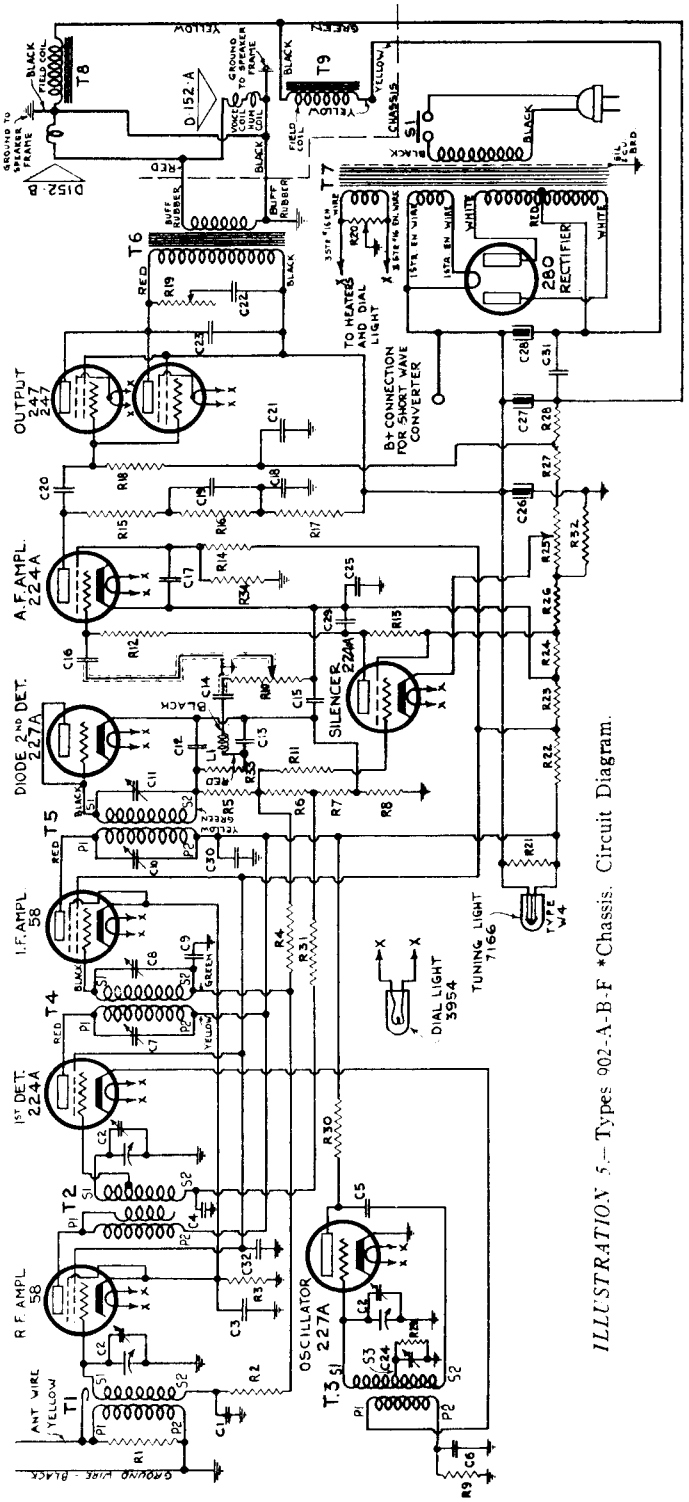


ILLUSTRATION 5.—Types 902-A-B-F *Chassis. Circuit Diagram.

Symbol	DESCRIPTION	Part No.
C1	R. F. by-pass condenser, .05 mfd. (200 v.)	7213
C2	Tuning (gang) condenser	7178
C3	R. F. by-pass condenser, .25 mfd. (200 v.)	7214
C4	R. F. by-pass condenser, .05 mfd. (200 v.)	7213
C5	Osc. coupling condenser, .00035 mfd. (M)	7216
C6	Det. by-pass condenser, .05 mfd. (200 v.)	6978
C7	I. F. tuning condenser, (Part of T4)	7069
C8	I. F. tuning condenser, (Part of T4)	7069
C9	I. F. by-pass condenser, .05 mfd. (200 v.)	7213
C10	I. F. tuning condenser, (Part of T5)	7071
C11	I. F. tuning condenser, (Part of T5)	7071
C12	Diode by-pass condenser, .0001 mfd. (M)	6556
C13	Diode by-pass condenser, .0001 mfd. (M)	6556
C14	A. F. coupling condenser, .1 mfd. (200 v.	7220
C15	A. F. by-pass condenser, .5 mfd. 200 v.	7221
C16	A. F. coupling condenser, .05 mfd. (200 v.	7217
C17	A. F. filter condenser .5 mfd. (200 v.)	7221
C18	A. F. filter condenser .25 mfd. (400 v.)	7228
C19	A. F. filter condenser, .05 mfd. (200 v.)	7213
C20	Output coupling condenser, .05 mfd. (400 v.)	7225
C21 (1)	Output filter condenser .25 mfd (200 v.	7226
C21 (2)	Output filter condenser .04 mfd (200 v.	6948
C22	A. F. tone control condenser, .2 mfd. (400 v.)	7309
C23	A. F. resonating condenser, .005 mfd. (400 v.)	6941
C24	Osc. aligning condenser, .00082 mfd. (600 kc)	6790
C25	A. F. by-pass condenser, 1.0 mfd. (200 v.)	7174
C26	Power filter condenser, 8.0 mfd. (435 v.)	7336
C27	Power filter condenser, 8.0 mfd. (435 v.)	7336
C28	Power filter condenser, 8.0 mfd. (435 v.)	7336
C29	Silencer by-pass condenser, .1 mfd (200 v.)	7239
C30	I. F. by-pass condenser, .25 mfd. (400 v.)	7228
C31	Hum filter condenser, .3 mfd. (200 v.)	7229
C32	R. F. by-pass condenser, .5 mfd. (200 v.)	7221

Symbol	DESCRIPTION	Part No.
R1	Antenna resister, 10,000 ohms (½ w.)	6911
R2	R. F. filter resister, 25,000 ohms (½ w.)	7187
R3	R. F.-1. F. min. bias resistor, 190 ohms (w.w.)	7188
R4	I. F. filter resistor, 500,000 ohms (½ w.)	7142
R5	A. V. C. resistor, 100,000 ohms (½ w)	7219
R6	A. V. C. resistor, 300,000 ohms (½ w.)	7191
R7	A. V. C. resistor, 50,000 ohms (½ w.)	7192
R8	A. V. C. resistor, 100,000 ohms (½ w.)	7219
R9	Det., first bias resistor, 10,000 ohms (½ w.)	7194
R10	Level control (potentio) resistor, 500,000 ohms (var. c.)	7071
R11	Silencer filter resistor 400,000 ohms (½ w.)	6887
R12	A. F. grid leak resistor, 1,000,000 ohms (½ w	7189
R13	Silencer plate resistor, 1,000,000 ohms (½ w	7196
R14	A. F. screen resistor, 50,000 ohms (½ w.)	7196
R15	A. F. plate resistor, 40,000 ohms (½ w.)	7145
R16	A. F. plate resistor, 35,000 ohms (½ w.)	6901
R17	A. F. filter resistor, 25,000 ohms (½ w.)	6902
R18	Output grid leak resistor, 250,000 ohms (½ w.	6909
R19	A. F. tone control (rheo) resistor, 50,000 ohms (var. c.)	7198
R20	Hum adjusting (potentio) resistor, 20 ohms (var. w.)	7199
R21	Voltage divider resistor, 3,440 ohms (1 w.)	7200
R22	Voltage divider resistor, 13,000 ohms (2 w.)	7304
R23	Voltage divider resistor, 11,000 ohms (1 w.)	7202
R24 (x)	Voltage divider resistor, 340 ohms (w.w.)	7203
R25	Silencer control (potentio) resistor, 35,000 ohms (var. c.)	6916
R26 (x)	Voltage divider resistor, 800 ohms (w.w.	6479
R27	Output bias divider resistor, 83,000 ohms (½ w.)	6916
		7206

Symbol	DESCRIPTION	Part No.
R28	Output bias divider resistor, 180,000 ohms (½ w.)	7207
R29	Osc. grid leak resistor, 100,000 ohms (½ w.)	6898
R30	Osc. plate resistor, 60,000 ohms (1 w.)	7208
R31	Det. (first) filter resistor, 200,000 ohms (½ w.)	7209
R32 (x)	Voltage divider resistor, 340 ohms (w.w.)	6916
R33	Det. (Diode) resistor, 100,000 ohms (½ w.)	7219
R34	A. F. bleeder (screen) resistor, 100,000 ohms (1 w.)	3799
T1	R. F. transformer, antenna stage	6509
T2	R. F. transformer, interstage	6510
T3	Oscillator coil	7061
T4	I. F. transformer, 1st stage	7069
T5	I. F. transformer, 2nd stage	7071
T6	A. F. transformer, output	7157
T7 (1)	Power transformer, 25 cycle	7162
T7 (2)	Power transformer, 60 cycle	7138
T8 (3)	Type D152A speaker, (field 420 ohms)	7170
T9 (4)	Type D152B speaker, (field 420 ohms)	7171
L1	R. F. choke	7370
S1	On-off switch (Part of tone control assembly)	7199
(x)	R24, 26 and 32 single unit.	
(1)	Used in 25 cycle chassis only (902-A—902-F).	
(2)	Used in 60 cycle chassis only (902-B).	
(3)	Indicates upper unit.	
(4)	Indicates lower unit.	
(M)	Indicates mica condensers.	
(400 v.)	Indicates voltage rating of condensers.	
(½ w.)	Indicates watts rating of resistor.	
(var. c.)	Indicates variable carbon resistors.	
(var. w.)	Indicates variable wirewound resistors.	
(w.w.)	Indicates wirewound resistors.	

*For revised silencer circuit of types 902-A and B see Illust. 3. For 902-F silencer circuit see Illust. 4.

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DATA ON THE TYPE 902 CHASSIS

INTRODUCTION

Type 902 is a ten tube chassis of the superheterodyne type incorporating the following features:

(1) Automatic volume control.
(2) Automatic silencer.
(3) Visual tuning indicator.
(4) Extended frequency range of 1,500 to 520 kcs.
(5) Dual speakers.
(6) Dual pentode output.
(7) Converter "B" terminal.

This chassis is made in three types, viz.: 902-A, 902-B and 902-F, corresponding to 25 cycle, 60 cycle, and universal consoles. The differences in these three chassis are caused mainly by the difference in supply frequency and are three in number: (1) power transformer; (2) value of condenser C22 and (3) silencer circuit. These differences will be discussed later in the text.

In the paragraphs that follow circuit elements will be designated as in the circuit diagrams of illustrations 3, 4 and 5, and to intelligently read the following discussion frequent reference to these circuit diagrams will be necessary.

ANTENNA STAGE

The incoming signal is applied to the grid of the first tube through a tuned radio frequency coupling transformer T1, having uniform gain throughout the broadcast band. The primary coil of this transformer is mounted inside the secondary coil at its low potential end and terminates in the antenna and ground lead wires coded yellow and black respectively. This primary is coupled to the secondary both inductively and capacitively. The secondary of this transformer is tuned by section of the variable tuning (gang) condenser C2.

Transformer T1 is so designed as to maintain alignment with the radio frequency coupling transformer T2 and oscillator coil T3 with any reasonable value of antenna capacity. *In this connection it may be pointed out that most shielded lead-in installations do not constitute a reasonable antenna capacity, the capacity usually being sufficient to almost constitute a primary short circuit and seriously impairing alignment,* unless a condenser of .0002 to .0005 mfd. is inserted in series with the antenna lead at the receiver end. The resistance R1 of 10,000 ohms shunting primary of T1 is for the purpose of giving improved alignment and is of particular value with low capacity antennae.

RADIO FREQUENCY AMPLIFICATION

A single stage of tuned radio frequency amplification employing a type 58 R.F. pentode is used preceding the first detector. The input circuit to this tube consists of the secondary of transformer T1, described in preceding paragraph, and condenser C1 which completes the radio frequency path to ground (chassis). The primary of transformer T2 is connected in the plate circuit of this tube and thus couples the output to the grid circuit of the first detector.

Transformer T2 is similar to transformer T1, being of the uniform gain type with primary both inductively and capacitively coupled to the secondary. A glance at the circuit diagram will show that the primary has two sections, one section of which consists of an open ended winding. This winding, over the lower portion of the secondary, provides capacitive coupling between primary and secondary. The other (main) section of the primary is mounted inside the secondary, and also at the low end. While this latter section of the primary has been called the main section, it is only because through it the plate voltage is supplied to the tube. Both sections are essential to satisfactory transformer characteristics. The secondary of this transformer is tuned by a section of the gang condenser C2. It will be noticed that the grid of the first detector tube is connected to a tap in the secondary of transformer T2 rather than to its high potential end. While this results in somewhat lower gain in this stage than would otherwise be obtainable, it gives improved selectivity 350 kilocycles "off resonance" and, therefore, greatly increased image suppression over that which would be possible under alternative of connecting the control grid to the high potential end of transformer T2 secondary.

Adequate by-passing of the radio frequency energy in cathode, screen and plate circuits of the R.F. amplifier is provided by the condensers C3, C32 and C30 respectively. These condensers also provide by-passing for the first detector and I.F. amplifier. The R.F. amplifier tube (type 58) in common with I.F. amplifier tube, (type 58) obtains its initial bias by self bias through resistor R3 in series from their connected cathodes to ground.

FIRST DETECTOR

In the first detector stage the incoming signal is heterodyned by a locally generated voltage, 175 kilocycles higher in frequency than signal frequency, to produce a new or intermediate frequency of 175 kilocycles. The first detector tube in this set is a type 224A. The input to this tube is obtained from transformer T2, as described in preceding section "Radio Frequency Amplification", condenser C4 providing the radio frequency path to ground. The heterodyne voltage, referred to previously, is introduced into the cathode circuit of the first detector tube by that winding of the oscillator coil T3 (pick up coil) which is connected between cathode of the first detector tube and the junction of resistor R9 and condenser C6.

The first detector tube obtains its initial bias voltage by self bias from resistor R9 connected from the "pick up" coil (referred to above) to ground. The radio frequency and intermediate frequency by-passing for this resistor, R9, is provided by the con-

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Data on the Type 902 Chassis—Continued

denser C6. Screen grid by-passing is provided by condenser C32 and plate circuit by-passing by condenser C30.

OSCILLATOR

The locally generated heterodyning voltage, mentioned under section "First Detector", is obtained from a vacuum tube oscillator utilizing a 227A tube. Coil T3 is termed the oscillator coil and in conjunction with C24 provides the necessary coupling between plate and grid circuits of the tube to produce sustained oscillations of the frequency to which the grid circuit of the tube is tuned. The "pick up" coil, connected in cathode circuit of the first detector tube, is coupled to coil T3, connected in grid and plate circuits of the oscillator tube. Thus a voltage is induced in the "pick up" coil and through it fed into the cathode circuit of the first detector tube.

The constants in this oscillator circuit are so proportioned, that the oscillator voltage introduced into the first detector circuit, is practically constant throughout the broadcast band. Coil T3 consists of tapped solenoid coil with the "pick up" coil wound over it at the plate end. The grid circuit of the tube consists of a section of gang condenser C2, C24 and portion of coil T3. The plate circuit of the tube consists of the condenser C5, C24 and portion of coil T3. Thus the grid and plate circuits are coupled inductively by coil T3 and capacitively through the common condenser C24. The inductive coupling is most effective at the high frequency end of the broadcast range, and the capacitive coupling at the low end so that throughout the tuning range, the coupling and, therefore, the oscillator output is uniform.

The tuned portion of coil T3 is that portion connected between grid of oscillator tube and condenser C24, and is tuned by a section of gang condenser C2 in series with C24. The cathode of the oscillator tube is grounded, the tube being grid leak biased by resistor R29. Thus condenser C24 serves a triple purpose.

(1) By-passing resistor R29.
(2) Providing coupling between grid and plate circuits.
(3) In series with section of gang condenser C2 and being variable is adjusted to maintain oscillator frequency 175 kilocycles above signal frequency.

The 227A oscillator tube receives its plate voltage through resistor R30 which is sufficiently high in value to serve as a radio frequency filter increasing oscillator efficiency and preventing undesirable coupling between oscillator and other parts of circuit.

INTERMEDIATE FREQUENCY AMPLIFICATION (175 kcs.)

The output of the 224A first detector contains the resultant 175 kilocycle voltage produced through heterodyning of the incoming signals by the locally generated oscillator voltage. This component of the output is retained by means of an intermediate frequency transformer T4 which is tuned to 175 kilocycles. The primary is connected in the plate circuit of the first detector and is tuned to 175 kilocycles by condenser C7. The secondary of this transformer T4 is also tuned to 175 kilocycles by condenser C8. Amplification at 175 kilocycles is accomplished by means of a type 58 R.F. pentode. The input circuit of this tube consists of the secondary of transformer T4 and condenser C9 which provides the intermediate frequency path to ground. In the plate circuit of this tube is the primary of T5 and this provides the coupling to the diode second detector. Primary and secondary of T5 are both tuned to 175 kilocycles by means of condensers C10 and 11 respectively.

As mentioned under section "Radio Frequency Amplification", the intermediate frequency amplifier tube obtains its initial bias by the voltage drop across R3. The associate by-pass in this case being C3. Adequate by-passing of screen and plate circuits is provided by C32 and 30 respectively.

SECOND DETECTOR (Diode)

A type 227A tube with plate and grid connected together is used as a diode second detector providing linear detection over a wide range of voltages. The cathode of this tube is connected to junction of R7 and 8, while the grid and plate are connected to the high potential end of the secondary of transformer T5.

The useful component voltages of the diode output are obtained: (1) from the voltage drop across resistors R5, 6, 7 and 33; (2) condensers C14, 15 and resistor R10. These useful components are: (1) d.c. voltage which is used for automatic volume control and silencer purposes; and (2) audio frequency voltage which is retained and amplified in the succeeding amplifier stages. There is a third component of the diode output consisting of current at a frequency of 175 kilocycles or its harmonics. This output is undesirable and is rejected by filters comprising condensers C12, 13, resistors R5, 33 and the choke L1. Good filtering at this point is necessary to ensure stability and to minimize the beats which might occur at harmonics of the intermediate frequency, when the radio frequency component of the second detector output is permitted to couple back into the radio frequency circuits of the receiver.

It may appear that this diode circuit is unduly complicated, but these apparent complications are occasioned by the fact that the cathode of the first audio amplifier tube is not at ground potential. To avoid degeneration, the cathode of the diode must be at the same audio frequency potential as the cathode of the audio frequency amplifier tube. This has been very closely approached by making the direct audio frequency path from diode cathode to ground high by means of resistor R8, while the audio frequency path to the cathode of first audio tube has been made relatively low by means of condenser C15.

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OBSERVED VOLTAGE AND CURRENT READINGS*

(Types 902-A, 902-B and 902-F Chassis)

58 R. F. AMPLIFIER					
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		220-225
Plate Current	(Ip)	(a)		4-6 mils
Screen Grid Volts	(Esg)	(a)		90-100
Screen Grid Current	(Isg)	(a)		Not over 1/3 of Ip.
Control Grid Volts	(Ecg)	(a)	(b)	2.5-3
Suppressor Grid Volts	(Esug)	(a)	(b)	2.5-3
Cathode Volts	(Ek)	(a)		2.5-3
224A DETECTOR (FIRST)				
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		220-225
Plate Current	(Ip)	(a)		.6-.8 mils
Screen Grid Volts	(Esg)	(a)		90-100
Screen Grid Current	(Isg)	(a)		Not over 1/3 of Ip.
Control Grid Volts	(Ecg)	(a)		4-6
Cathode Volts	(Ek)	(a)		7.5-8.5
58 I.F. AMPLIFIER				
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		220-225
Plate Current	(Ip)	(a)		4-6 mils
Screen Grid Volts	(Esg)	(a)		90-100
Screen Grid Current	(Isg)	(a)		Not over 1/3 of Ip.
Control Grid Volts	(Ecg)	(a)	(b)	2.5-3
Suppressor Grid Volts	(Esug)	(a)	(b)	2.5-3
Cathode Volts	(Ek)	(a)		2.5-3
227 DIODE DETECTOR (SECOND)				
Heater Volts *(Only voltage which can be measured.)*	(Ef)	(a)		2.4 a.c.
224A or 57 SILENCER				
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		Indication only
Plate Current	(Ip)	(f)		0
Screen Grid Volts	(Esg)	(a)	(e)	5.5-7.5
Screen Grid Current	(Isg)	(a)		0
Control Grid Volts	(Ecg)	(a)		.4-.5
Cathode Volts	(Ek)	(a)	(e)	0-3.0
224A A.F. AMPLIFIER				
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		140-150
Plate Current	(Ip)	(a)		.75-.85 mils
Screen Grid Volts	(Esg)	(a)		40-50
Screen Grid Current	(Isg)	(a)		Not over 1/3 of Ip.
Control Grid Volts	(Ecg)	(a)	(c)	Indication only.
Cathode Volts	(Ek)	(a)		12-14
247 OUTPUT AMPLIFIER				
Filament Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		215-225
Plate Current	(Ip)	(a)		22-30 mils
Screen Volts	(Esg)	(a)		240-250
Screen Current	(Isg)	(a)		5-7 mils
Grid Volts	(Ecg)	(a)	(d)	Indication only
227A OSCILLATOR				
Heater Volts	(Ef)	(a)		2.4 a.c.
Plate Volts	(Ep)	(a)		40-50
Plate Current	(Ip)	(a)		2.5-3 mils
Grid Volts	(Eg)	(a)	(c)	Indication only
Cathode Volts	(Ek)	(a)		0

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280 RECTIFIER

Filament Volts	(Ef)	(a)		4.8 a.c.
Plate Volts	(Ep	(a)	(g)	680-700 a.c.
Plate Current	(Ip)	(a)	(h)	45-50 mils

PRIMARY DRAIN

120 volts, 25 cycles (902-A-F)	108 watts
120 volts, 60 cycles (902-B)	105 watts
120 volts, 60 cycles (902-F)	102 watts

**IMPORTANT:* The observed values in this table are for reference only and are subject to considerable variation because of tube and primary voltage variation. It is impossible to obtain reasonable readings at certain sockets because of extremely high values of resistances across which measurements must be made. Under such conditions plate current readings may be used as some indication of proper voltage values being present.

Refer to the following table when taking readings and *set the silencer control for minimum effect.* The volume control may be adjusted to "full on" position.

Use only a high resistance voltmeter for direct current readings. (1,000 ohms per volt or better).

All measurements should be taken at 120 volts line.

(a) Read with tube in analyzer and analyzer adapter in chassis tube socket.
(b) Read as positive (+) cathode volts.
(c) Value of resistance in circuit will not allow reading at socket. Use plate current as indication of bias. (Control grid voltage.)
(d) Actually 16.5 volts. Value of resistance in circuit will not allow reading at socket. Use plate current as indication of bias. (Control grid voltage).
(e) Varies with setting of silencer control (R25).
(f) Actually 6-7 microamperes. Value too low to read on analyzer.
(g) Plate to plate of 280 socket, tube in position and under load.
(h) 40 to 50 mils per plate, making total of 90-100 mils.

ALIGNMENT

It is essential, of course, in aligning the various chassis to have available a calibrated service oscillator capable of producing a signal at points throughout the broadcast band as well as at 175 kilocycles, which is the frequency of the intermediate frequency stages.

The following is the recommended method of making alignment adjustments on the type 902 chassis and should be closely adhered to, to avoid the probability of mis-alignment.

(1) Connect the output meter across the voice coil terminals of the speaker. These terminate at two lugs on the speaker frame to which the chassis leads are attached. See symbol "Y" in Illustration 1.

(2) Connect oscillator output lead to control grid cap of first detector tube at point indicated by "X" in Illustration 1. Control grid lead should be removed. Connect shield of oscillator lead to chassis ground.

(3) Set receiver tuning at point near 550 kilocycles which is entirely free from interference or incoming signals.

(4) Place set in operation and set volume control at maximum. Adjust the silencer lever to full counter-clockwise position (no silencer action).

(5) Adjust service oscillator to 175 kilocycles (exactly), and place in operation.

(6) Align adjusting screws C11, C10, C8 and C7 in that order for maximum reading on output meter.*

(7) Transfer oscillator output lead to antenna wire of chassis.

(8) Reconnect grid clip to first detector tube cap.

(9) Adjust both receiver and oscillator in tune at 1400 kilocycles. If difficulty is encountered in securing sufficient attenuation with service oscillator output control directly connected to antenna lead, a 100,000 ohm resistance connected in series with antenna lead will reduce the signal sufficiently.

(10) Adjust oscillator trimming condenser indicated by symbol "C" in Illustration 1 or 2. This condenser peaks at a point approximately three-quarters of minimum capacity setting, (i.e., the adjusting screw turned almost "full out").

(11) Align adjusting screws "B" and "A" in that order for maximum increase on output meter. "B" is the R.F. stage trimming or aligning condenser and "A" is a similar unit for adjusting the antenna stage.

(12) Adjust service oscillator and receiver in tune at 600 kilocycles. Adjust the padding condenser "D" (Illustration 1) for maximum indication on output meter.* The tuning condenser should be varied slightly while peaking this padding condenser "D." If the gang condenser is left stationary a false peak will be obtained and the receiver will be weak at or near 550 kilocycles.

*Always have service oscillator output at lowest possible value, which will give readable indication on output meter. When aligning I. F. stages, if sufficient attenuation is not available on service oscillator output control, the volume control of the receiver may be reduced slightly. When aligning at broadcast frequencies, lack of sufficient attenuation in service oscillator output control can be overcome by inserting 100,000 ohm resistance in series between oscillator and antenna lead of receiver. As an alternative to this, the antenna lead of the receiver may be wound around the oscillator output lead instead of directly connected to it, thus giving a capacitive coupling.

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PARTS LIST

"MONTROSE" MODEL
TYPE 902-A CHASSIS (25 CYCLE)

Part No.	Code	Description	List Price
6120	HABIT	Bracket, dial light	$ .25
7166	ALERT	Bulb, tuning indicator W4	.70
3954	BALLY	Bulb, dial	.20
7370	ALLOY	Choke, R. F., L1	1.75
7178	BAFFY	Condenser, gang C2	8.50
7214	BRAWN	Condenser, tubular, .25 mfd., C3	.75
7216	BREAK	Condenser, mica, .00035 mfd., C5	.35
6978	BRAZE	Condenser, tubular, .05 mfd., C6	.50
7213	BEGUN	Condenser, tubular, .05 mfd., C9, C1, C4, C19	.50
6556	BEGET	Condenser, mica, .0001 mfd., C12, C13	.35
7220	BOSKY	Condenser, tubular, .1 mfd., C14	.50
7221	BOSOM	Condenser, tubular, .5 mfd., C15, C17, C32	.60
7217	BATHE	Condenser, tubular, .05 mfd., C16	.50
7228	BASTE	Condenser, tubular, .25 mfd., C18, C30	.75
7225	BOLUS	Condenser, tubular, .05 mfd., C20	.50
7226	BOTCH	Condenser, tubular, .25 mfd., C21	.75
7309	BOUGH	Condenser, tubular, .2-.15 mfd., C22	.60
6941	BREAD	Condenser, tubular, .005 mfd., C23	.30
6790	BAIZE	Condenser, oscillator padding, C24	1.00
7174	BOSCH	Condenser, 1 mfd., C25	1.00
7336	BLIND	Condenser, electrolytic, 8 mfd., C26, C27, C28	2.00
7239	BRAXY	Condenser, tubular, .1 mfd., C29	.50
7229	BOUND	Condenser, tubular, .3 mfd., C31	.80
6850	BONNE	Drive assembly, gang	.45
7182	BAHAR	Drive assembly, tone color	.50
7121	BESOT	Drive gear, silencer, (Fibre)	.20
7179	BAIRN	Drive pinion, tone color (Rubber)	.10
7348	BETEL	Driven gear assembly, silencer	.25
6887	BANAL	Potentiometer, level control, R10	2.00
7200	BERTH	Potentiometer, centre tap resistor, R20	.70
6479	BOURN	Potentiometer, silencer control, R25	2.00
6911	BELLY	Resistor, carbon, 10,000 ohms, R1	.35
7187	BOOTH	Resistor, carbon, 25,000 ohms, R2	.35
7188	BRASH	Resistor, carbon, 190 ohms, R3	.35
7142	BEAUT	Resistor, carbon, 500,000 ohms, R4	.35
7219	BLOAT	Resistor, carbon, 100,000 ohms, R5, R8, R33	.35
7191	BRASS	Resistor, carbon, 300,000 ohms, R6	.35
7192	BRAVE	Resistor, carbon, 50,000 ohms, R7	.35
7194	BRANT	Resistor, carbon, 10,000 ohms, R9	.35
7189	BRAND	Resistor, carbon, 900,000 ohms, R11	.35
7196	BLISS	Resistor, carbon, 1 meg., R12, R13	.35
7145	BEDIN	Resistor, carbon, 50,000 ohms, R14	.35
6901	BLOOM	Resistor, carbon, 40,000 ohms, R15	.35
6902	BRACT	Resistor, carbon, 35,000 ohms, R16	.35
6909	BOXER	Resistor, carbon, 25,000 ohms, R17	.35
7198	BLOND	Resistor, carbon, 250,000 ohms, R18	.35
7304	BUTTE	Resistor, carbon, 3,440 ohms, R21	.40
7202	BRAIL	Resistor, carbon, 13,000 ohms, R22	.40
7203	BRAID	Resistor, carbon, 11,000 ohms, R23	.40
6916	BOVIN	Resistor, tapped candohm, R24, R26, R32	.70
7206	BRAIN	Resistor, carbon, 83,000 ohms, R27	.40
7207	BRAKE	Resistor, carbon, 180,000 ohms, R28	.40
6898	BOWIE	Resistor, carbon, 100,000 ohms, R29	.35
7208	BRACE	Resistor, carbon, 60,000 ohms, R30	.40
7209	BRAVO	Resistor, carbon, 200,000 ohms, R31	.35
3799	AMEER	Resistor, carbon, 100,000 ohms, R34	.40
7199	BOWER	Rheostat, tone control R19 and switch	2.50
7176	BAGGS	Scale, dial	.50
7092	BRAWL	Shield, pentode	.12
7112	BABEL	Sockets, (24-27)	.35
7094	BABOO	Sockets, (58)	.40
7113	BACON	Sockets, (280)	.30
7297	BUNCO	Socket, tuning indicator	.55
7162	BREAM	Transformer, power 25 cycle, T7	12.00
7157	BREED	Transformer, output, T6	4.00

"MONTROSE" MODEL
TYPE 902-A CHASSIS (25 CYCLE)—*Continued*

Part No.	Code	Description	List Price
7069	BRENT	Transformer, 1st I. F., T4	3.50
7071	BREVE	Transformer, 2nd I. F., T5	3.50
6509	BRIAR	Transformer, R. F. antenna stage, T1	2.75
6510	BRIBE	Transformer, R. F. interstage, T2	3.50
7061	BORON	Transformer, osc. stage, T3	3.50

"MONTROSE" MODEL
TYPE 902-B CHASSIS (60 CYCLE)

All parts same as 902-A with the following exceptions:

6948	BRIEF	Condenser, tubular, .04 mfd., C21	.50
7138	BRIDE	Transformer, power, 60 cycle, T7	10.00

"MONTROSE" MODEL
CABINET FITTINGS

6744	BRIER	Cabinet, console	on app.
5291	HOCUS	Channels, chassis mounting	.50
7165	BRILL	Chassis, 25 cycle (902-A)	75.00
6949	BROAD	Chassis, 60 cycle (902-B)	75.00
5331	HOLLY	Escutcheon plate	1.00
5411	ADVER	Knobs, small	.20
4747	PODGY	Knobs, large	.20
5309	HOIST	Pads, chassis mounting	.10
5327	ADDER	Shield, tube	.20
7167	BIFUR	Shield, W58 (base)	.10
7168	BORAX	Shield, W58 (top)	.15
7120	BIBLE	Silencer, control lever	.25
7170	BRING	Speaker D152A dynamic	11.00
7171	BRINK	Speaker D152B dynamic	11.00
7295	BRINY	Tuning indicator, lens and bezel	.25
7292	BRISK	Tuning indicator, reflector	.15

SILENCER CIRCUIT REVISION
TYPES 902-A, B CHASSIS

All parts same as for type 902-A, B, except following:

7219	BLOAT	Resistor, carbon, 100,000 ohms	.35
7822	BROCK	Resistor, carbon, 217,000 ohms	.35

"MONTROSE" MODEL
TYPE 902-F CHASSIS (UNIVERSAL)

All items the same as 902-A with following additions:

7414	BRUIT	Potentiometer, silencer control, R25	2.00
7478	BUXOM	Resistor, carbon, 500,000 ohms, R11	.35
7844	AMICE	Resistor, carbon, 250,000 ohms, R13	.35
7823	AMISS	Resistor, carbon, 100,000 ohms, R27	.35

The following is omitted:

6916		Resistor R26 32	

All prices are f.o.b. the Company's warehouse, and are subject to change without notice.

D-152-A SPEAKER (Upper)

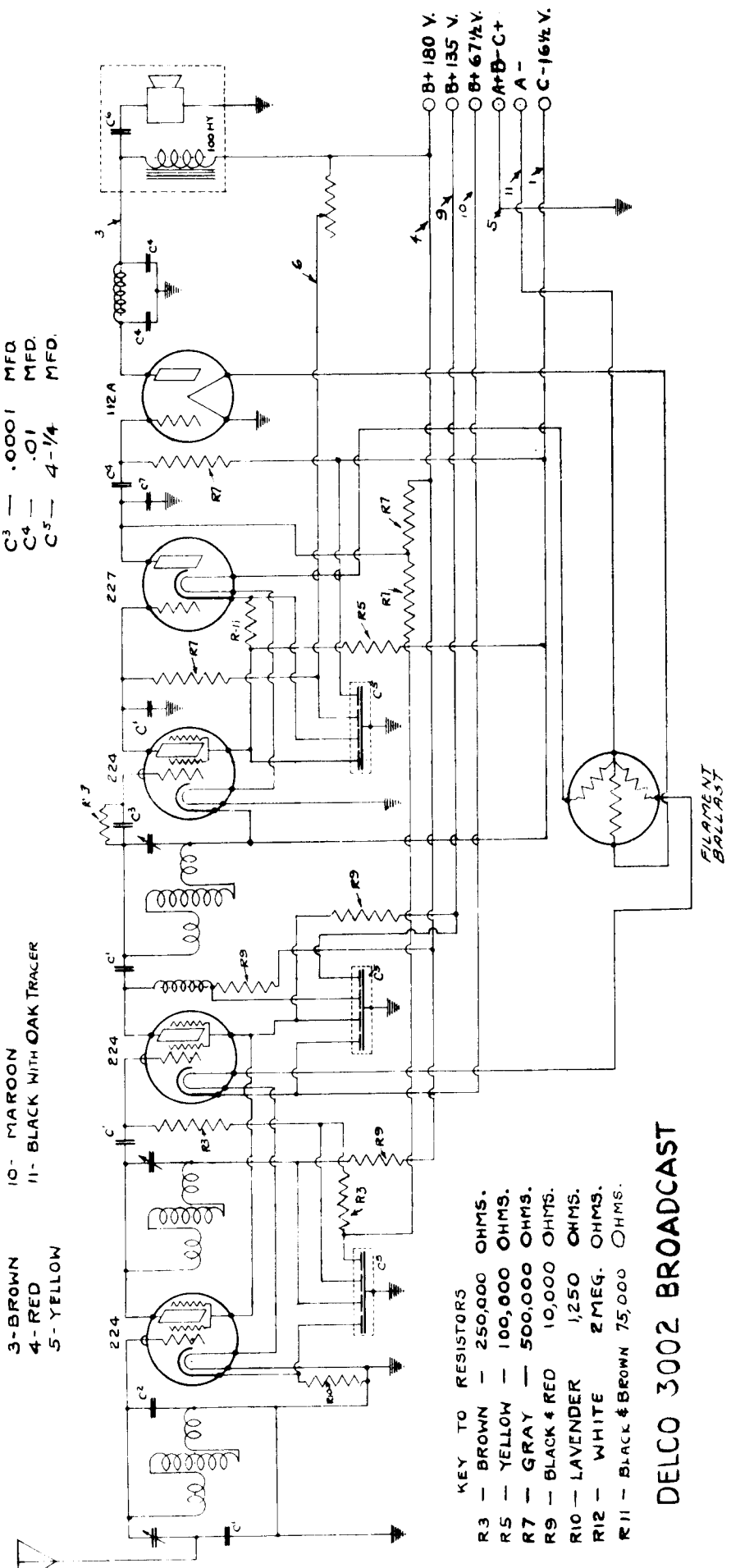
7211	ANELE	Coil, field, 420 ohms	3.50
6824	BLADE	Coil, hum neutralizing	.50
7360	ANISE	Cone and voice coil assembly	4.25
7288	BORIC	Cone frame and pole plate assembly	2.00
6822	BLANK	Pot and pole assembly	1.50
7369	BLARE	Terminal panel assembly	.50

D-152-B SPEAKER (Lower)

7212	ANGLE	Coil, field, 420 ohms	3.50
7361	ANKLE	Cone and voice coil assembly	4.25
7289	BLEAR	Cone frame and pole plate assembly	2.00
6822	BLANK	Pot and pole assembly	1.50
7369	BLARE	Terminal panel assembly	.50

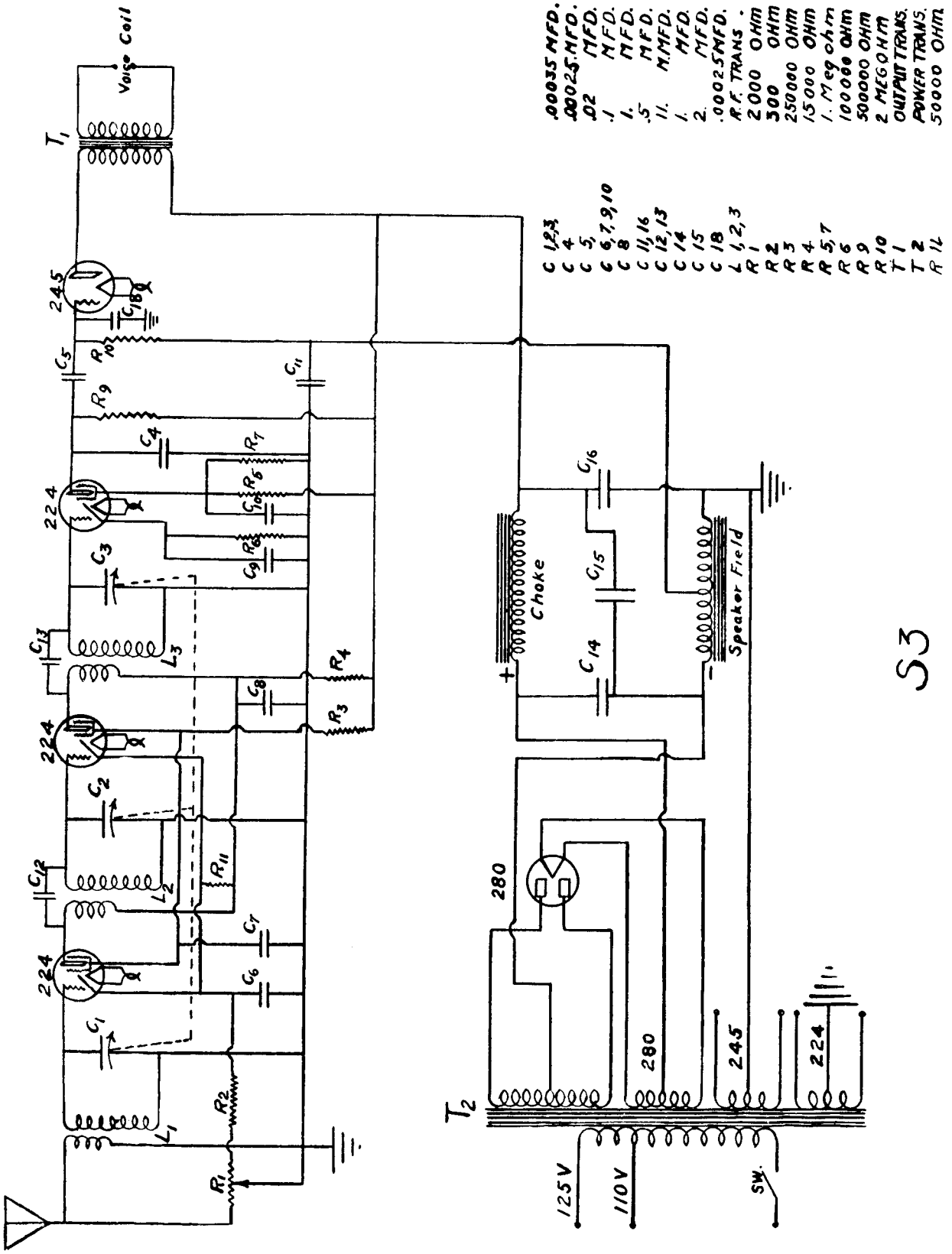
All prices are f.o.b. the Company's warehouse, and are subject to change without notice.

DELCO



DELCO 3002 BROADCAST

ECHOPHONE RADIO MANUFACTURING CO. LTD.



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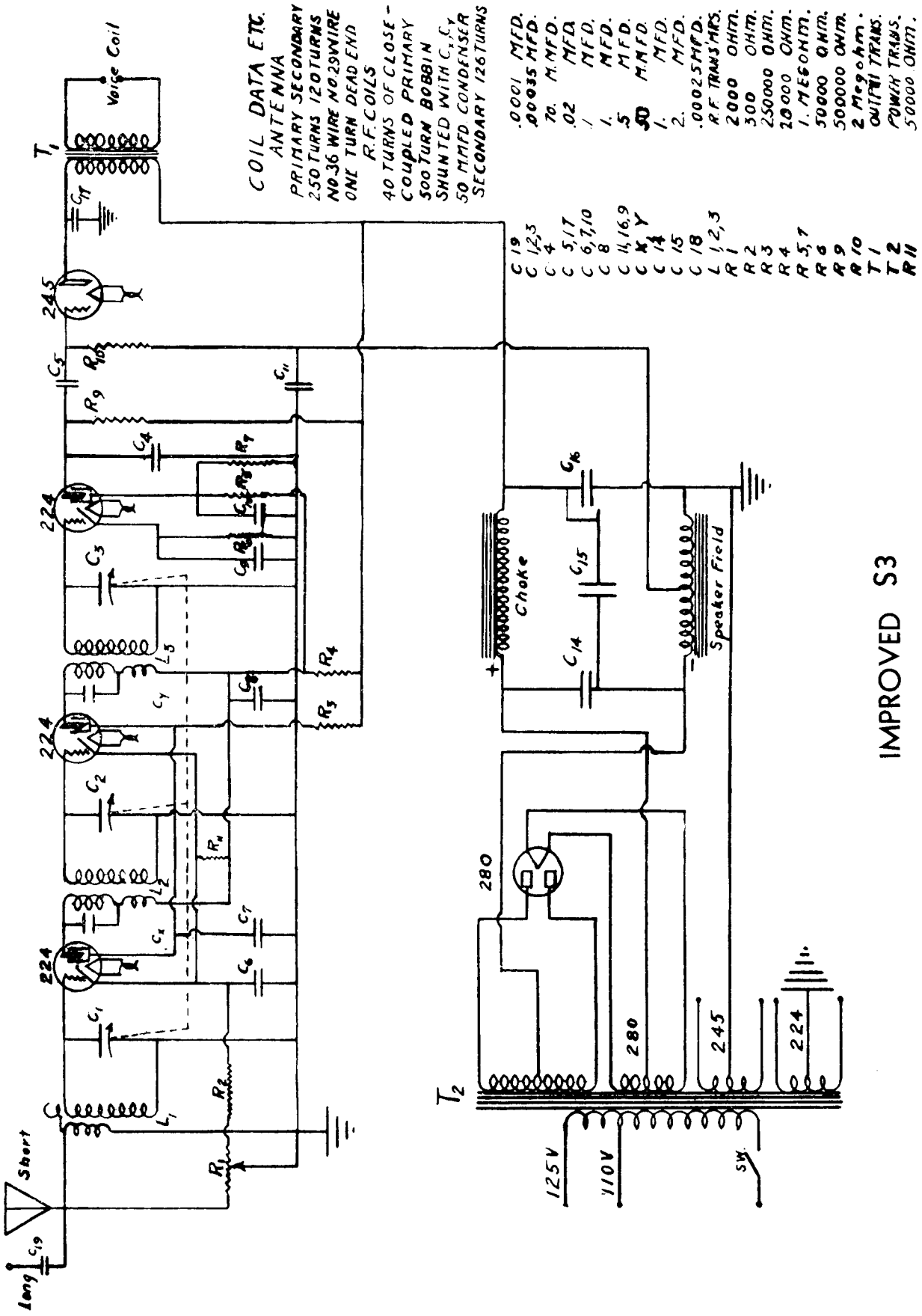

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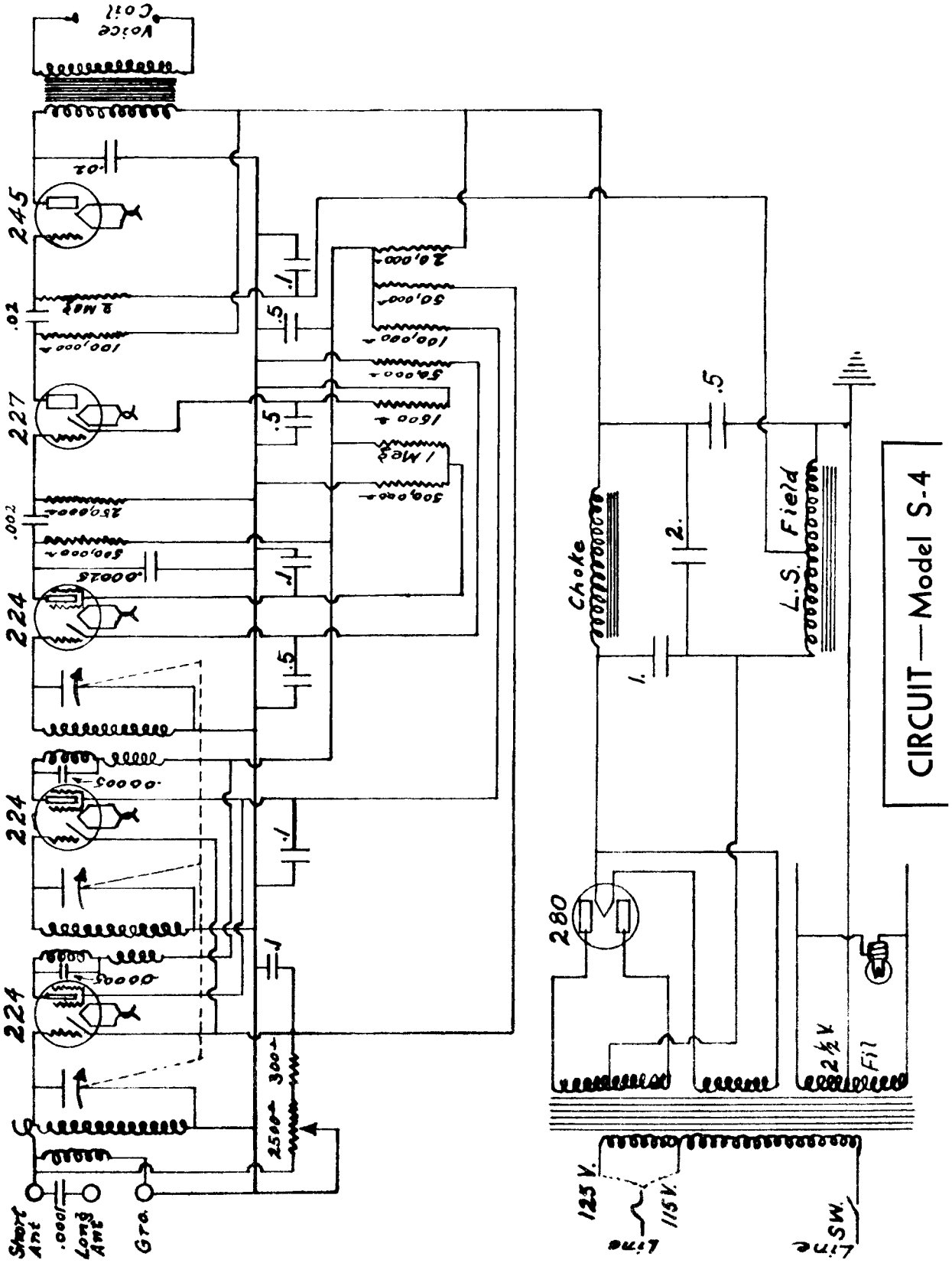

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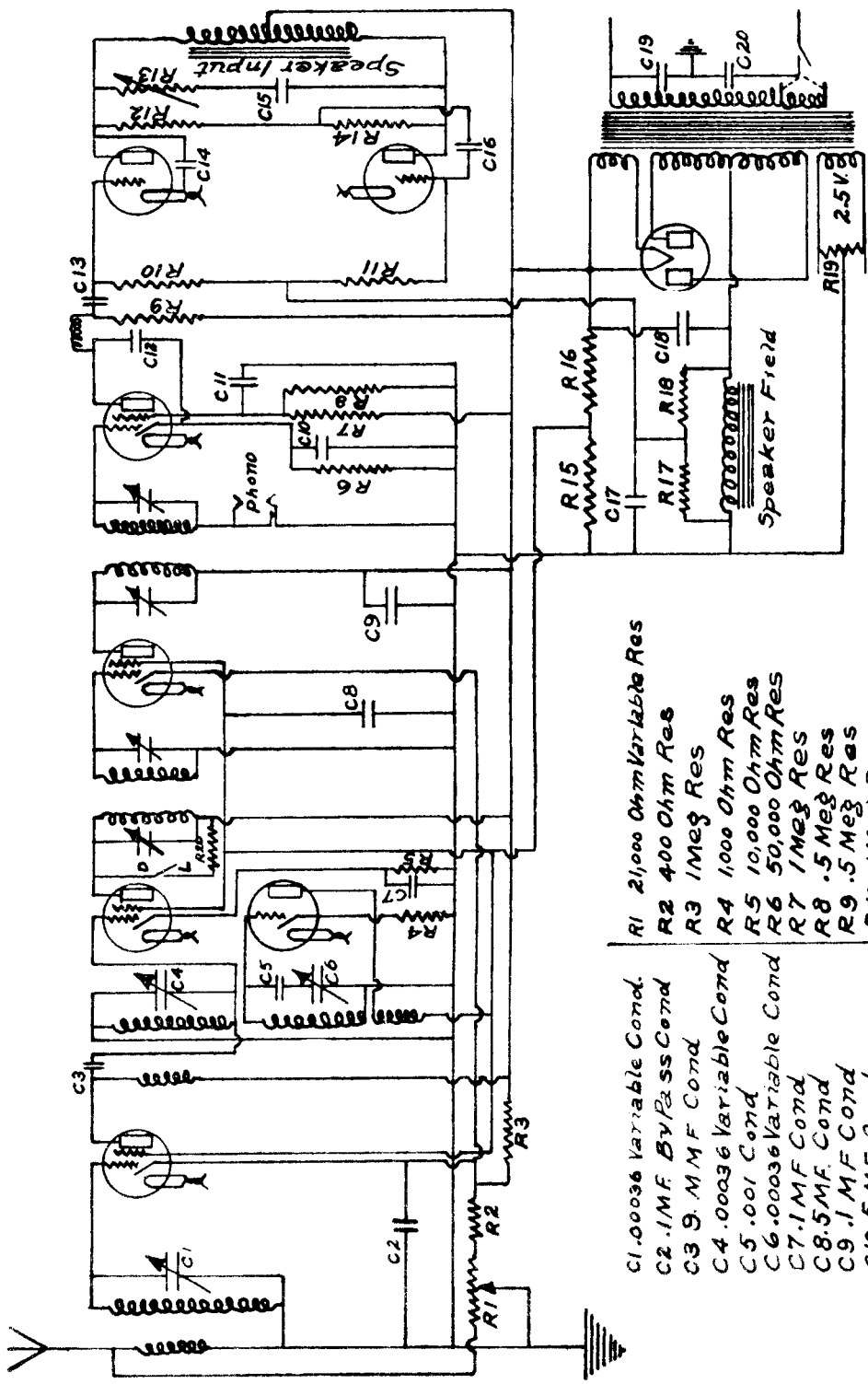
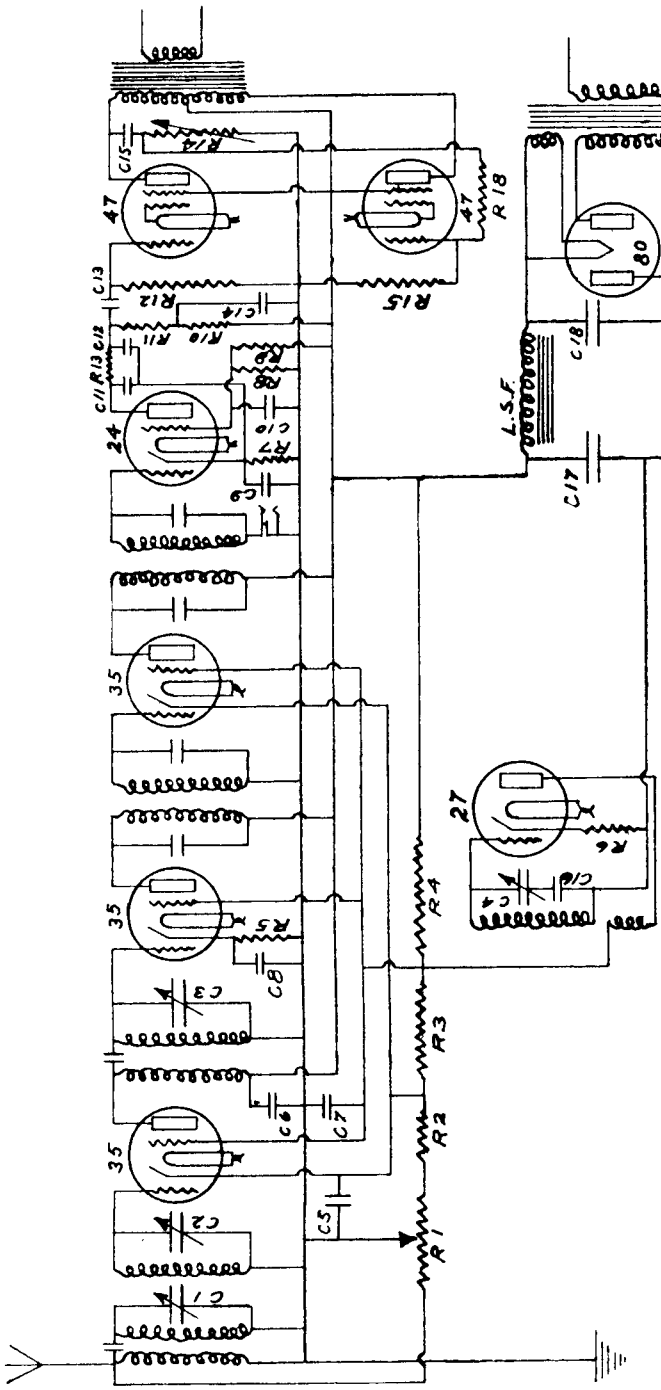


C1 .00036 Variable Cond.
C2 .1 MF By Pass Cond
C3 9. MMF Cond
C4 .00036 Variable Cond
C5 .001 Cond
C6 .00036 Variable Cond
C7 .1 MF Cond
C8 .5 MF. Cond
C9 .1 MF Cond
C10 .5 MF Cond
C11 .1 MF Cond
C12 .00025 Cond
C13 .02 MF Cond
C14 .02 MF Cond
C15 .1 MF Cond
C16 .02 MF Cond
C17 .02 MF Cond
C18 8. MF Cond
C19 .05 MF Cond
C20 .05 MF Cond

R1 21,000 Ohm Variable Res
R2 400 Ohm Res
R3 1 Meg Res
R4 1,000 Ohm Res
R5 10,000 Ohm Res
R6 50,000 Ohm Res
R7 1 Meg Res
R8 .5 Meg Res
R9 .5 Meg Res
R10 1 Meg Res
R11 1 Meg Res
R12 .25 Meg Res
R13 15,000 Ohm Variable Res
R14 1 Meg Res
R15 50,000 Ohm Res
R16 20,000 Ohm Res
R17 1 Meg Res
R18 1 Meg Res
R19 .20 Ohm Center Tapped Res
R20 5,000 Ohm Res.

ECHOPHONE RADIO MANUFACTURING CO. LTD.

Model 80 Superheterodyne

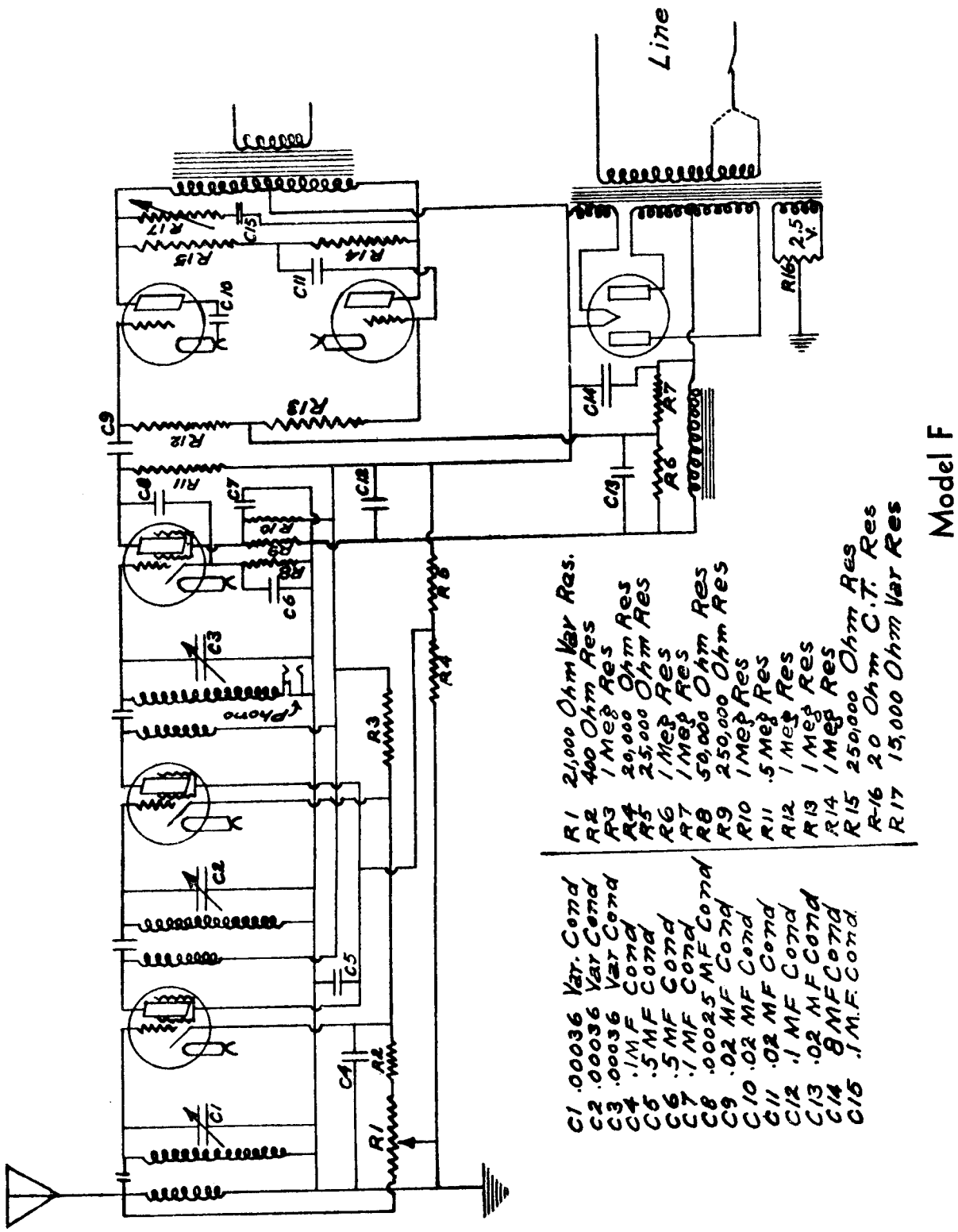


R1 20,000 Ohm Volume Control
With R2 200 Ohm Fixed Bias
R3 25,000 Ohm 1 Watt
R4 20,000 Ohm 2 Watt
R5 1500 Ohm .5 Watt
R6 1000 Ohm .5 Watt
R7 50,000 Ohm 1 Watt
R8 .5 Meg .5 Watt
R9 1 Meg .5 Watt
R10 .5 Meg .5 Watt
R11 .5 Meg .5 Watt
R12 .5 Meg .5 Watt
R13 150,000 Ohm .5 Watt
R14 20,000 Ohm Tone Control
R15 10,000 Ohm .5 Watt
R16 250 Ohm 2 Watt
R17 20 Ohm Center Tappad Res
R18 .25 Meg 1 Watt
All Resistors +- 10 %
Unless Otherwise Specified.

C1 .00036 Var. Cond.
C2 .00036 Var. Cond.
C3 .00036 Var. Cond.
C4 .00036 Var. Cond.
C5 .1 MF 200 V. Cond.
C6 .1 MF 300 V. Cond.
C7 .5 MF 200 V. Cond.
C8 .1 MF 200 V. Cond.
C9 .5 MF 200 V. Cond.
C10 .1 MF 200 V. Cond.
C11 .00025 Cond.
C12 .0001 Cond.
C13 .006 MF 400 V. Cond.
C14 .1 MF 200 V. Cond.
C15 .05 MF 400 V. Cond.
C16 .001 Cond. +- 3%
C17 4 MF 450 V. Cond.
C18 8 MF 450 V. Cond.

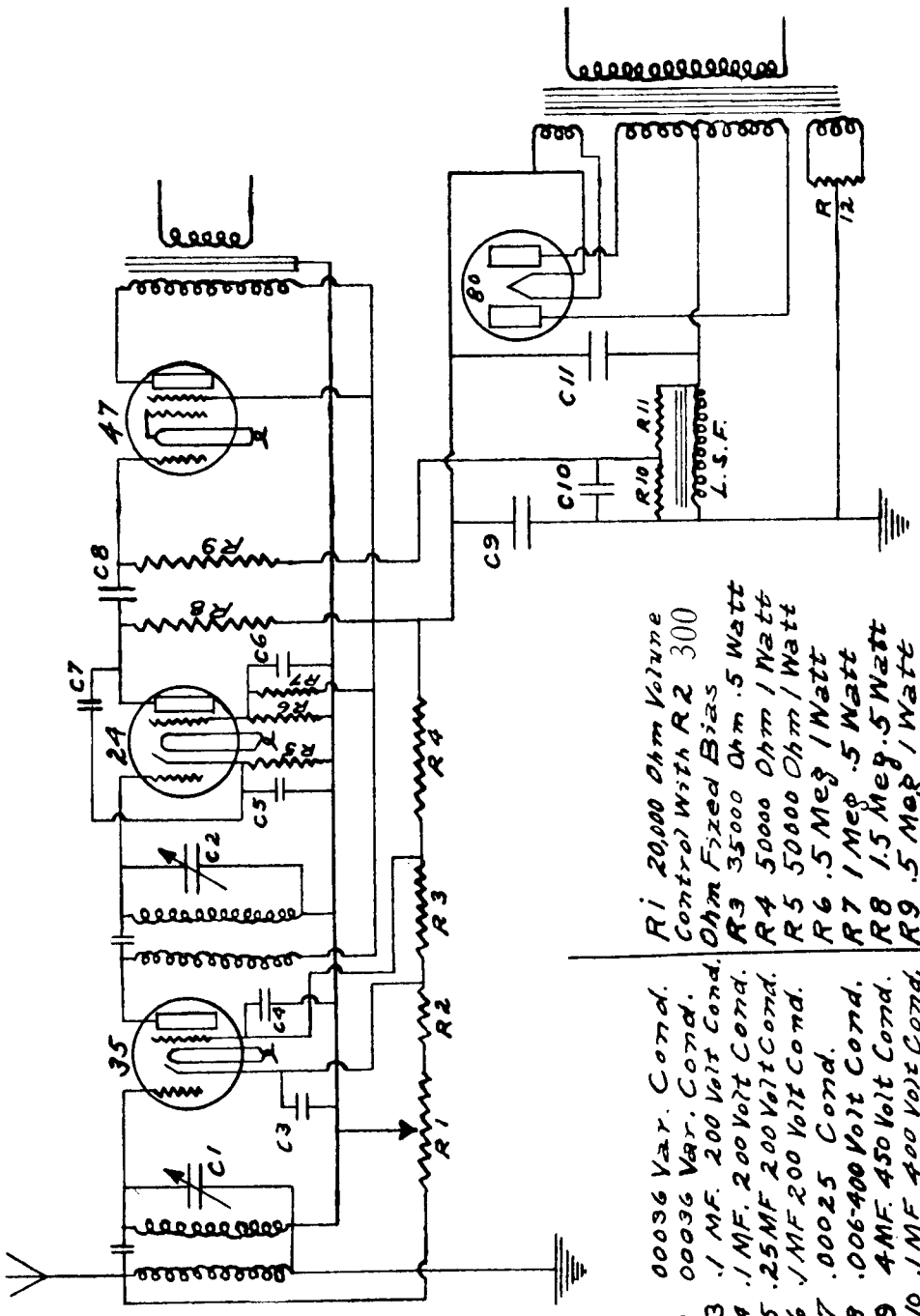
All Cond. +- 10 %
Unless Otherwise Specified.

ECHOPHONE RADIO MANUFACTURING CO. LTD.



ECHOPHONE RADIO MANUFACTURING CO. LTD.

Model 40 Echoette



C1	00036 Var. Cond.
C2	00036 Var. Cond.
C3	.1 MF. 200 Volt Cond.
C4	.1 MF. 200 Volt Cond.
C5	.25MF 200 Volt Cond.
C6	.1 MF 200 Volt Cond.
C7	.00025 Cond.
C8	.006-400 Volt Cond.
C9	4MF 450 Volt Cond.
C10	.1 MF 400 Volt Cond.
C11	8MF 450 Volt Cond.

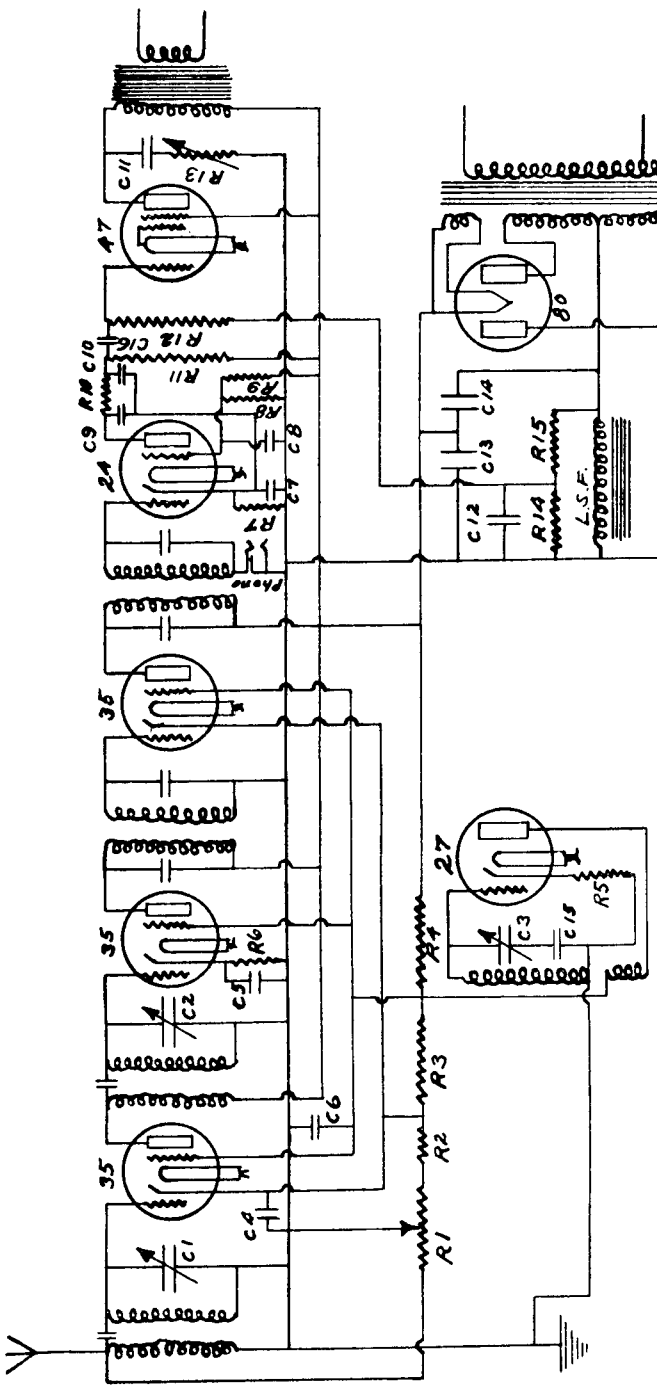
All Cond. +- 10 % Unless Otherwise Specified

R1	20,000 Ohm Volume Control With R2 300 Ohm Fixed Bias
R3	35000 Ohm .5 Watt
R4	50000 Ohm 1 Watt
R5	50000 Ohm 1 Watt
R6	.5 Meg 1 Watt
R7	1 Meg .5 Watt
R8	1.5 Meg .5 Watt
R9	.5 Meg 1 Watt
R10	.2 Meg .5 Watt
R11	1 Meg .5 Watt
R12	20 Ohm C.T. Resistor

All Resistors +- 10 % Unless Otherwise Specified

ECHOPHONE RADIO MANUFACTURING CO. LTD.

Model 60 Superheterodyne



R1 2000 Ohm Volume Control With R2 200 Ohm Fixed Bias
R3 25,000 Ohm 1 Watt
R4 20000 Ohm 2 Watt
R5 1000 Ohm .5 Watt
R6 1500 Ohm .5 Watt
R7 50,000 Ohm .5 Watt
R8 .5 Meg .5 Watt
R9 1. Meg .5 Watt
R10 150,000 Ohm .5 Watt
R11 .5 Meg 1 Watt
R12 .5 Meg 1 Watt
R13 20,000 Ohm Tone Control
R14 20,000 Ohm .5 Watt
R15 1. Meg .5 Watt
R16 20 Ohm Center tapped Res.

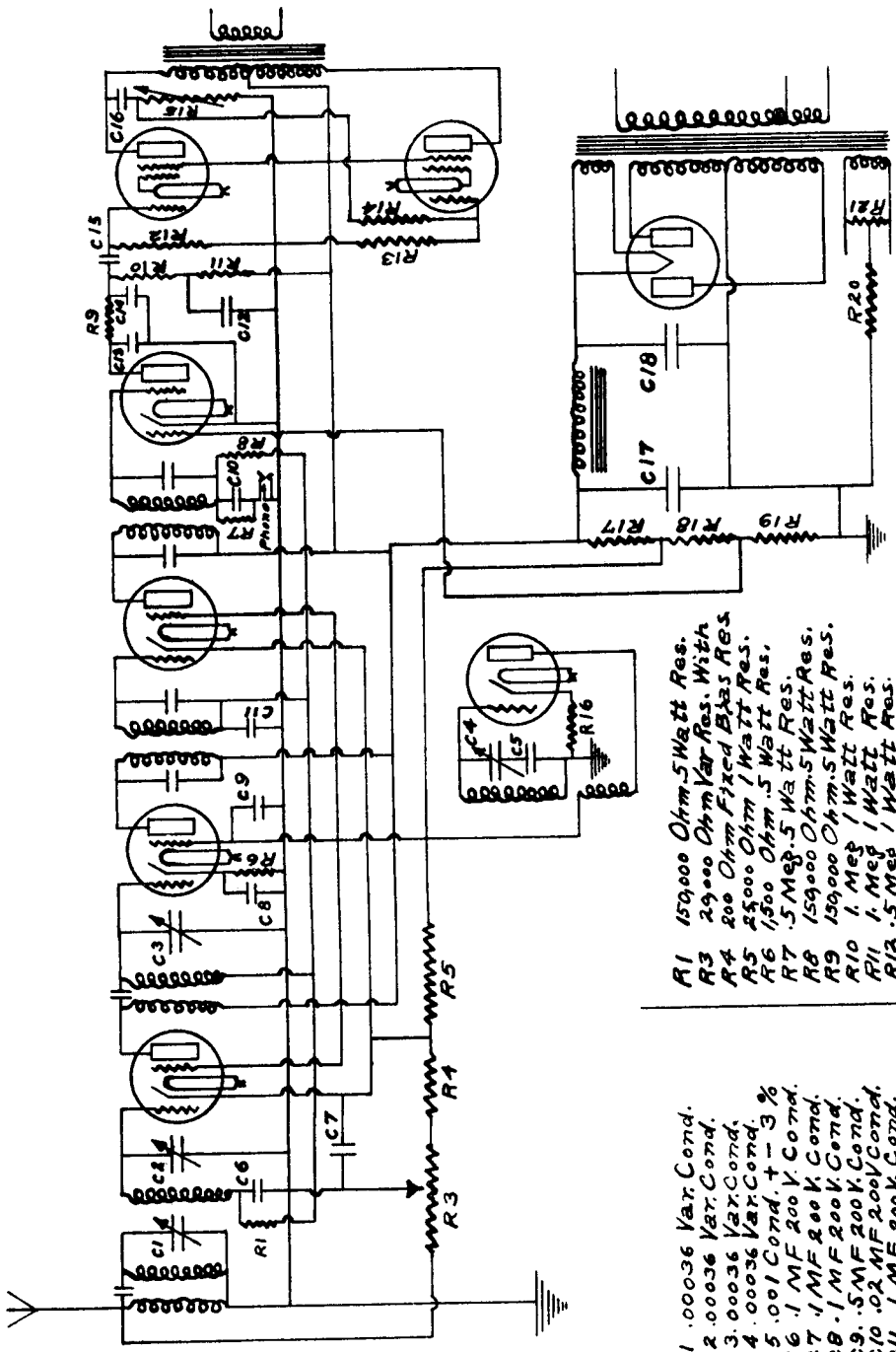
All Resistors +- 10% Unless Otherwise Specified

C1 .00036 Var. Cond.
C2 .00036 Var. Cond.
C3 .00036 Var. Cond.
C4 .1 MF 200 V. Cond.
C5 .1 MF 200 V. Cond.
C6 .1 MF 200 V. Cond.
C7 .5 MF 200 V. Cond.
C8 .1 MF 200 V. Cond.
C9 .00025 Cond.
C10 .001 Cond.
C11 .05 MF 400 V. Cond.
C12 .1 MF 400 V. Cond.
C13 8 MF 450 V. Cond.
C14 8 MF 450 V. Cond.
C15 .001 Cond. +- 3%
C16 .006 MF 400 V. Cond.

All Condensers +- 10% Unless Otherwise Specified

ECHOPHONE RADIO MANUFACTURING CO. LTD.

Model 90 Superheterodyne



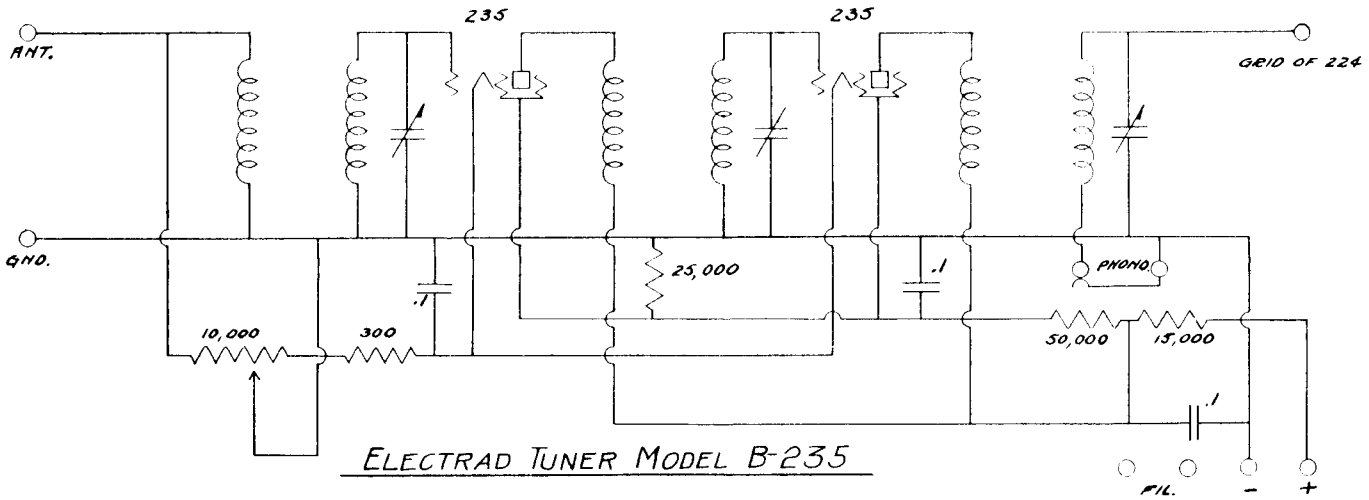
R1	150,000 Ohm .5 Watt Res.
R3	29,000 Ohm Var Res. With
R4	200 Ohm Fixed Bias Res
R5	25,000 Ohm 1 Watt Res.
R6	1,500 Ohm .5 Watt Res.
R7	.5 Meg. .5 Watt Res.
R8	150,000 Ohm .5 Watt Res.
R9	150,000 Ohm .5 Watt Res.
R10	1. Meg 1 Watt Res.
R11	1. Meg 1 Watt Res.
R12	.5 Meg 1 Watt Res.
R13	10,000 Ohm 1 Watt Res.
R14	.25 Meg 1 Watt Res.
R15	20,000 Ohm Tone Control
R16	1,000 Ohm .5 Watt Res.
R17	15,000 Ohm 1 Watt Res.
R18	50,000 Ohm 1 Watt Res.
R19	2,000 Ohm 1 Watt Res.
R20	250 Ohm 2 Watt Res.
R21	20 Ohm Center Tapped Res.

All Resistors +- 10% Unless Otherwise Specified

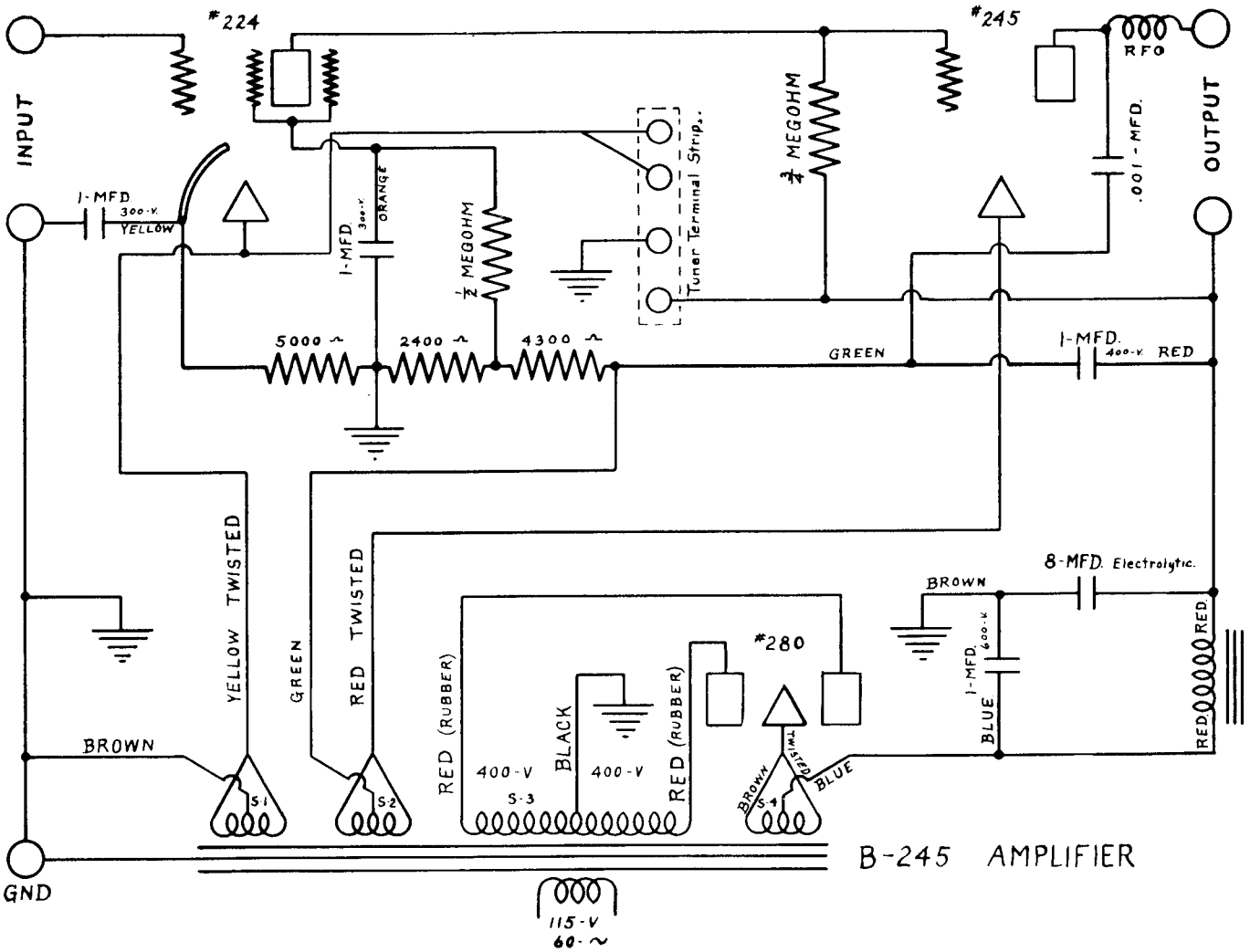
C1	.00036 Var. Cond.
C2	.00036 Var. Cond.
C3	.00036 Var. Cond.
C4	.00036 Var. Cond. +- 3 %
C5	.001 Cond. +- 3 %
C6	.1 MF 200 V. Cond.
C7	.1 MF 200 V. Cond.
C8	.1 MF 200 V. Cond.
C9	.5 MF 200 V. Cond.
C10	.02 MF 200 V. Cond.
C11	.1 MF 200 V. Cond.
C12	.1 MF 200 V. Cond.
C13	.00025 Cond.
C14	.0001 Cond.
C15	.02 MF 400 V. Cond.
C16	.05 MF 400 V. Cond.
C17	8 MF 450 V. Cond.
C18	12 MF 450 V. Cond.

All Condensers +- 10% Unless Other Wise Specified

ELECTRAD INC.

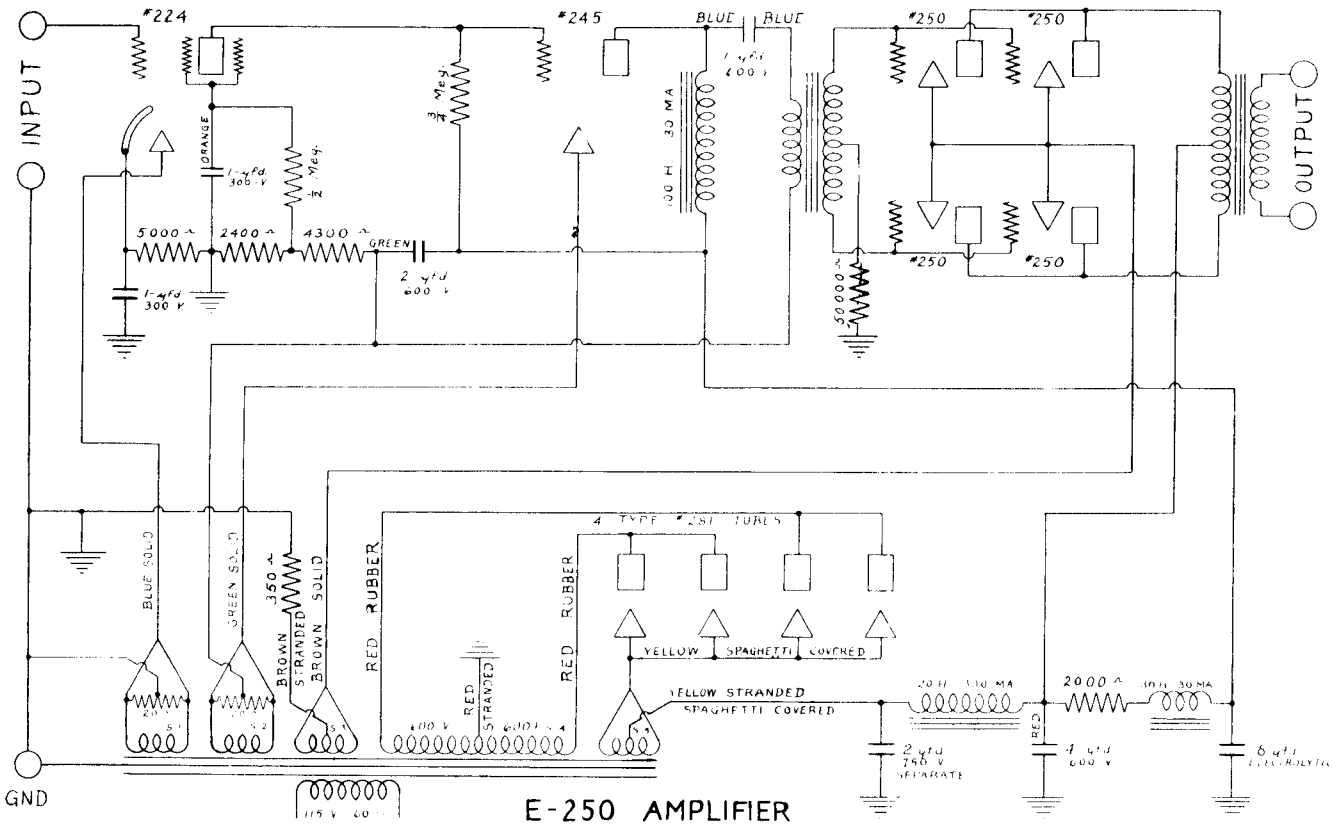


ELECTRAD TUNER MODEL B-235

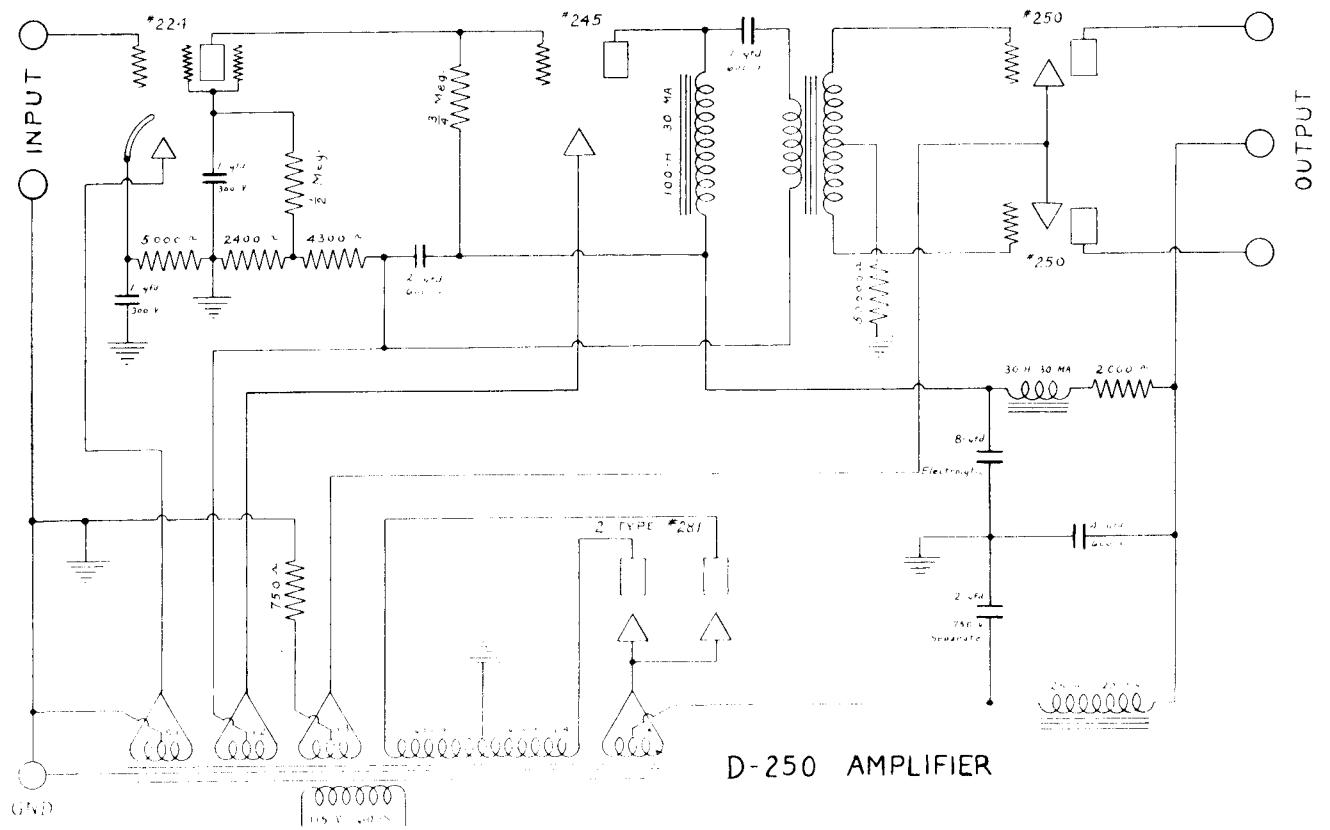


B-245 AMPLIFIER

ELECTRAD INC.

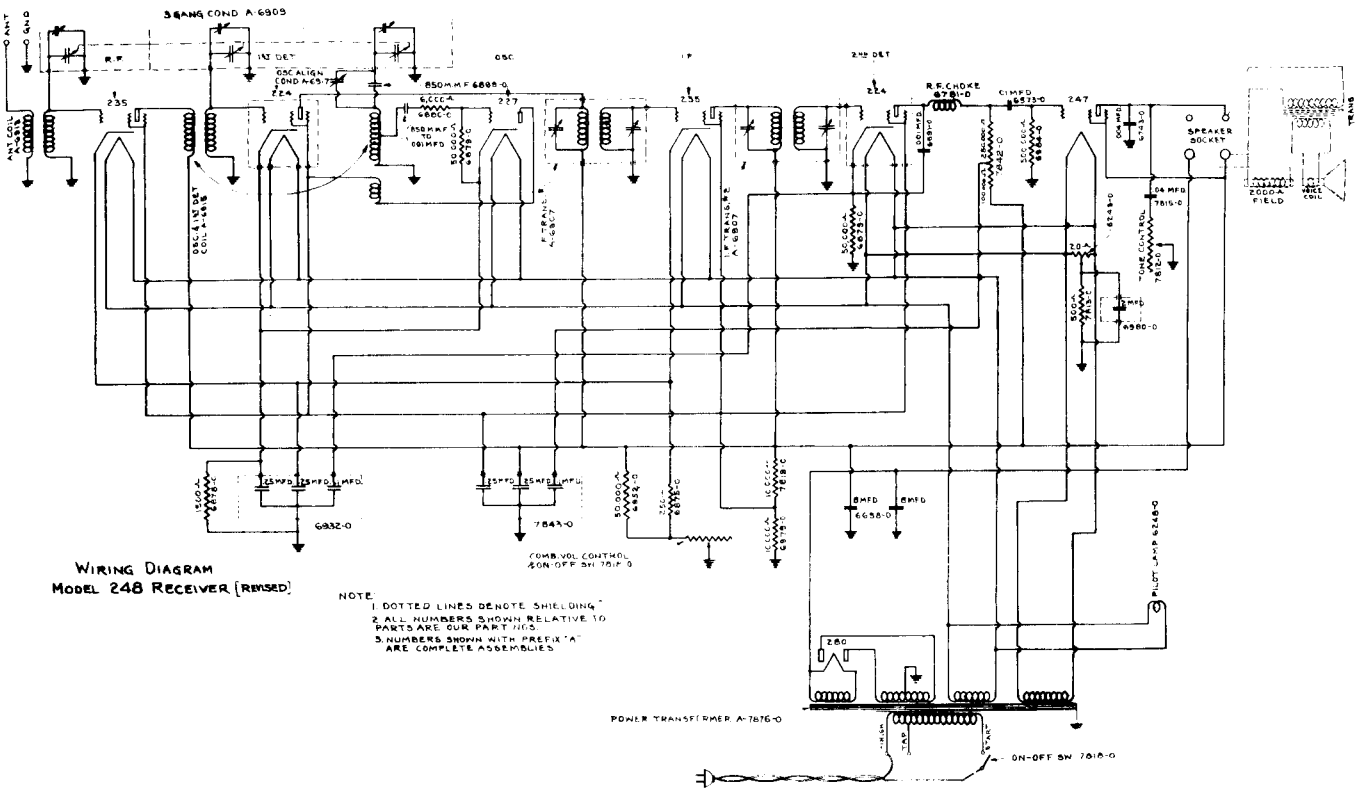


E-250 AMPLIFIER



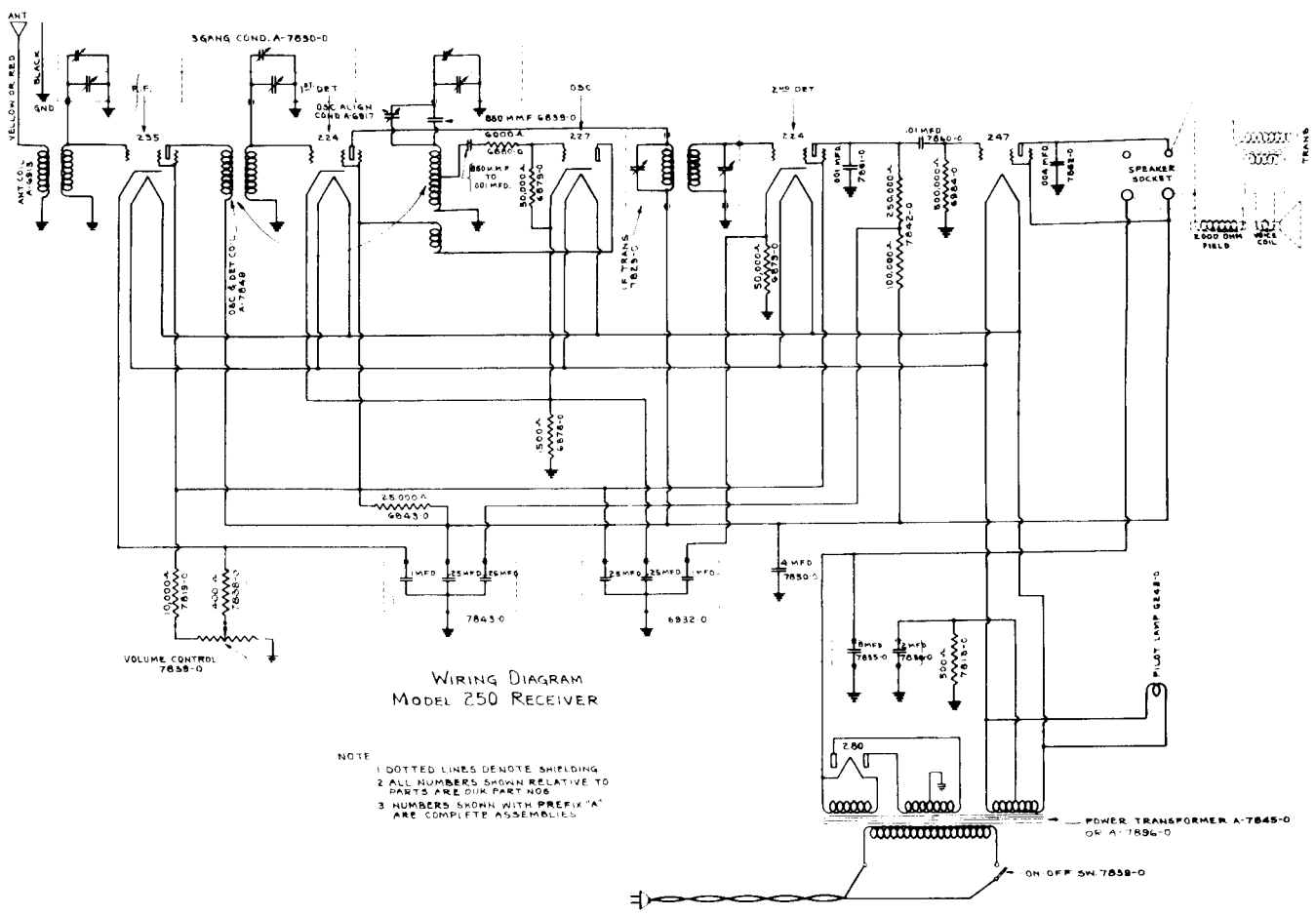
D-250 AMPLIFIER

ELECTRICAL RESEARCH LABORATORIES, INC.



WIRING DIAGRAM
MODEL 248 RECEIVER (REVISED)

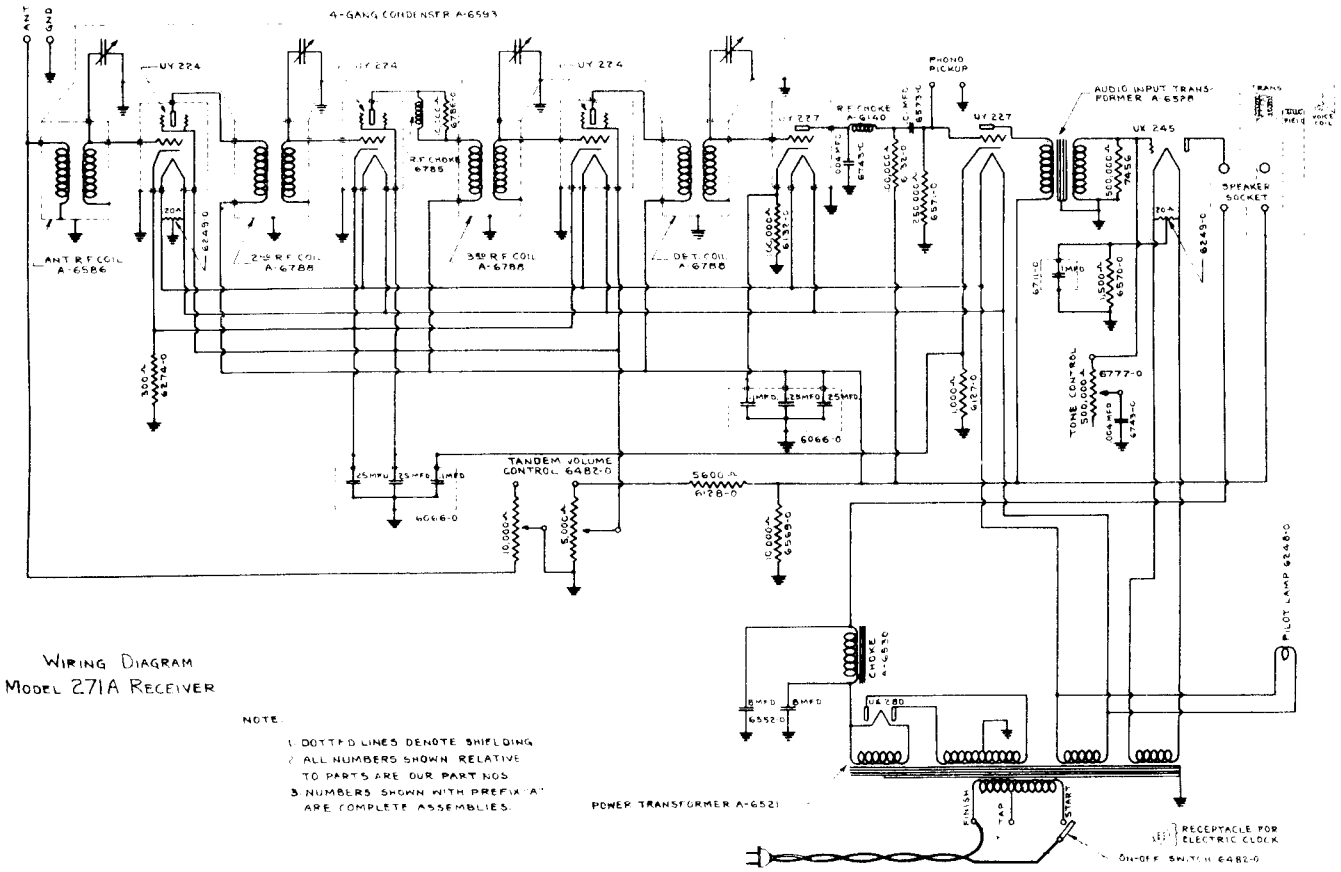
NOTE
1. DOTTED LINES DENOTE SHIELDING
2. ALL NUMBERS SHOWN RELATIVE TO PARTS ARE OUR PART NOS.
3. NUMBERS SHOWN WITH PREFIX "A" ARE COMPLETE ASSEMBLIES



WIRING DIAGRAM
MODEL 250 RECEIVER

NOTE
1. DOTTED LINES DENOTE SHIELDING
2. ALL NUMBERS SHOWN RELATIVE TO PARTS ARE OUR PART NOS
3. NUMBERS SHOWN WITH PREFIX "A" ARE COMPLETE ASSEMBLIES

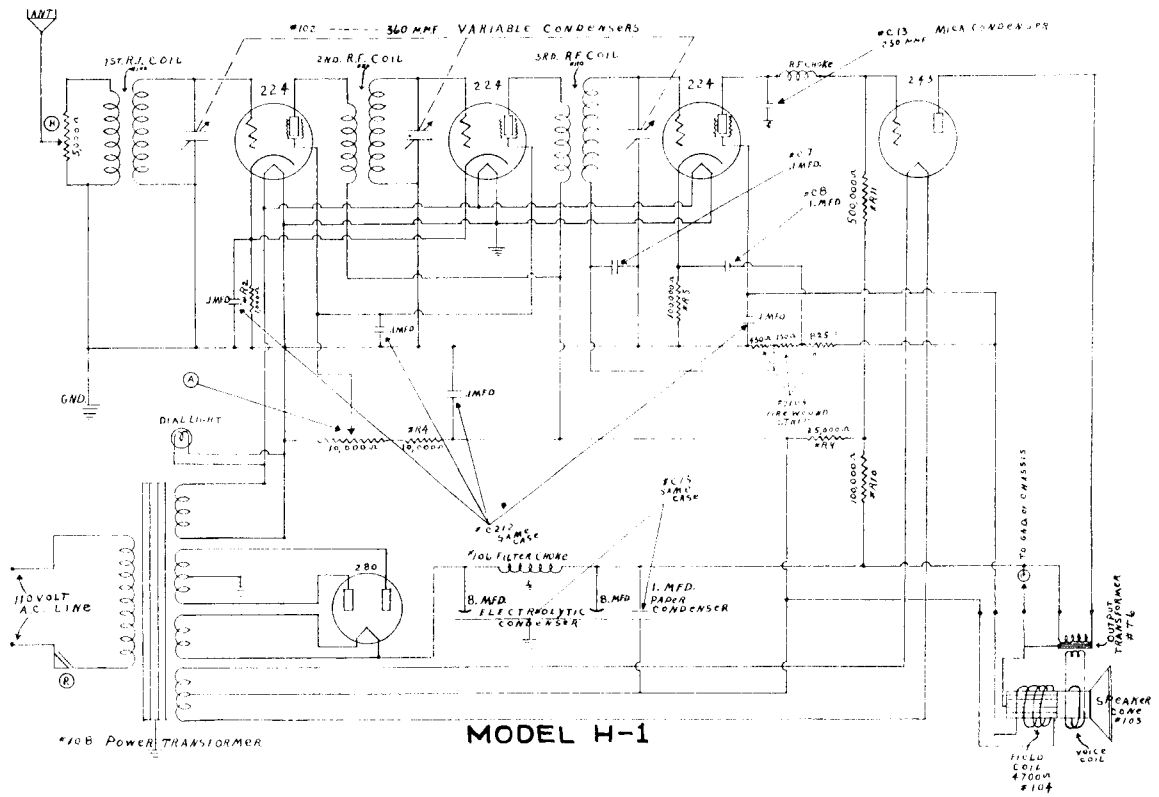
ELECTRICAL RESEARCH LABORATORIES, INC.



WIRING DIAGRAM
MODEL 271A RECEIVER

NOTE
1. DOTTED LINES DENOTE SHIELDING
2. ALL NUMBERS SHOWN RELATIVE TO PARTS ARE OUR PART NOS.
3. NUMBERS SHOWN WITH PREFIX 'A' ARE COMPLETE ASSEMBLIES.

JESSE FRENCH AND SONS PIANO CO.



MODEL H-1

ELECTRICAL RESEARCH LABS.

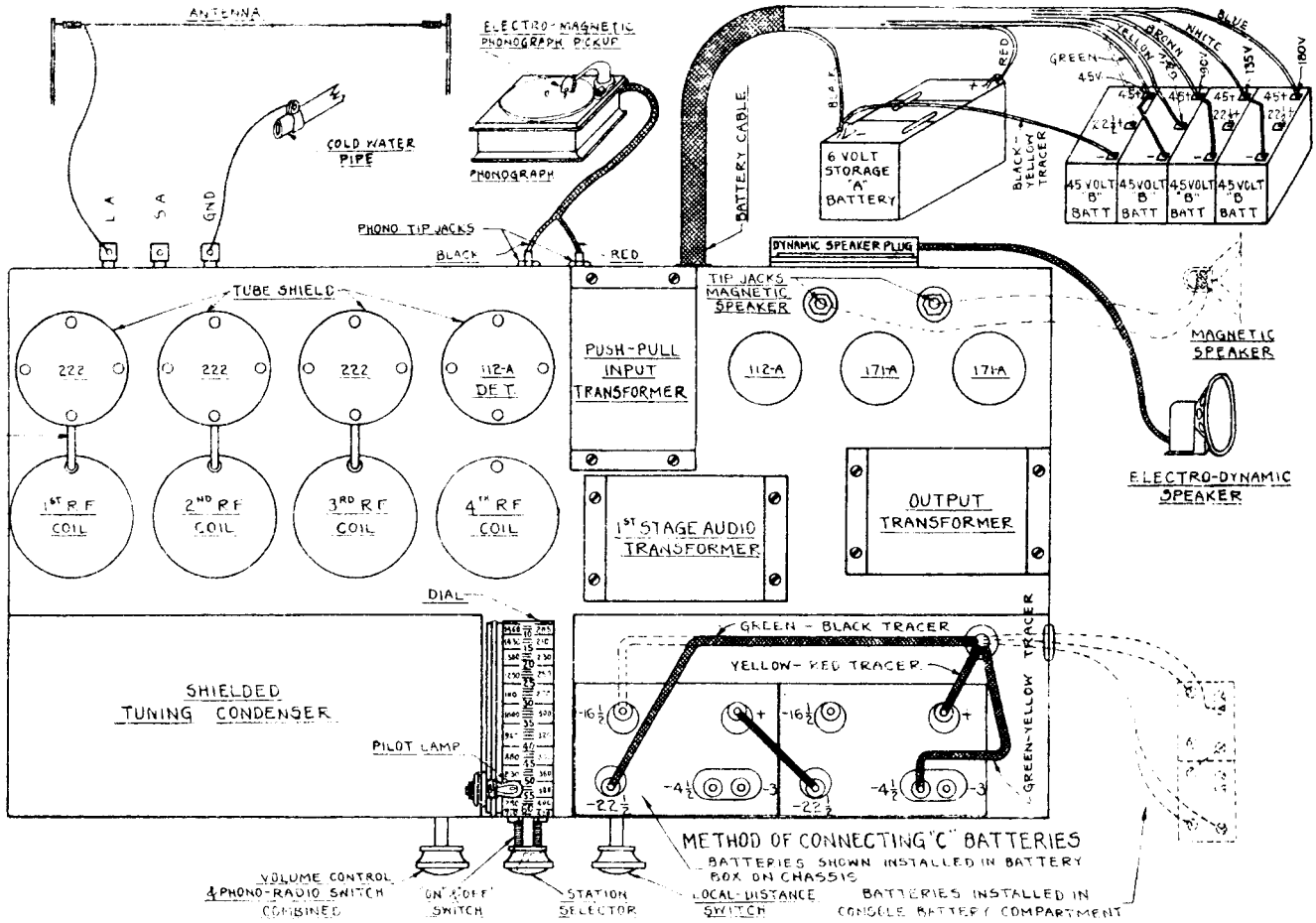


Figure 1

Showing Connections and Tube Arrangement

EQUIPMENT REQUIRED

TUBES: The following tubes are required.
Three (3) Type UX 222 or CX 322
Two (2) Type UX 112-A or CX 112-A
Two (2) Type UX 171-A or CX 371-A

SPEAKER: The Erla Power Speaker, Electro-dynamic type, model 222 is recommended. Any good magnetic type cone speaker can be used.

PHONOGRAPH PICKUP: (optional.) The use of the Erla Model P-62 Electro Magnetic Phonograph Pickup and arm is recommended. This pickup has a volume control built into its base and is easily installed on any phonograph. It makes possible the electrical reproduction of phonograph records through your receiver and loud speaker.

BATTERIES: The following batteries are required:
One (1) 6-volt storage battery (100-124 ampere hours)
Four (4) 45 Volt "heavy duty" dry B batteries
Two (2) 22½ volt dry C batteries (Burgess No. 5156)

NOTE: Only three "B" batteries may be used with somewhat reduced tone quality. Connect both blue and white leads to B + 135 and use from 22½ to 27 volts negative C.

AERIAL AND GROUND: The use of an outside antenna is not necessary under ordinary conditions. Twenty or thirty feet of insulated wire arranged in any convenient manner such as around the picture moulding or base board, or what is best, in a straight length through a hallway, is ample.

In a building of steel construction an outside antenna will be required to obtain best results. Also, in locations a considerable distance from a broadcasting station an outside antenna may be used advantageously. Generally speaking, the total length of the antenna, from the receiver to the far end, should not exceed thirty feet. However, in locations remote from broadcasting stations or where local conditions are unfavorable to radio reception a longer aerial may be used. The antenna proper must be supported by suitable glass or porcelain insulators and the use of an approved lightning arrester is recommended. An insulated flat strip window lead-in is the easiest to install.

A good ground connection is absolutely essential. A ground clamp should be attached to the nearest cold water pipe or radiator, preferably the former, first filing or sandpapering the pipe clean to insure a good electrical connection. A length of ordinary insulated wire may be used to connect the ground clamp to the ground post on the receiver.

ELECTRICAL RESEARCH LABS.

INSTALLATION

SPEAKER: In console model receivers, the Erla Power Speaker is shipped from the factory in a separate carton. Unpack carefully. To install cabinet speaker, tip forward and hang on the hooks in front over the grille. It is not fastened down but simply hung in place. (See Figure No. 3.) The table type speaker should be placed along side of receiver.

LOCATION: In determining the best place in which to put your receiver, in addition to a harmonious arrangement with the furniture, several other factors should be taken into consideration. The location should be convenient to a good ground and suitable to the connection of a satisfactory aerial, as explained above. Finally, advantage should be taken of the acoustical arrangements of the room.

INSERTING THE TUBES: All sockets are plainly marked indicating the tube to be inserted. See Figure 1. The three screen grid (222) and the detector (112-A) tubes are installed in the four shielded sockets at the left rear of the chassis, facing the front of the receiver. The thimble contact attached to the flexible lead is placed over the metal cap at the top of each screen grid tube. This connection must be made before putting the tube shields in place. The other 112-A and the two 171-A tubes are inserted at the right rear. Insert all tubes carefully, in the correct sockets, pressing them down firmly until the base rests on the socket plate.

CONNECTIONS: The aerial and ground are connected to the binding posts at the left rear of the chassis. See Figure 1. These posts are marked L. A. for long antenna, S. A. for short antenna and GRD for ground. An antenna of over thirty feet should be connected to the L. A. post and under thirty feet to the S. A. post.

If the Erla electrodynamic speaker is used the plug connects with the socket at the right rear of the chassis. It can be inserted only in one position, i. e., with the speaker cable projecting toward the right. Special provisions are made to connect a magnetic type speaker. Merely insert the two speaker cord tips into the two tip jacks at rear right hand corner of chassis alongside of power tubes. See **Figure 1.**

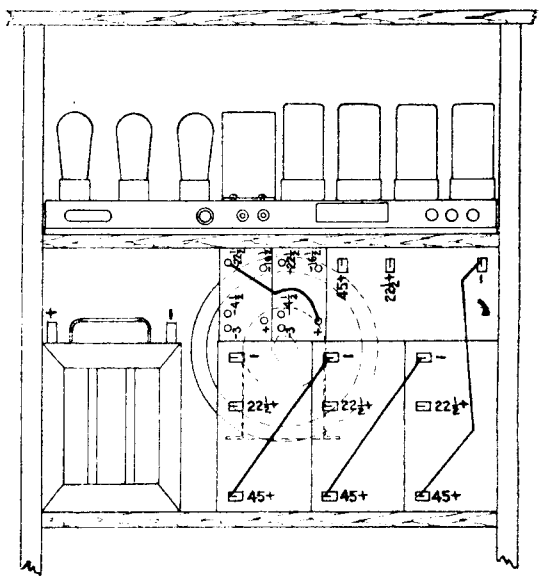


Figure 2
Showing Battery Arrangement in Console Models

CONNECTING the BATTERIES

BATTERY CABLE CONNECTIONS: See Figure 1. The leads from the battery cable are connected as follows: RED to the A battery positive terminal (A+); BLACK to the A battery negative terminal (A—); BLACK with YELLOW tracer to negative B (B—); GREEN to B plus 45 (+45); YELLOW to B plus 67½ (+67½); BROWN to B plus 90 (+90); WHITE to B plus 135 (+135) and BLUE to B plus 180 (+180). Short pieces of insulated wire must be used to connect the four B batteries in series

C BATTERY CONNECTIONS. See Figure 1. The YELLOW with RED tracer lead connects to positive C (+C); GREEN with YELLOW tracer to negative 4½ (—4½) and GREEN with BLACK tracer to negative 45 (—45). The two 22½-volt batteries must be connected with a short piece of insulated wire, run from the positive (+) of one to the negative (—) of the other. Note: In the TABLE MODEL the two C batteries are placed end to end in the metal container provided for them in the receiver, see Figure 1, and should be connected to the three leads which project up through the hole in the bottom of container.

Console Model. In the console model receiver the C batteries are not placed in the metal container. Therefore, the C battery wires are drawn through the hole on the right side of the container. The location of these batteries should be in accordance with Figure 2 where the "C" batteries are shown placed in the battery compartment.

OPERATION

TUNING CONTROLS: Study carefully and thoroughly familiarize yourself with the above diagram of the tuning controls. See Figure 4. To tune in a program:

1. Throw the ON and OFF switch to the right. The dial light should immediately glow.

2. Turn Volume Control Knob about one-half way to the right.

3. The Local-Distance Switch is to be turned to the right for maximum volume and distance and to the left for local reception of loud local stations.

4. After a suitable program has been selected, volume should be regulated with the Volume Control Knob. Always tune the station accurately with the Station Selector and regulate the volume afterwards with the Volume Control Knob.

NOTE: The station dial is graduated in wave length in meters and frequency in kilocycles. The approximate setting for any desired station may be obtained from the newspapers or magazines publishing lists of broadcasting stations and programs.

5. When through operating the set simply throw the ON and OFF switch to the left; to the OFF position. This disconnects all batteries.

USING A PHONOGRAPH PICKUP: On the back center of the chassis are two phone-tip jacks. The phonograph pickup (such as the Erla Model P-62) cord tips are inserted here and can be left connected permanently.

CAUTION: Do not ground the tone arm or cord connection. A shock may be experienced if the phonograph pickup and chassis or the ON and OFF switch are touched at the same time, which is obviously unnecessary

Turn the Volume Control Knob to the extreme left. This operates the phono-radio switch, and throws the pickup into the circuit. The set is now ready for phonograph reproduction.

ELECTRICAL RESEARCH LABS.

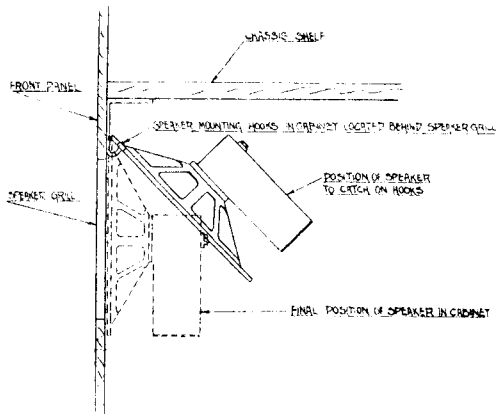


Figure 3

Showing method of mounting speaker in cabinet

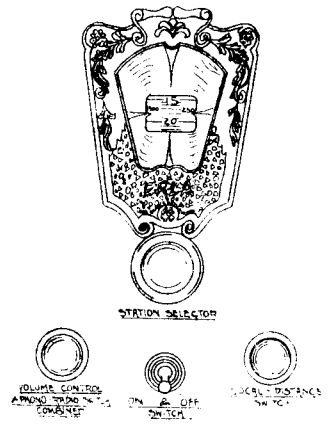


Figure 4

Showing Location of Tuning Controls

TROUBLE SHOOTING

MAINTENANCE: Owing to the careful construction and rigid factory inspection, and the fact that there are few moving parts, practically no attention is necessary. It may be well, however, to occasionally check the tubes by either taking them all out and having them tested by the dealer, or trying out new tubes one at a time in place of each in the set and noting any difference in performance, preferably on a distant station. Be careful that the ON and OFF switch is turned off when inserting or removing tubes, and that the correct type of tube is always inserted into the proper socket. An occasional inspection of the aerial, lead-in and ground connection is also advisable, all connections being carefully checked and cleaned and tightened if necessary. The dial light bulb should give service for approximately 1,000 hours. Should it burn out a replacement can be purchased from your dealer. This lamp is type-3 Miniature base 6 volts.

NOISES IN RECEPTION: NOTE: There are various possible causes for the noises which are sometimes heard in connection with broadcast reception. Some of these noises are preventable, others may be eliminated in course of time and still others are just transient, local disturbances.

1. HOWL: An unpleasant howl may be due to the detector tube. If this occurs interchanging the two 112-A tubes may eliminate the trouble. If this does not effect a remedy the detector tube must be replaced. A metal cap sometimes referred to as a microphonic howl arrester placed over the detector tube will often correct a microphonic howl.

2. BACK-GROUND NOISE: Most noises heard as "background" to broadcasting (especially when listening to a distant station, when the volume control is well advanced and the set is in a sensitive condition) are due to small electrical discharges in the atmosphere or the sparking of various electrical machinery and wiring. The latter type of disturbances are radiated from the wiring attached to the machinery and are picked up by your antenna and ground system. This can be readily proved by disconnecting the antenna and ground wires from the set, which action will cause such noises to disappear.

3. INTERMITTENT AND FRYING NOISE: A noise which is due to a poor connection or any trouble in the receiver or batteries will continue with the antenna and ground disconnected. Should there be persistent or annoying noises (other than tube noises or atmospheric static) present in reception and disappearing when the antenna and ground are disconnected, a thorough investigation of electrical machinery in the neighborhood is advised. Occasionally noises will be caused by poor contact of an electric light bulb, sparkling of an electrical motor in electrical refrigerators, etc.

4. SQUEALING: Squealing noises in reception may be caused by the operation of a regenerative type of receiver in a nearby locality. A continuous whistle on a certain dial setting is generally due to a heterodyne caused by two stations broadcasting on the same or nearly the same wave length.

5. MECHANICAL VIBRATION: If the tube shields, or the shield over the condenser, held down by four hexagon nuts, become loose a rattling or mechanical vibration may occur. This can be easily located by placing your hand on each shield individually. To tighten up the tube shields remove and bend them out. The slotted side will permit the shield to be expanded so that a forced fit can be obtained.

NO RECEPTION or WEAK SIGNALS

1. ANTENNA AND GROUND: Check antenna and ground lead-in wires to see if they are properly connected to set. Inspect outside antenna if this type of installation is in use.

2. BATTERIES: Check the storage battery with a hydrometer; B and C batteries with a voltmeter.

3. TUBES: See if the tubes are all lighted and firmly fitted in their sockets. Check the latter by pressing down gently on top of each tube.

4. SPEAKER: Note if speaker plug is properly placed in its socket.

If the above tests fail to indicate anything wrong, the difficulty should be taken up with the Erla dealer from whom the set was purchased. Should for any reason this be impossible, write to the factory giving the dealer's name and serial number of the set and we will advise you how to proceed in order to obtain the required service.

PHILCO RADIO & TELEVISION CORP.

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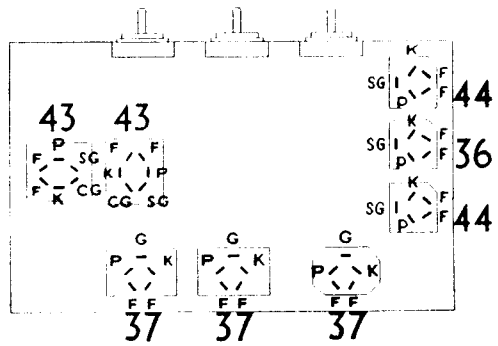
Service Bulletin—No. 131

Model 47 Series

The Philco Radio of the 47 series is an eight tube direct current (D.C.) superheterodyne, employing the high-efficiency 6.3 volt filament tubes, automatic volume control, and superpower push-pull pentode output. The chassis is made for operation on 115 volts D.C. and 230 volts D.C. The complete instrument is made in two different types, one known as the 121 code, employing a single dynamic speaker, and the other known as the 221 code employing twin dynamic speakers. These code numbers appear on the radio chassis as a part of the model number. Chassis of one code are not interchangeable with those of another. On the 230 volt models, a ballast lamp type 4 in series with one side of the power line is used on the single speaker models and a type 5 on the twin speaker models. The intermediate frequency used in adjusting the superheterodyne circuit of the 47 series is 260 kilocycles. The power consumption of the 115 volt models is 45 watts; that of the 230 volt models is 90 watts.



F = Filament SG = Screen Grid K = Cathode
P = Plate CG = Control Grid

Tube Sockets

Table 1—Tube Socket Data*—D.C. Line Voltage 115 Volts

Tube Type	Tube Circuit	Filament Volts F to F	Plate Volts P to K	Screen Grid Volts SG to K	Control Grid Volts CG to K	Cathode Volts K to F
44	R. F.	6.3	100	100	.4	40
36	Det.-Osc.	6.3	100	65	5.0	30
44	I. F.	6.3	100	100	.4	25
37	Det.-Rect.	6.3	0	....	.2	22
37	1st Audio	6.3	75	....	.4	2.
37	2nd Audio	6.3	90	....	.4	10
43	Push-Pull	25.	110	112	10.	80
43	Output	25.	110	112	10.	80
4	Ballast (121) 230 Volts	110	....	....	....	....
5	Ballast (221) 230 Volts	110	....	....	....	....

*All readings were taken from the under side of the chassis, using test prods and leads with a suitable high resistance multi-range D.C. voltmeter for all readings. Volume control at maximum and station selector turned to low frequency end.

Table 2—Resistor Data

No. on Figs. 3 and 4	Resistance (Ohms)	Color		
		Body	Tip	Dot
(39)	70 & 16		Round Tubular	
(5)	5,000	Green	Black	Red
(15)	8,000	Gray	Black	Red
(1) (30)	10,000	Brown	Black	Orange
(22) (42)	25,000	Red	Green	Orange
(26)	70,000	Violet	Black	Orange
(31)	99,000	White	White	Orange
(6) (14) (25) (34) (43)	1,000,000	Brown	Black	Green

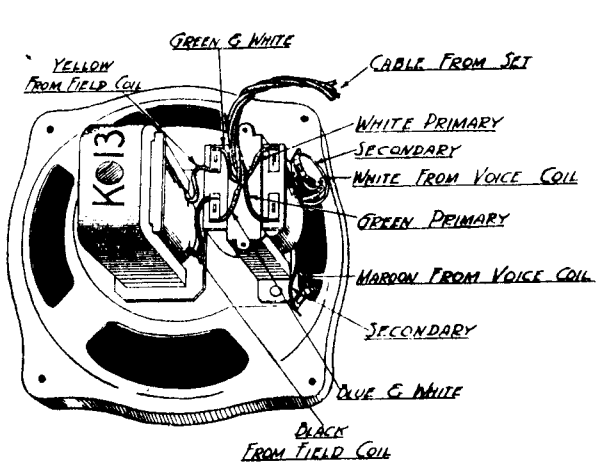


Fig. 1—Single Speaker Connections—121 Code.

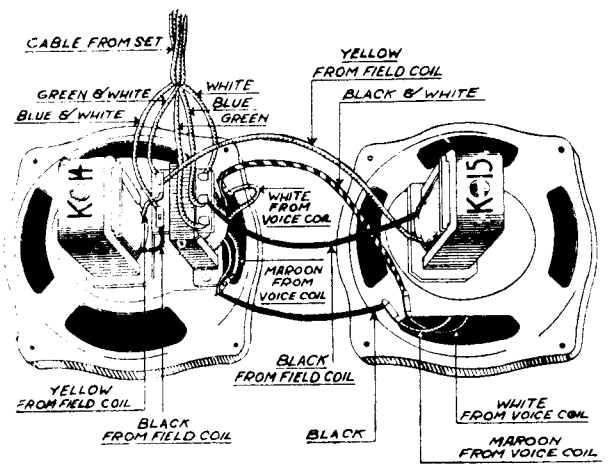


Fig. 2—Twin Speaker Connections—221 Code

PHILCO RADIO & TELEVISION CORP.

MODEL 47 SERIES

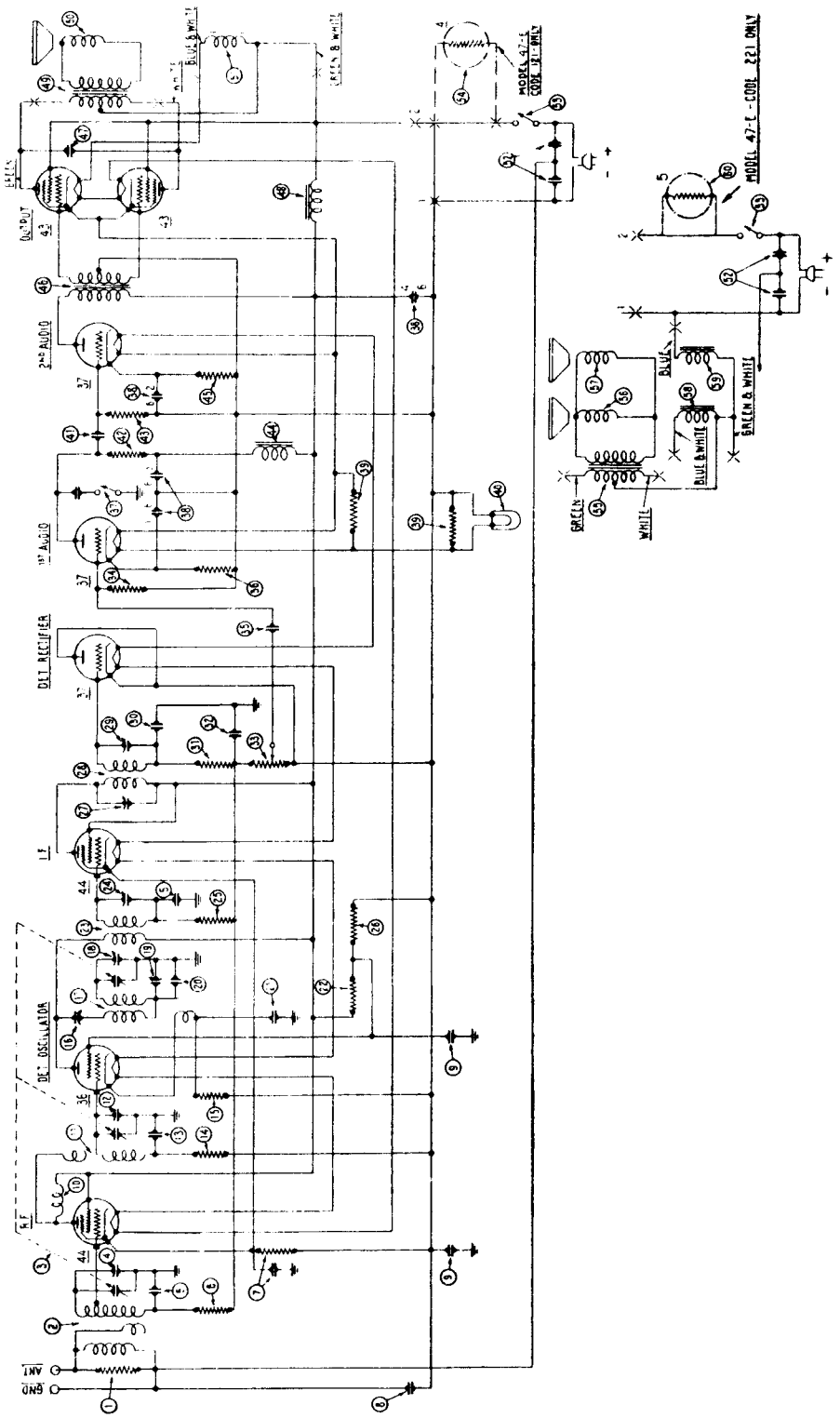


Fig. 3—Schematic Wiring Diagram

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MODEL 47 SERIES

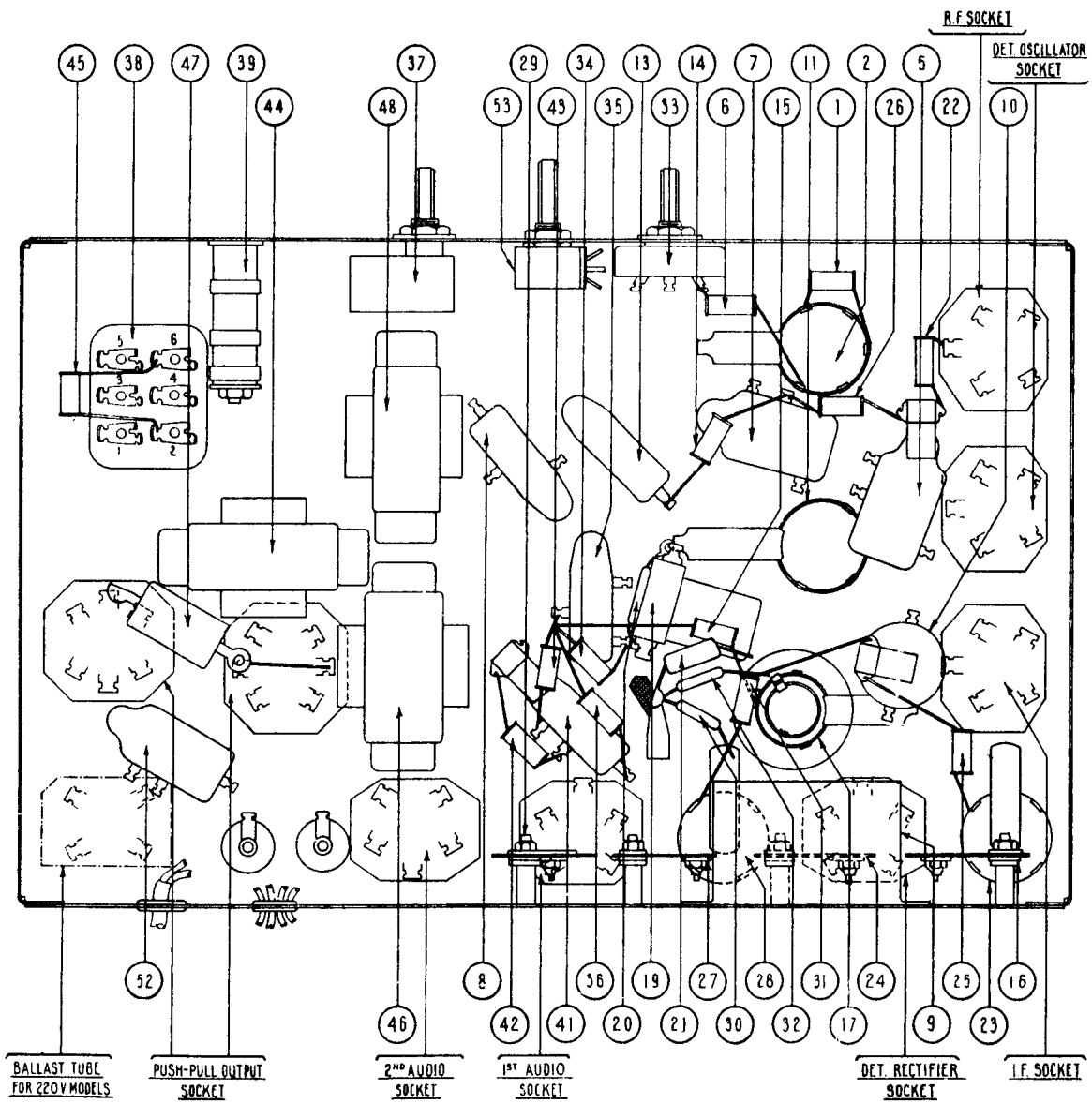


Fig. 4—Parts Diagram

Adjusting Model 47

These receivers are accurately adjusted at the factory prior to shipment. Under normal conditions it will never be necessary to re-adjust the compensating condensers. If for any reason such adjustment should be required, it should not be attempted without first receiving the proper instruction and equipment from your distributor. The Philco Model 095 Oscillator has been especially designed for use in this work and will be found the most inexpensive and most reliable for the purpose.

PHILCO RADIO & TELEVISION CORP.

PHILCO

REPLACEMENT PARTS MODEL 47

No. on Figs. 3 and 4	Description	Part No.
①	Resistor (10,000 ohms)	4412
②	R. F. Transformer	04339
③	Tuning Condenser Assembly	05098
④	Compensating Condenser—R. F. —Part of Tuning Condenser Assembly	
⑤	Condenser (.05 Mfd. Double)	3615-AF
⑥	Resistor (1,000,000 ohms)	4409
⑦	Condenser (.18 Mfd. & 200 ohm resistor)	4989-S
⑧	Condenser (.05 Mfd.)	3615-H
⑨	Condenser (.25 Mfd. Double)	05109
⑩	R. F. Choke	03103
⑪	Detector Transformer	05093
⑫	Compensating Condenser—Detector—Part of Tuning Condenser Assembly	
⑬	Condenser (.05 Mfd.)	3615-L
⑭	Resistor (1,000,000 ohms)	4409
⑮	Resistor (8,000 ohms)	5838
⑯	Compensating Condenser — 1st I. F. Primary	04000-M
⑰	Oscillator Coil	04186
⑱	Compensating Condenser—High Frequency—Part of Tuning Condenser Assembly	
⑲	Compensating Condenser—Low Frequency	04000-F
⑳	Condenser (410 Mmf.) Yellow and Orange	5120
㉑	Condenser (700 Mmf.) White and Yellow	5863
㉒	Resistor (25,000 ohms)	4516
㉓	First I. F. Transformer	05094
㉔	Compensating Condenser—1st I. F. secondary	04000-A
㉕	Resistor (1,000,000 ohms)	4409
㉖	Resistor (70,000 ohms)	5385
㉗	Compensating Condenser—2nd I. F. Primary	04000-A
㉘	Second I. F. Transformer	05095
㉙	Compensating Condenser—2nd I. F. Secondary	04000-A
㉚	Condenser (110 Mmf.) Blue and Golden Yellow	4519
㉛	Resistor (99,000 ohms)	4411
㉜	Condenser (110 Mmf.) Blue and Golden Yellow	4519
㉝	Volume Control	6499
㉞	Resistor (1,000,000 ohms)	4409
㉟	Condenser (.01 Mfd.)	3903-G
㊱	Resistor (10,000 ohms)	4412
㊲	Tone Control	04757
㊳	Filter Condenser Bank	05003
㊴	Resistor—Wire wound (70 ohms and 16 ohms)	6716
㊵	Pilot Light	6608
㊶	Condenser (.01 Mfd.)	3093-T
㊷	Resistor (25,000 ohms)	4516
㊸	Resistor (1,000,000)	4409
㊹	Filter Choke (High Resistance)	5314
㊺	Resistor (5,000 ohms)	5310
㊻	Input Transformer	6064
㊼	Condenser (.002 Mfd.) Blue	4059
㊽	Filter Choke	6712
㊾	Output Transformer — Single Speaker (K-13)	2550
㊿	Voice Coil and Cone Assembly	02823
(51)	Speaker Field Assembled with Pot (K-13)	02745
(52)	Condenser (.015 Mfd. Double)	3793-M
(53)	On-off Switch	6498
(54)	Ballast Lamp No. 4—Single Speaker	6739
(55)	Output Transformer — Twin Speaker (K-14, K-15)	2544
(56)	Voice Coil and Cone Assembly	02823
(57)	Voice Coil and Cone Assembly	02823
(58)	Speaker Field Assembled with Pot (K-14)	02745
(59)	Speaker Field Assembled with Pot (K-15)	02744
(60)	Ballast Lamp No. 5 — Twin Speaker	6740
	Tube Shield	05058
	Knob (large)	03063
	Knob (medium)	03064
	Knob (small)	03437
	Knob Spring (large)	5262
	Knob Spring (small)	4147
	Grid Clip	4897
	Four Prong Socket Assembly	5026
	Five Prong Socket Assembly	4956
	Six Prong Socket Assembly	6417
	Dial Complete	04832
	Bezel	6435
	Chassis Mounting Screw	W-468
	Mounting Washer	W-315
	Rubber Washer	5189
	Mounting Clamp	6440
	Cone Retaining Ring	2600

PHILCO RADIO & TELEVISION CORP.

Code Numbering of Philco Coils

For purposes of identification, the various coils which are used in Philco receivers are now being code marked before being shipped from the Philco National Service Station. The following is a complete list of all of these coils with the code number which is marked on the mounting bracket. The approximate D. C. resistance of the primary and secondary windings is also given to assist in servicing and also as a further aid in identification.

Code No.	Part No.	Type	D. C. Resistance		Used in Models	Key No. in Service Bulletin Diagram
			Primary	Secondary		
1	3075A	R. F.	1.5	1.9	511, 86, 87	(3)(5)(6)
2	3075B	R. F.	2.2	2.0	511, 86, 87	(2)(2)(3)
3	3506B	R. F.	.....	2.0	65	(2)
4	3506A	R. F.	Outer 6.4 / Inner 40.0	2.1	65	(7)
5	3744A	R. F.	19.6	2.2	95, 96	(3)(2)
6	3744B	R. F.	.....	2.1	95, 96	(9)(7)
7	3744C	R. F.	37	2.2	95, 96	(12)(12)
8	03345	I. F.	70	80	90 (Pentode Output) 15	(13)(8)
9	3884A	R. F.	16	7	76, 77, 40, 41	(4)(2)(5)(2)
10	3884B	R. F.	.....	6.4	76, 77, 40, 41	(13)(5)(5)(5)
11	3884C	R. F.	Outer 1.7 / Inner 45	6.2	76, 77, 40, 41	(10)(9)(14)(11)
12	3884N	R. F.	20	4.2	20, 21	(2)
13	3884P	R. F.	11	3.2	20, 21	(10)
14	3884S	R. F.	17	4.5	111, 112	(2)
15	3884T	R. F.	.....	4.5	111, 112	(5)
16	3884U	Osc.	.....	4.3	111, 112	(14)
17	3884V	R. F.	Outer 6 / Inner 30	4.4	111, 112, 15	(9)(15)
18	3884X	R. F.	20	4.2	46, 46E	(2)
19	3884Y	R. F.	11.7	4.0	46, 46E	(8)
20	4182A	R. F.	16	5.3	30	(2)
21	4182B	R. F.	Outer 2.1 / Inner 46.	5.5	30	(8)
22	03014	R. F.	.....	6.6	90 (all Models)	(5)(5)
23	03015	R. F.	18.7	6.4	90 (all Models)	(7)(7)
24	03016	Osc.	1.5	6.5	90 (all Models)	(44)(37)
25	03082	R. F.	8.8	4.3	70	(2)
26	03083	R. F.	16.4	4.3	70, 35	(6)(7)
27	03084	Osc.	1.5	6.7	70	(8)
28	03283	R. F.	24	6.5	50	(2)
29	03284	R. F.	65	6.5	50	(5)
30	03320	R. F.	9.3	4.5	35	(2)
31	03321	Osc.	2.3	7.4	35	(9)
32	03360	R. F.	10.7	6.8	90 (Pentode Output)	(2)
33	03013	R. F.	9.2	6.5	90 (45's Output)	(2)
34	03009	R. F.	68	68	90 (all Models), 35	(13)(10)(17)
35	03038	I. F.	68	68	111, 112, 15	(25)(29)
36	03039	I. F.	6.2	70	111, 112	(31)
37	03040	I. F.	95	65	111, 112	(37)
38	03091	I. F.	27.5	27.5	70	(19)
39	03092	I. F	74	55	70, 35	(22)(20)
40	03143	I. F.	70	82	90 (45's Output)	(18)
41 / 42	03734	R. F.	.....	.....	4, 470, 490	(1)(16)
43	03880	R. F.	Outer 3.0 / Inner 25.	6.5	51	(2)
44	03881	R. F.	26	6.2	51	(5)
45	03882	Osc.	Outer 6.8 / Inner 4.5	5.0	51	(8)
46	03887	I. F.	160	155	51	(12)
47	03886	I. F.	160	160	51	(16)
48	03263	I. F.	76	55	270	(22)
49	04317	R. F.	Inner 24. / Outer 3.3	6.6	90D, 91	(2)(2)
50	04409	R. F.	92	5.8	90D, 91	(8)(12)
51	04408	Osc.	Inner 4 / Outer 5.2	3.7	90D, 91	(12)(19)
52	04319	I. F.	67	67	90D, 91	(18)(25)
53	04320	I. F.	55	55	90D, 91	(24)(31)
54	04339	R. F.	Inner 10.9 / Outer 2.2	4.0	47, 70B, 71	(2)(2)(2)
55	04185	R. F.	.....	3.8	70B, 71	(2)(9)
56	04186	Osc.	Inner 4.7 / Outer 8.6	4.8	47, 70B, 71	(17)(15)(13)
57	04190	I. F.	55	55	70B, 71	(22)(9)
58	04348	R. F.	25	6.6	7	(2)
59	04508	R. F.	Inner 5. / Outer 5.3	4.2	7	(9)
60	04981	R. F.	17	4.3	15	(2)
61	04982	R. F.	.....	.....	15	(7)
62	04983	Osc.	3.4	4.2	15	(19)
63	04979	I. F.	68	2.2	15	(30)
64	05093	R. F.	.....	.....	47	(11)
65	05094	I. F.	.....	.....	47	(23)
66	05095	I. F.	80	75	47	(28)
67	04352	I. F.	160	150	7	(17)
68	04353	I. F.	160	150	7	(22)

PHILCO RADIO & TELEVISION CORP.

Parts Information on 25 Cycle Models

Model 71-121

Referring to Service Bulletin Number 128, use (51) power transformer 6455. Change (53) electrolytic condenser (6 Mfd.) to 8 Mfd. 6707. Change (56) electrolytic condenser (6 Mfd.) to 8 Mfd. 6706.

Model 71-221

Referring to Service Bulletin Number 128, use (51) power transformer 6458. Change (53) electrolytic condenser (8 Mfd.) 6707 to 10 Mfd., 6893. Change (56) electrolytic condenser (8 Mfd.) 6706 to 10 Mfd., 5142.

Model 91-121

Referring to Service Bulletin Number 129, use (54) power transformer 6555. Change (55) electrolytic condenser (6 Mfd.) 4916 to 10 Mfd., 5142. Change (57) electrolytic condenser 4916 to 14 Mfd. 5725. Change (66) condenser (.18 Mfd.) 4989K to .5 Mfd., 05150. Change (40) resistor (25,000 ohms) 4516 to 51,000 Ohms, 4518. The physical positions of (55) and (57) are interchanged, although their electrical connections remain the same.

Model 91-221

Referring to Service Bulletin Number 129, use (54) power transformer 6805. Change (40-A) B. C. Resistor 6807 to 6808. Change (55) electrolytic condenser (8 Mfd.) 6707 to 10 Mfd. 5142. Change (57) electrolytic condenser (8 Mfd.) 6706 to 14 Mfd. 5725. Change (40) resistor (25,000 ohms) 4516 to 51,000 ohms, part 4518. Change (66) condenser (.18 Mfd.) 4989K to .5 Mfd. and .75 Mfd. 05213. The .5 Mfd. section takes the place of 4989K and the .75 section (white wire) is connected to the blue and white lead of the speaker cord. The physical positions of (55) and (57) are interchanged, although their electrical connections remain the same.

Model 15

Referring to Service Bulletin Number 130, use power transformer, part 6673. Change (68) electrolytic condenser 6 Mfd. 6707 to read 8 Mfd. 6707. Change (70) electrolytic condenser 6 Mfd. 6706 to 8 Mfd. 6707. (69) condenser .18 Mfd. not used. Change (33) filter condenser 03489 to part 05302. This new condenser contains the following capacities: .015, .5, .75, 1., 2-1.5 Mfd. The sections between terminals 2-6 and 4-6 are both raised from .5 Mfd. to 1.5 Mfd. The .75 section is brought out with two rubber covered leads, and connects across the filter choke (67) in place of the .18 Mfd. condenser (69) which was removed.

Auto Radio Hints

There are still a few installation men who have an occasional job on which they cannot get rid of all motor noise. Usually this is caused by the distributor. The high tension terminals or contacts are not lined up perfectly due to shrinkage or warping of the head or to wear in the distributor gears. The rotor may strike a few of the contacts and miss the rest.

When peening a rotor under such conditions, the best plan is to chalk the contacts or terminals and then after the rotor has been carefully peened, turn over the motor a few times with the ignition turned off. Remove the distributor head and examine the chalked terminals. If the rotor has cut the chalk on a few of the contacts, these contacts should be scraped down with a hard sharp tool and the rotor again peened.

This procedure should be carried on until the rotor just traces a line through the heavy chalk layer on all the contacts. Obstinate cases of interference can be eliminated this way.

WESTON ELECTRICAL INSTRUMENT CORP.

Adapters for Weston Model 555

Type	Adapter Number	Minimum MA.	Readings Change
'32	19294	2.8	1
'33	19625	10	13
'34	19294	4	6
'36	none req'd	3	4.5
'37	none req'd	4	4
'38	none req'd	7	3
'41	#42	8	4
'42	#42	8	4
'44	none req'd	7	3

Above 3 tubes tested at 5 volts.

Type	Adapter Number	Minimum MA.	Readings Change
'46	19625	10.5	7
'47	19625	10.5	7
'56	none req'd	5	6
'57	#57	.5	2
'58	#57	.5	2
G-2	#2	3.5 per plate	
'80	J-10457	Same as other plate	
'82	#82	7.5 per plate	
'83	#82	7.5 per plate	

Adapters for Weston Model 565 Test Set Used as a Tube Checker

(Minimum readings on 20 MA. scale)

Type	Filament Voltage	Grid Test Button Up	Grid Test Button Down	Adapter Number
'00A	5.0	1.5	5.0	
'01A	5.0	4.5	8.5	
'10	7.5	5.0	10.0	
'12A*	5.0	2.5	4.0	
'20	3.3	7.0	8.0	
'22	3.3	4.0	7.5	D-65080 or ND-19294
'24	2.5	4.0	7.5	D-65080
'26	1.5	5.5	8.5	
'27	2.5	5.0	8.0	
'30	2.0	3.8	7.0	
'31	2.0	10.0	15.0	
'32	2.0	5.5	6.2	D-65080 or ND-19294
'33*	2.0	1.9	2.4	ND-19625
'34	2.0	4.5	6.5	D-65080 or ND-19294
'35	2.5	4.2	8.5	D-65080
'36	6.3	4.5	10.0	D-65080
'37	6.3	4.4	8.1	
'38*	6.3	5.9	8.5	D-65080
'39	6.3	4.0	6.5	D-65080
'40	5.0	.5	4.5	
'41*	6.3	3.0	4.5	D-65080 or #42
'42*	6.3	3.1	4.7	D-65080 or #42
'44*	6.3	2.0	3.3	D-65080
'45*	2.5	3.5	5.0	
'46*	2.5	2.2	2.9	ND-19625
'47*	2.5	3.0	4.5	ND-19625
'50*	7.5	4.0	5.5	
'56	2.5	5.7	10.0	
'57	2.5	3.5	9.0	#57
'58	2.5	5.9	10.0	#57
'71A*	5.0	5.0	6.5	
'80*	5.0	10.0	.....	J-10457
'81*	7.5	11.0	.....	
'82*	2.5	7.5 per plate		#82
'83*	5.0	7.5 per plate		#82
'99	3.3	2.8	3.5	

* For these power tubes set MA. toggle switch to 100 but read on 20 scale. '22-'32-'34 tube D-65080 is placed in UY socket and ND-19294 in UX socket, tube is placed in ND-19294 with clip from D-65080 to top of tube.

Testing Special Tubes—General Notes

The Philco No. 43 tube has a 25 volt filament and accordingly cannot be tested on the commercial devices without some special means for filament supply.

It should be noted that testing the 6.3 volt tubes on 5 volts, as is necessary in the older models not having a tap for the former voltage, may give results at variance with the table. Tests on rated voltage as in more recent models are of course more representative.

Data on the more complicated diodes and other coming types will be made available just as soon as equipment is made available to test them, and when a sufficient number have been tested to establish an average.

Adapters for Jewell Patterns 199 and 444 and Weston Models 547, 565 and 566 Analyzers

Adapters numbered 70161 and 70162, popularly known as the No. 61-62 adapter set, when used as a unit, will allow the testing of 6 prong tubes in these analyzers provided they are equipped with the 5 prong plug and cord arranged for a control grid cap. Model 547 which carried a 4 prong plug may be considered as a 5 prong arrangement since the 5th terminal was brought out in its center. When using the adapter set with this arrangement, the 5 prong adapter will be placed on the plug and then the adapter set will be attached. Pattern 199 and Model 547 Analyzers were not equipped with the latch type lock used at present and it will, therefore, be necessary to cut off the latching pin on this adapter set when it is used with these older models.

Pattern 199 Analyzers with Serial Numbers under 10,006 without control grid leads are not adaptable to this arrangement unless they have been revised to take care of screen grid tubes. Neither are any analyzers suitable for this work if equipped only for 4 prong testing. Such analyzers dated back to before the middle of 1928.

This adapter set is very simple to use, one end being placed over the plug and the other in the analyzer socket, the loose lead bringing over the excitation to the 6th prong. This lead is split and its potential may be measured to the contact in the cord, or, in the case of the Pattern 444 and Model 565, these may be plugged into the jacks marked "Pentode Grid". List price per set of adapters—$3.00.

WESTON ELECTRICAL INSTRUMENT CORP.

Weston and Jewell Adapters for New Type Tubes

Many new tubes with new bases, new electrode arrangements, and new pin connections have been announced in the last few months. While these tubes are, in some cases, radically different from anything previously used, they still function as electron tubes. Adapters can therefore be supplied to test them. These are listed below along with expected readings on various types of tube testers.

In making a test be sure to refer to the table covering the particular tube checker being used and to the line in the table giving values for the tube being tested. The adapter (if required) should be plugged into the socket referred to, the filament voltage selector switch set where this is required, the tube placed in the adapter, and such cap connections made as are provided for. The tester should then be manipulated as for a normal tube of the general type being tested, rectifier tubes being tested on the high ranges. Detailed instructions are given where required.

Adapters for Jewell Pattern 209

Tube	Adapter Number	Socket	Readings MA.	Test	Tube	Adapter Number	Socket	Readings MA.	Test
'33	J-11385	'26	8.7–16.2	2.8–5.2	'46	J-11385	'45	7.0–13.0	3.5–6.5
'34	none req'd	'26	0.0– 0.3	1.2–1.8	'47	J-11385	'45	7.0–13.0	3.5–6.5
'35–51	none req'd	'24	0.1– 1.4	0.8–1.9	'56	none req'd	'24	4.9– 7.0	4.5–6.0
'36	J-8684	'00A	0.3– 0.4	0.8–1.6	'57	‡ 57	'24	0.0– 0.8	1.8–3.4
'37	J-8684	'00A	3.5– 6.5	2.0–3.6	'58	‡ 57	'24	0.0– 0.5	1.4–2.6
'38	J-8684	'00A	1.0– 2.0	0.7–1.3	'80	J-10457	'80	Same as other plate	
'39	J-8684	'00A	0.0– 0.5	1.2–2.0	'82	‡ 82	'45	19.0–26.0	.....
'41	‡ 42 and J-8684	'00A	0.0– 1.0	1.0–2.0	'83	‡ 82	'00A	19.0–26.0	.....
'42	‡ 42 and J-8684	'00A	0.0– 1.0	1.0–2.0	GA	J-11385	'00A	6.5–12.0	3.0–5.0
'44	J-8684	'00A	0.0– 1.0	1.0–2.0	G-2	‡ 2	'24	1.5– 3.0	.....

Adapters for Jewell Patterns 210 and 214, Serial Nos. Below 1232

Tube	Adapter Number	Filament Volts	Reading Units	Tube	Adapter Number	Filament Volts	Reading Units
'33	J-11385	2.0	52	'44	none req'd	6.3 or 5.0	26
'34	none req'd	2.0	31	'46	J-11385	2.5	75
'35–51	none req'd	2.5	30	'47	J-11385	2.5	75
'36	none req'd	6.3 or 5.0	36*	'56	none req'd	2.5	52
'37	none req'd	6.3 or 5.0	36	'57	‡ 57	2.5	52
'38	none req'd	6.3 or 5.0	35	'58	‡ 57	2.5	52
'39	none req'd	6.3 or 5.0	30	'82	‡ 82	2.5	35†
'41	‡ 42††	6.3 or 5.0	40	'83	‡ 82	5.0	35†
'42	‡ 42††	6.3 or 5.0	37				

* If no 6.3 volt tap is available, readings may be somewhat low on 5 volt tap.
† Hold down 100 MA. button.
General—Unit reading is subject to a 30% variation on the Pattern 210, and on Pattern 214, Serial Nos. below 1232, the same would apply.
†† Attach control grid lead to cap on adapter, and plug in tester.

Adapters for Jewell Pattern 214, Serial Nos. Above 1232 and Pattern 538

Tube	Adapter Number	Filament Volts	Socket	Reading	Tube	Adapter Number	Filament Volts	Socket	Reading
'34	none req'd	2.0	4 prong regular	Same as '32	'56	none req'd	2.5	5 prong regular	Same as '47
'39	none req'd	6.3	5 prong regular	Same as '37–'38	'57	‡ 57	2.5	5 prong regular	Same as '47
'41	‡ 42†	6.3	5 prong regular	Same as '71A	'58	‡ 57	2.5	5 prong regular	Same as '71A
'42	‡ 42†	6.3	5 prong regular	Same as '45	*'82	‡ 82	2.5	4 prong regular	Same as '01A
'44	none req'd	6.3	5 prong regular	Same as '24	*'83	‡ 82	5.2	4 prong regular	Same as '01A
'46	none req'd	2.5	'33–'47	Same as '47					

* Hold down rectifier button.
† Attach control grid lead to cap on adapter, and plug in tester.

Adapters for Jewell Patterns 533 and 336

Tube	Adapter Number	Socket	Reading	Tube	Adapter Number	Socket	Reading
'34	none req'd	'32	Same as '32	'56	none req'd	'27	Same as '47
'39	none req'd	'38	Same as '37–'38	'57	‡ 57	'24	Same as '47
'41	‡ 42	'38	Same as '71A	'58	‡ 57	'24	Same as '71A
'42	‡ 42	'38	Same as '45	'82	‡ 82	'45	Same as '01A*
'44	none req'd	'38	Same as '01A	'83	‡ 82	'01A	Same as '01A*
'46	none req'd	'47	Same as '47				

* Hold down rectifier test button.

WESTON ELECTRICAL INSTRUMENT CORP.

Adapters for Jewell Pattern 540, Serial Nos. below 1899

Tube	Adapter Number	Filament Volts	Socket	Reading
'34	none req'd	2.0	4 prong regular	Same as '32
'39	none req'd	6.3	5 prong regular	Same as '37–'38
'41	‡ 42	6.3	5 prong regular	Same as '71A
'42	‡ 42	6.3	5 prong regular	Same as '45
'44	none req'd	6.3	5 prong regular	Same as '01A
'46	none req'd	2.5	'33–'47	Same as '47
'56	none req'd	2.5	5 prong regular	Same as '47
'57	‡ 57	2.5	5 prong regular	Same as '47
'58	‡ 57	2.5	5 prong regular	Same as '71A
'82	‡ 82	2.5	4 prong regular	Same as '01A*
'83	‡ 82	5.0	4 prong regular	Same as '01A*

* Hold down rectifier test button.

Adapters for Jewell Patterns 535 and 536

A complete new set of readings on these patterns is given below, because of revisions in test limits of many of the older tubes. The new limits should be used and marked on the cards carrying the tube designations.

Tube Type	Adapter Number	Socket	Button Color and Number	Readings MA.	Readings Minimum Test
'01A			Maroon 1	12–32	20
'10			Orange 2	25–55	6
'12A			Orange 2	6–13	10
'20			Maroon 1	15–45	7
'22			Maroon 1	6–36	9
'24			Maroon 1	20–50	29
'26			Orange 2	13–22	7
'27			Orange 2	12–22	9
'30			Maroon 1	14–26	16
'31			Orange 2	34–62	6
'32			Maroon 1	19–36	12
'33			Orange 2	28–51	7
'34	None	32	Orange 2	8–30	3.5
'35			Maroon 1	20–44	13
'36			Maroon 1	16–34	28
'37			Orange 2	13–24	8
'38			Orange 2	18–34	7
'39	None	38	Maroon 1	18–50	26
'41	‡ 42	38	Orange 2	20–50	11
'42	‡ 42	38	Orange 2	20–50	10
'44	None	38	Orange 2	8–30	6
'45			Green 3	32–62	5
'46	None	47	Green 3	25–70	5.5
'47			Orange 2	35–62	12
'50			Green 3	20–60	4
'55	‡ 55	27	Orange 2	8–30	11
'56	None	27	Orange 2	7–25	11
'57	‡ 57	24	Maroon 1	4–15	33
'58	‡ 57	35	Maroon 1	18–38	19
'71A			Orange 2	40–70	10
'90			Maroon 1	11–34	22
'80			Green 3	Min. 40	
'81			Green 3	Min. 34	
'82	‡ 82	See Note	Green 3	Min. 28	
'83	‡ 82	*80	Green 3	Min. 30	

NOTE: To test the 82 mercury vapor rectifier tube in the Pattern 535 or 536 it is necessary to wire a socket for it, since rectifier plate test voltage is not brought to a socket having a 2.5 volt filament.

On the Pattern 535, take off the back plate and connect a wire from the left-hand upper (plate) terminal of the 80 socket to the left-hand upper (plate) terminal of the 4 prong spare socket directly below the 47 socket. This spare socket already has 2.5 volts applied to it. The 82 adapter may then be plugged into this spare and tests made directly.

To arrange a spare socket in the Pattern 536 for the 82 tube it is necessary to wire the filament terminals of a 4 prong spare socket in parallel with the filament terminals of the adjacent 45 socket. A wire should then be run from the lower right-hand (plate) terminal of the 81 socket to the lower right-hand (plate) terminal of the spare socket. The 82 adapter may then be plugged into this socket for testing the 82 tubes.

* In the Pattern 535, in testing the 83 tube, plug the 82 adapter in the right-hand 80 socket in order to bring up potential on the proper terminals.

Special Adapters for Pattern 675

While the Pattern 675 will take care of all tubes announced at the May 1932 Trade Show and probably all tubes which will be in large production for the ensuing year, there are a few tubes which will be used in unknown quantity that may be considered as special and which require adapters.

Tube Type	Adapter Number	Socket	MA.	Test
Philco '41	‡ 42	38	6.6–12	2.6–4.2
Philco '42	‡ 42	38	6–11	2.6–4.2
Philco '44	None	38	3.6– 6.4	2.0–3.4
Philco '83	‡ 82	RP80	21.0–35.0	— —

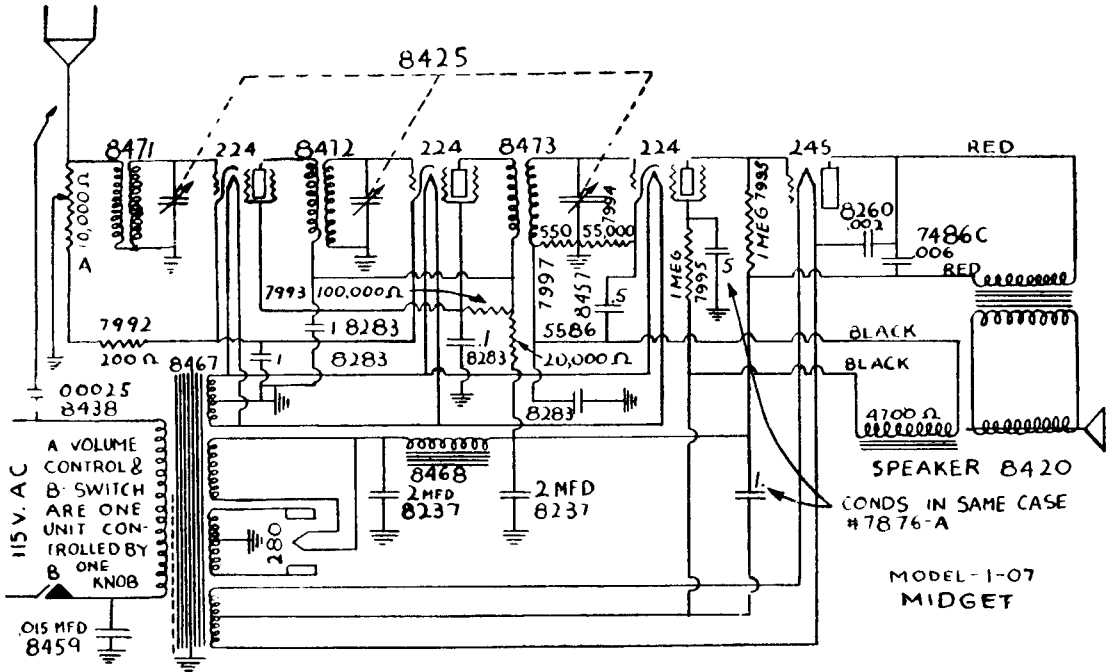
Adapters for Weston Model 533

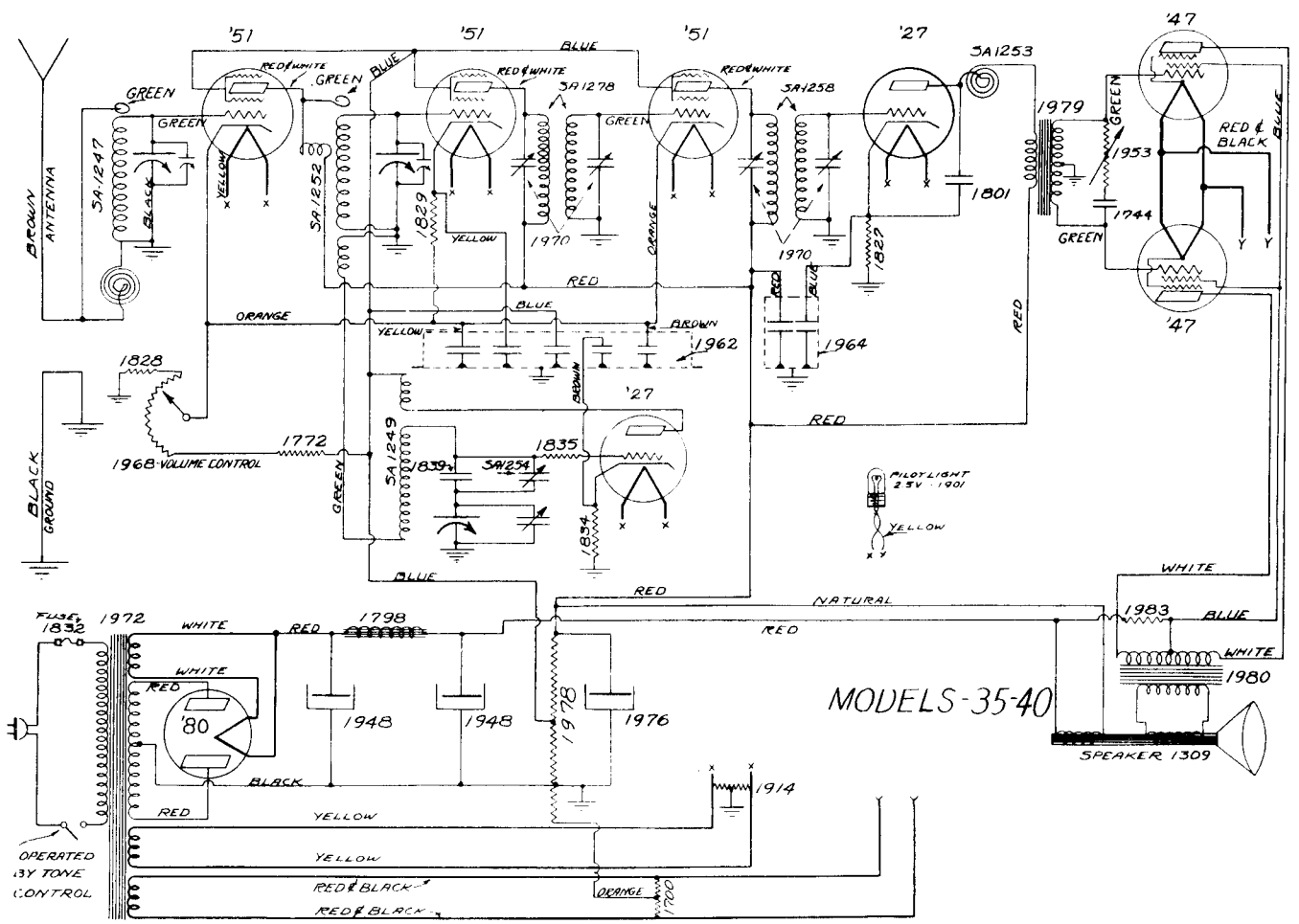
Type	Adapter Number	Minimum MA.	Readings Change
'32**	19294	2.5	1
'33**	19625	8	1
'34**	19294	4.5	.8
'36***	65080	4.5	3.5
'37***	none req'd	5	4
'38***	65080	8	3.5
'39***	65080	5	3.5
'41***	65080 and ‡ 42	6	4
'42***	65080 and ‡ 42	6	4
'44***	65080	5	3
'46	19625	10	7
'47	19625	10	7
'56	none req'd	4.8	6
'57	‡ 57	.1	2
'58	‡ 57	.5	2
G-2	‡ 2	3.5 per plate	
'80	J-10457	Same as other plate	
'82	‡ 82	30 per plate	
'83	‡ 82	30 per plate	

** Reading taken with filament at 1.5 volts and voltage adjuster set three points high.

*** Tested with filament at 5 volts.

FEDERATED PURCHASER





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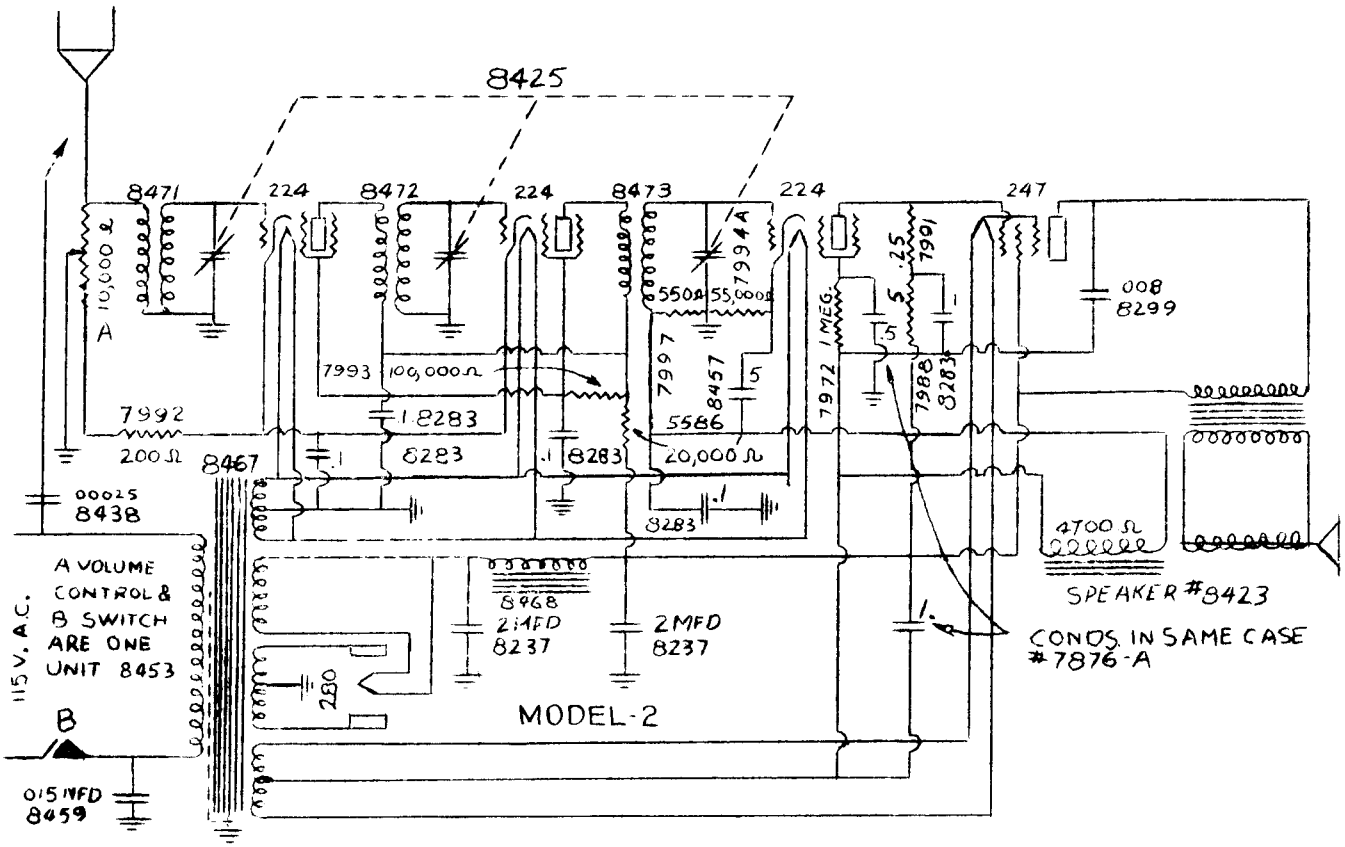
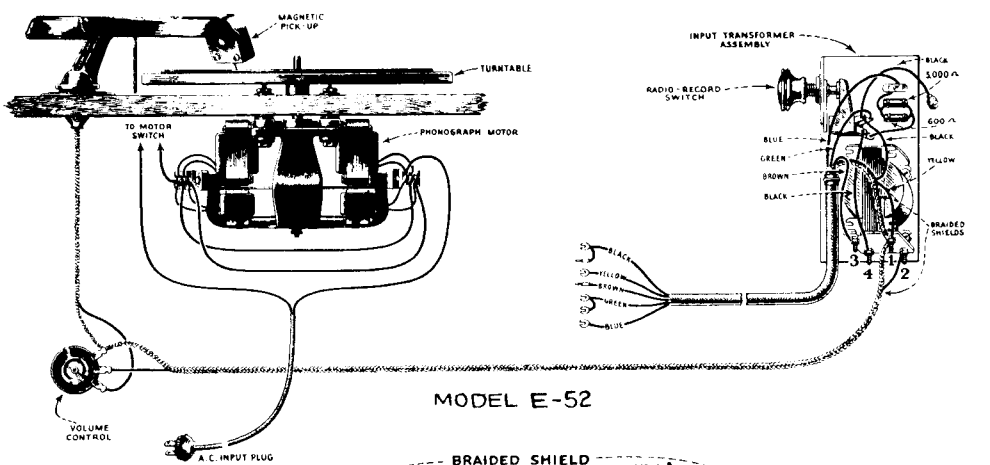
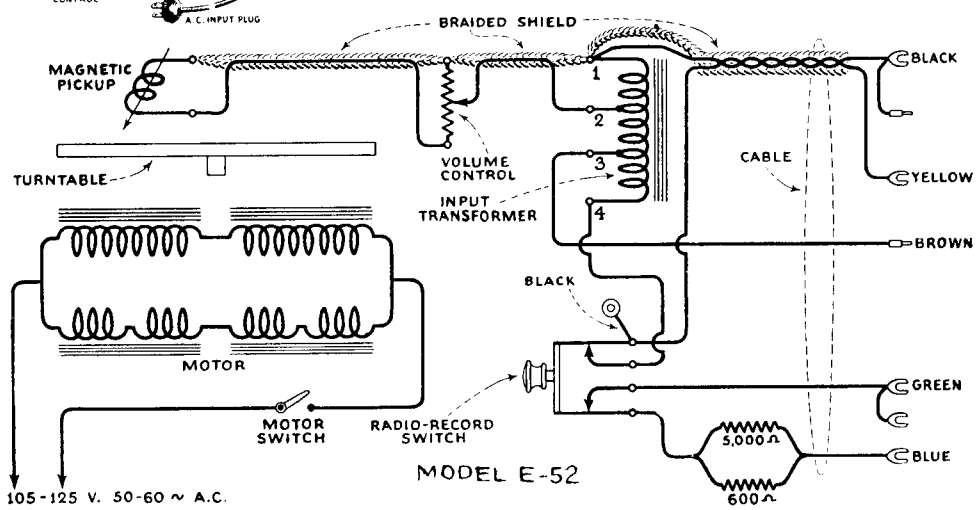


GENERAL ELECTRIC CO.





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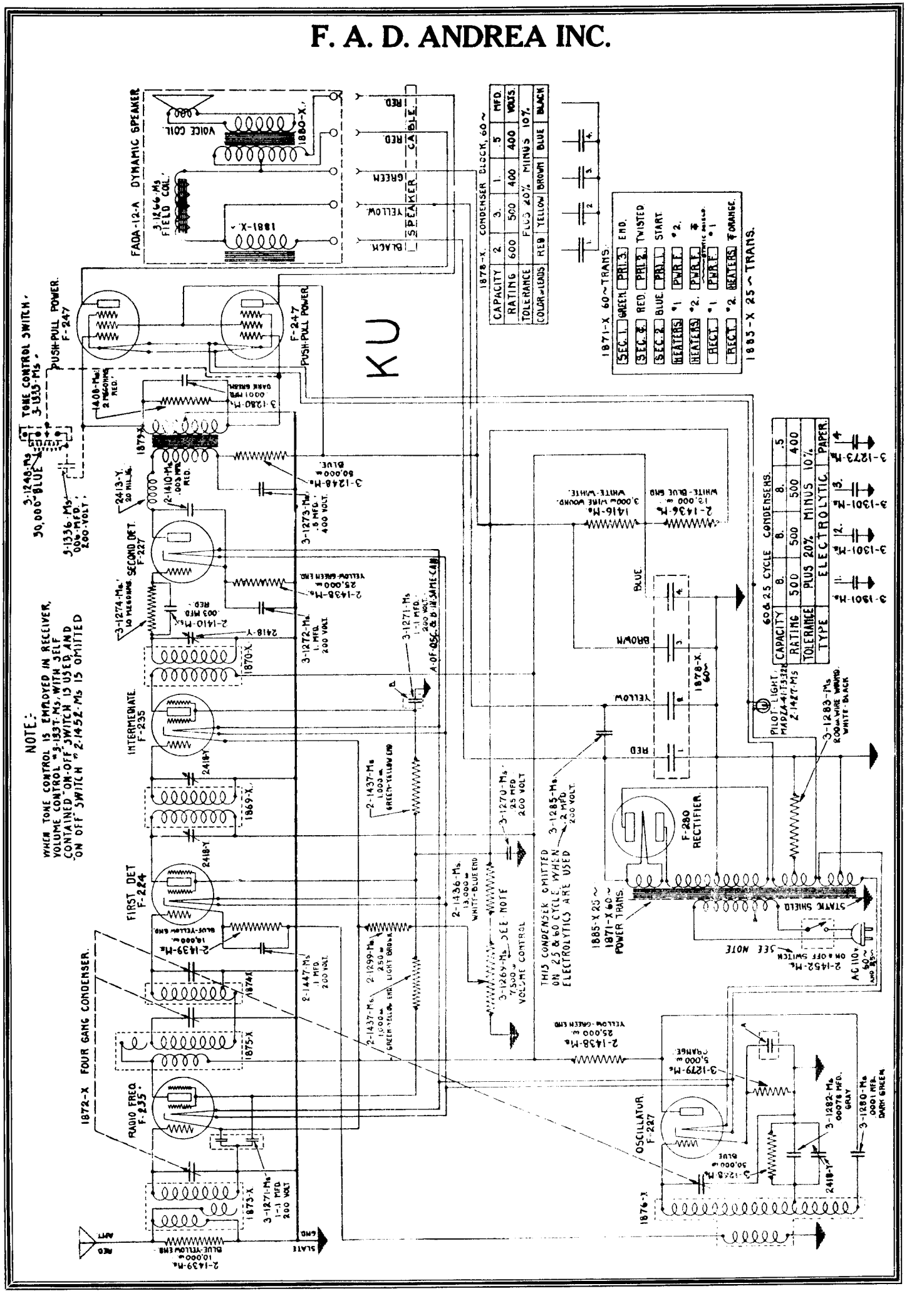

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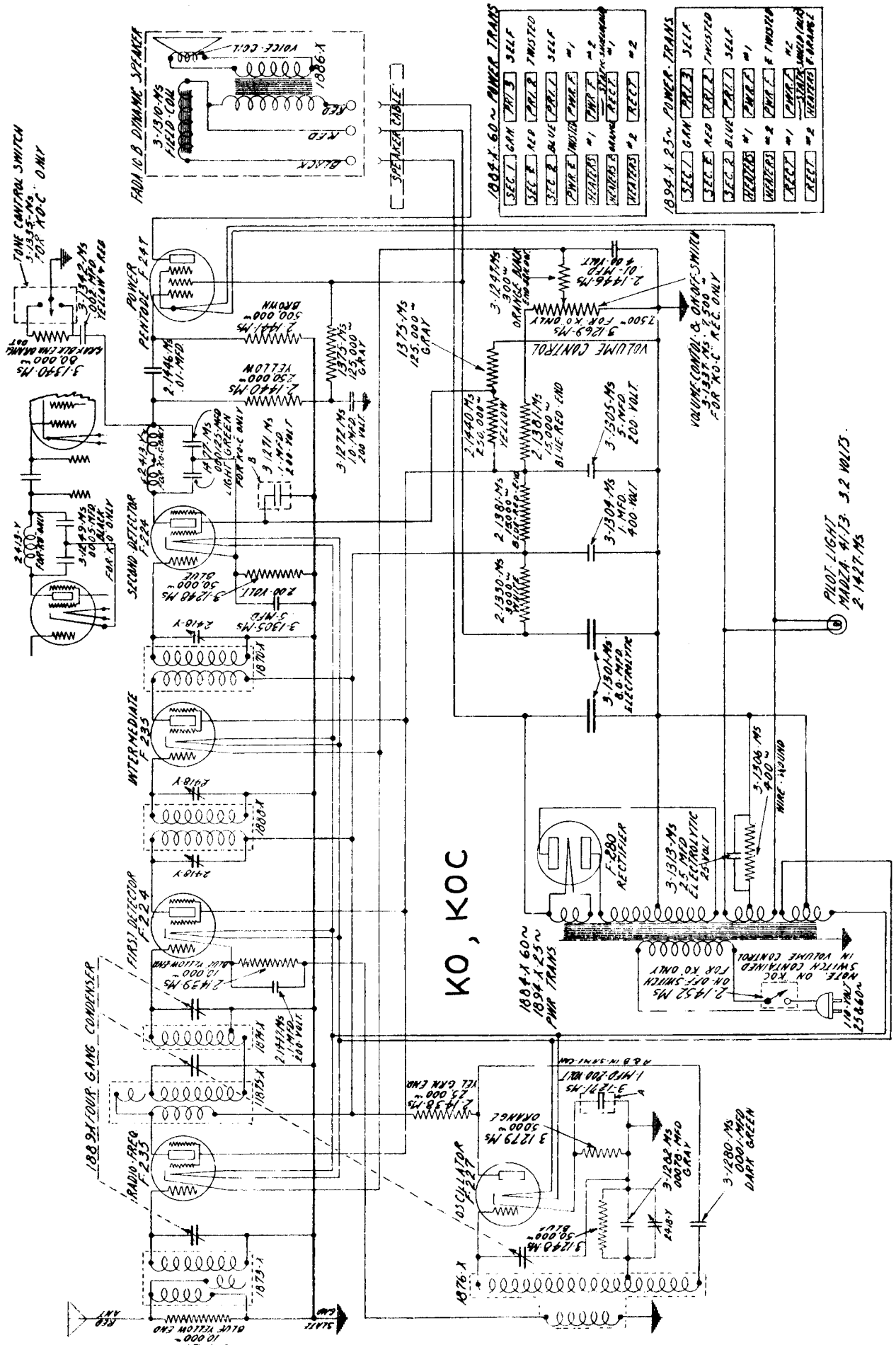

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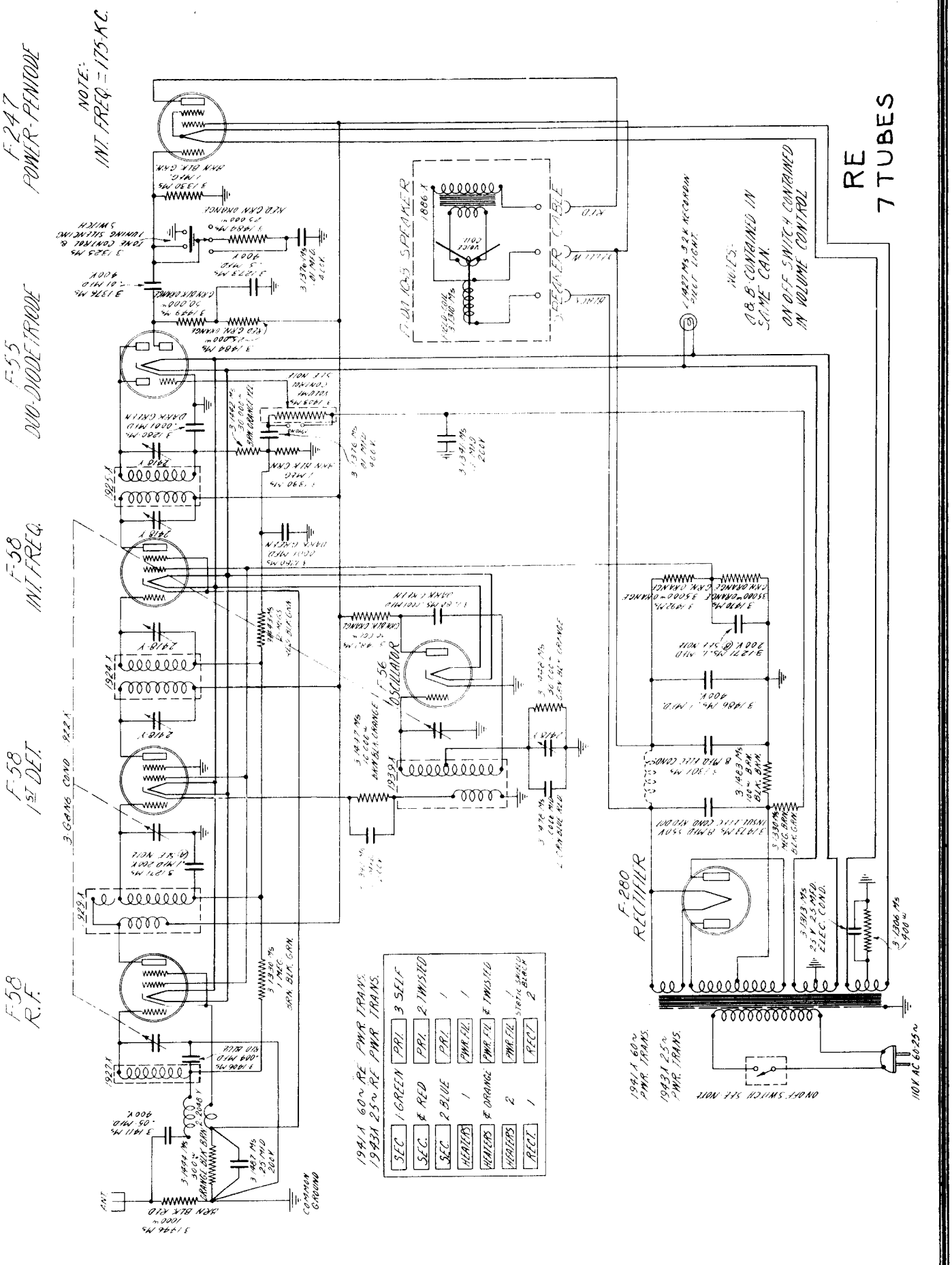

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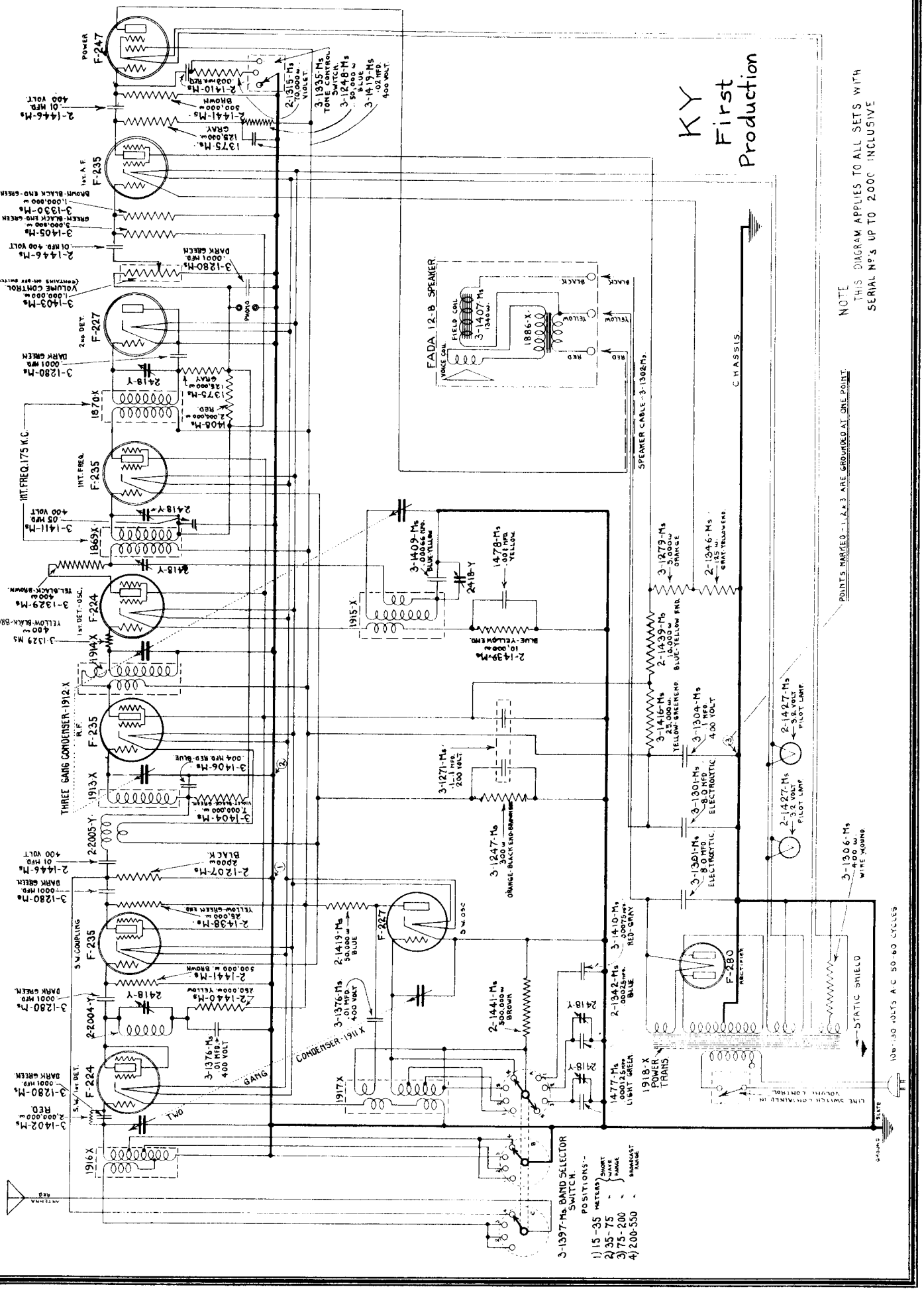

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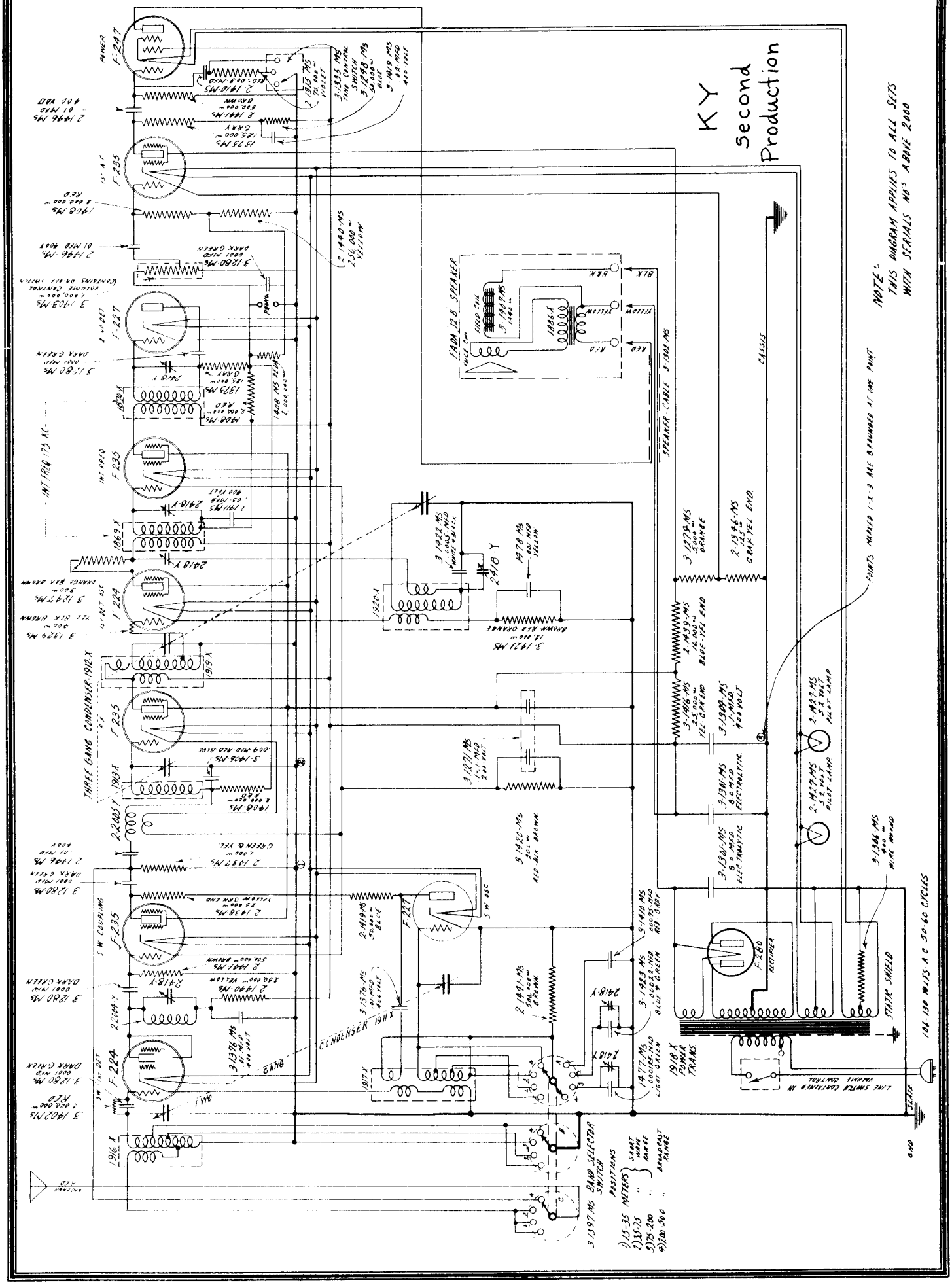

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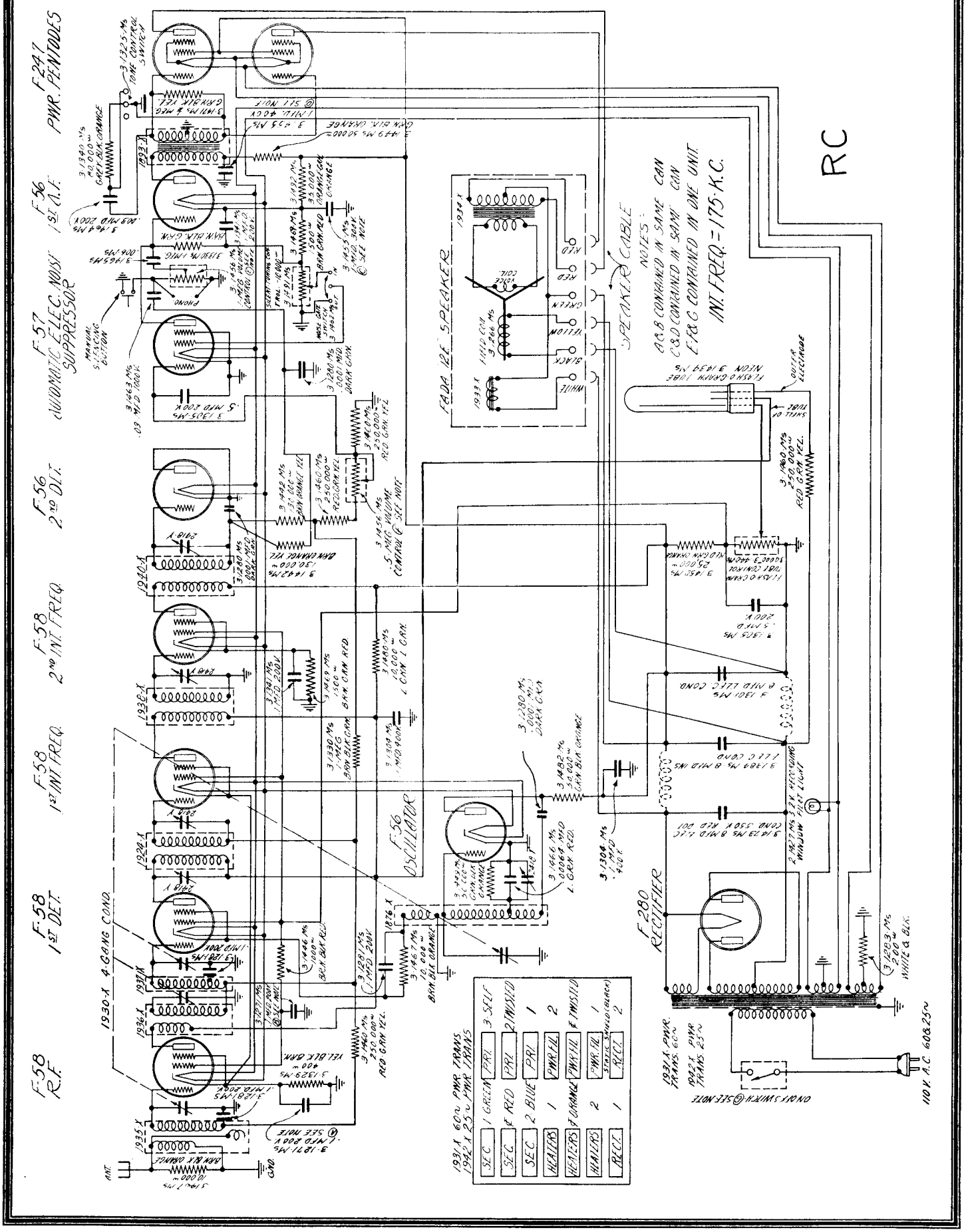

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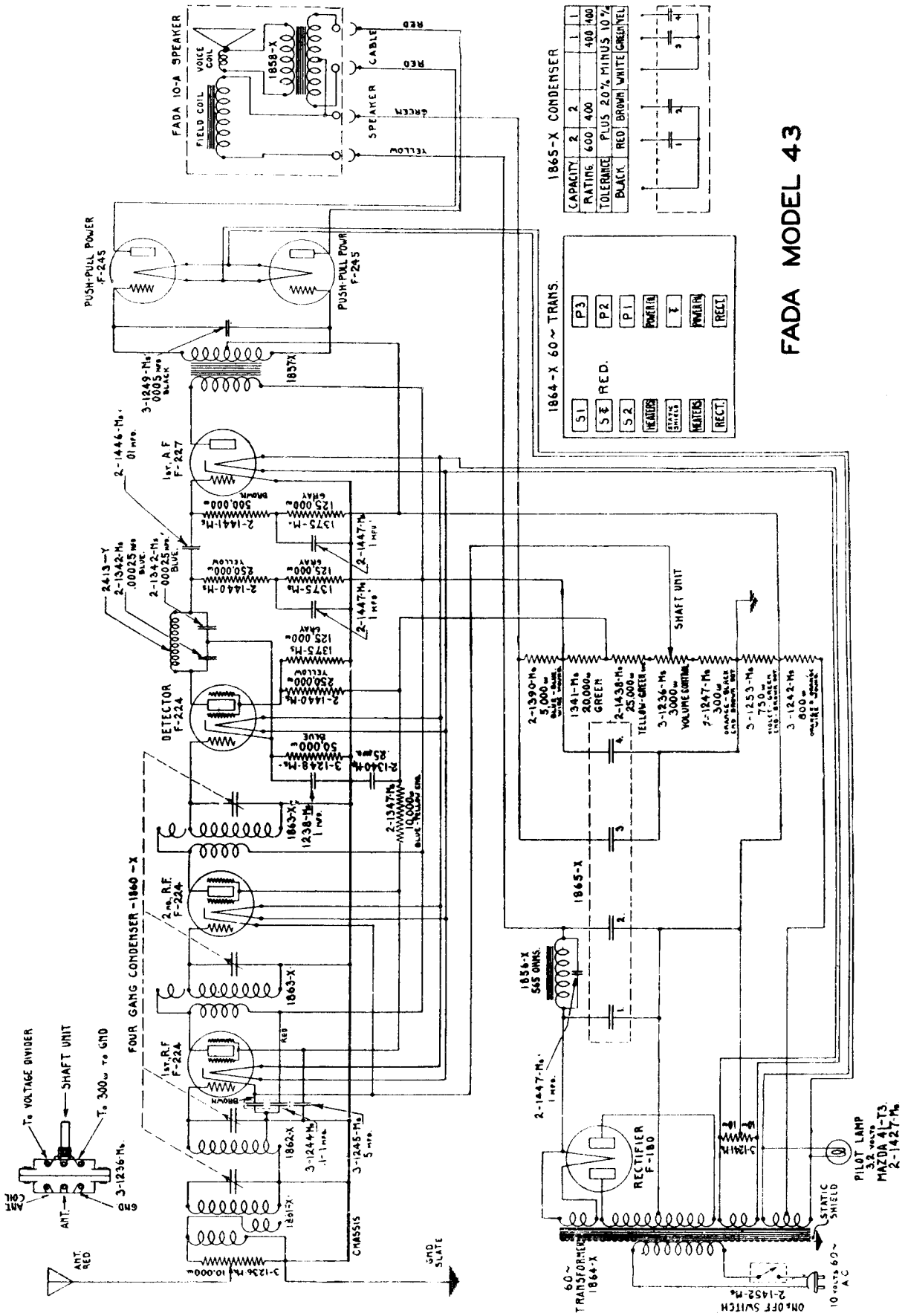


GENERAL ELECTRIC COMPANY

S-42-B

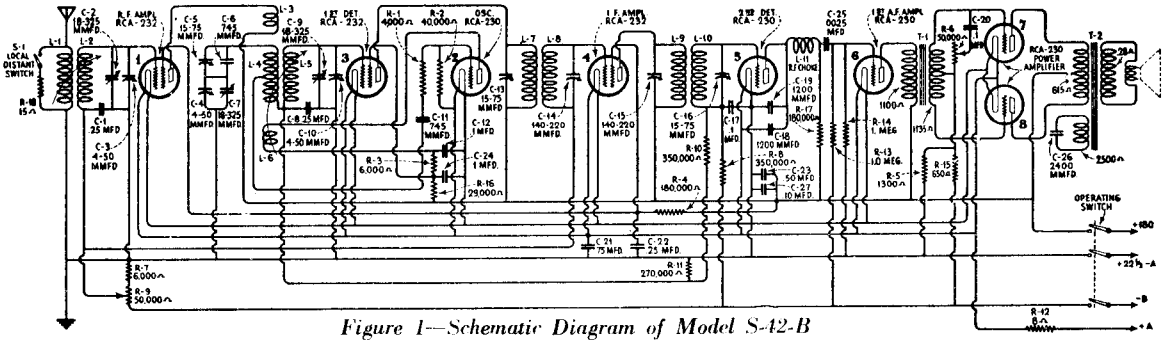


Figure 1—Schematic Diagram of Model S-42-B

RADIOTRON SOCKET VOLTAGES

BATTERIES AT FULL VOLTAGE—NO SIGNAL BEING RECEIVED

These voltages are those obtained with one of the usual set analyzers. The values indicated, therefore, are not necessarily the voltages that actually appear at the Radiotron Sockets when the voltmeter is not connected.

Tube No.	Filament to Control Grid Volts	Filament to Screen Grid Volts	Filament to Plate Volts	Plate Current M. A.	Filament Volts
VOLUME CONTROL AT MINIMUM					
1	22	55	155	0	2.0
2	—	—	50	3.0	2.0
3	0.5	65	150	0.5	2.0
4	22	55	155	0	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	1.5	2.0
7	15.0	—	150	0	2.0
8	15.0		150	0	2.0
VOLUME CONTROL AT MAXIMUM					
1	1.5	45	150	2.5	2.0
2	—	—	50	3.0	2.0
3	0.5	60	150	0.5	2.0
4	1.5	45	150	2.5	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	1.5	2.0
7	15.0	—	150	0	2.0
8	15.0	—	150	0	2.0

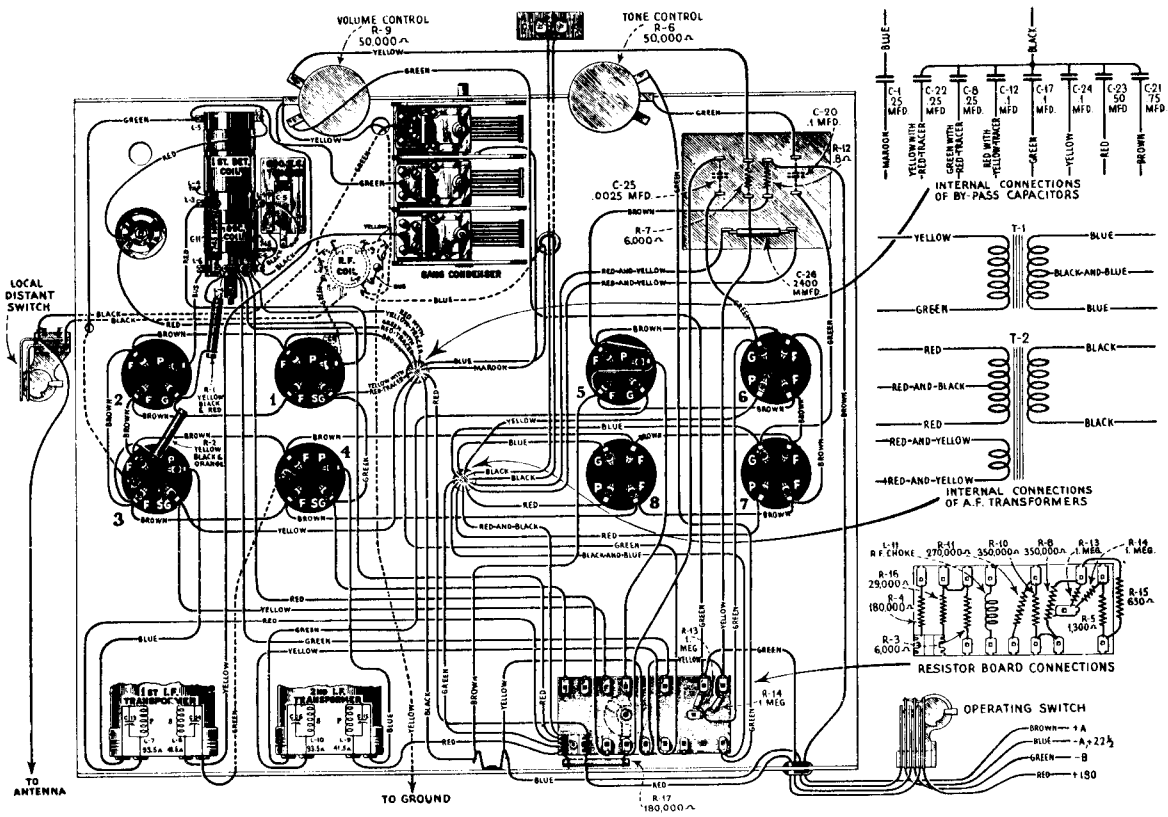
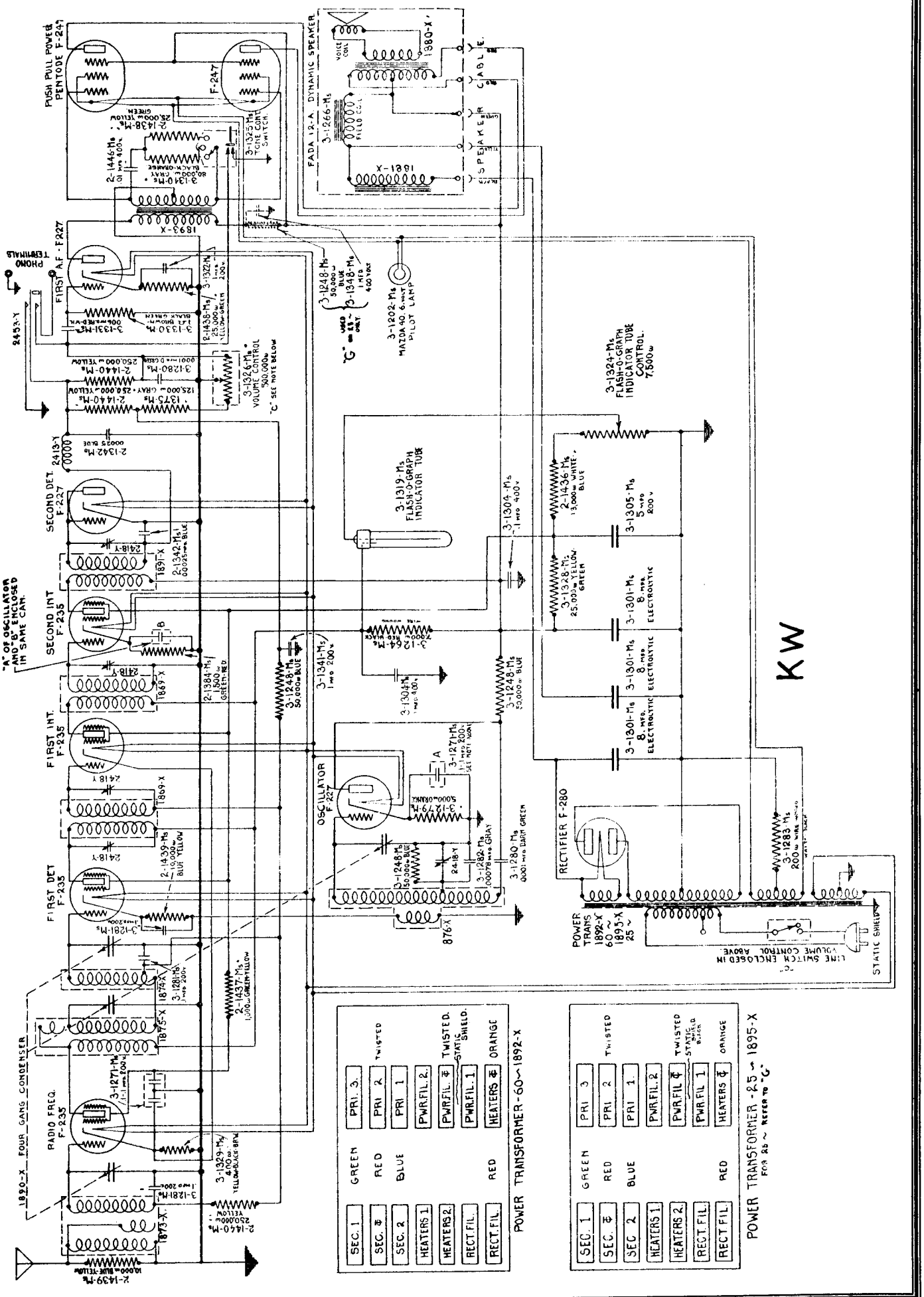


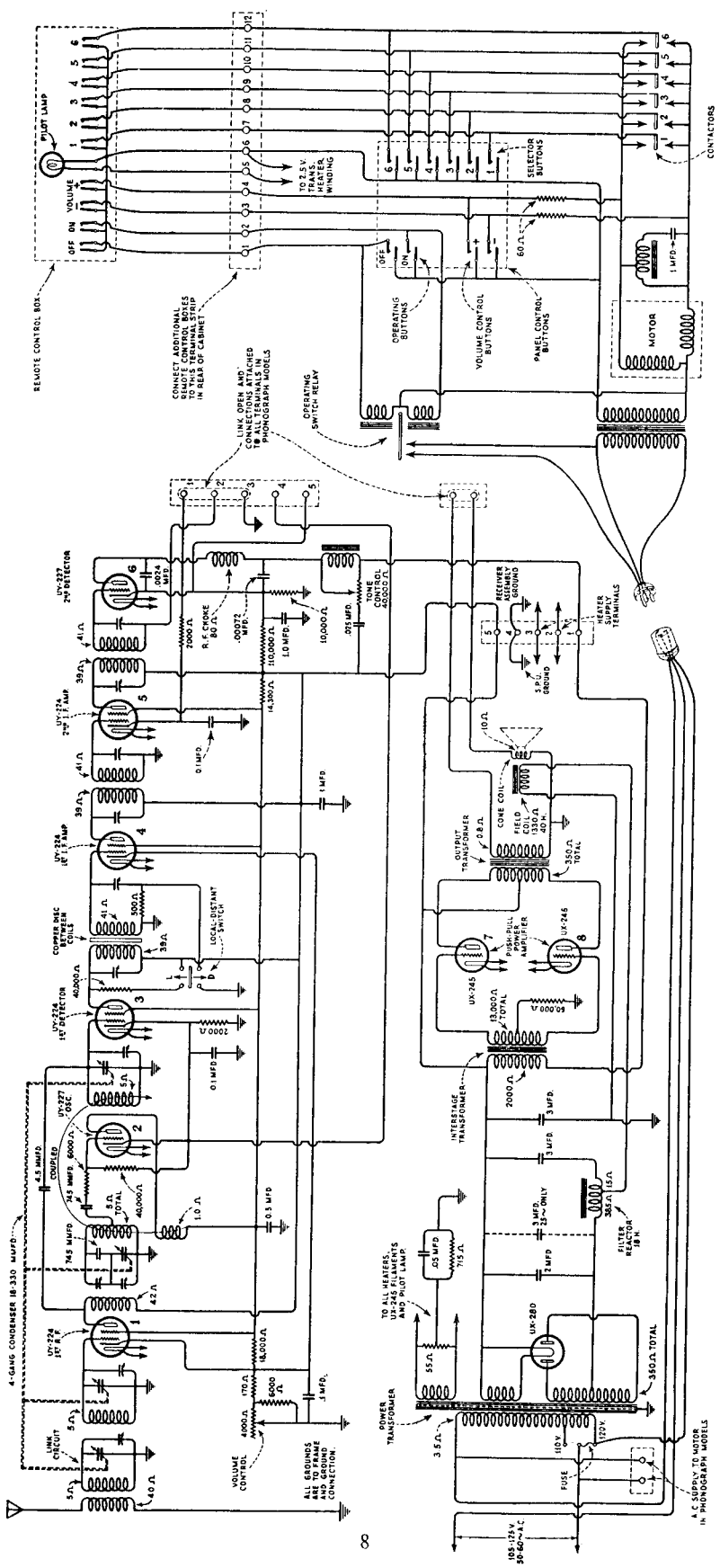
Figure 2—Wiring Diagram of Model S-42-B

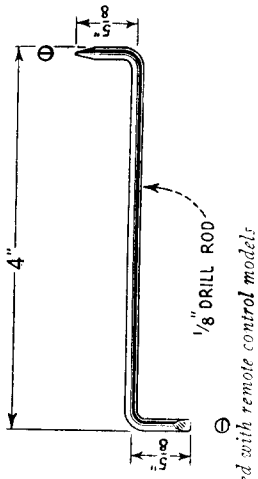
F. A. D. ANDREA INC.



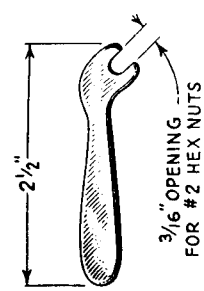
GENERAL ELECTRIC CO.

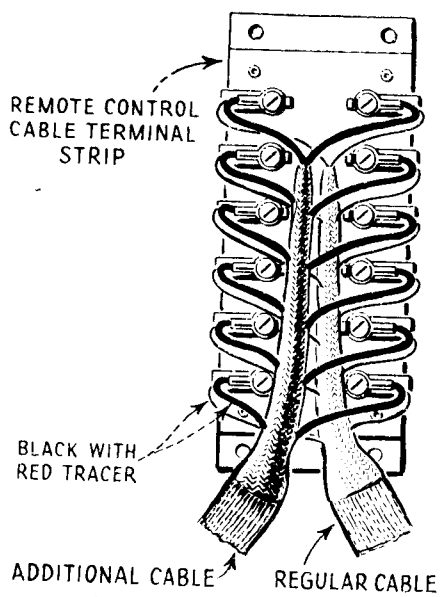
H-51-R AND H-71-R





Construction details of special tools used with remote control models





Connections for adding additional boxes

DELCO APPLIANCE CORP.

DELCO 32-VOLT RADIO RECEIVER CHASSES

Models RB-3 Console, RC-3 Jr. Console and RA-3 Compact

These three cabinet model receivers, designed for farm districts powered by 32-volt supply systems, are manufactured by the Delco Appliance Corp., Rochester, N. Y., and employ the same chassis, the schematic circuit of which is shown below. The 32-volt or "farm lighting" power line supplies only the filament potential, as shown; the plate potentials must be obtained from a block of "B" batteries or from a Delco Power Unit.

Before connecting the power unit, turn the power switch to the "off" position. The power switch is incorporated in the volume control and is turned off by turning the left-hand knob to the left or in a counter-clockwise direction as far as it will go. Connect the power unit to the chassis by means of the 3-lead cable according to the following color code: red, "Plus 135 V." connection on the Delco power unit; maroon, "Plus 67.5 V." tap; black, the negative lead. The "A" lead on the receiver chassis is plugged into the 32-volt power line; reversing the position of the plug in some instances may improve reception a little.

As indicated in the diagram, this 32-volt chassis employs four type '36 screen-grid tubes and two type '38 pentodes; these '38's are connected in parallel,—plate-to-plate, grid-to-grid, etc.

In shunt with each of the tuning condensers in the gang is a trimmer. The nuts of these small condensers are accessible for adjustment through four holes in the top of the condenser shield. A bakelite aligning tool must be used, in order to prevent injury to the inductances within their respective shield cans. The frequency at which it is recommended that this chassis be aligned is 1400 kc. Adjust the volume by means of the volume control until the station signals can be heard faintly but clearly.

If the pointers on the dial window do not correctly indicate the frequency of the stations, the dial may be rotated to the correct position. To do this, it will be necessary to remove the chassis from the cabinet.

After the chassis is removed from the cabinet, measure the vertical distance from the bottom of the cabinet to the indicating points on the dial window (inside the cabinet). Tune in a station of known frequency and loosen the two square-head set screws which hold the dial and hub assembly to the tuning condenser shaft. Hold the condenser rotor stationary and turn the selector dial on the condenser shaft until the frequency shown on the selector dial of that particular station is the same vertical distance from the bottom of the chassis as that previously measured from the bottom of the cabinet to the indicating points on the dial window inside the cabinet.

Lock the selector dial assembly on the shaft by tightening the two square-head screws and reassemble the chassis in the cabinet.

The dial light is rated at 6 volts and has a standard flash-light base. It can be removed or replaced easily by lifting the dial light, socket and bracket assembly up and off the dial light mounting bracket.

A good ground connection is necessary for best operation. Use an approved ground clamp to make a connection to a cold water pipe or a six-foot iron rod driven into moist ground. The antenna may be 100 to 150 feet long.

The knob at the left of the station selector dial window operates the combination volume control and off-on switch. The toggle switch located on the left-hand side of the cabinet is the local-distance switch shown in the schematic circuit as SW.1. The large knob at the right is the tuning control and the central one is the tone selector.

Note that when the local-distance switch is in the up or "distance" position, the receiver is adjusted for maximum sensitivity. However, when the switch is in the down or "local" position battery power is conserved, as described below. In this position the volume on distant stations is very greatly reduced, and satisfactory reception is possible only from local stations. Incidentally, this provides better control of volume on local stations and, as will be observed by reference to the schematic circuit, there is conservation of the battery current.

Tubes for these 32-volt receivers are available from the Delco company, and are somewhat special in their characteristics, although, in lieu of these, the more standard types may be used; they carry the designations D-236 for the screen-grid type, and D-238 for the pentode.

As will be evident by reference to the schematic circuit, the problem of operating on a 32-volt supply necessitates the use of a receiver design entirely different from other types. To meet this situation adequately it has been considered advisable, in the design of the Delco 32-volt radio set, to limit the line current demands to supplying only the filament current required by a number of heater- or cathode-type tubes, the '36's and '38's shown in the schematic circuit. This system of connection eliminates the need for heavy filter chokes in the "A" circuit.

There then remains the matter of supplying "B" and "C" potentials to the circuit. The most satisfactory solution to this problem, it was decided, would be the use of "B" batteries to supply "B" current; and the principle of voltage drop across a resistor in series with the "B" supply to furnish the required "C" potential. Of course, this voltage is subtracted from the total "B" voltage available, and the remainder constitutes the voltage which will be available for use at the plates of the tubes.

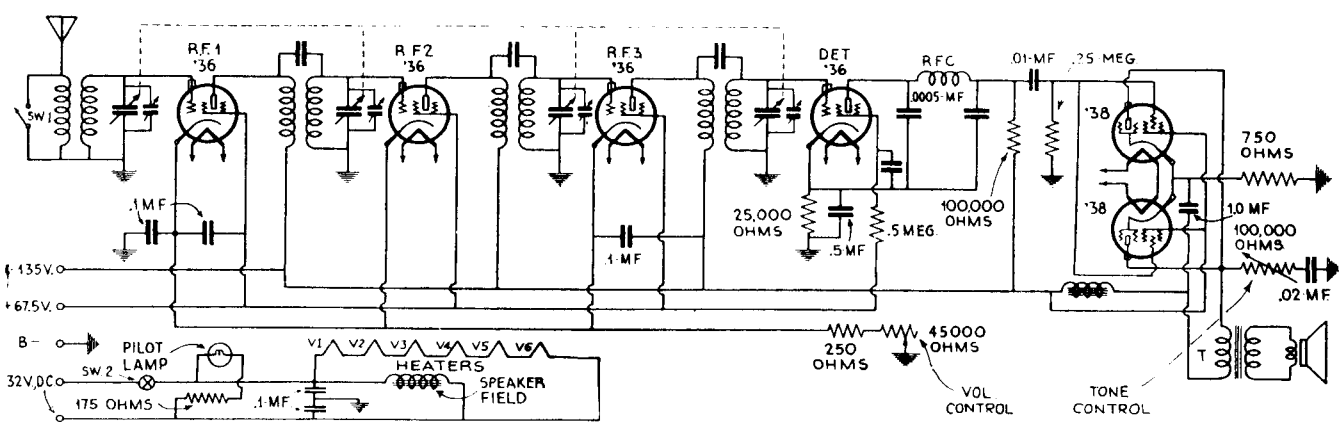
The "C" potential for tubes RF1, RF2 and RF3 is the drop across a fixed 250 ohm resistor and that portion of a variable 45,000 ohm resistor which may be in the circuit at the time; variation of this value constitutes the only volume control in this receiver, except for the change which is effected when switch SW1 is operated, or the tone control is adjusted.

The detector is of the plate-rectification or power type, the high negative bias required for this form of circuit operation being obtained as the drop across a 25,000 ohm resistor in the screen-grid detector cathode lead. Bias for the pentode tubes is obtained from a 750 ohm cathode resistor. The power output circuit is not push-pull but is parallel, as previously stated.

The screen-grids of the pentodes are isolated from the plates, as far as A.C. is concerned, by means of an iron-core choke coil and 1. mf. fixed condenser in the high voltage lead common to both, as shown in the schematic circuit. The output of the pentodes is transformer coupled to the dynamic reproducer voice coil by means of the usual output-type audio transformer; the field coil of which is connected directly across the 32-volt supply.

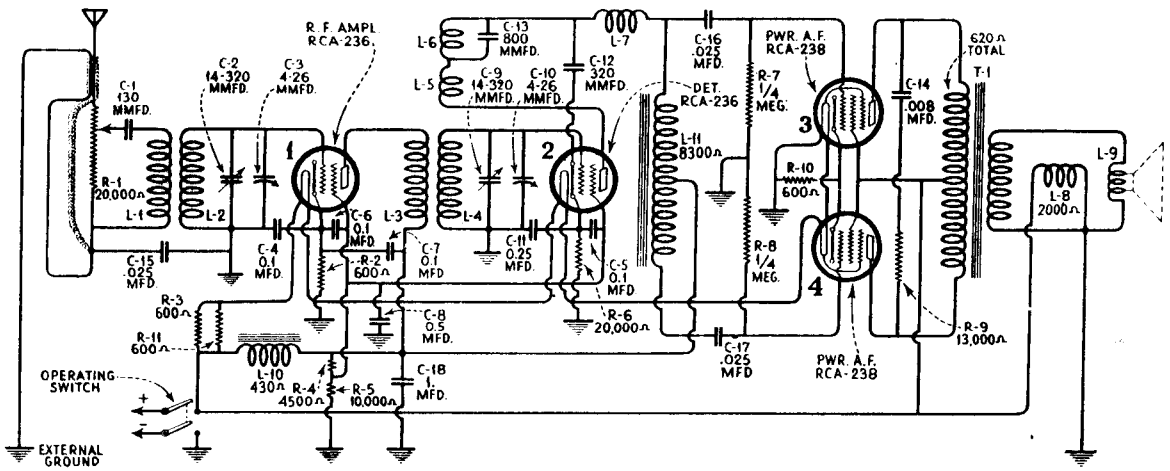
To improve the tuning characteristics, small coupling condensers are connected to the high potential ends of the R.F. tuning coils.

A line-filter, consisting of two, 0.1-mf. fixed condensers connected in series and the center-tap grounded, is connected across the 32-volt power line. Its use prevents surges from affecting the operation of the set.



Schematic circuit of the Delco 32-Volt Receivers, Models RB-3 Console, RC-3 Jr. Console, and RA-3 Compact. The detector is resistance-capacity coupled to the power output tubes through a fixed condenser of .01-mf. It is always well to check condensers in this position, for leakage; occasionally, an open circuit may develop, and the usual tests should be applied where such a condition is suspected.

GENERAL ELECTRIC CO.



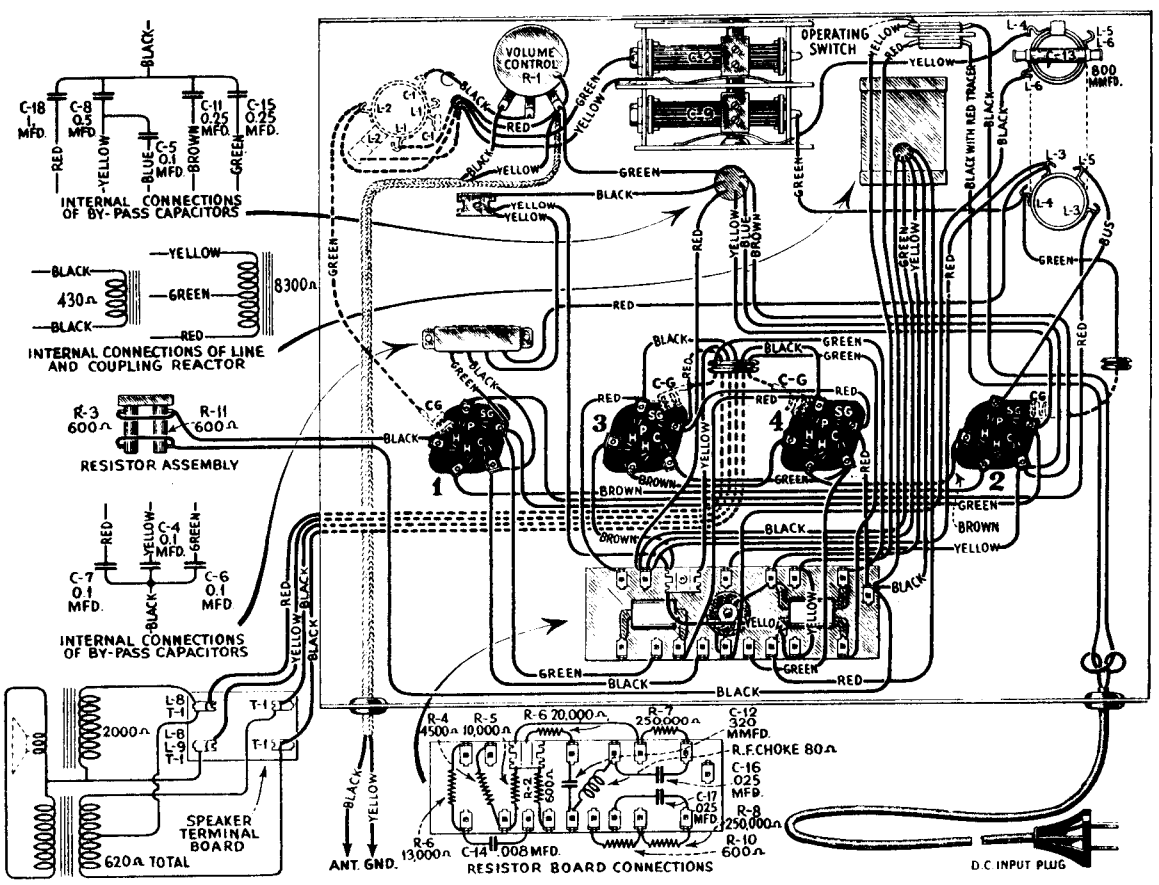
RADIOTRON SOCKET VOLTAGE

MODEL T-12-D

110 VOLT D. C. LINE

These readings are obtained with the usual set analyzers and are not true readings of the voltage at which the Radiotrons operate.

Radiotron No.	Cathode to to Control Grid Volts	Cathode to Screen Grid Volts	Cathode to Plate Volts	Plate Current M. A.	Heater Volts
1	1.5	62	98	2.0	6.0
2	3.2	54	92	0.2	6.0
3	0.3	99	95	5.5	6.0
4	0.3	99	95	5 5	6.0



GENERAL ELECTRIC CO

SERVICE NOTES
FOR

General Electric Radio Model J-70 and J-75

ELECTRICAL SPECIFICATIONS

Voltage Rating ..... 105–125 Volts
Frequency Rating ..... 50–60 cycles and 25–60 cycles
Power Consumption ..... 95 Watts
Type of Circuit ..... Super-Heterodyne
Type and number of Radiotrons ..... 2 RCA-235, 2 UY-227, 1 UY-224, 1 RCA-247 and 1 UX-280
Number of R.F. Stages ..... One
Number of I.F. Stages .. One using one tuned input transformer and one untuned output transformer
Type of Second Detector ..... Power self biasing
Type of Tone Control ..... Variable resistance in series with condenser that tunes secondary of interstage transformer at "low" position
Number of Audio Stages ..... One—Single Pentode
Type of Rectifier ..... Full wave, UX-280
Undistorted output ..... 2.25 Watts

PHYSICAL SPECIFICATIONS—J-70

Height ..... 16 27/32 inches
Depth ..... 9 3/8 inches
Width ..... 14 3/4 inches
Weight alone ..... 30 1/2 lbs.
Weight Packed for Shipment ..... 37 lbs.

PHYSICAL SPECIFICATIONS—J-75

Height ..... 38 1/2 inches
Depth ..... 11 inches
Width ..... 23 inches
Weight alone ..... 58 lbs.
Weight Packed for Shipment ..... 77 lbs.

The General Electric Models J-70 and J-75 are seven tube Super-Heterodyne radio receivers incorporating such features as Super Control Screen Grid Radiotrons in the R.F. and I.F. stages, single Pentode output stage and the inherent sensitivity, selectivity and tone quality of the General Electric Super-Heterodyne. Model J-70 is a table model and J-75 is a small console. Except for the cabinet, speakers and output circuit, both models are identical.

Service work in conjunction with this receiver will be very similar to that of other table type receivers. However, there are several new features of this model which require some consideration.

The second I.F. transformer in this receiver is of the untuned variety, making the set slightly less sensitive and selective than the S-22. This decreased selectivity permits the omission of the 600 K.C. adjustable capacitor used on the S-22, S-132 and other Super-Heterodyne receivers. When aligning adjustments are necessary, it is therefore only necessary to tune one I.F. transformer and the three tuning capacitors. The I.F. transformer is adjusted at 175 K.C. and the tuning capacitors at 1400 K.C. In the case of the latter, the dial should be set at 1400 as well as the oscillator and the three screws adjusted for maximum output. This will permit the dial to read very accurately.

The schematic diagram, the wiring diagram, the voltage readings and the replacement parts are given in the following pages.

RADIOTRON SOCKET VOLTAGES

120 Volt A. C. Line

VOLUME CONTROL AT MINIMUM

Radiotron No.	Cathode to Heater Volts, D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1. R. F.	50	50	60	235	0	0	2.66
2. Osc.	50	0	—	55	4.5	—	2.66
3. 1st Det.	10	9	100	260	1.0	0.25	2.66
4. I. F.	50	50	60	235	0	0	2.66
5. 2d Det.	25	10	—	250	1.0	—	2.66
6. Pwr.	—	10	290	280	35	—	2.66

VOLUME CONTROL AT MAXIMUM

Radiotron No.	Cathode to Heater Volts, D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1. R. F.	3.0	3.0	65	260	3.0	0.5	2.66
2. Osc.	3.0	0	—	60	5.0	—	2.66
3. 1st Det.	6.0	5.5	60	260	0.75	0.25	2.66
4. I. F.	3.0	3.0	65	260	3.0	0.5	2.66
5. 2d Det.	25	10.0	—	250	1.0	—	2.66
6. Pwr.	—	10.0	290	280	35	—	2.66

GENERAL ELECTRIC CO

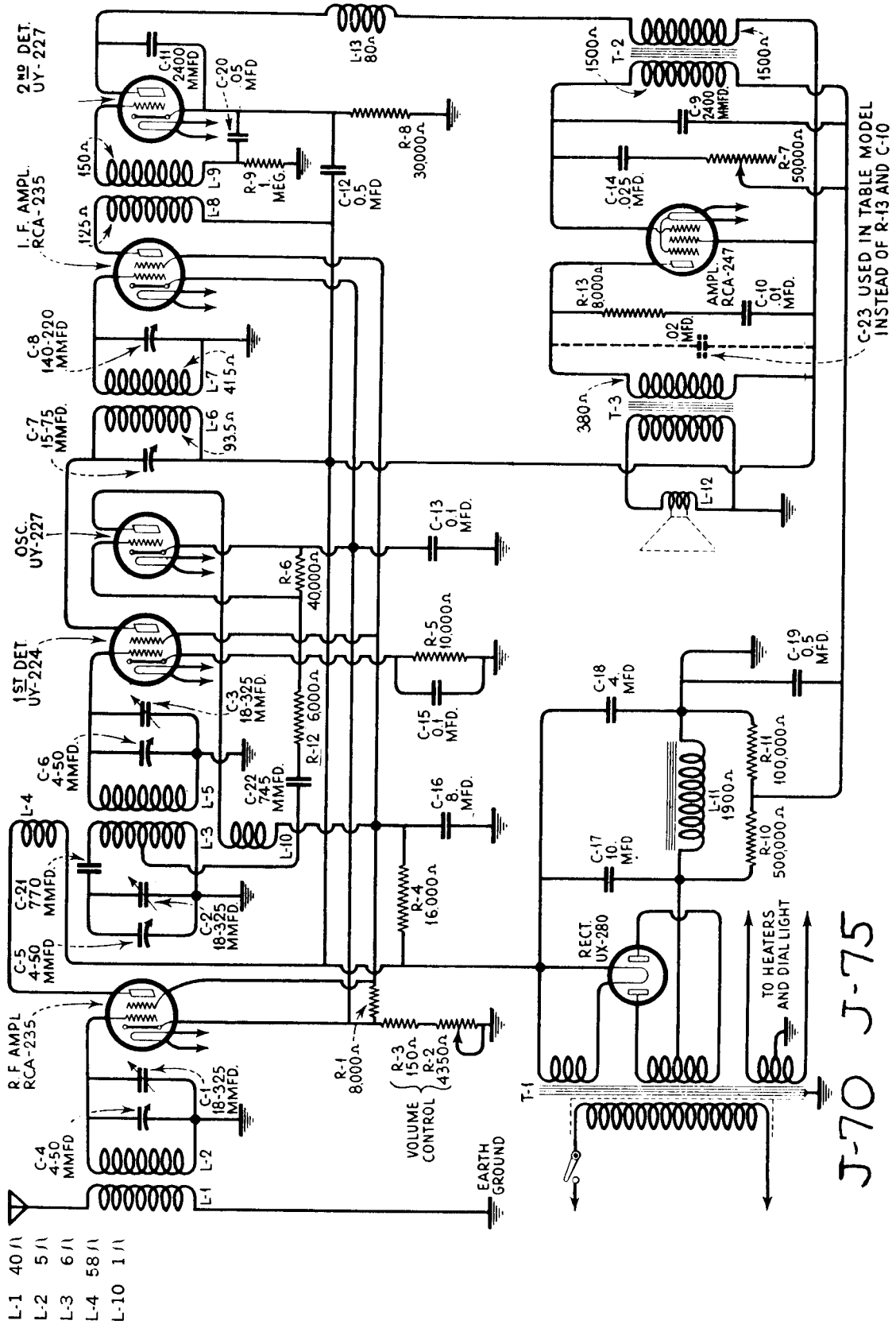
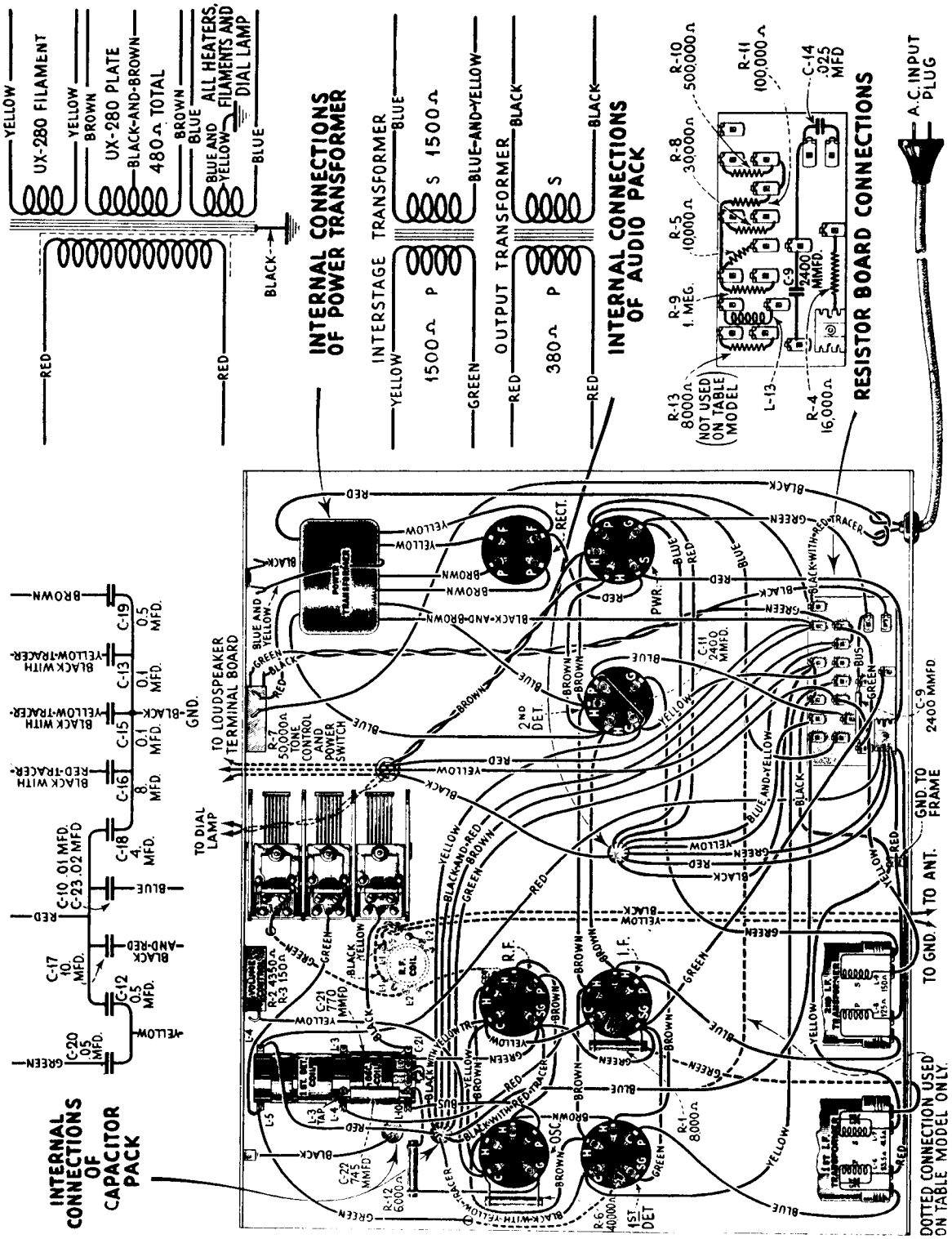
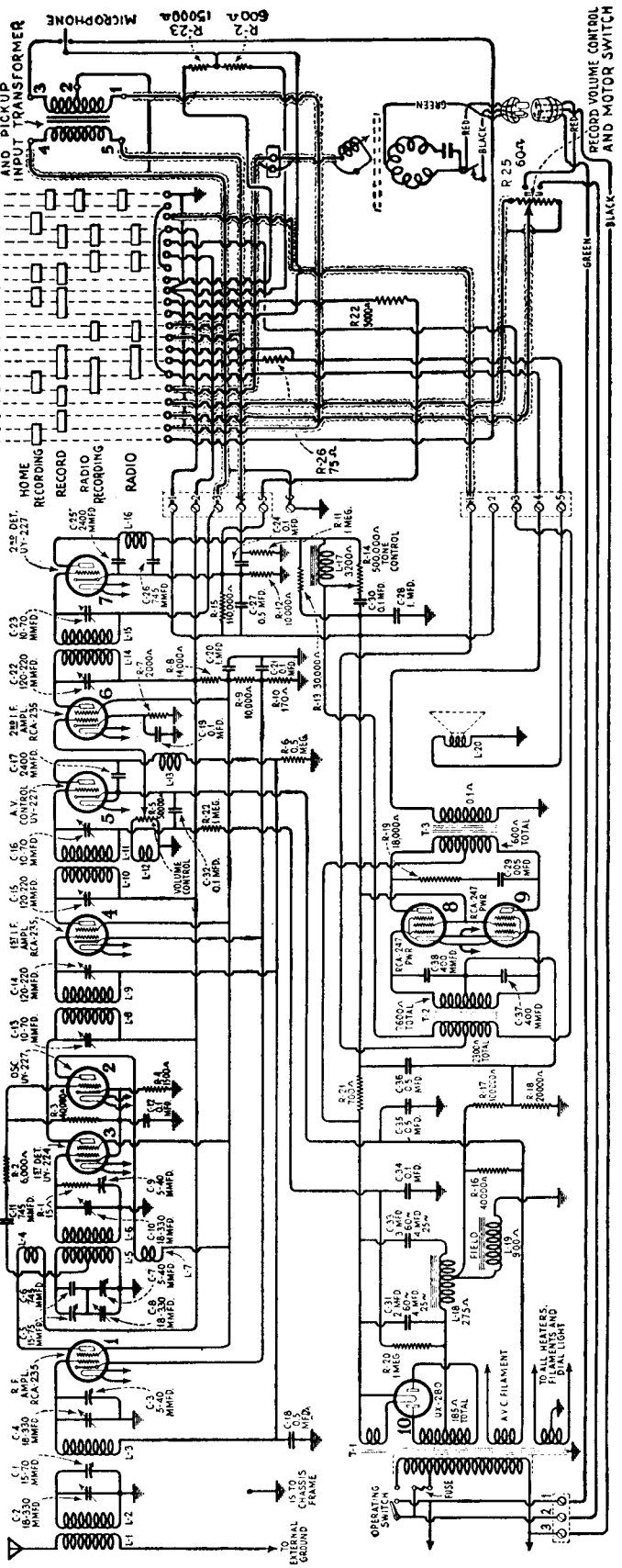


Fig. 1—Schematic Wiring Diagram

GENERAL ELECTRIC CO



GENERAL ELECTRIC CO.
F. A. D. ANDREA INC.



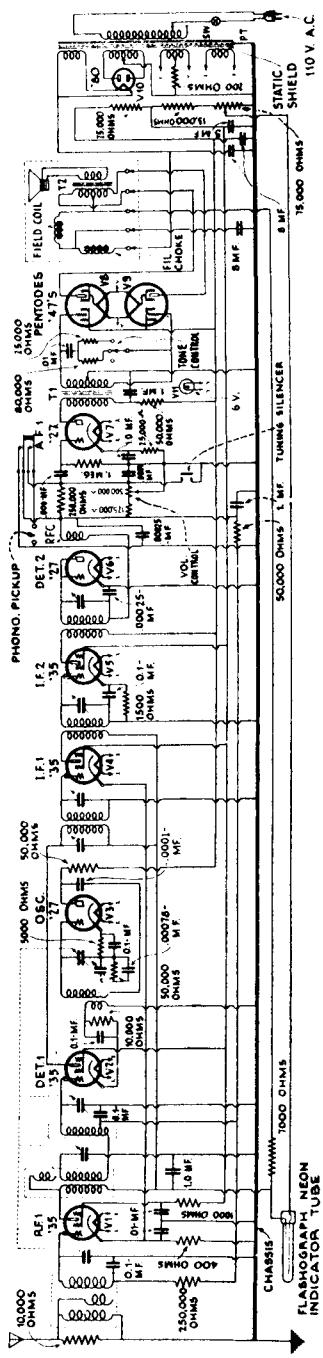
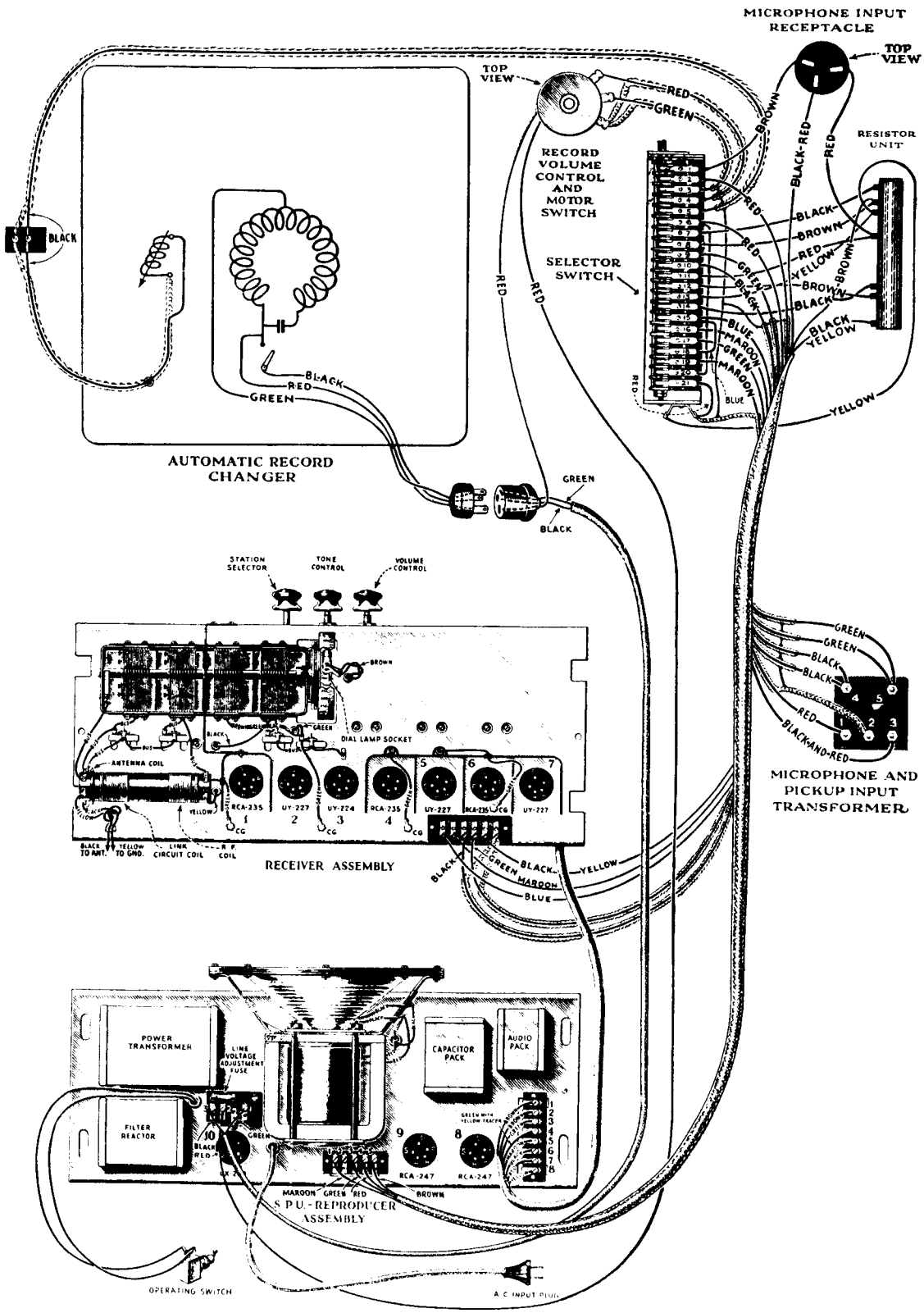


Diagram of the Fada models "48" and "49" receivers. This chassis is of the superheterodyne type employing a diode detector, a Tuner-Lite for indicating maximum response, and is equipped with an automatic volume control and push-pull pentodes.

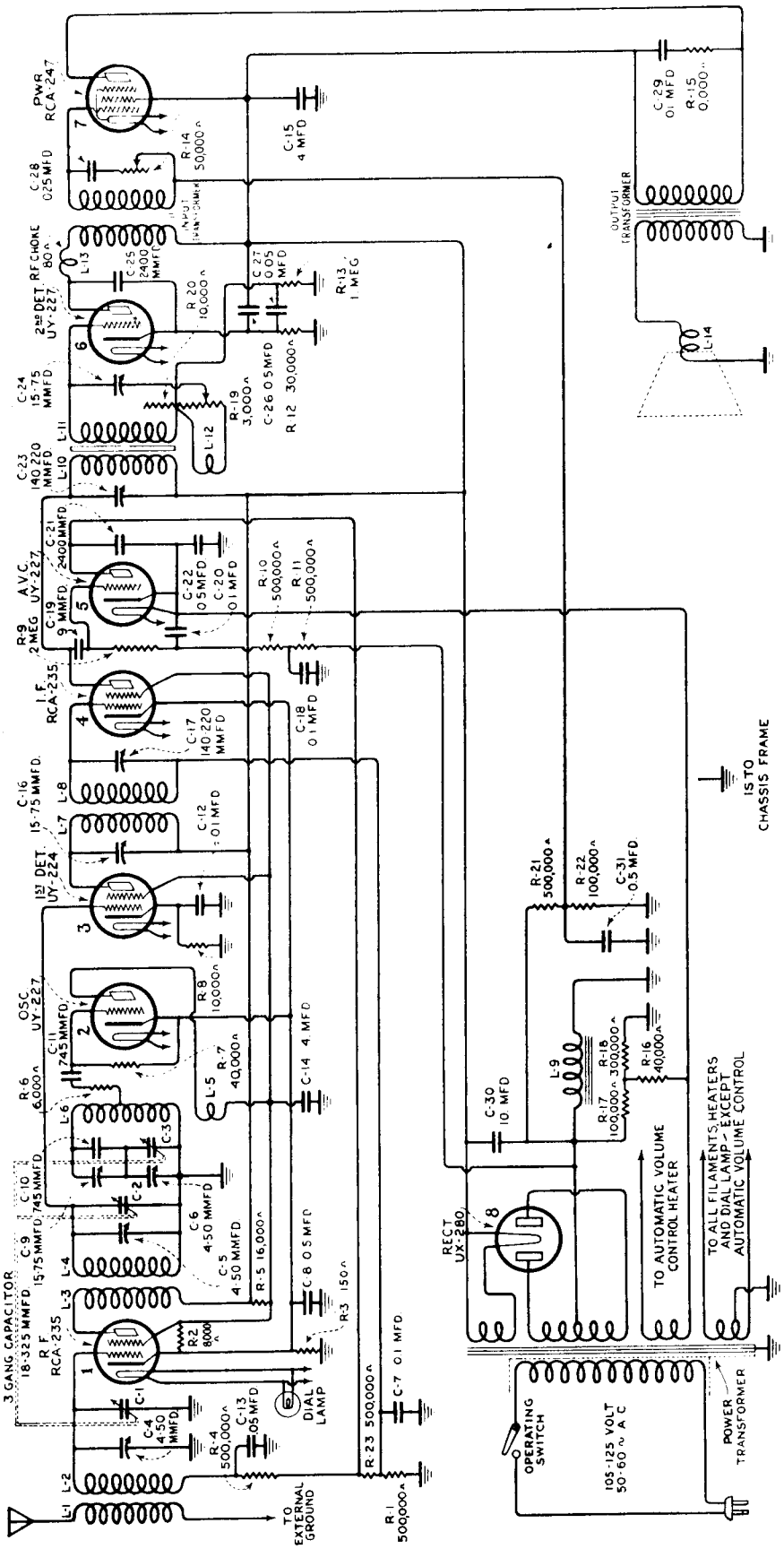
GENERAL ELECTRIC CO.

MODEL H-72

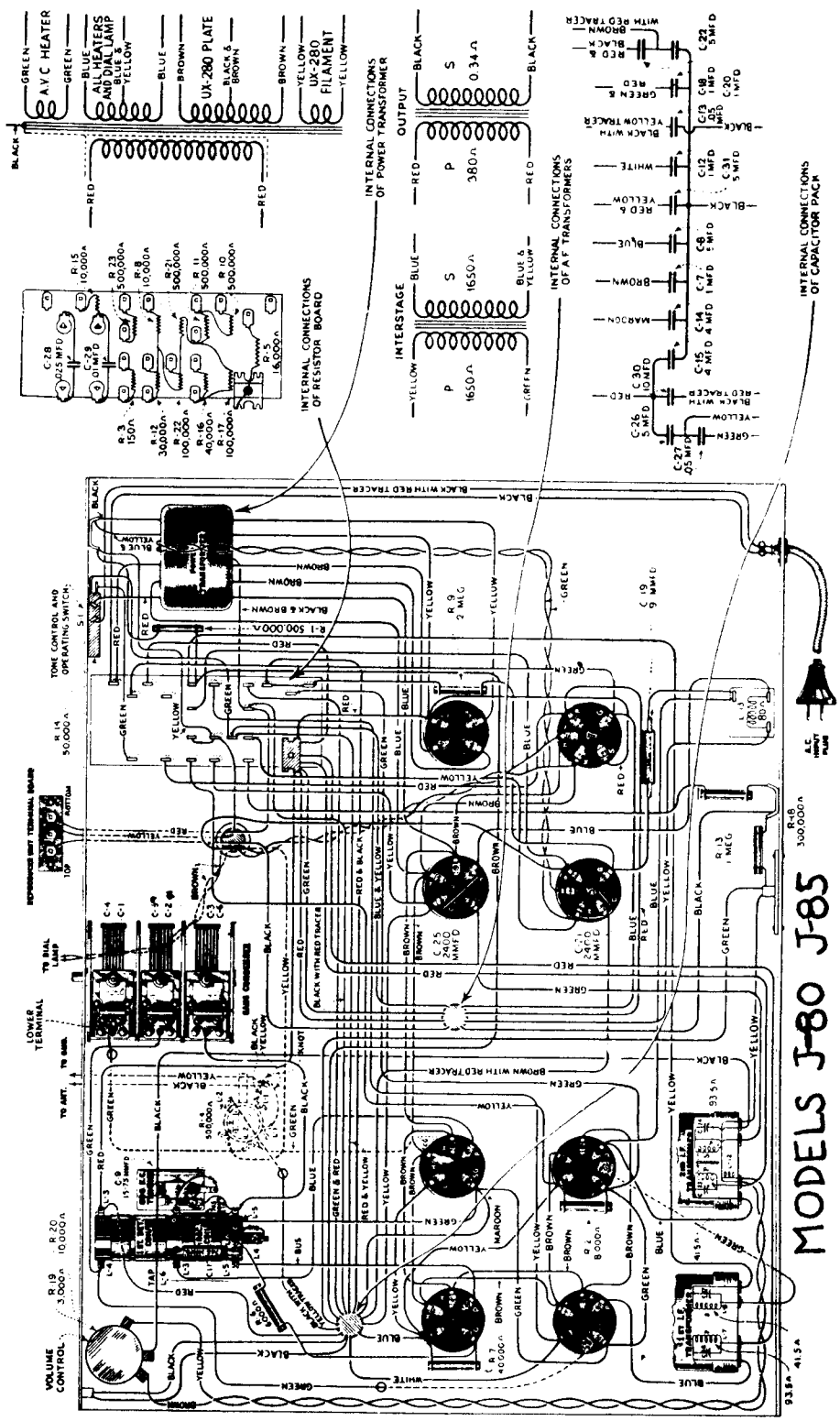


GENERAL ELECTRIC CO.

MODELS J-80 - J-85



GENERAL ELECTRIC CO.



RADIOTRON SOCKET VOLTAGES

120 VOLT LINE

VOLUME CONTROL DOES NOT AFFECT VOLTAGES

Radiotron No.	Cathode to Heater Volts, D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1. R. F.	4.0	0.5	70	260	4.0	0.5	2.5
2. Osc.	4.0	0	—	65	6.0	—	2.5
3. 1st Det.	7.0	6.0	70	260	0.75	0.1	2.5
4. I. F.	4.0	4.0	70	260	4.0	0.5	2.5
5. 2nd Det.	28.0	10.0	—	250	1.0	—	2.5
6. A. V. C. -	0	0	—	25	0	—	2.2
7. Power	—	10.0	290	280	35.0	—	2.5

GENERAL ELECTRIC CO.

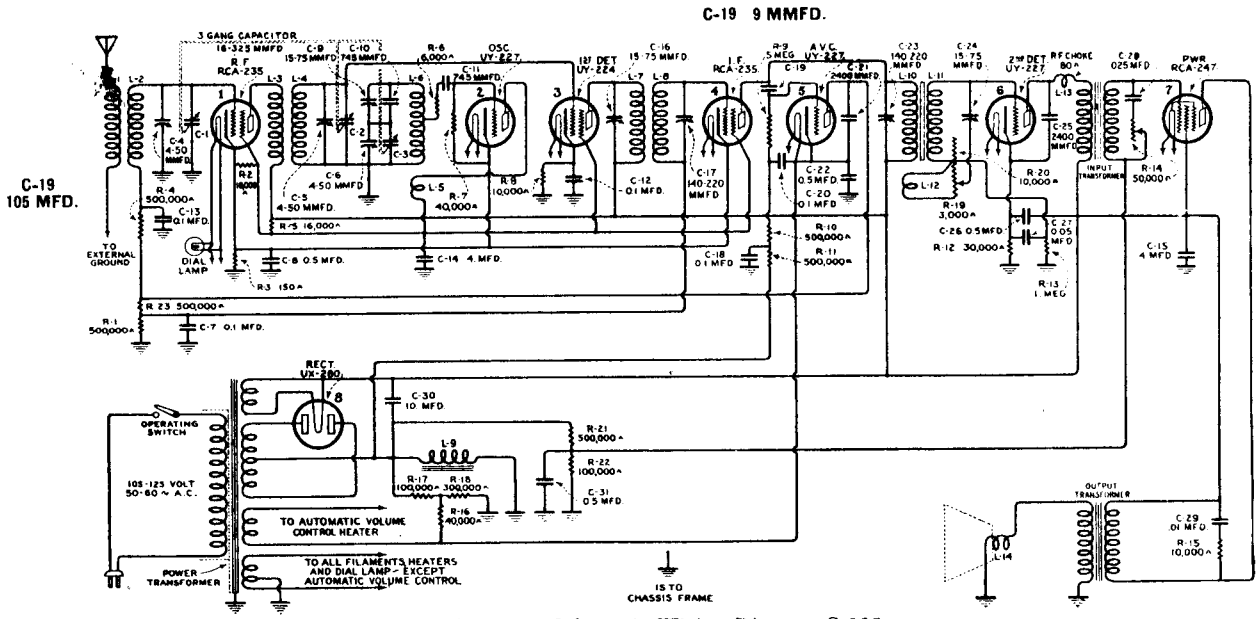


Figure 1—Schematic Wiring Diagram S-132

RADIOTRON SOCKET VOLTAGES MODEL S-132

110 VOLT A. C. LINE

(Volume Control Setting Does Not Affect Voltages)

Radiotron No.	Cathode to Heater Volts, D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1	2	*0.1	75	210	5.0	0.5	2.2
2	8	0	—	60	5.0	—	2.2
3	7	7.0	70	205	0.5	0.1	2.2
4	2	*0.1	75	210	5.0	0.5	2.2
5	0	0	—	30	0	—	2.2
6	20	*8.0	—	185	0.5	—	2.2
7	—	10	210	210	25	—	2.2

*Not true reading due to resistance in circuit.

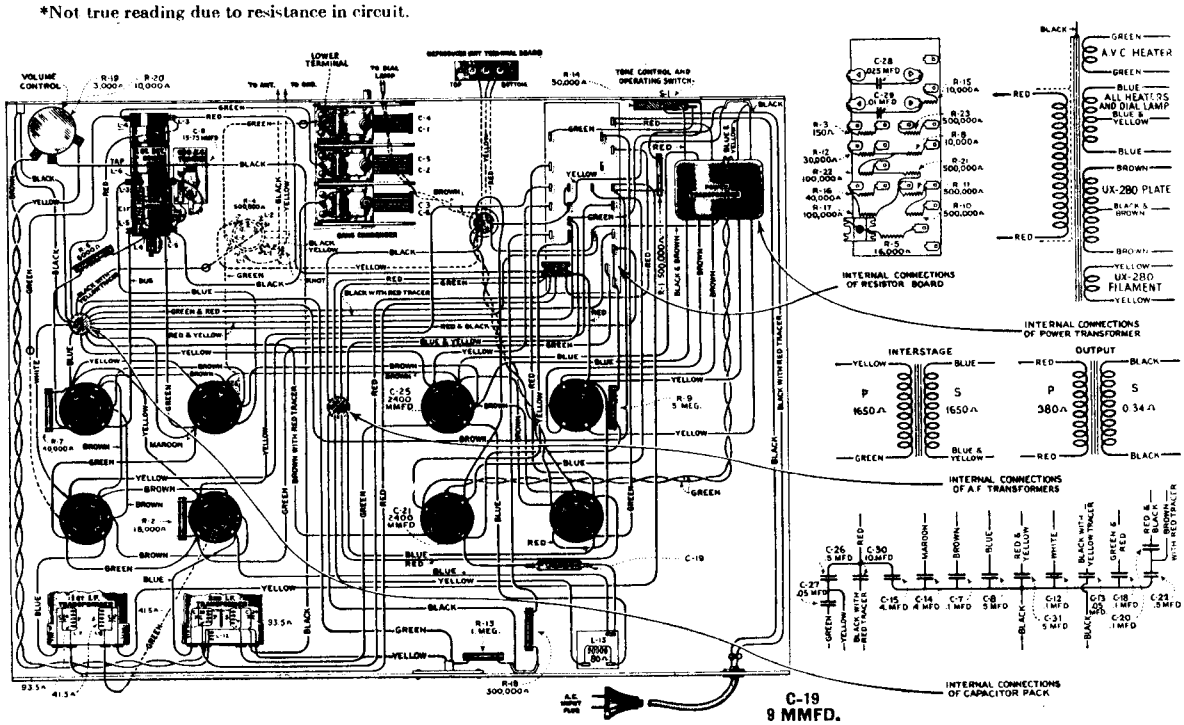
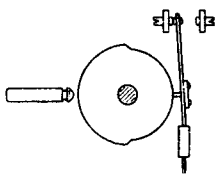
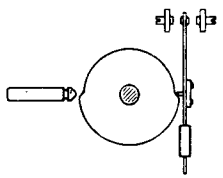
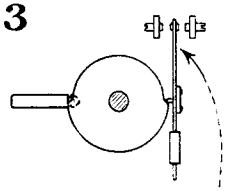
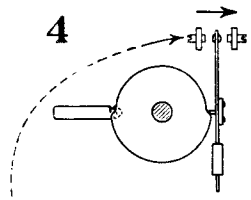
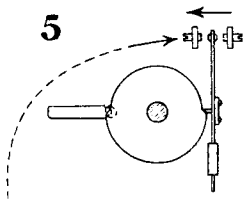
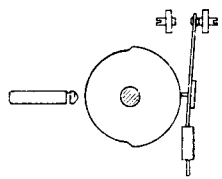
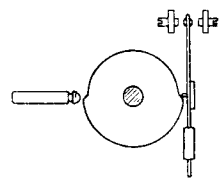
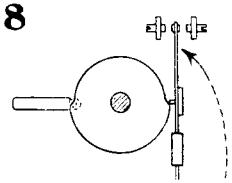
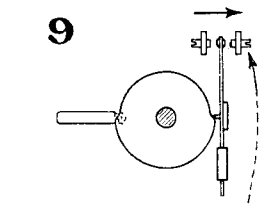
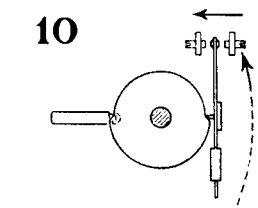


Figure 2—Wiring Diagram S-132

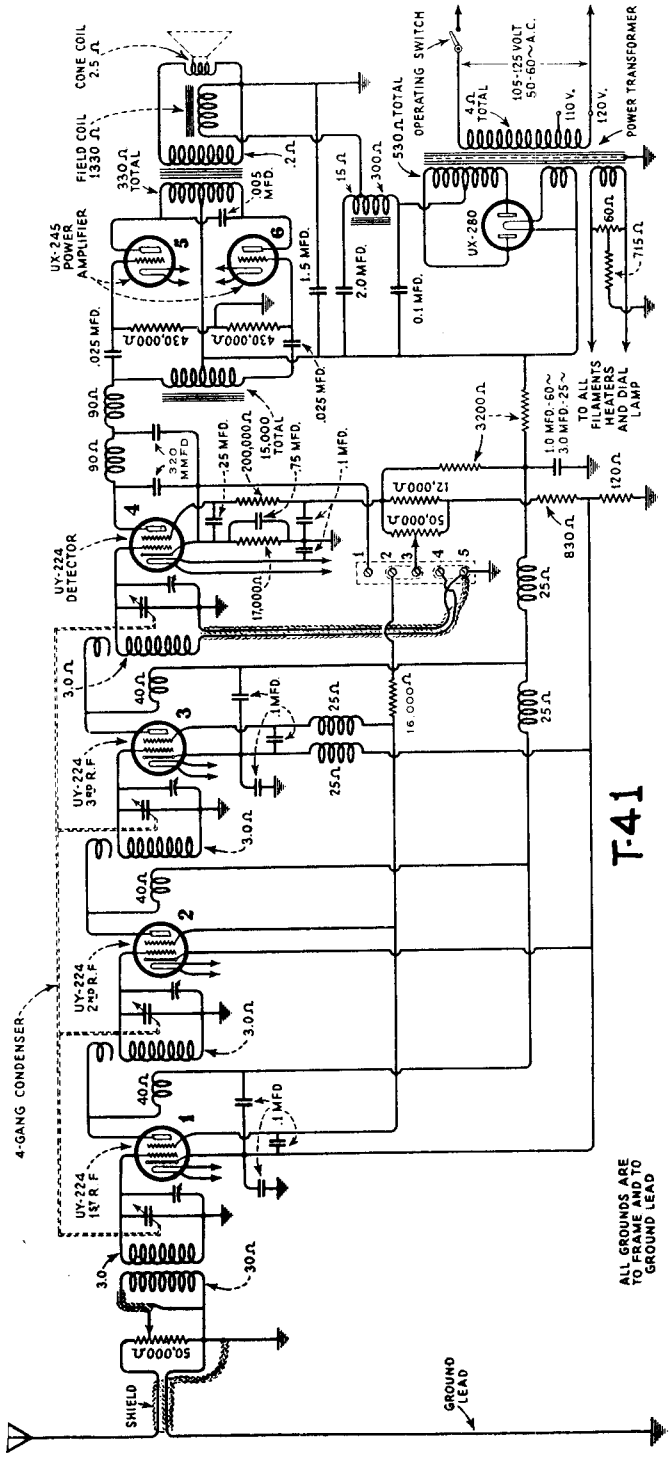
MOTOR CONTACTOR ADJUSTMENT CHART

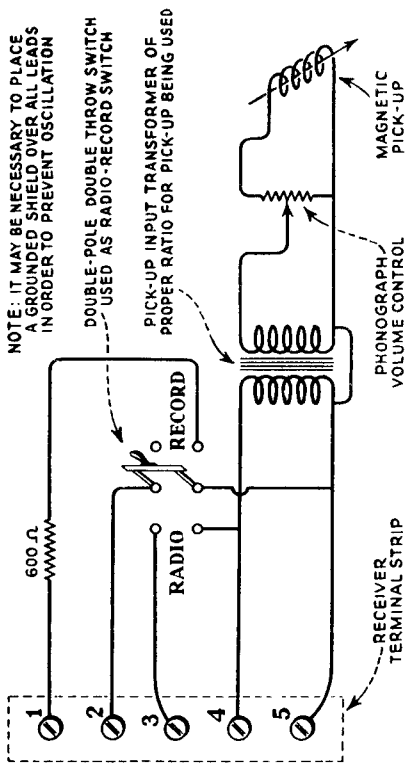
Repeat Entire Procedure For All Contactors

TURN STATION SELECTOR KNOB UNTIL CONTACTOR IS TO ONE SIDE  **1**	PUSH SELECTOR BUTTON ON PANEL UNTIL THE MOTOR STOPS AND CONTACTOR IS CENTERED  **2**	THEN PUSH SETTING BUTTON. IF CONTACTOR DOES NOT MOVE, ADJUSTMENT IS O.K. **3**  *DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED*	IF CONTACTOR MOVES IN THIS DIRECTION WHEN SETTING BUTTON IS PRESSED, ADJUST AS INDICATED. **4**  *TURN THIS SCREW CLOCKWISE A LITTLE AT A TIME UNTIL CONTACTOR DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED. (TURN SELECTOR KNOB AND RETUNE WITH SELECTOR BUTTON AFTER EACH TRIAL ADJUSTMENT)*	IF CONTACTOR MOVES IN OTHER DIRECTION, ADJUST AS INDICATED. **5**  *TURN THIS SCREW COUNTER CLOCKWISE A LITTLE AT A TIME UNTIL CONTACTOR DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED. (TURN SELECTOR KNOB AND RETUNE WITH SELECTOR BUTTON AFTER EACH TRIAL ADJUSTMENT)*
AFTER MAKING PRECEDING ADJUSTMENTS TURN STATION SELECTOR KNOB UNTIL CONTACTOR IS TO THIS SIDE  **6**	PUSH SELECTOR BUTTON ON PANEL UNTIL THE MOTOR STOPS AND CONTACTOR IS CENTERED  **7**	THEN PUSH SETTING BUTTON. IF CONTACTOR DOES NOT MOVE, ADJUSTMENT IS O.K. **8**  *DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED.*	IF CONTACTOR MOVES IN THIS DIRECTION WHEN SETTING BUTTON IS PRESSED, ADJUST AS INDICATED. **9**  *TURN THIS SCREW COUNTER CLOCKWISE A LITTLE AT A TIME UNTIL CONTACTOR DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED. (TURN SELECTOR KNOB AND RETUNE WITH SELECTOR BUTTON AFTER EACH TRIAL ADJUSTMENT)*	IF CONTACTOR MOVES IN THIS DIRECTION, ADJUST AS INDICATED. THEN REPEAT ALL ADJUSTMENTS ON ALL SIX CONTACTORS. **10**  *TURN THIS SCREW CLOCKWISE A LITTLE AT A TIME UNTIL CONTACTOR DOES NOT MOVE WHEN SETTING BUTTON IS PRESSED. (TURN SELECTOR KNOB AND RETUNE WITH SELECTOR BUTTON AFTER EACH TRIAL ADJUSTMENT)*

H-51-R AND H-71-R

GENERAL ELECTRIC CO.





Tube No.	Cathode to Heater Volts D.C.	Cathode or Filament to Control Grid-Volts D.C.	Cathode to Screen Grid Volts D.C.	Cathode or Filament to Plate Volts D.C.	Plate Current M.A.	Screen Grid Current M.A.	Heater or Filament Volts
Volume Control at Maximum							
1	—40	—2.5	+85	160	3.0	0.2	2.3
2	—36	—2.5	+85	155	3.5	0.15	2.3
3	—36	—2.5	+75	155	3.5	0.15	2.3
4	—28	—7.5	+55	225	0.5	0.1	2.3
5	—	*—1.0	—	200	25.0	—	2.3
6	—	*—1.0	—	200	25.0	—	2.3
Volume Control at Minimum							
1	—40	—1.0	+6	200	0	0	2.3
2	—40	—1.4	+6	200	0	0	2.3
3	—40	—0.8	+6	200	0	0	2.3
4	—28	—8.4	+75	230	.6	0	2.3
5	—	*—1.0	—	205	25.0	—	2.3
6	—	*—1.0	—	205	25.0	—	2.3

GENERAL ELECTRIC CO.

General Electric Modern Longfellow Grandfather Clock-Radio

Models H-91 and H-91-R

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating	105–125 Volts
Frequency Rating	50–60 Cycles or 25–40 Cycles
Power Consumption	120 Watts
Recommended Antenna Length	25–75 Feet
Type of Circuit	A. C. Screen Grid Super-Heterodyne
Number of Radiotrons	3 RCA-235, 1 UY-224, 3 UY-227, 2 RCA-247, 1 UX-280—Total of 10
Number of Radio Frequency Stages	One
Type of First Detector	Tuned Input Grid Bias
Number of Intermediate Stages	Two
Type of Second Detector	Power Grid Bias
Type of Automatic Volume Control	UY-227
(Controlling bias voltage on R. F. and I. F. stages by means of drop across resistor in plate circuit)	
Number of Audio Stages	One (Push-Pull)
Type of Rectifier	Full Wave, UX-280
Type of Loudspeaker	Dynamic with Special High Frequency Filter
Wattage Dissipation in Loudspeaker Field	Ten
Undistorted Output	Four Watts

PHYSICAL SPECIFICATIONS

Height	78 Inches
Depth	14¼ Inches
Width	17½ Inches
Weight (Packed for Shipment)	205 Pounds
Weight (Alone)	136 Pounds
Packing Case Dimensions	81½ Inches x 21¼ Inches x 19 Inches

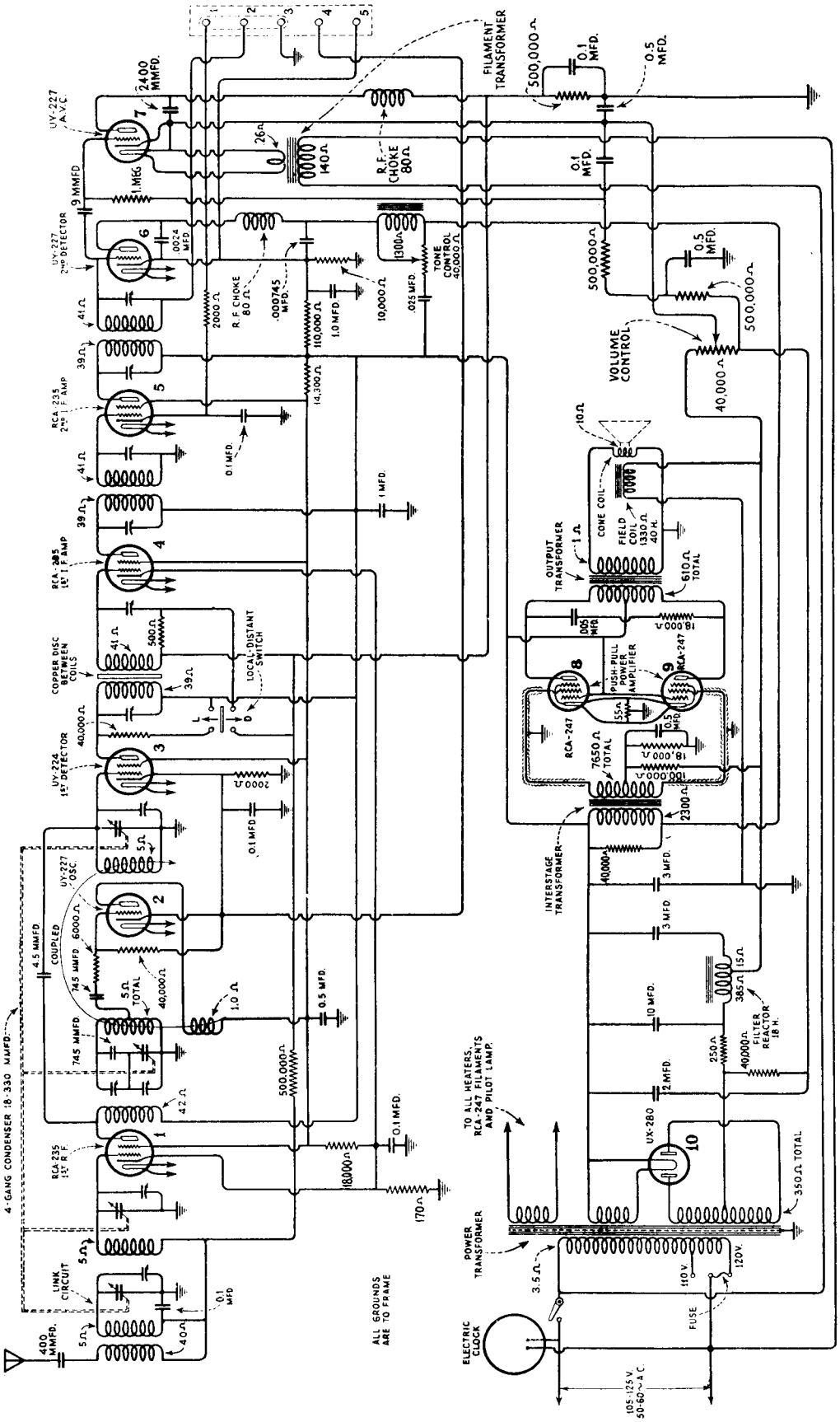
INTRODUCTION

General Electric Radio, Models H-91 and H-91-R are ten tube, Super-Heterodyne type radio receivers incorporated in the cabinet of a massive electric Grandfather clock. Mechanical and electrical excellence together with the beauty of fine period furniture characterize this instrument.

Model H-91 is a straight radio receiver and model H-91-R is of the remote control type. Ten Radiotrons are used, three RCA-235 as R. F., and I. F. stages one UY-224 as first detector, three UY-227 as oscillator, automatic volume control and 2nd detector; two RCA-247 as the power output stage and one UX-280 as the rectifier.

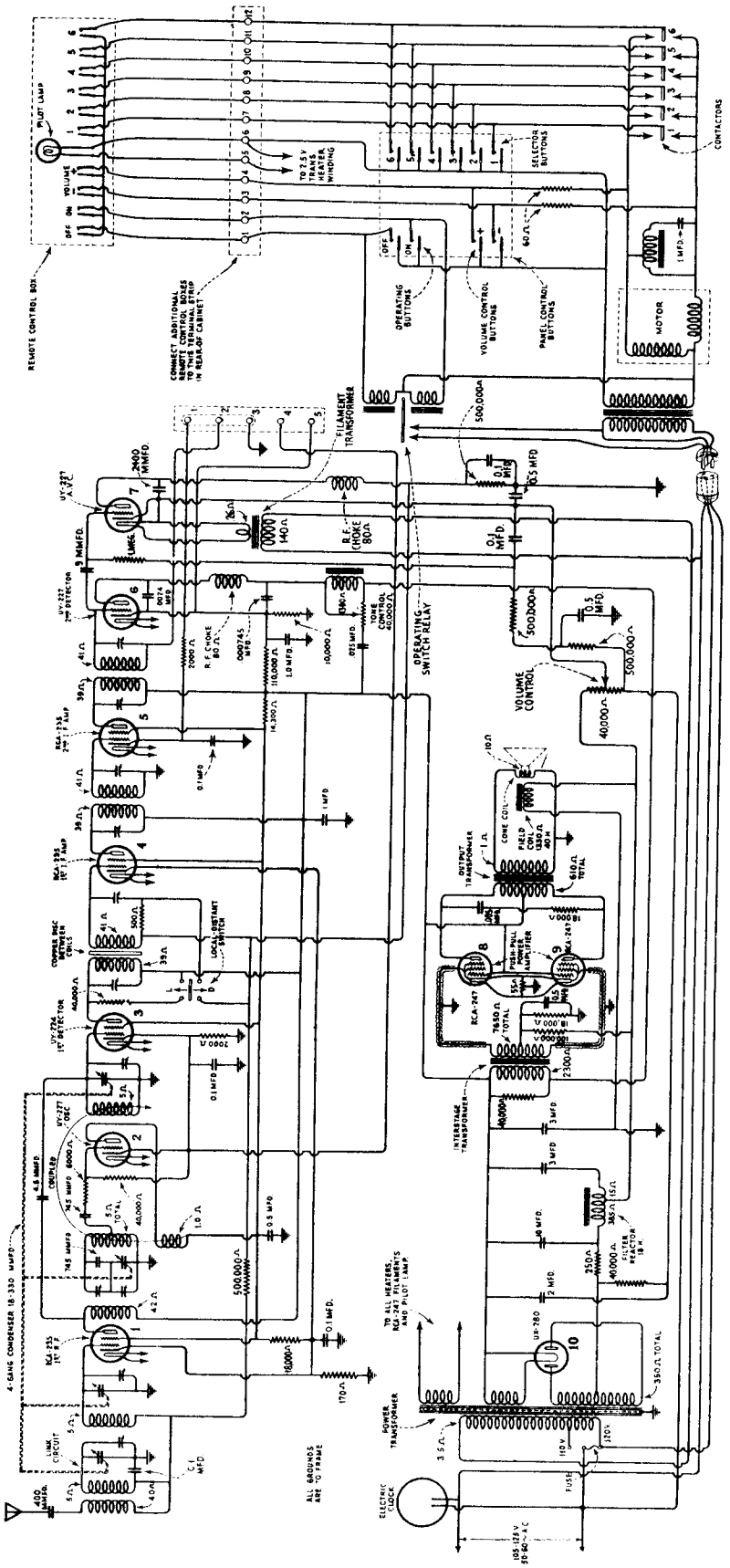
These instruments, with the exception of the cabinet are similar to the model H-51 and H-51-R except than an automatic volume control tube and Radiotrons RCA-235 and RCA-247 in the R. F., I. F. and Power stages, have been included. For service data other than on the remote control unit that is applicable to vertical operation and on the automatic volume control circuit, reference should be made to the Service Notes already issued on the Model H-51 and H-51-R.

GENERAL ELECTRIC CO.



Schematic Diagram of Model H-91

GENERAL ELECTRIC CO.



Schematic Diagram of Model H-91-R

VOLUME CONTROL AT MAXIMUM

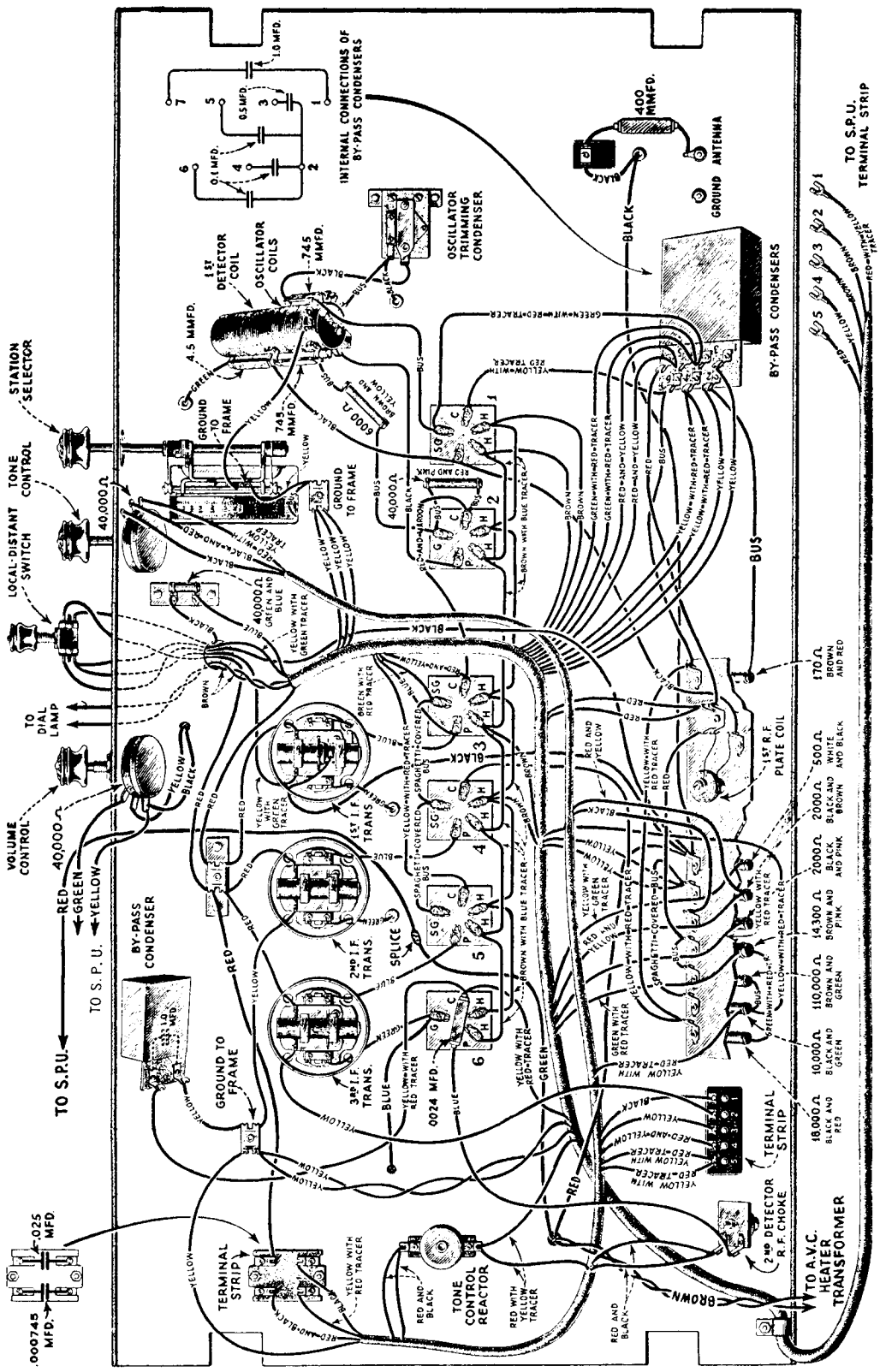
Radiotron No.	Cathode to Heater Volts	Cathode or Filament to Control Grid Volts	Cathode or Filament to Screen Grid Volts	Cathode or Filament to Plate Volts	Plate Current M. A.	Screen Grid Current M. A.	Heater or Filament Volts
1	50	0	72	235	3.0	0.55	2.2
2	8	0	—	55	3.0	—	2.2
3	6.5	6.5	65	225	0.5	0	2.2
4	0	0	75	210	5.0	0.55	2.2
5	4.5	4.5	70	225	2.5	0.5	2.2
6	20	20	—	200	0.5	—	2.2
7	0	0	—	25	0	—	2.2
8	—	*12	235	235	22	6.0	2.2
9	—	*12	235	235	22	6.0	2.2

* Not true reading due to resistance in circuit.

VOLUME CONTROL AT MINIMUM

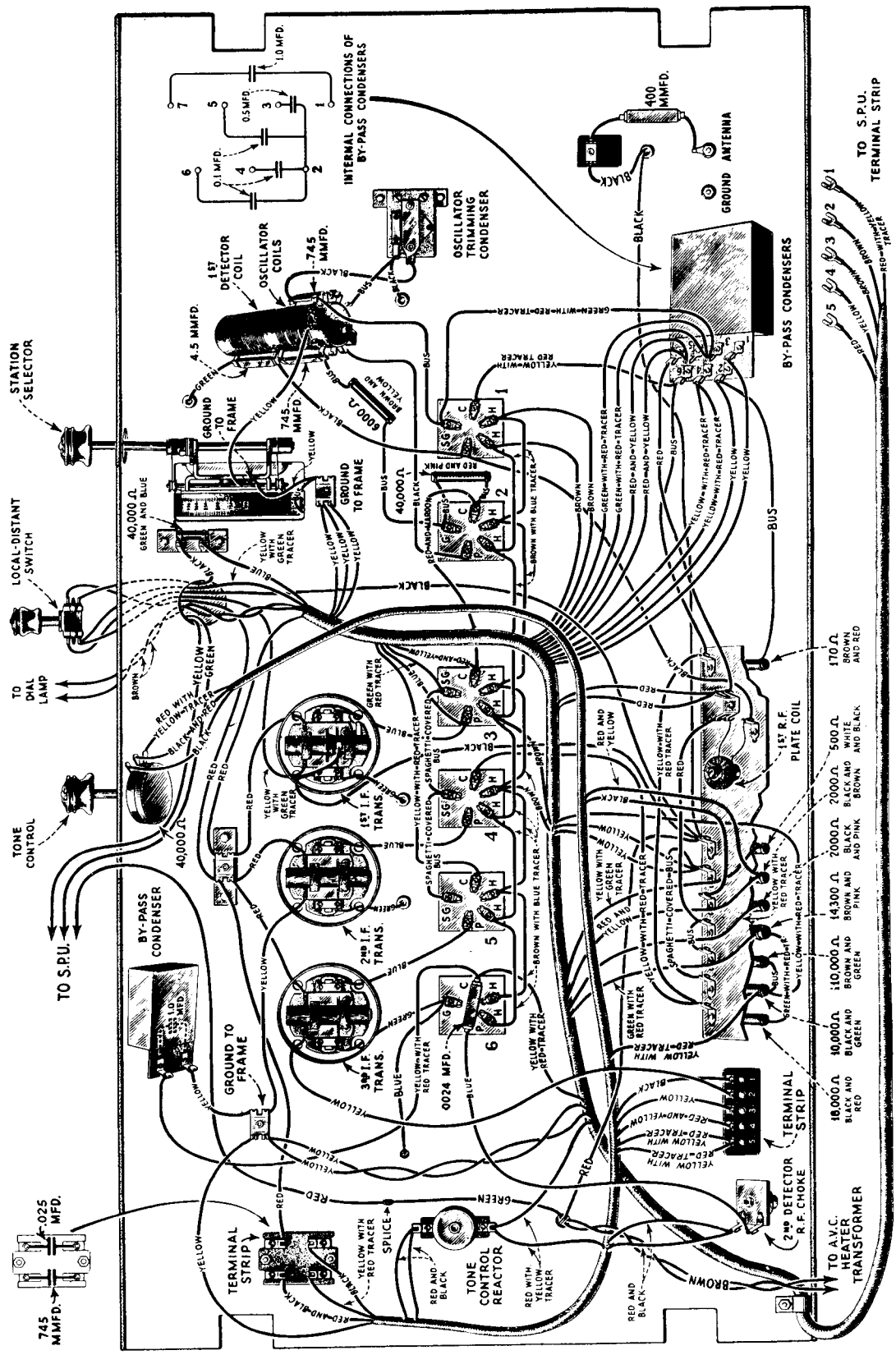
Radiotron No.	Cathode to Heater Volts	Cathode or Filament to Control Grid Volts	Cathode or Filament to Screen Grid Volts	Cathode or Filament to Plate Volts	Plate Current M. A.	Screen Grid Current M. A.	Heater or Filament Volts
1	50	10	85	230	4	0	2.2
2	10	—	—	100	—	—	2.2
3	8.0	8.0	80	230	0.5	0	2.2
4	0	0	85	230	0	0	2.2
5	5.0	5.0	80	230	5.0	0.5	2.2
6	20	20	—	230	0.5	—	2.2
7	0	0	—	25	0	—	2.2
8	—	*12	235	235	22	6.0	2.2
9	—	*12	235	235	22	6.0	2.2

GENERAL ELECTRIC CO.



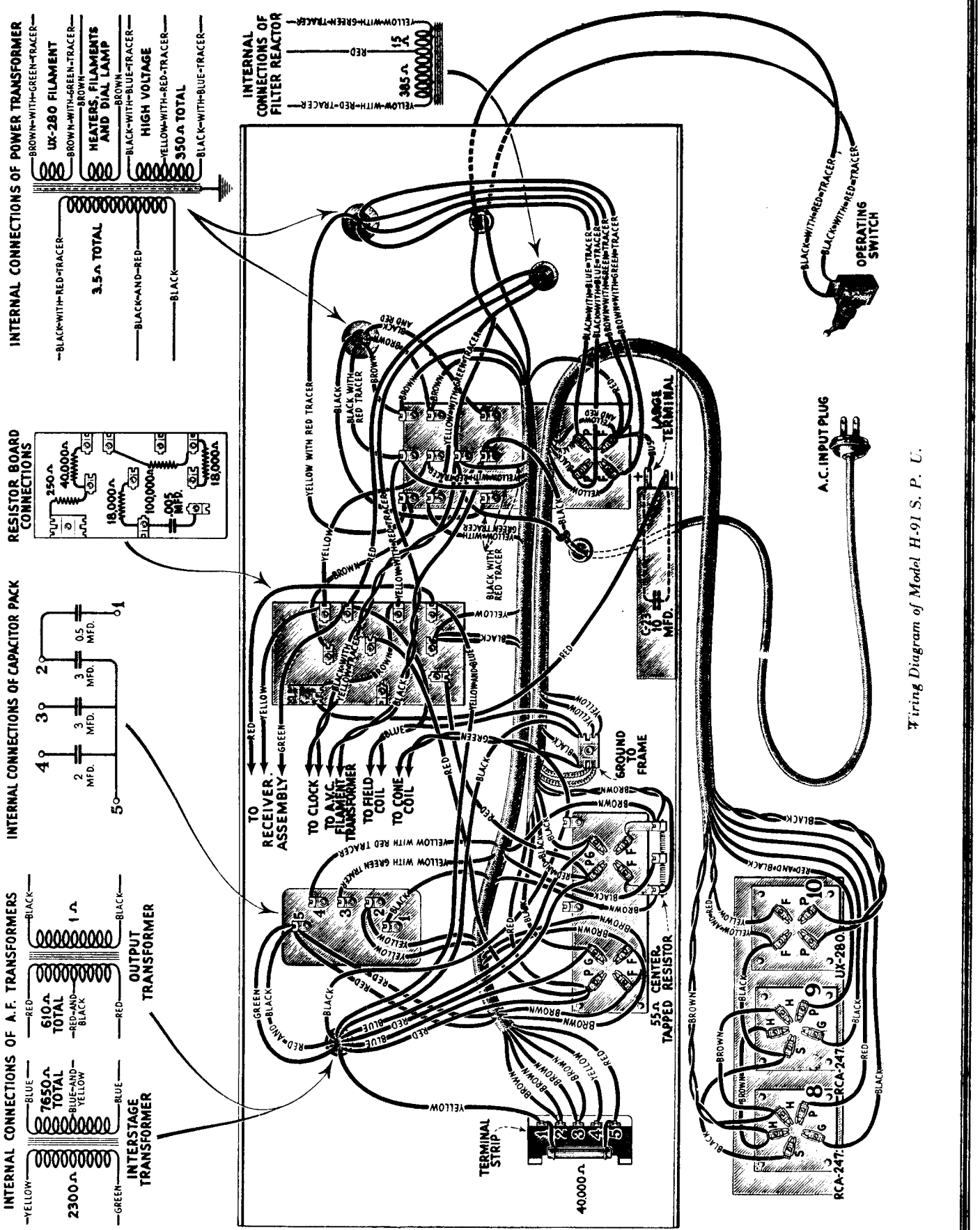
Wiring Diagram of Model H-91 Receiver Assembly

GENERAL ELECTRIC CO.



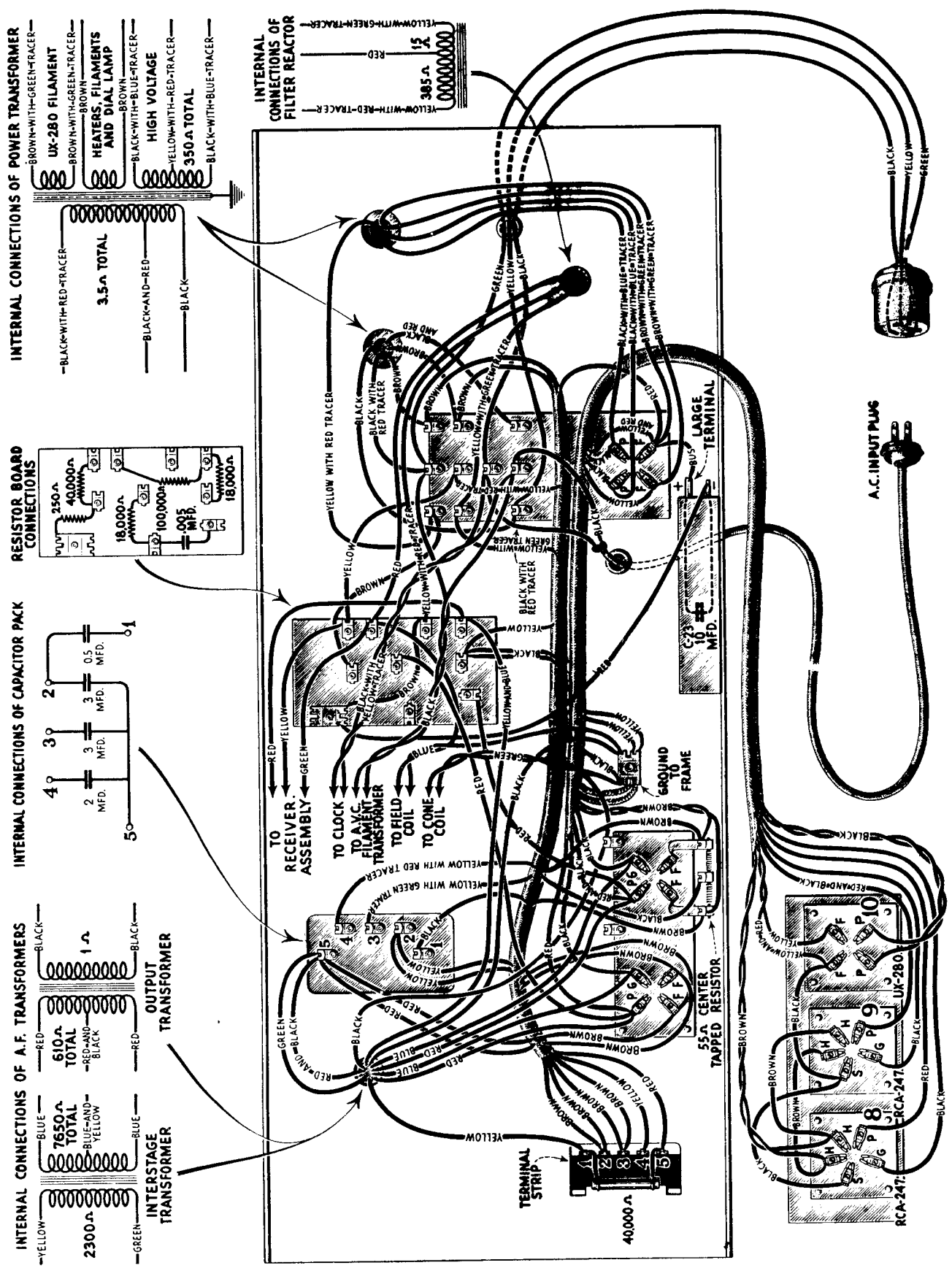
Wiring Diagram of Model H-91-R Receiver Assembly

GENERAL ELECTRIC CO.



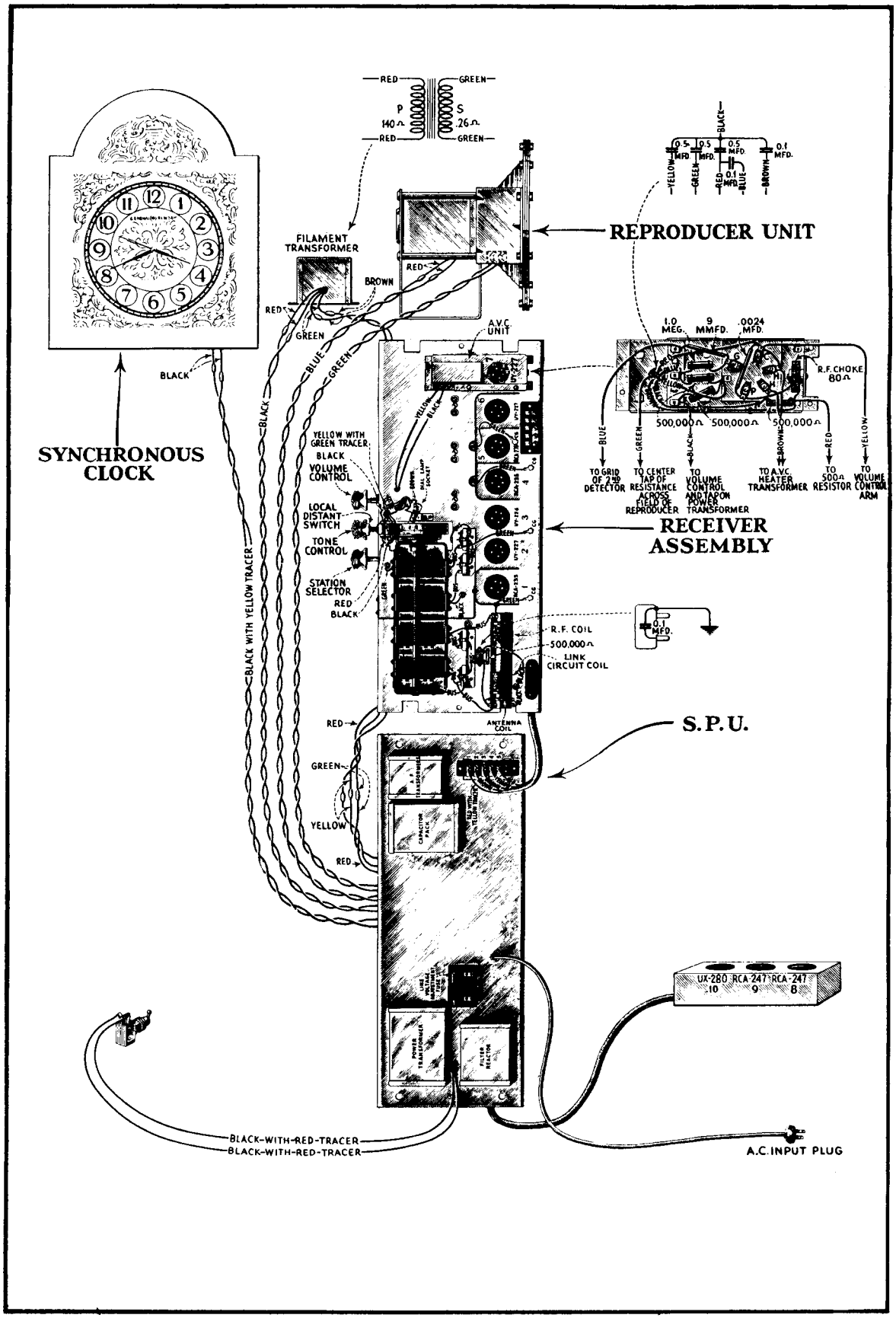
Wiring Diagram of Model H-91 S. P. U.

GENERAL ELECTRIC CO.



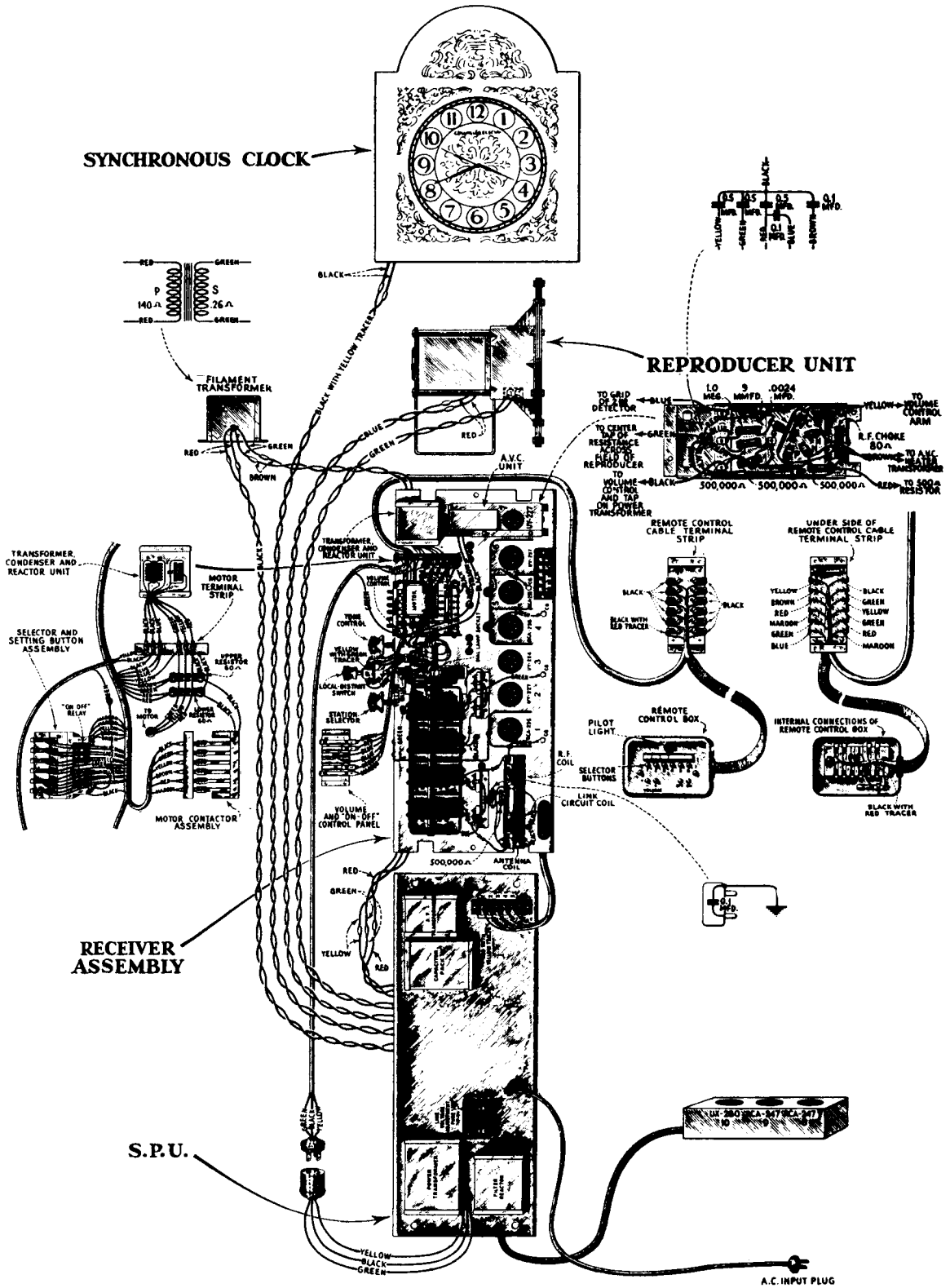
Wiring Diagram of Model H-91-R S. P. U.

GENERAL ELECTRIC CO.

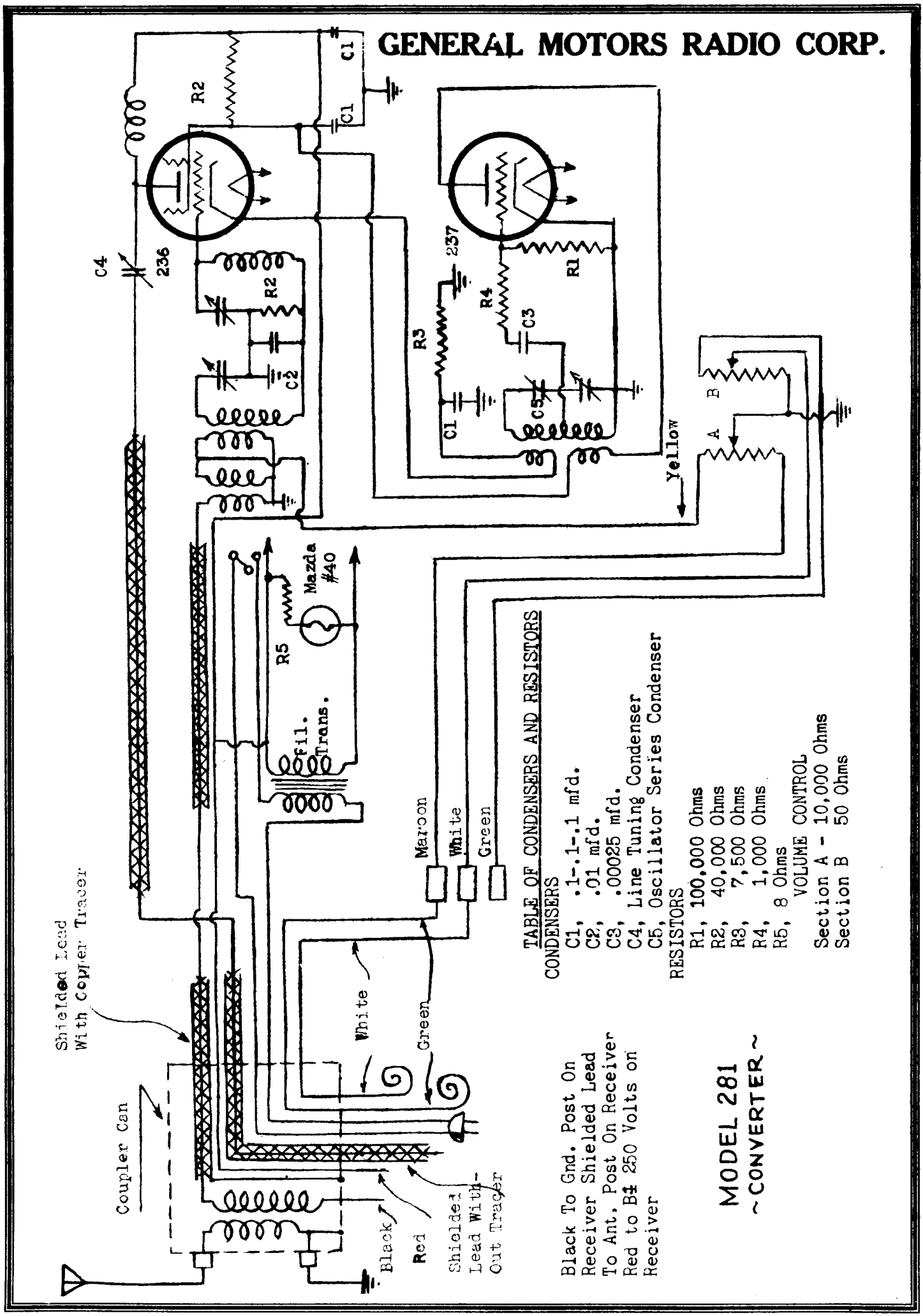


Assembly Wiring of Model H-91

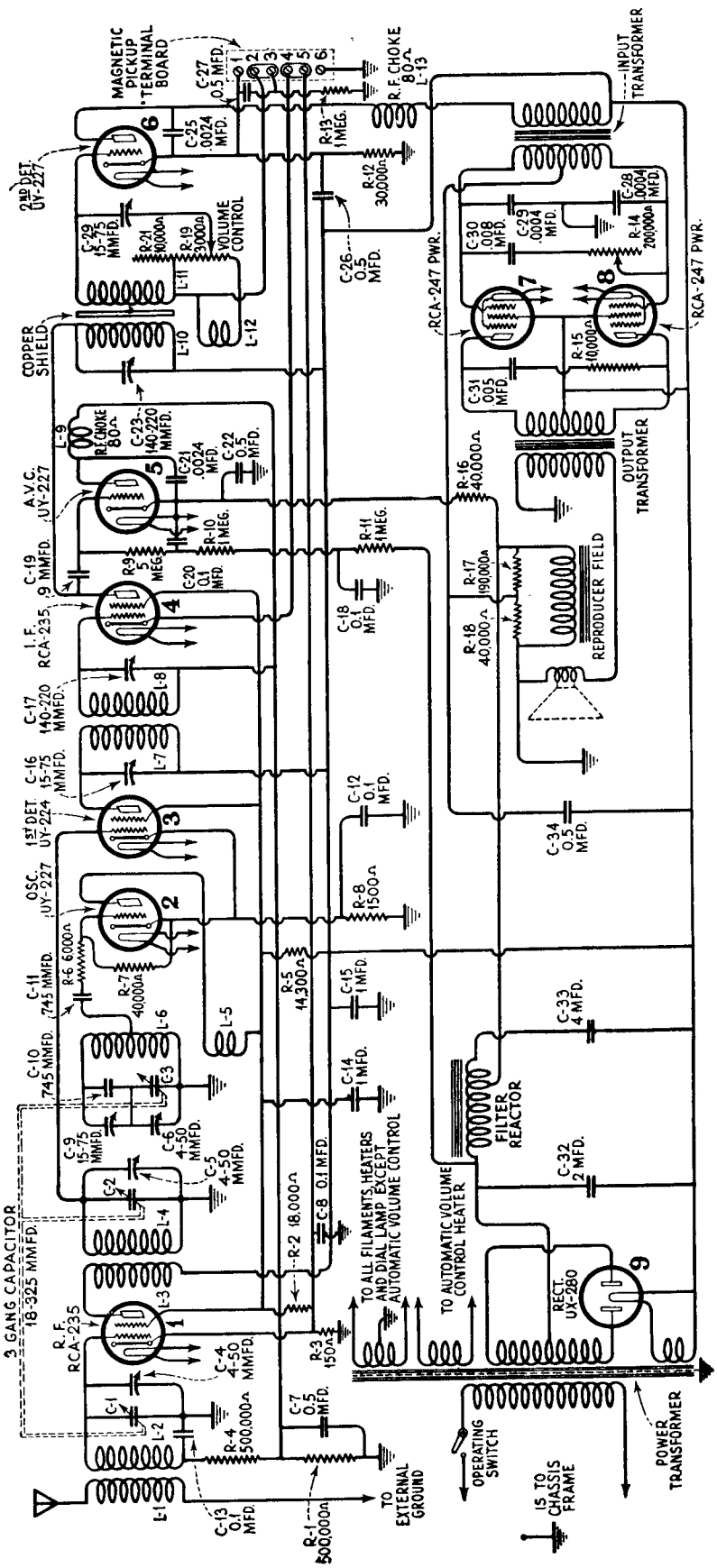
GENERAL ELECTRIC CO.

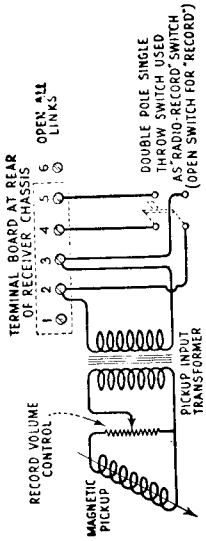


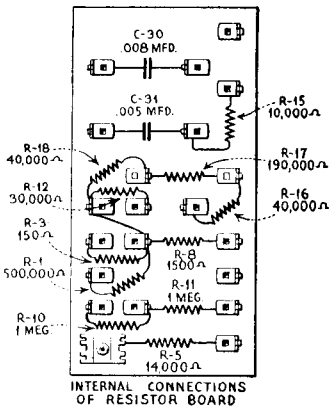
Assembly Wiring of Model H-91-R

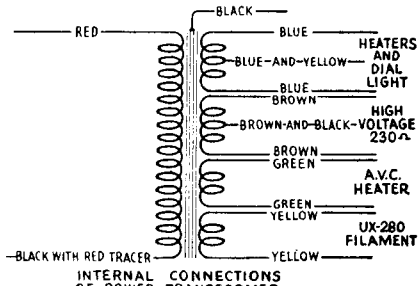

GENERAL MOTORS RADIO CORP.
C1
C1
R2
C4
236
R2
C2
237
R3
R4
C3
R1
C1
C5
B
A
Yellow
Mazda #40
R5
Fil. Trans.
Maroon
White
Green
Shielded Lead With Copper Tracer
Coupler Can
White
Green
Black
Red
Shielded Lead With-Out Tracer
Black To Gnd. Post On Receiver Shielded Lead To Ant. Post On Receiver Red to B+ 250 Volts on Receiver
TABLE OF CONDENSERS AND RESISTORS
CONDENSERS
C1, .1-.1-.1 mfd.
C2, .01 mfd.
C3, .00025 mfd.
C4, Line Tuning Condenser
C5, Oscillator Series Condenser
RESISTORS
R1, 100,000 Ohms
R2, 40,000 Ohms
R3, 7,500 Ohms
R4, 1,000 Ohms
R5, 8 Ohms
VOLUME CONTROL
Section A - 10,000 Ohms
Section B 50 Ohms
MODEL 281
~CONVERTER~

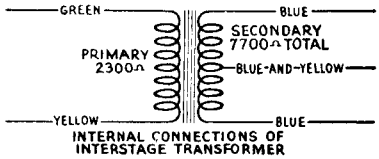
GENERAL ELECTRIC CO.

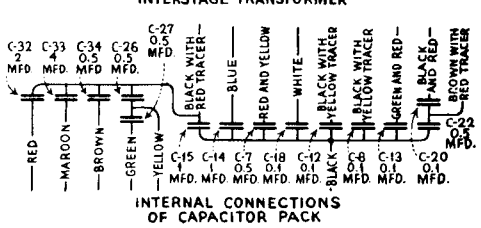




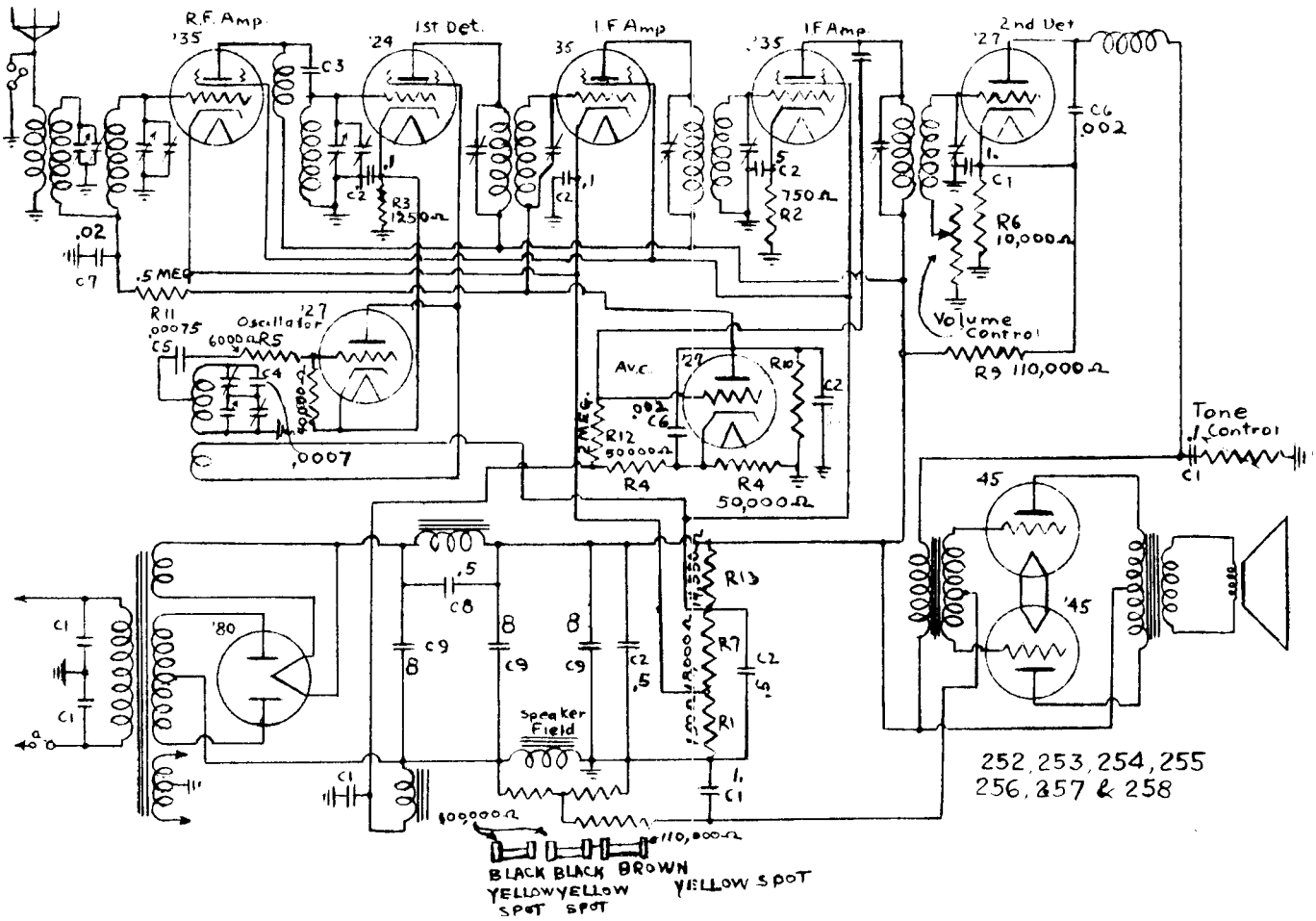




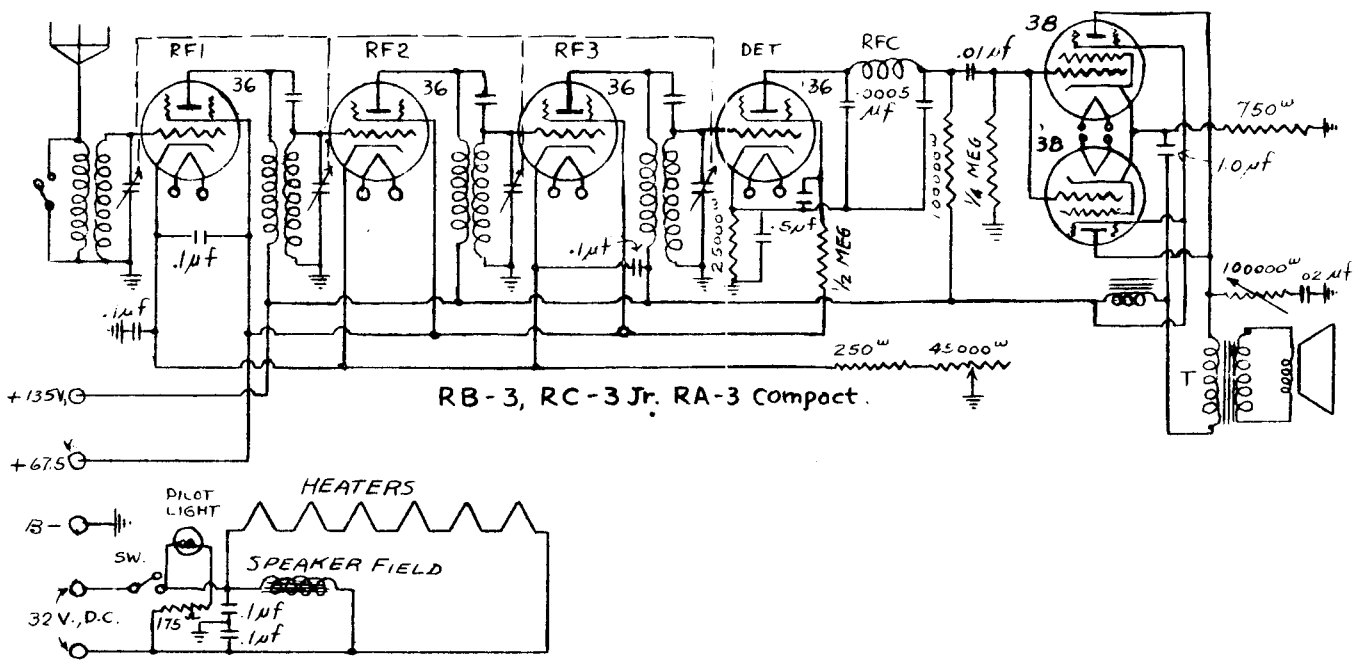




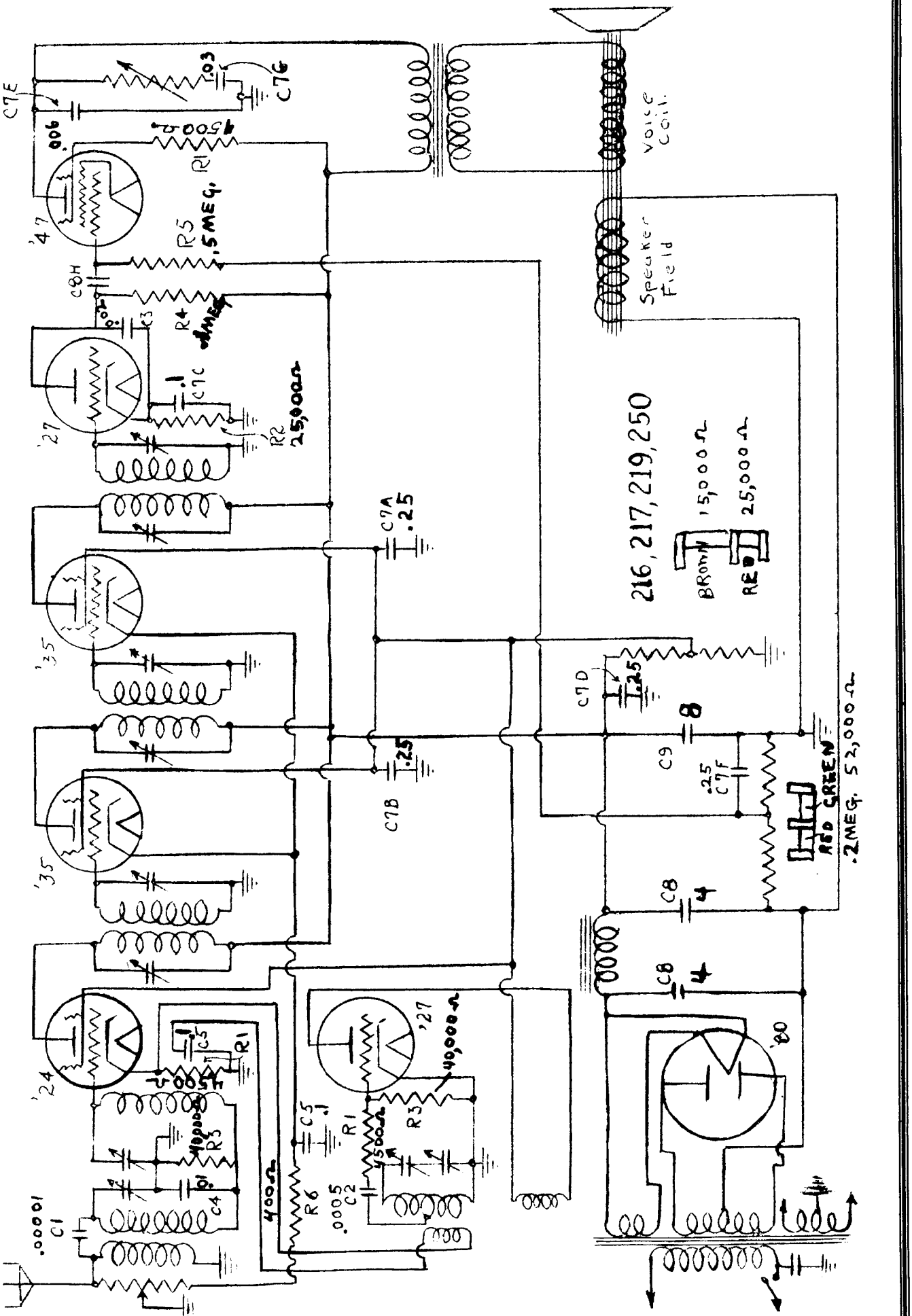
GENERAL MOTORS RADIO CORP.



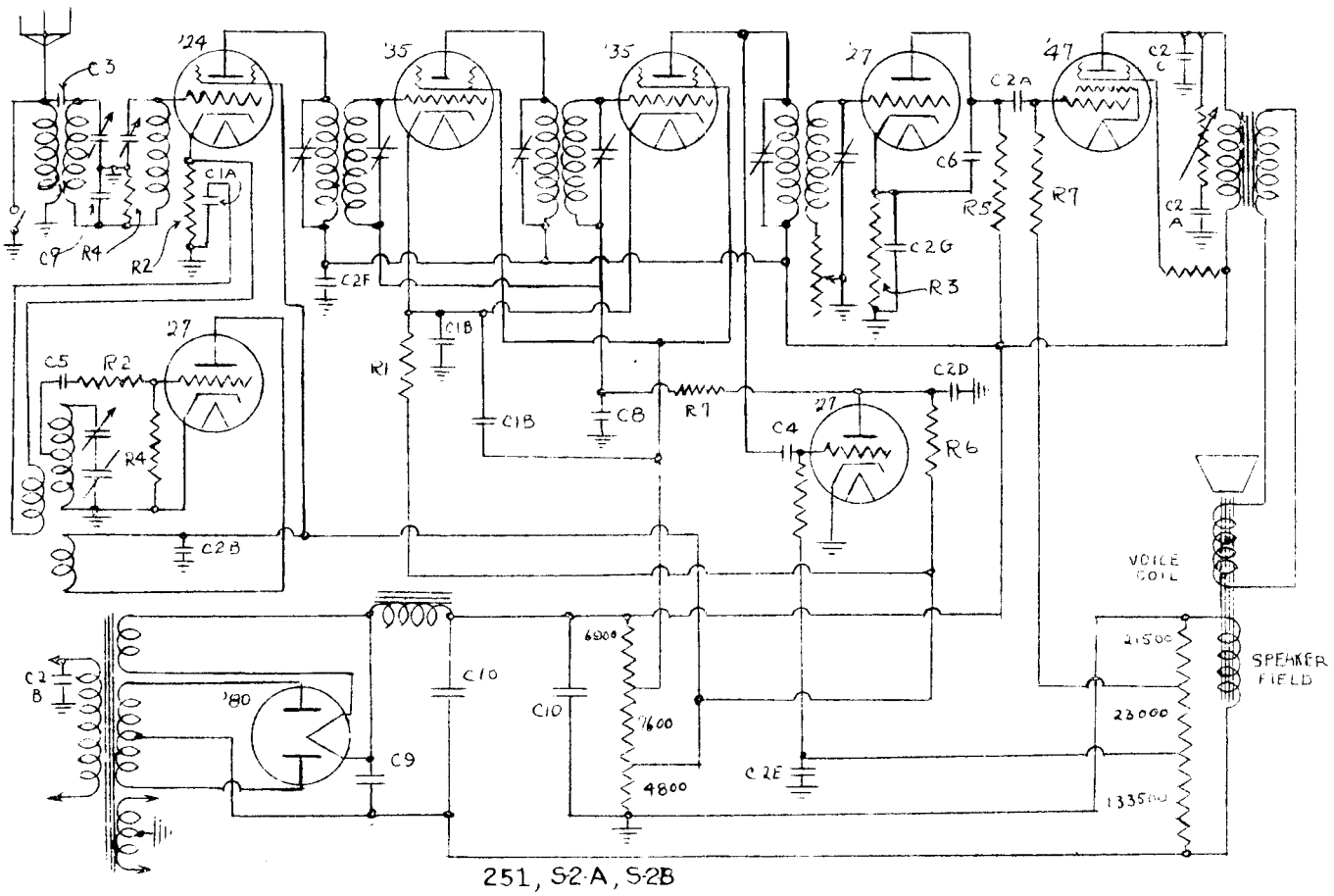
DELCO



GENERAL MOTORS RADIO CORP.



GENERAL MOTORS RADIO CORP.



251, 52-A, 52-B

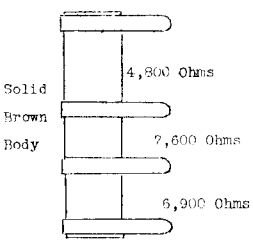
TABLE OF RESISTORS AND CONDENSERS:

251, 52-A, 52-B

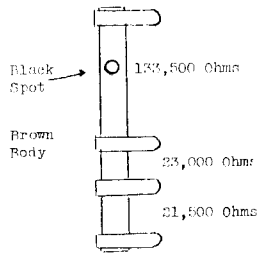
Resistors

No.	Body	End	Spot	Resistance	Watts
R1	Orange	Black	Brown	300	1/2
R2	Yellow	Green	Red	4,500	1/2
R3	Red	Green	Orange	25,000	1/2
R4	Yellow	Black	Orange	40,000	1/2
R5	Brown	Black	Yellow	100,000	1/2
R6	Red	Green	Yellow	250,000	1/2
R7	Green	Black	Yellow	500,000	1/2
R8	Red	Black	Green	2 Megohms	1/2

Voltage Divider



Pentode Bias



CONDENSERS

No.	Capacity	
C1A	.1 Mfd.	By-Pass Condenser Pack No. 1
C1B	1.0 Mfd.	
C2A	.05 Mfd.	By-Pass Condenser Pack No. 2
C2B	.1 Mfd.	
C2C	.006 Mfd.	
C2D	.25 Mfd.	
C2E	1.0 Mfd.	
C2F	.25 Mfd.	
C2G	.1 Mfd.	
C3	.00001 Mfd.	
C4	.00025 Mfd.	
C5	.00075 Mfd.	
C6	.002 Mfd.	
C7	.01 Mfd.	
C8	1.0 Mfd.	
C9	4.0 Mfd.	(Electrolytic)
C10	8.0 Mfd.	(Electrolytic)

TESTING WITH A SET ANALYZER: 251, 52-A, 52-B

The following chart shows the approximate readings that should be obtained with any of the more reliable makes of set analyzers.

NOTE: Do Not attempt to take readings on the type 247 (Pentode) tube unless your set analyzer is equipped to test sets using this type of tube. Readings at the 247 tube socket will be misleading if the set analyzer is not adapted to test Pentode tubes.

TUBE IN SET ANALYZER

Type of Tube	Position of Tube	Fil. Volts	Plate Volts*	Control Grid Volts	Screen Grid Volts	Cathode Volts#	Pentode Screen Volts	Normal Plate MA	Rated Fil. Volts
224	1st Det.	2.1	255	1.0	77	6.0	--	1.0	2.0
235	1st I.F.	2.1	260	.3	100	9.0	--	1.6	2.0
235	2nd I.F.	2.1	260	.3	100	9.0	--	1.6	2.0
227	2nd Det.	2.15	145	.0	--	1.0	--	.3	2.0
227	Osc.	2.15	75	.0	--	0	--	2.0	2.0
227	A.V.C.	2.15	60	.0	--	0	--	.0	2.0
247	A.F.	2.15	275	1.0	--	--	275	30.0	2.0
280	Rect.	4.9	300	--	--	--	--	90-75	4.70

Line Volts: 110 Volume on Full

* Use 600 Volt Scale. # Measured from Cathode to Heater.

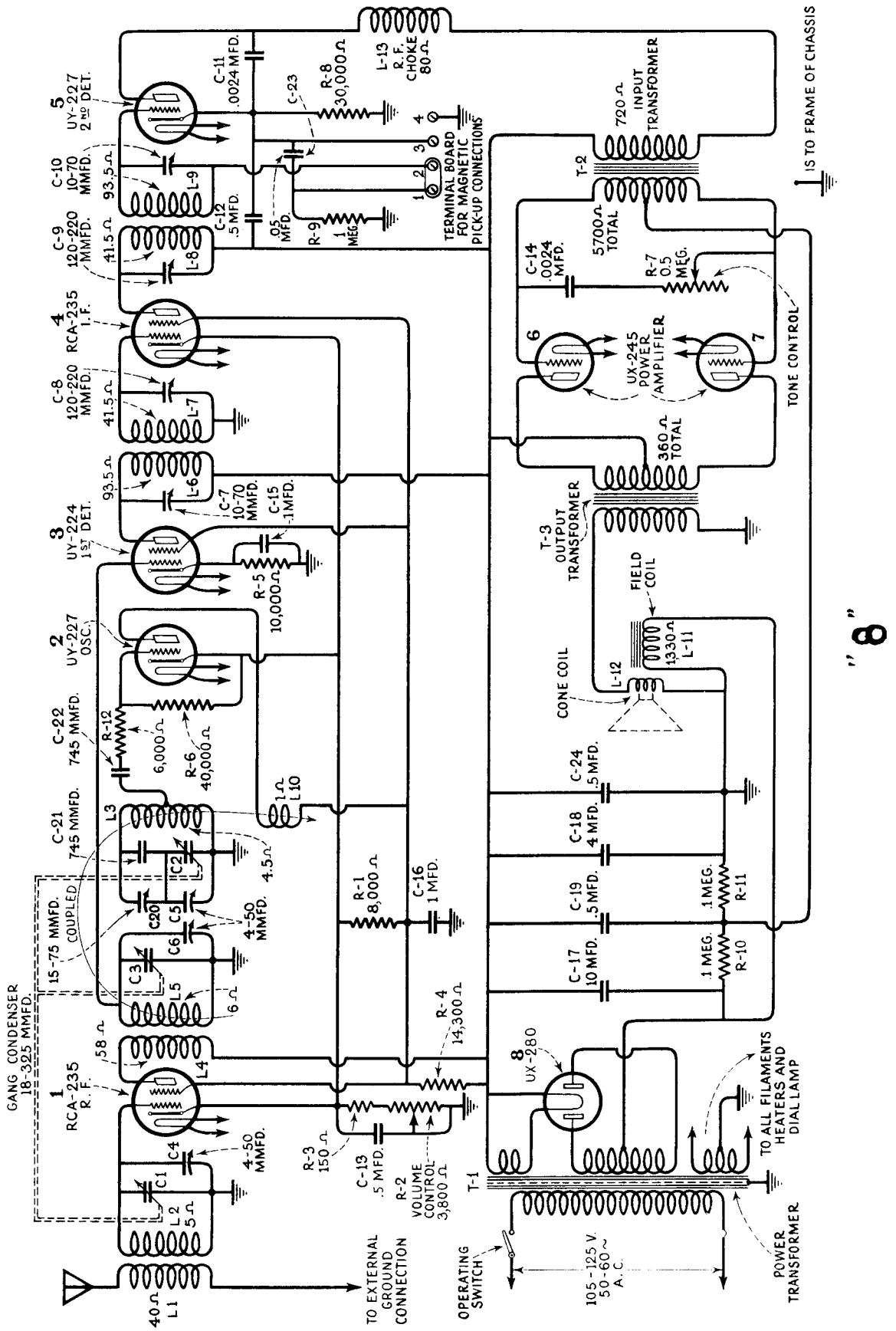
It should be noted that readings obtained with set analyzers will vary with different makes of analyzers, with different line voltages and with different tubes. The readings shown in the above table therefore, are only average values and for this reason, each service man should compile a chart similar to the one illustrated using his own set analyzer and a set that is known to be operating properly.

NOTE: (1) Use voltmeters having resistance of 1,000 Ohms per volt.

(2) Measure all plate voltages on 600 Volt Scale.

(3) Rated Filament voltages are those measured at the tube sockets with a high grade instrument. In general there is about a .1 volt drop in the set analyzer cable.

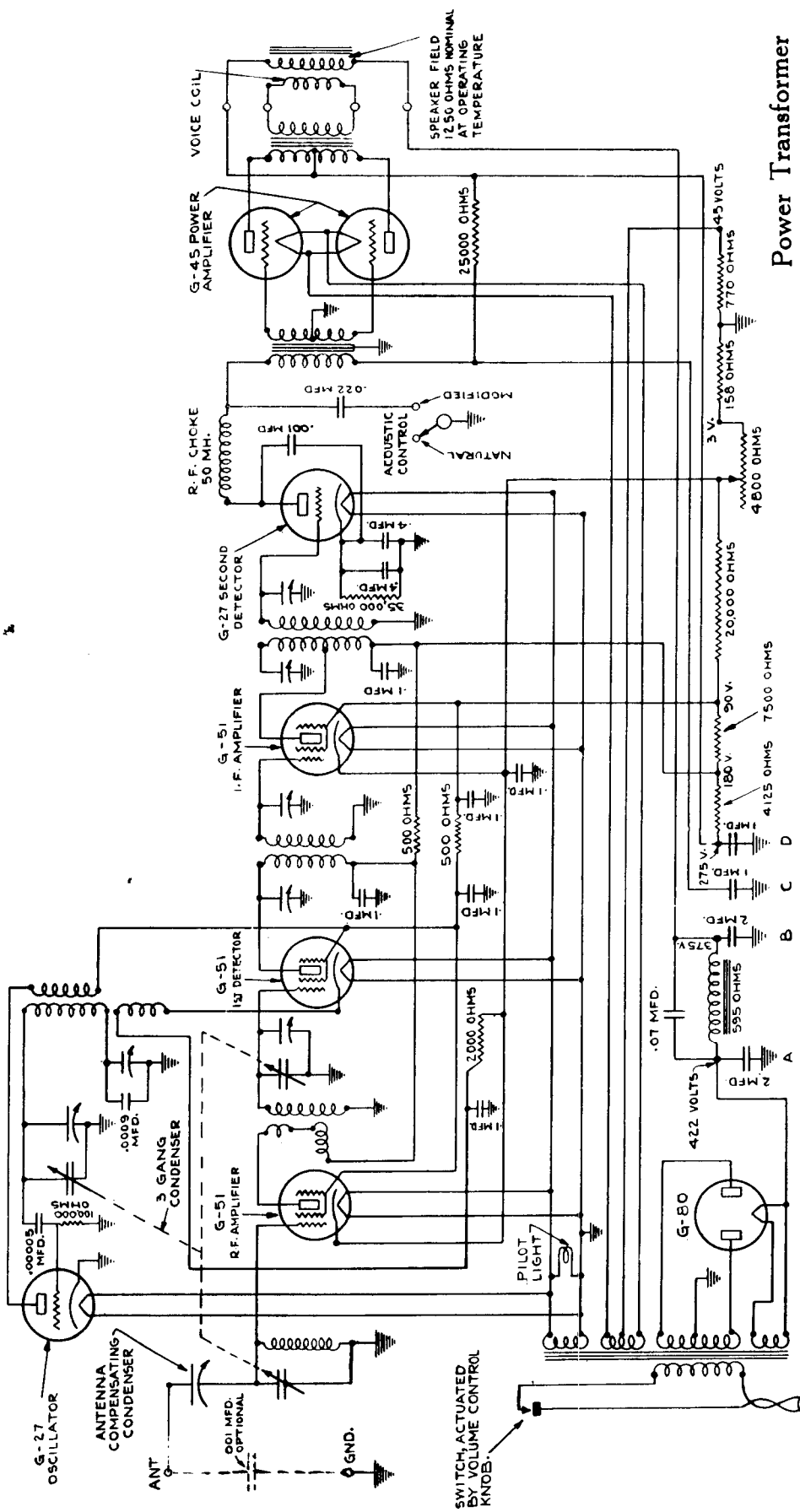
GRAYBAR ELECTRIC CO.



"8"

GRIGSBY-GRUNOW CO.

MODEL 20 CHASSIS 110 AND 220 VOLTS - 50-60 AND 25-40 CYCLE



Power Transformer

Primary—Red (No. 24)
Primary—Red (No. 24)
Filament } 45—Blue
Filament }
Heater } 51—Red (2 strands No. 18)
Heater }
Center Tap 45—Red (stranded)
Anode—Green (stranded)
C. T. Anode—Bare (stranded)
Anode—Green (stranded)
Filament } 80—Orange (No. 18)
Filament }

Filter Unit

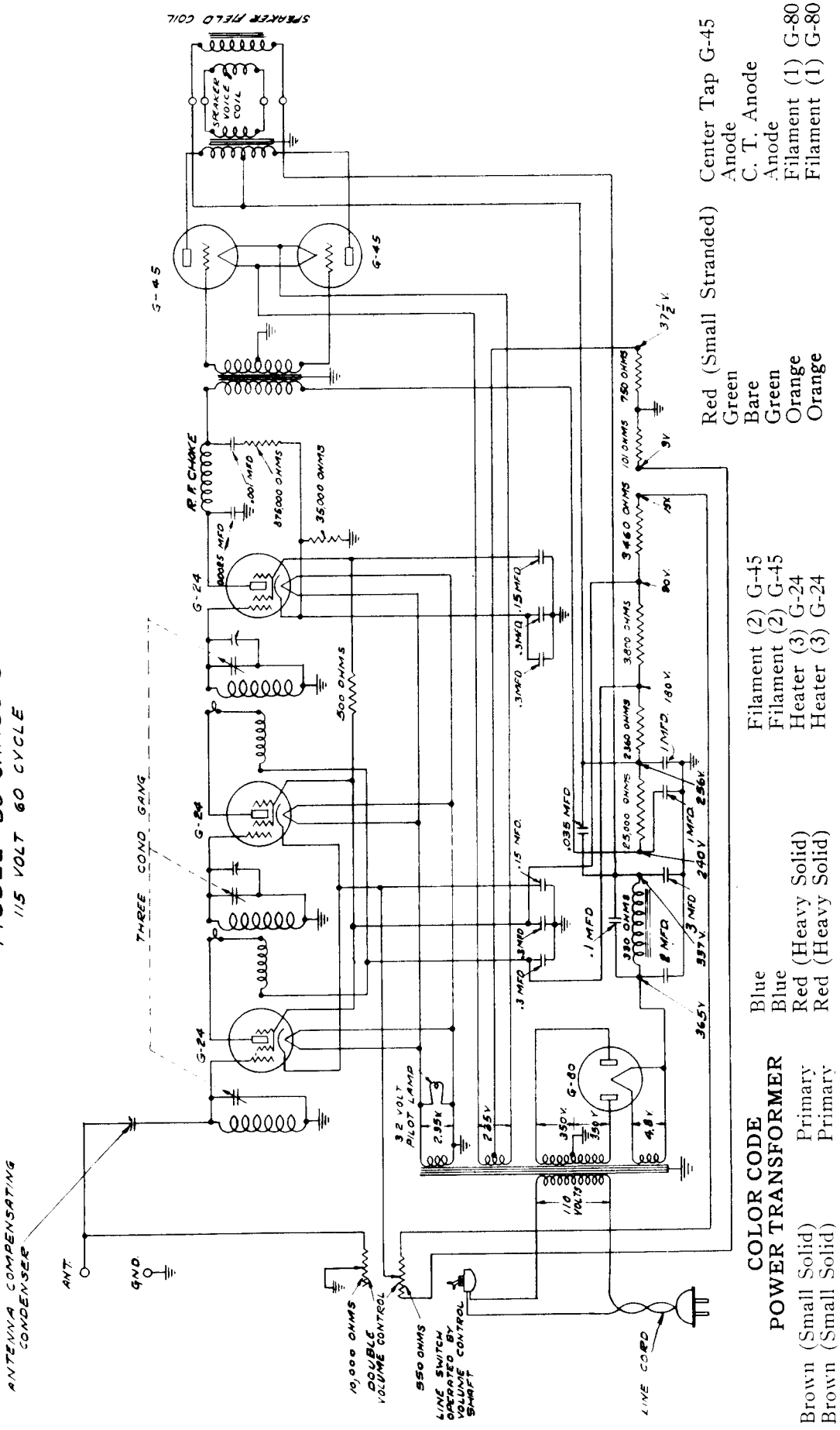
Condenser

2 microfarad condenser—Orange (stranded)
2 microfarad condenser—Blue (stranded)
1 microfarad condenser—Red (stranded)
1 microfarad condenser—Green (stranded)
.07 microfarad condenser—White (stranded)
Condenser common—Black (stranded)

Choke

G-80 socket (Filament)—Orange (stranded)
Junction speaker Field and Choke—Blue (stranded)

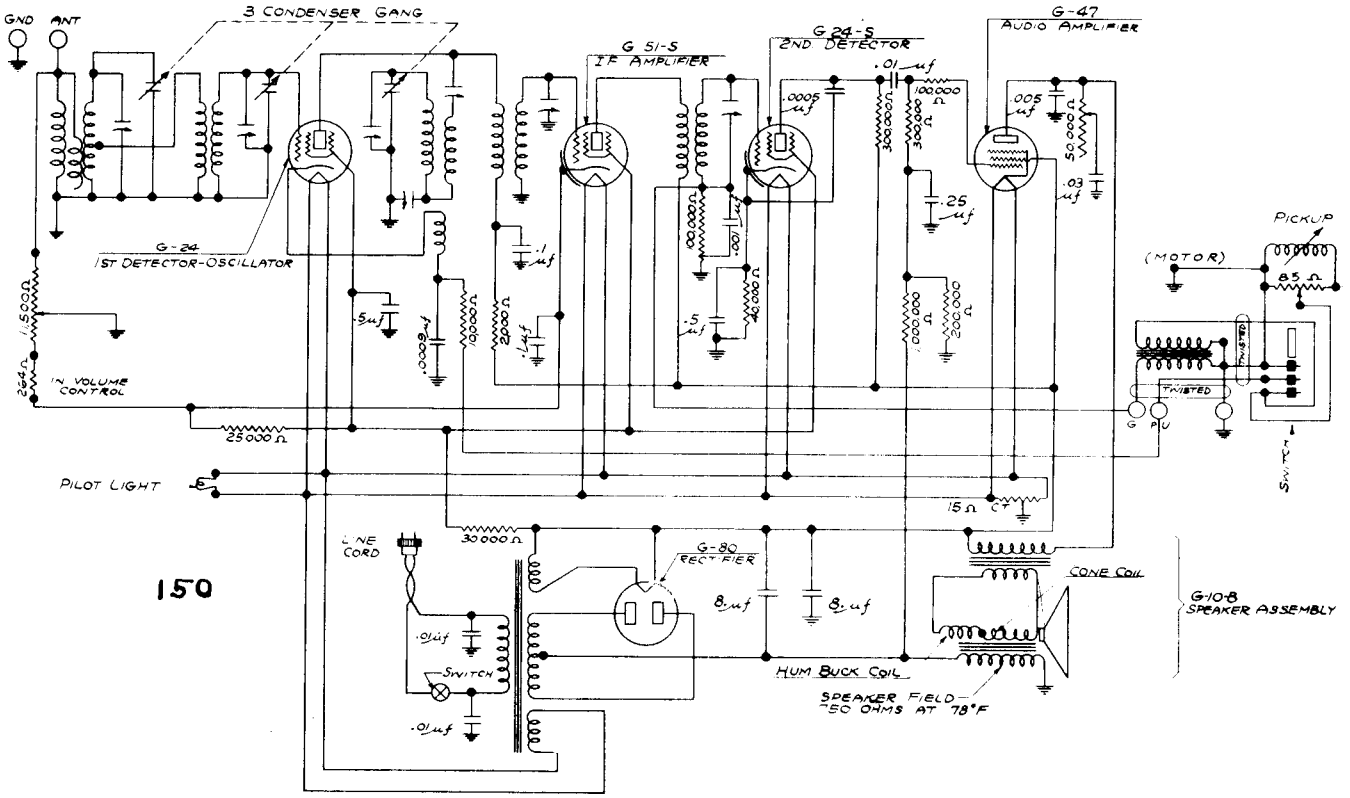
GRIGSBY-GRUNOW CO.

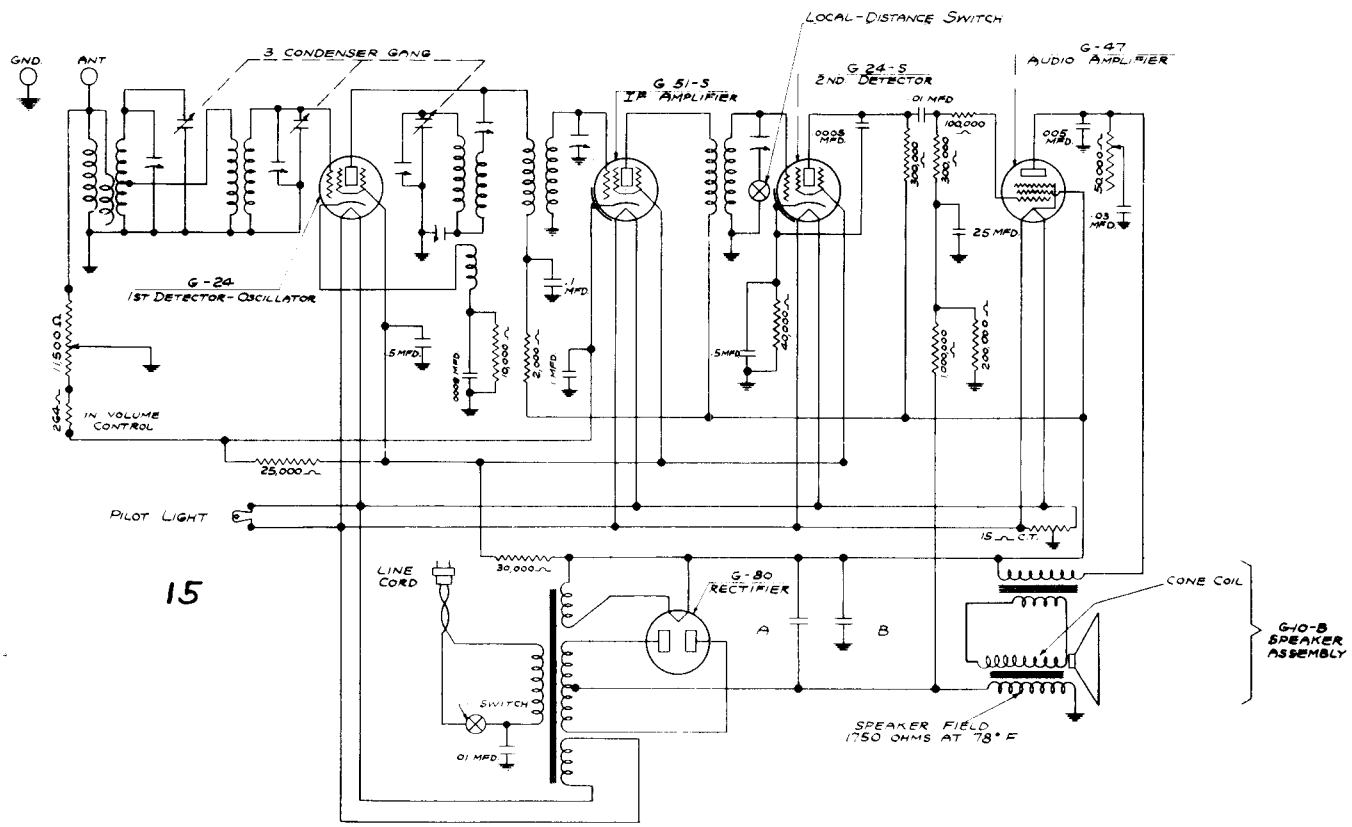


COLOR CODE	
POWER TRANSFORMER	
Brown (Small Solid)	Primary
Brown (Small Solid)	Primary
Blue	
Blue	
Red (Heavy Solid)	
Red (Heavy Solid)	

Filament (2) G-45	Red (Small Stranded)
Filament (2) G-45	Center Tap G-45
Heater (3) G-24	Green
Heater (3) G-24	Anode
	Bare
	C. T. Anode
	Green
	Anode
	Orange
	Filament (1) G-80
	Orange
	Filament (1) G-80

GRIGSBY-GRUNOW CO.





GRIGSBY-GRUNOW CO.

Technical Data Pertaining to Model 220 Chassis

The Circuit

The same chassis is employed in the Collingwood and Abbeywood models. The chassis designation is Model 220. In the Model 220 chassis there has been utilized all of the beneficial features of Chassis 35, 200 and 210. The circuit arrangement is as follows: Type G-35-S radio frequency amplifier stage, Type G-27-S oscillator, Type G-35-S first detector stage, Type G-35-S first intermediate frequency stage, Type G-35-S second intermediate frequency stage, Type G-2-S duodiode second detector stage, Type G-35-S compensated first audio stage, Type G-27-S second audio stage, Two Type G-50 push-pull high power output stage. Two Type G-81 tubes are employed for rectifiers, bringing the total number of tubes to twelve. Four gang tuning is employed in the radio frequency in this chassis, which makes for complete elimination of images and harmonics. Special highly selective I.F. transformers of the tapped type are used to insure adequate selectivity. The Type G-35-S audio amplifier stage is unique in that special means are provided for giving that deep, rich bass so desirable, but the obtaining of this bass is had without loss of the higher overtone frequencies. The use of push-pull Type G-50 power amplifier tubes gives that reserve energy necessary for the obtaining of full depth without distortion of overload.

Method of Biasing

The initial bias on the R.F., first detector, and first I.F. tubes is obtained by means of a common self-bias resistor of 180 ohms in the cathode circuit. The second I.F. tube makes use of a separate self-bias resistor of 700 ohms to insure its smooth operation into the duodiode circuit. The oscillator is of the grid leak type, and is, therefore, self-biasing. The screen Grid first audio stage obtains its bias from the voltage divider, while the G-27 second audio stage uses self-bias. The output tubes obtain their bias by the voltage drop across the resistance of one of the speaker fields, connected in the filament circuit.

Automatic Volume Control

The automatic volume control system employed in the Model 220 Chassis is of the exclusive Majestic type using the new G-2-S duodiode tube for a second detector. Automatic control is obtained by applying the second detector bias to the R.F., First Detector, and First I.F. stages to control their amplification. The second I.F. stage is not effected by the A.V.C. action to insure smooth working into the second detector stage.

The manual volume control is a 200,000 ohm potentiometer in the grid circuit of the first audio stage.

Power Supply System

The Power supply system of the Model 220 chassis consists of the power transformer, two type G-81 rectifiers, a filter choke which is tuned to the hum frequency, a 2 mfd. paper condenser, a 4 mfd. paper condenser, and an 8 mfd. electrolytic condenser. One of the speaker fields functions as a second filter choke.

Sensitivity

The sensitivity of this chassis is naturally of a very high order, because of the relatively large number of tubes employed. Special care has been taken in the design to prevent disturbing background noises, so common with many highly sensitive receivers. In cases where low sensitivity is encountered, the G-35-S tubes should be carefully checked before trying to remedy this condition by realigning the condensers.

Radio Phonograph Switch

Both the Collingwood and Abbeywood Models have a radio phonograph switch which is located below the central control or station selector. This switch is turned to the right for radio operation, and to the left for phonograph operation. There are pick-up terminals on the Model 220 chassis employed in both these sets, although the Collingwood is not a combination receiver.

GRIGSBY-GRUNOW CO.

"Off" and "On" Line Switch

The "Off" and "On" line switch is attached to the acoustic control shaft. Turning the acoustic control completely to the left turns the receiver off. The first fifteen degrees of rotation of the acoustic control to the right will turn the receiver on. The balance of rotation to the right controls the tone, the treble position being at the extreme right, and the bass position at the extreme left, just before the switch is turned off.

Antenna and Ground Terminals

Terminals are provided on the Model 220 chassis for antenna and ground connections. Antenna and ground terminals are located at the rear of the chassis, and clearly marked. Normal antenna length should be approximately 30 to 40 feet. When the receiver is to be operated in localities several hundred miles distant from broadcasting stations, a longer antenna is recommended. In such cases where consistent long distance reception will be required, antenna length should be approximately one hundred feet.

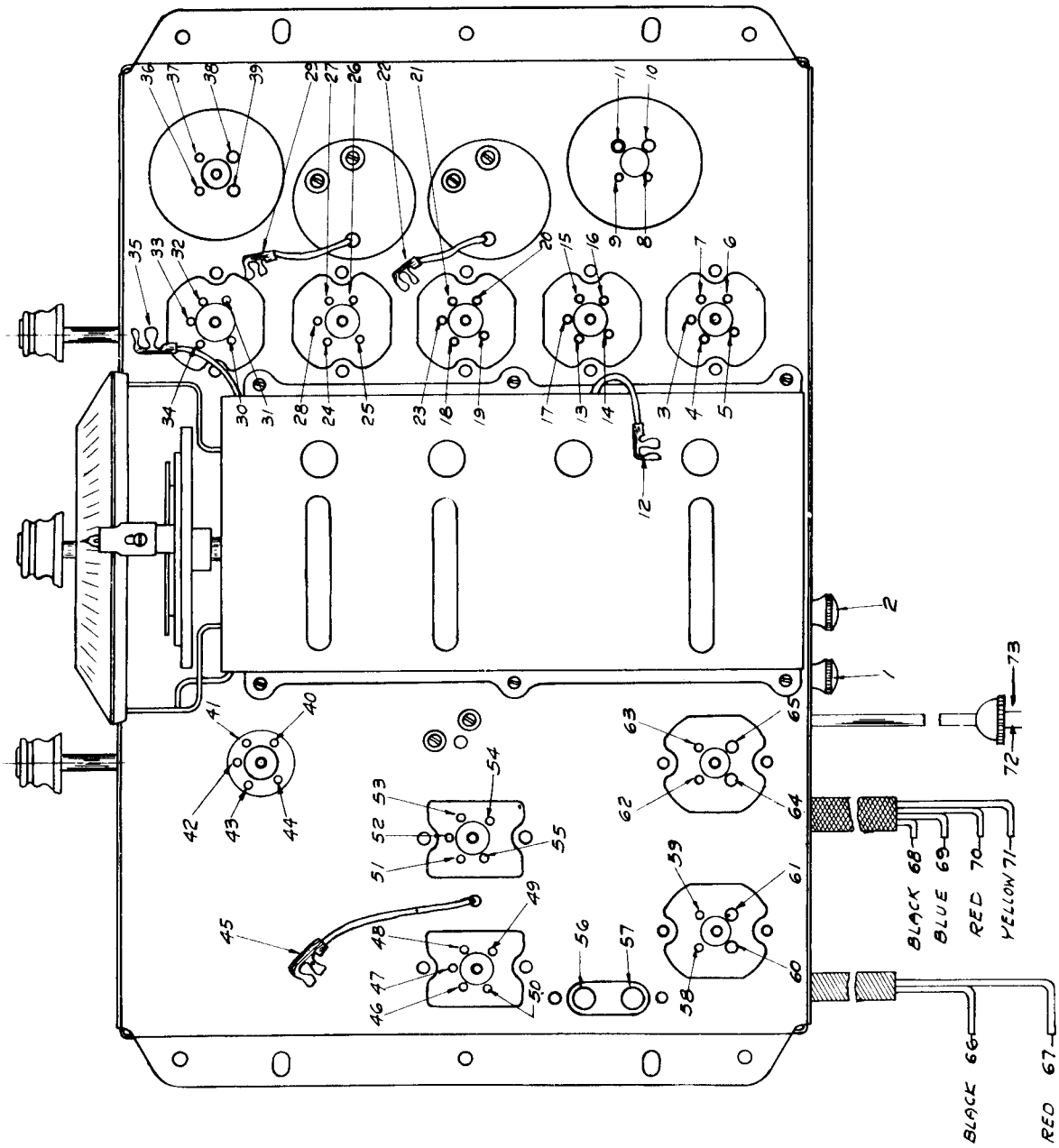
Models G-10-E, G-14-E, G-14-C and G-14-D Dynamic Speakers Employed in Models Collingwood and Abbeywood

Both the Collingwood and Abbeywood Models are equipped with twin speakers. The Collingwood model employs the G-10-E, a small dynamic speaker (field resistance 765 ohms), to produce the high tones, and the G-14-E, a large dynamic speaker (field resistance 5500 ohms), to produce the low tones. The Abbeywood Model employs the G-14-C, a large dynamic speaker (field resistance 5500 ohms), to produce the low tones, and the G-14-D, a large dynamic speaker (field resistance 765 ohms) to produce the high tones. These speakers operating simultaneously produces an almost flat audio frequency response curve which gives these receivers a truly faithful reproduction.

Color Code of Power Transformer

Start of Primary	Black
Finish of Primary	Yellow
Start of 7.5 volt Rectifier filament	Black
Finish of 7.5 volt Rectifier filament	Black
Start of 2.5 volt Heater No. 1	Yellow
Finish of 2.5 volt Heater No. 1	Yellow
Start of 2.5 volt Heater No. 2	Black
Center tap of 2.5 volt Heater No. 2	Red
Finish of 2.5 volt Heater No. 2	Black
Start of 7.5 volt filament	Yellow
Center tap of 7.5 volt filament	Brown
Finish of 7.5 volt filament	Yellow
Start of Anode	Red
Center tap of Anode	Black
Finish of Anode	Red

GRIGSBY-GRUNOW CO.



Continuity Diagram of Model 220 Chassis

MODEL 220 CONTINUITY CHART

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
1	H R	Open	.76	Ground Connection
2	L R	3	.12	Primary of Antenna Coil
3 and 7	L R	3	.74	2.5-Volt Heater Winding (R. F.) and Ground Connection
3 to 7	L R	3	.68	2.5-Volt Heater Winding (R. F.)
4	H R	Open	.6	Oscillator Coil, C_2, Phono-Switch and C_3
5	H R	Open	.16	R_{12}
6	H R	Open	.76	Ground Connection
8	H R	Open	0	No Connection
9	L R	55	.26	One-Half of High Voltage Secondary and Center Tap Ground
10 and 11	H R	Open	0	G-81 Filament Winding C_{17}, C_{18} and Filter Choke
10 to 11	L R	3	.5	G-81 Filament Winding
12	H R	Open	.02	Secondary of 2nd R. F. Coil, C_{12}, R_{11}, C_{21}, R_3 and R_4
13	H R	Open	.5	Primary of 1st I. F. Transformer C_{11}, C_{22}
14	H R	Open	.6	See Terminal No. 4
15 and 17	Same as Terminals Nos. 3 and 7			
15 to 17	Same as Terminals Nos. 3 to 7			
16	L R	Open	.82	Oscillator Coil C_6, R_1, C_1 and R_5
18	H R	Open	.5	Primary of 2nd I. F. Transformer, also see Terminal No. 13
19	H R	Open	.6	See Terminal No. 4
20	L R	Open	.5	See Terminal No. 16
21 and 23	Same as Terminals Nos. 3 and 7			
21 to 23	Same as Terminals Nos. 3 to 7			
22	L R	55	.28	Secondary of 1st I. F. Transformer, C_{14}, R_{13}, also see Terminal No. 16
24	H R	Open	.5	Primary of 3rd I. F. Transformer, also see Terminal No. 13

MODEL 220 CONTINUITY CHART—Continued

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
25	H R	Open	.6	See Terminal No. 4
26	L R	55	.22	C_5 and R_{22}
27 and 28	Same as Terminals Nos. 3 and 7			
27 to 28	Same as Terminals Nos. 3 to 7			
29	H R	Open	.1	Secondary of 2nd I. F. Transformer
30	H R	Open	.6	See Terminal No. 4
31	L R	Open	.42	See Terminal No. 16
32 and 33	Same as Terminals Nos. 3 and 7			
32 to 33	Same as Terminals Nos. 3 to 7			
34	H R	Open	.5	Primary of 1st R. F. Coil, also see Terminal No. 13
35	H R	Open	.02	C_{13}, R_{10}, also see Terminal No. 12
36	H R	Open	0	No Connection
37	L R	55	.26	One-Half of High Voltage, Secondary and Center Tap Ground
38 and 39	Same as Terminals Nos. 10 and 11			
38 to 39	Same as Terminals Nos. 10 to 11			
40	H R	Open	.06	Secondary of 3rd I. F. Transformer, C_{24}, R_{14}, C_8 and R_4
41	H R	Open	.76	Ground Connection
42 and 43	L R	3	.5	Ground at Center Tap of 2.5-Volt Heater Winding (A. F.)
42 to 43	L R	3	.6	2.5-Volt Heater Winding (A. F.)
44	Same as Terminal No. 40			
45	H R	3	.08	R_{20} and Ground Connection
46 and 47	Same as Terminals Nos. 41 and 42			
46 to 47	Same as Terminals Nos. 41 to 42			
48	L R	55	.3	R_6 and Ground Connection

MODEL 220 CONTINUITY CHART—Continued

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED, SPEAKER DISCONNECTED, AND VOLUME AND ACOUSTIC CONTROL IN MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
49	H R	Open	.68	R_6 and R_7
50	H R	Open	.28	C_8, R_{17}, Audio Choke; also see Terminal No. 13
51 and 52	Same as Terminals Nos. 42 and 43			
51 to 52	Same as Terminals Nos. 42 to 43			
53	L R	Open	.12	C_{10} and R_{16}
54	H R	Open	0	C_9 and R_{18}
55	H R	Open	.46	C_4, Primary of Input Transformer: also see Terminal No. 13
56	H R	Open	.76	Ground Connection
57	H R	Open	.34	R_{15} and C_{20}
58	L R	Open	.18	Secondary of Input Transformer and Center Tap Ground
59	H R	Open	0	Plate Terminal of G-50 Tube Socket and Speaker Cable
60 and 61	H R	Open	0	7.5-Volt Filament Winding and Center Tap
60 to 61	L R	3	.46	7.5-Volt Filament Winding
62	Same as Terminal No. 58			
63	Same as Terminal No. 59			
64 and 65	Same as Terminals Nos. 42 and 43			
64 to 65	Same as Terminals Nos. 42 to 43			
66	H R	Open	.76	Ground Connection on Speaker Cable
67	H R	Open	0	See Terminals Nos. 60 and 61
68	H R	Open	.48	See Terminal No. 13
69	H R	Open	0	G-81 Filament Winding, C_{17}, C_{18} and Filter Choke
70	H R	Open	0	See Terminal No. 59
71	H R	Open	0	See Terminal No. 59
72	H R	Open	0	C_{15}, C_{16}, Primary of Power Transformer and A. C. Switch
73	H R	Open	0	See Terminal No. 72

CONTINUITY WITH SPEAKER CONNECTED

ALL CONTINUITIES TO GROUND WITH TUBES REMOVED AND VOLUME AT MAXIMUM POSITION

Terminal No.	Continuity Meter Switch Position No. 1	Continuity Meter Switch Position No. 2	Normal Reading	If Meter Reading Differs Greatly from "Normal Reading" Investigate the Following:
66	H R	Open	.76	Ground Connection
67	L R	Open	.46	765-Ohm Field Coil
66 to 67	L R	Open	.46	765-Ohm Field Coil
68	H R	Open	.5	See Terminal No. 13 Above
69	H R	Open	.44	5,500-Ohm Field Coil; also see Terminal No. 69 Above
68 to 69	H R	Open	.64	5,500-Ohm Field Coil
70 and 71	H R	Open	.44	Primary of Output Transformer; also see Terminal No. 69
70 to 71	L R	55	.1	Primary of Output Transformer

*Note that the readings vary according to the polarity of the test leads. Use the polarity giving approximately the same results as given above.

MODEL 220 CHASSIS TABLE OF VOLTAGE AND CURRENT READINGS

ALL D. C. VOLTAGE READINGS ARE TO GROUND

Tube Purpose	Type Tube	Filament Voltage A. C.	Plate Voltage D. C.	Filament to Ground D. C.	Cathode to Ground D. C.	Plate Current M. A.-D. C.	Screen Voltage D. C.	Screen Current M. A.-D. C.
R. F. Amp.	G-35-S	2.5	250	0	3	4.8	100	.5
Oscillator	G-27-S	2.5	100	0	0	8.5		
1st Detector	G-35-S	2.5	250	0	6	5.0	100	.7
1st I. F. Amp.	G-35-S	2.5	250	0	3	9.2	100	1.0
2nd I. F. Amp.	G-35-S	2.5	250	0	3.5	3.5	100	.6
2nd Detector	G-2-S	2.5	0	0	0	0		
1st Audio	G-35-S	2.5	185	0	2	1.5	46	.3
2nd Audio	G-27-S	2.5	280	0	20	4.5		
Power Amp.	G-50	7.5	500	84		40		
Power Amp.	G-50	7.5	500	84		40		
Rectifier	G-81	7.5		550		60		
Rectifier	G-81	7.5		550		60		

First Condenser—550 Volts D. C.
Second Condenser—520 Volts D. C.
Third Condenser—250 Volts D. C.
Line Voltage—115 Volts
Volume Control—Maximum
Phono Switch—Radio Position

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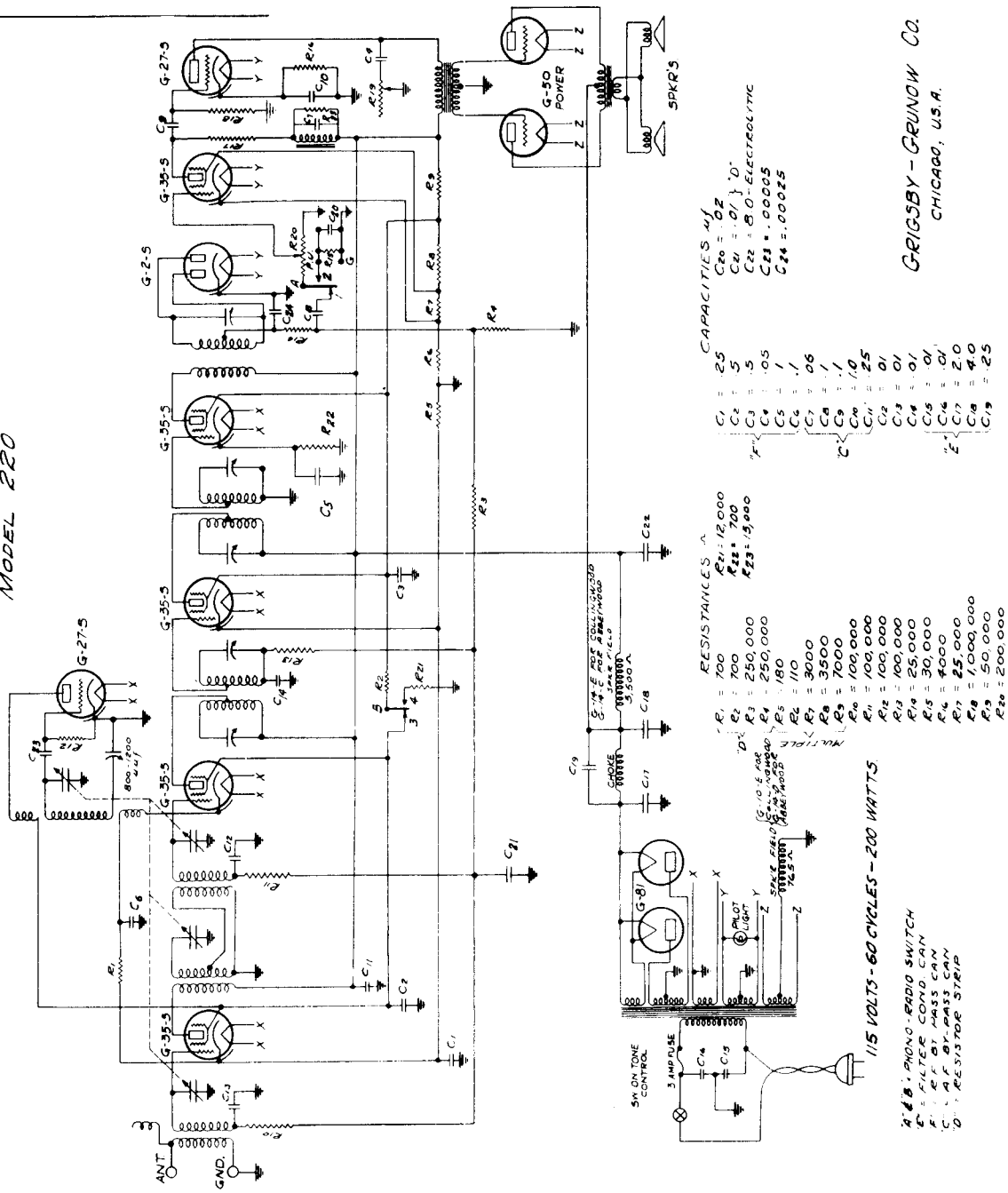
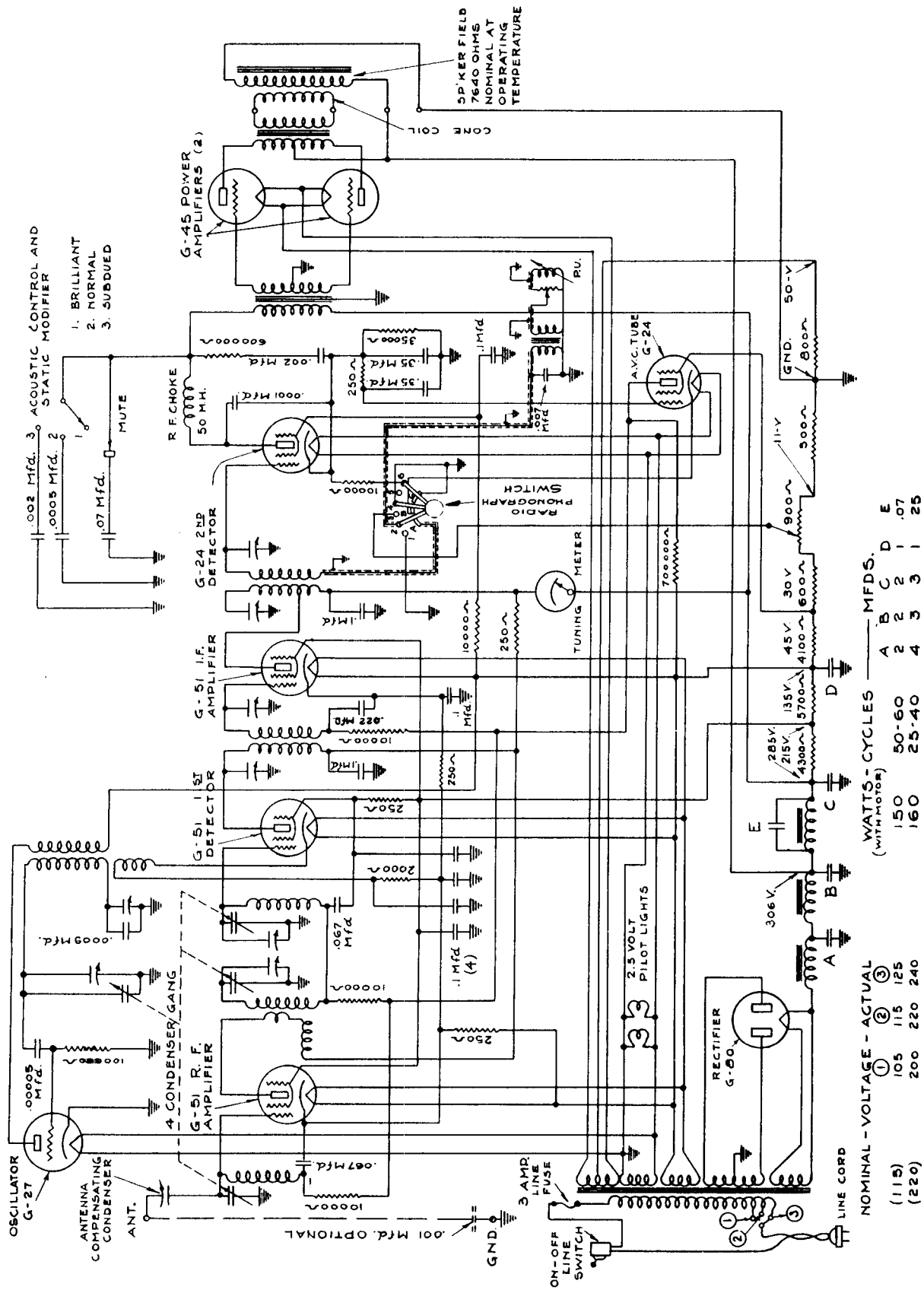
FIG 132
2-28-32 / 5-1-32 / 7-15-32

SCHEMATIC DIAGRAM OF MAJESTIC AUTOMATIC VOLUME CONTROL SUPERHETERODYNE RECEIVER
MODEL 220



GRIGSBY-GRUNOW CO.

SCHEMATIC DIAGRAM OF MAJESTIC SCREEN GRID SUPERHETERODYNE AUTOMATIC VOLUME CONTROL RECEIVER AND ELECTRIC PHONOGRAPH COMBINATION MODEL 160 CHASSIS 115 AND 220 VOLTS, 25 - 40 AND 50 - 60 CYCLES.



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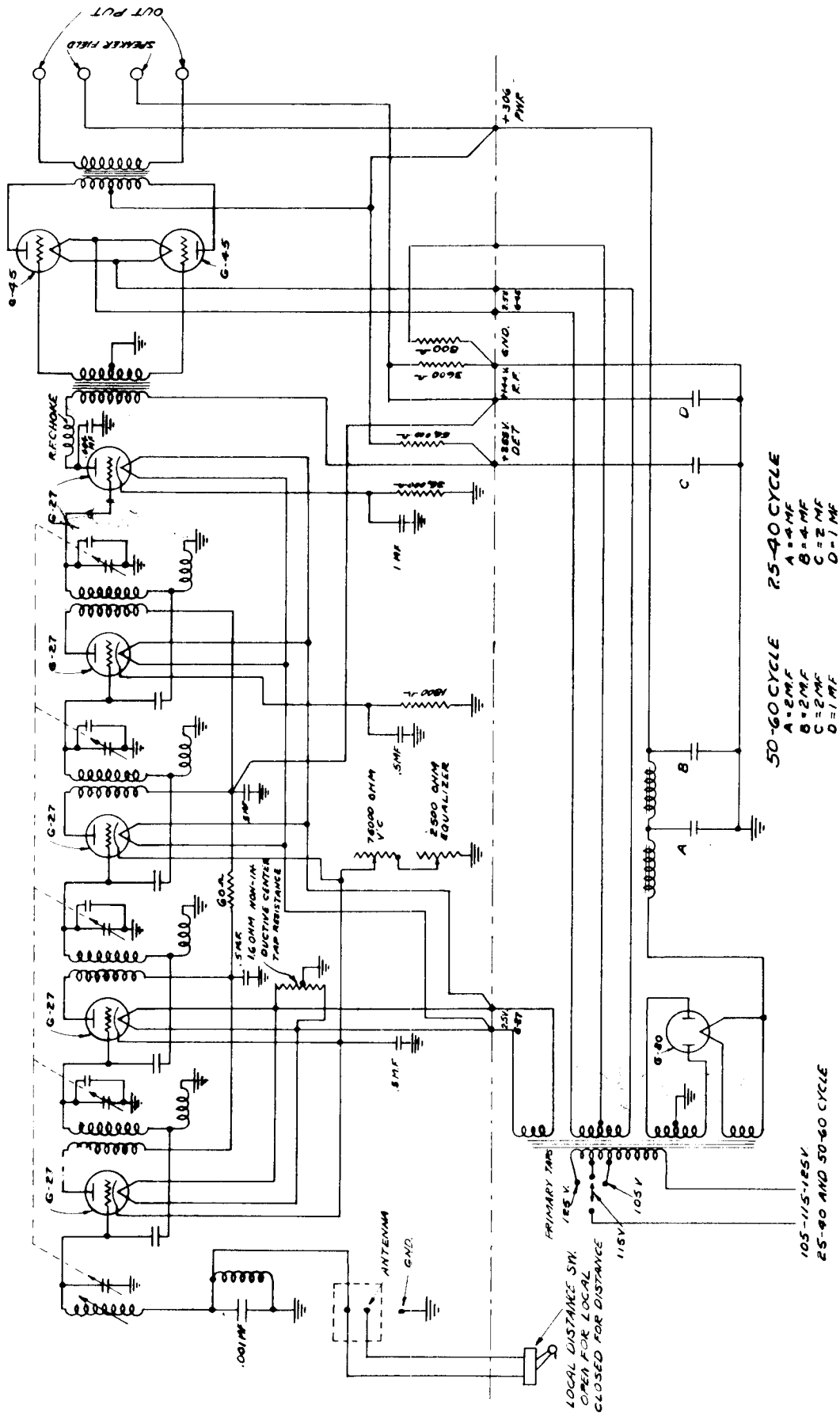
SCHEMATIC DIAGRAM FOR MODEL 90-B MAJESTIC CHASSIS

25-40 AND 50-60 CYCLE



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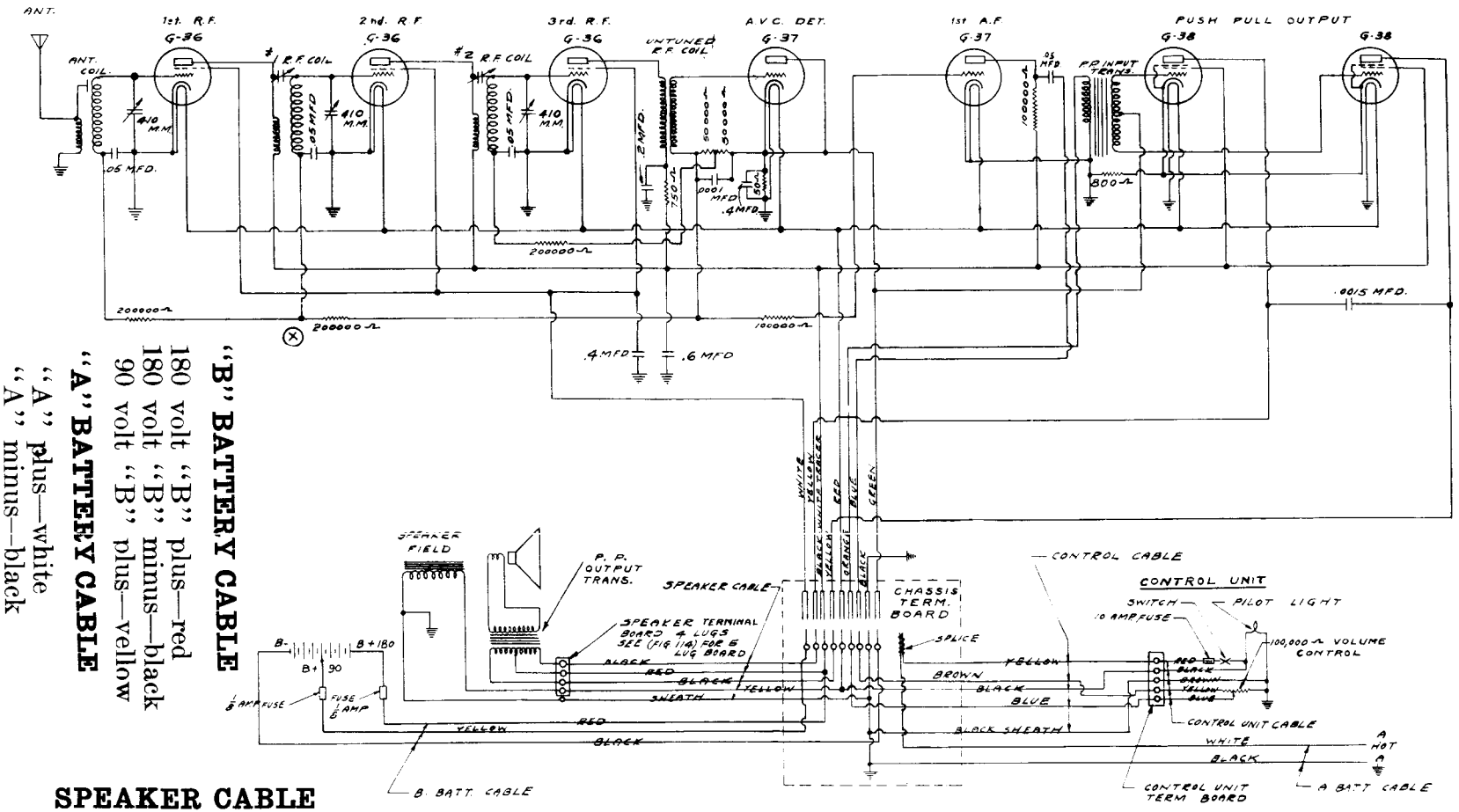

Schematic Diagram Majestic
Auto Radio
Model-110

"B" BATTERY CABLE

180 volt "B" plus—red
180 volt "B" minus—black
90 volt "B" plus—yellow

"A" BATTERY CABLE

"A" plus—white
"A" minus—black

SPEAKER CABLE

Field Supply "A" plus—yellow
Field Supply "A" minus—ground cable shield
Pentode Plates—black
Positive "B" center tap—red

CONTROL CABLE

Switch—yellow from chassis to red from control cable.
Switch—black from chassis to black from control cable.
Volume control—Center Arm—blue from chassis to blue from control cable.
Right stop (high side)—brown from chassis to yellow from control cable.
Left Stop (low side)—Control cable shield ground.

All leads marked "A" plus in color code of the Service Manual signify the ungrounded side of the car battery, and not necessarily the positive side.

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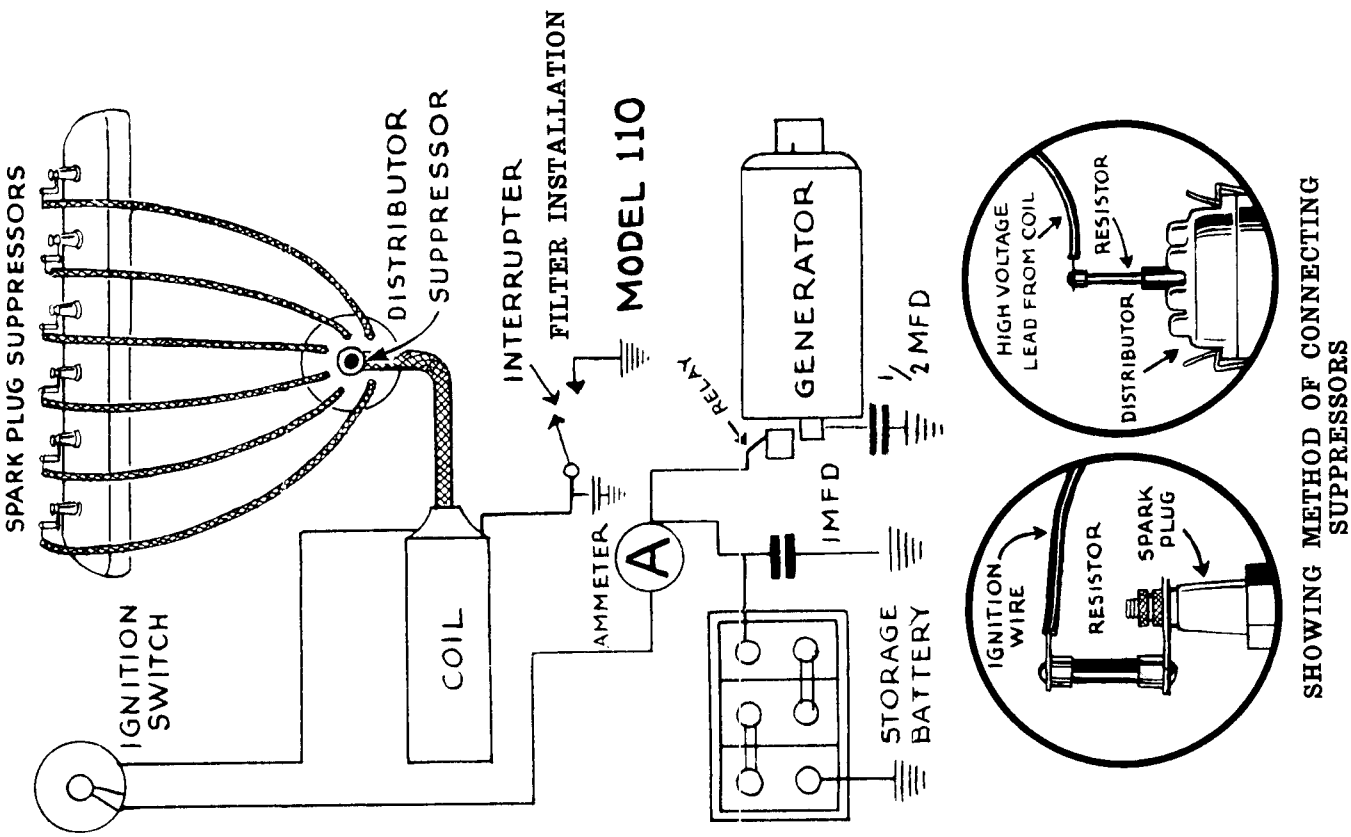

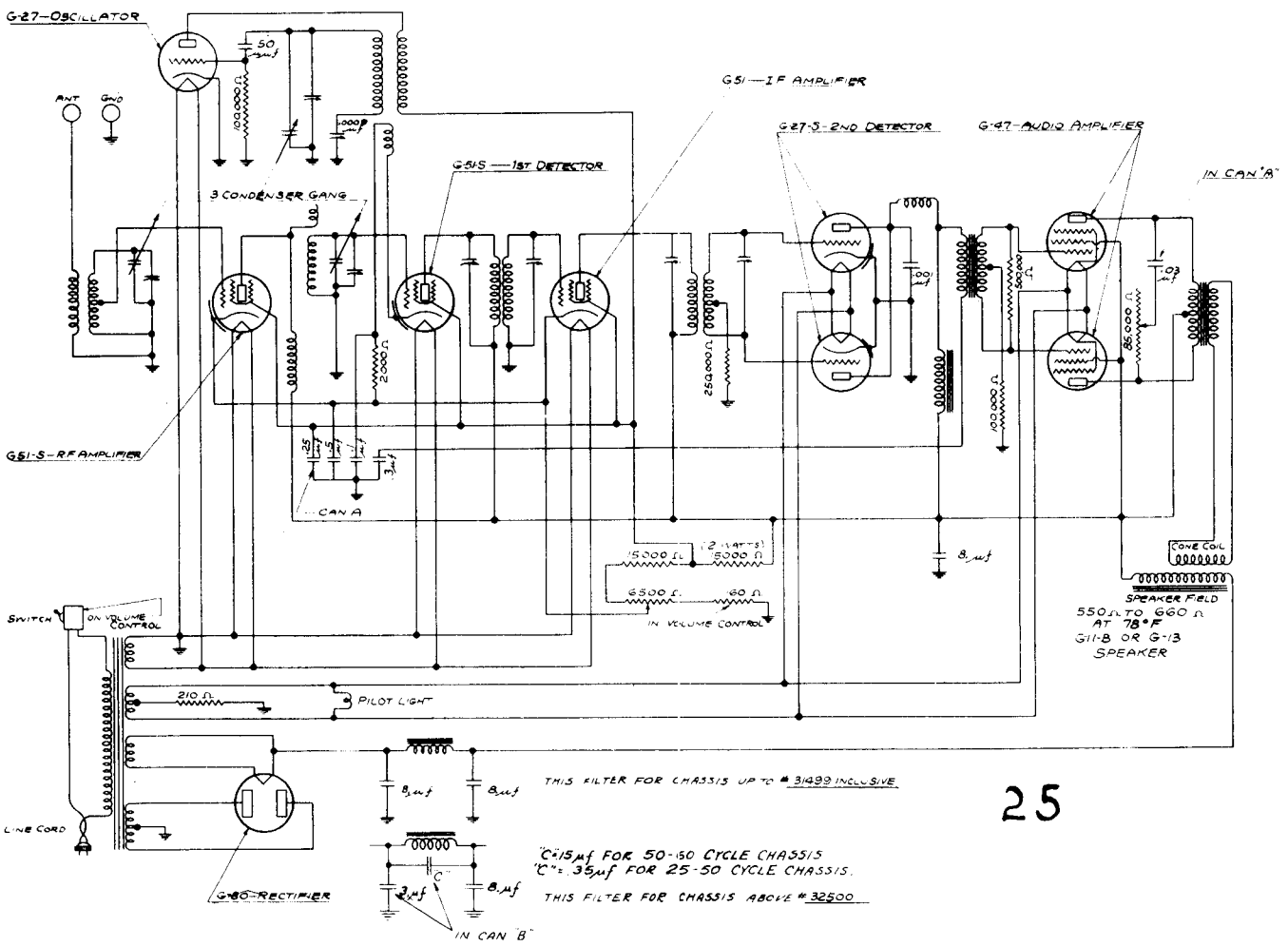

25

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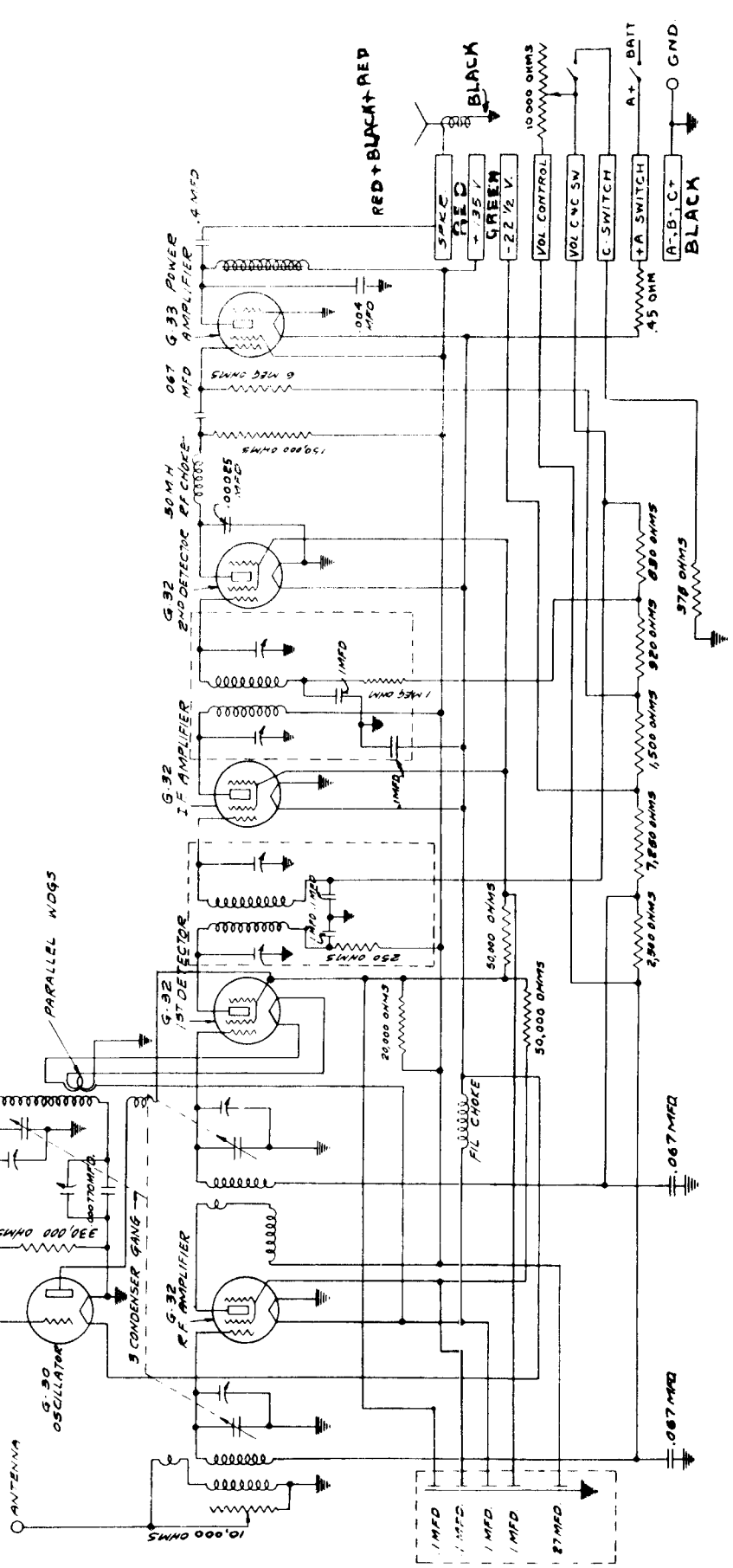
HOME BATTERY RECEIVER MODEL -120



BIAS VOLTAGES

	Volume Control at Maximum		Volume Control at Minimum
R. F.	3 volts	R. F.	11 volts
Osc.	0 volts	Osc.	0 volts
1st Det.	8 volts	1st Det.	14 volts
I. F.	3 volts	I. F.	3 volts
2nd Det.	8 volts	2nd Det.	8 volts
Pentode	13.5 volts	Pentode	13.5 volts

COLOR CODE

Volume Control and Switch Connections

Antenna section of volume control—Red and Black.
"C" bias section of volume control—Blue and Yellow.
"A" battery side of switch—Red.
Jumper switch to volume control—Blue.
Switch to "C" bias—White.

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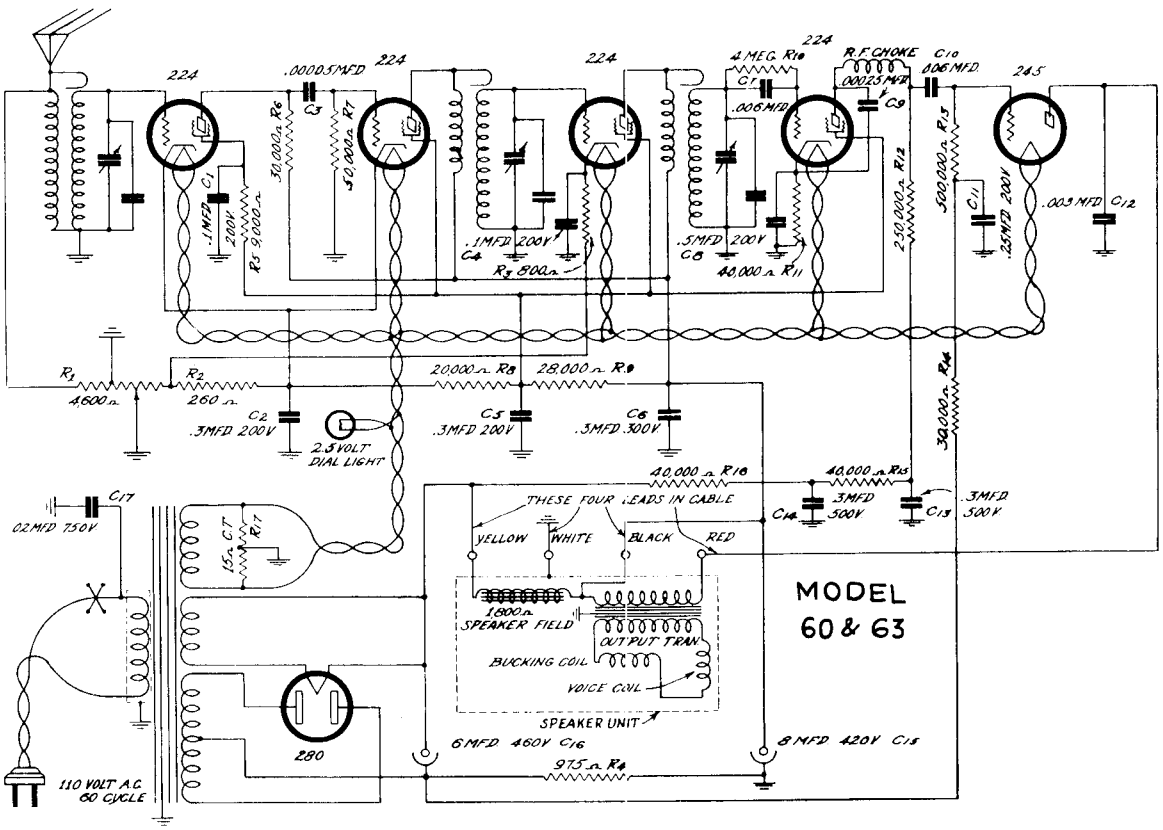
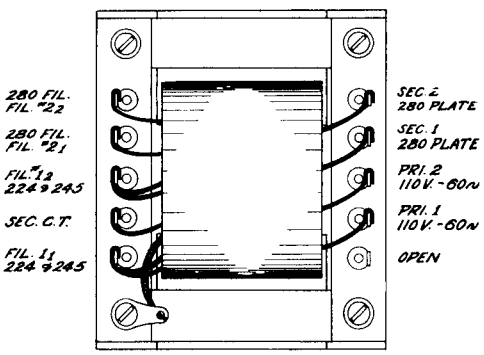
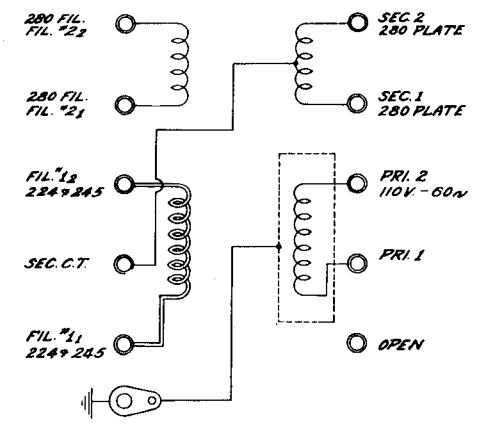
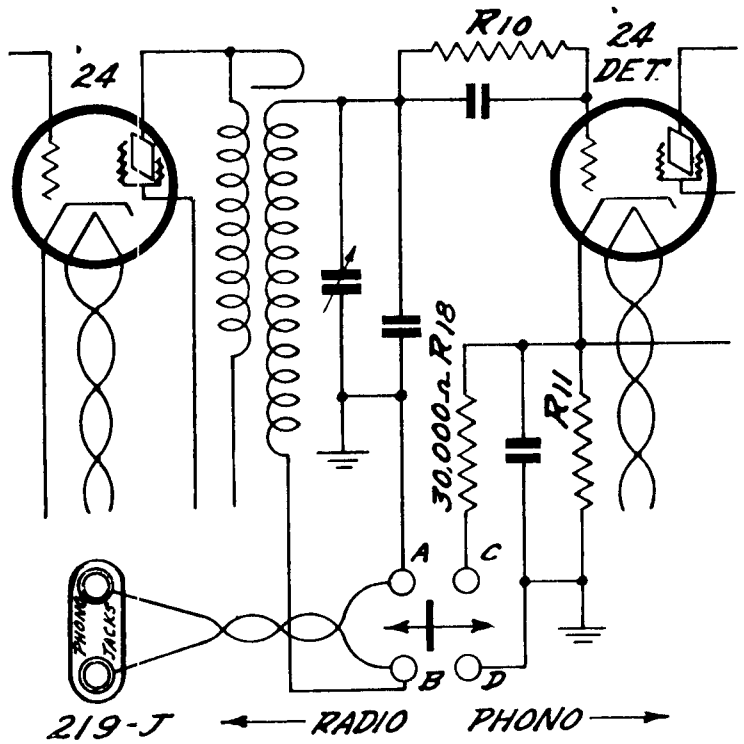


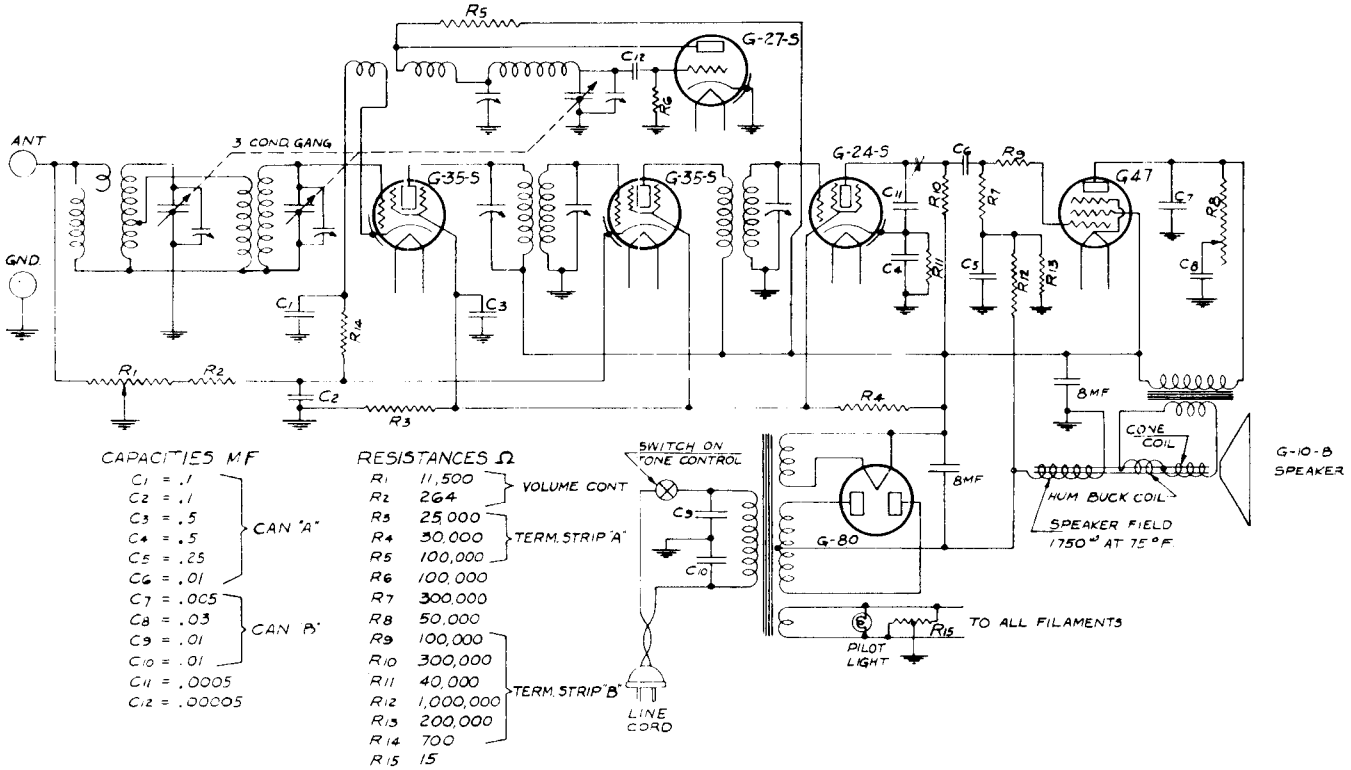






GRIGSBY-GRUNOW CO.

SCHEMATIC DIAGRAM OF MAJESTIC SCREEN GRID SUPERHETERODYNE RECEIVER
MODEL 55 CHASSIS —— 115 VOLTS 50-60 CYCLES 70 WATTS



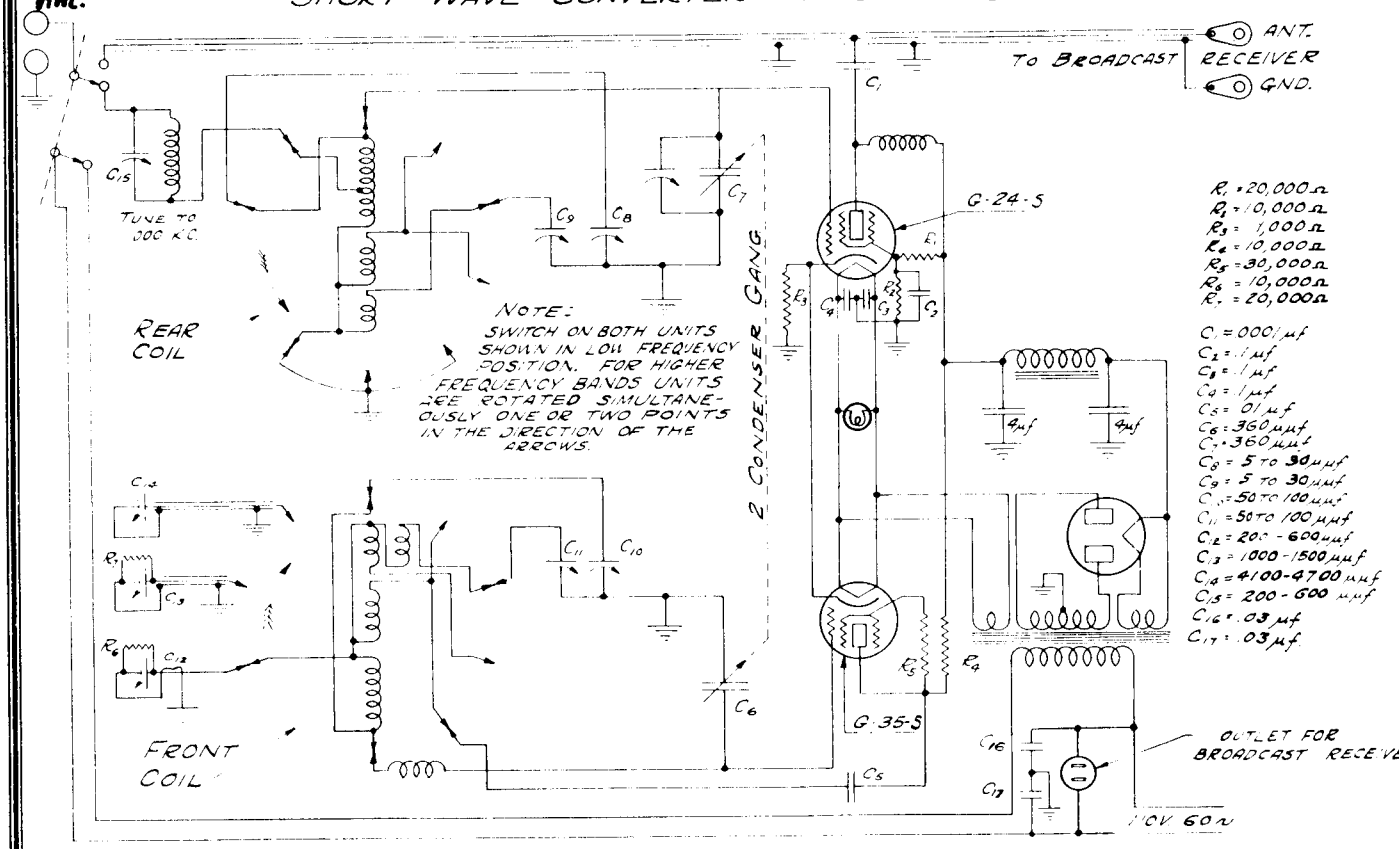
CAPACITIES MF

C1	.1	CAN "A"
C2	.1	
C3	.5	
C4	.5	
C5	.25	
C6	.01	
C7	.005	CAN "B"
C8	.03	
C9	.01	
C10	.01	
C11	.0005	
C12	.00005	

RESISTANCES Ω

R1	11,500	VOLUME CONT
R2	264	
R3	25,000	TERM. STRIP "A"
R4	30,000	
R5	100,000	
R6	100,000	
R7	300,000	
R8	50,000	
R9	100,000	TERM. STRIP "B"
R10	300,000	
R11	40,000	
R12	1,000,000	
R13	200,000	
R14	700	
R15	15	

SCHEMATIC DIAGRAM OF MAJESTIC SELF POWERED UNIVERSAL SHORT WAVE CONVERTER — MODEL 10 CHASSIS.

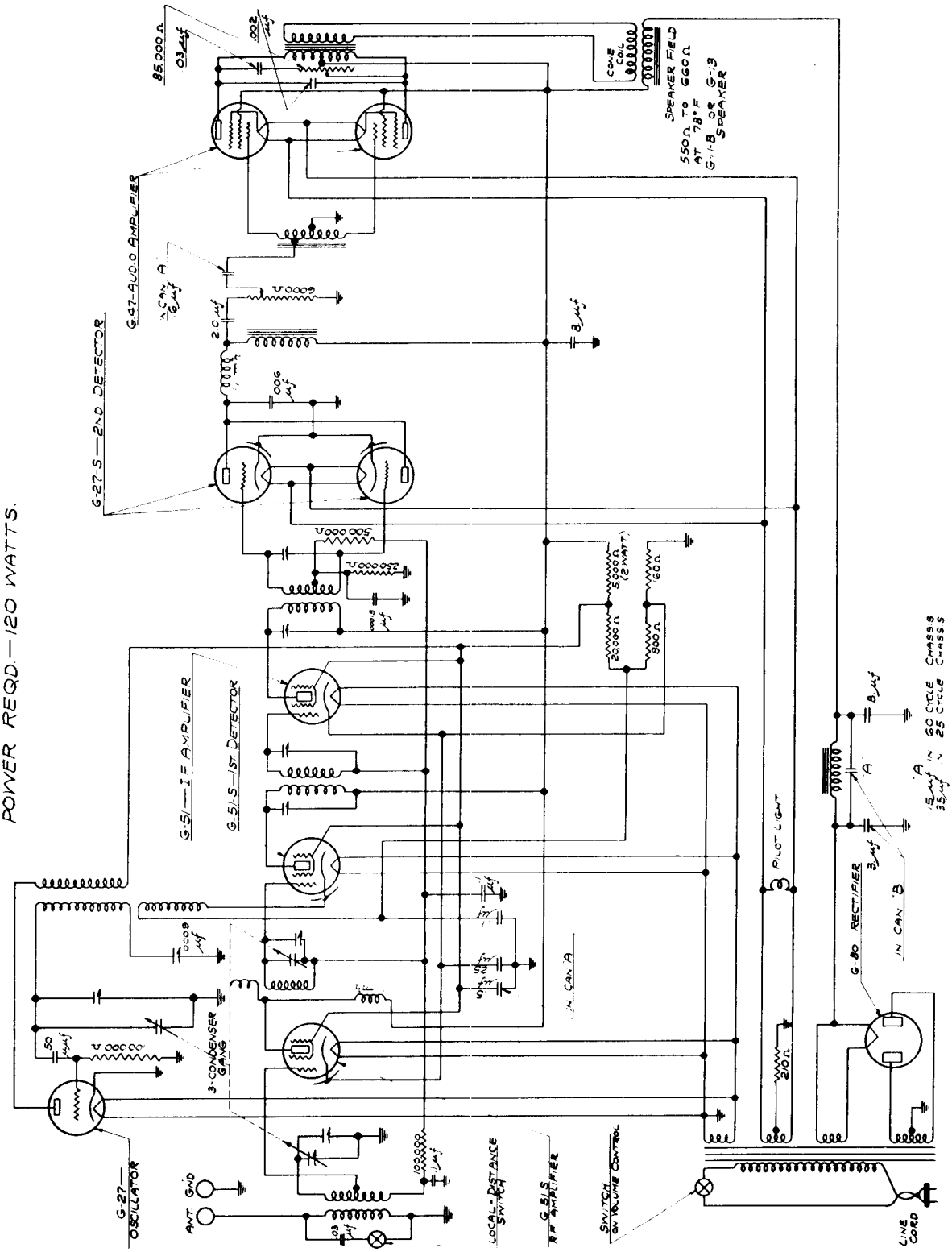


R1 = 20,000Ω
R2 = 10,000Ω
R3 = 1,000Ω
R4 = 10,000Ω
R5 = 30,000Ω
R6 = 10,000Ω
R7 = 20,000Ω

C1 = 000 μf
C2 = .1 μf
C3 = .1 μf
C4 = 1 μf
C5 = .01 μf
C6 = 360 μμf
C7 = 360 μμf
C8 = 5 TO 30 μμf
C9 = 5 TO 30 μμf
C10 = 50 TO 100 μμf
C11 = 50 TO 100 μμf
C12 = 200 - 600 μμf
C13 = 1000 - 1500 μμf
C14 = 4100-4700 μμf
C15 = 200 - 600 μμf
C16 = .03 μf
C17 = .03 μf

GRIGSBY-GRUNOW CO.

SCHEMATIC DIAGRAM OF MAJESTIC SCREEN GRID SUPERHETERODYNE AUTOMATIC VOLUME CONTROL RECEIVER—MODEL 25-B CHASSIS—115 AND 230 VOLTS, 25 AND 50-60 CYCLES. POWER REQD.—120 WATTS.



GRIGSBY-GRUNOW CO.

SCHEMATIC DIAGRAM OF MAJESTIC SCREEN GRID SUPERHETERODYNE AUTOMATIC VOLUME CONTROL RECEIVER.——MODEL 35 CHASSIS—COLLINGWOOD MODEL 351——115 AND 230 VOLTS, 25-50 AND 50-60 CYCLES. POWER REQD.——150 WATTS.

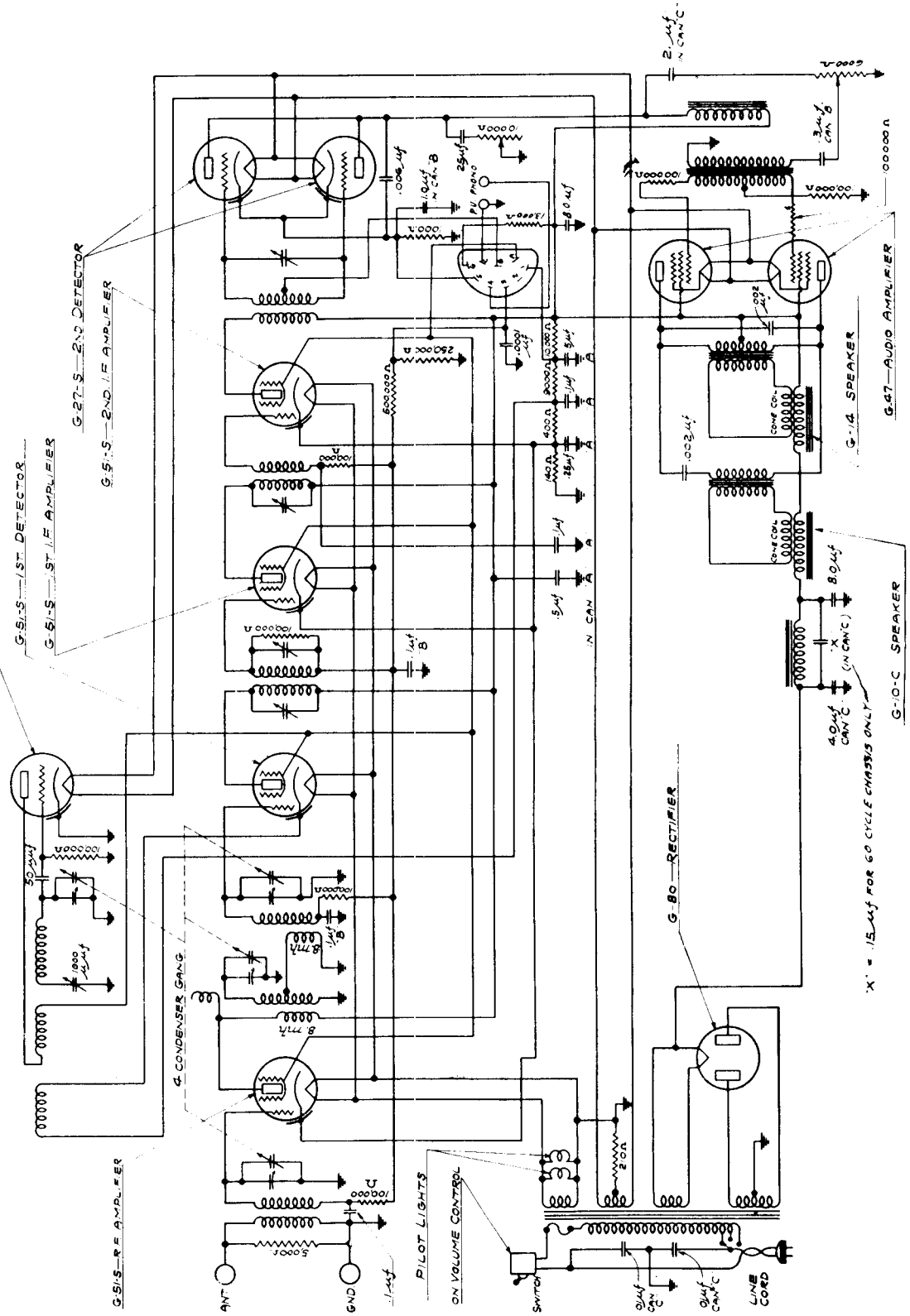


TABLE OF VOLTAGES TO GROUND

MODEL 25-B

Tube Purpose	Type	Fil. Volts A. C.	Plate Volts D. C.	Fil. to Ground D. C.	Cathode Volts D. C.	Plate Current M. A.-D. C.	Screen Volts D. C.	Screen Current M. A.-D. C.
R. F. Amp.	G-51-S	2.5	260		3	4.2	90	1.2
1st. Det.	G-51-S	2.5	260		7	1.3	90	.4
Osc.	G-27	2.5	90			3.5		
I. F.	G-51-S	2.5	260		3	5	90	1.6
2nd. Det.	G-27-S	2.5	135	16		14		
2nd. Det.	G-27-S	2.5	135	16		14		
Power Amp.	G-47	2.5	250	16		30	250	7.2
Power Amp.	G-47	2.5	250	16		30	250	7.2
Rectifier.	G-80	5		400		120 Total		

First Condenser—400 Volts D. C.
Second Condenser—330 Volts D. C.
Third Condenser—250 Volts D. C.

Line Voltage—115 Volts
Speaker Field—75 Volts
Volume Control—Maximum.

TABLE OF VOLTAGES TO GROUND

MODEL 35

Tube Purpose	Type	Fil. Volts	Plate Volts D. C.	Filament to Ground D. C.	Cathode Volts	Plate Current M. A.-D. C.	Screen Current M. A.-D. C.	Screen Volts
R. F. Amp.	G-51-S	2.5	265		4	5	0.5	90
1st Det.	G-51-S	2.5	265		8	1	0.5	90
Osc.	G-27	2.5	90			4		
1st I. F.	G-51-S	2.5	265		4	5	0.5	90
2nd I. F.	G-51-S	2.5	265		4	5	0.5	90
2nd Det.	G-27-S	2.5	115			12		
2nd Det.	G-27-S	2.5	115			12		
Power Amp.	G-47	2.5	250	16.5		32	7	260
Power Amp.	G-47	2.5	250	16.5		32	7	260
Rectifier.	G-80	5.0				130 Total		

LINE VOLTAGE 115

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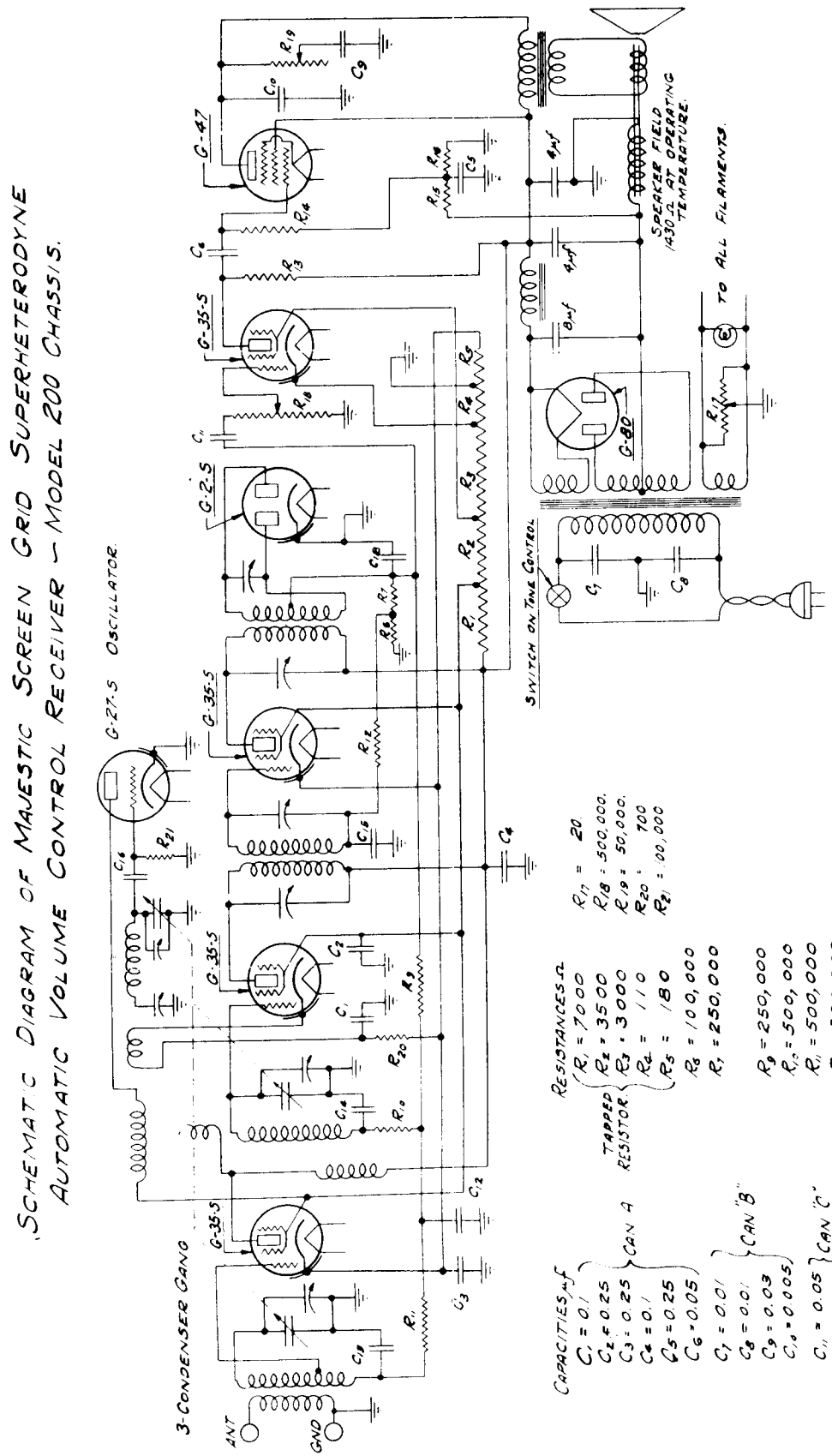
SCHEMATIC DIAGRAM OF MAJESTIC SCREEN GRID SUPERHETERODYNE
AUTOMATIC VOLUME CONTROL RECEIVER – MODEL 200 CHASSIS.



CAPACITIES mf
C_1 = 0.1
C_2 = 0.25
C_3 = 0.25
C_4 = 0.1
C_5 = 0.25
C_6 = 0.05
CAN A

C_7 = 0.01
C_8 = 0.01
C_9 = 0.03
C_{10} = 0.005
CAN "B"

C_{11} = 0.05
C_{12} = 0.01
CAN "C"

C_{13} = 0.01
C_{14} = 0.1
C_{15} = 0.01
C_{16} = 0.00005
C_{18} = 0.0005

RESISTANCES Ω
R_1 = 7000
R_2 = 3500
R_3 = 3000
R_4 = 110
R_5 = 180
TAPPED RESISTOR

R_6 = 100,000
R_7 = 250,000
R_8 = 250,000
R_{10} = 500,000
R_{11} = 500,000
R_{12} = 500,000
R_{13} = 100,000
R_{14} = 300,000
R_{15} = 1,000,000
R_{16} = 200,000

R_{17} = 20
R_{18} = 500,000.
R_{19} = 50,000.
R_{20} = 700
R_{21} = 100,000

115 VOLTS – 60 CYCLES – 85 WATTS.

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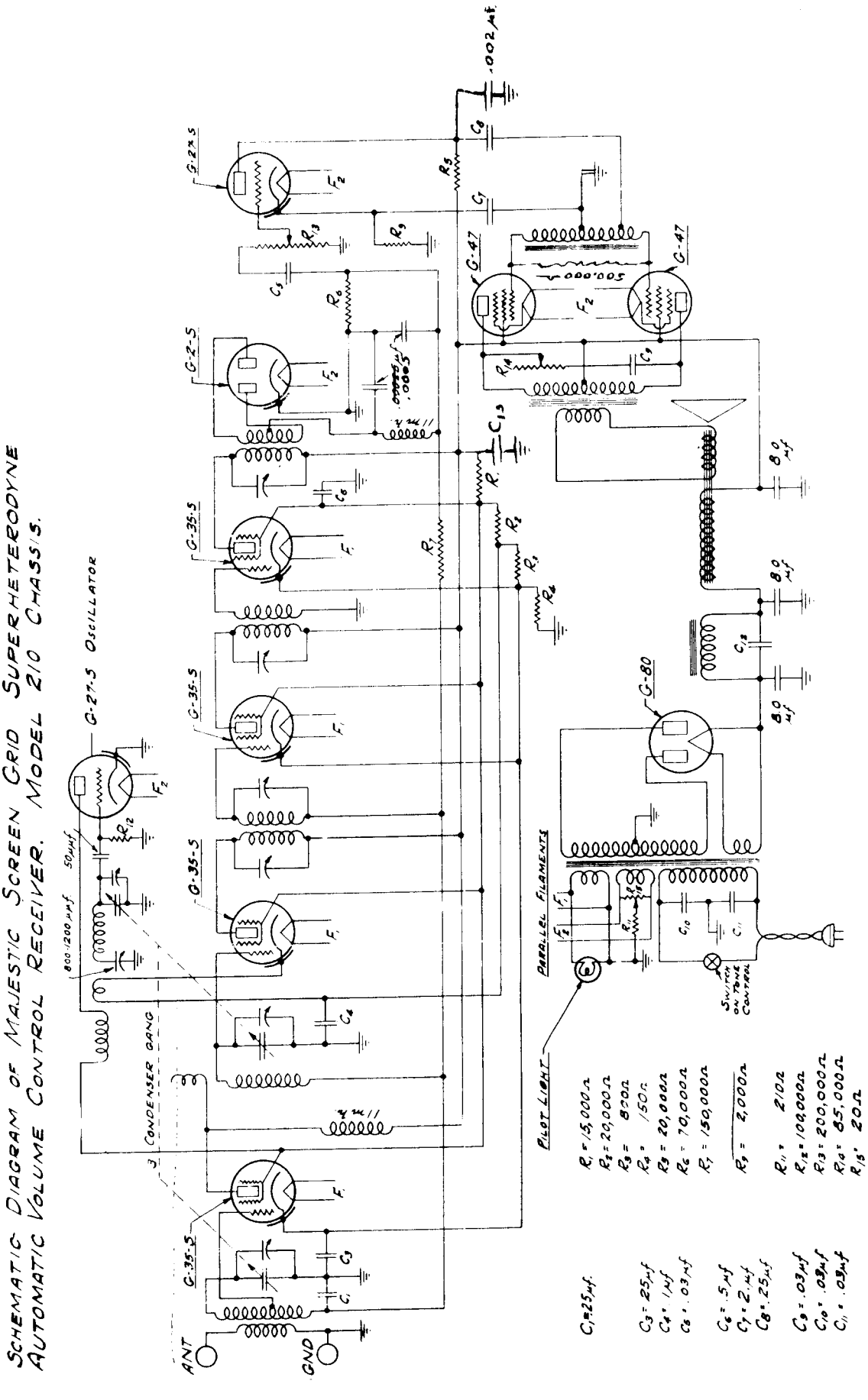

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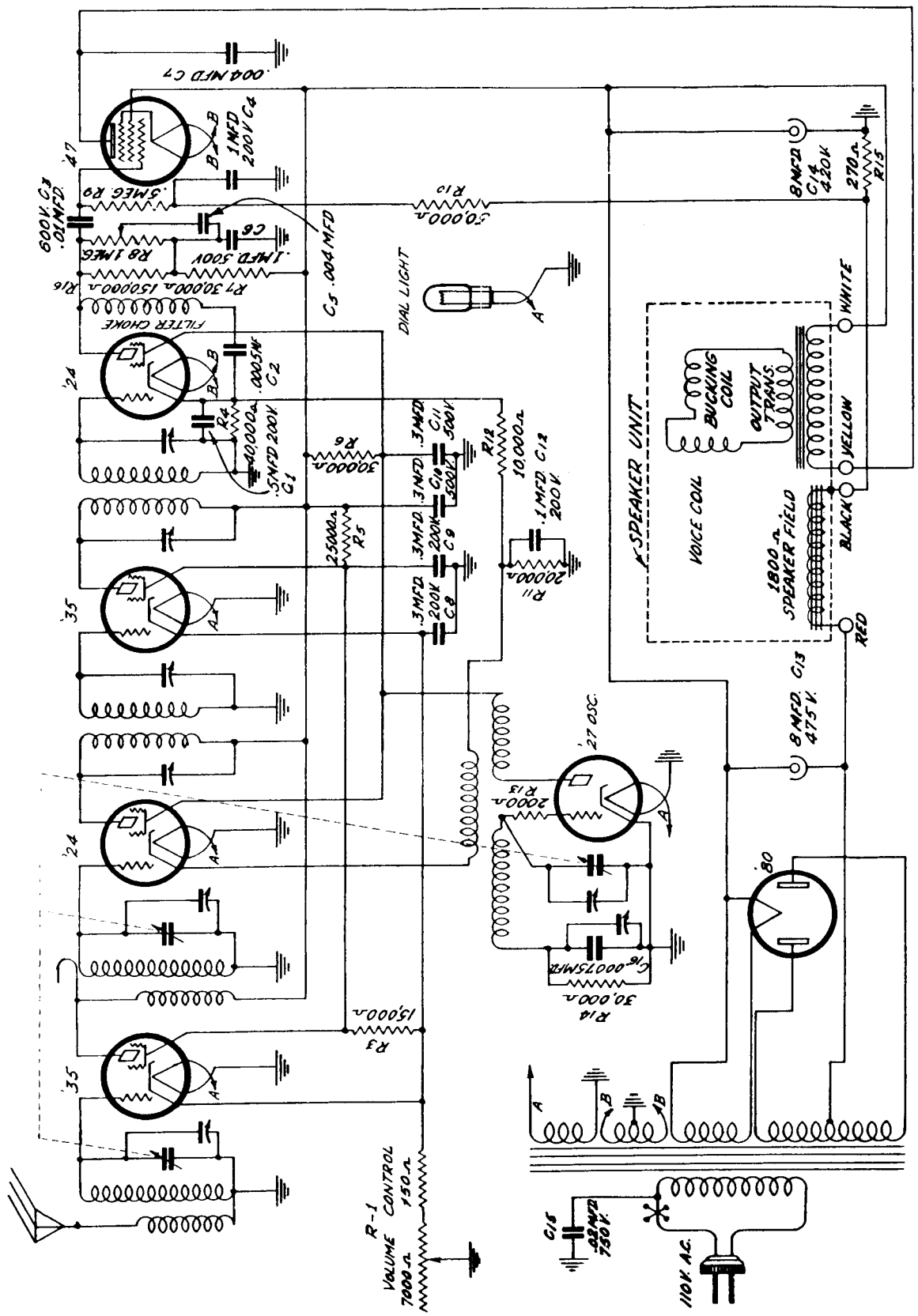
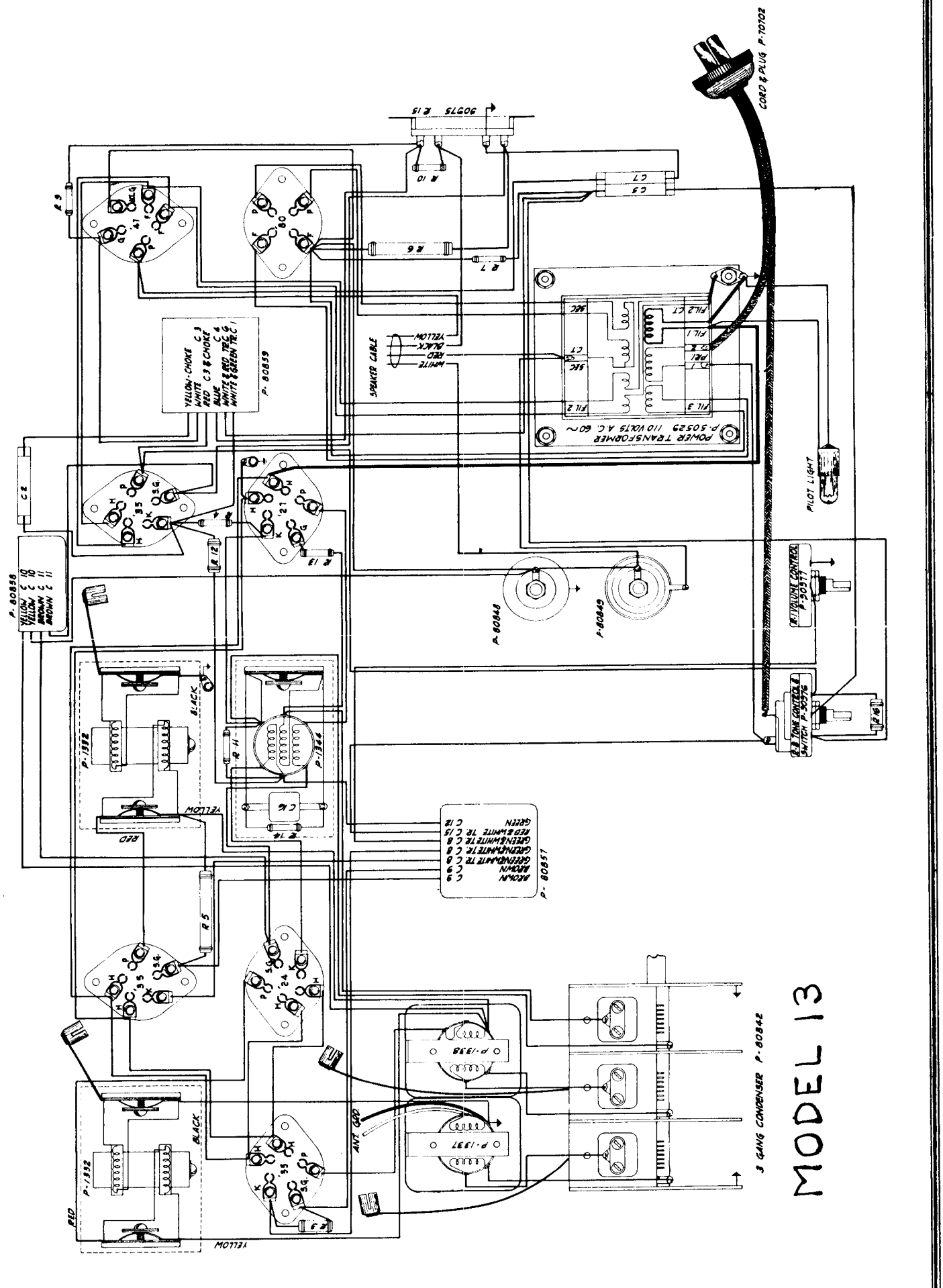


GULBRANSEN COMPANY



GULBRANSEN COMPANY

MODEL 13

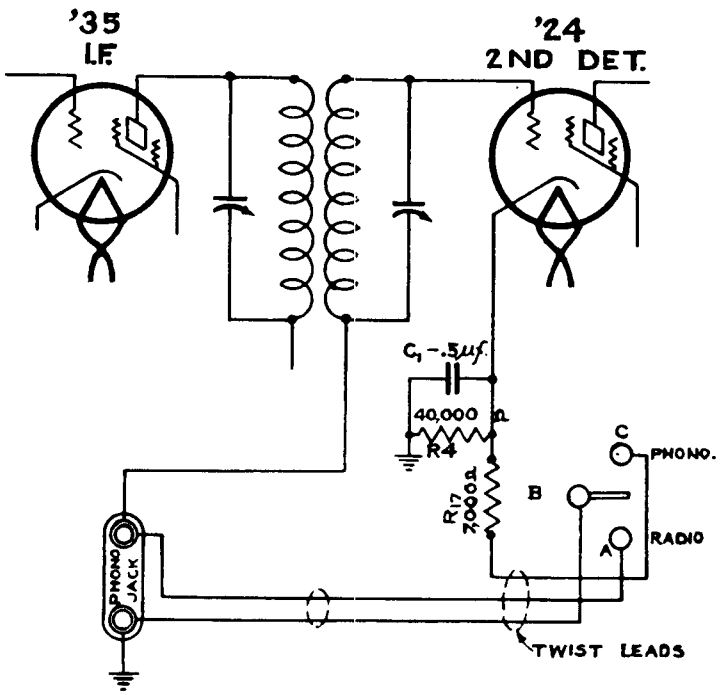
ANALYZER CHART

All voltages taken with a 1.000 ohm per volt voltmeter on the scale indicated in the column headed "Meter Scale." Turn the volume all the way on and connect the antenna and ground leads together. The grid, plate, and screen grid voltages are measured to cathode of the '24 and '35 tubes and to filament of the '47 tube.

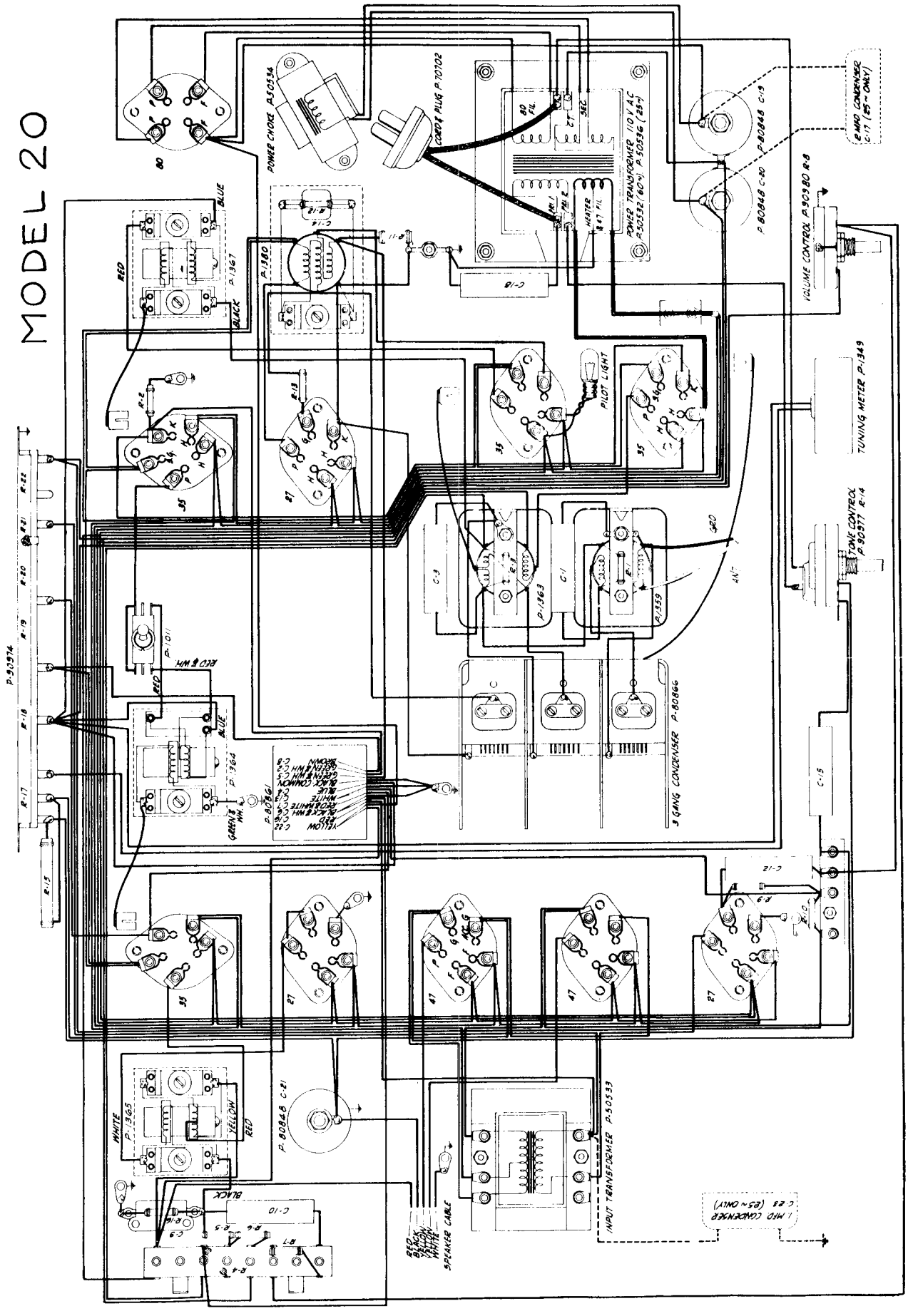
The grid voltage on the '27 oscillator cannot be taken except with a very sensitive, low scale voltmeter. The voltage is approximately .05 volts when the A.C. line voltage is 110 volts.

Tube	Circuit	Meter Scale	90 V.	100 V.	110 V.	120 V.	130 V.
R.F. (Ant.) '35	Grid	0—10	1.5	1.7	1.9	2.1	2.3
	Screen Grid	0—100	53.	58.	63.	66.	69.
	Plate	0—250	195.	210.	225.	238.	250.
1st Det. '24	Grid	0—25	14.	14.3	14.5	15.	16.
	Screen Grid	0—100	63.	64.	65.	67.	70.
	Plate	0—250	190.	205.	220.	233.	245.
Int. '35	Grid	0—10	1.5	1.7	1.9	2.1	2.3
	Screen Grid	0—100	53.	58.	63.	66.	69.
	Plate	0—250	195.	210.	225.	237.	250.
2nd Det. '24	Grid	0—25	14.	14.3	14.5	15.	16.
	Screen Grid	0—100	63.	64.	65.	67.	70
	Plate	0—250	110.	123.	135.	145.	154.
Osc. '27	Grid						
	Plate	0—100	76.	78.	80.	82.	84.
Aud. '47 (See Caution Above)	Grid	0—10	2.1	2.4	2.7	3.	3.3
	Accelerating Grid	0—250	188.	210.	225.	240.	250.
	Plate	0—250	170.	190.	205.	220.	230.
'80 Rect.	Filament to Ground	0—1000	198.	215.	233.	250.	263.

Phonograph Connection



GULBRANSEN COMPANY



GULBRANSEN COMPANY

MODEL 20

TUBE AND VOLTAGE TESTS

The tubes should be tested in a set analyzer and the voltage readings taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

The measurement of grid bias voltages (except on the '47 pentodes) is not recommended, as this causes an abnormal rise in plate current which is injurious to the tube. Further, the measurement of actual grid bias voltages is impossible due to the high resistance in the grid circuits. When the receiver does not function properly and the trouble is apparently due to improper grid bias on any tube or tubes, the cause of the trouble may be determined by applying the proper continuity tests.

CAUTION: IN ORDER THAT THE EFFICIENCY OF EACH TUBE MAY BE COMPARED WITH THAT OF OTHER TUBES OF THE SAME TYPE, THEY MUST NOT BE TESTED IN THE SOCKET IN WHICH THEY ARE USED. TEST ALL '35 TUBES IN THE SECOND I. F. SOCKET AND TEST THE '27 TUBES IN THE FIRST A. F. SOCKET. TAKE THE VOLTAGE READINGS AT THE SOCKET IN WHICH THE TUBE IS USED.

DO NOT ATTEMPT TO TAKE VOLTAGE READINGS OR TEST THE '47 PENTODE TUBES WITH A SET ANALYZER WHICH IS NOT DESIGNED TO TEST THAT TYPE OF TUBE. A SPECIAL ADAPTER IS NECESSARY AND INFORMATION REGARDING SAME MAY BE OBTAINED BY WRITING TO THE MANUFACTURER OF THE ANALYZER. The latest type analyzers only are designed to test pentode tubes. The UY socket in an analyzer which is used to test '24, '35, and '27 tubes cannot be used to test '47 pentodes. A break-in adapter and the external binding posts of the analyzer may be used to take voltage readings when a set analyzer adapter is not available.

Comparison of the voltage readings taken and those shown in the chart below will show any irregularities. The cause of any variation may be determined by applying the proper continuity tests.

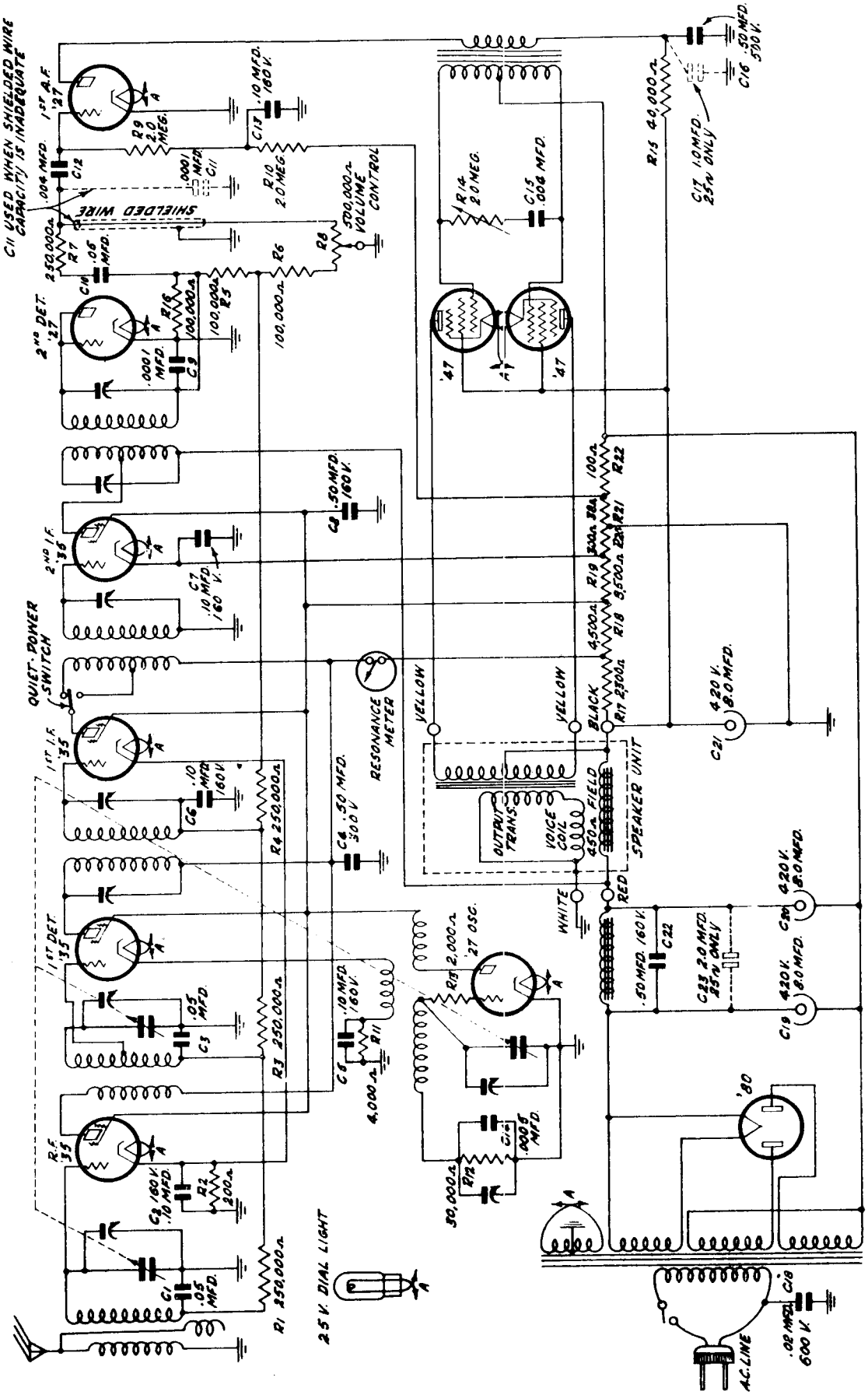
All voltages taken with a 1,000 ohm per volt voltmeter on the scale in the column headed "Meter Scale." Turn the volume all the way on, connect the antenna and ground leads together and turn the gang condenser plates all the way out. CHECK THE LINE VOLTAGE.

NOTE: Voltage readings will vary with different sets of tubes. Unless the voltages are radically different than normal, they may be considered satisfactory.

Tube	Circuit	Meter Scale	90 V.	100 V.	110 V.	120 V.	130 V.
R.F. '35	Screen						
	Grid	0—100	67.	75.	82.	90.	97.
	Plate	0—250	136.	151.	166.	181.	196.
1st Det. '35	Screen						
	Grid	0—100	63.	70.	77.	84.	91.
	Plate	0—250	132.	147.	163.	179.	194.
Oscillator '27	Plate	0—100	70.	77.	85.	92.	100.
1st I.F. '35	Screen						
	Grid	0—100	67.	75.	82.	90.	97.
	Plate	0—250	136.	151.	166.	181.	196.
2nd I.F. '35	Screen						
	Grid	0—100	65.	72.	79.	86.	94.
	Plate	0—1000	227.	252.	277.	303.	328.
1st A.F. '27	Plate	0-100	87.	95.	104.	115.	122.
2nd A.F. '47	Grid	0-25	12.7	14.	15.4	17.	18.3
	Accelerating Grid	0-1000	192.	208.	235.	252.	278.
	Plate	0-1000	180.	200.	220.	240.	261.
'80 Rect.	Current (Both Plates)	0-100	89. M.A.	98. M.A.	108. M.A.	118. M.A.	128. M.A.
(See below)	Plate to Plate voltage	0-1000	547.	568.	690.	712.	733.

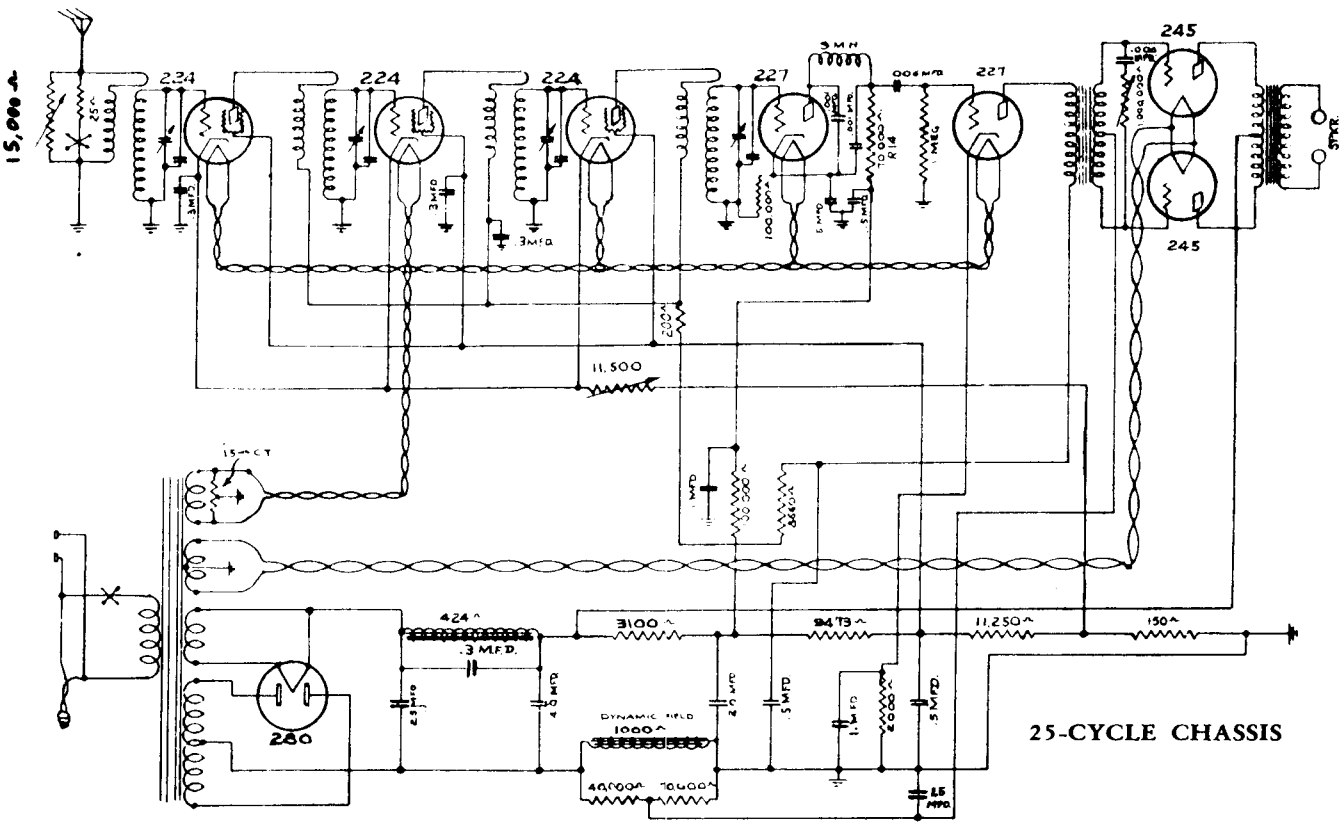
The '80 rectifier plate voltages shown are the totals of both plates, measured from each plate to center tap of high voltage secondary.

GULBRANSEN COMPANY



GULBRANSEN COMPANY

MODEL 80A



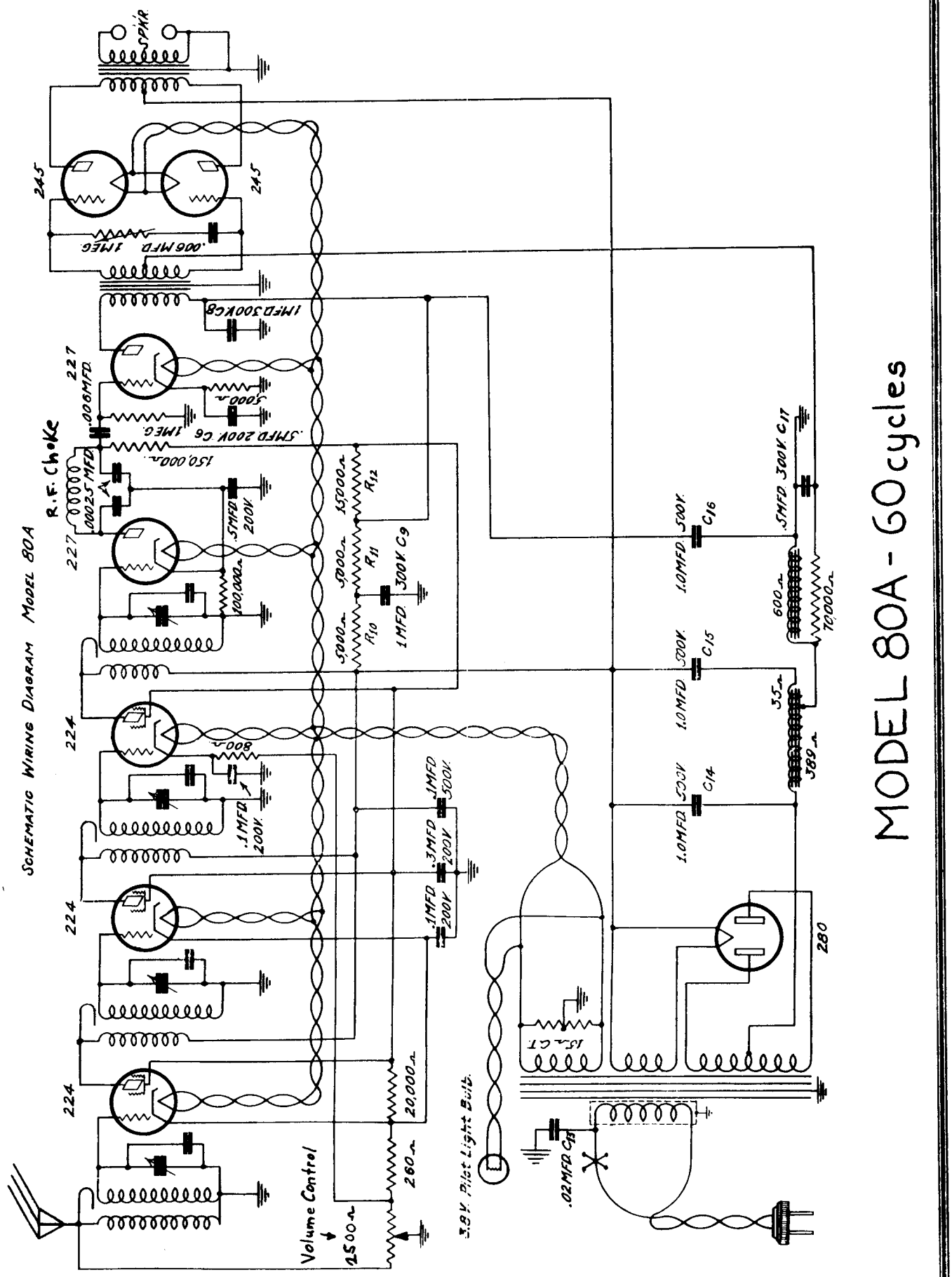
ANALYZER CHART

All D.C. voltages taken with a 1000 ohm per volt meter on the scale indicated in column headed "Meter Scale." Turn on the volume control all the way on and connect the antenna and ground leads together.

The grid, plate, and screen grid votages are measured to cathode of the heater tubes and to filament of three- element tubes.

Tube	*Circuit*	*Meter Scale*	90 V.	100 V.	110 V.	120 V.	130 V.
1st two 224 R.F. Amplifier tubes	Grid	0—5	—2.5	—2.9	—3.3	—3.7	—4.1
	Screen Grid	0—100	62	70	76	84	90
	Plate	0—1000	220	240	270	295	310
2nd 224 R.F. Amplifier tube	Grid	0—5	—1.9	—2.3	—2.6	—3.0	—3.4
Detector 227 tube	Grid	0—10	2.4	2.7	—3.0	—3.3	—3.6
	Plate	0—100	21.0	24.0	26.0	29.0	32.0
227 Audio Amplifier tube	Grid	0—10	.3	.4	.5	.55	.6
	Plate	0—250	90	145	158	170	183
245 Power tubes	Grid	0—100	30	34	39	43	47
	Plate	0—1000	220	240	275	300	320
280 Rectifier tube	Plate	0—1000	300	330	360	400	415
280 Filament to ground		0—1000	210	230	250	280	300

GULBRANSEN COMPANY



GULBRANSEN COMPANY

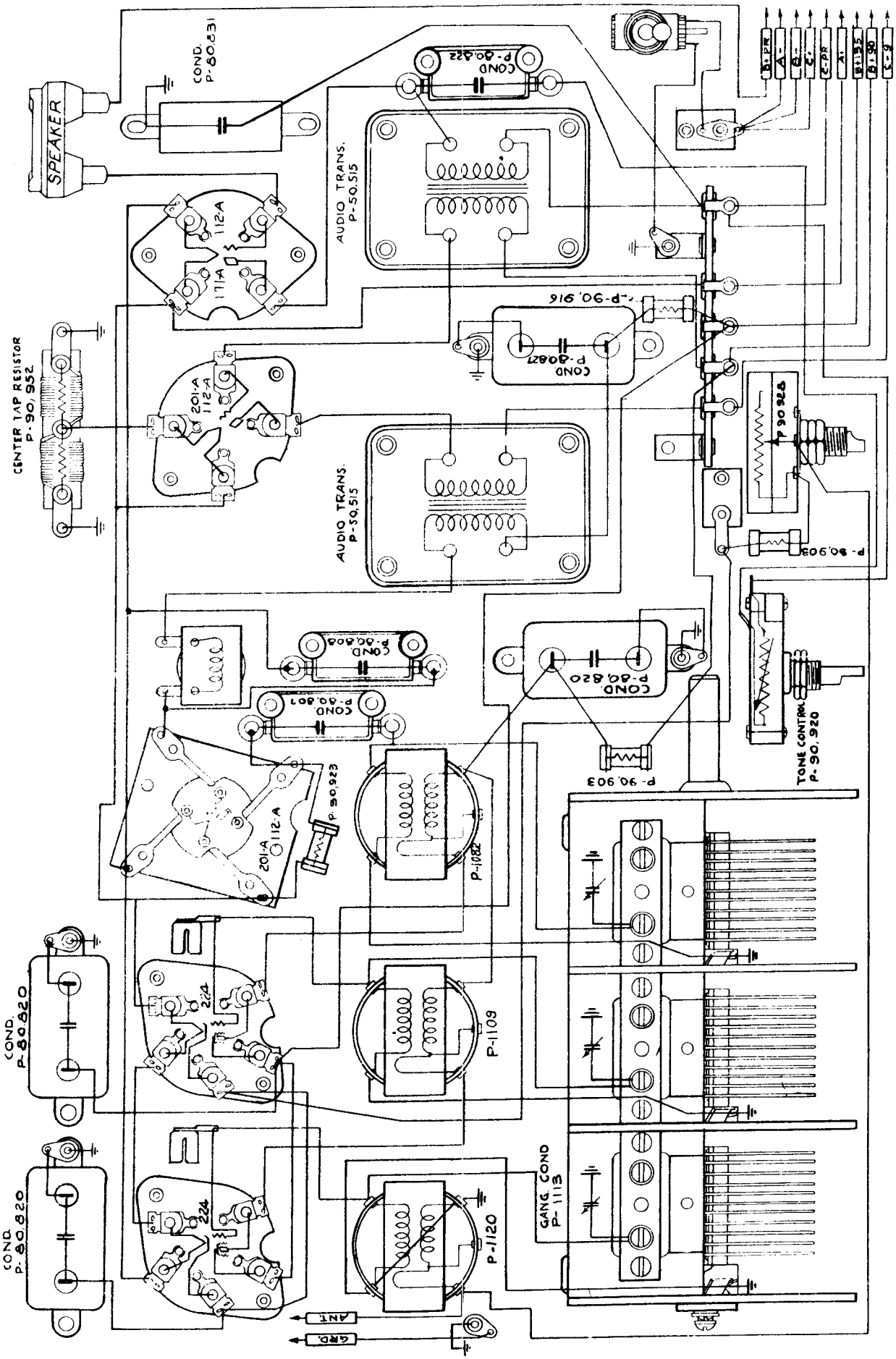
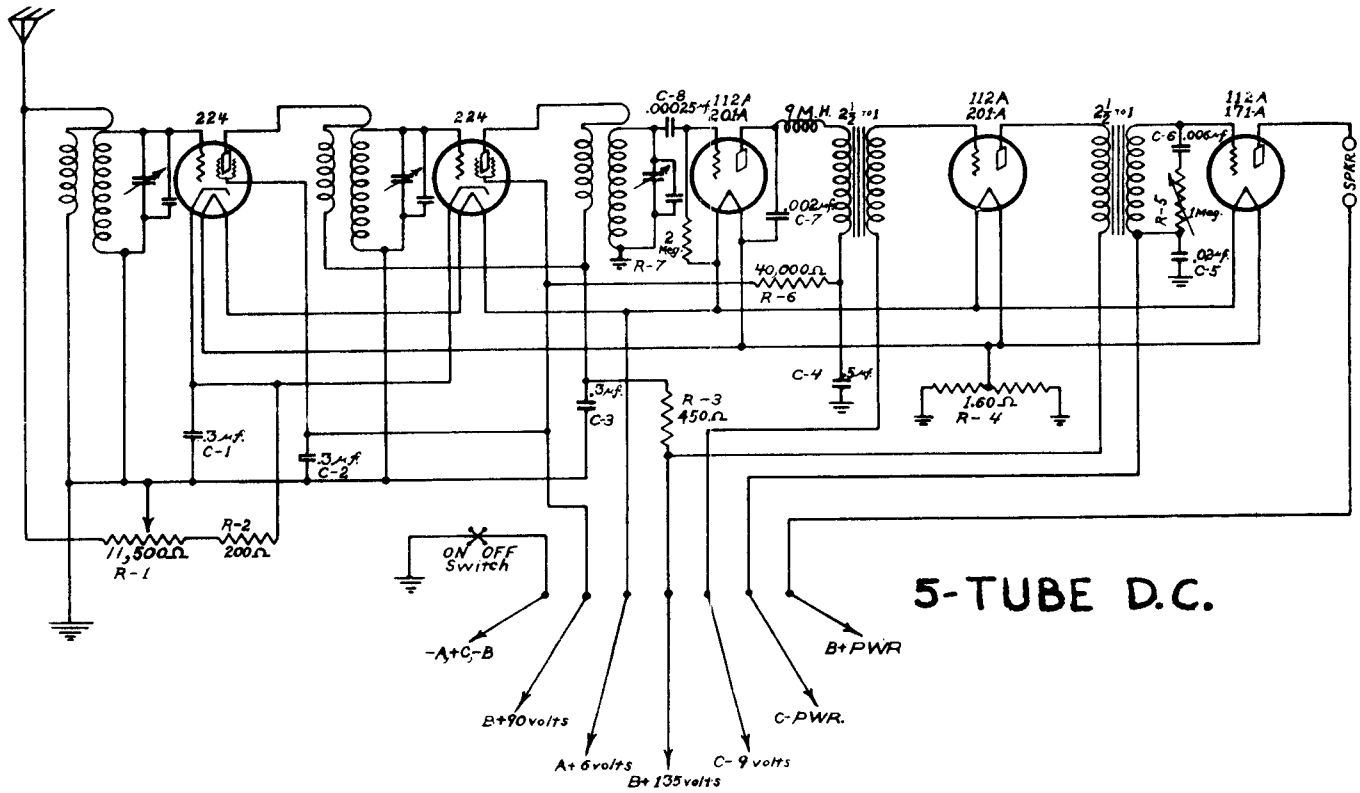


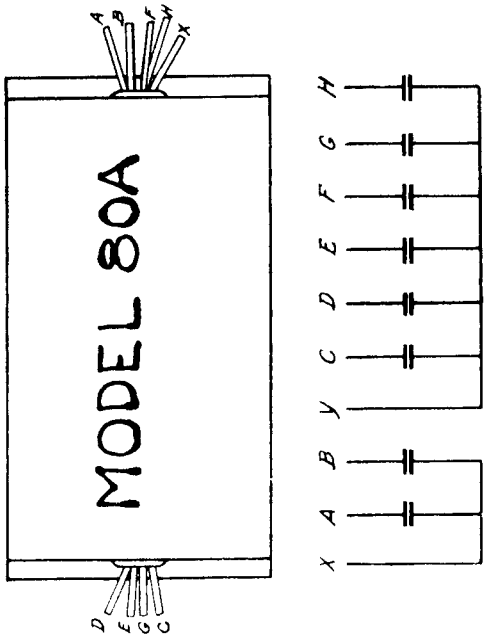
Figure 1. Pictorial Wiring Diagram.

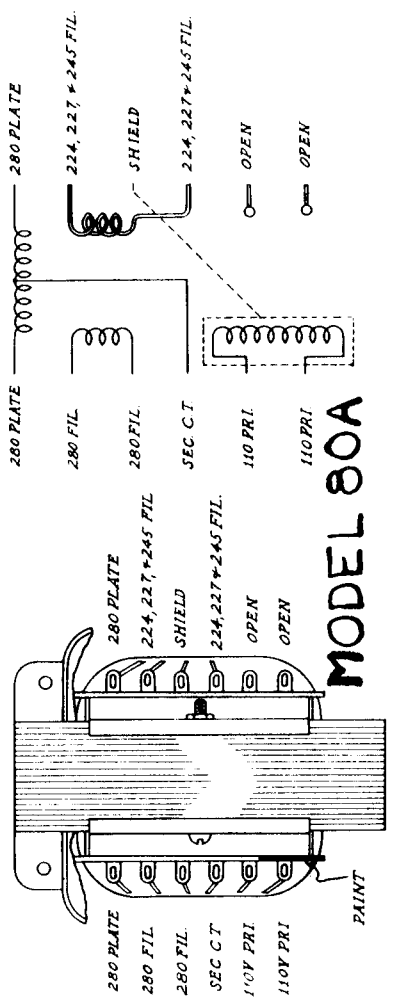
5-TUBE DC MODEL

GULBRANSEN COMPANY

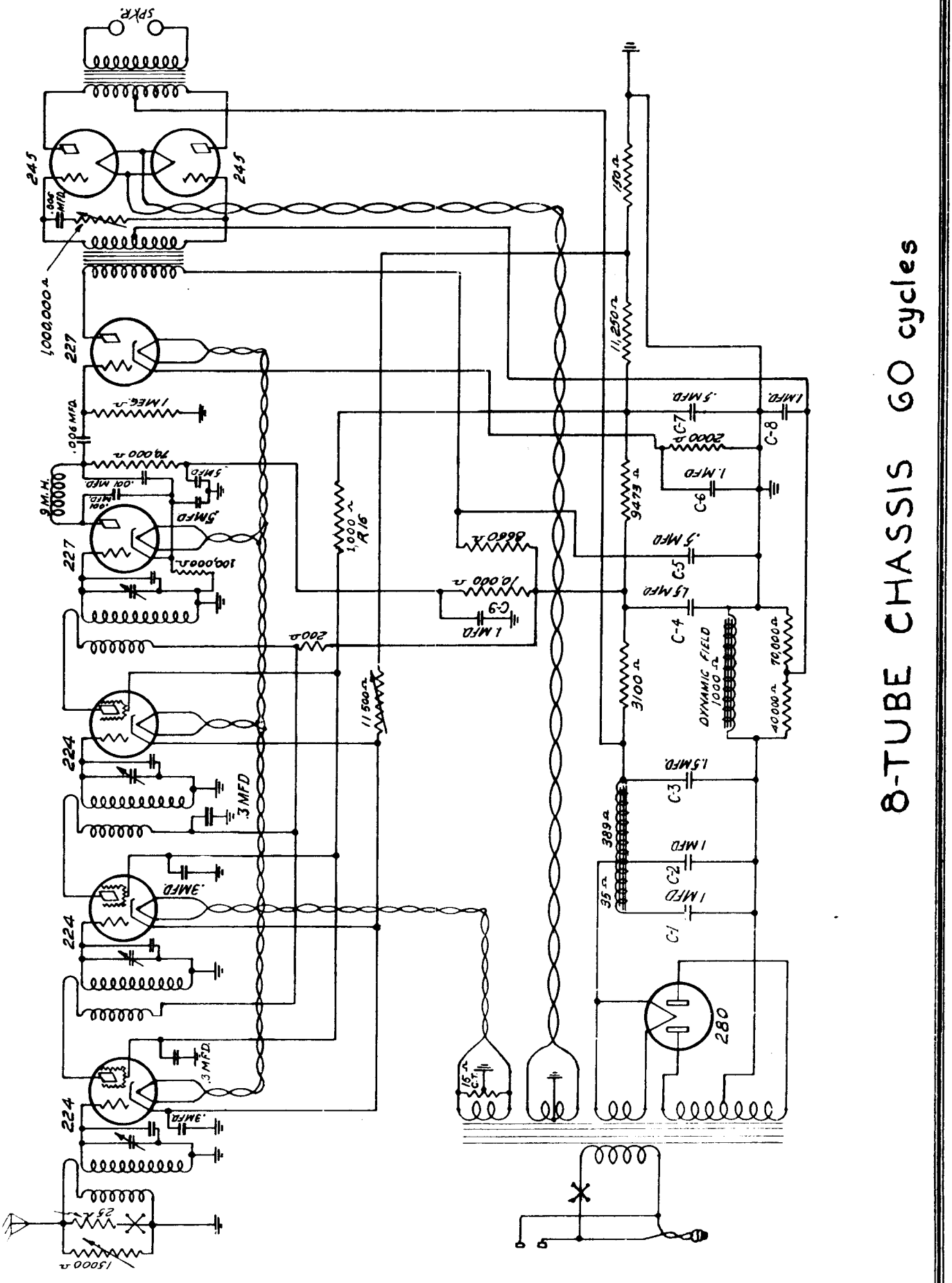


LEAD CODE	COLOR	CAPACITY
A	C-14 RED & YELLOW	1.0 MFD
B	C-15 RED	1.0 MFD
C	C-16 YELLOW & BLACK	1.0 MFD
D	C-9 RED	1.0 MFD
E	C-8 BLUE	1.0 MFD
F	C-17 GREEN	0.5 MFD
G	C-6 GREEN & WHITE	0.5 MFD
H	C-13 WHITE	.02 MFD
X	YELLOW	COMMON
Y	GROUNDED TO CAN	COMMON





GULBRANSEN COMPANY



GULBRANSEN COMPANY

8-TUBE CHASSIS

CAPACITY		
CODE	60 CYCLE	25 CYCLE
A	1.0 MF. C-2	
B	1.0 MF. C-1	2.5 MF. C-1
C	1.5 MF. C-3	4. MF. C-3
D	1.0 MF. C-9	1.0 MF. C-9
E	1.0 MF. C-6	1.0 MF. C-6
F	0.5 MF. C-7	0.5 MF. C-7
G	1.0 MF. C-8	1.5 MF. C-8
H	0.5 MF. C-5	0.5 MF. C-5
K	1.5 MF. C-4	2.0 MF. C-4
X	COMMON	COMMON
Y	COMMON	COMMON

Filter Condenser (60 and 25 cycle receivers).

VOLTAGE CHARACTERISTICS

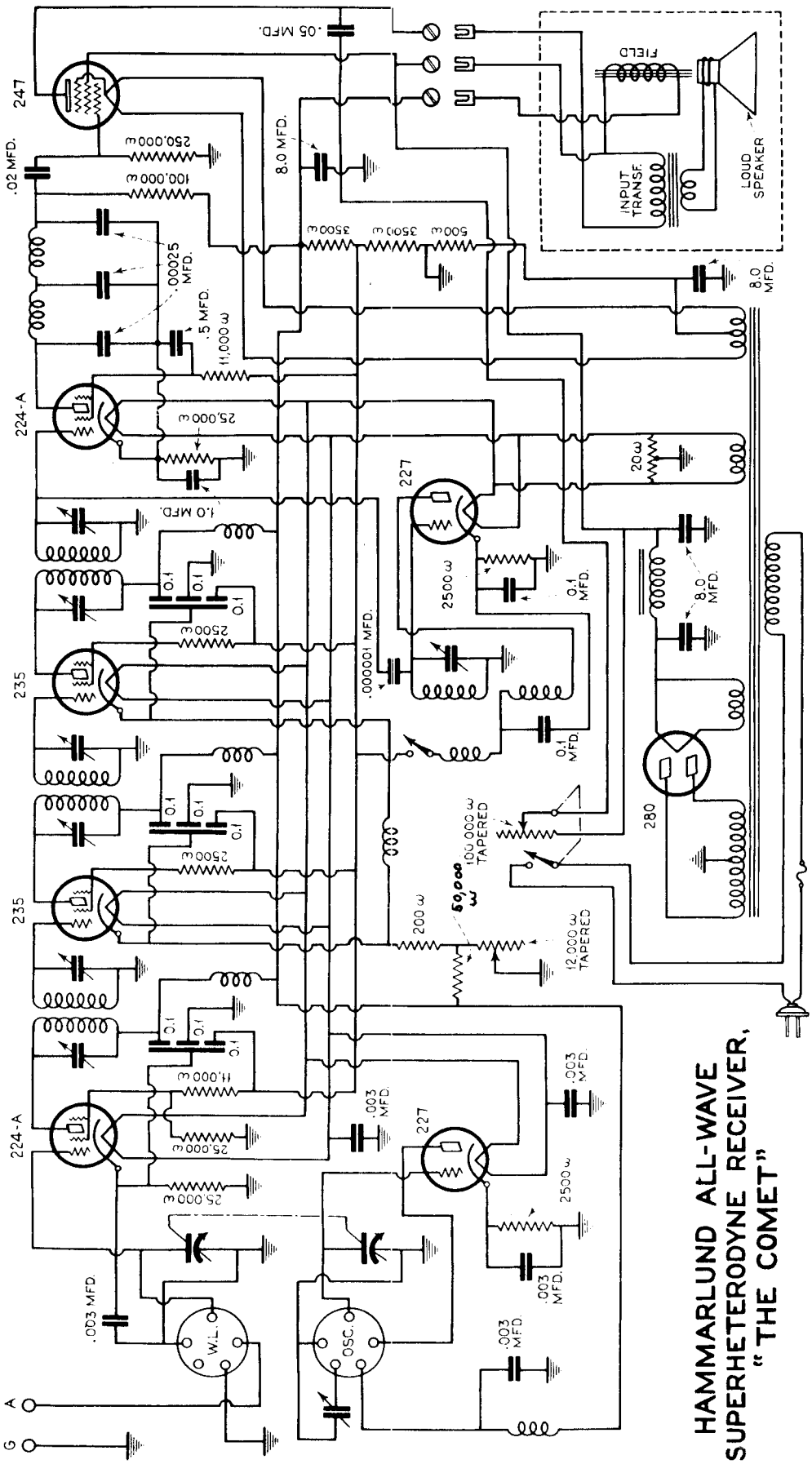
CHECK YOUR LINE VOLTAGE BEFORE TAKING READINGS

Tube Circuit Under Test		LINE VOLTAGE 90 V.	100 V.	110 V.	120 V.	130 V.
224	Fil.	1.7	1.9	2.1	2.3	2.5
	Plate	151	166	183	199	215
	Screen	72	79	84.7	93	100
	Grid*	−2.2	−2.6	−2.9	−3.2	−3.6
	Cathode	2.2	2.6	2.9	3.2	3.6
227 Det.	Fil.	1.7	1.9	2.1	2.3	2.5
	Plate	87	97	104	112	122
	Grid*	−13.4	−15.0	−16.5	−18.2	−20.0
	Cathode	13.4	15.0	16.5	18.2	20.0
227 1st A.F.	Fil.	1.8	1.9	2.2	2.4	2.6
	Plate	109	120	129	139	150
	Cathode	6.9	7.9	8.9	9.8	11.0
245 2nd A.F.	Fil.	1.8	1.9	2.2	2.4	2.6
	Plate	211	235	258	285	310
	Grid	36	42.4	47	53	59
280 Rect.	Fil.	3.6	4.0	4.5	4.8	5.2

*NOTE: Grid voltages on the 224 and detector tubes are measured from grid to cathode terminals on the tube socket. The grid voltage on the first audio tube cannot be measured from grid to cathode, but is measured from cathode to ground. The above voltages are approximate, and will vary with different tubes.

Power Transformer.

HAMMARLUND-ROBERTS, INC.



HAMMARLUND ALL-WAVE SUPERHETERODYNE RECEIVER, "THE COMET"

HOWARD RADIO COMPANY

HOWARD MODEL 45 A. V. C. SUPERHETERODYNE WITH MODEL A. V. H. CHASSIS

The values of the components of this receiver chassis are as follows: Resistors R1, R3, R5, ½-meg. (½-watt); R2, R6, 500 ohms (½-watt); R4, 6,000 ohms (½-watt); R7, 30,000 ohms; R8, volume control, ½-meg.; R9, ½-meg.; R10, 3,000 ohms; R11, 2,000 ohms; R12, R13, 150,000 ohms (½-watt); R14, 2 megs.; R15-R16-R17-R18-R19, voltage divider, 9,900 ohms; R20, R21, 10 ohms (center-tapped); R22, 200 ohms.

Condensers C4, C5, C6, C7, I.F. trimmers; C8, C9, C10, C15, C16, 0.1-mf.; C11, .00025-mf.; C12, .001-mf.; C17, C18, 0.25-mf.; C19, C23, 0.5-mf.; C21, .05-mf.; C24, 1. mf.; C25, C26, 8 mf. (420 volts); C27, 4 mf. (420 volts).

In the interest of obtaining best results with the Automatic Volume Control receiver, it is important that the type '27 control tube V9 be a selected one, with a definite plate current cut-off when tested at 180 volts plate and 20 volts bias on the grid. This cut-off should be less than 5 microamperes. If there is no means available for checking the tube (in the form of a special tube tester), an immediate check for tube performance can be obtained in the set itself.

For instance, disconnect the antenna and short-circuit the aerial lead, leaving the control tube out of the socket, and note the swing of the tuning meter. Then insert the tube in the socket and if it is a good automatic volume control tube, *there should be no change in the position of the pointer on the tuning meter.* If there is a change in the position of the tuning meter pointer, namely, a swing toward the *right,* it is an indication that the A.V.C. tube does not have a definite plate cut-off; instead, it is drawing plate current and as a result the bias voltage on the regular R.F. and I.F. tubes has been raised, with the consequent cutting down in plate current.

The Model 45 speaker has a 350-ohm field, and as such it cannot be used with the Models 35 and 40 receivers.

The receiver housed in the regular cabinet is the "Model 45"; the chassis is the "Model AVH."

The automatic volume control functions in holding the second detector input voltage at a definite level, a system which is different from that in other receivers. A reduction of background noises, between stations, will be noted.

The only service met with to date on the Model "H" receiver has been in connection with the shorting out of the R.F. plate bypass condenser, the red lead of which may accidentally become wedged underneath the first I.F. coil can. The insulation does not cut through immediately but, after being in service for a number of days, the pressure on the insulation may be such as to gradually cut through it, shorting out the plate bypass condenser, and thus producing zero voltage on the plates of the R.F., first detector, and I.F. tubes.

The A.V.C. tube is so connected by means of a 2-megohm resistor, R14, that the grid is at absolute "B—" potential. The cathode of the tube is connected to a point on the voltage divider which is at 24 volts positive, with respect to "B—" or the grid. There then exists between the cathode and the grid a potential difference of 24 volts with the grid negative by this amount. The plate of this tube connects to ground by means of two 150,000-ohm resistors, R12-R13. Since ground is connected to 124 volts, positive (with respect to "B—"), there exists between the cathode and the plate a potential *difference* of 100 volts. In order to bypass any R.F. energy which may appear on the plate, a non-inductive condenser C22 is connected from the plate of the A.V.C. tube to the cathode.

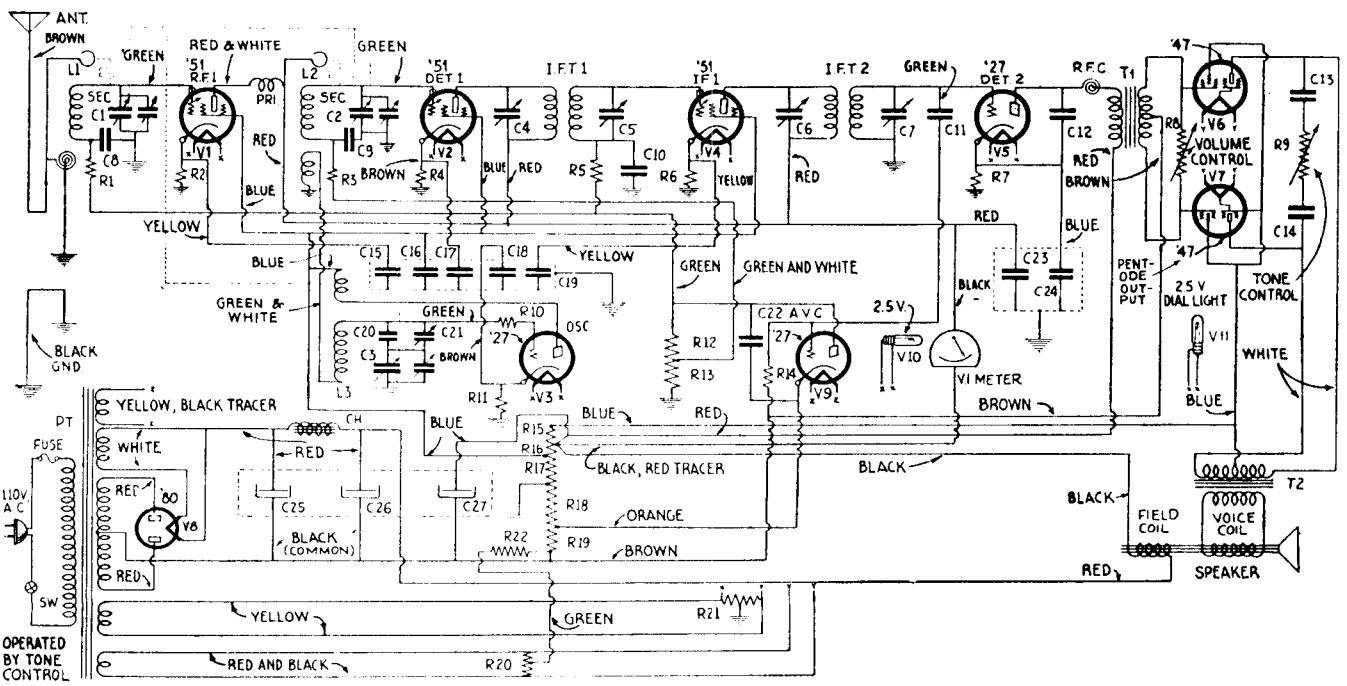
With the condition of no-signal there exists a bias of 24 volts and a plate potential of 100 volts. Under these conditions, there is no plate current flowing and the tube is said to be adjusted to cut-off. Since no plate current is flowing, there exists no voltage drop across the plate circuit resistors and, therefore, there is no bias voltage on the grids of the controlled tubes. The only bias on the R.F., first detector, and I.F. is caused by the respective voltage drops across their cathode resistors. These resistors are designed to give the most sensitive operating point.

In the case of a received signal, energy passes through the receiver to the second-detector grid. Here the A.V.C. (automatic volume control) tube grid, and the second-detector grid, are in parallel. The signal voltage is fed to the grid of the A.V.C. tube through a small fixed condenser, C11.

It will be seen that during the positive half of the incoming cycle, the peak voltage of the signal swing subtracts from the original bias voltage; which means that the instantaneous bias on the tube is less than the original bias and the tube begins to draw current in its plate circuit. Since this current flows in the resistors in the plate circuit of the A.V.C. tube, there exists a voltage drop across these resistors; also, the flow of the electrons is from plate to ground so that the plate becomes negative with respect to ground. Now, since the original potential of the cathode of the R.F., first-detector, and I.F. tubes is positive with respect to ground, it follows that if the grids of the respective tubes are connected to a resistor in the plate circuit of the A.V.C. tube, that any potential existing across this resistor is added to the original bias and makes the grids more negative than the original bias by the amount of the voltage drop across the resistor in the A.V.C. tube plate.

It is at once apparent that the greater the signal voltage appearing at the grid of the A.V.C. tube, the more plate current will flow in the plate circuit: an increase in plate current means an increase in bias on the R.F., first-detector, and I.F. tubes; an increased bias on these tubes means less amplification and, therefore, less grid swing on the second-detector and A.V.C. tube. This cycle goes on until a constant voltage is obtained across the second-detector input, or, in other words, until a condition of equilibrium is reached.

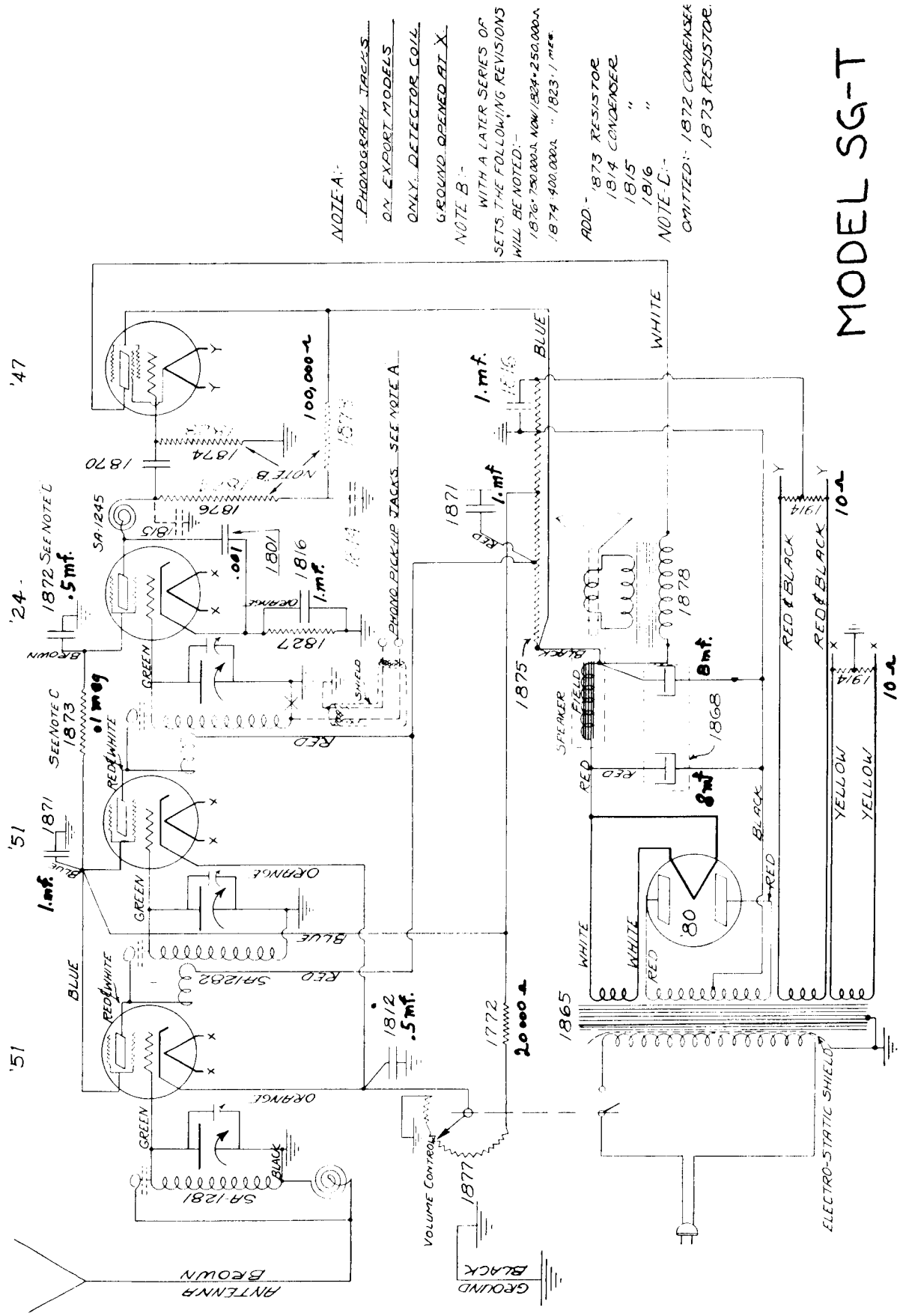
Since R8 is located where the tone control is normally connected, it was necessary to relocate the tone control, C13-R9-C14. As less resistance is included between the two condensers, they become more effective in bypassing the higher audio frequencies; at the same time, they resonate the primary of T2 to a lower audio frequency.



Resistor R15 is 450 ohms; R16, 3,000; R17, 3,750; R18, 2,250; R19, 450. Condensers C13-C14, 0.1-mf.; C20, .0009-mf.

HOWARD RADIO COMPANY

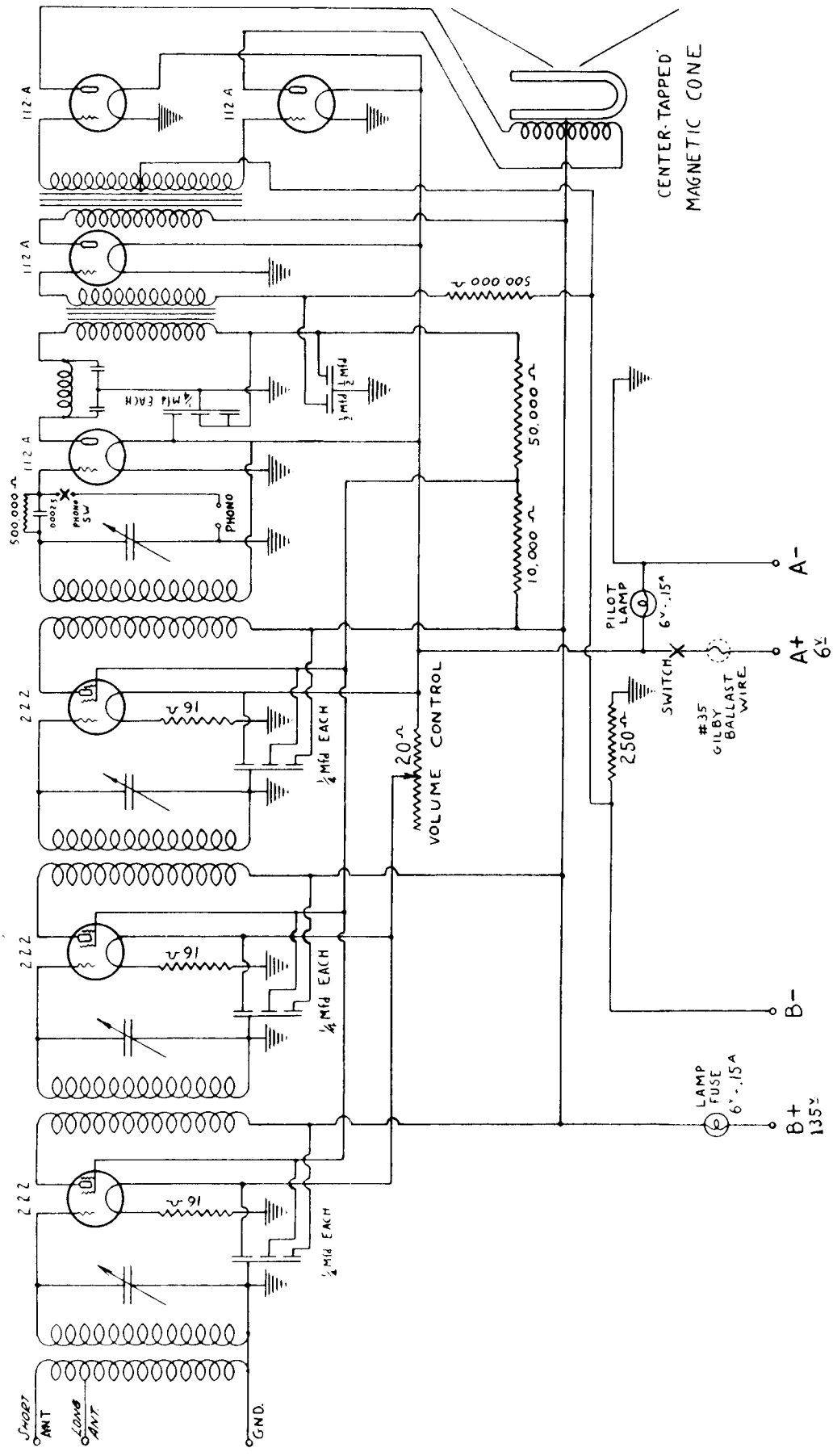
MODEL SG-T



COLIN B. KENNEDY CORP.

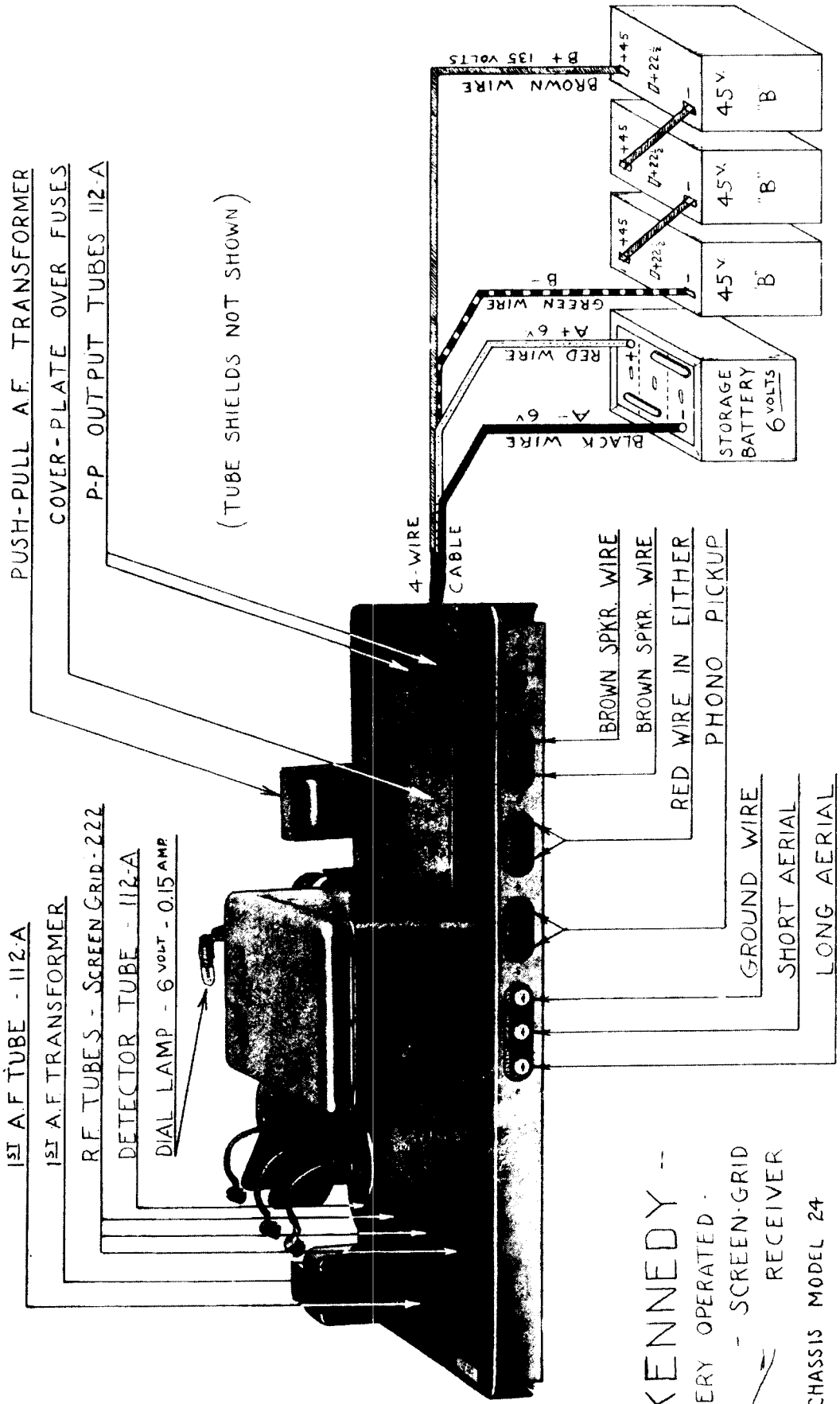
Schematic Diagram Model 24 Chassis

KENNEDY BATTERY OPERATED SCREEN GRID RECEIVER
SCHEMATIC DIAGRAM CHASSIS MODEL 24



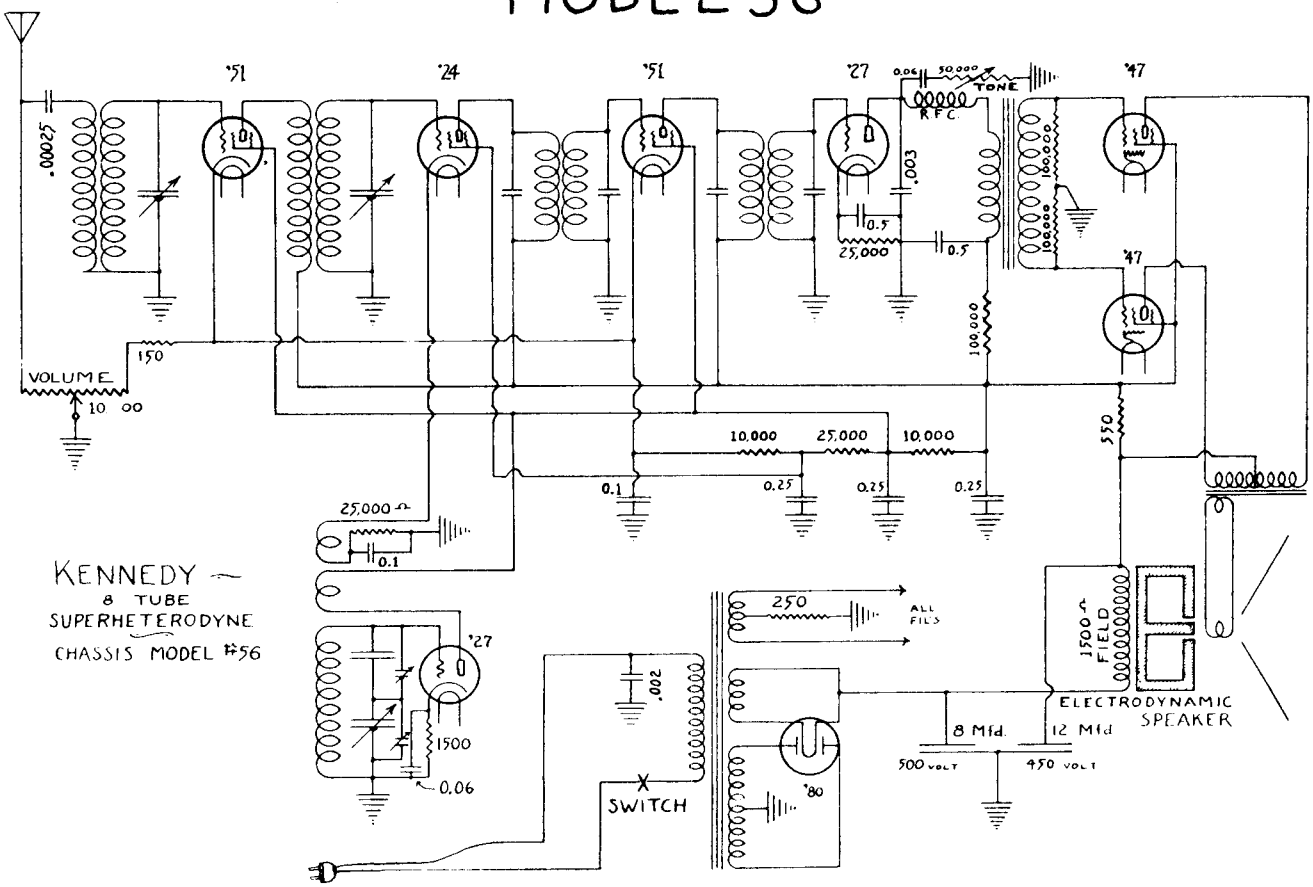
COLIN B. KENNEDY CORP.

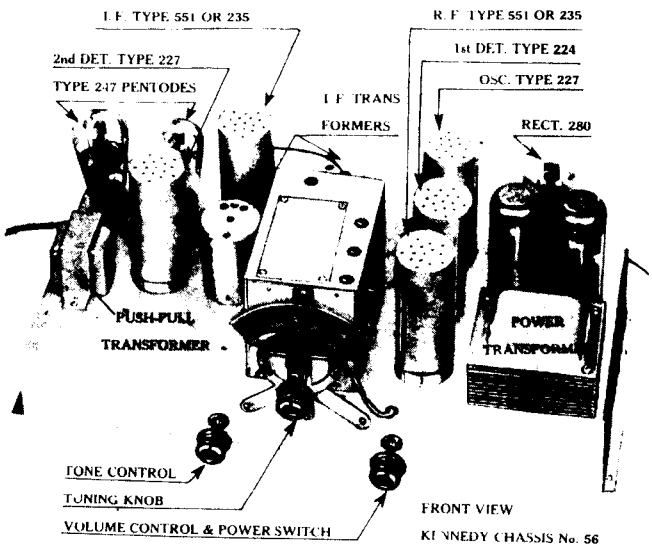
Rear View Model 24 Chassis



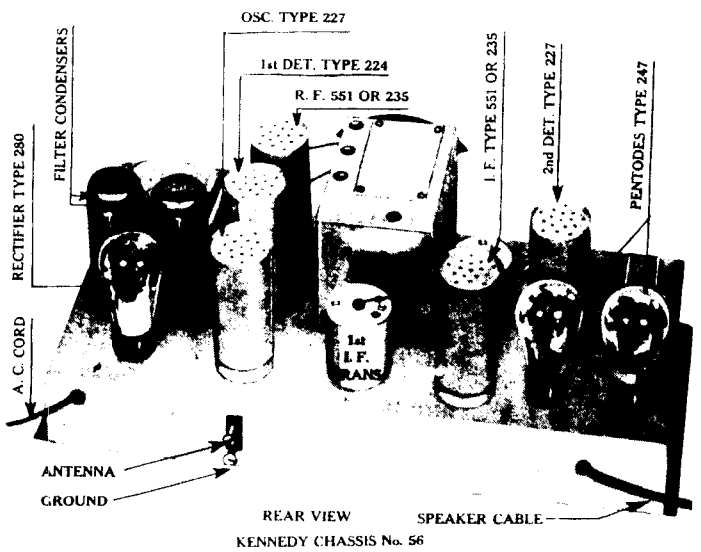
COLIN B. KENNEDY CORP.

MODEL 56





FRONT VIEW



REAR VIEW

The tubes employed in this receiver are as follows, voltages as read with a 1,000 ohm per volt D. C. meter being included for service convenience:

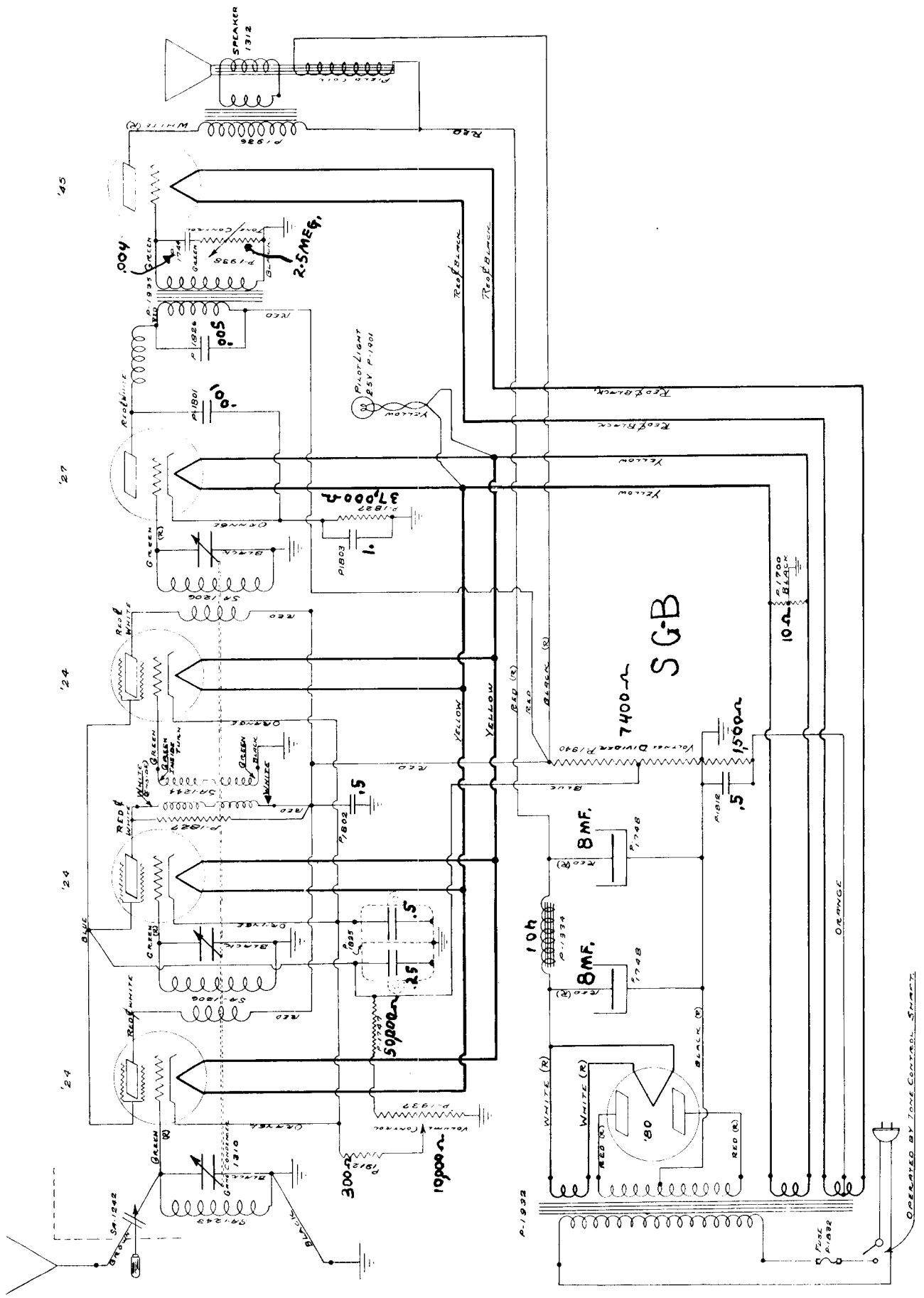
Purpose	*Type*	*F.I.A.C.*	*Plate*	*Screen*	*Bias*
Radio Frequency	551	2.35	208	98	3 to 30
1st Detector	224	2.35	208	30	5
Oscillator	227	2.35	90		10
Intermediate Freq.	551	2.35	208	98	3 to 30
2nd Detector	227	2.35	120		16
Power Tubes	247	2.35	220	208	14
Rectifier	280	4.90			

Volume control full on except for R.F. and I.F. bias extremes. Line voltage 115.

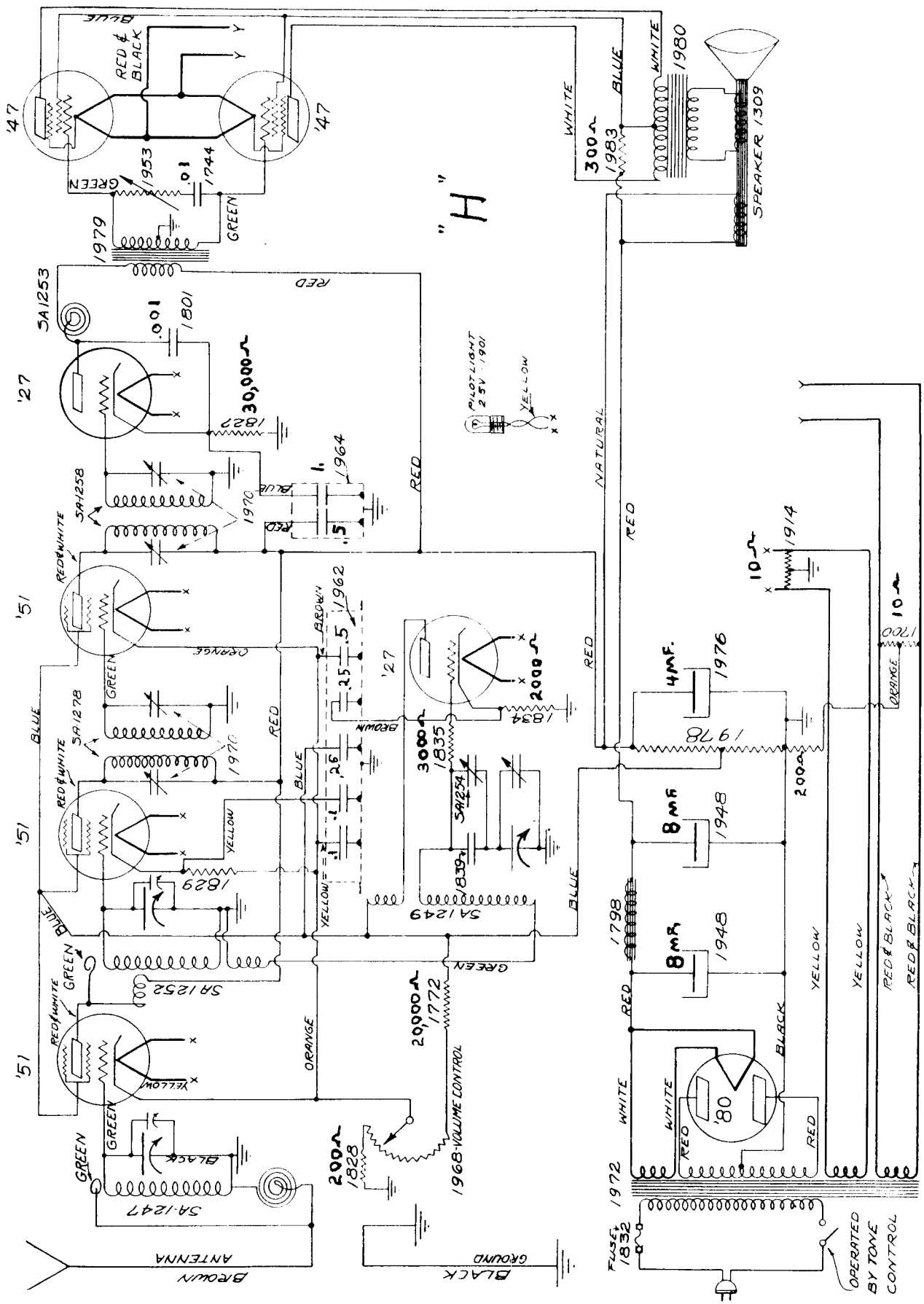
Plate, screen and bias voltages measured from ground or chassis to respective terminals.

Small deviations above or below the values given may be expected due to variations in parts, tubes and meters used.

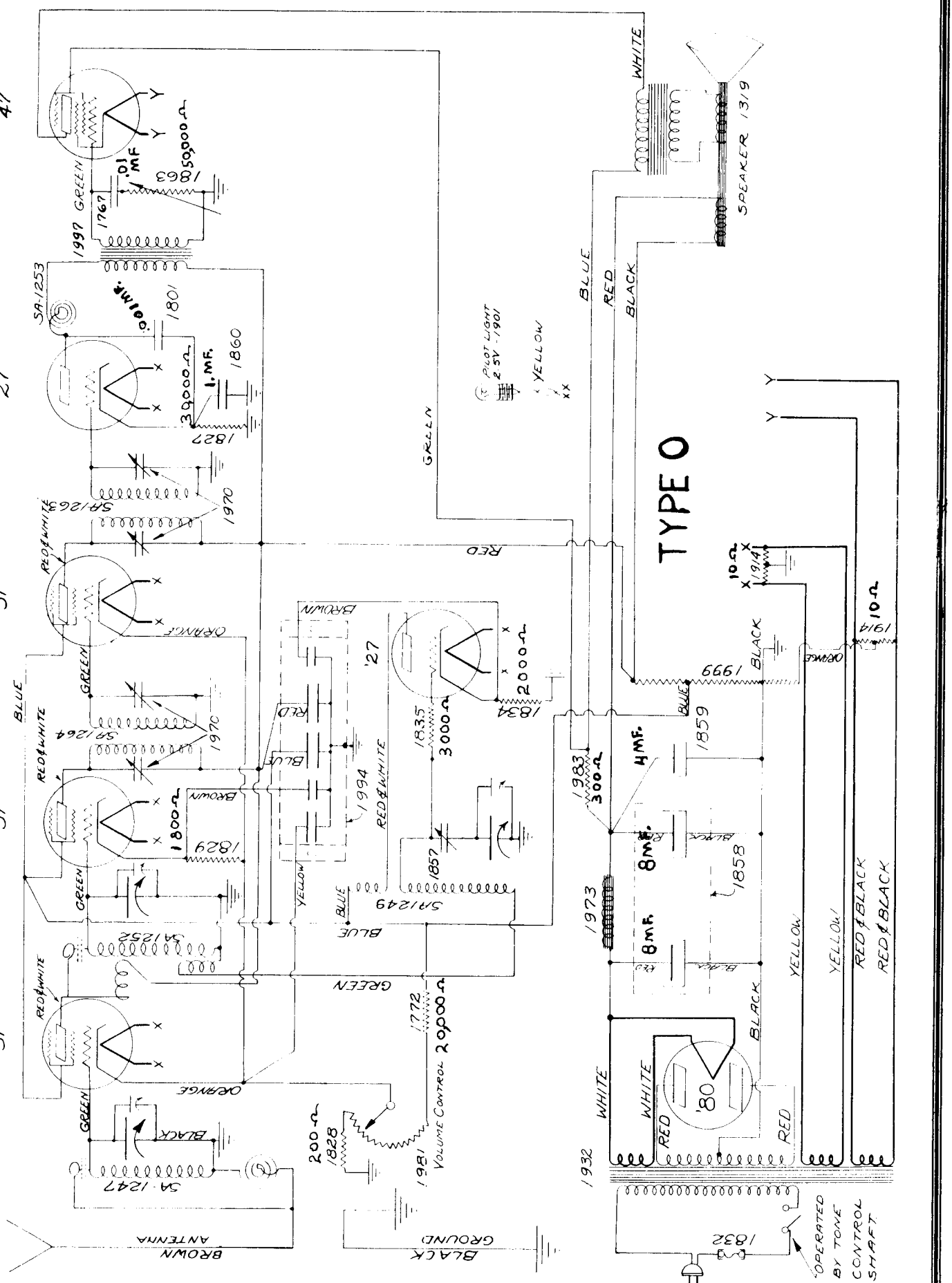
HOWARD RADIO COMPANY



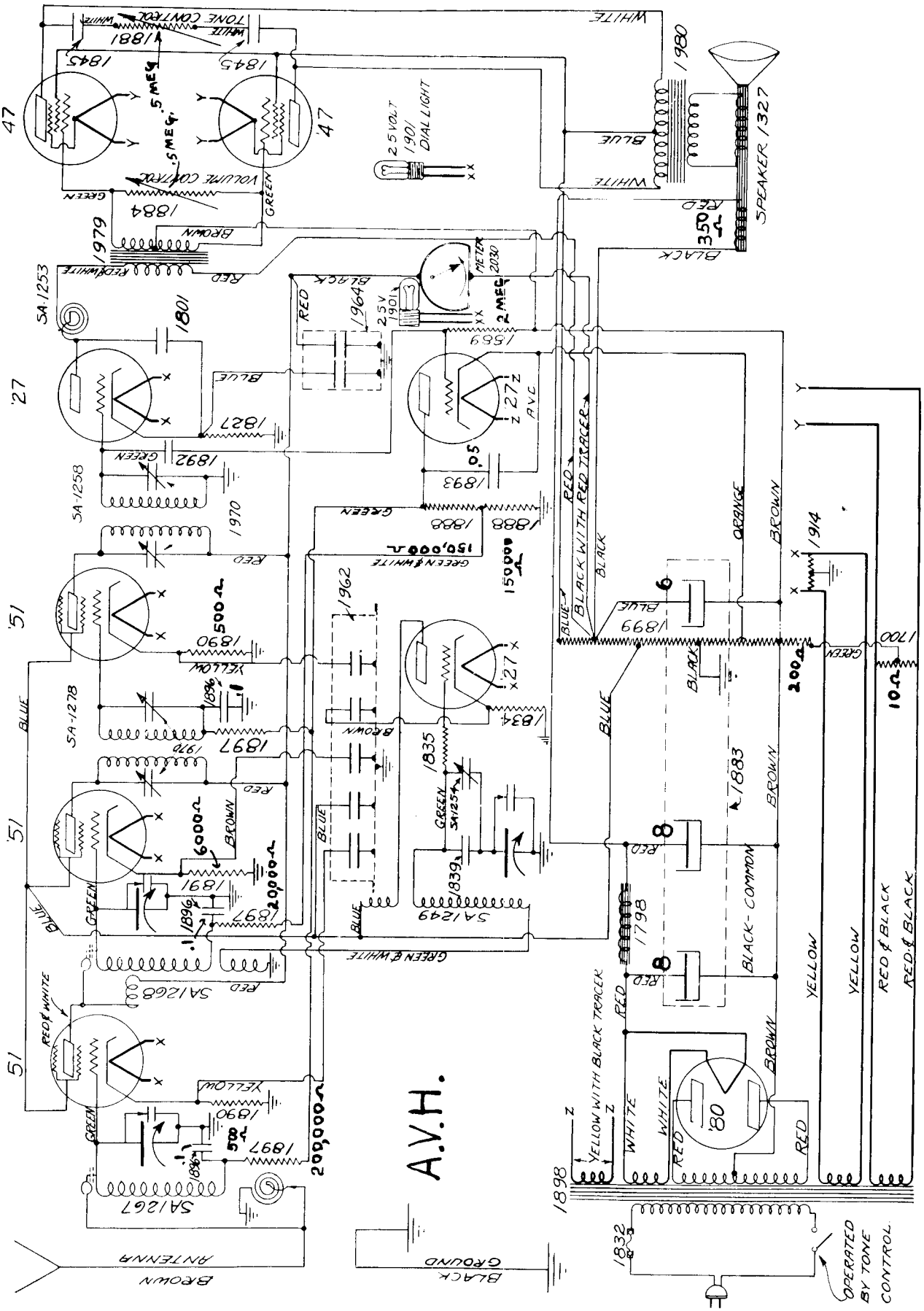
HOWARD RADIO COMPANY



HOWARD RADIO COMPANY



HOWARD RADIO COMPANY


A.V.H.
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47
27
27
51
51
51
51
80
SA-1253
SA-1258
SA-1278
SA1268
SA1267
SA1249
SA1254
1881
1845
1845
1884
1979
1980
SPEAKER 1327
25 VOLT 1901 DIAL LIGHT
METER 2030
1964
1901
1801
1827
1892
1970
1893
1888
1962
1834
1835
1839
1899
1914
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1970
1970

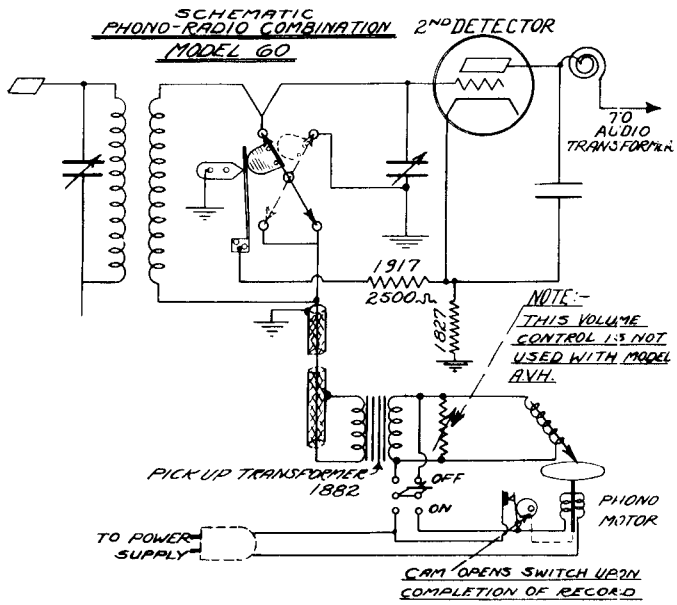
HOWARD RADIO COMPANY

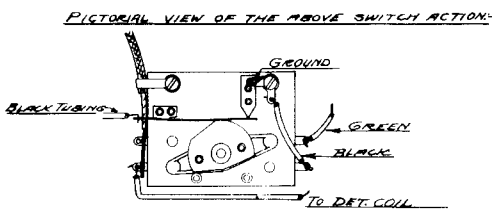
HOWARD A.V.C. SERVICE NOTES FOR A.V.H. RECEIVER

In the interest of obtaining best results with the Automatic Volume Control receiver it is important that the control tube (type 227) be a selected tube, -- one which has a definite plate current cutoff when tested at 180 volts plate and 20 volts bias on the grid. This cutoff should be less than 5 microamperes. If you do not have any means for checking the tube, in the form of a special tube tester, an immediate check for tube performance can be obtained in the set itself. For instance, disconnect the antenna and short circuit the aerial lead, leaving the control tube out of the socket, and note the swing of the tuning meter. Then insert the tube in the socket and if it is a good automatic volume control tube, there should be no change in the position of the pointer on the tuning meter. If there is a change in the position of the tuning meter pointer, namely, a swing toward the right, it is an indication that the automatic volume control tube does not have a definite plate cutoff, but it is drawing plate current and consequently, the bias voltage on the regular RF and IF tubes has been raised, with the consequent cutting down in plate current.

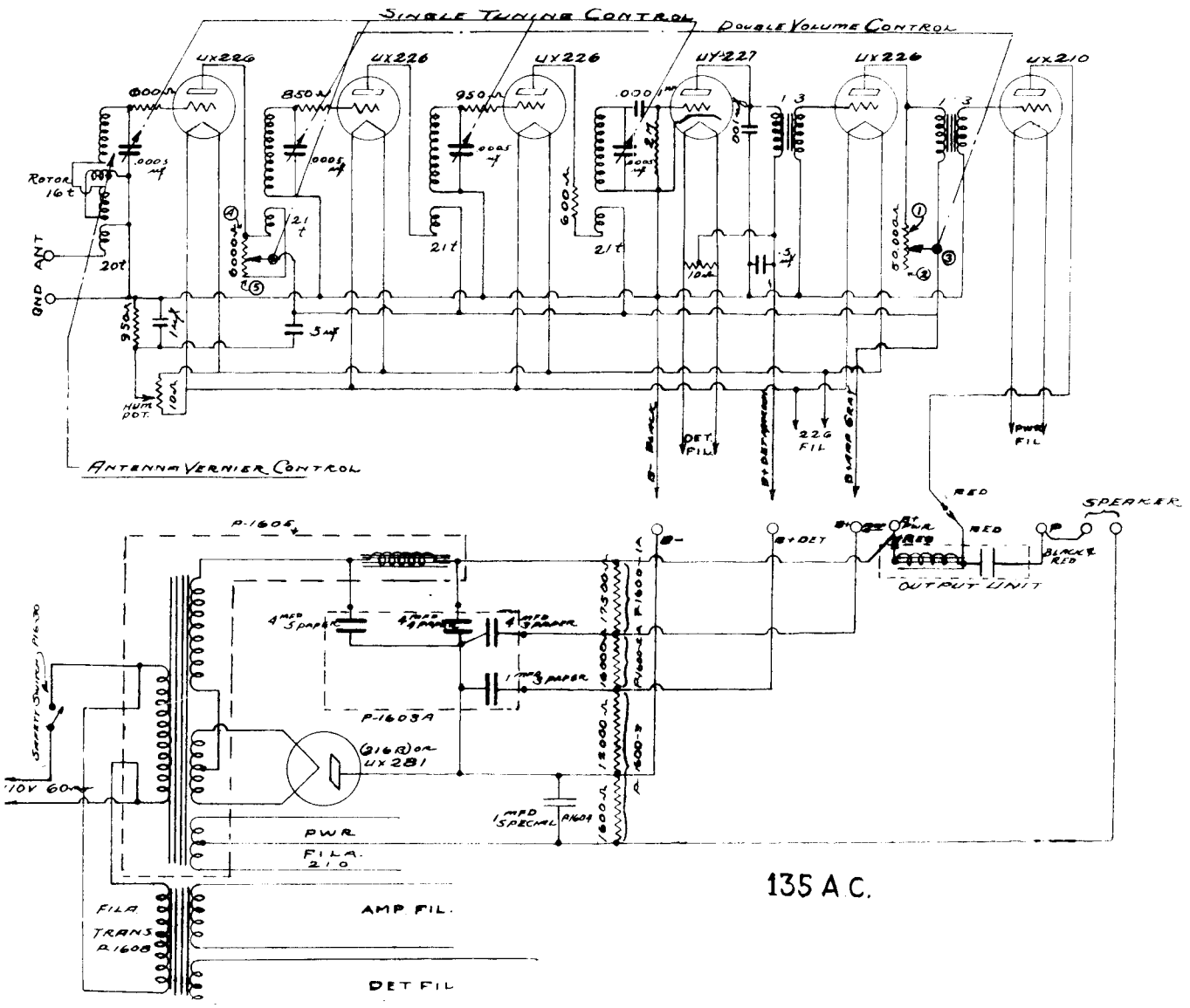
It might be a good point to mention at this time that the tuning meter in a 13 milliampere full scale reading meter and that it is connection in series with the B plus lead that furnishes voltage for the RF, first detector and IF tubes. In view of the fact that this tuning meter is in series with the plates of the amplifying tubes, you can very readily note whether or not the control tube is functioning in a proper manner, by noting the performance of said tube by its reaction on the plate current of the respective tubes as shown by the swing of the pointer on the tuning meter.

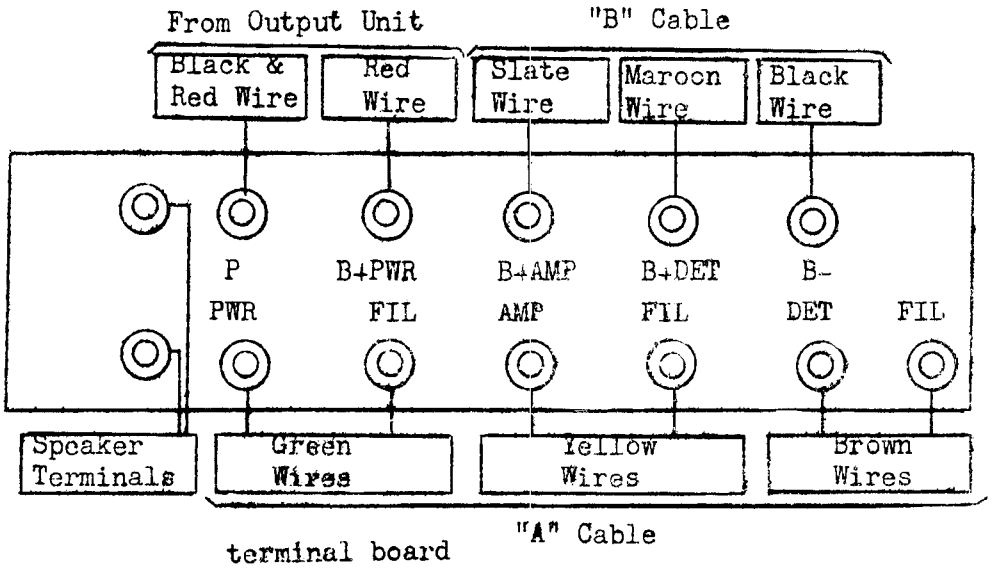
For further information with reference to this receiver, special mention is made of the fact that the speaker furnished with this receiver is different from the regular speaker furnished with the Model 35 and 40 receivers. The difference lies in the fact that the Model 45 speaker has a 350 ohm field, and as such it cannot be used with the Model 35 and 40 receivers. Please note this fact in order to prevent trouble in the future with reference to service troubles which may arise due to the use of the wrong type speaker.





HOWARD RADIO COMPANY





HAMMARLUND MFG. CO.

Operating Instructions for

HAMMARLUND ALL-WAVE RECEIVER "THE COMET"

[SECOND EDITION: Revised to include Improvements]

The following tubes are used in the Comet: Four 58's; two 57's; one 247, and one 280.

The tube sockets are correspondingly numbered and care should be taken to see that the tubes are inserted in the proper sockets. The two Isolantite sockets in the center of the chassis are for the plug-in tuning coils.

Place plug into a 110 volt, 60 cycle Alternating Current outlet only. Connect the antenna and ground. No special type antenna is required and almost any length will prove satisfactory, except in locations where severe interference is encountered. Under such conditions a rather short antenna will generally improve matters. However, too much stress cannot be put on the need for experiment in the matter of antenna layouts for short wave reception. Each receiving location has its own peculiarities and since the receiver noise level in the "Comet" is so exceptionally low, any improvement in the signal to noise ratio of the antenna system will pay big dividends in the form of improved weak signal reception. Ground connections are also a matter for experiment. All variable or high resistance joints must be carefully avoided in both antenna and ground systems. The "Ant-Gnd" block in the "Comet" has three terminals. When the conventional Antenna and Ground arrangement is used a jumper should be connected from the "G" terminal to the adjacent "A" terminal and then to the ground wire. The remaining "A" terminal should then be connected to the antenna.

Various types of balanced antenna systems such as doublets often provide improved reception at high frequencies. For proper operation of such a system the primary of the antenna coupler in the receiver should not be grounded. In the "Comet" the two ends of this primary are connected to the two "A" terminals. The "G" terminal is connected direct to the chassis. The two leads from any balanced antenna system may therefore be connected to the two "A" terminals. The "G" terminal may or may not be connected to ground depending on which condition yields better results. In certain locations quieter reception may often be secured by the use of two separate ground connections and a conventional antenna. In this case the antenna should be connected to one "A" terminal, one ground connection to the other "A" terminal, and the remaining ground to the "G" terminal.

The "Comet" loud speaker has a three wire cable with a special connector terminal. This cable should be attached to the triple terminal block on the back edge of the chassis. The three spade lugs on the cable connector should be slipped under the screw heads from the rear and the three screws tightened. When properly attached the cable connector will be even with the back edge of the chassis. *Under no circumstances should the set be turned on with the speaker disconnected.*

Coils marked OSC go in left-hand coil socket. Coils marked W. L. go in right-hand socket. However, no damage will result if a coil is inserted in the wrong socket, but the set will not function properly.

Large knob in center is main tuning control. Upper left-hand knob is OSC vernier. Upper right-hand knob is W. L. vernier. Lower left-hand knob is combination switch and tone control. When turned far as it will go in counter-clockwise direction the set is turned off. Lower right-hand knob is volume control. Toggle switch in center under main tuning knob controls the intermediate frequency oscillator. To the right—on—and to the left—off—.

To tune in a station say between 14 and 30 meters, insert the No. 11 OSC coil in the left-hand coil socket and the No. 11 W. L. coil in the right-hand coil socket. Turn on the set and turn the volume control about half way on. Then throw the toggle switch to the right starting the intermediate oscillator. Adjust the W. L. vernier until the rushing sound is loudest and then turn the main tuning control *very* slowly until a whistle is heard. If the whistle is continuous tune it to a low pitch and throw the toggle switch to the left stopping the intermediate oscillator. If the whistle was caused by the carrier wave of a short wave broadcast station speech or music should now be heard. A slight readjustment of both verniers should now be made and the volume control adjusted for clearest reception. It is extremely important that the dial be turned very slowly since otherwise stations will be passed over. Signals of other wavelengths may be tuned in in the same manner.

As stations are heard it is a good plan to keep a "log" or record showing the coils used, the dial setting, and the wavelength of the station. In this way a tuning list will gradually be built up which will furnish a guide for searching for other stations as well as locating these same stations at some subsequent date.

SHORT WAVE PECULIARITIES

The "Comet" Superheterodyne is probably the most outstanding recent contribution to the Short Wave Communication field. In addition to being the most reliable short wave receiver, it is also a high quality receiver for broadcasting, two really exceptional sets in one.

It is now entirely feasible to cover distances that would seem miraculous only a short time ago. This distant reception is most reliably accomplished on short waves and in

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many cases quality is better than on regular broadcast wavelengths, and with more freedom from static. Strange to say, reception from greatest distances is best accomplished in daylight rather than night-time, due to certain peculiarities of short waves.

An understanding of some of the peculiarities of short waves is essential if the capabilities of a short wave receiver are to be fully realized. The following has for the most part been taken from articles in radio publications fully cognizant with short wave receiving conditions throughout the world. To some readers there may not be much that is new, but to those starting fresh in the game it will be of immense help in enabling short wave reception from many foreign stations to be immediately enjoyed and will eliminate the hours of exasperation usually attendant to beginners' first efforts at operating a short wave receiver.

One magazine of prominence states, "At the outset, let us be frank and admit that the short wave *converter*, which is now in creasing vogue, is a temperamental instrument, and is not as efficient as a "pure" short wave set. The reason for the odd behavior of the converter at times must be ascribed direct to the broadcast set in conjunction with which it is used." "Comet" owners do not have this handicap to contend with for the "Comet" is a complete receiver, and of the very highest order of development.

The same magazine calls attention to the fact that every location is an entity by itself. This is particularly so in large cities, but is not so serious in the country. In large cities we have peculiarities in "dead spots" and poor reception from short waves due to "absorption" by large steel structures, and other freak conditions which no one can foretell. In the open country conditions are vastly better, but in the city short wave receiving conditions are "spotty" and must be studied. Sometimes the change of an aerial in a poor location will work wonders. The foregoing applies only to short wave reception. When the "Comet" is operated on regular broadcasting wavelengths it becomes a standard broadcasting receiver and is subject only to the well known limitations applying to any other receiver of equivalent quality.

HINTS ON SHORT WAVE TUNING

The magazine of the International Short Wave Club in their October, 1931, issue, published the best article on short wave tuning we have ever seen. The greater part of the following has been taken from it.

We are daily in contact with hundreds of listeners who do not seem to understand that certain details of tuning are necessary to get good results from a shore wave receiver. Tuning a short wave set is entirely different than tuning a regular broadcast receiver. A great many details make up this difference, as high frequencies or short waves have characteristics entirely unlike the long waves. Receivers, too, are made somewhat different inasmuch as the wavebands covered must be compensated for by different coils and not just one set of coils. All in all, it is simply a matter of the operator learning how to tune his set. A good receiver does not solve the question of results on short waves, for the operator must learn something about short waves and their peculiarities also. Once this is mastered, it is just as simple to get distant stations under ordinary circumstances as to get local stations.

As stated previously, the first thing a new listener should do is to log as many local stations as possible and mark down their dial settings. Since stations do not appear on every part of the dials, these stations will act as guides to locating distant stations. The operator should also find just what each dial on his set does when tuned, and what effect they have on the stations once they are tuned in. Locating the spot where stations are heard the best is a good idea.

We repeat that the wavelength dial should be rotated slowly, and by slowly we mean just that. Don't skim over the dials and expect stations to come rolling in. The "Comet" has a special easy tuning feature. This is the intermediate oscillator which permits stations to be located by the squeal method as described in the section of this folder devoted to special operating instructions for the "Comet."

In "fishing" for stations, the listener should time his reception, or tune on certain wavelengths at certain times of the day. From 14 to 20 meters all tuning should be done from daybreak till 3 P. M., local time. From 20 to 33 meters, stations to the east of the listener will be heard best from about 11 A. M. till 10 P. M. Stations to the west of the listener in this band should be heard best from midnight till about two hours after daybreak, when they will fade out. From 33 to 70 meters, distant stations can be heard only after darkness falls. Very little in the way of distance can be heard above 70 meters, although the ships, police, fire, coast guard and aircraft stations are all heard above that wavelength.

Short wave stations have a habit of changing in volume from time to time, these changes being affected mostly by the amount of daylight between the stations and the listener. For example, European stations are always best for American listeners during the summer months. In reverse, South Americans are best during the winter months. Each year we hear from hundreds of listeners arguing that winter months are best for distant reception and others that summer months are best. It depends mostly on the habits of the listener and his location. By habits we mean, the stations for which he generally tunes. There is not the least doubt that European stations are best during the summer months and stations like G5SW, I2RO, PCJ, Zeesen and OXY are best during these months.

Differences in time is one thing which is hard for short wave fans to understand. Listening to "Big Ben" strike midnight at 7:00 P. M. in New York brings this to mind, but still listeners who fail to hear this station at 8:00 P. M. wonder why it is not found. Almost all stations broadcast on schedules that conform with time in their part of the world. Europeans, with the exception of PCJ, who broadcast special programs for American and Australian listeners at times, close down as early as 6:00 P. M. South Americans are heard from then till midnight, Eastern Standard Time. Stations in Siam, Japan and that part of the world get busy while New Yorkers are thinking about breakfast. And people in Japan are getting ready to go to bed. It is, therefore, quite natural that listeners should tune for Euro-

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pean stations in the afternoons providing they live in the United States, and tune for stations in the Antipodes in the early mornings. Always keep a good station list on hand.

A few pointers for new listeners are:

Don't expect to find stations on all parts of the dials. Short wave stations are widely separated except in a very few places.

Don't expect stations to tune broadly. Most distant stations tune very sharp.

Don't expect to hear the world the first day you tune. It requires some knowledge of tuning to get excellent results.

Don't expect to hear a station simply because it is on the air. Many things govern short wave reception.

Don't get discouraged. If reception is poor one day, it may be fine the next.

Don't skim over the dials. Tune slowly.

Don't pass up any weak signals. Oftimes a weak program can be brought out plainly by a careful tuning.

Don't tune for stations when they are not on the air. Use a good station list. Refer to timely schedule information appearing in short wave magazines, such as the International Short Wave Club periodical.

Don't tune haphazardly. Learn where stations should be found on the dials of your particular receiver.

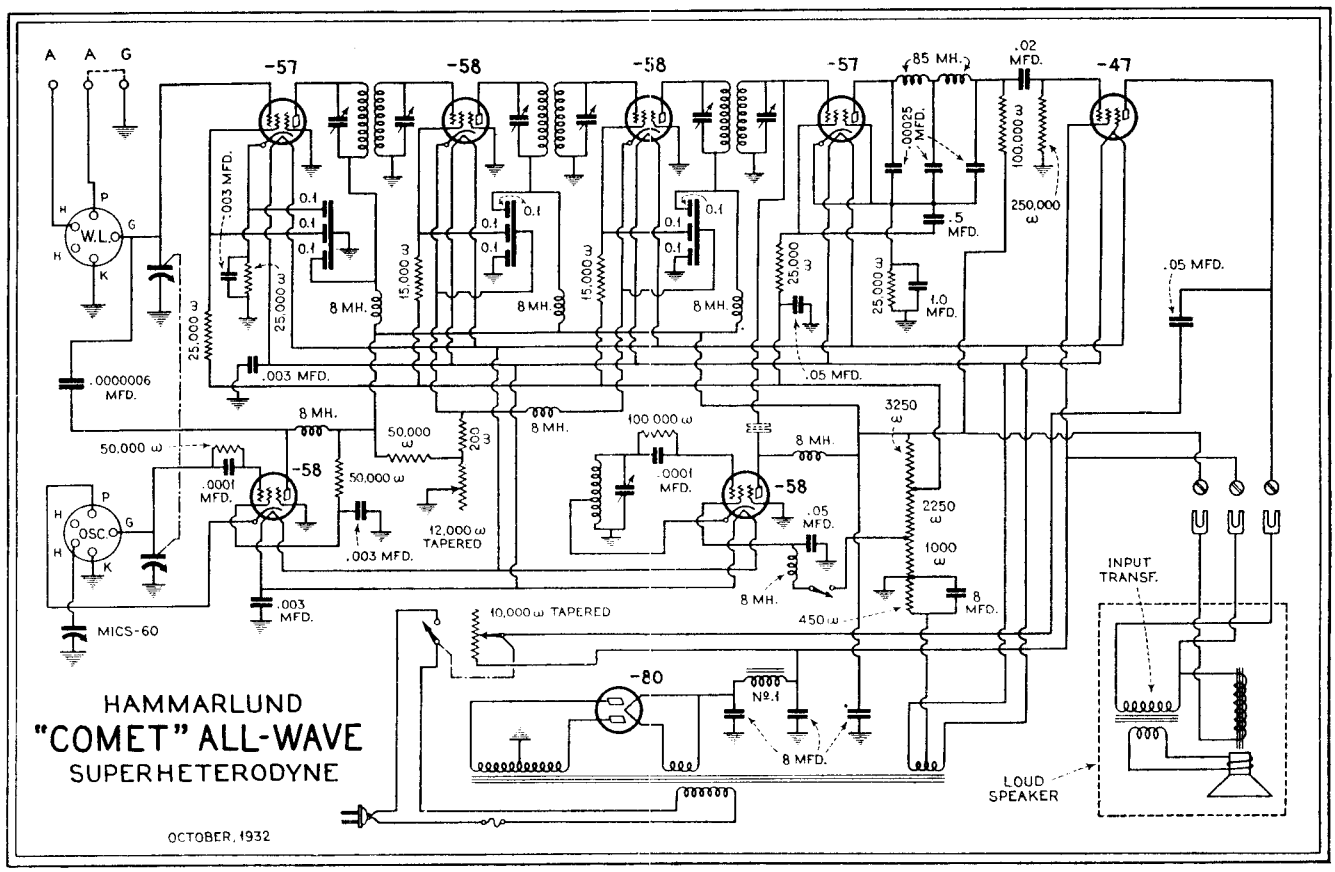
Don't expect wonderful results with a poor receiver. A good receiver is necessary for good results.

Don't tune above 33 meters for distant stations in daylight.

Don't tune below 25 meters for distant stations after dark.

The following tables show voltages at various points in the circuit of the "Comet." When checking up on these voltages, a high resistance DC voltmeter with 1,000 ohms per volt resistance, such as the Weston No. 489, should be used. Connect the negative terminal of this voltmeter to the chassis, turn on the set and adjust the volume control to minimum position. Attach a piece of wire to the positive terminal of the voltmeter. The free end of this wire is then brought to the terminals shown below.

	Volts (Approximate)
Top terminal of voltage divider	200 "
Second terminal of voltage divider	100 "
Third terminal of voltage divider	30 "
Fourth terminal of voltage divider	0 "
Bottom terminal of voltage divider	20 "
K terminal of first detector	5 "
K terminal of first and second I.F. (Max.)	35 "
(Varies with volume control) (Min.)	3 "
K terminal of second detector	5 "
P terminal of second detector	135 "
P terminal of H.F. oscillator, first and second I.F., first detector and I.F. oscillator	200 "
G terminal of first detector, second detector and first and second I.F.	110 "
G terminal of H.F. oscillator	90 "



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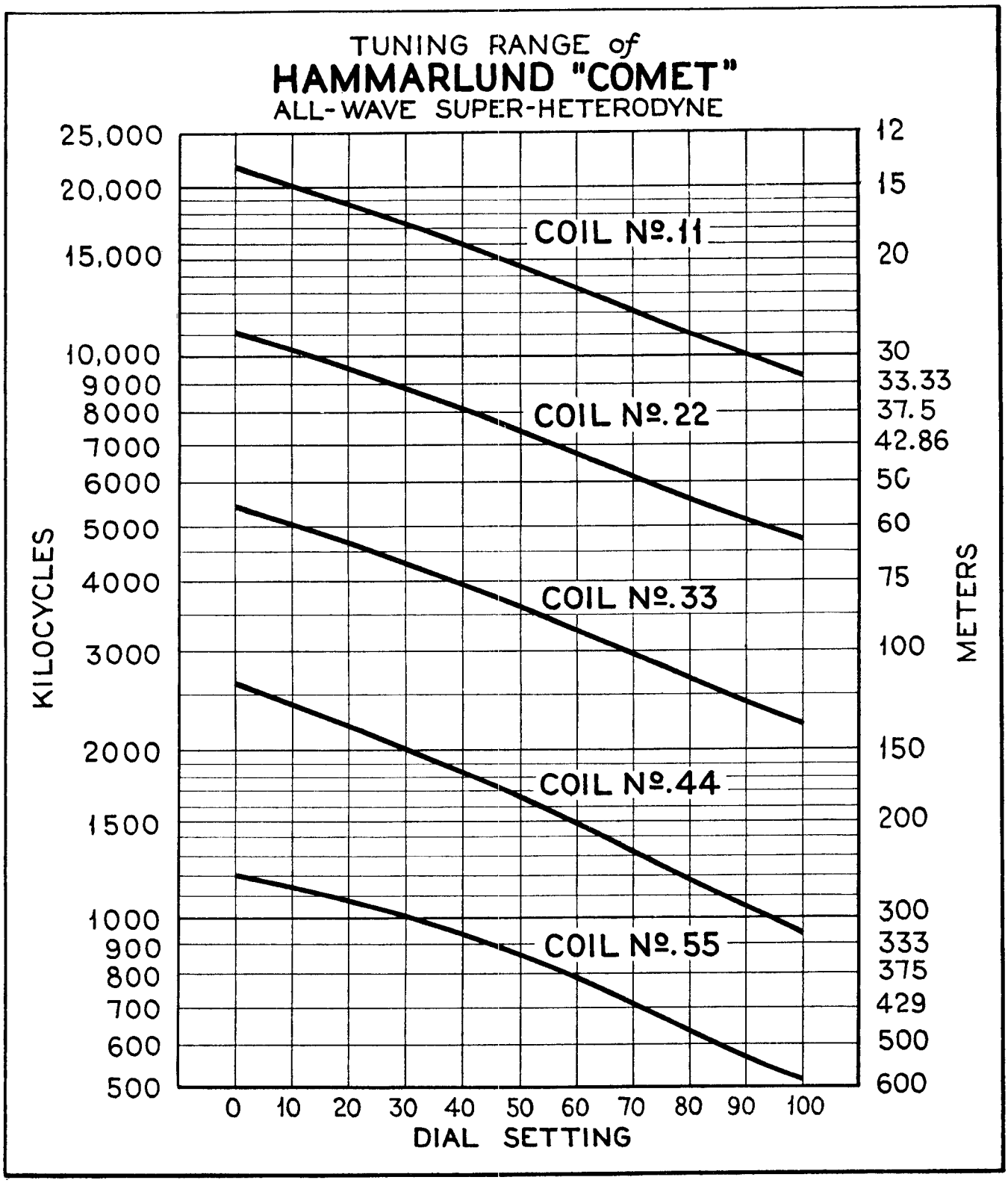


This tuning chart will assist you greatly in finding broadcast and short wave stations. For instance, if you wish to tune in to G5SW, who transmit on 25.53 meters, look at coil No. 11 curve. You will find that this wavelength falls at about 72 on the tuning dial. Let us take OXY as another example. This station is on 31.51 meters. Looking at coil No. 22 curve, you will note that this frequency will be found at about 19 on the dial.

GALVIN MFG. CORP.

GALVIN MOTOROLA MODEL 61 AUTOMOTIVE RECEIVER

(Incorporating a type 85 duodiode-triode tube as a combination second-detector, automatic volume control and first A.F. amplifier.)

This automotive receiver incorporates the following tube combination: Tube V1, type '36 screen-grid as an R.F. amplifier; V2, type '39 variable-mu R.F. pentode as a combination oscillator and first-detector; V3, type '36 screen-grid I.F. amplifier; V4, type 85 duodiode-triode as a combination second-detector, automatic volume control and A.F. amplifier; V5, type 41 high-mu special automotive pentode second A.F.

High voltages are obtained from the storage battery of the car by means of an interrupter system and step-up transformer, in the manner described in the Sept. 1932 issue of RADIO-CRAFT, pg. 152. 152.

Following are the values of the components of this modern radio set: Condensers C1, C2, C3, tuning condenser gang; C4, C8, coupling condensers; C5, C6, C7, I.F. trimmers; C9, C13, C17 (buffer), .05-mf.; C10, 0.5-mf.; C11, 0.25-mf.; C12, 500 mmf.; C14, .002-mf.; C15, .01-mf.; C16, 1. mf.; C18, C19, 8 mf.; C20, C21, 0.1-mf.

Resistor R1, volume control potentiometer, 0.5-meg.; R2, R4, R7, R8, 0.1-meg.; R3, 75,000 ohms; R5, 5,000 ohms; R6, 500 ohms; R9, 0.2-meg.; R10, 50,000 ohms; R11, 0.7-meg.

It is not recommended that any repairs be made to a defective Elkonode (interrupter.) All such units should be returned to the factory (Galvin Mfg. Corp., Chicago, Ill.), or to the manufacturers of the Elkonode (see label on unit).

An open buffer condenser, C17, will be indicated by failure of the rectifier tube V6 to stay ionized. A purple glow in the tube is an indication of correct operation of this type of rectifier; a shorted C17 condenser will be indicated by spasmodic operation of the Elkonode, as well as failure of V6 to glow. As a general rule, when spasmodic operation of the Elkonode is observed it is an indication that the Elkonode is not feeding into the correct load; it either is underloaded or overloaded; two undesirable conditions.

After the Elkonode has been removed, it may be tested by applying 6 volts to the large terminals, with positive polarity to the brown wire; it is also necessary to connect a 5,000-ohm resistor across the red (or green) and black wires, together with an 8 mf. electrolytic condenser and a voltmeter. With this setup, the Elkonode should consume not more than 2.25 A.; the voltage drop across the 5,000-ohm load should be between 160 and 170 volts, provided the battery voltage is exactly 6.3.

The following precautions should be observed: Do not remove the receiver section of the set from the power pack, with the set turned on; the BR tube, V6, should not be removed from its socket unless the set is turned off. Since the "A" supply is polarized, it is necessary to make certain that the red wire connects to the positive terminal and the white wire to the negative terminal of the battery; do not operate the set with the "A" leads reversed, otherwise the Elkonode will be damaged beyond repair. For this reason, the polarity of the car battery should be double-checked by means of a voltmeter before the set is put into operation. (Reversed connection to the "A" battery will be indicated by low "B" voltage, spasmodic operation of the Elkonode and erratic flashing of V6.)

An ideal place for the reproducer is face-out, with the reproducer flush with the instrument board, but such a position is undesirable because of the space factor. Therefore, the first alternative is to leave it at the same level but to move it back to the bulk-head, for good operation.

If there is not room to mount the reproducer in that position, a second method is to face the reproducer toward the floor-boards, with the front-edge of the reproducer against the instrument board and the side against the side of the car, a position available in most cars.

It generally necessitates two holes being drilled through the instrument board to hold the reproducer and an additional bracket run from the adjacent side of the reproducer to the side of the car. This location is rather new to some installation men, but its acoustic properties are superior because of the additional baffle effect which results from the close proximity to the instrument board.

Following is a listing of the preferred location for automotive radio receivers to be used in the 1931 car models specified:

Ford, Model A: Motor compartment on the left side;

Chevrolet: Motor compartment on the left side or below the cowl on the right inside; (For 1932 model, remove carburetor and air cleaner, temporarily.);

Buick: Below the cowl on the right inside;

Chrysler: Right side of car under cowl;

Pontiac: Left side of motor compartment or right side of car under cowl;

DeSoto: Ditto;

Plymouth: Left motor compartment or right side of car, under cowl;

Cadillac: Ditto;

Lincoln: Center of motor compartment or right side of car, under cowl;

Packard: Ditto; (Light Eight, left side of motor compartment.);

Oakland, V8: Below cowl on right side or right side of car, under cowl;

Studebaker: Left motor compartment or right side of car, under cowl;

Oldsmobile: Right motor compartment or right side of car, under cowl;

Auburn: Right motor compartment or right side of car, under cowl.

(The "bulkhead" is the partition in the car which separates the motor compartment from the driver's compartment.)

Car manufacturers have furnished the following data regarding their provisions, in 1932 models, concerning automotive radio antennas:

Chrysler: Roof antenna with lead-in and provisions for "B" battery box;

Dodge: Ditto;

DeSoto: Ditto;

Plymouth: Ditto;

Reo: Equipped with roof antenna and lead-in;

Rockne: Ditto;

Studebaker: Ditto;

Buick: All models, $6.00 additional for antenna installation;

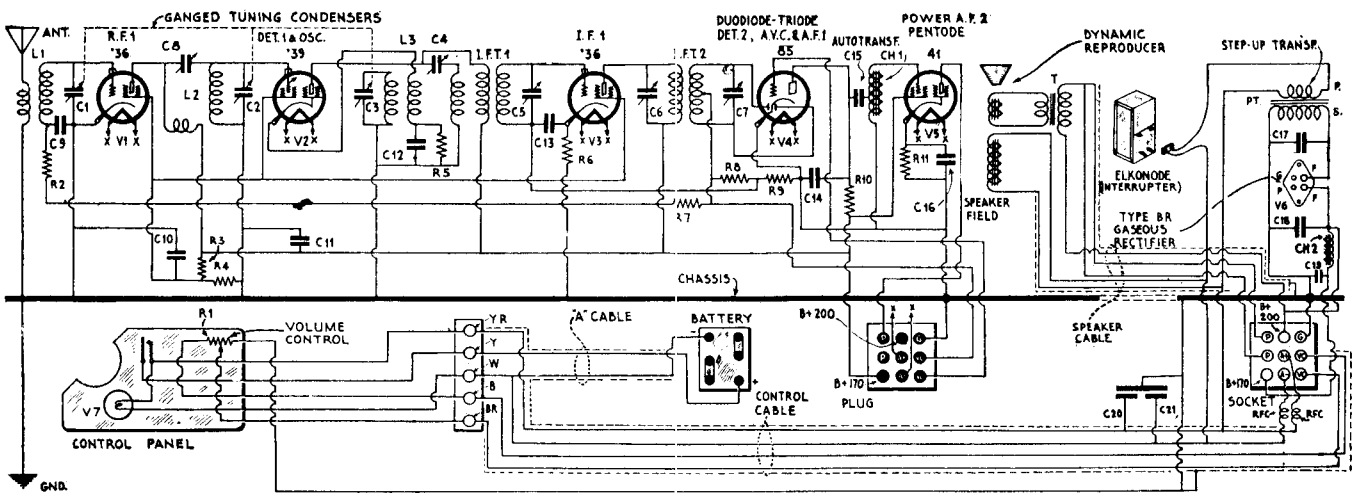
Franklin: Roof antenna but no lead-in;

Ford: Ditto;

Cunningham: All models, additional charge for antenna installation.

Check the proposed antenna for ground by means of a 0-200 V. meter, of 1,000 ohms-per-volt type, and a 200 V. battery. Even on damp days the leakage should not exceed 2 V. Lack of peak resonance on the antenna trimmer indicates a leaky antenna, or one having too great capacity; in general, an antenna screen area of about 9 sq. ft. will be satisfactory.

The dynamic reproducer may be checked for a rubbing voice coil by applying 50 V., 60 cycles, to the two outside or "B" terminals of the output transformer; instead of a clear, steady hum, a rubbing noise will be heard, if the voice coil is not floating entirely clear.



KOLSTER RADIO, Inc.

KOLSTER MODELS K-140 AND K-142 10-TUBE SUPERHETERODYNE

(Dual reproducers, dual band-selectors, antenna transmission line, phono.-radio operation; A.V.C.; provisions for connecting remote control and an S.W. converter; neon-tube visual tuning.)

A radio receiver that excellently represents the advances which have been made in radio receiver design is the Kolster model K-140 (50- to 60-cycle) and the model K-142 (25- to 60-cycle) 10-tube superheterodyne.

Following are the condenser values employed in these chasses: C1, C2, C3, C4, 4-gang tuning condenser unit; C1A, C2A, C3A, C4A, R.F. trimmer condensers; C5, padding condenser, 600 mmf.; C5A, pad R.F. trimmer condenser; C6 to C11, I.F. trimmers; C12, tone control, 50 mmf. to .0045-mf.; C13, 0.5-mf.; C14, C31, 100 mmf.; C15, C16, C23, C24, C29, 0.1-mf.; C17, 1. mf.; C18, C25, 500 mmf.; C19, C20, C21, dry electrolytic, 8 mf.; C22, dry electrolytic, (25 cycles, only), 4 mf.; C26, C28, C30, 0.25-mf.; C27, .01-mf.; C32, .025-mf.; C33, electrolytic, 4 mf.

Resistor R1, manual volume control, 0.5-meg.; R2, 500 ohms; R3, R4, R5, R6, R9, R14, R23, 0.25-meg.; R7, 750 ohms; R8, 0.5-meg.; R10, R16, R19, R20, 25,000 ohms; R11, R15, 5,000 ohms; R12, 75,000 ohms; R13, 50,000 ohms; R17, 3,000 ohms; R18, 0.1-meg.; R21, 10,000 ohms (60 cycles), or 8,000 ohms (25 cycles); R22, 10,000 ohms.

Tube operating characteristics at a line potential of 115 V. are as follows: Filament potential, V1 to V9, 2.3 V.; V10, 4.7 V. (The following potentials are measured to the cathode of the respective tube indicated.) Heater potential, V1, V4, V5, 2.5 V.; V2, 6 V.; V3, V6, zero; V7, 10 V. Control-grid potential, V1, 0.2-V.; V2, V6, 1. V., and V7, 1. V. (with vol. control at maximum) to 10 V. (with vol. control at minimum); V3, 2V.; V4, 6 V.; V5, 3.6 V.; V8, V9, 4 V. Screen-grid potential, V1, 85 V.; V2, 80 V.; V4, V5, 110 V.; V8, V9, 245 V. Plate potential, V1, 130 V.; V2, 120 V.; V3, 90 V.; V4, V7, 175 V.; V5, 180 V.; V6, zero; V8, V9, 225 V.; V10, plate-to-plate potential, 725 V., A.C. Plate current, V1, 1. ma.; V2, 0.4-ma.; V4, 1.1 ma.; V5, 1.2 ma.; V8, V9, 5 ma.

Any attempts to align the I.F. circuits of the K-140 chassis in the usual manner will result in instability and poor over-all fidelity, if adjustments are made in the conventional manner and with a modulated oscillator, tuning for maximum output. In fact, no attempt should be made to vary these settings, which are determined by special test equipment at the factory for obtaining 10 kc. selectivity throughout the entire broadcast band, unless it is absolutely necessary. The procedure is as follows:

Remove the voice-coil shunt connection and connect the output meter to the secondary of transformer T2. Next, remove the oscillator tube and the cap lead of V5, and connect the output of a 175 kc. service oscillator to the cap of the tube. Then, adjust C10 and C11 for maximum output. Replace the cap lead, couple the service oscillator to V4, and adjust C8 and C9 for maximum output at 175 kc. Next, couple the service oscillator to V2 and adjust C6 and C7 for maximum at 175 kc. The oscillator output should be coupled directly to the grids, without a dummy antenna. If the oscillator is capacitatively coupled the open grid circuit may result in circuit oscillation; in this case the grid circuit may be completed to ground through 1,000 ohms.

Now, to obtain the full tone quality for which the reproducers and the balance of the set are designed, it will be necessary to flatten out the I.F. channel so that it presents uniform gain for frequencies of 170 and 180 kc. (The gain with the flat-topped adjustment is less than when the circuits are adjusted for peak resonance.)

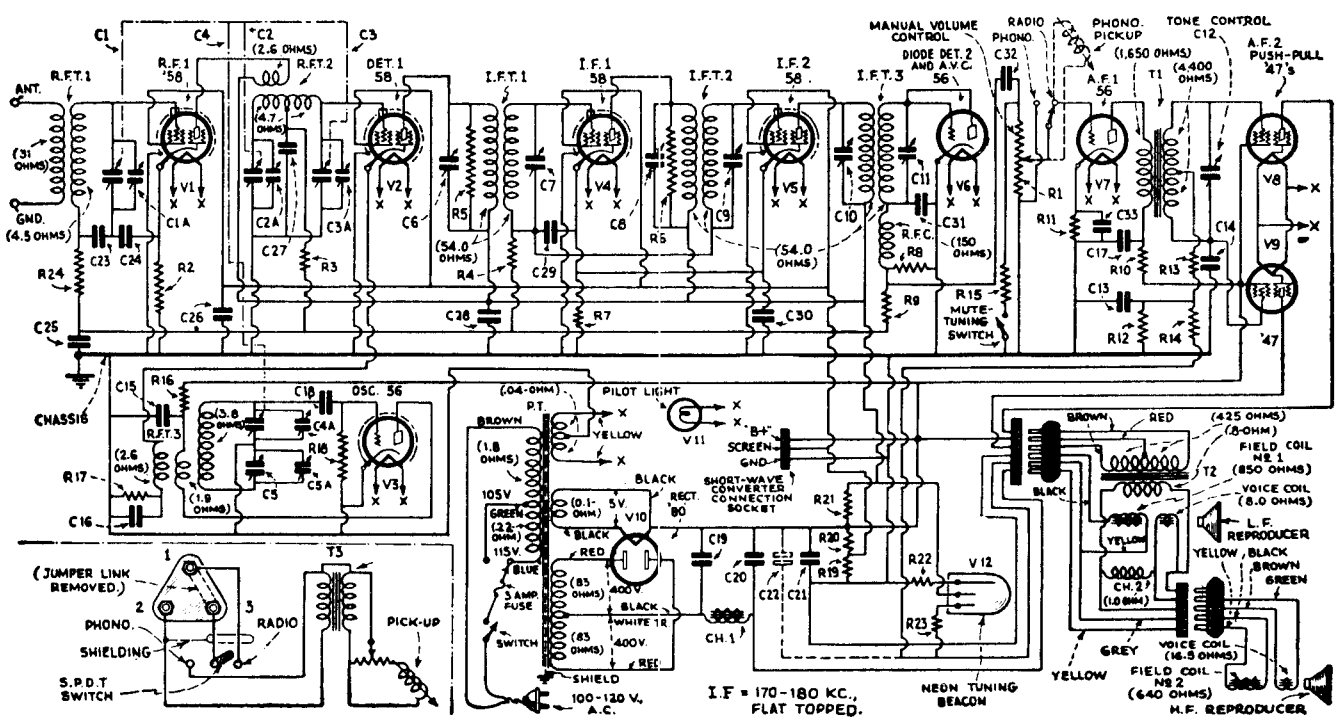
Set the service oscillator at 180 kc. and adjust the I.F. trimmers to obtain a preliminary output reading; repeat this performance, at 170 kc., to obtain the same output reading. (It will be necessary to go over the six trimmers several times.) When thus aligned the I.F. amplifier portion of the receiver should indicate the same gain at 170 and 180 kc., and less at 175 kc.

In aligning the R.F. circuits, it is necessary that the R.F. selectivity be superimposed on the middle of the I.F. selectivity graph in order that the overall selectivity figure will be symmetrical. Replace the oscillator tube and shield, couple the service oscillator to the antenna and ground terminals of the chassis (not the antenna terminal and the chassis), and operate the service oscillator at 600 kc. Adjust C4A for maximum output, while rocking the tuning dial across the 600 kc. setting, until the output remains fairly constant with a shift of several kc. either side of 600 kc.; then, finish by adjusting C1A, C2A and C3A. Reset the service oscillator to 1,400 kc. and align the oscillator circuit first. By adjusting the oscillator trimmer it is easy to locate the two peaks and the dip in the middle; the oscillator should be aligned for this dip. Finally, align the remaining R.F. circuits by adjusting C1A, C2A and C3A for maximum output. Alignment at 1,400 kc. should not affect alignment at 600 kc.

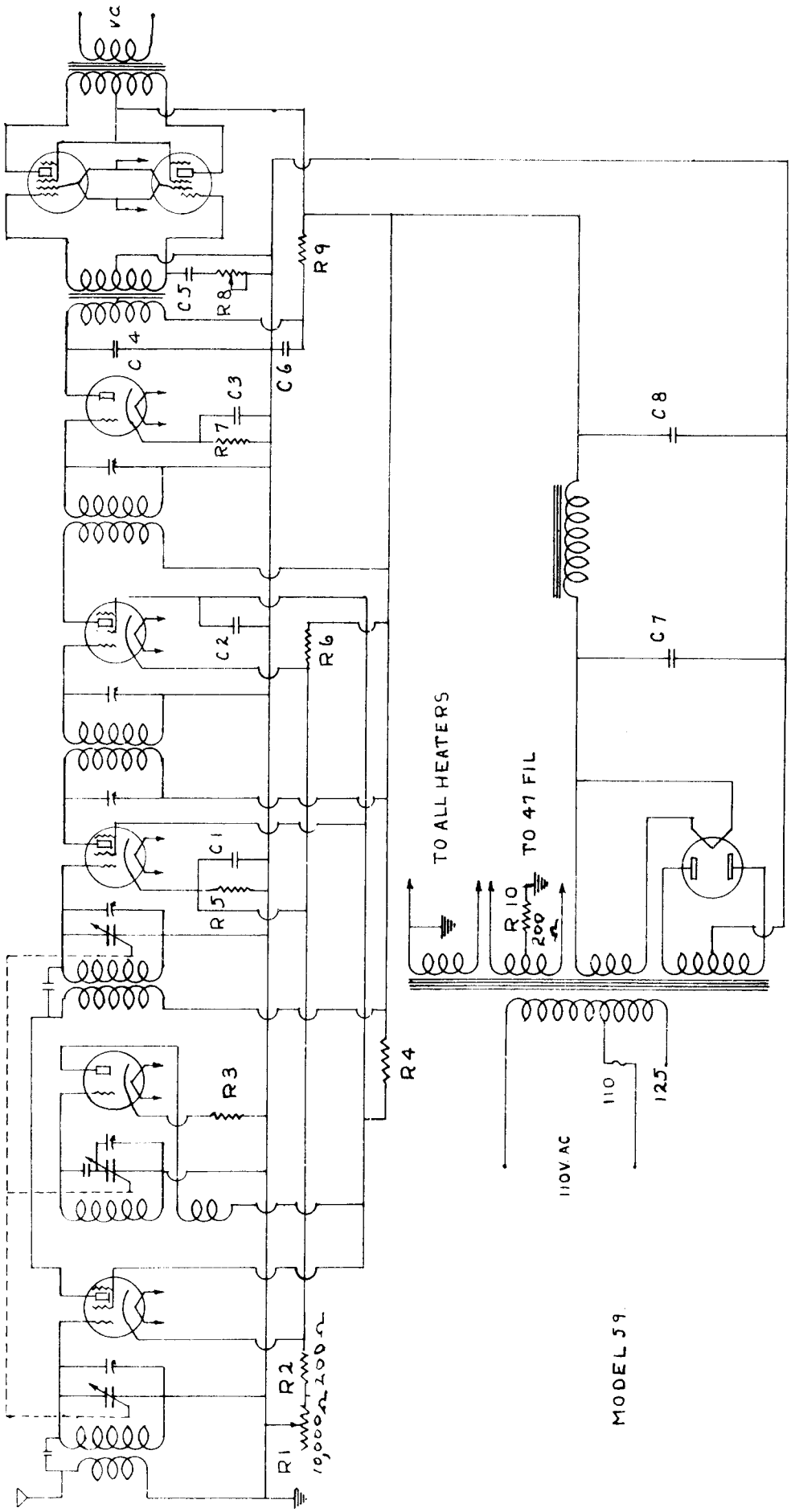
The insert indicates the circuit arrangement at the rear of the chassis for phono-radio operation; also, remote control (terminals 1 and 2). Transformer T3 and resistor R1 must be matched to the pickup, if it is of low-impedance type; T3 may be omitted if the pickup is of high-impedance type.

If the neon beacon tuning beam does not extend sufficiently high during the reception of distant stations, it may be necessary to reduce the value of resistor R2 to perhaps 7,000 ohms. If the value is made too low, the beam length will extend too far during the reception of local station programs.

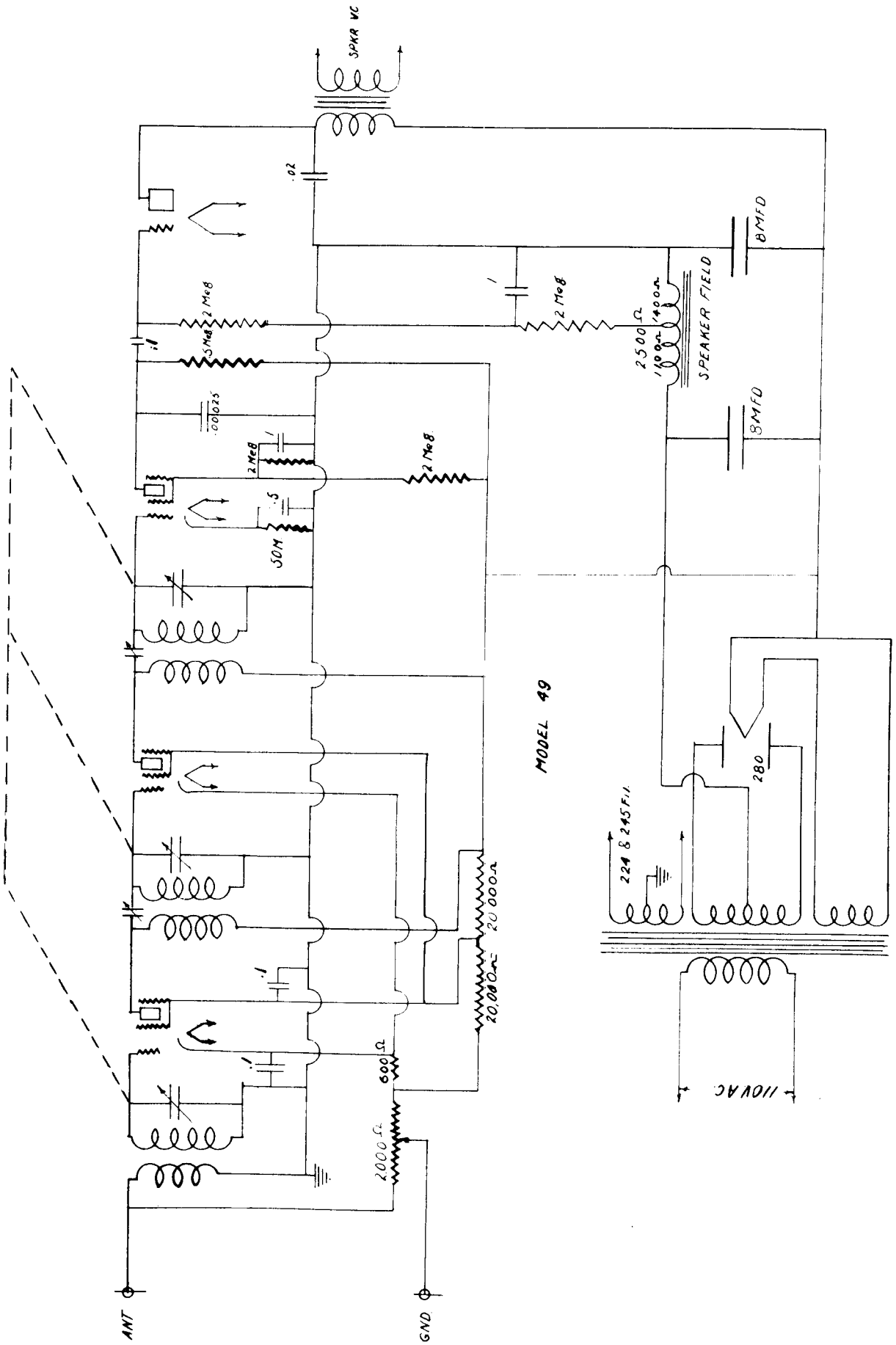
A complete Kolster installation includes an antenna "rejectostat" (coupler), an R.F. transmission line (as contrasted with the relatively inefficient "shielded leadin" ordinarily used) up to 1,000 ft. long, and a receiver rejectostat" (coupler); this greatly reduces the proportion of noise pickup. The R.F. transmission line is No. 18 rubber-covered twisted pair, shielded with copper-braided sleeving, and protected with a 1/16-in. rubber covering; (or Beldin Transmission Line Shielded Cable may be used).



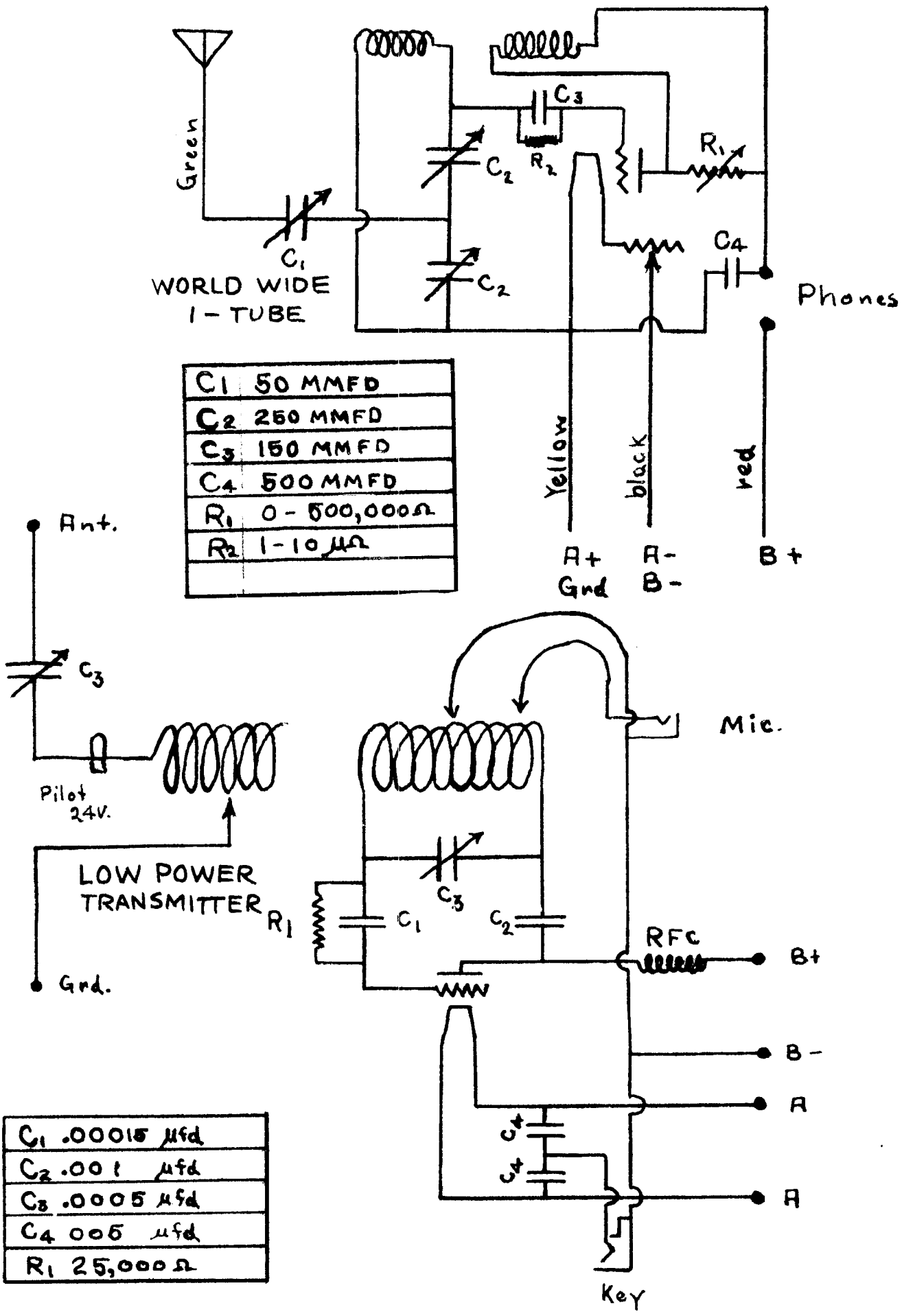
HORN RADIO CO.



HORN RADIO CO.



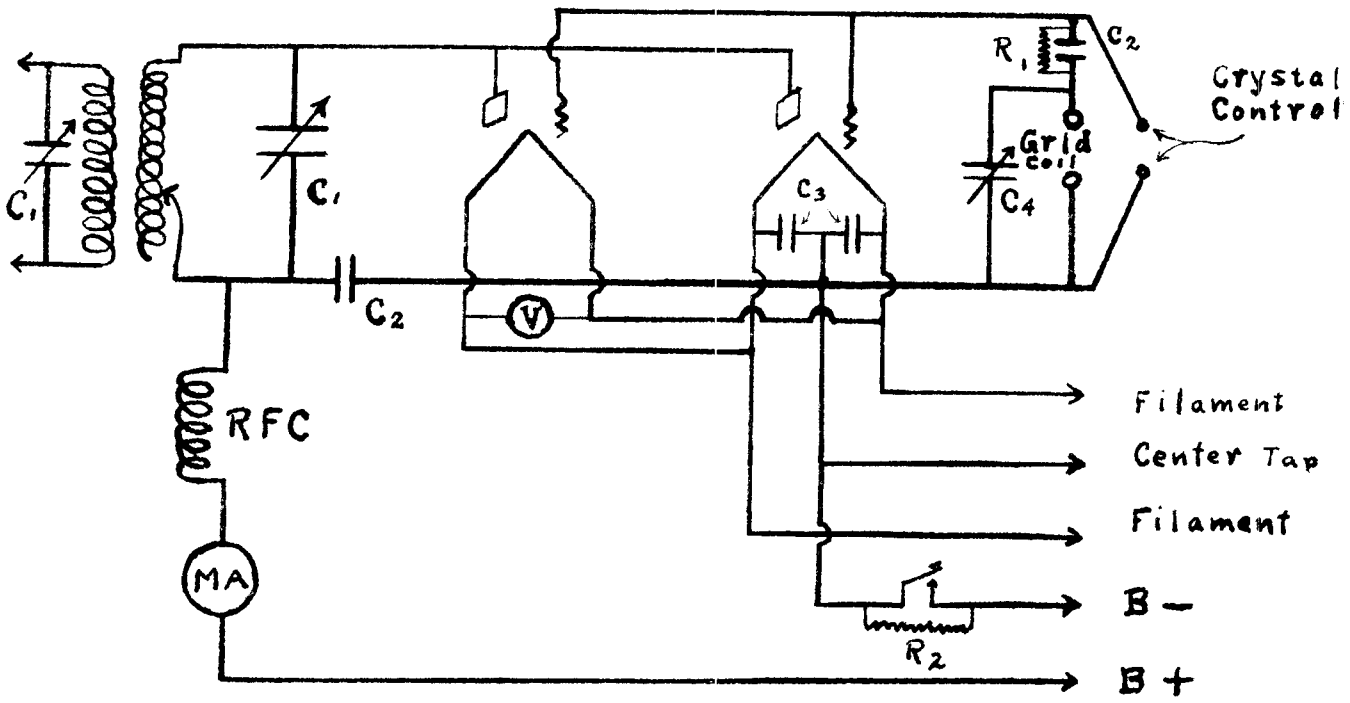
CHAS. HOODWIN CO.



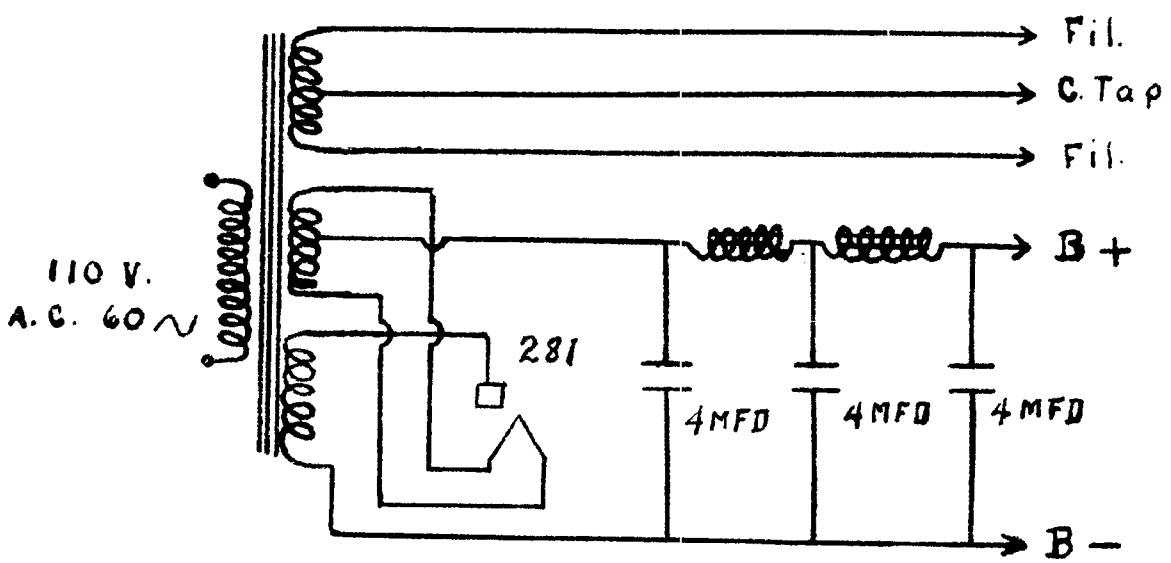
C_1	50 MMFD
C_2	250 MMFD
C_3	150 MMFD
C_4	500 MMFD
R_1	0 – 500,000Ω
R_2	1 – 10 MΩ

C_1	.00015 μfd
C_2	.001 μfd
C_3	.0005 μfd
C_4	005 μfd
R_1	25,000Ω

CHAS. HOODWIN CO.

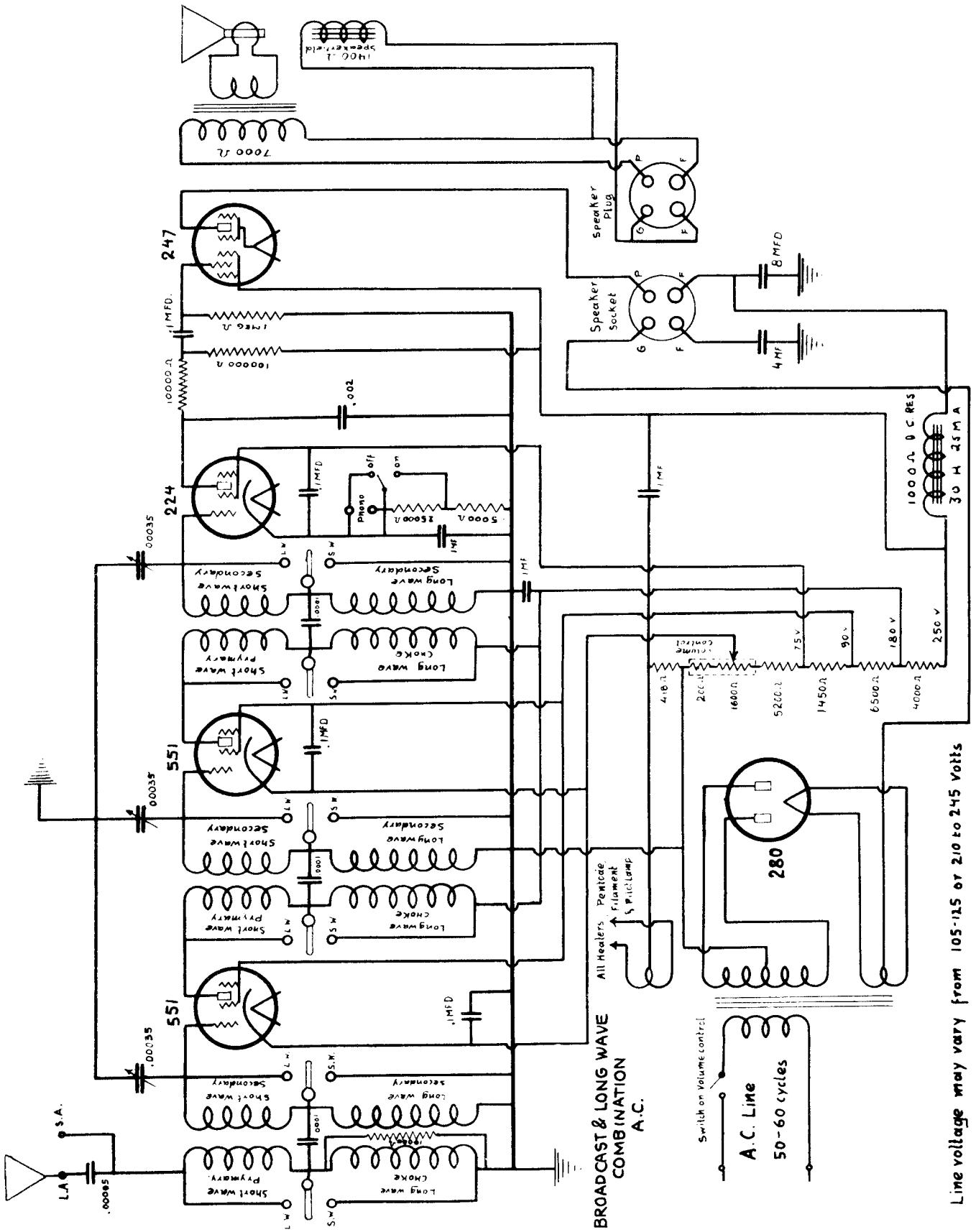


C_1	.0007 MFD
C_2	.00025 MFD
C_3	.005 MFD
C_4	.0001 MFD
R_1	25,000 ~
R_2	20,000 ~

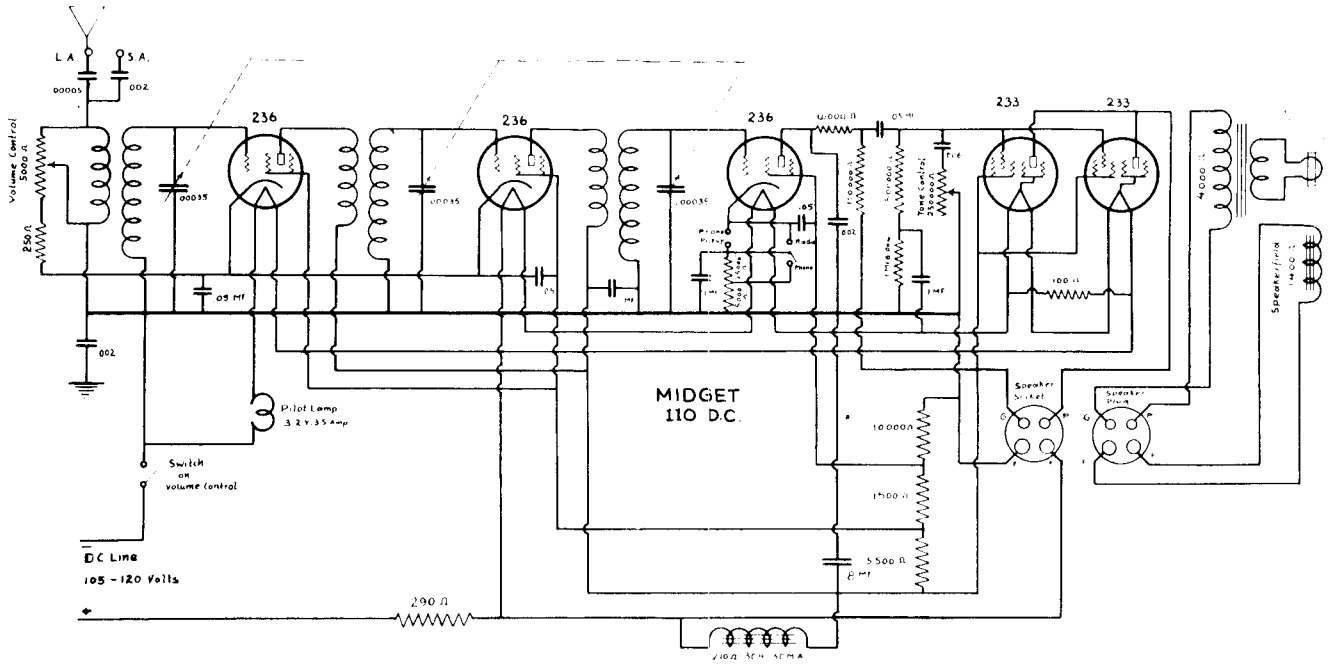


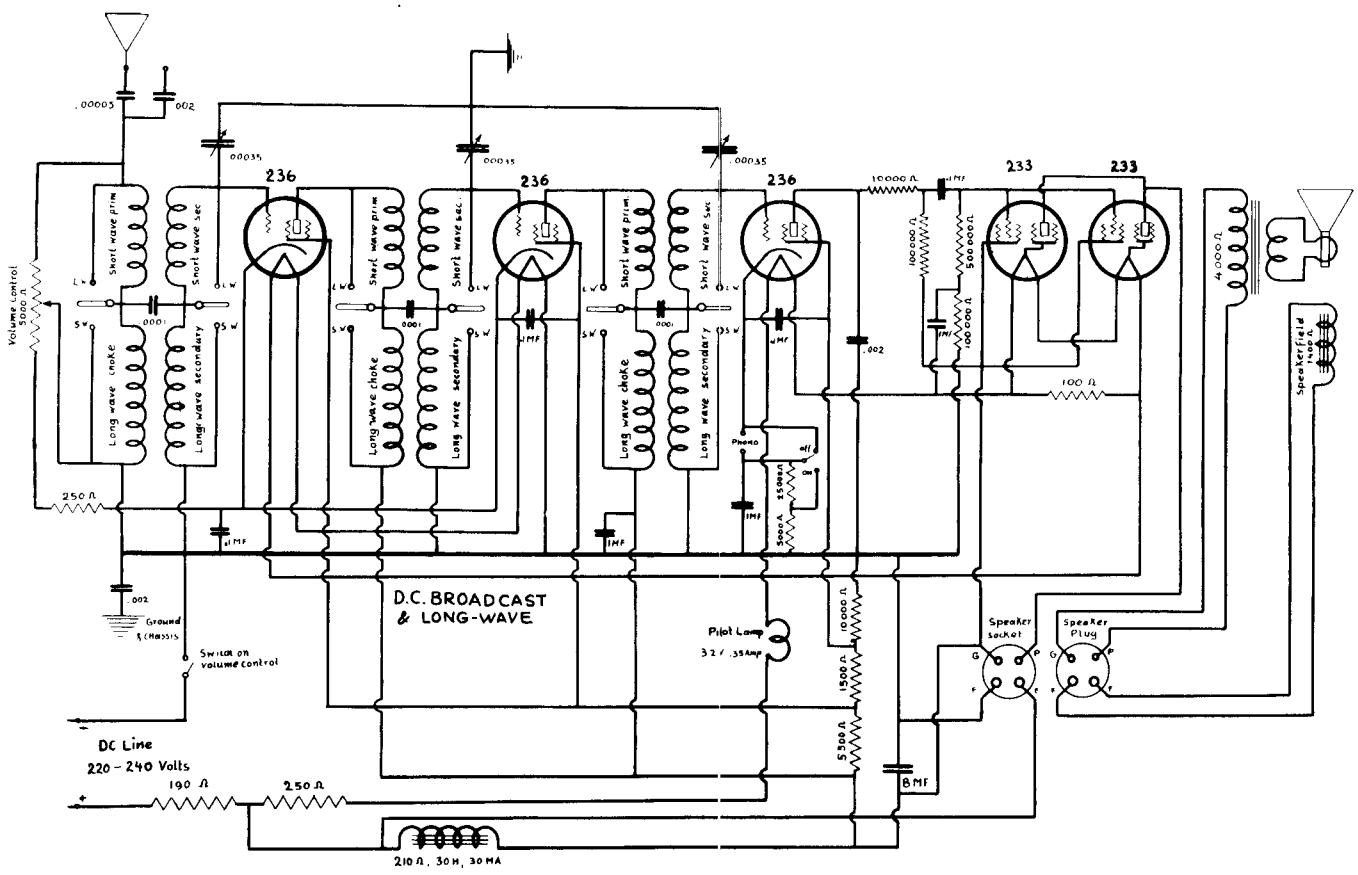
POWER PACK

INSULINE CORPORATION OF AMERICA

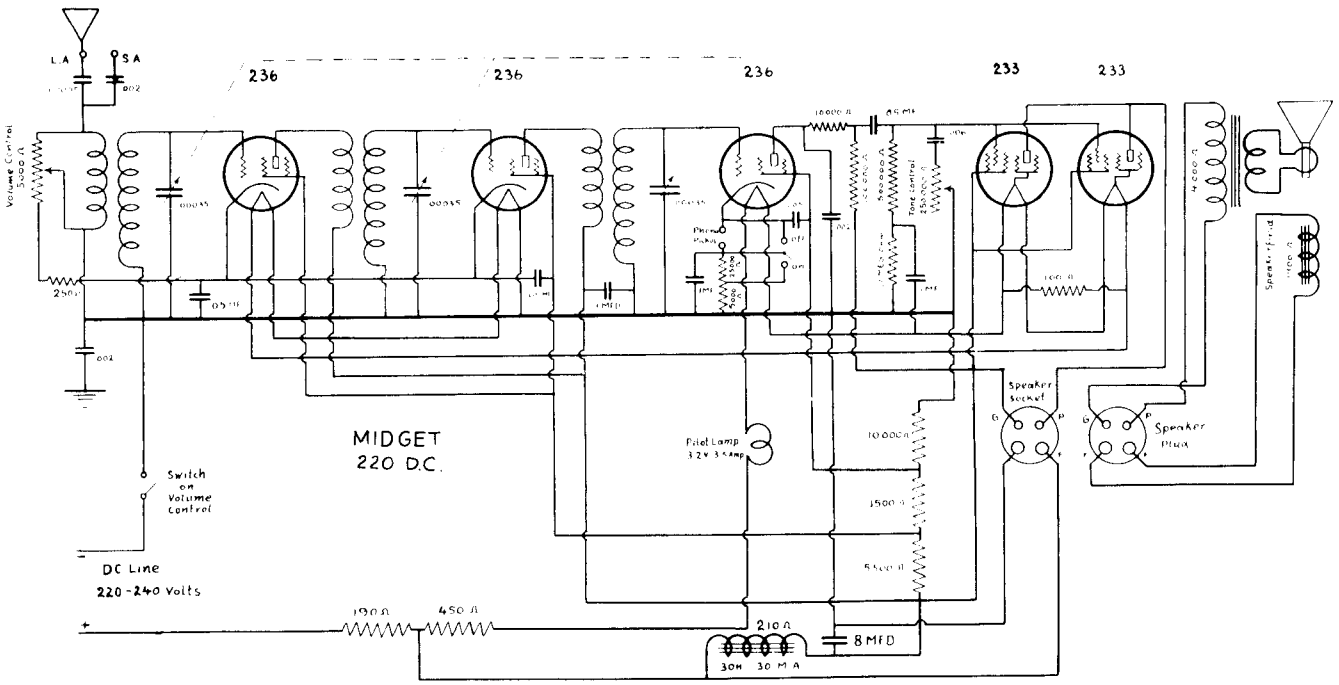


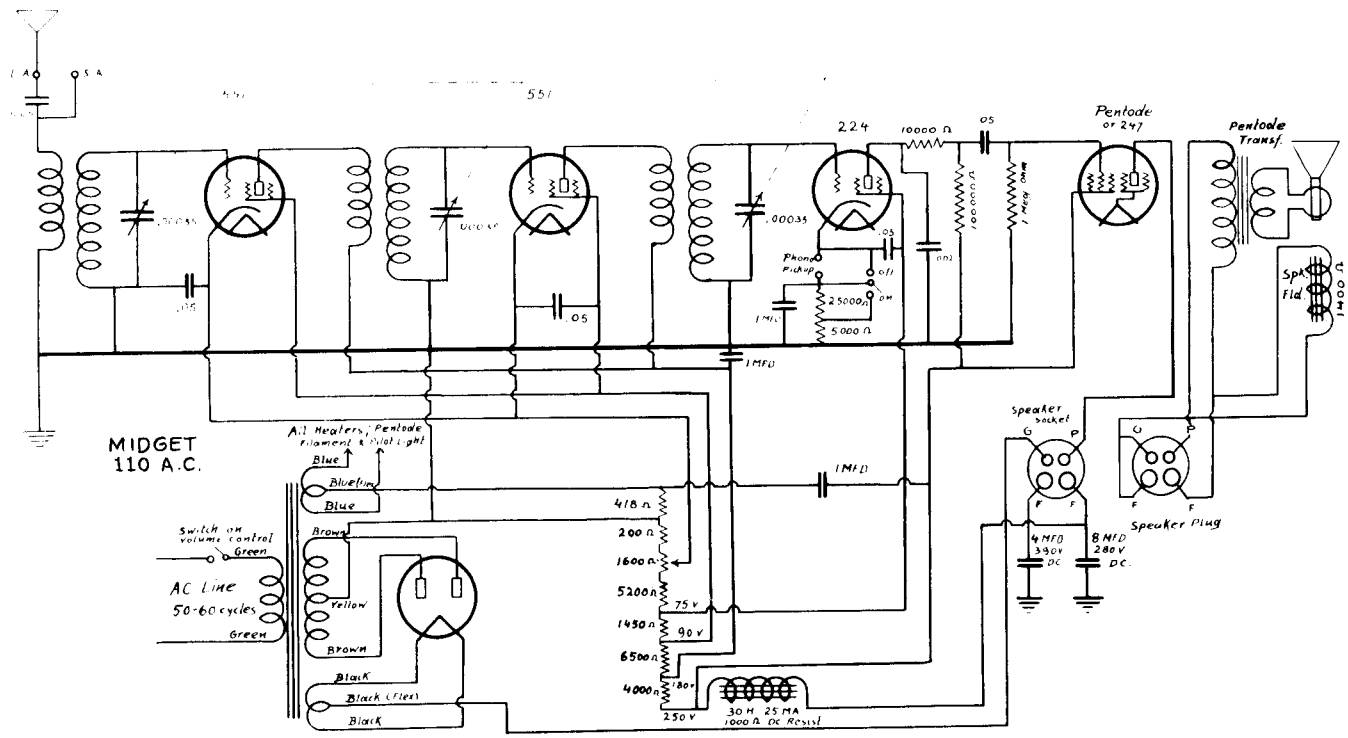
INSULINE CORPORATION OF AMERICA





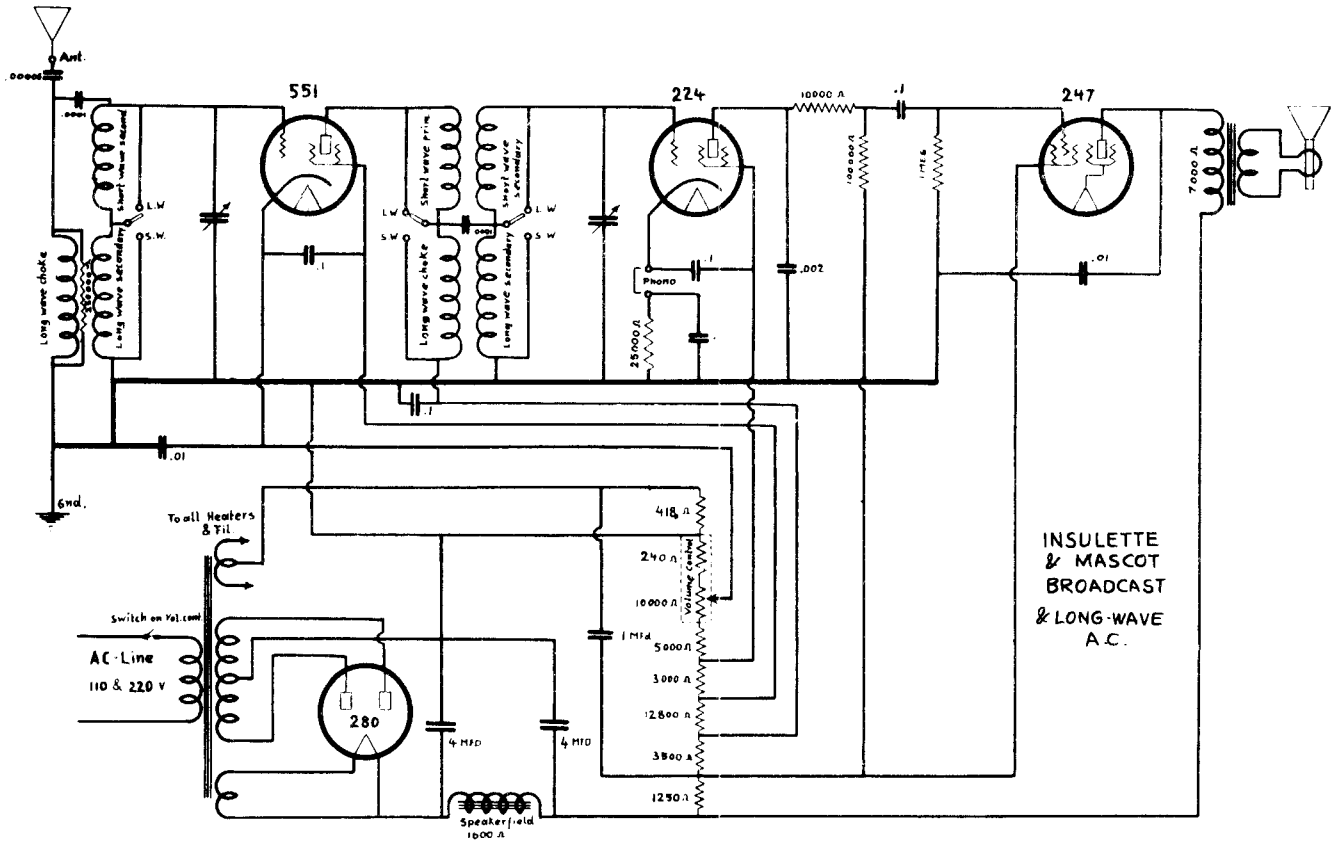
INSULINE CORPORATION OF AMERICA

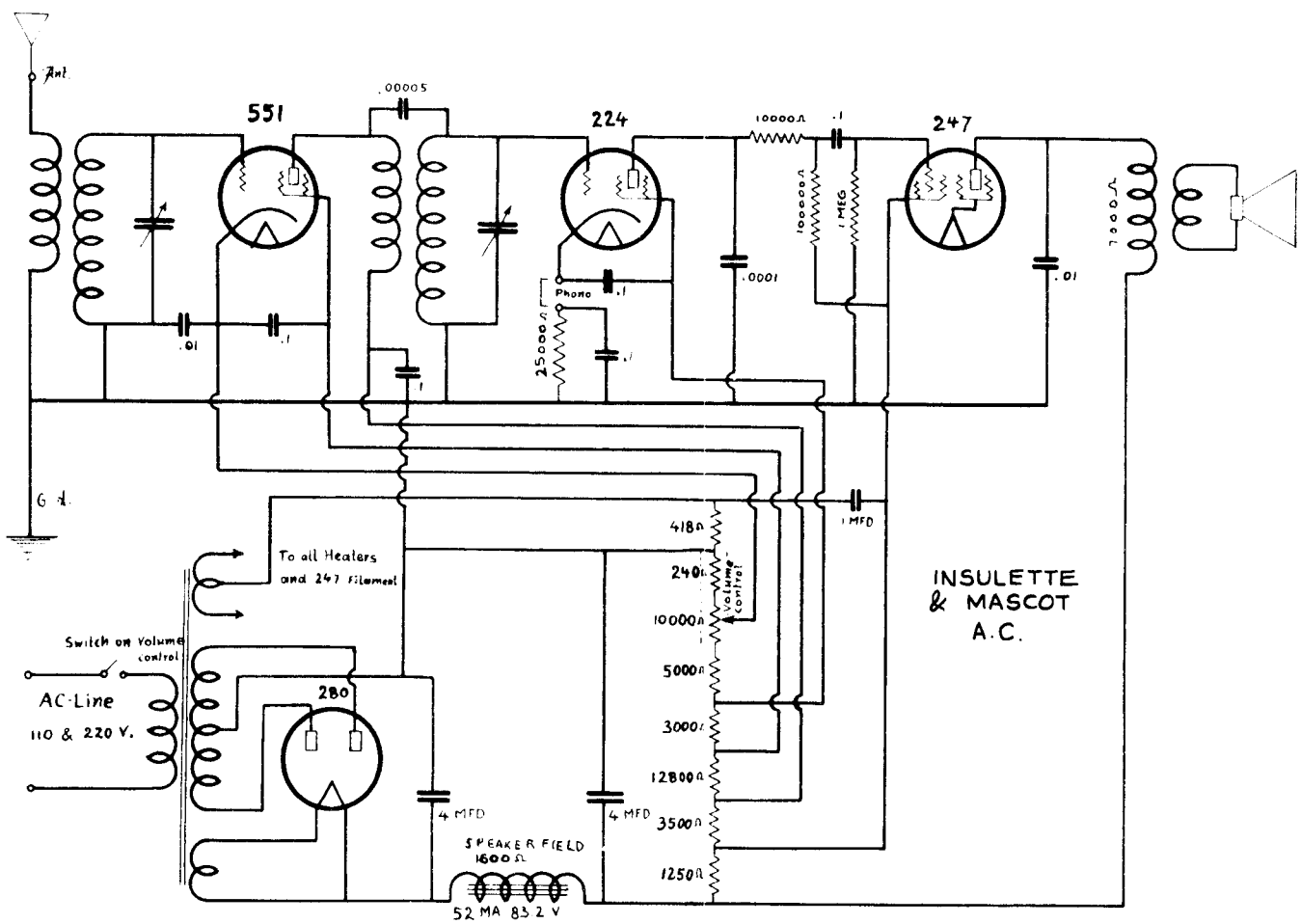




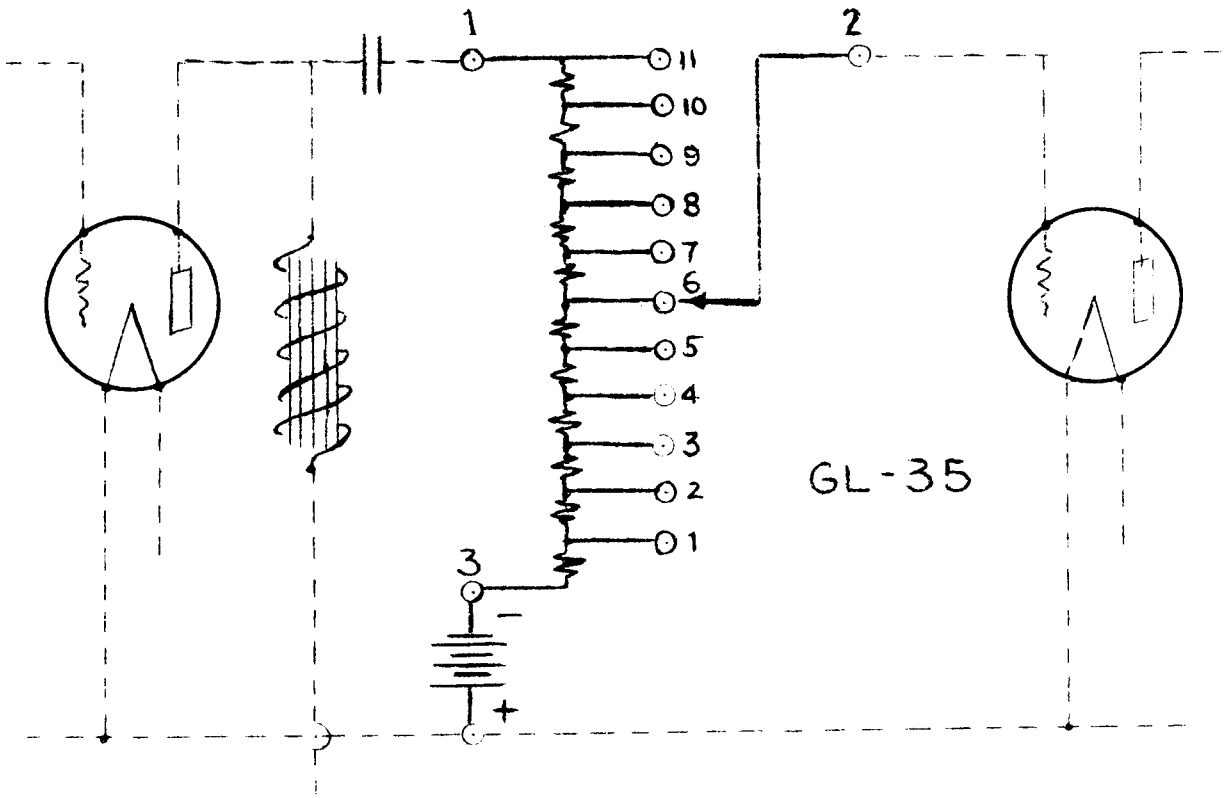
Line Voltage may safely vary between
105 - 120 Volts
or 205 - 250 Volts

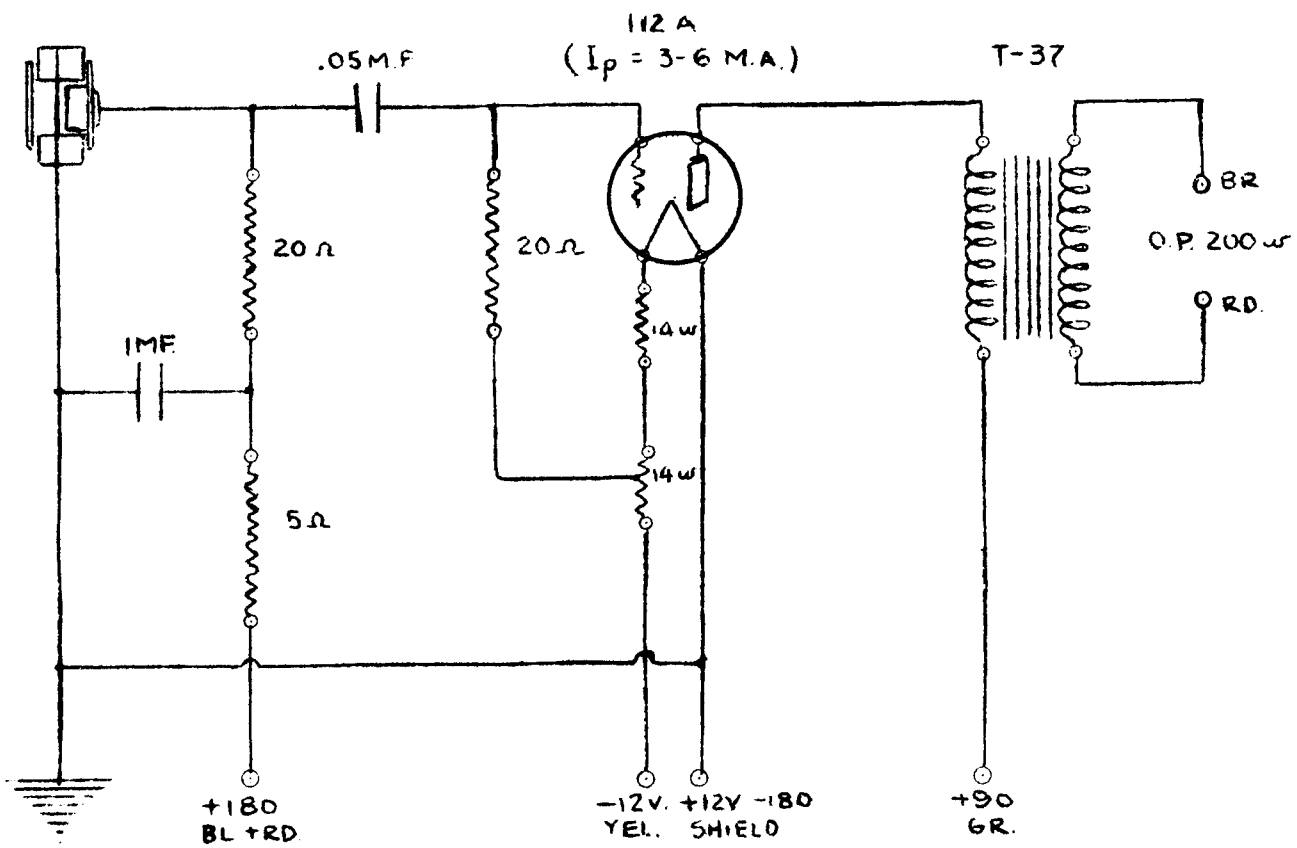
INSULINE CORPORATION OF AMERICA





JENKINS AND ADAIR, INC.

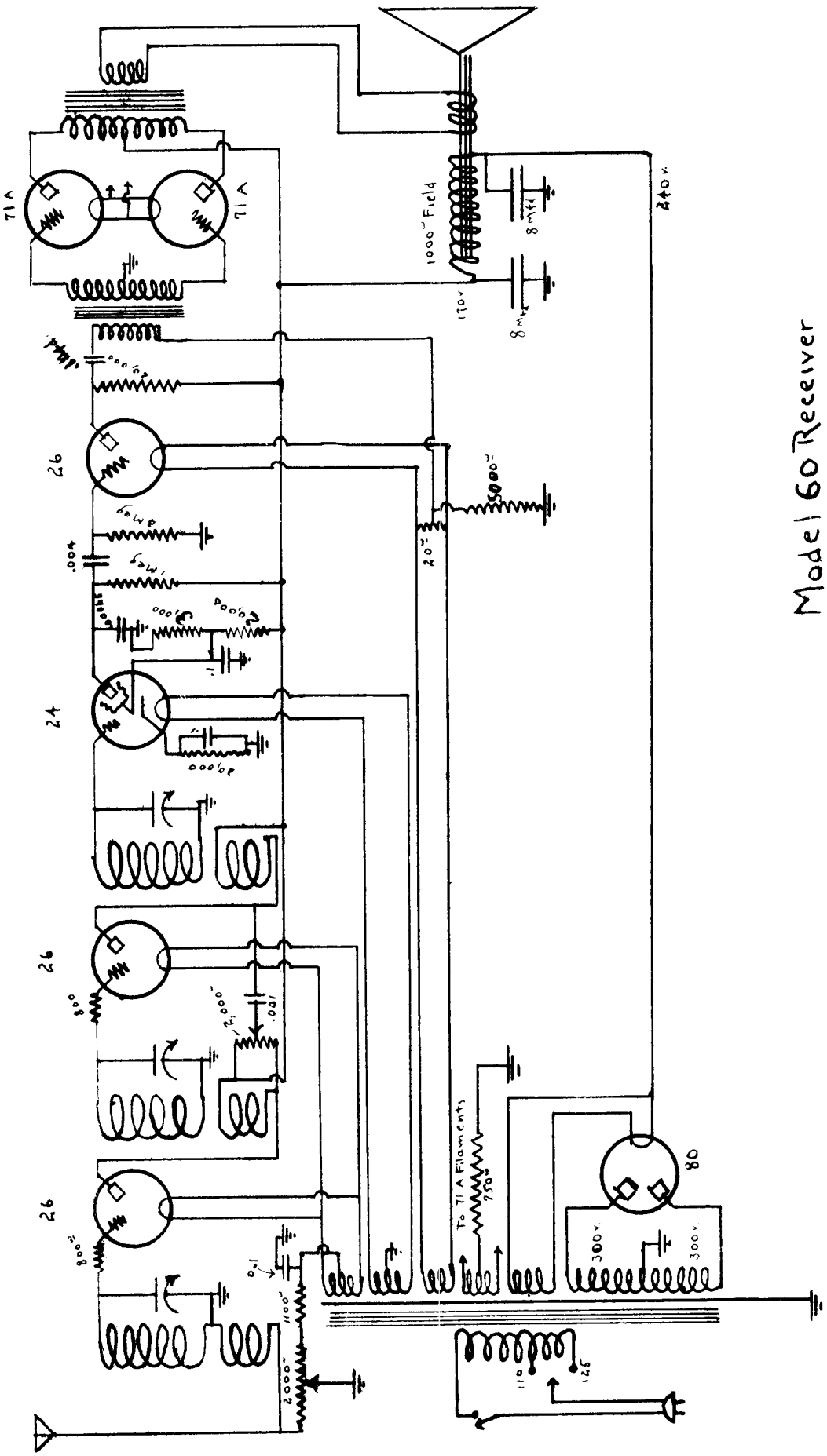




CONDENSER TRANSMITTER

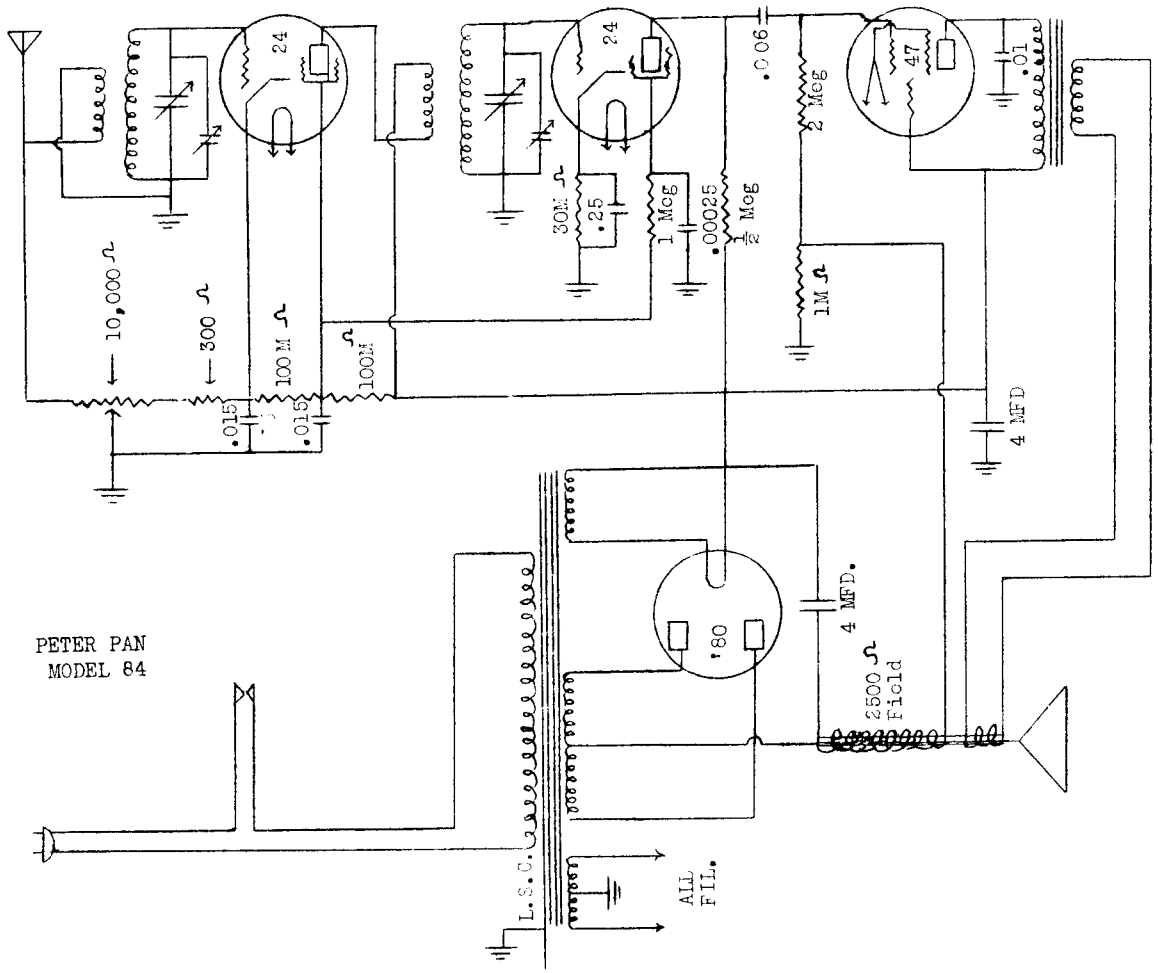
TYPE C-12

JACKSON-BELL CO.



Model 60 Receiver

JACKSON-BELL CO.



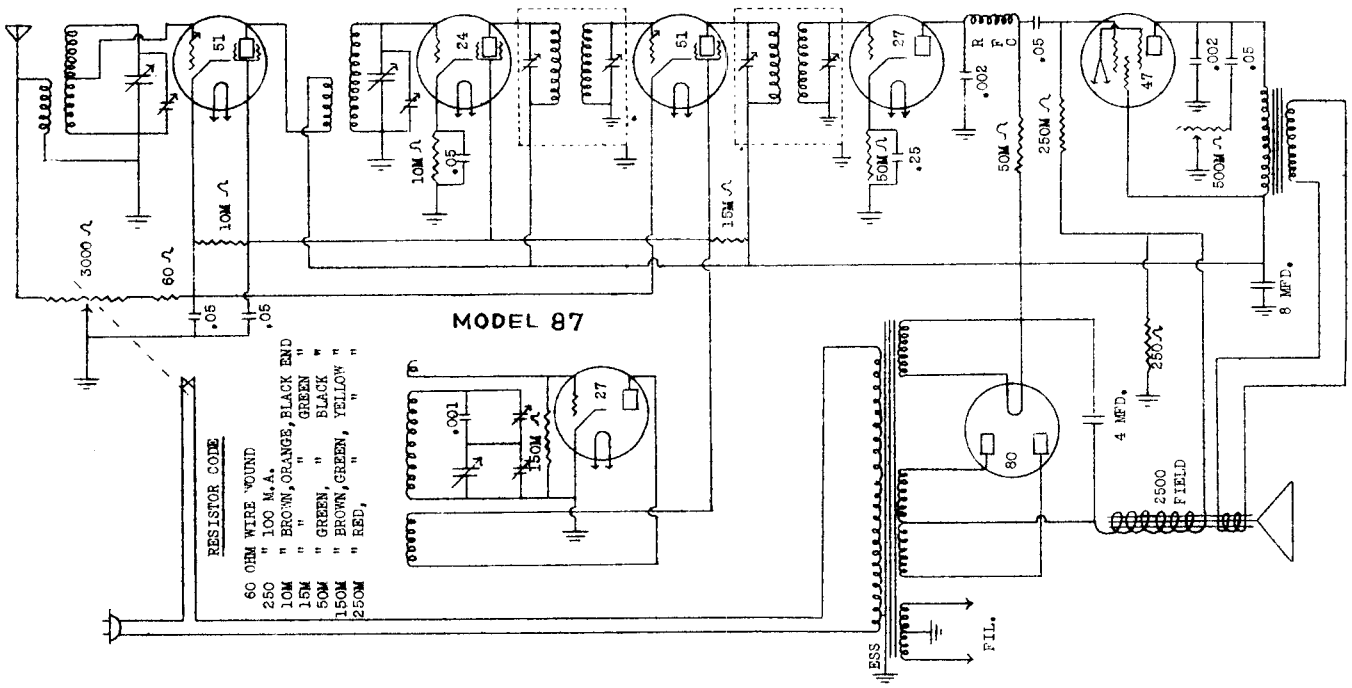
VOLTAGE AND CURRENT VALUES

With the volume control at maximum, the following readings should be obtained, with an allowable 10% variation:-

Line Voltage,	110 V.
R.F.Plate Voltage,	200 V.
R.F. Screen Voltage,	60 V. *
R.F. Cathode Bias,	1.5 V.
R.F. Plate Current,	2.2 M.A.
Detector Plate Voltage,	80 V.
Detector Screen Voltage,	60 V.
Detector Cathode,	5 V.
Detector Plate Current,	0.15 M.A.
Pentode Plate Voltage,	190 V.
Pentode Screen Voltage,	200 V.
Pentode Grid Voltage,	13 V.
Pentode Plate Current,	24.0 M.A.
R.F.Filament,	2.2 V.
Detector Filament,	2.2 V.
Pentode Filament,	2.2 V.
Rectifier Filament,	4.1 V.

*These readings made with the 300,000 ohm voltmeter in a Jewel 199 Set Analyzer are not true readings, due to the high resistances in the receiver circuit.

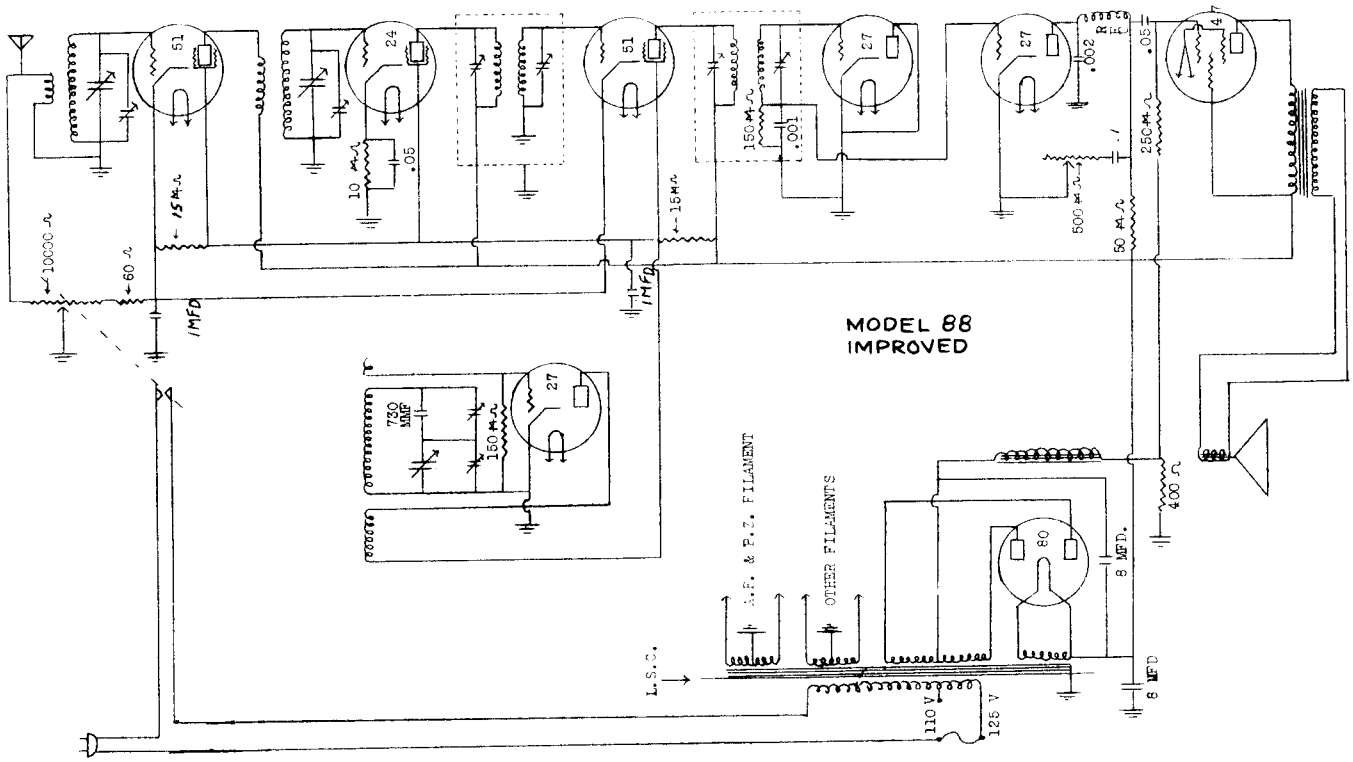
JACKSON-BELL CO.



AVERAGE VOLTAGES & CURRENTS:

	FIL. VOLTS	PLATE VOLTS	SCREEN VOLTS	VOLUME CONTROL MAXIMUM GRID VOLTS	CATHODE VOLTS	PLATE CURRENT
R.F. Tubes	2.25	195.	95	0	1.5	3.25 MILLS
First Detector Tube	2.25	195.	95	0	3.	.5 "
First I.F. Tube	2.25	195.	95	0	1.5	3.25 "
Second Detector Tube	2.25	145.	--	0	12.5	.5 "
Oscillator Tube	2.25	65.	--	0	--	3. "
Output Tube	2.25	185.	195	11	--	24. "
Rectifier Tube	4.5	260.	--	--	--	45. "

JACKSON-BELL CO.



VOLTAGES AND CURRENT VALUES

THE FOLLOWING VOLTAGES MUST BE CHECKED WITH VOLUME CONTROL AT MAXIMUM

** ** **

R.F. PLATE	200 V.
R.F. SCREEN GRID	75 V.
R.F. CATHODE	1½ V.
R.F. FILAMENT	2 V.
FIRST INTERMEDIATE FREQUENCY PLATE	200 V.
FIRST INTERMEDIATE FREQUENCY SCREEN GRID	75 V.
FIRST INTERMEDIATE FREQUENCY CATHODE	1½ V.
FIRST INTERMEDIATE FREQUENCY FILAMENT	2 V.
DETECTOR PLATE	0 V.
DETECTOR GRID	-3 V.
DETECTOR CATHODE TO GROUND	0 V.
DETECTOR FILAMENT	2¼ V.
TRANSILATOR PLATE	200 V.
TRANSILATOR SCREEN GRID	75 V.
TRANSILATOR CATHODE	5¼ V.
TRANSILATOR FILAMENT	2 V.
OSCILLATOR PLATE	75 V.
OSCILLATOR GRID	-¼ V.
OSCILLATOR CATHODE TO GROUND	0 V.
FIRST AUDIO PLATE	40 V.
FIRST AUDIO GRID	-3 V.
FIRST AUDIO CATHODE TO GROUND	0 V.
P.Z. OR '47 SPACE CHARGE GRID	200 V.
P.Z. OR '47 PLATE	195 V.
P.Z. OR '47 GRID	16 V.
P.Z. OR '47 FILAMENT	2¼ V.
80 PLATE	25 MILLS DRAIN PER PLATE
80 FILAMENT	4½ V.

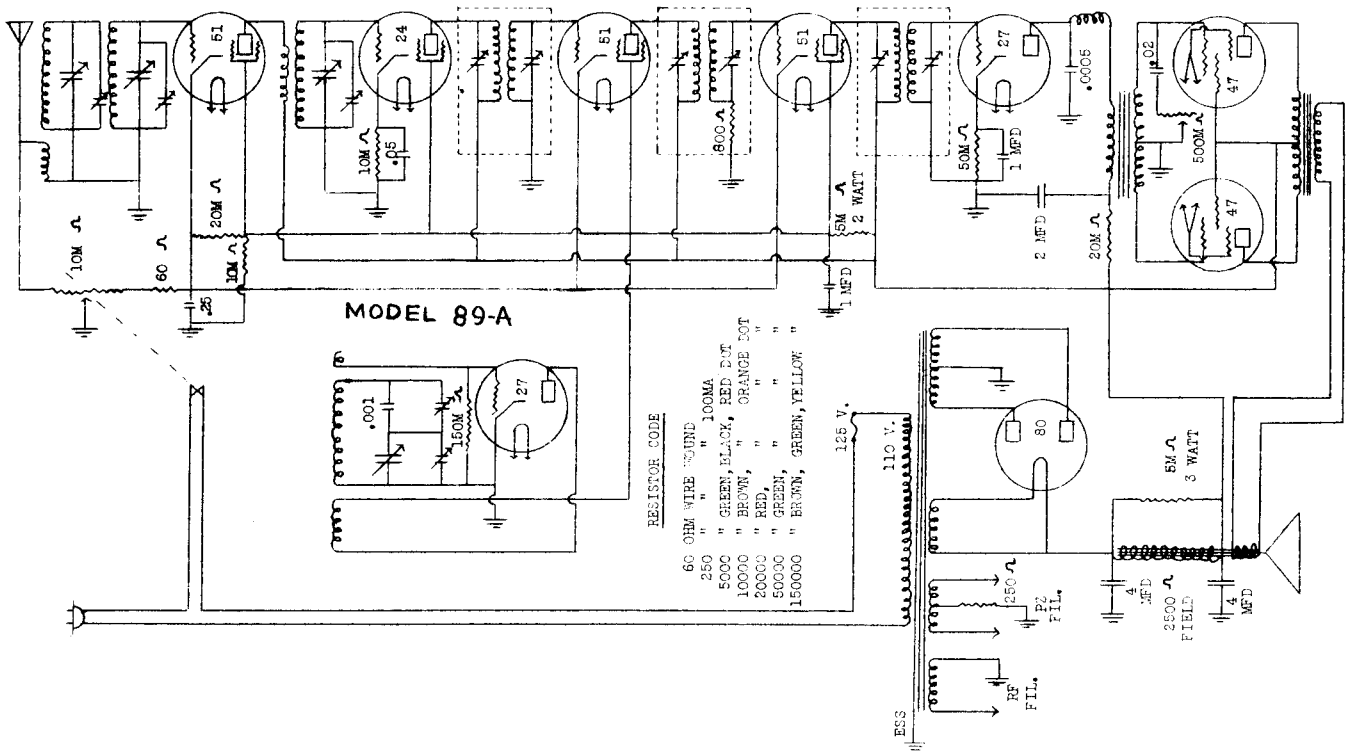
These voltages will be obtained with a 1000 Ohm per volt meter. Meters of different resistances will vary in voltage readings, due to high resistance in series with different potentials.

RESISTANCE COLOR CODE * CARBON RESISTORS

1 WATT

60 Ohm	- Wire Wound
400 "	" " Insulated, 3 Watt
10000 "	- Brown - Black end - Orange Dot
15000 "	- Brown - Green end - Orange Dot
50000 "	- Green - Black end - Orange Dot
150000 "	- Brown - Green end - Yellow Dot
1 Meg	- Red - Green end - Yellow Dot
1	- Small mica condenser
.00073	- Orange and Yellow Dot - 3% Tolerance

JACKSON-BELL CO.



AVERAGE VOLTAGES & CURRENTS:

	FIL. VOLTS	PLATE VOLTS	SCREEN VOLTS	GRID VOLTS	CATHODE VOLTS	PLATE CURRENT
R.F. Amplifier Tube	2.3	200	100	0	2.0	3.5
First Detector Tube	2.3	200	100	0	4.0	.5 MA
First I. F. Tube	2.3	200	100	0	2.0	3.5
Second I. F. Tube	2.3	200	100	0	2.0	3.5
Second Detector Tube	2.3	180	---	-	8	.2 MA
Oscillator Tube	2.3	100	---	0	0	6 MA
Output Tube (1)	2.3	185	200	16	-	20 MA
Output Tube (2)	2.3	185	200	16	-	20 MA
Rectifier Tube	5.0	375	---	-	-	35 PER PLATE

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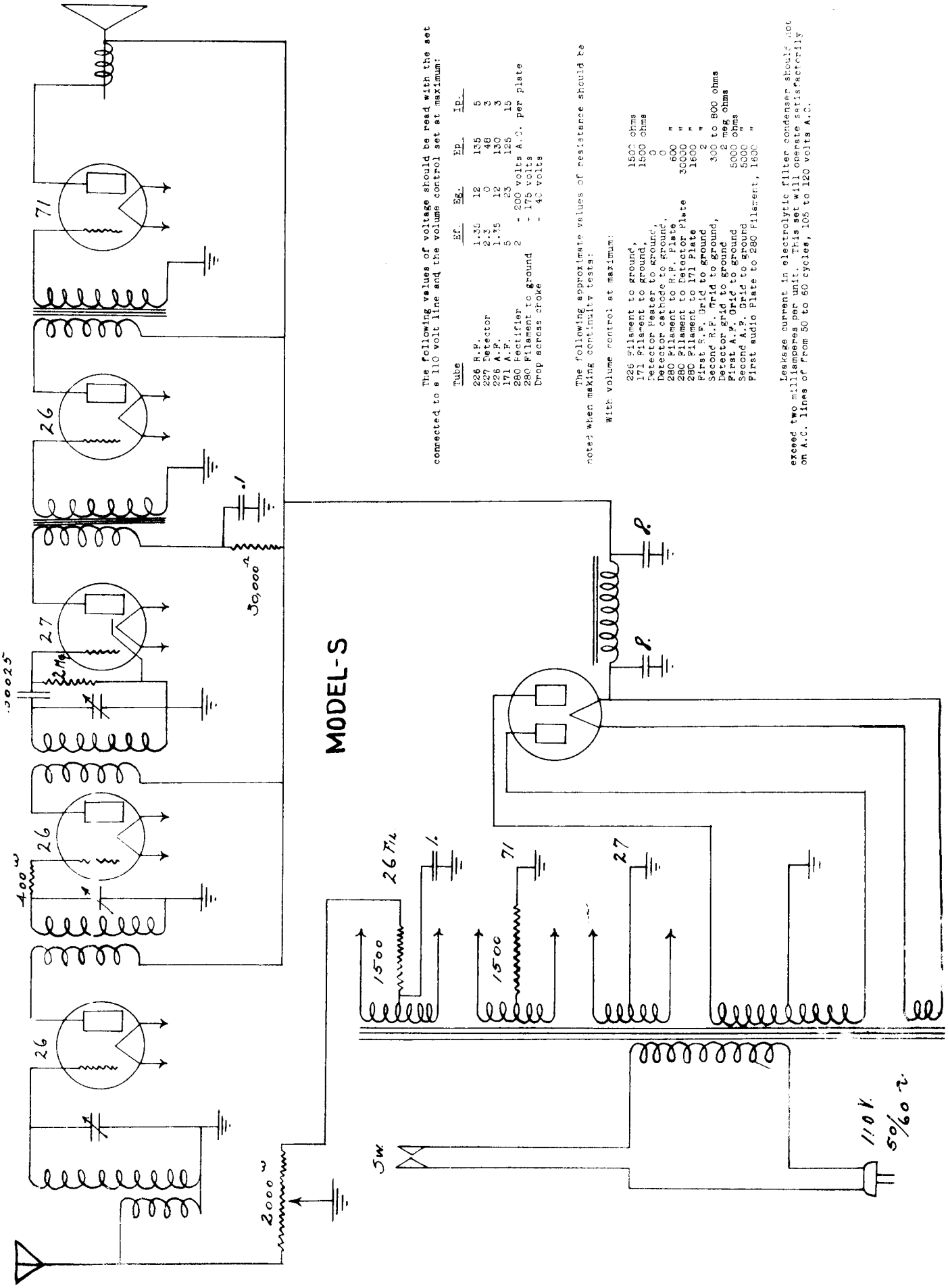


The following values of voltage should be read with the set connected to a 110 volt line and the volume control set at maximum:

Tube	Ef.	Eg.	Ep	Ip
226 R.F.	1.35	12	135	5
227 Detector	2.7	0	48	3
226 A.F.	1.35	12	130	3
171 A.F.	5	23	125	15
280 Rectifier	2	- 200 volts A.C. per plate		
280 Filament to ground		- 175 volts		
Drop across choke		- 40 volts		

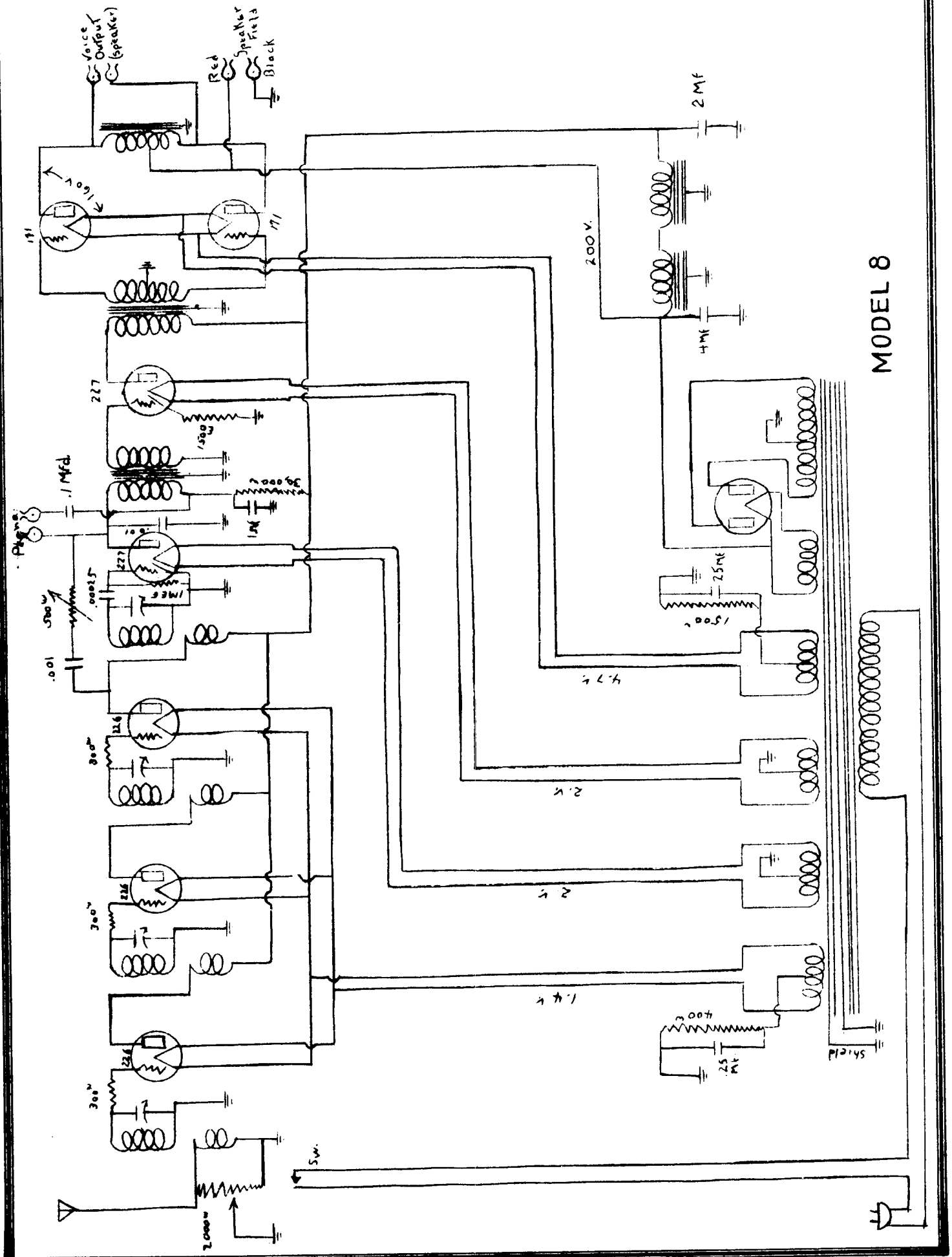
The following approximate values of resistance should be noted when making continuity tests:

With volume control at maximum:

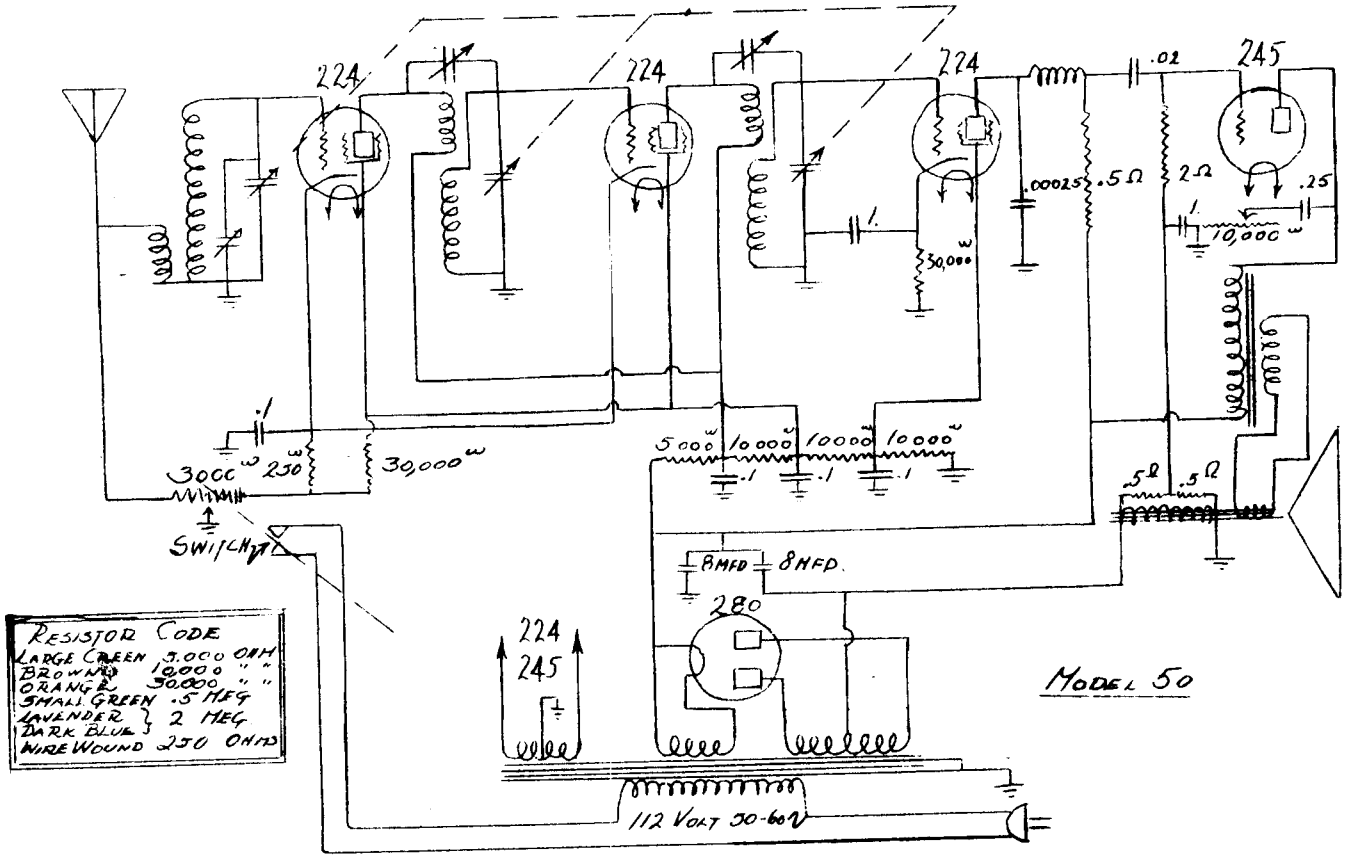
226 Filament to ground,	1500 ohms
171 Filament to ground,	1500 ohms
Detector Heater to ground,	0
Detector cathode to ground,	0
280 Filament to R.F. Plate	600 "
280 Filament to Detector Plate	30000 "
280 Filament to 171 Plate	1600 "
First R.F. Grid to ground	2 "
Second R.F. Grid to ground,	300 to 800 ohms
Detector grid to ground	2 meg ohms
First A.F. Grid to ground	5000 ohms
Second A.F. Grid to ground	5000 "
First audio Plate to 280 Filament,	1600 "

Leakage current in electrolytic filter condenser should not exceed two milliamperes per unit. This set will operate satisfactorily on A.C. lines of from 50 to 60 cycles, 105 to 120 volts A.C.

JACKSON-BELL CO., LTD.



JACKSON-BELL CO., LTD.



VOLTAGE AND CURRENT VALUES:

With the volume control at maximum, the following readings should be obtained with an allowable variation of 10%:-

R.F. Plate Voltage	160
R.F. Screen Grid Voltage	75
R.F. Grid Bias	2
R.F. Plate Current	2.2 mils approx.
R.F. Screen Current	.3 " "
245 Plate Voltage	210
245 Plate Current	23 " "
245 Bias Voltage	50*
Detector Screen Grid Voltage.	40
Detector Bias Voltage	5**
Detector Plate Current	.1 mils (no signal in receiver)
Detector Plate Voltage	100***

Voltage readings were made with a 1000 ohm per volt meter, 250 volt range.

*The reading here on a set analyzer will show about 2 volts due to the fact that the 2 meg. ohm resistor is in series with the meter. To check grid voltage, drop across speaker divided by 2 will be the approximate voltage applied to grid. If plate current is about 25 mils and voltage about 220, it is safe to assume that the grid bias is O.K.

**Detector bias reading is taken at the overload point of an incoming signal where it generally reaches a maximum of 5 volts. With zero volume control, the reading here is approximately 4 volts. This, of course, is not the true reading, because resistance of volt meter becomes a parallel circuit, cutting down the resistance, and of course, dropping the voltage. Reading taken in this case was with 10,000 ohm meter (1000 per volt, 10 volt scale.)

***This reading is subject to considerable variation with meters of various resistances, as the voltage at this point is measured through a 500,000 ohm resistor. The voltage at the opposite end of the resistor should be 220 volts.

TRANSFORMER VOLTAGES:

224 - 245 Filament on one winding, 2.20 volts.
280 Filament - 4.5
High voltage winding, 315 each side of center tap.

RESISTANCE COLOR CODE - CARBON RESISTORS.

1 Watt

10,000 ohms - Brown with Black Band, Orange Dot.
30,000 " - Orange with Black Band
500,000 " - Green with Black Band & Yellow Dot
2 meg. - Blue

2 Watt

5,000 ohms - Green with Black Band and Red Dot
300 " - R.F. Bias Resistor is wire wound.

RESISTANCE COLOR CODE - CARBON RESISTORS.

1 WATT

300 Ohm	- Wire Wound			
1100 "	- Blue			
2200 "	- Solid Red			
3000 "	- Orange	- Black End	- Red Dot	
5000 "	- Green	- " "	- " "	
10000 "	- Brown	- " "	- Orange Dot	
20000 "	- Red	- " "	- " "	
30000 "	- Orange	- " "	- " "	
¼ meg	- Red	- Green "	- Yellow "	
½ "	- Green	- Black "	- " "	
1 "	- Brown	- " "	- Green "	
2 "	- Purple			
1000 ohm	- Brown	- Black "	- Red "	
50000 "	- Green	- " "	- Orange "	

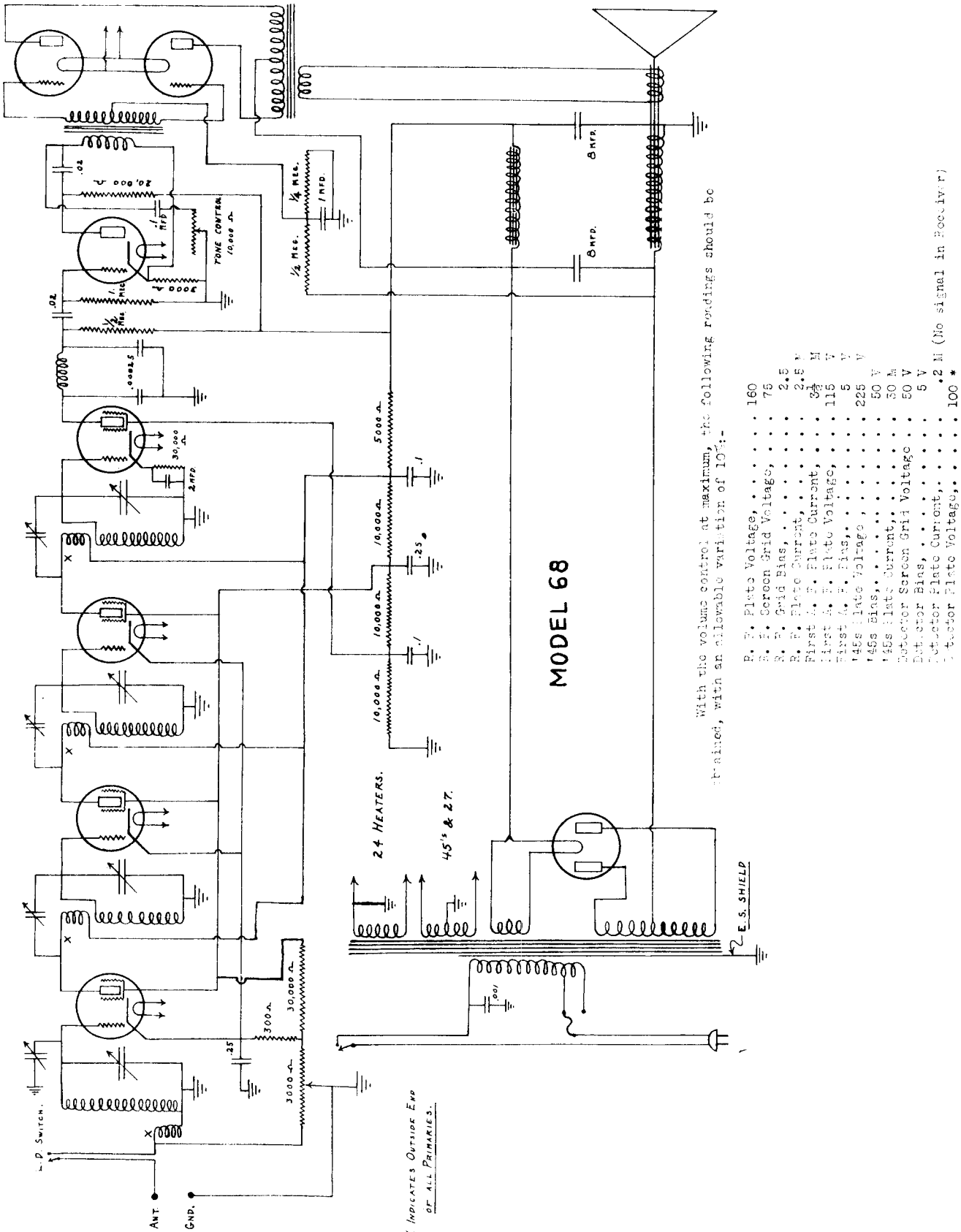
2 WATT

5000 Ohm - Green with Black Band and Red Dot
2200 " - Red
300 " - R.F. Bias Resistor is Wire Wound.

RADIO FREQUENCY COILS.

Radio frequency coils in this Receiver are wound with 130, and 132 turns on the secondaries. The antenna coil has 132 turns, the second, third and detector coils have 130 turns.

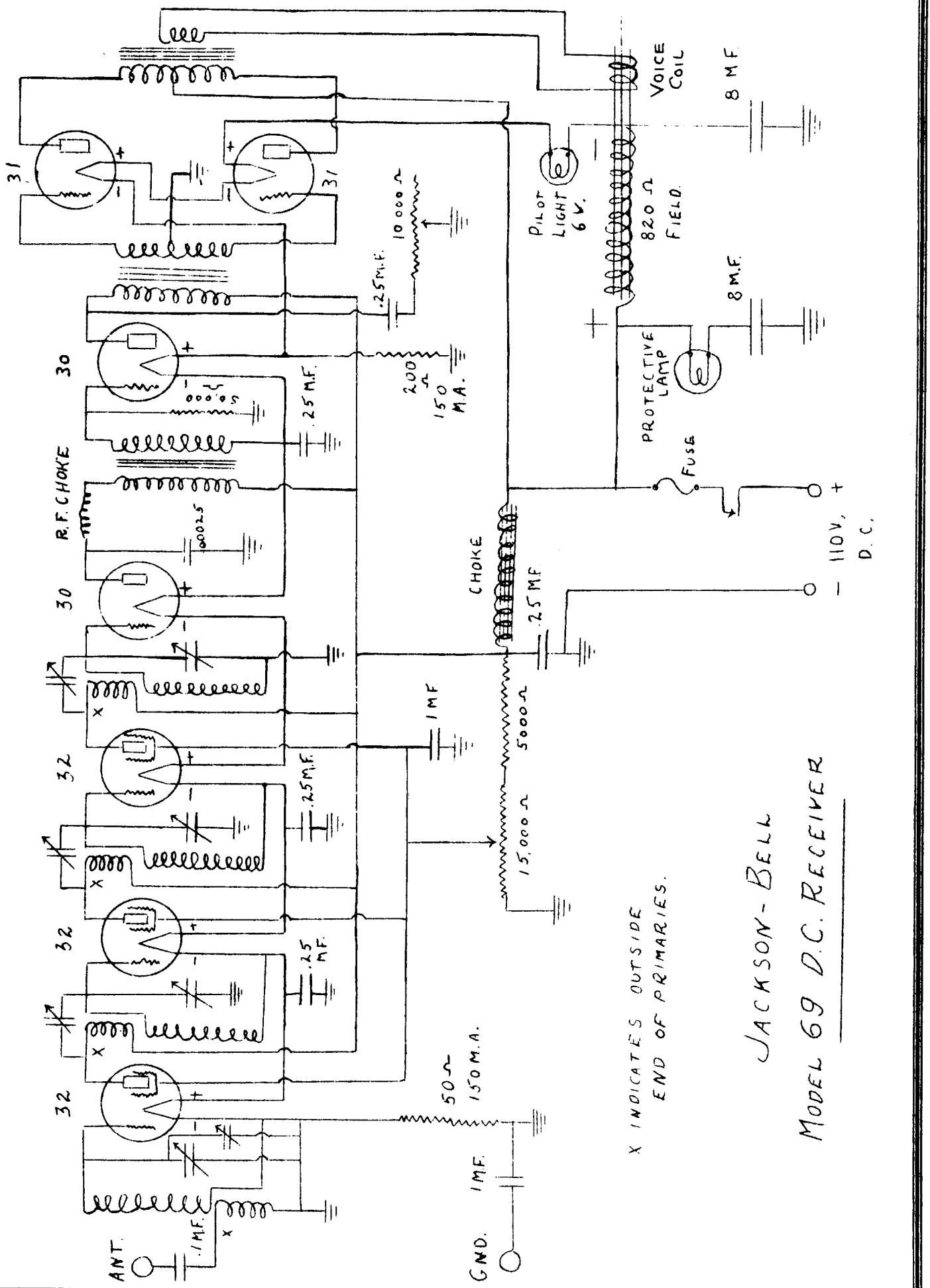
JACKSON-BELL CO., LTD.



With the volume control at maximum, the following readings should be obtained, with an allowable variation of 10%:-

R. F. Plate Voltage,	160
R. F. Screen Grid Voltage,	75
R. F. Grid Bias,	2.5
R. F. Plate Current,	2.5 M
First A. F. Plate Current,	3½ M
First A. F. Plate Voltage,	115 V
First A. F. Bias,	5 V
'45s Plate Voltage,	225 V
'45s Bias,	50 V
'45s Plate Current,	30 M
Detector Screen Grid Voltage	50 V
Detector Bias,	5 V
Detector Plate Current,	.2 M (No signal in Receiver)
Detector Plate Voltage,	100 *

JACKSON-BELL CO., LTD.



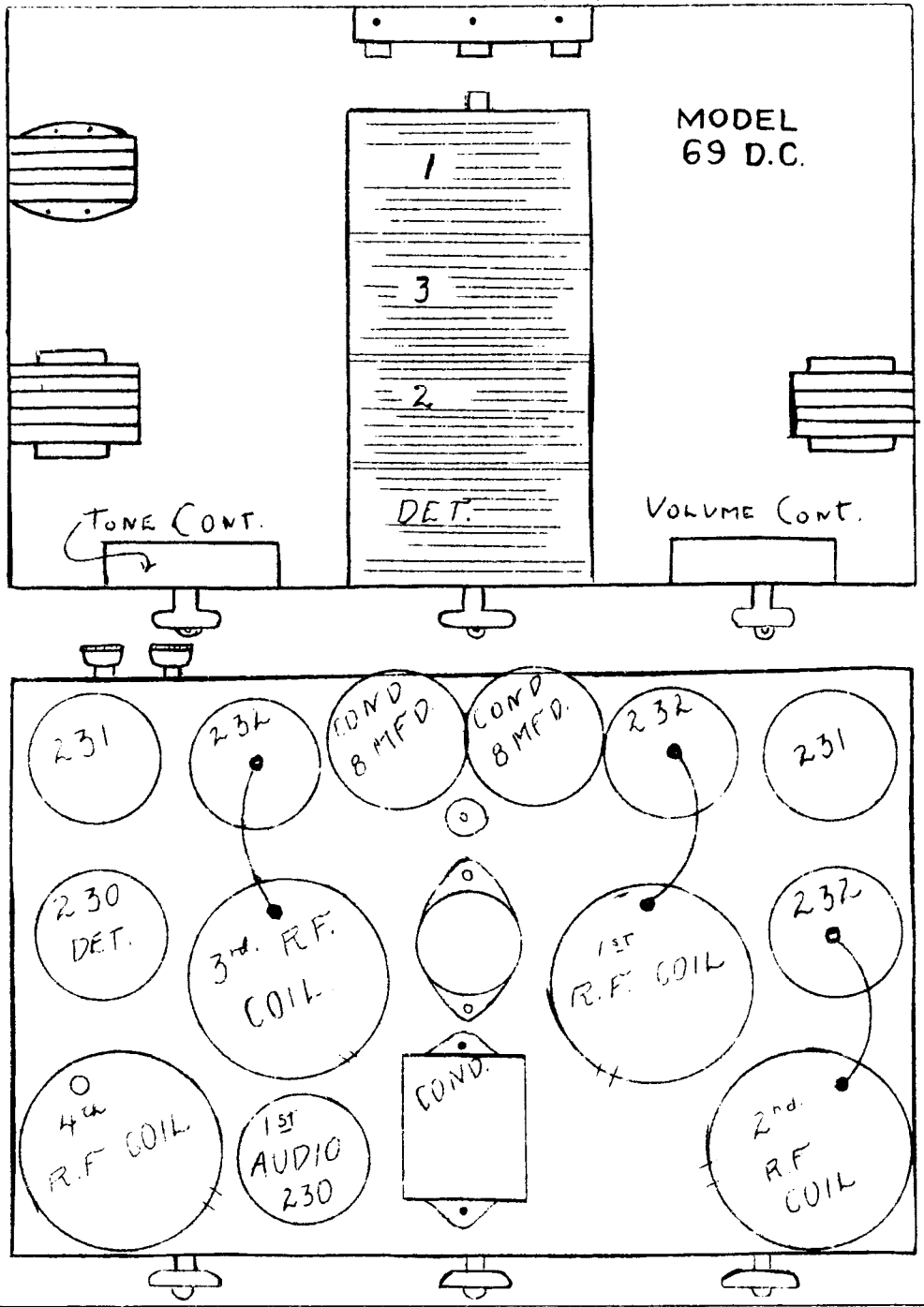
D.C. line 110 volts, voltages check as follows:-

R.F. Filament,.....	2 volts
R.F. Plate,.....	90 "
R.F. Screen Grid,.....	60 "
R.F. Bias,.....	2 "
Detector Filament,.....	2 "
Detector Plate,.....	90 "
Detector Bias,.....	10½ "
First Audio Filament,.....	2 "
First Audio Plate,.....	90 "
First Audio Bias,.....	2 "
Push-Pull Filament,.....	2 "
Push-Pull Plate,.....	95 "
Push-Pull Bias,.....	12½ "

CARBON RESISTOR COLOR CODE.

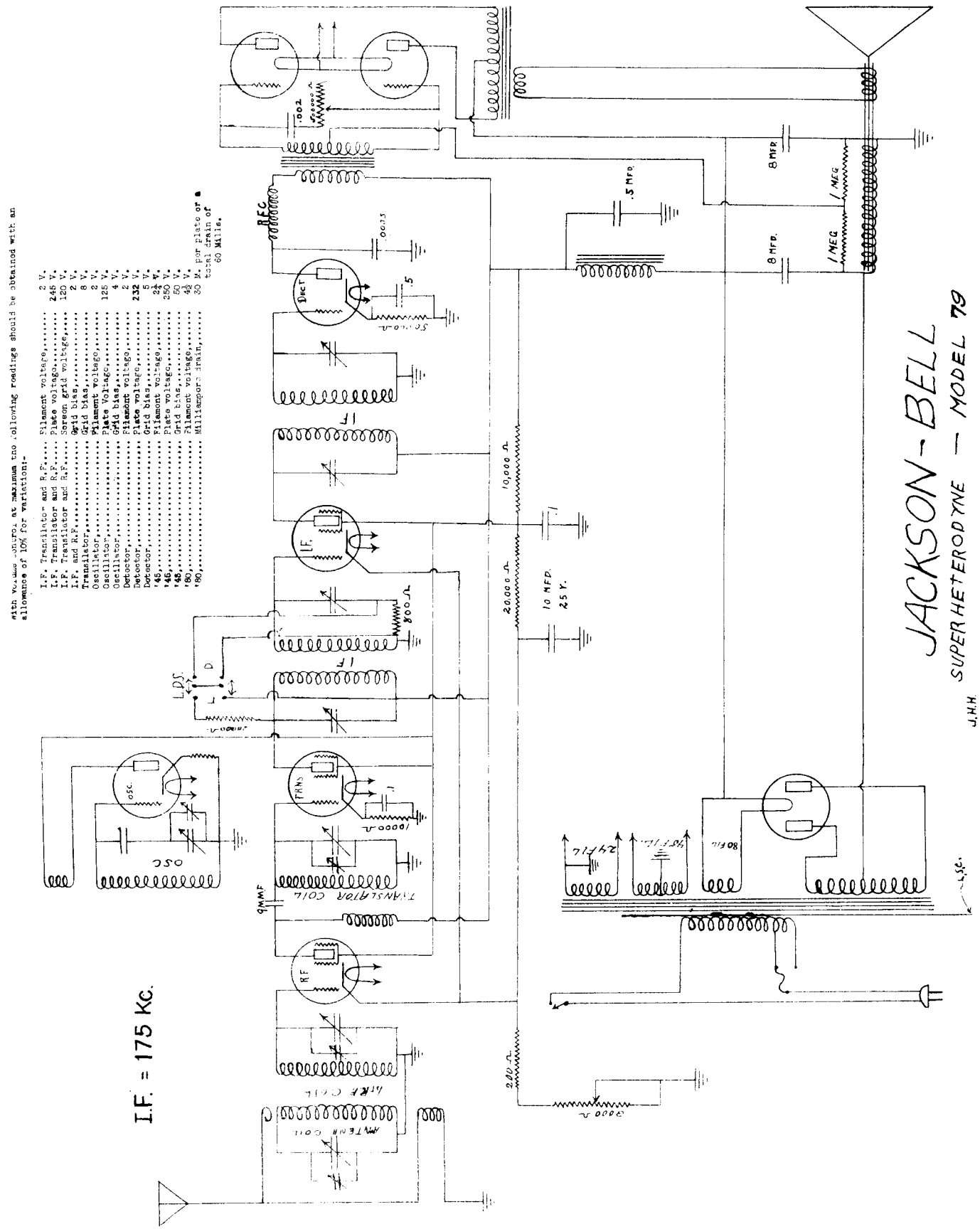
300	Ohm	- Wire Wound		
1100	"	- Blue		
2200	"	- Solid Red		
3000	"	- Orange	- Black End	- Red Dot
5000	"	- Green	- " "	- " "
10000	"	- Brown	- " "	- Orange Dot
20000	"	- Red	- " "	- " "
30000	"	- Orange	- " "	- " "
½	meg	- Red	- Green "	- Yellow "
½	"	- Green	- Black "	- " "
1	"	- Brown	- " "	- Green "
2	"	- Purple		
1000	ohm	- Brown	- Black "	- Red "
50000	"	- Green	- " "	- Orange "

NOTE: For a short time, the 20,000 ohm is solid black.



JACKSON-BELL CO., LTD.

JACKSON-BELL CO., LTD.



with Volume control at maximum the following readings should be obtained with an allowance of 10% for variation:-

I.F. Translator and R.F.	Filament voltage	2 V.
I.F. Translator and R.F.	Plate voltage	245 V.
I.F. Translator and R.F.	Screen grid voltage	120 V.
I.F. and R.F.	Grid bias	2 V.
Translator	Grid bias	8 V.
Oscillator	Filament voltage	2 V.
Oscillator	Plate Voltage	125 V.
Oscillator	Grid bias	4 V.
Detector	Filament voltage	2 V.
Detector	Plate voltage	232 V.
Detector	Grid bias	5 V.
'45	Filament voltage	2½ V.
'45	Plate voltage	250 V.
'45	Grid bias	50 V.
'80	Filament voltage	4½ V.
'80	Milliamperes drain	30 M. per plate or a total drain of 60 Mills.

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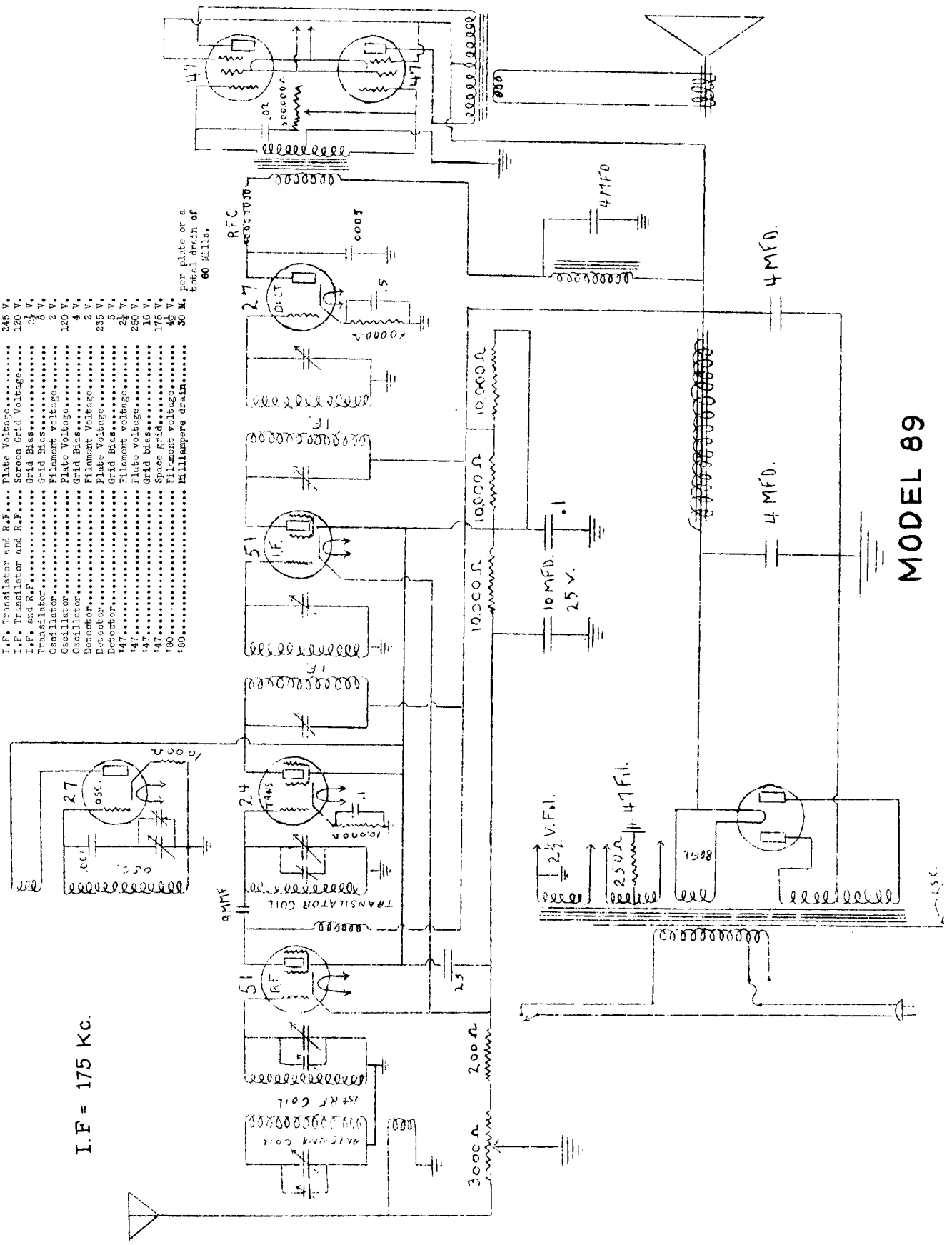
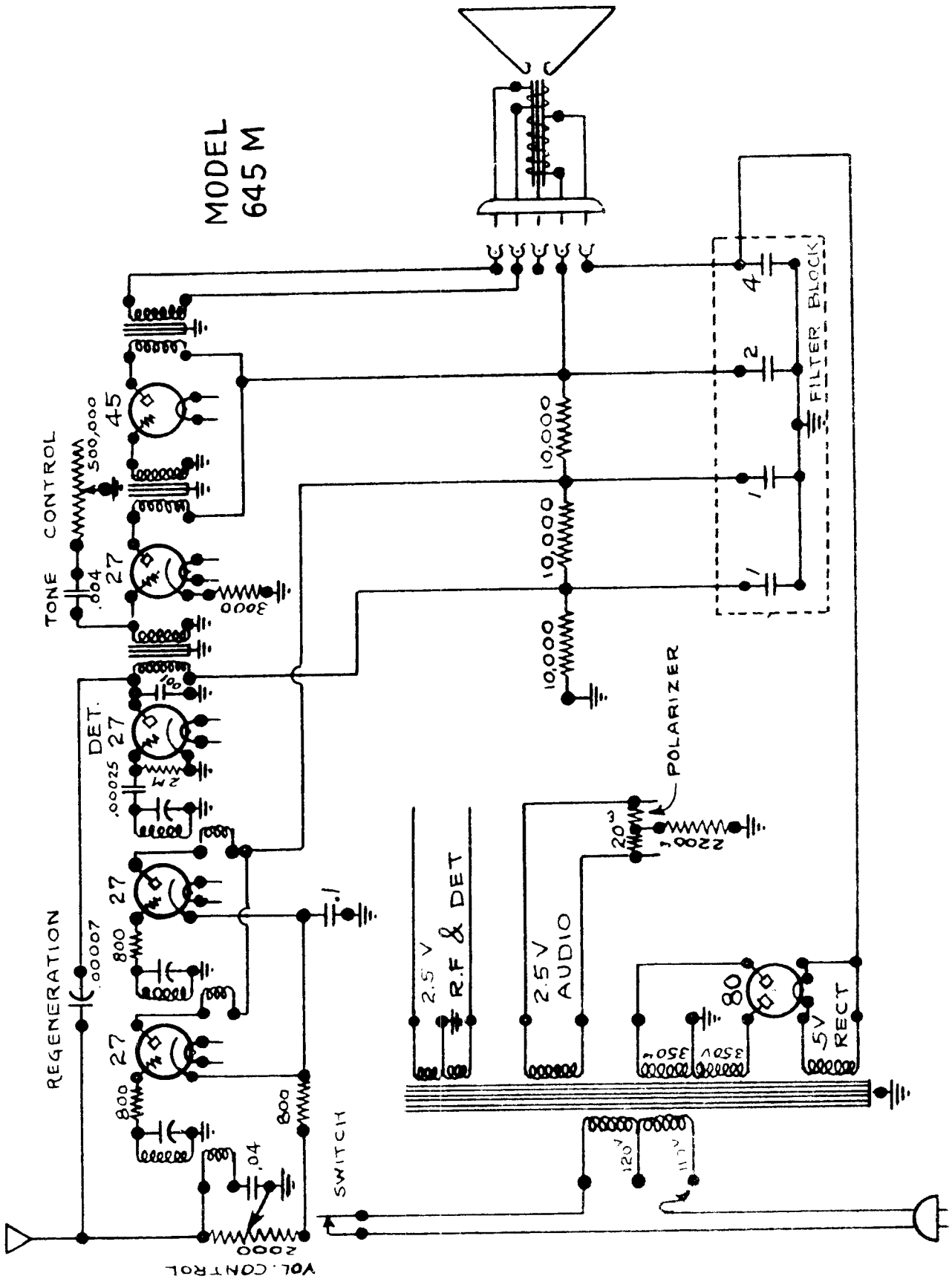
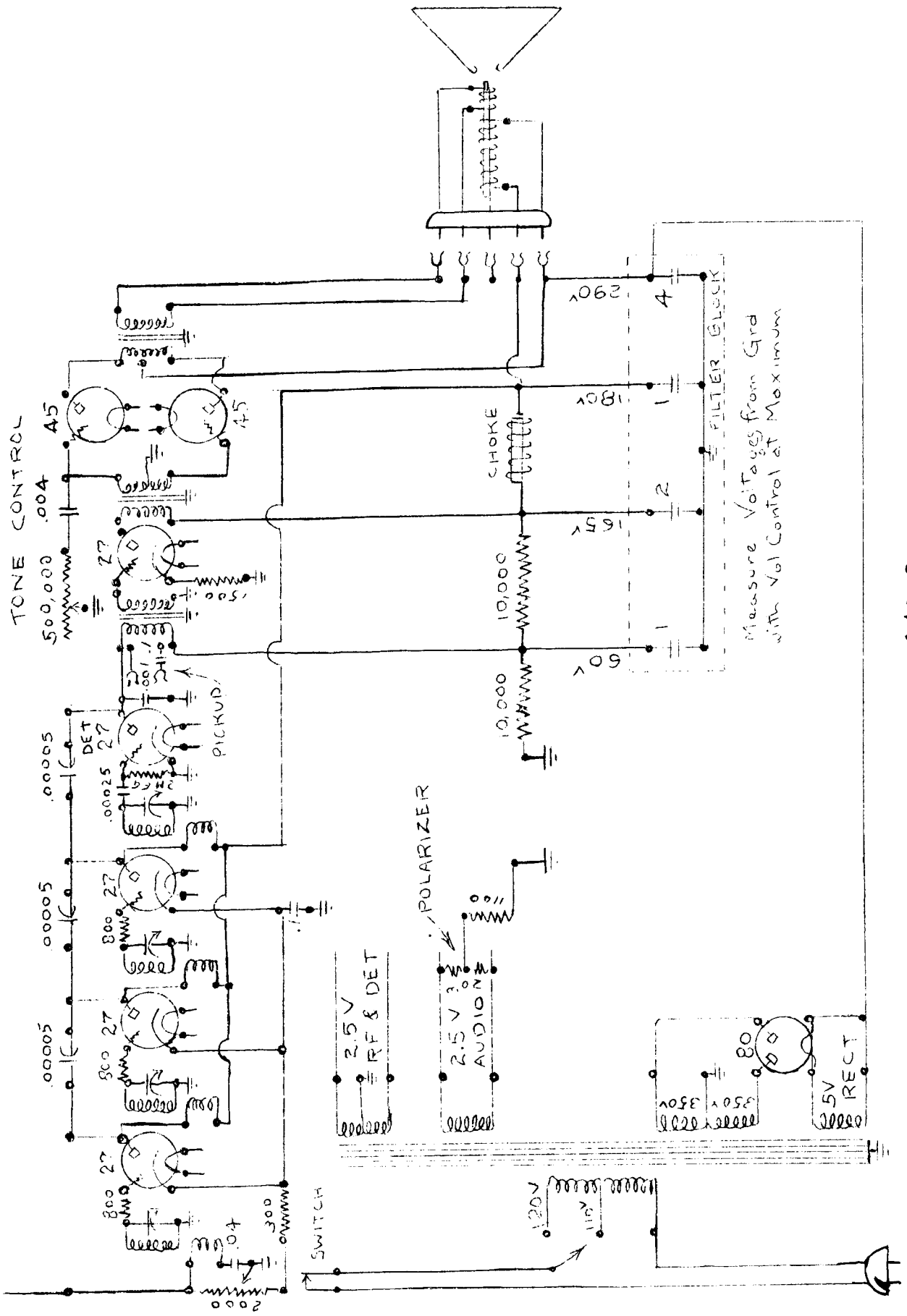


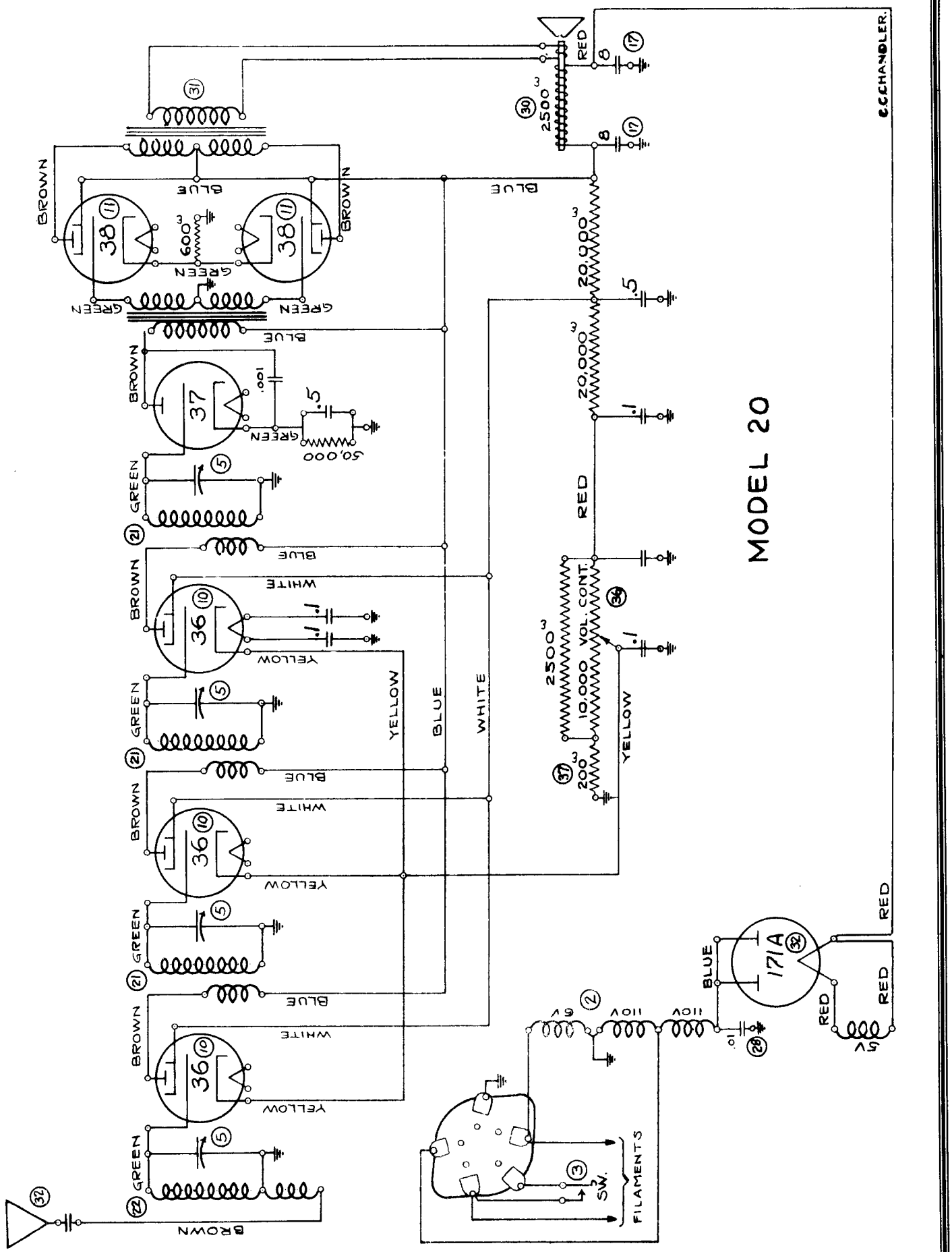
JACKSON-BELL CO., LTD.



JACKSON-BELL CO., LTD.



KELLER-FULLER MFG., CO. LTD.



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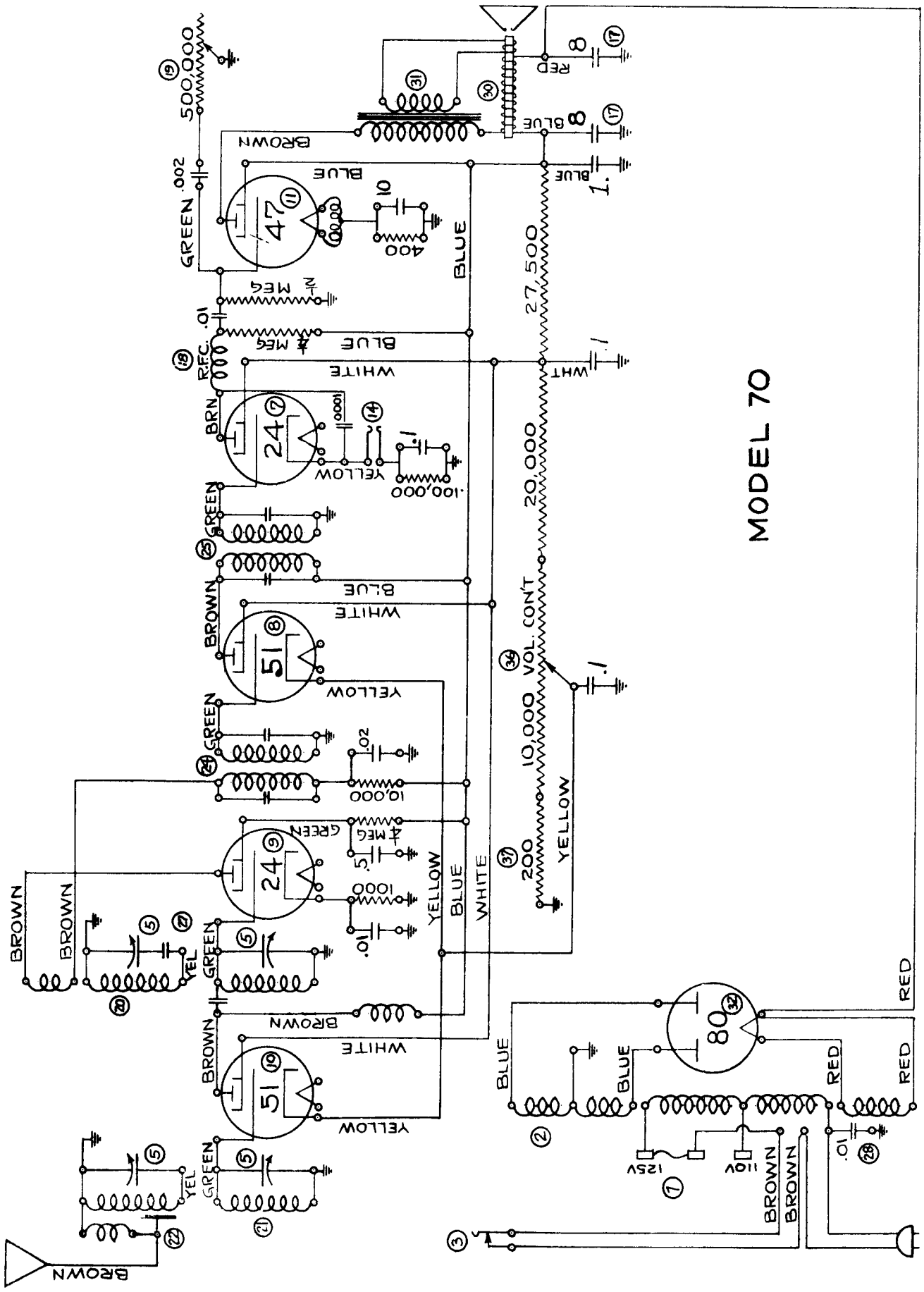

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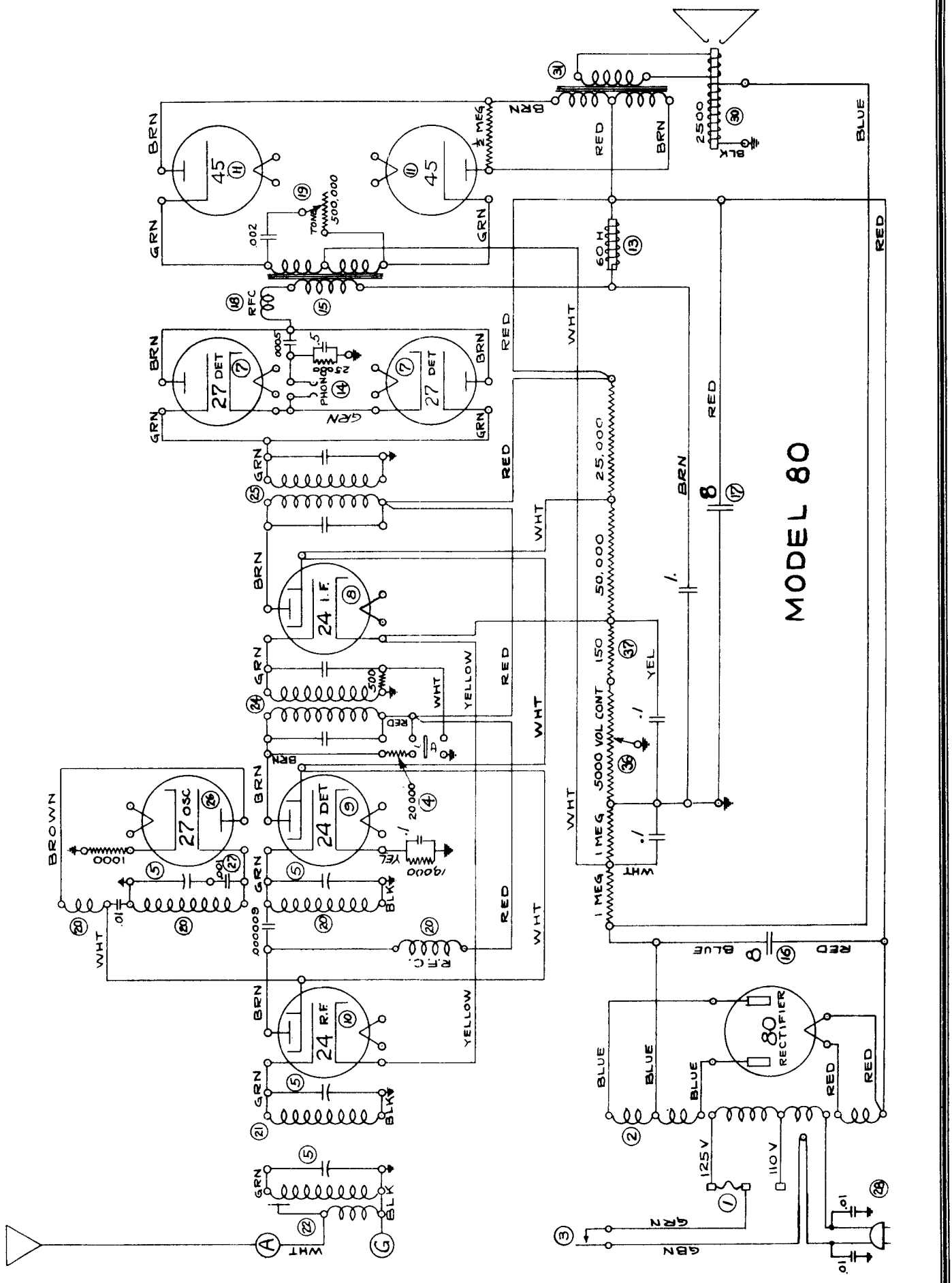
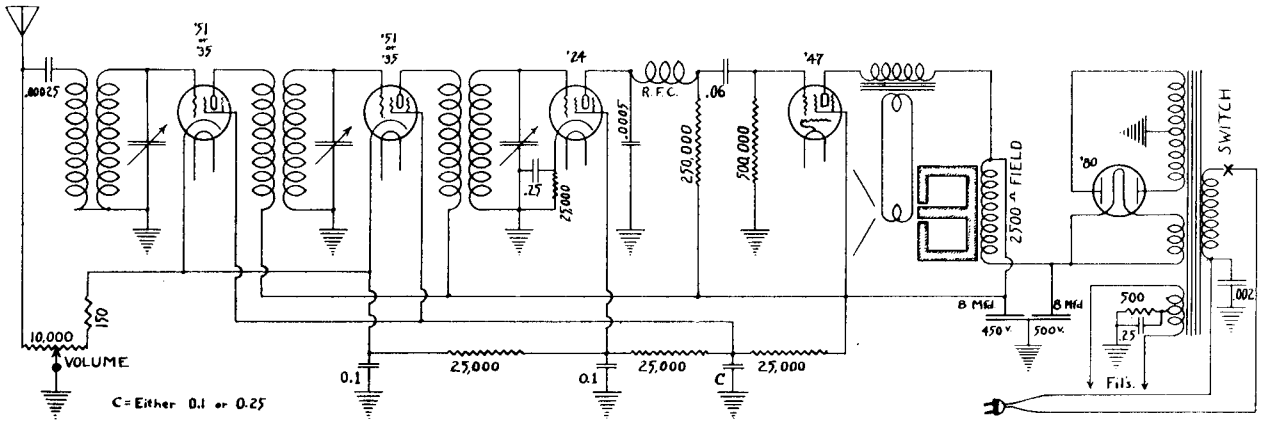


COLIN B. KENNEDY CORP.

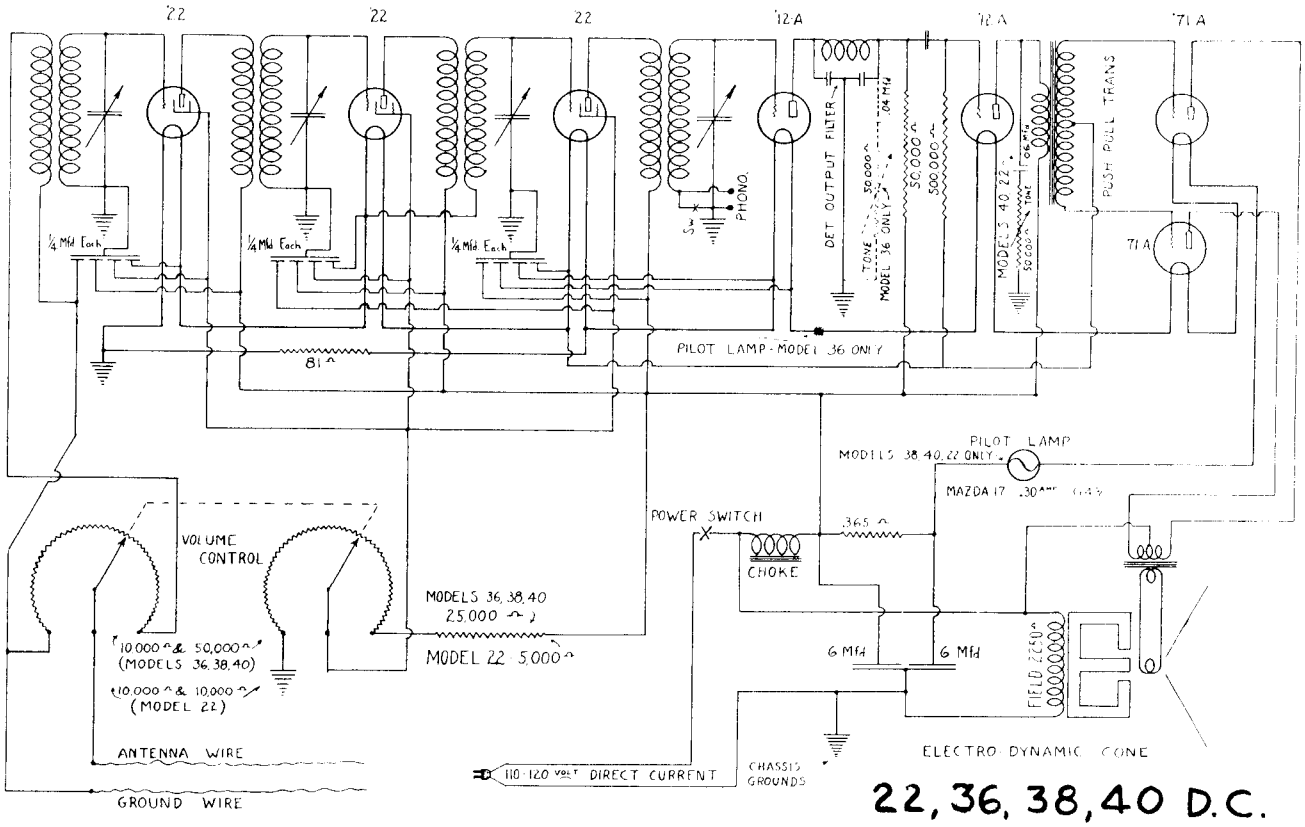


Tube	Type	Fil. A.C.	Plate	Screen	Bias
1st R.F.	551	2.3	250	175	2.5 to 39
2nd R.F.	551	2.3	250	175	2.5 to 39
Detector	224	2.3	155	.....	4
Power Tube	247	2.3	235	235	16
Rectifier	280	4.8	340-340	.....	....

Line voltage = 115. Volume full on.

A 1,000-ohm-per-volt meter used to obtain the above. Small deviations above or below the values given may be expected, due to variations in parts, tubes and meters.

MODEL-50



22, 36, 38, 40 D.C.

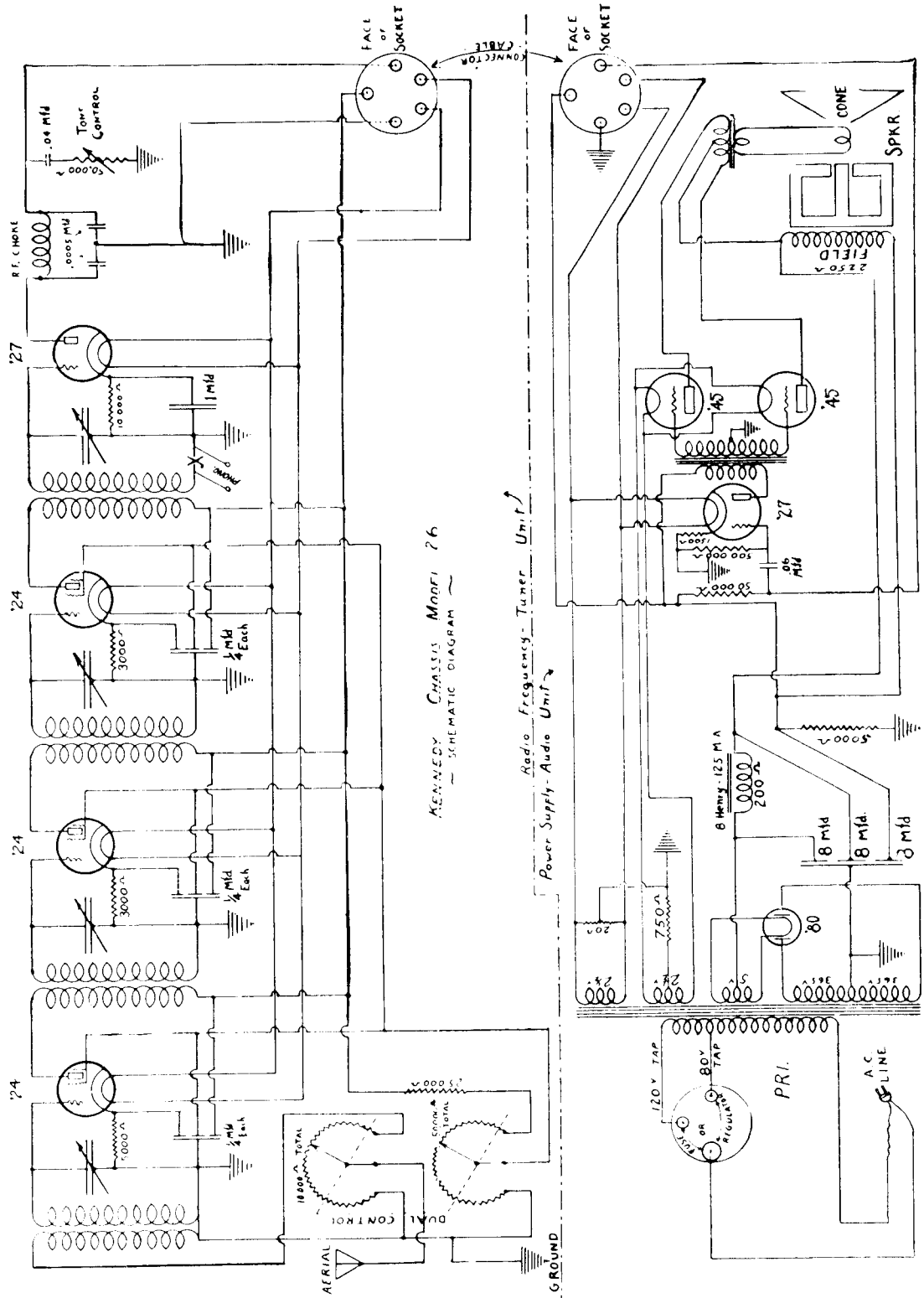
SPECIAL NOTICE

Due to the similarity of the D. C. and A. C. chassis and the fact that the circuits of the various D. C. models are almost identical, all current model D. C. servicing instructions are covered by this service manual.

The mechanical layout of the D. C. models corresponds to the equivalent A. C. model in each case except for the few variations noted below.

D. C. Model	*Corresponding A. C. Model*
36	26
38	30
40	32
22	20B

COLIN B. KENNEDY CORP.



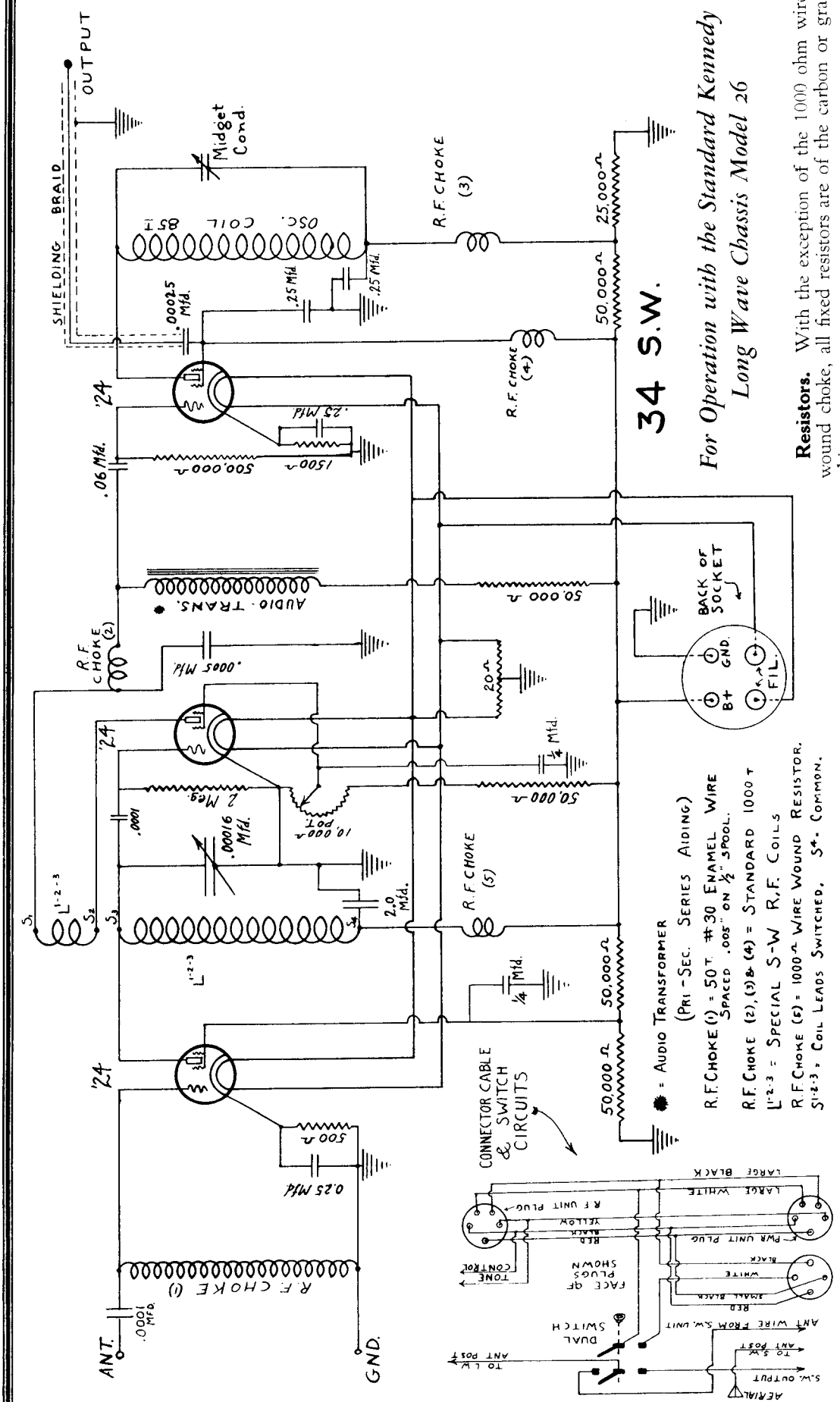
Resistors

The resistance values of the various colored biasing resistors employed are as follows:

Green	3,000 ohms.	Yellow	50,000 ohms.
Blue	5,000 ohms.	Brown	500,000 ohms.
Grey	10,000 ohms.	Red	1,500 ohms.

TUBE	FILAMENT	PLATE	BIAS	SCREEN
1st R. F.	2.3	160	3.5	85
2nd R. F.	2.3	160	3.5	85
3rd R. F.	2.3	160	3.5	85
Detector	2.3	125	10	....
1st A. F.	2.3	155	9	....
Power Tubes	2.3	230	45	....
Rectifier	4.8	....	....	....

COLIN B. KENNEDY CORP.



34 S.W.

For Operation with the Standard Kennedy Long Wave Chassis Model 26

Resistors. With the exception of the 1000 ohm wire wound choke, all fixed resistors are of the carbon or graphite type.

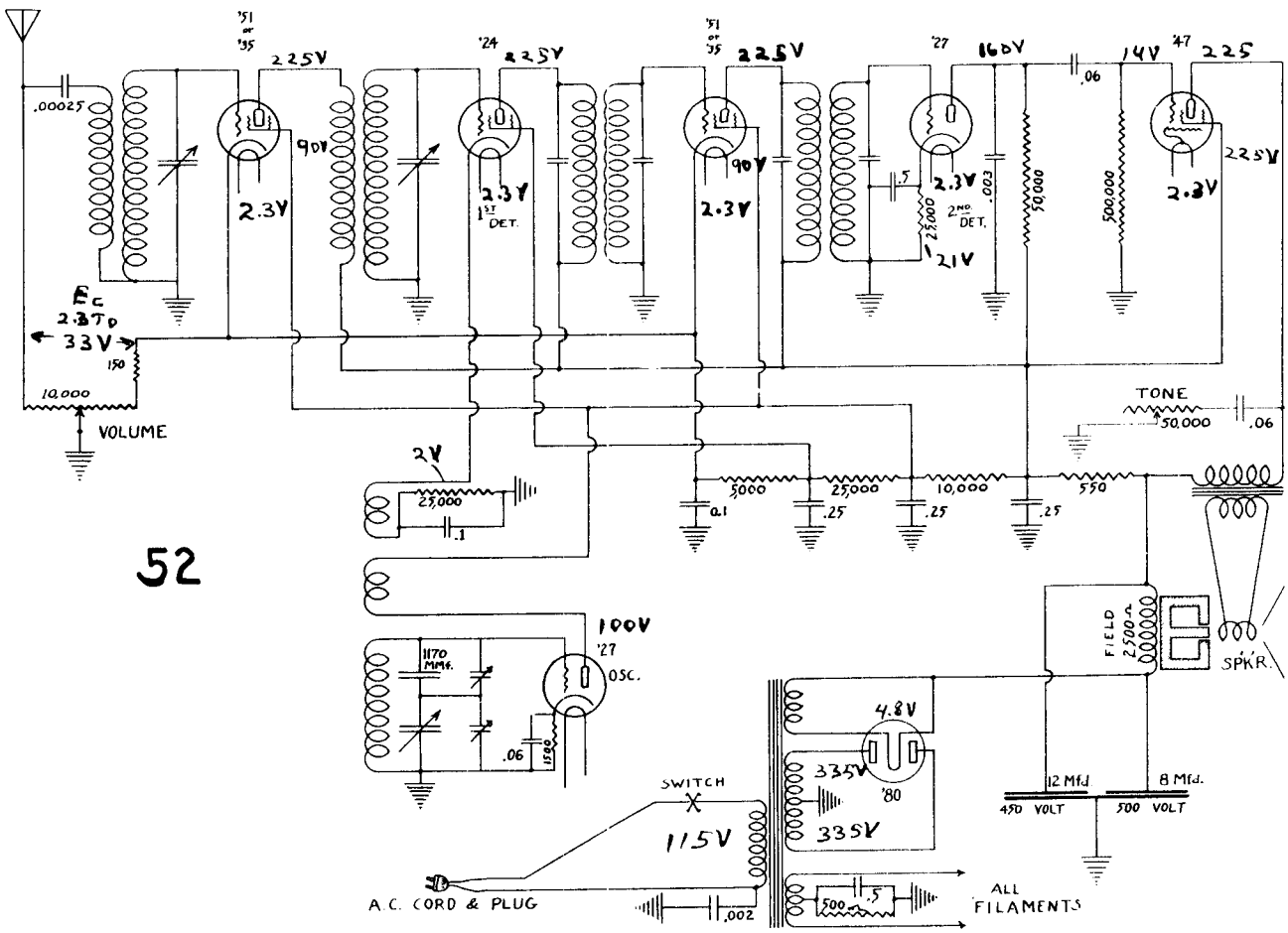
Yellow	50,000	ohms
Red	1,500	ohms
Red (large)	2	megohms
Grey	25,000	ohms
Brown	500,000	ohms
Black	500	ohm

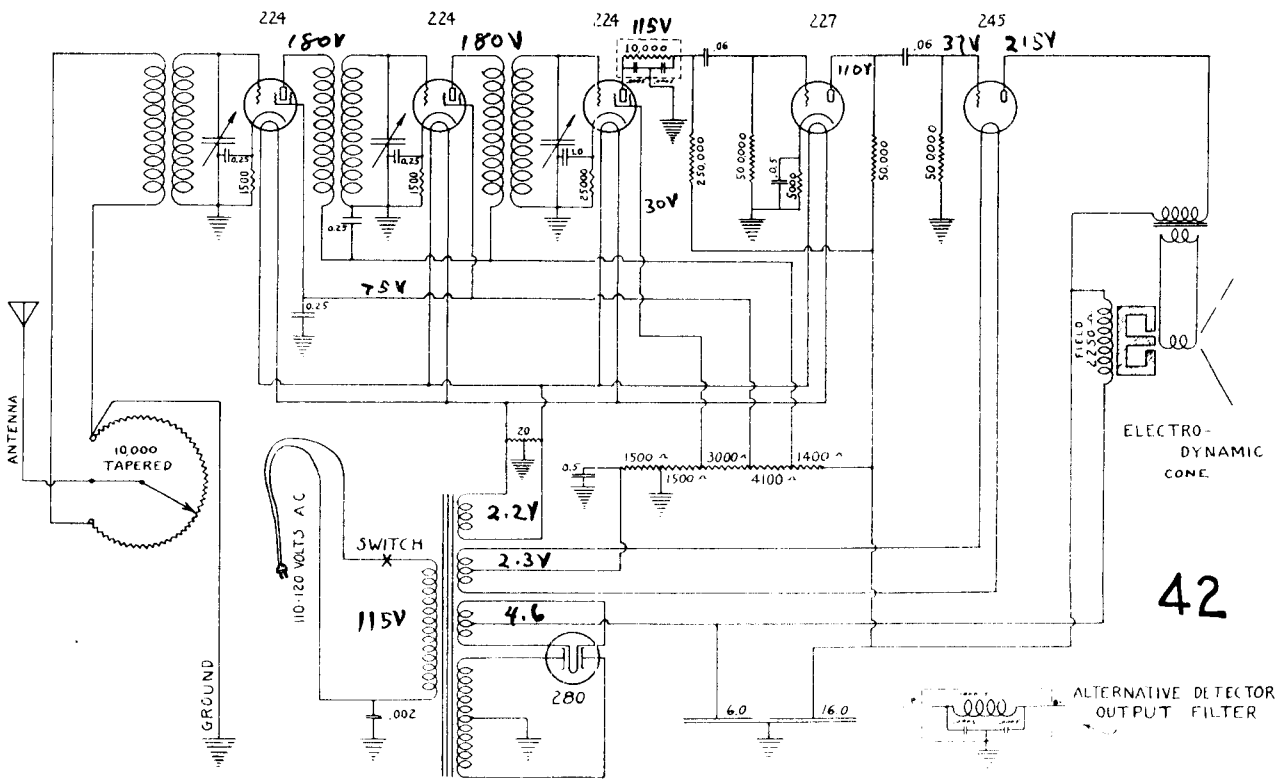
(Flexible covered resistor)

The volume and regeneration control is a 10,000 ohm wire wound potentiometer.

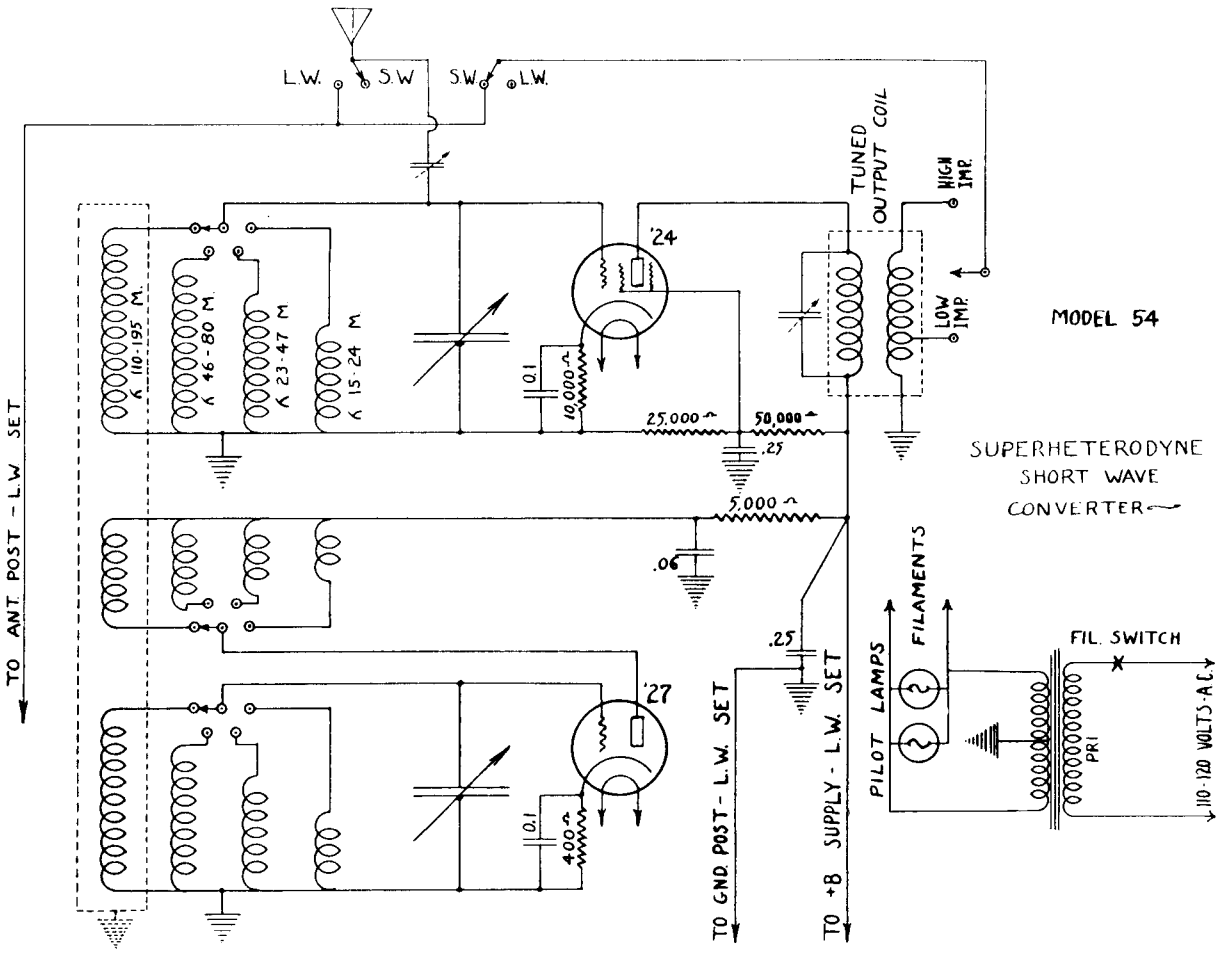
Radio frequency tube:	Plate	160 volts
	Screen	70 volts
	Cathode (bias)	1.1 volts
Detector tube:	Plate	140 volts
	Screen	30 volts
	(Volume on Maximum)	
Oscillator tube:	Plate	55 volts
	Screen	160 volts
	Cathode (bias)	5 volts

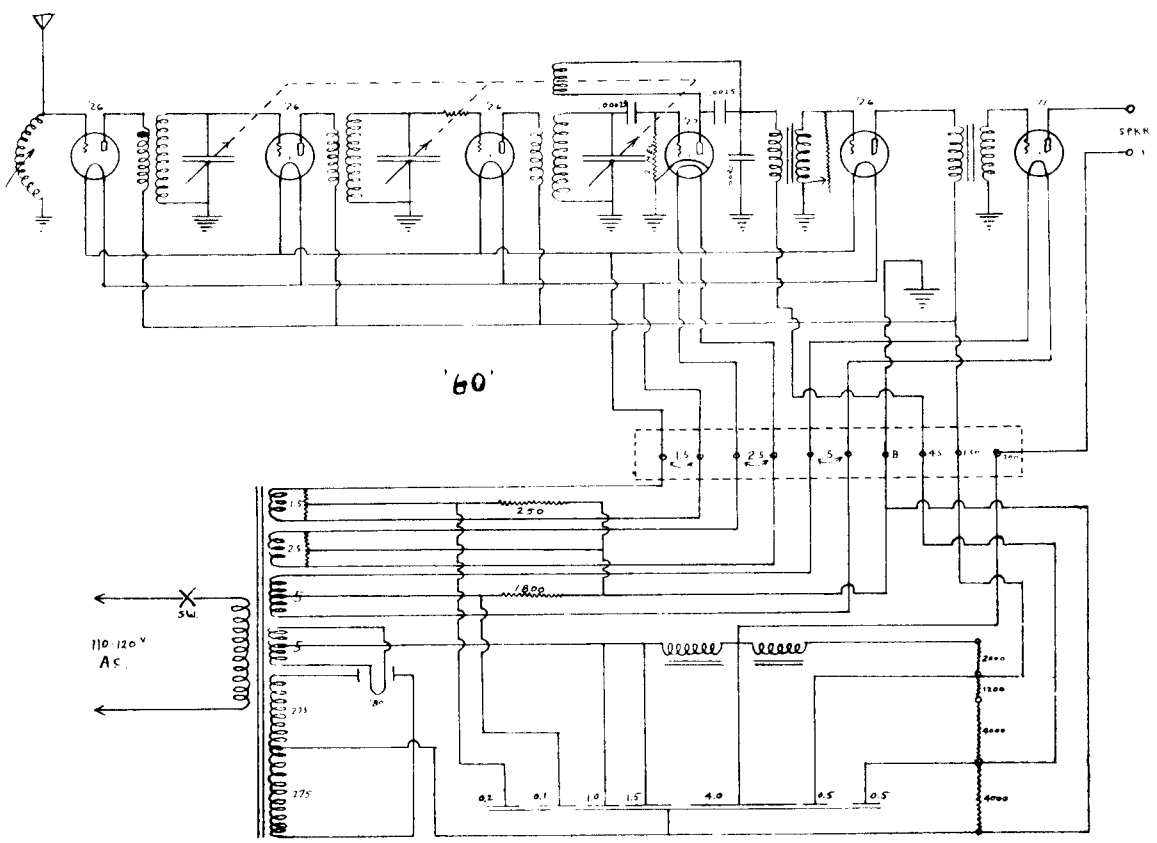
COLIN B. KENNEDY CORP.



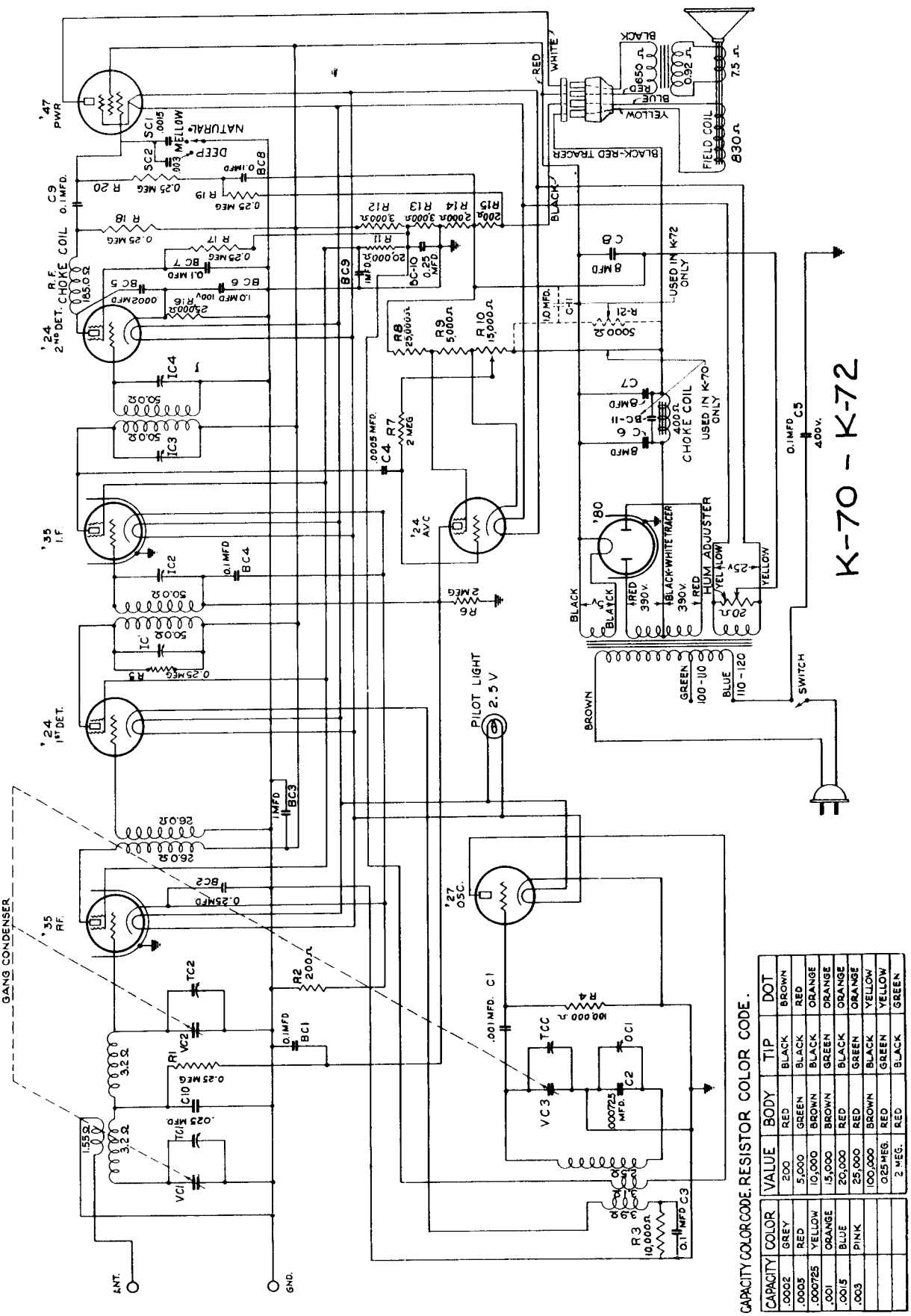


COLIN B. KENNEDY CORP.





KOLSTER RADIO, INC.



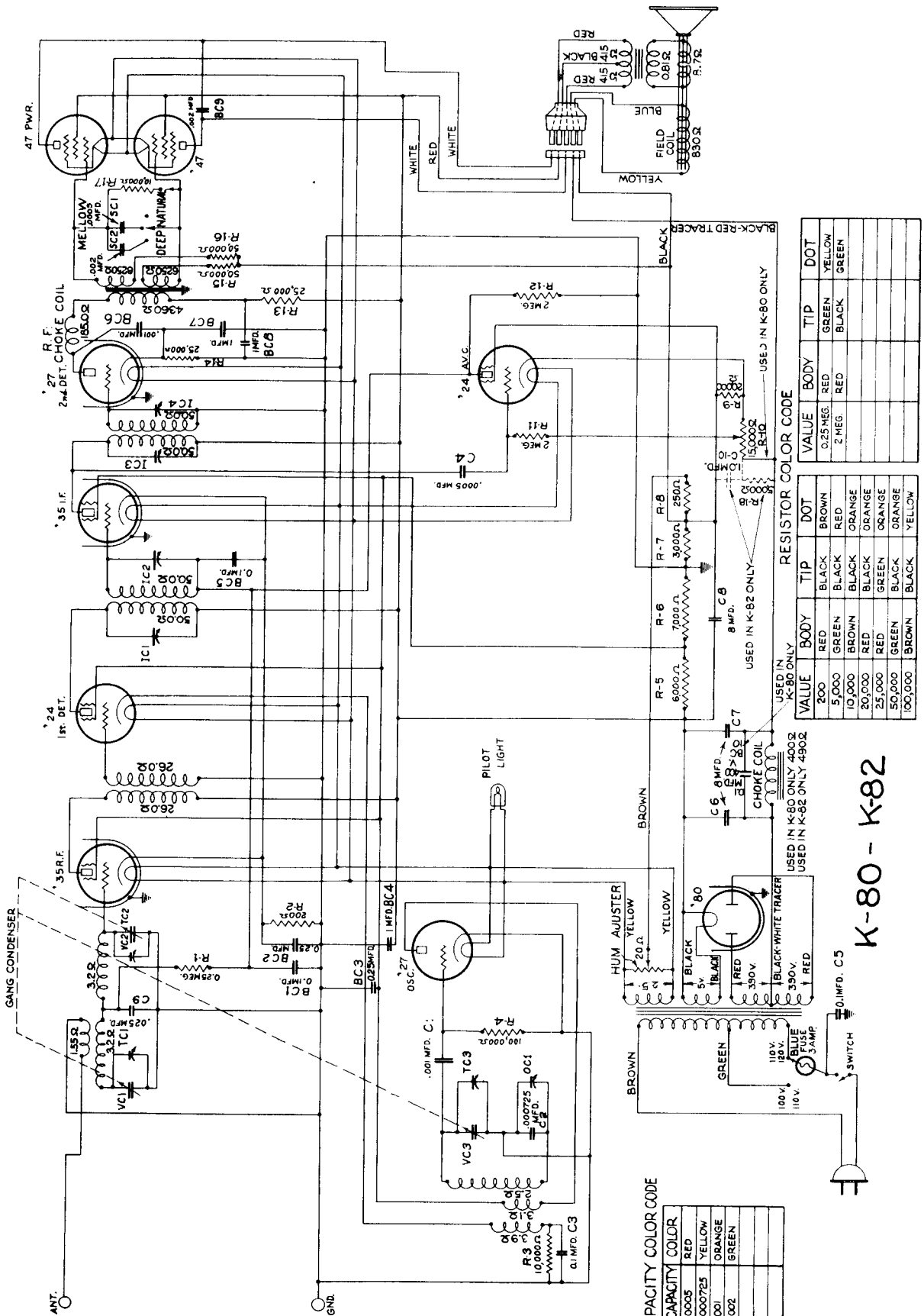
CAPACITY COLOR CODE.

CAPACITY	COLOR
.0002	GREY
.0005	RED
.000725	YELLOW
.001	ORANGE
.0015	BLUE
.003	PINK

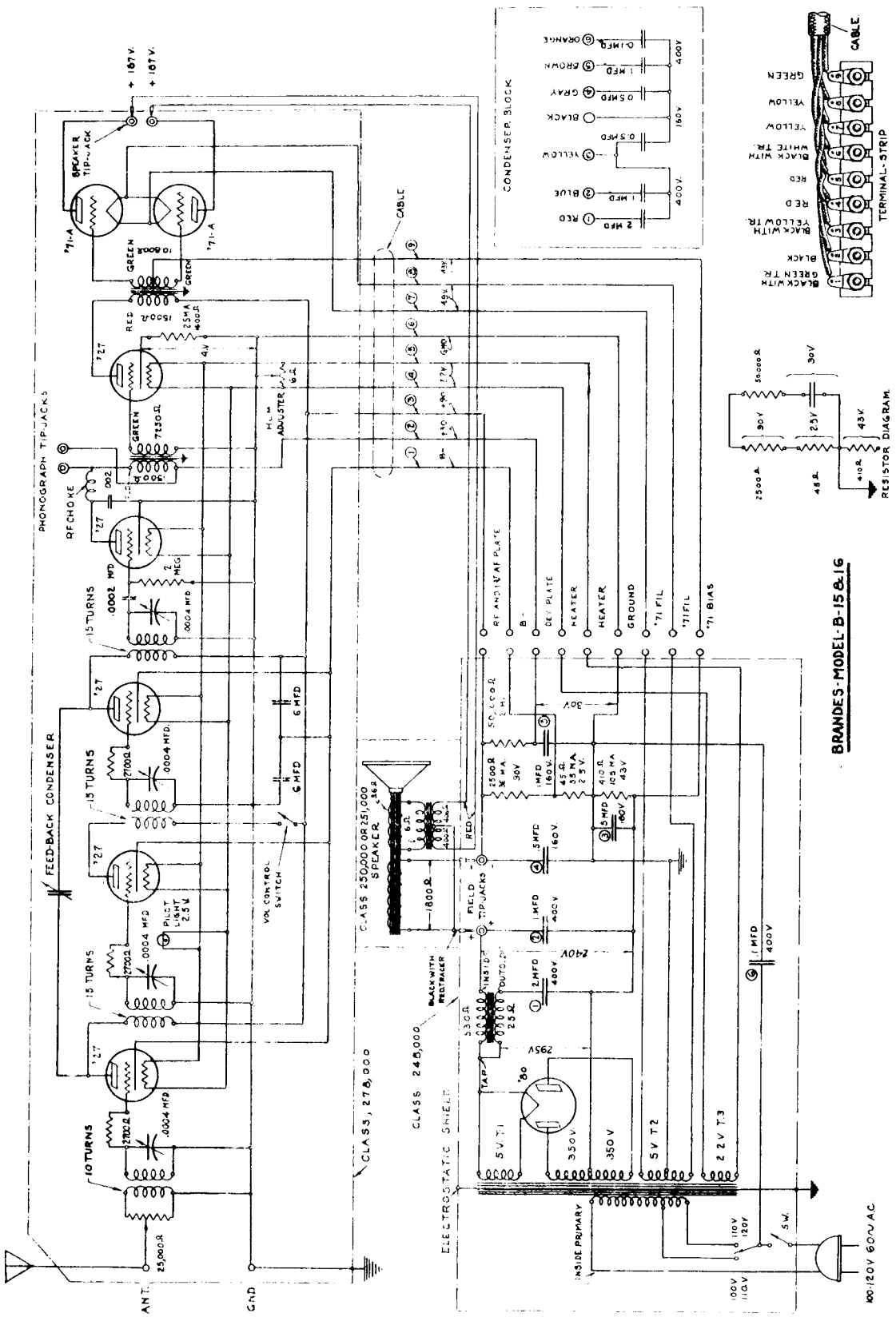
RESISTOR COLOR CODE.

VALUE	BODY	TIP	DOT
200	RED	BLACK	BROWN
5,000	GREEN	BLACK	RED
10,000	BROWN	BLACK	ORANGE
15,000	BROWN	GREEN	ORANGE
20,000	RED	BLACK	ORANGE
25,000	RED	GREEN	ORANGE
100,000	BROWN	BLACK	YELLOW
0.25 MEG.	RED	GREEN	YELLOW
2 MEG.	RED	BLACK	GREEN

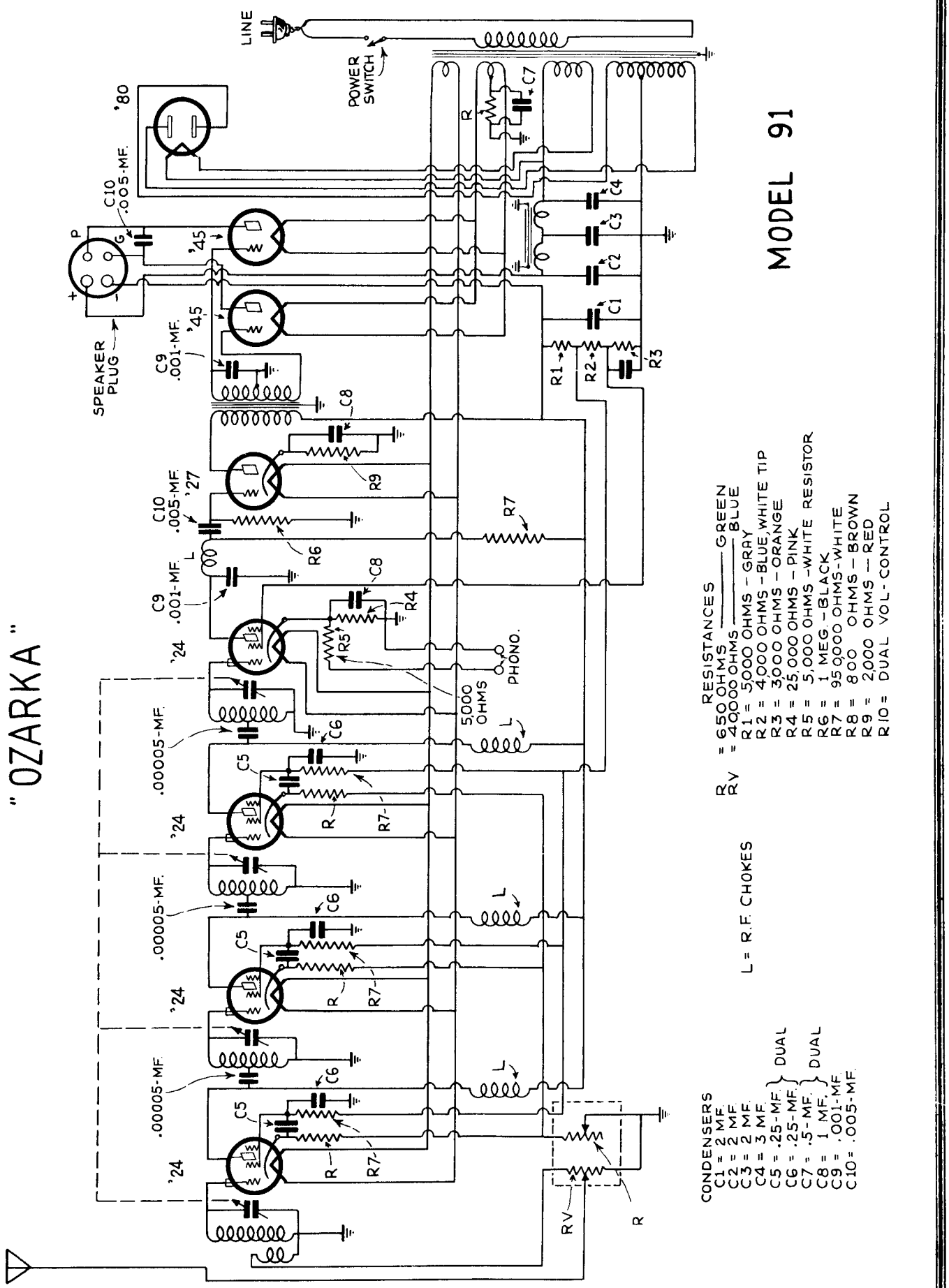
KOLSTER RADIO, INC.



KOLSTER RADIO, INC.

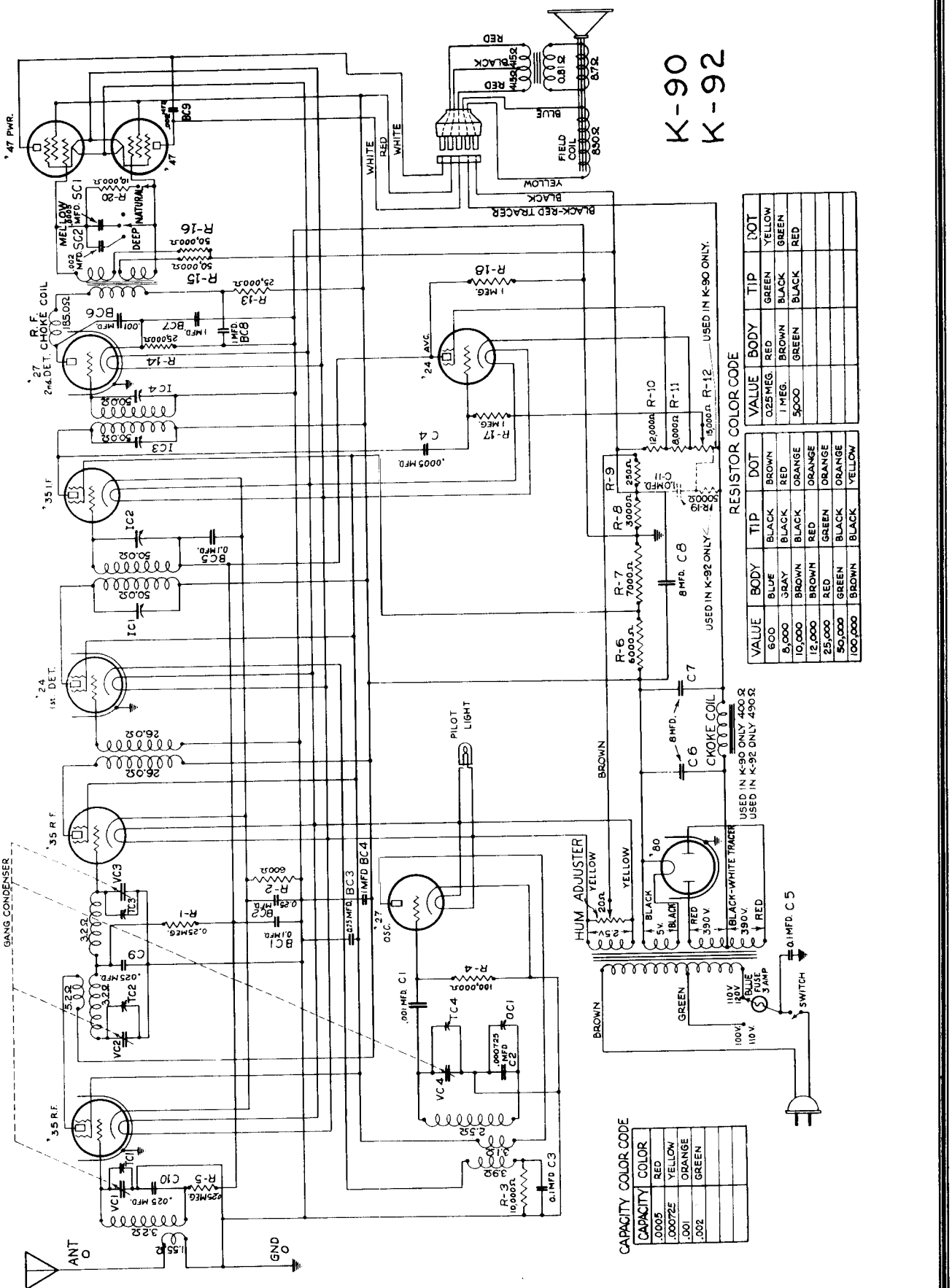


OZARKA, INC.


"OZARKA"
MODEL 91
LINE
POWER SWITCH
SPEAKER PLUG
'80
'45
'27
'24
C10 .005-MF.
C9 .001-MF.
C8
C7
C6 .00005-MF.
C5
C4
C3
C2
C1
R
R1
R2
R3
R4
R5
R6
R7
R9
L
5,000 OHMS
PHONO.
RV
P
G
+
-
RESISTANCES
RV = 650 OHMS ——— GREEN
RV = 40000 OHMS ——— BLUE
R1 = 5000 OHMS – GRAY
R2 = 4,000 OHMS – BLUE, WHITE TIP
R3 = 3000 OHMS – ORANGE
R4 = 25,000 OHMS – PINK
R5 = 5,000 OHMS – WHITE RESISTOR
R6 = 1 MEG – BLACK
R7 = 95,000 OHMS – WHITE
R8 = 800 OHMS – BROWN
R9 = 2,000 OHMS – RED
R10 = DUAL VOL-CONTROL
L = R.F. CHOKES
CONDENSERS
C1 = 2 MF.
C2 = 2 MF.
C3 = 3 MF.
C4 = 3 MF.
C5 = .25-MF. } DUAL
C6 = .25-MF. }
C7 = .5-MF. } DUAL
C8 = 1 MF. }
C9 = .001-MF.
C10 = .005-MF.

KOLSTER RADIO, INC.

K-90
K-92



RESISTOR COLOR CODE

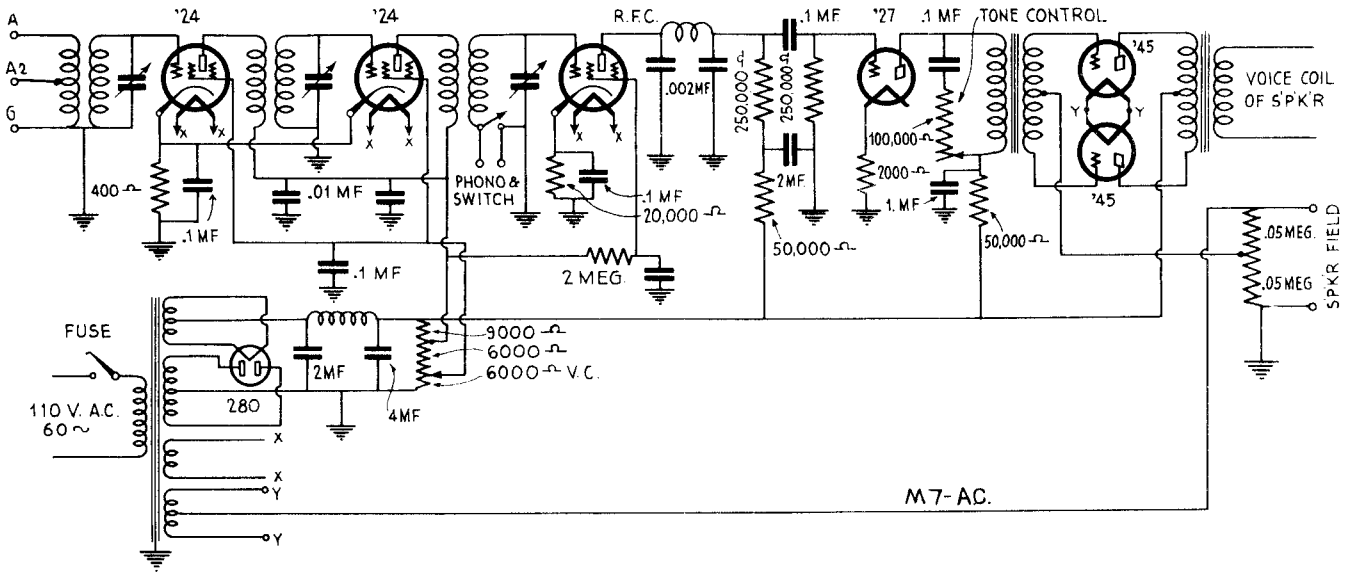
VALUE	BODY	TIP	DOT
600	BLUE	BLACK	BROWN
8,000	GRAY	BLACK	RED
10,000	BROWN	BLACK	ORANGE
12,000	BROWN	RED	ORANGE
25,000	RED	GREEN	ORANGE
50,000	GREEN	BLACK	ORANGE
100,000	BROWN	BLACK	YELLOW

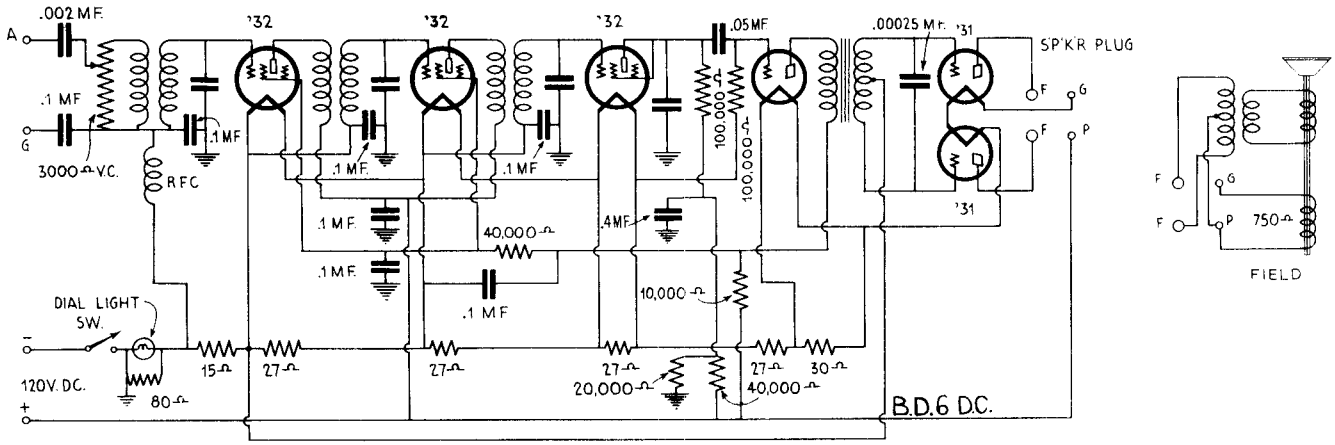
VALUE	BODY	TIP	DOT
0.25 MEG.	RED	GREEN	YELLOW
1 MEG.	BROWN	BLACK	GREEN
5000	GREEN	BLACK	RED

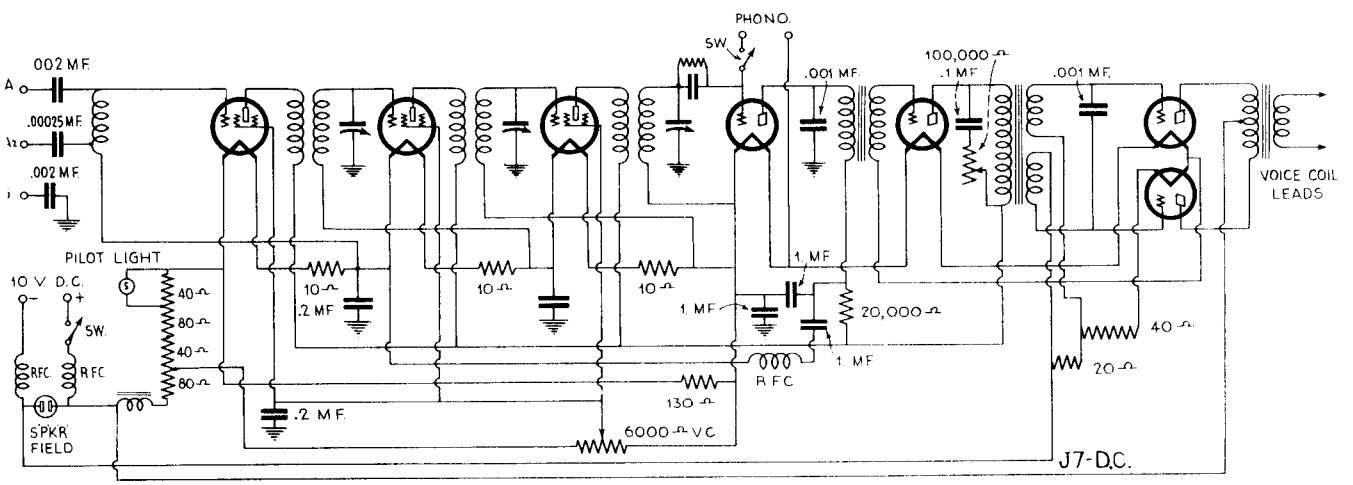
CAPACITY COLOR CODE

CAPACITY	COLOR
.0005	RED
.000725	YELLOW
.001	ORANGE
.002	GREEN

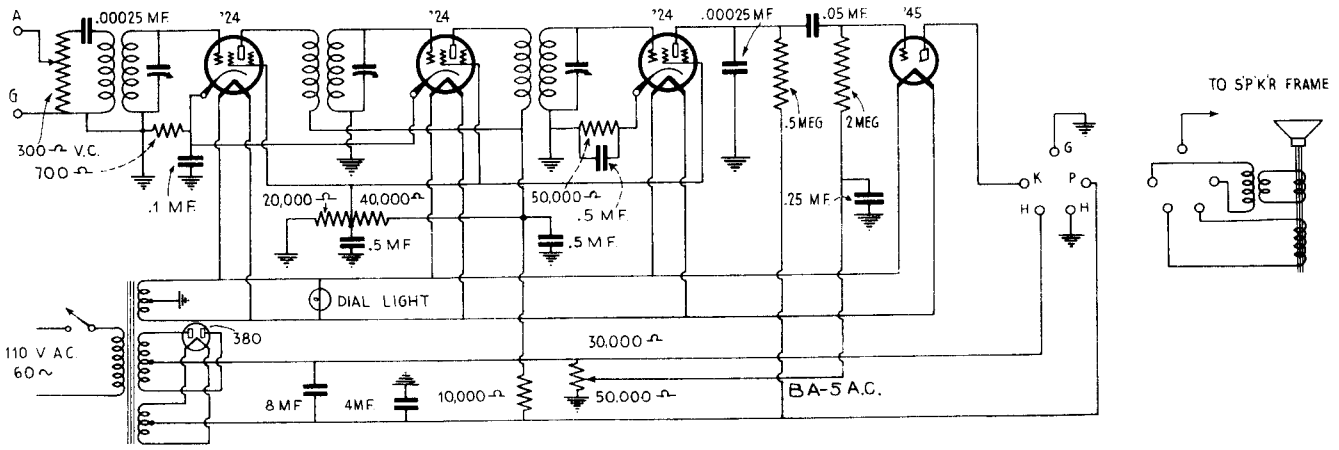
LANG RADIO CO.

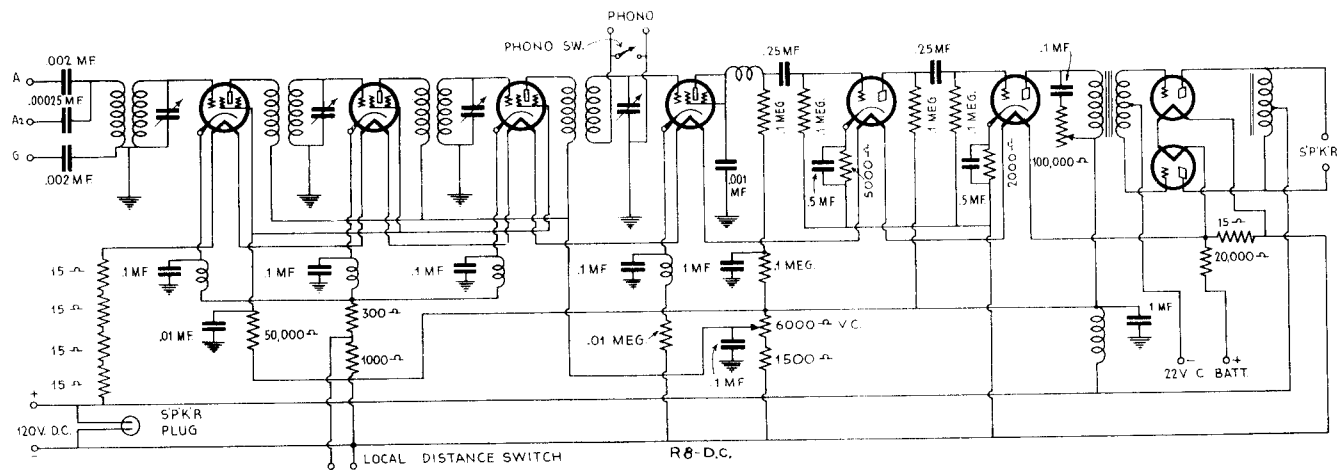


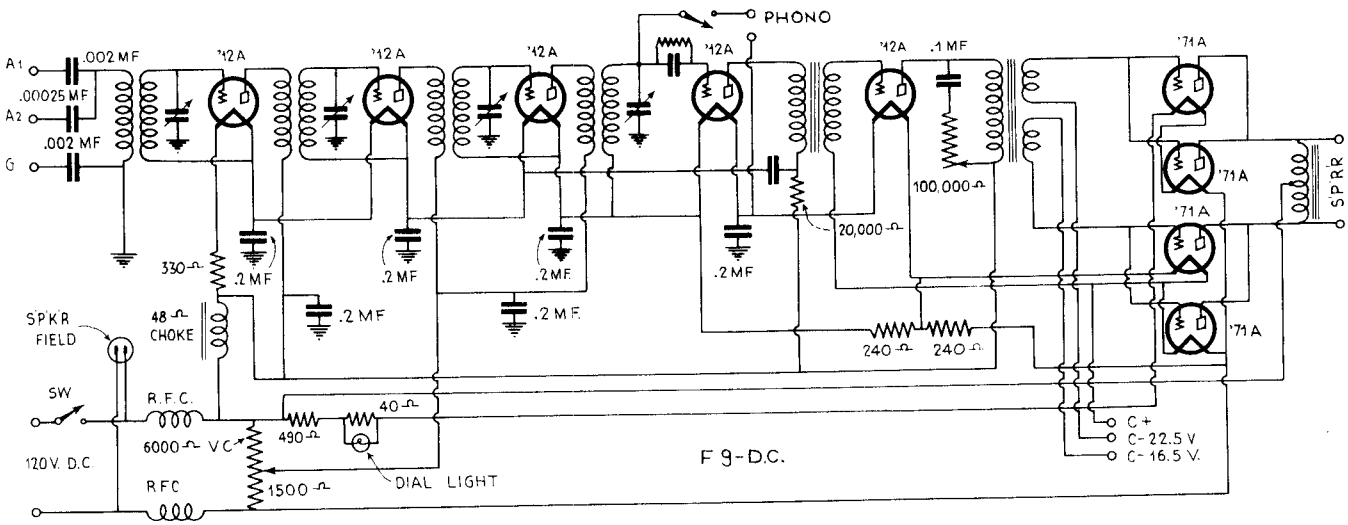




LANG RADIO CO.

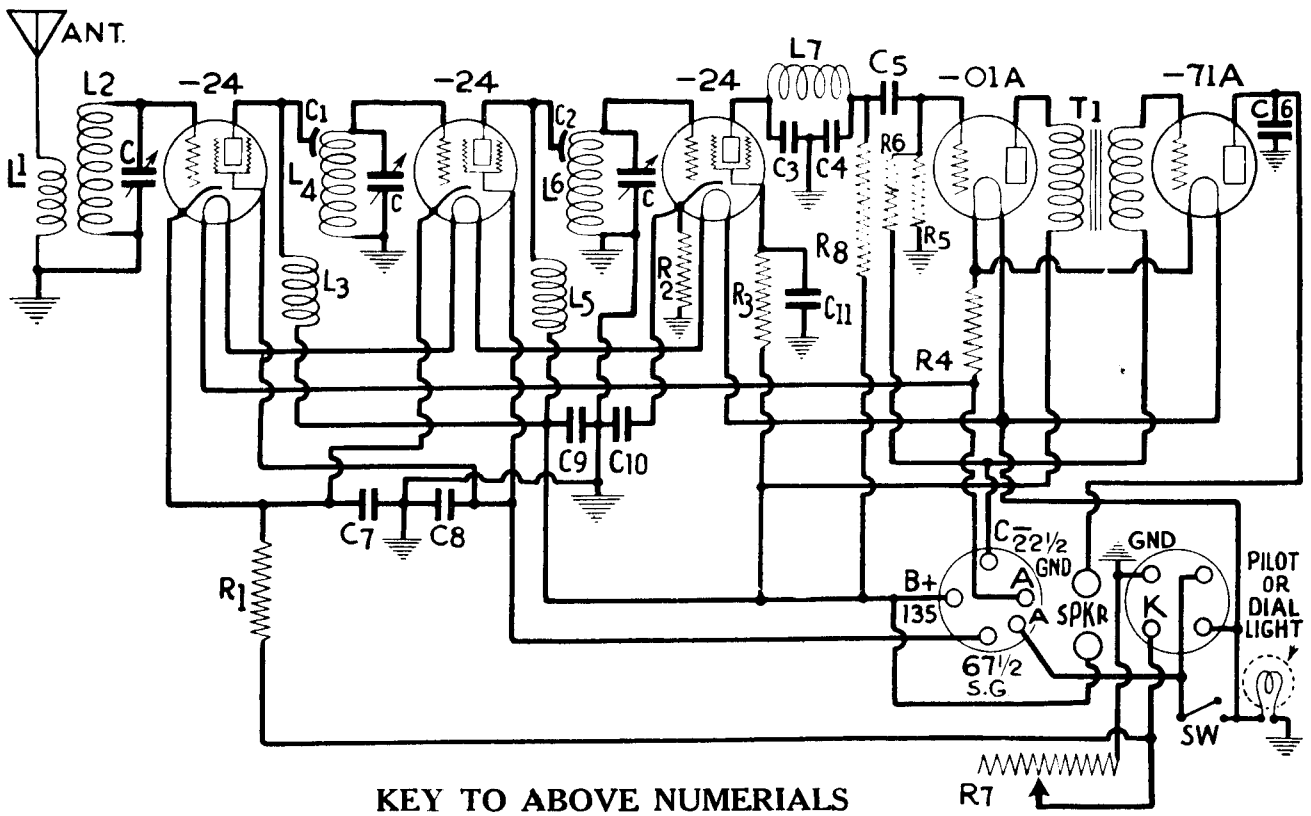






GALVIN MANUFACTURING CORP.

MOTOROLA



KEY TO ABOVE NUMERIALS

L1—Antenna primary
L2, L4, L6—R. F. secondarys
L3, L5—R. F. plate chokes
L7—Detector plate choke
C, C1, C2—Main tuning condensers
C1, C2—R. F. coupling condenser. Cap. 9.6 micro-microfarads
C3, C4—0001 mfd. condensers
C5, C6, C11—.003 mfd. condensers
C7, C8, C9, C10—.25 mfd. by pass condensers
R1—200 -ᔓ- (Gray) resistor
R2—25,000 -ᔓ- (Black) resistor
R3, R6—3 meg (Blue or Pink) resistor
R4—2 -ᔓ- wire wound resistor
R5, R8—1 meg (Lavender) resistor
R7—300,000 -ᔓ- Volume control

Voltage Readings at the Tube Socket

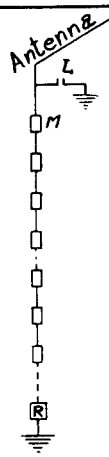
TUBE NO. IN ORDER ①	TYPE OF TUBE ②	POSITION OF TUBE 1 ST. R.F. DET., ETC. ③	READINGS, PLUG IN SOCKET OF SET									
			TUBE OUT		TUBE IN TESTER							
			A VOLTS ④	B VOLTS ⑤	A VOLTS ⑥	B VOLTS ⑦	C VOLTS (CONTROL GRID) ⑧	CATHODE - HEATER ⑨ VOLTS	NORMAL PLATE ⑩ M.A.	PLATE M.A. GRID ⑪ TEST	PLATE CHANGE ⑫ M.A.	SCREEN GRID ⑬ VOLTS
1	24	1st R.F.		112.5	2	110	1	1.	2.2	3.2	1.	67.5
2	24	2nd R.F.		"	2	110	1	1.	2.2	3.2	1	67.5
3	24	Det		"	2	38	.3	.6	.6	1.6	1	6
4	01-A	1st Aud.		"	5	100	2		2.5	7.5	5	
5	71-A	2nd Aud.		"	5		22.5		5	18.	13	
6												
7												
8												
9												
10												

NOTE—These readings were made with the negative terminal of the "A" Battery grounded.

(MULTICUPLER) AMY, ACEVES AND KING INC.

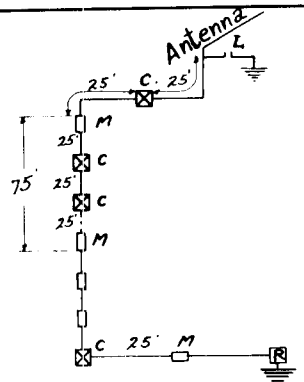
TYPICAL RISER DIAGRAMS FOR MULTICOUPLER ANTENNA SYSTEM INSTALLED IN CONDUIT

A



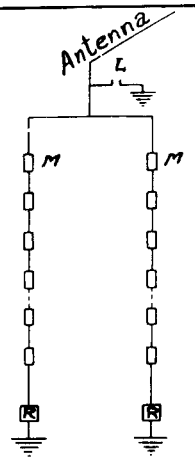
Typical straight vertical riser with radio outlet on each floor, using one aerial. Terminal resistance shown at end of line, in series with aerial downlead to ground

B



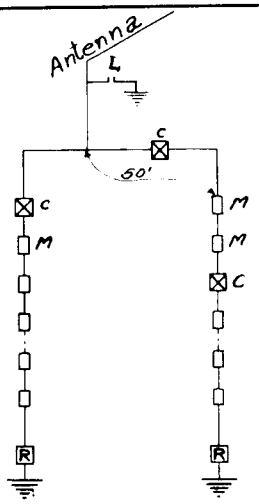
Riser with distance from aerial entrance bushing to first multicoupler or radio outlet approximately 50 feet. Note loading coil inserted approximately mid-way, then two loading coils in run approximately 75 feet without any outlets. Distance between two last outlets is approximately 50ft., requiring loading coil.

C



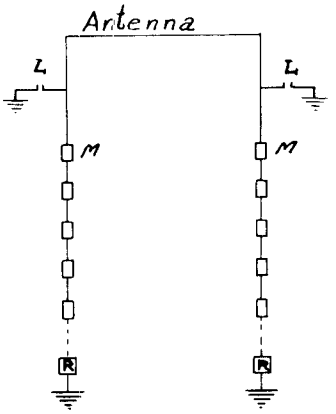
Two straight branch risers, connected to one aerial each with terminal resistance

D



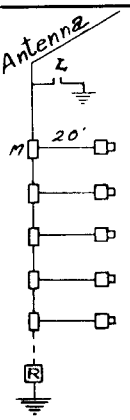
Two typical branch risers on one aerial, off set requiring loading coils.

E



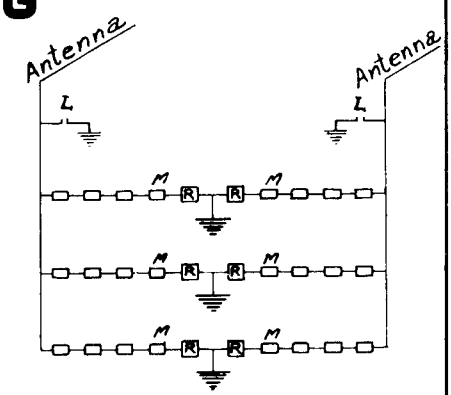
Another variation of two branch risers on one aerial showing one branch connected to one end of aerial and one to other end.

F



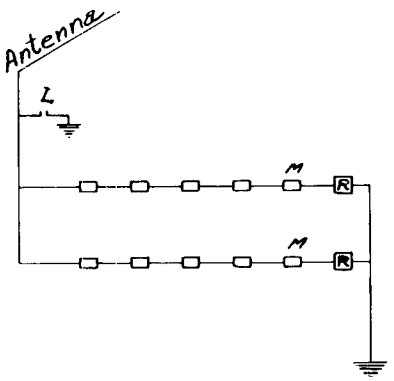
Showing radio outlets in different location from riser. Multicoupler is installed in 4"x4" box with 3/4" cover and blank plate usually in closets. Branch to outlet plate can be run in 1/2" conduit but not over 20 ft. from multicoupler.

G



Typical riser for three story building, three branches for one aerial, Not over four outlets on each branch. Riser shown for 24 suite building.

H



Typical riser for two story building two branches for one aerial.

Legend

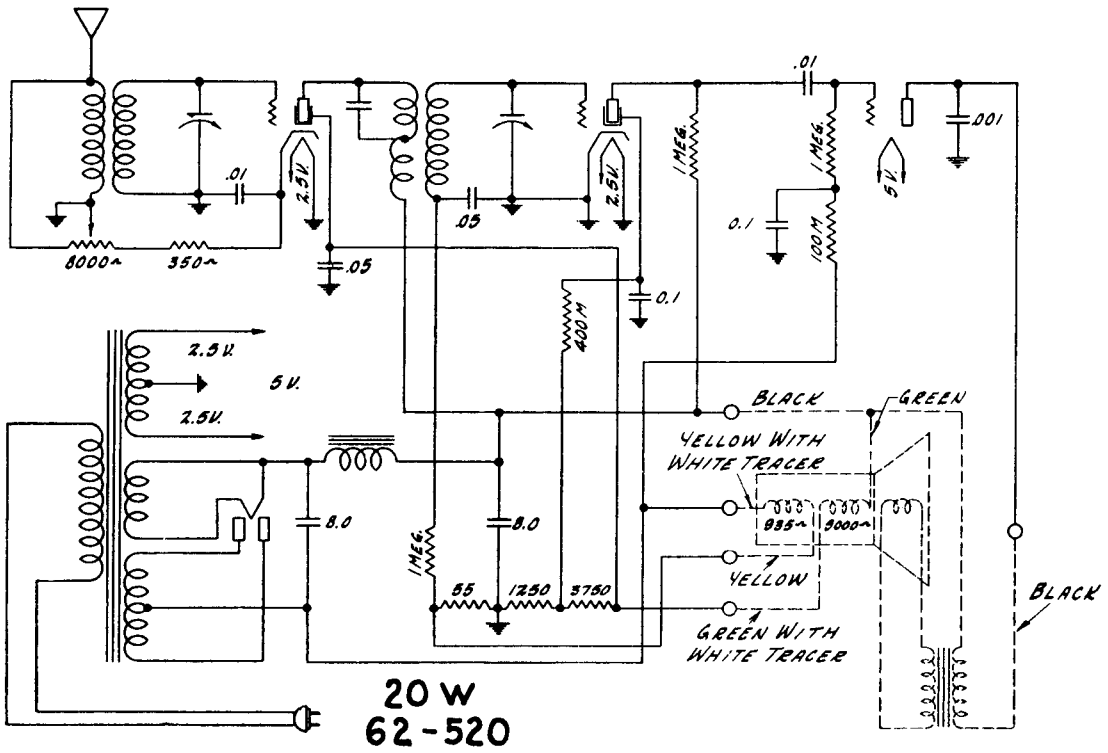
M□ Multicoupler radio outlet
C⊠ Load Coil
L Lightning Arrester
□ Branch Radio Outlet
R Terminal Resistance
Water pipe ground

Note:
When two risers are connected to one antenna the number of outlets on each branch should be kept as nearly equal as possible. Maximum difference should not exeed four. An aerial not less than 75 feet long is required when two branch risers are operated from one aerial.

Types of Risers for Various Buildings

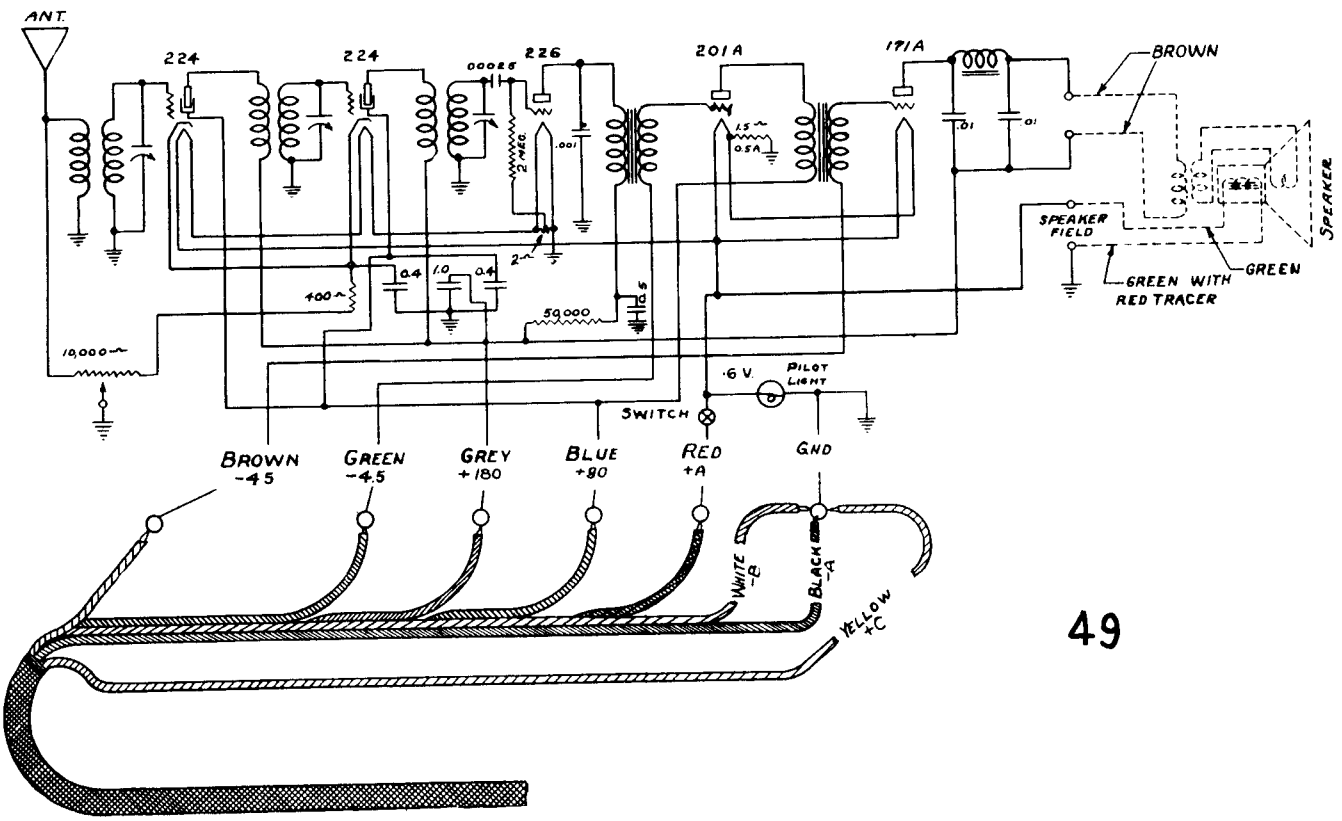
A and B for buildings 3 to 30 stories, maximum outlets 30; Antenna 75' long.
C and D for buildings 6 to 10 stories, maximum outlets 20; Antenna 75' long.
E and F for buildings 3 to 10 stories, maximum outlets 20; Antenna 75' long.
H for buildings two stories high, maximum outlets 12; Antenna 75' long.

MONTGOMERY WARD AND CO.



DOTTED LINES SHOWN ARE IN SPEAKER.

Type of Tube	Position of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
224	1	1st Radio	2.5	196	2.2	85	1.4	2.2	5.	7.1
224	2	Detector	2.5	95	2.3	17	.015		.1	.2
171A	3	1st Audio	5.1	191	43.				18.	20.
280	4	Rectifier	5.1						23. Per Plate	



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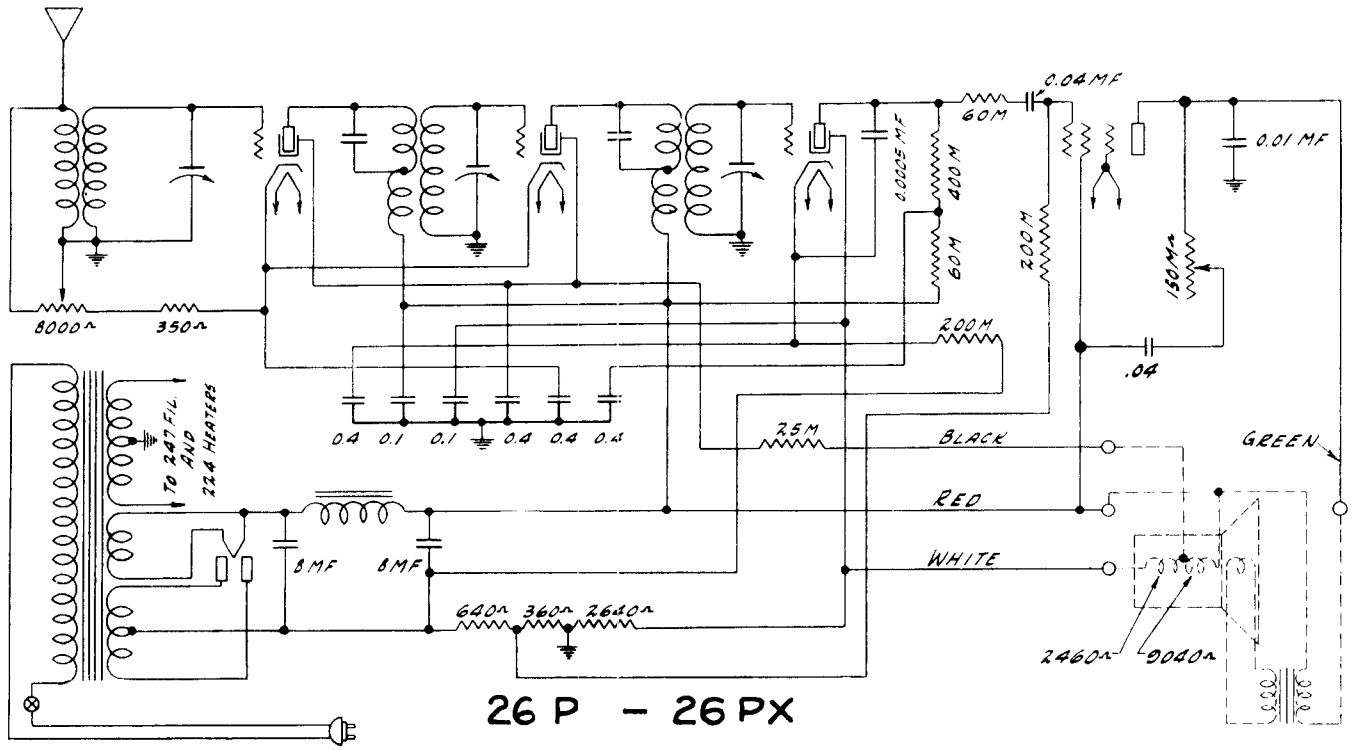
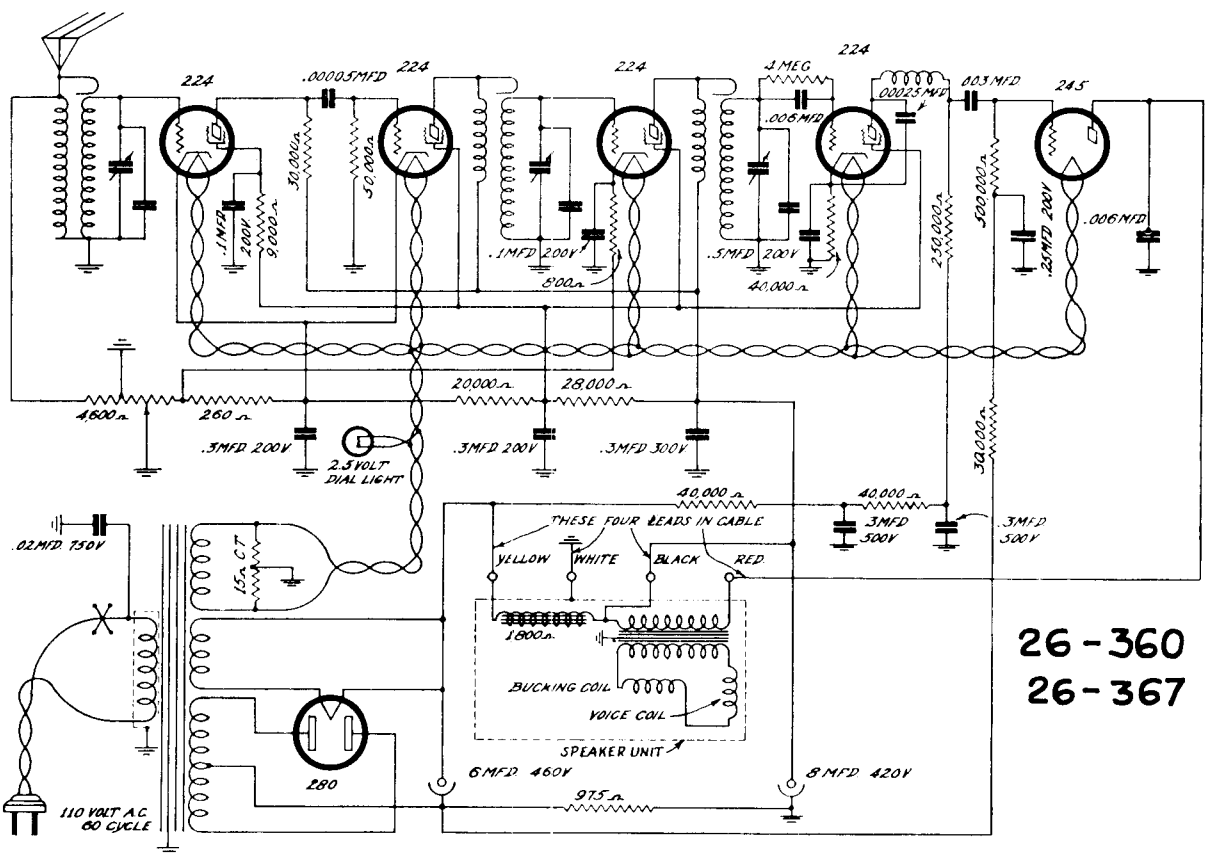


26 P – 26 PX



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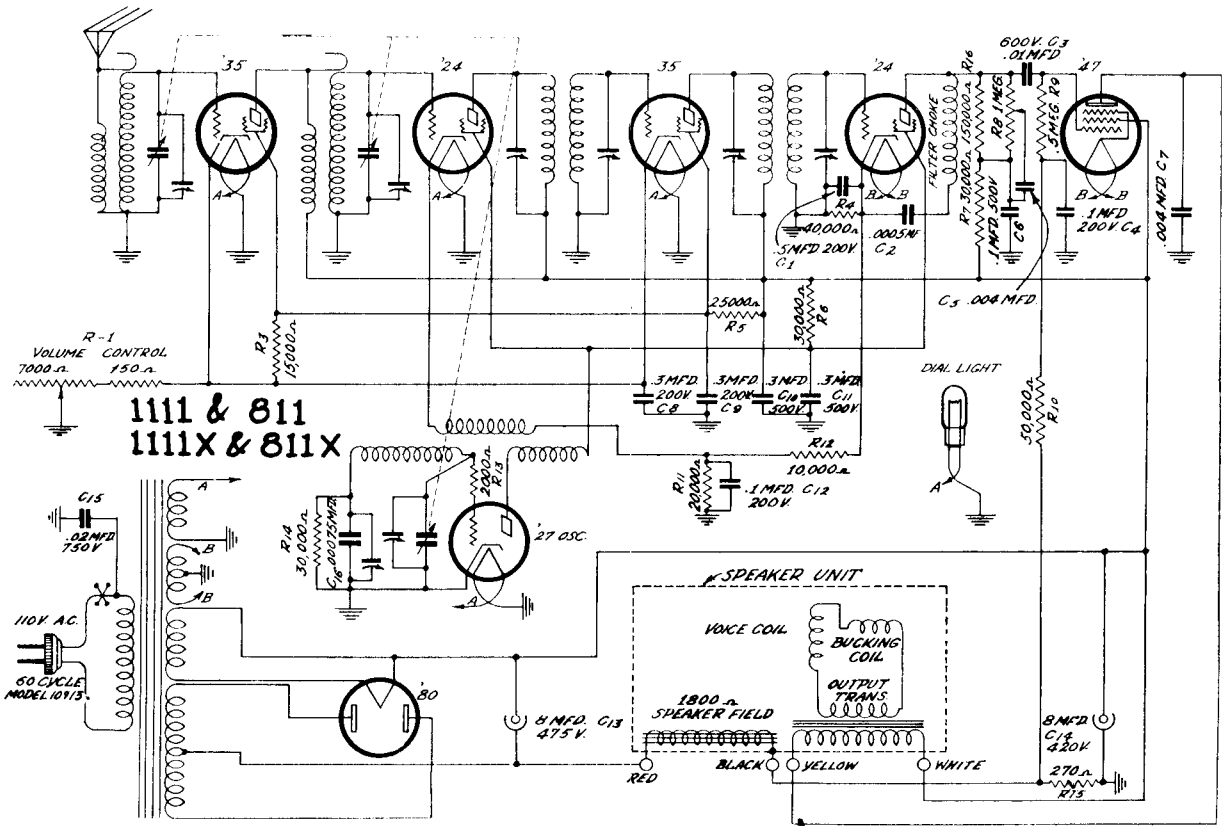

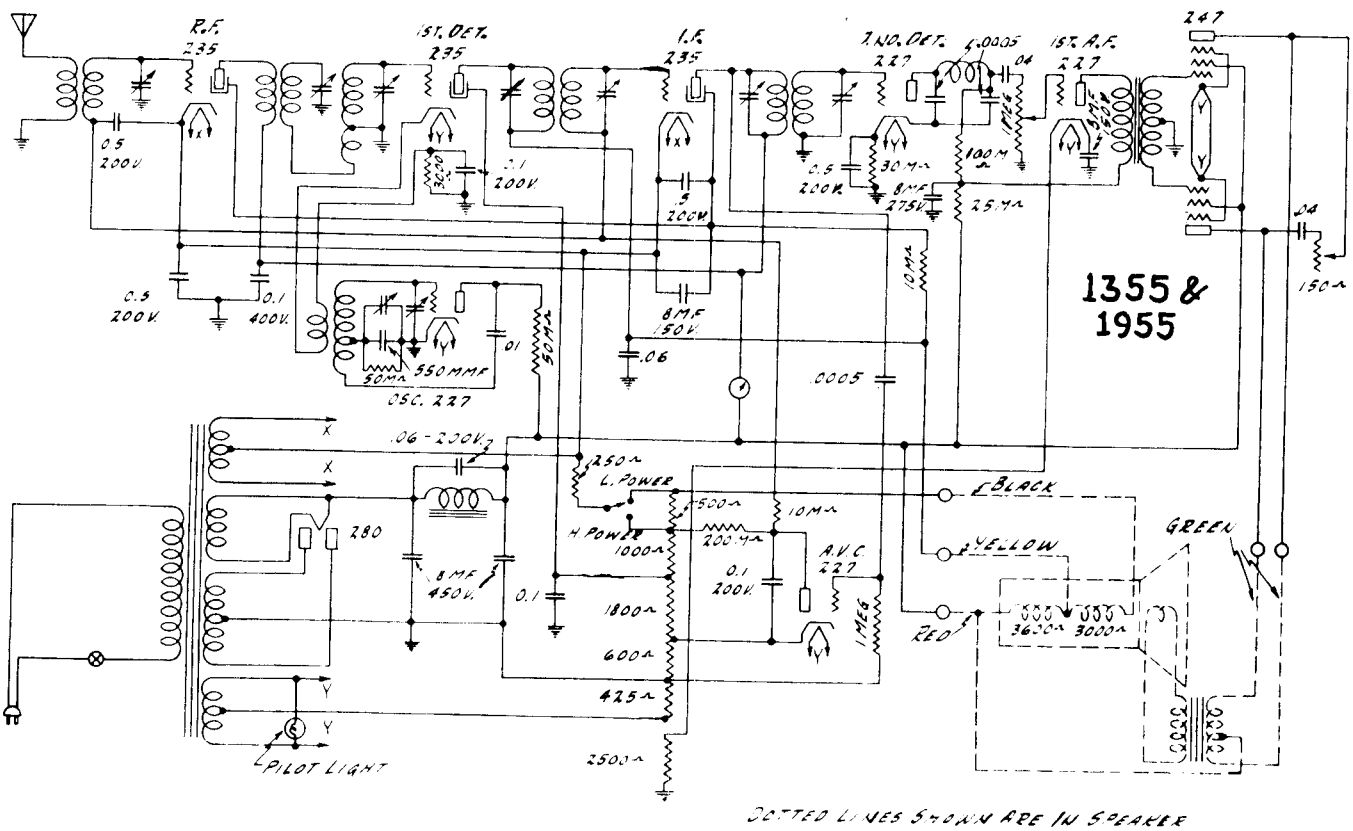

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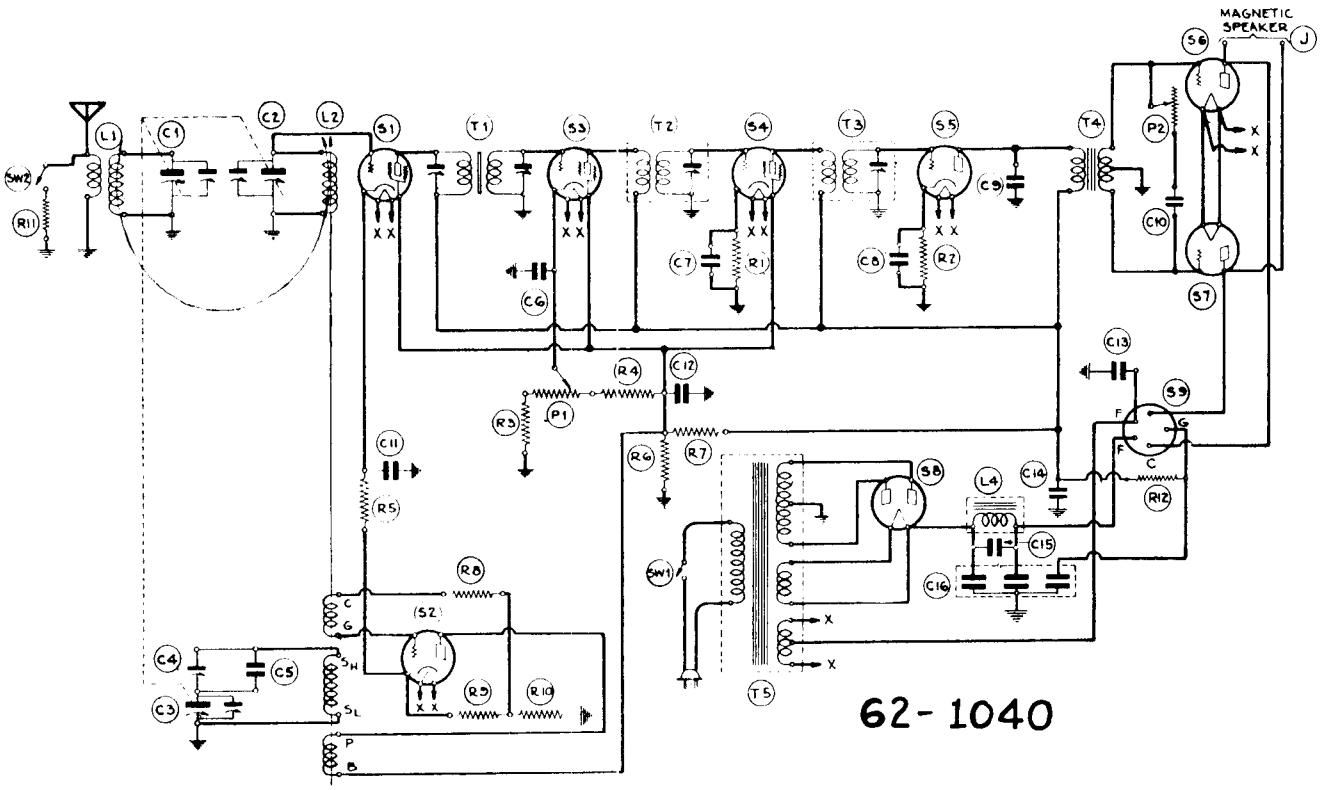
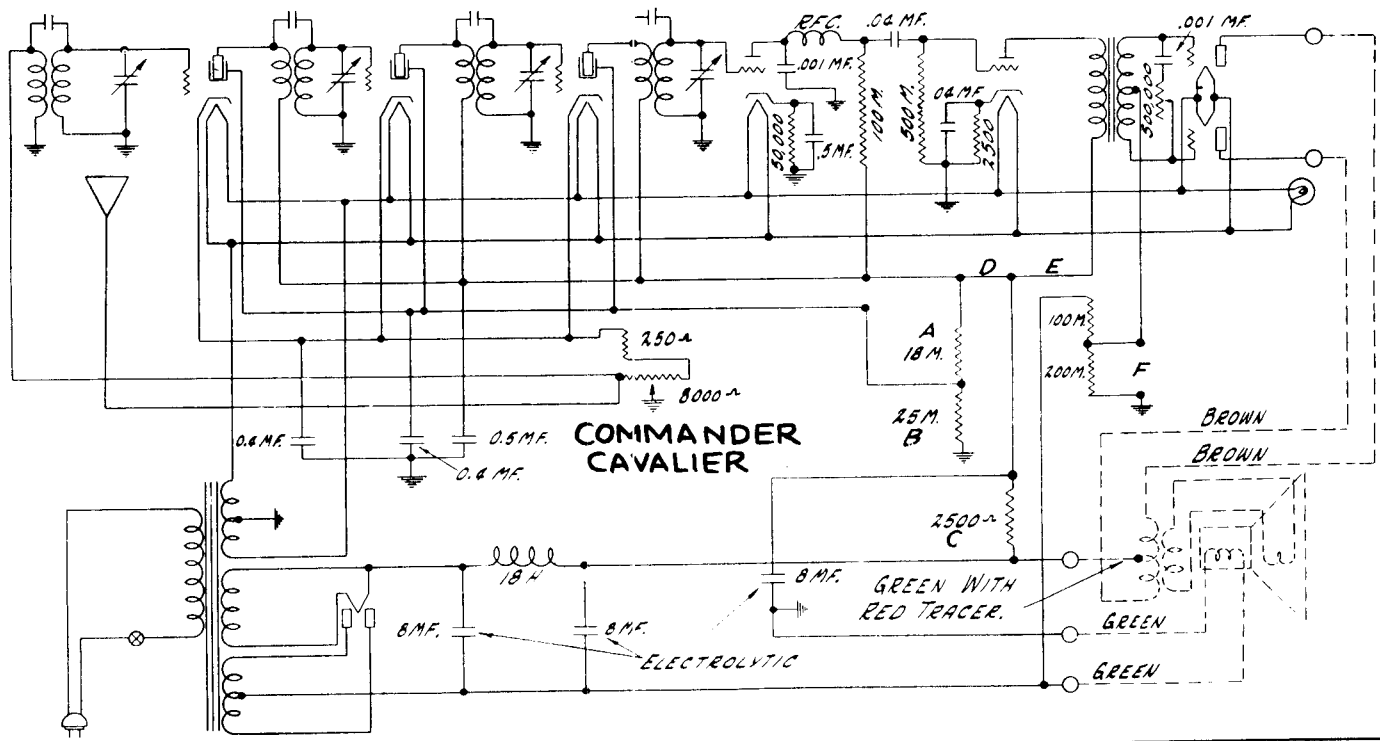


C1-C2-C3 —425 Mmfd. Max., 417 nominal
C4 —Variable 250-600 Mmfd.
C5 —750 Mmfd. Nominal 10% (Mica)
C6 —0.1 Mfd.
C7 —0.1 Mfd.
C8 —1.0 Mfd. 150 V.
C9 —.001 Mfd. Mica
C10—.003 Mfd.
C11—0.1 Mfd.
C12—1.0 Mfd. 150 V.
C13—0.1 Mfd.
C14—1.0 Mfd. 300 V.
C15—.25 Mfd.
C16—Three 4 Mfd. Units (Dry Electrolytic)

R1 —750 ohms wire wound
R2 —25,000 ohms 1 watt
R3 —200 ohms wire wound
R4 —25,000 ohms 1 watt
R5 —10,000 ohms 1 watt
R6 —10,000 ohms 1 watt
R7 —3500 ohms 3 watt
R8 —400 ohms wire wound
R9 —100 ohms—wire wound, tapped at 100 ohms
R10—1000 ohms
R11—100 ohms
R12—4000 ohms 2 watt
P1 —10,000 ohm wire wound pot.
P2 —½ megohm variable tapered res.



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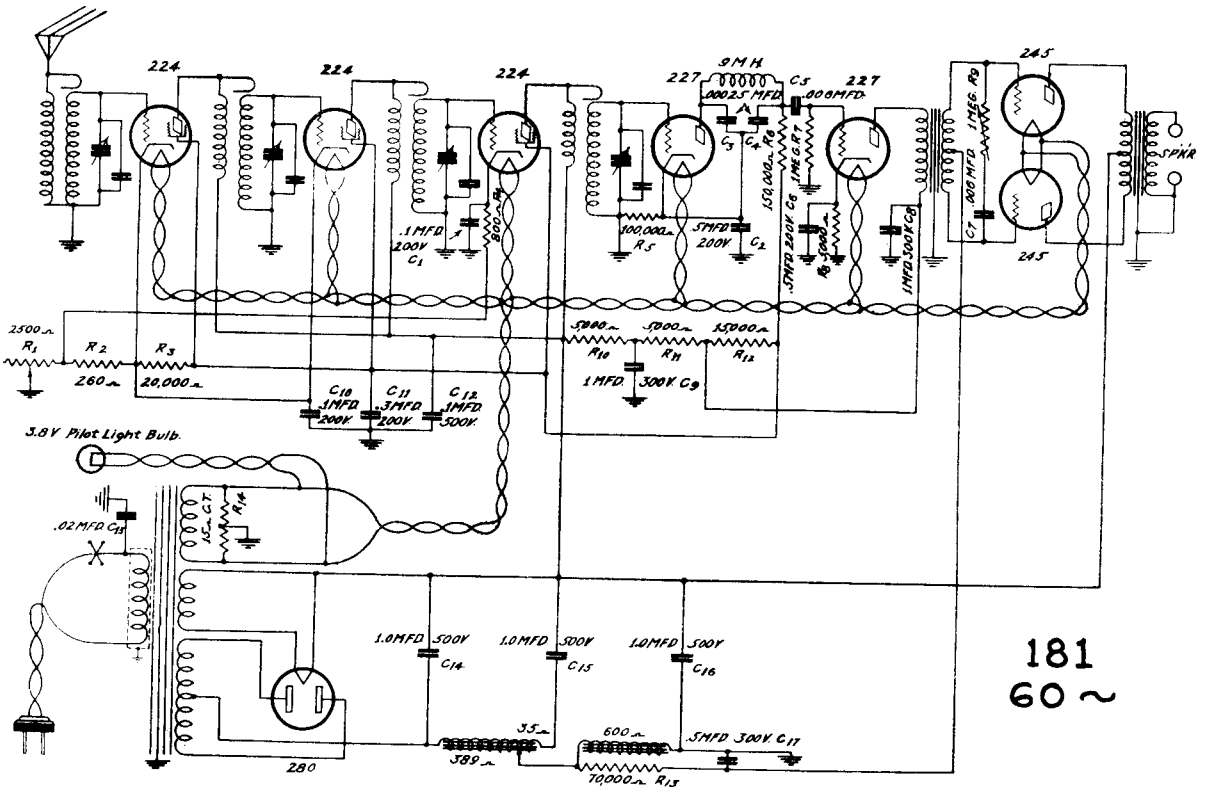
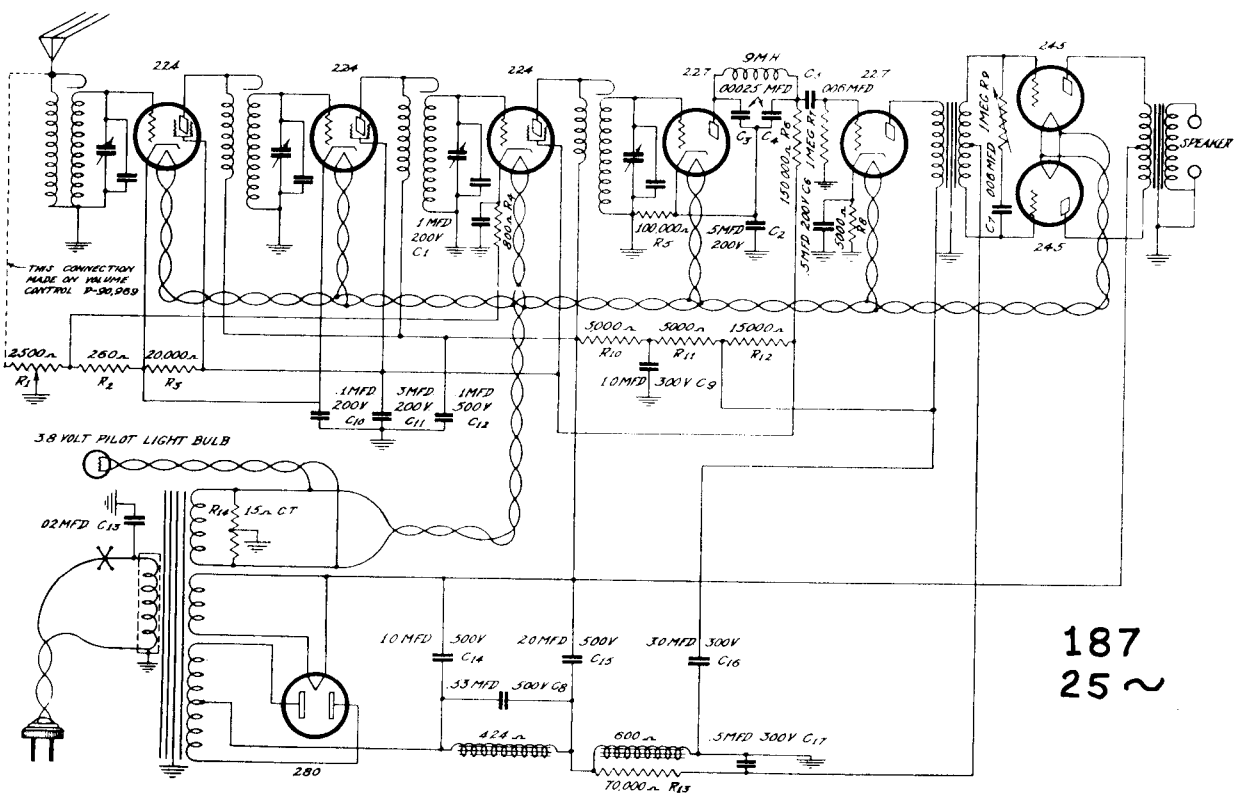


Figure 1



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General Description

This receiver is a 5 tube Super-Heterodyne using one 224 tube as oscillator and first detector, one 235 as I. F. amplifier, one 224 second detector, and a 247 power tube as an audio amplifier.

The Preselector

The primary winding is on a small bobbin inside the coil form. This winding is concentric with the secondary winding with resulting inductive coupling. Capacitive coupling is obtained by an extra turn of wire connected to the primary and wound on the coil form alongside one end of the secondary winding.

The second transformer in the preselector unit is coupled by a very small primary connected directly to the secondary of the first transformer. The secondary of the second transformer is tapped, the tap connection going to the grid of the 224 1st detector.

First Detector and Oscillator

The first 224 tube functions both as an oscillator and the 1st detector. Referring to Fig. 1 there are four coils shown to the right of this tube, all of these coils being in an inductive relation. These coils and the two I. F. tuning condensors make up the oscillator first I. F. assembly.

The first 224 tube is of the bias type. Bias voltage for this tube is established by the plate current returning to the cathode through the 3,000 ohm resistor. This resistor is bypassed with a .01 Mfd. condenser. The bias voltage is influenced to some extent by the oscillatory current and will vary within a range of about ¾ volt, depending on the frequency setting to which the receiver is tuned.

The 1400 K. C. trimmer condenser is located on top of the tuning condenser and is connected across the oscillator tuning condenser. The 600 K. C. trimmer condenser is connected between the coil and the tuning condenser. The adjusting screw is in back of the tuning condenser on top of the chassis.

I. F. Amplifier and Volume Control

A 235 tube is used as the I. F. amplifier. Bias voltage for this tube is variable and depends on the setting of the volume control arm. As indicated in Fig. 1, the resistance between the cathode and ground will vary between 350 and 8,350, depending on the setting of the arm.

Second Detector

A 224 tube is used as the 2nd detector or demodulator tube. This detector is also of the bias type. The tube is self-biased, the bias voltage being obtained by connecting the cathode through a 100,000 ohm resistor to the low potential end of the voltage divider resistor. Bias voltage for the detector in this case is established by the difference in drop across the 100,000 ohm resistor and the 300 ohm section of the voltage divider since these two voltages are in opposition with reference to the detector cathode.

Audio System

The audio stage is resistance coupled to the 2nd detector. The .001 Mfd. condenser in the plate circuit of the 2nd detector and the 60,000 ohm resistor acts as an I. F. filter.

A 400,000 ohm grid leak resistor is used in the grid circuit of the 247. Bias voltage for this tube is obtained by connecting the grid through the grid leak resistor to the low potential end of the voltage divider resistor.

Power Supply

The power system consists of a power transformer, two filter condensers, a voltage divider resistor and the speaker field which serves as the filter choke. This field is connected between the positive side of the two filter condensers. The voltage divider resistor is tapped to secure the required grid, plate and screen voltages.

Method of Aligning

These receivers are aligned on an oscillator at the factory, so that only in rare cases will you find the condensers need realigning. If you are quite sure the condensers are out of alignment, then proceed as follows:

Tune in a local station at approximately 1400 Kilocycles. Tune in the station selector knob until you have the signal tuned exactly in resonance, or in other words "right on the head." Then adjust the volume control for average room volume. Turn to Figure 2 of this manual and adjust the trimming condenser of the R. F. stage condenser slowly to the right or left until the signal is at maximum. Adjust the detector trimmer in the same manner. These adjustments will align the receiver perfectly in most cases. However, if the receiver still lacks volume or sensitivity, the oscillator adjustment may be checked by turning the trimmer located on top of the oscillator condenser to the right or left, not more than one-third of a turn from its present setting. This adjustment is very critical so that extreme care should be taken in order not to throw the oscillator adjustment completely out of alignment. The station selector knob may then be turned to a local station of approximately 600 Kilocycles, and the 600 Kilocycle oscillator trimmer carefully adjusted, a half turn in either direction until the maximum signal is obtained.

No Signals

Under this condition, first test all tubes either in a tube tester or by replacing each tube in the set with a new one. The 224 used in the first detector and oscillator stage is very critical and if this tube does not oscillate properly the receiver will be absolutely dead. Try a number of 224's in this position. Check the aerial and ground connections. Also see that the wall plug is making contact and that all of the tubes light. Look at the 280 rectifier tube. If the plates are red hot or heating badly this is an indication of a shorted filter condenser. Take all of the voltage readings as shown on the voltage chart and check any particular part of the circuit which does not give the proper voltage readings

Weak Signals

Weak signals may be due to defective tubes, poor antenna or ground installation, grounded antenna system or an antenna erected in a shielded location. Try the set on another antenna. Check the tubes carefully. Take the voltage readings of the set and compare them with the readings given in the voltage chart. Also test the field, voice coil and output transformer of the speaker for open circuit. Check the alignment as described under "Method of Aligning."

Broad Tuning

Poor selectivity is usually due to the antenna and lead-in being too long. Shorten the antenna. In some localities an antenna and lead-in of twenty-five to thirty feet is sufficient. Test all of the tubes. If the receiver still lacks selectivity carefully check the alignment as described under methods of aligning.

Oscillation

Oscillation may be due to a defective 224 or 235 tube, an improperly grounded chassis or a shield that is not properly grounded, an open .01 or .06 by-pass condenser, or to high line voltage. The remedy in each instance is of course to replace the defective part. In the case of high line voltage, use one of our voltage regulators.

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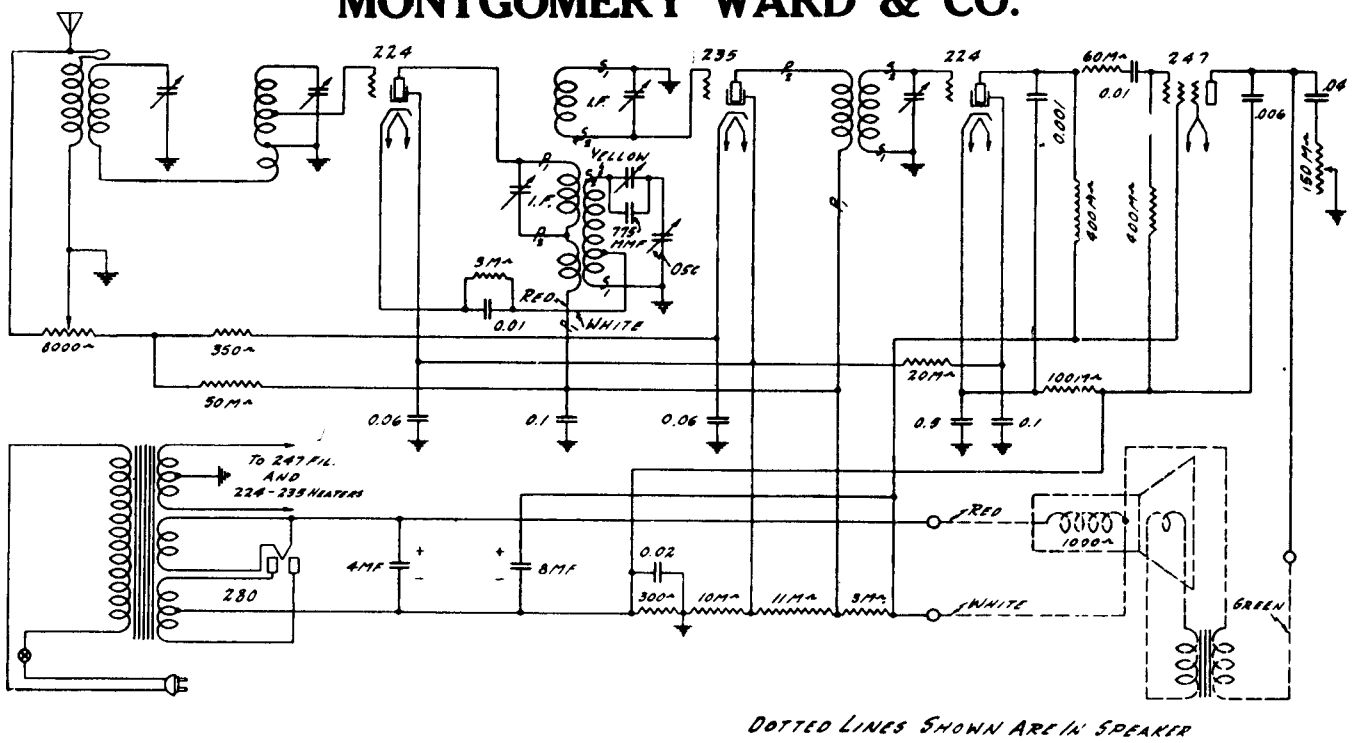

Figure 1—Schematic Diagram

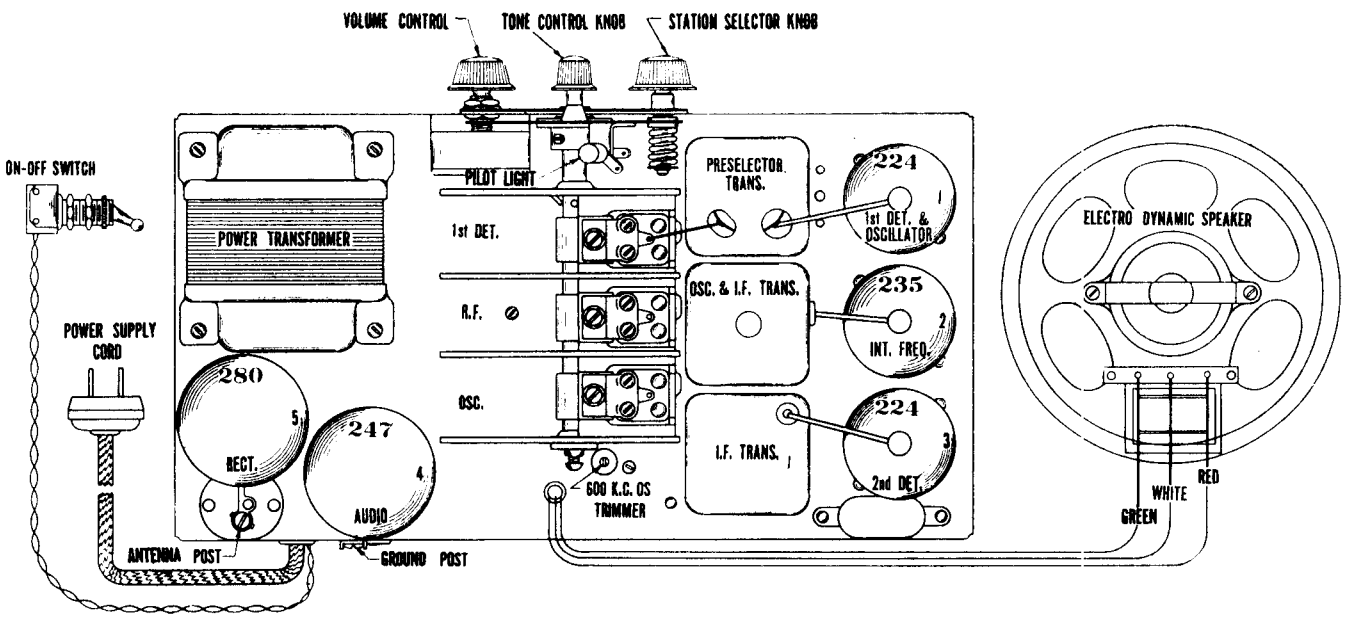

Figure 2—Top View of Chassis

Voltage Chart for Nos. 16, 18, 13 and 15 Chassis—Voltages at Sockets

LINE VOLTAGE 115—VOLUME CONTROL AT MAXIMUM

Type of Tube	Position of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
224	1	1st Det. & Osc.	2.25	165	4.5—5.25(1)	65	.4	4.5—5.25(1)	1.3	2.0
235	2	I. F.	2.25	165	2.5	65	1.5	2.5	6.4	7.4
224	3	2nd Det.	2.25	128	6.5	60 (2)	.05	6.5	.22	.23
247	4	Audio	2.25	205	16. (3)	225	8.0		29.	33.
280	5	Rect.	4.9						27. Per Plate	

(1) Varies with frequency setting of dial approximately as shown.
(2) Voltage as measured with 600,000 ohm meter.
(3) Measured across 300 ohm section of voltage divider resistor.

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Important Notice

Two entirely different chassis were supplied to the Retail Stores under the name "Grenadier." Each chassis, however, has a different Catalogue number and should be distinguished from this number. The Grenadier No. 62-12 uses the U. S. Radio 8 tube chassis and is exactly the same as our Nos. 1238 and 1838. Therefore, when servicing or ordering repair parts for the Grenadier No. 62-12, use the No. 1238 and 1838 service manual. Grenadier No. 62-14 (Catalogue No. 62-11) is the Wells-Gardner 8 tube chassis which will be described in this service manual.

General Description

The tubes used are as follows: R. F. 1st detector, and intermediate stages, '35 vari-mu; oscillator '27; 2nd detector and automatic volume control tube, '24 screen grid; audio, '47 pentode power supply rectifier, '80.

The chassis has one stage of radio frequency amplification, a first detector (mixer), an oscillator, one stage of intermediate frequency amplification, a second detector, one stage of audio frequency amplification, an automatic volume control system, and a power supply. The intermediate stage operates at a frequency of 175 kilocycles. All stages are transformer coupled with the exception of the audio stage which is resistance coupled to the second detector.

The antenna (R. F.), 1st detector and oscillator stages are tuned simultaneously by a three gang condenser operated by a knob on the receiver panel. Trimmer condensers are provided so that the gang may be accurately and permanently aligned.

The primary and secondary of both intermediate transformers are tuned with adjustable condensers which remain fixed after the transformers have been tuned to exactly 175 kilocycles.

The oscillator has an adjustable tracking condenser which is adjusted at 600 kilocycles and remains fixed thereafter.

Automatic Volume Control (A. V. C.)

The action of the A. V. C. tube controls the grid bias on the R. F., 1st detector, and 1st I. F. tubes and consequently the amplification of those tubes.

A signal of sufficient strength reaching the second detector, applies a voltage on the grid of the A. V. C. tube and the voltage thus applied depends upon the signal strength.

The plate of the A. V. C. tube will draw current when the grid voltage of the tube rises in potential and the drop in plate voltage is applied to the grids of the R. F. tubes, through their grid returns to the plate of the A. V. C. tube. This results in a control of the amplification of those tubes and a practically constant receiver output.

The manual volume control (R18, Fig. 1), sets the A. V. C. grid voltage at a point where only a signal of sufficient strength will cause an increase in grid potential.

Resonance Meter

This meter is a small milliameter in the plate return of the R. F. tube. When the receiver is turned on, and no signal is tuned in, the meter will indicate the total plate current drawn by the R. F. tube. When a signal is tuned in, the meter will indicate less current, and when tuned to resonance, the greatest swing (or least deflection), of the meter hand will be obtained.

The deflection of the meter hand will vary according to the setting of the manual volume control on this chassis

Power Supply

The 25 and 60 cycle power transformers have been designed to supply the tube voltages necessary for operation on any 95 volt to 130 volt A. C. supply, without adjustment or overloading.

The R. F., 1st detector, oscillator and 1st I. F. tubes have one side of their heater circuit grounded.

Dynamic Speaker

The dynamic speaker is especially designed for use with these chassis. The speaker field is used as a choke in the power supply and the voice coil is designed to permit faithful reproduction of all audio frequencies. The voice coil and speaker frame are grounded to prevent any "feedback" of a 175 K. C. frequency which might enter the speaker.

Condensers and Resistors

The blue lead on the filter block is common for condensers C4, C5, and C16, and the black lead is common for condensers C3, C15, C16, and C17. The second detector plate filter choke is also contained in the block and is connected by two yellow leads C8 (White-red leads) and C10 (red leads) are connected as shown in Fig. 1, Schematic Wiring Diagram.

Testing

(Tube and Voltage Tests)

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

Method of Aligning

These chassis will only lose their alignment when they have been subject to extremely rough handling or have been used under abnormal conditions, as for instance, a very hot or very humid location. Under any one of these conditions, the alignment may shift slightly and the chassis should be realigned according to the following procedure.

Tune in a local station of approximately 1400 Kilocycles, being very careful to tune this station in at the exact reasonance point. This may be easily done by carefully adjusting for maximum deflection of the tuning meter. Then reduce the volume to the desired level. Turn to Figure 2 and note the position of the first radio frequency trimmer adjustment. Slowly turn the trimmer to the right or left until the signal is at maximum intensity. Proceed to adjust the detector trimmer in the same manner. In most instances these two adjustments will align the chassis perfectly. If the receiver still lacks sensitivity after the first RF and detector trimmers have been adjusted, then the oscillator trimmer may be checked by turning the adjusting screw not more than a quarter of a turn to the right or left of its present adjustment. When aligning any of these receivers be sure that the condenser shield is firmly in place and that you are using good tubes in the chassis. This is particularly true in case of the oscillator and automatic volume control tube.

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Oscillator

Let us again call your attention to the importance of the oscillator tube. A *227* tube used in this socket that does not oscillate will completely stop any signals from reaching the intermediate frequency amplifier and the chassis will not operate. There is also a slight variation in the characteristics of tubes, and for this reason it is advisable to try a number of tubes in the oscillator position and to use the one which gives the most satisfactory performance.

Automatic Volume Control Tube

The automatic volume control tube is equally as important as the oscillator tube. In this chassis a *224* is used. If the A.V.C. tube's characteristics are not exact, it will cause the chassis to lack sensitivity or spoil the tone quality. The tuning meter will not function properly with a poor A.V.C. tube. If the grid circuit of this tube is open the chassis will lose its sensitivity and in some cases will not pass signals. In each installation, therefore, it is advisable to try a number of *224*'s in the automatic volume control position and use the tube which gives the most satisfactory performance as to control of volume, operation of tuning meter, and tone quality.

Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

25 Cycle Chassis No. 62-14X

The 25 cycle receivers use power transformer No. P50540 instead of P50539. Two 8.0 mfd. electrolytic condensers No. P80880 are used instead of No. P80873 and No. P80874. The .25 mfd choke condenser C10 is not used in the 25 cycle chassis.

Voltage Readings

The voltage readings on this chassis cannot be taken in the conventional way, namely between the tube elements and ground. You will note from diagram Figure No. 1, that the ground connection is taken off the shunt resistor near to the positive end, and the chassis is therefore, approximately 150 Volts positive, with respect to the tube elements. The correct voltage readings may be obtained by taking readings to the cathode of the heater type tubes, and filament of the *247*.

REMEMBER:—Voltage measurements will vary slightly with the different sets of tubes, and also with different chassis. Unless the voltages are radically different from normal, they may be considered satisfactory.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

TUBE	CIRCUIT	LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
R.F. '35	Screen grid	70	78	85	92	100
	Plate	143	159	175	191	207
1st Det. '35	Screen grid	70	78	85	92	100
	Plate	143	159	175	191	207
I. F. '35	Screen grid	70	78	85	92	100
	Plate	143	149	175	191	207
Oscillator '27	Plate	70	78	85	92	100
2nd Det. '24	Screen grid	66	73	80	87	94
	Plate	127	134	141	148	155
A. V. C. '24	——	14	15.5	17	18.5	20
	—Grid grid	24	26	28	30	32
Audio '47	Screne—Accel. Grid	199	221	244	267	289
	Plate	171	190	210	230	250
Rectifier '80	Current (both plates)	67 MA	75 MA	82 MA	89 MA	96 MA
	Plate to Plate Voltage	512	569	625	682	739

The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

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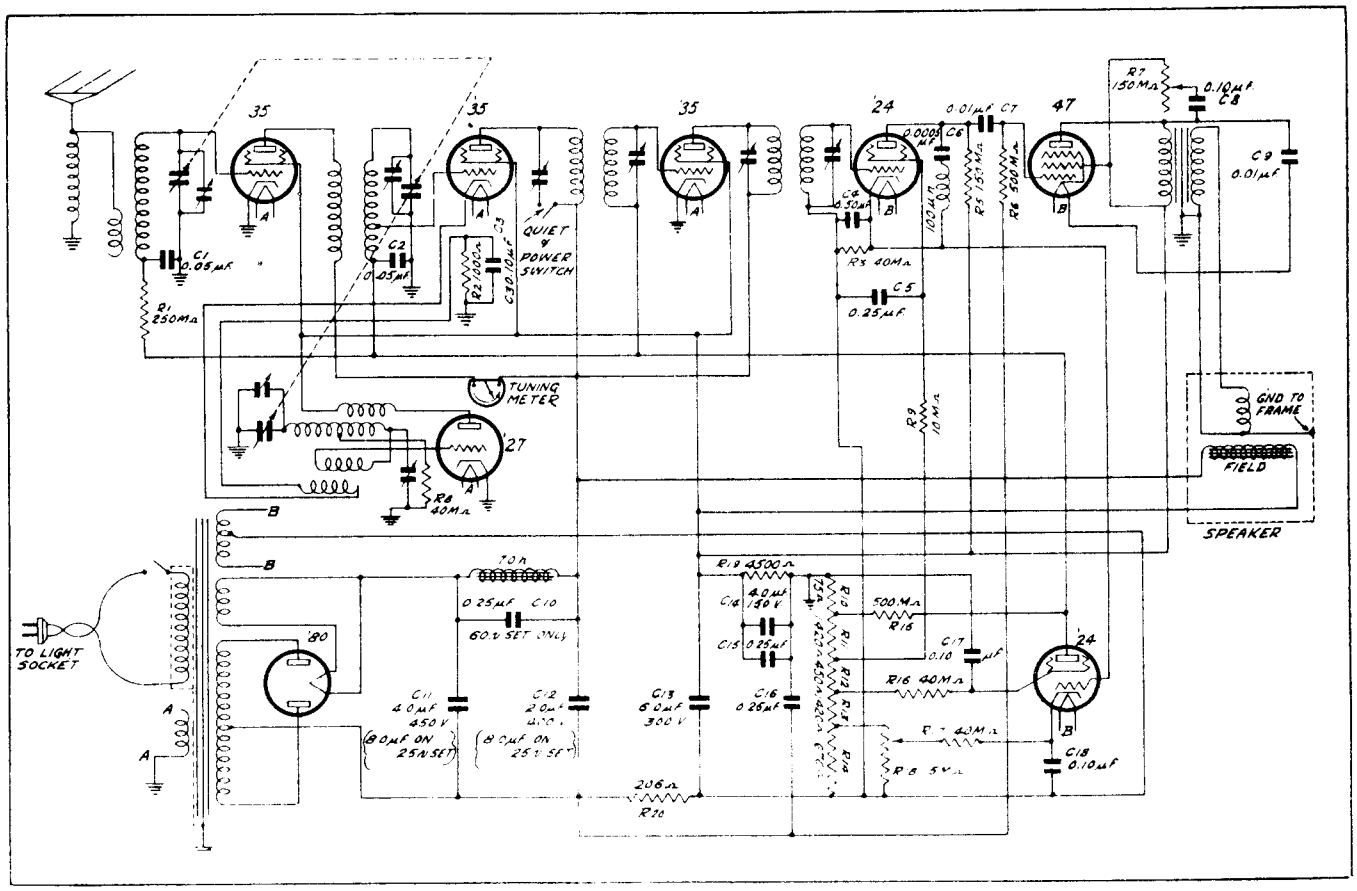

Figure 1—Schematic Diagram

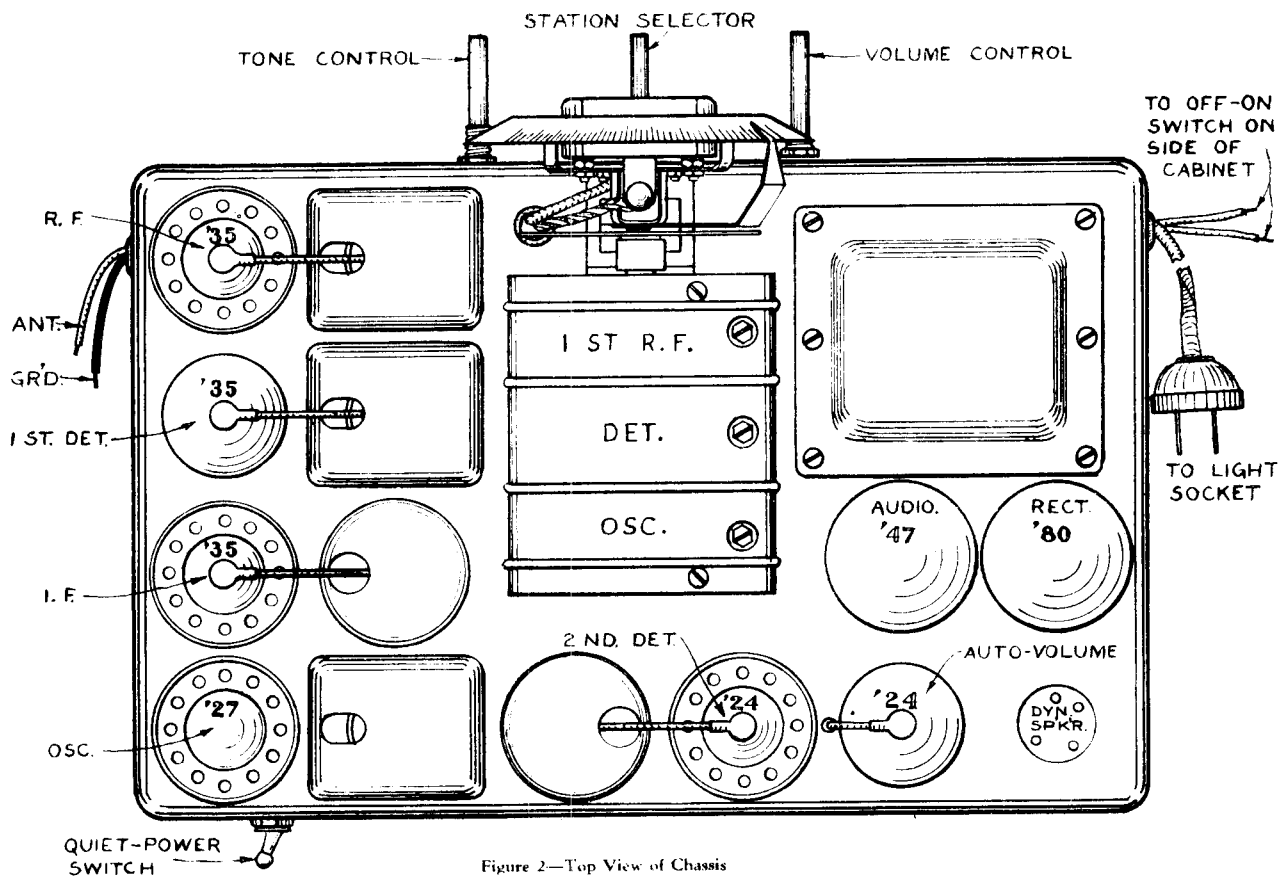

Figure 2—Top View of Chassis

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Service Manual Supplement Showing

Automatic Volume Control Change in

Airline 8 Tube Screen-Grid Superheterodyne

"Grenadier" No. 62-14

(Catalogue No. 62-11, 62-27, 62-19)

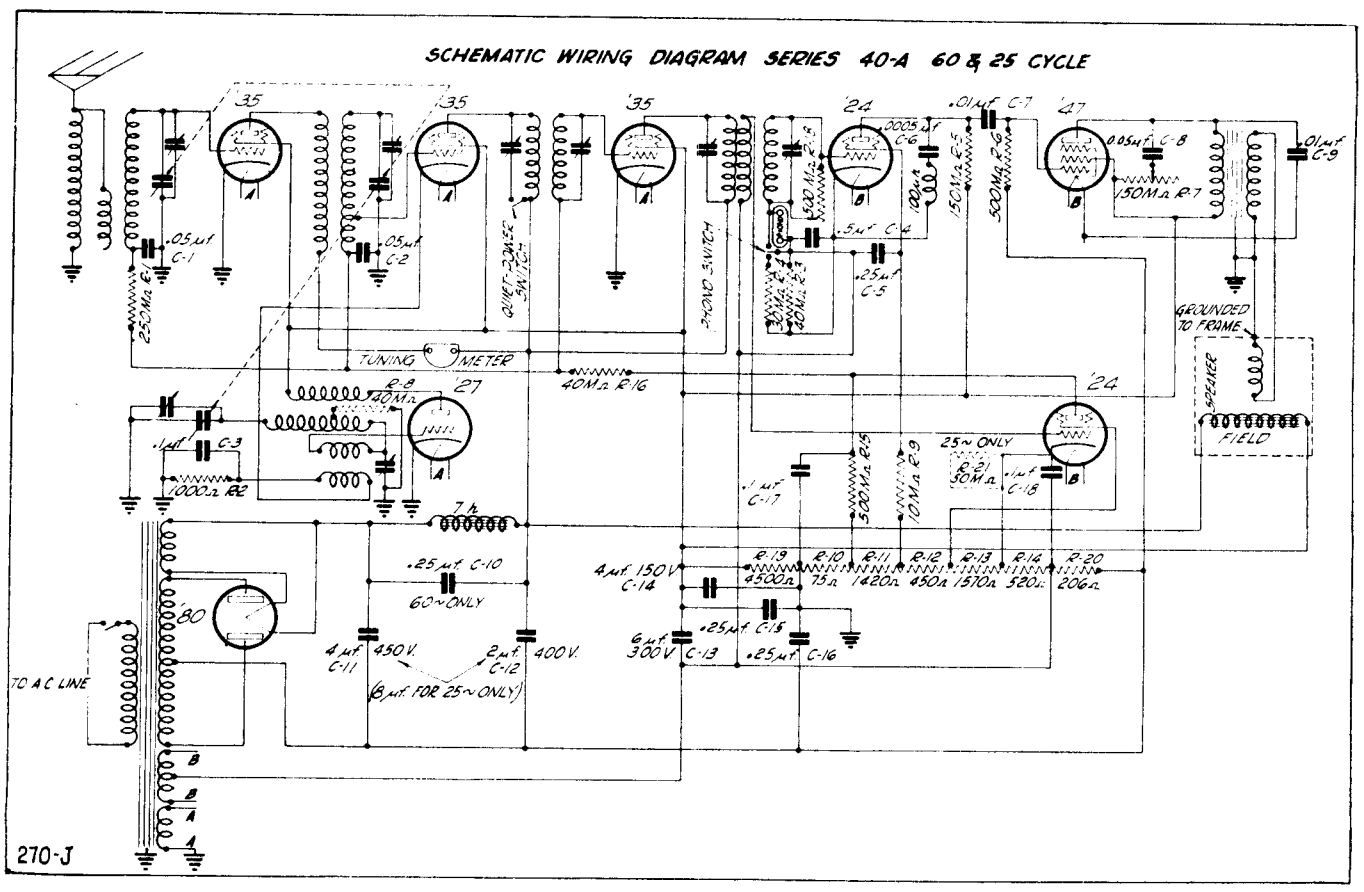
The automatic volume control system in this chassis has been changed and therefore some of the parts are not as listed and described in the service manual. The parts which differ are listed below and the revised automatic volume control circuit is shown in the schematic wiring diagram on the opposite side of this sheet. No other changes in the circuit or in the mechanical arrangement of the chassis have been made.

A chassis in which the automatic volume control system has been changed may be identified by a **green paint mark on the left rear corner of the chassis** near the speaker socket, or by two grid leaks brought out of the top of the 2nd I.F. transformer assembly. This chassis formerly had but one lead brought out of the top of the 2nd I.F. transformer assembly. The resonance meter furnishes a further means of identification as the deflection of the meter hand will not vary when the setting of the manual volume control is changed. This is due to the manual volume control having no effect on the action of the automatic volume control tube. The manual volume control is connected in parallel in the grid circuit of the 2nd detector tube and is used to vary the resistance in that circuit and, in so doing, control the input to that tube.

The following parts are for use only in a chassis having the revised automatic volume control system and are not interchangeable with those listed in the service manual repair parts list.

When ordering parts for replacement, be sure the correct part number is given.

Part No.	Name	Cost Price	Selling Price
P-90988-A	Candohm Resistor	$0.38	$0.95
P-90988	500,000-ohm Volume Control	.30	.75
P-1446	2nd I.F. Transformer Assembly	.70	1.75
P-70719	Shielded Volume Control Wire Assembly	.06	.15
P-1445	R.F. Interstage Coil Assembly (The 40,000-ohm Resistor, R16, is a part of this assembly. The 500,000-ohm Resistor, R15, is a part of the R.F. Interstage Coil Assembly (Part No. 1397) listed in the service manual.)	.37	.93



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Seven Tube Screen-Grid Super-Heterodyne Receiver

60 Cycle Chassis, No. 62-22, No. 62-30 (Catalogue No. 62-21)

25 Cycle Chassis, No. 62-22X, No. 62-30X

General Description

The complete circuit consists of an oscillator first detector unit in which the local signal is generated and combined with the R. F. signal to form the intermediate or beat frequency; the I. F. amplifier, the second detector or demodulator, the A. V. C. and localizer, the A. F. amplifier and the power system.

Tubes

A 235 tube is used in the first R. F. stage; a 224 as first detector and oscillator; a 235 in the I. F. stage; a 227 as second detector; 247 audio; 224 A. V. C.; and a 280 rectifier.

RF Amplifier

The R. F. amplifier consists of a R. F. or antenna input transformer with tuned secondary feeding into a 235 R. F. amplifier tube. This is followed by another R. F. transformer with tuned secondary feeding into the first detector. The .5 Mfd. condenser in the grid circuit of the 235 R. F. tube tends to prevent an over-all motor boating action. The 3000 Ohm resistor and a .1 Mfd. bypass condenser in this grid circuit prevents any tendency toward R. F. oscillation. In chassis with serial numbers above 1,070,000, the 3000 Ohm resistor is replaced by a 5 M. H. choke.

First Detector Oscillator

The first 224 tube functions both as an oscillator and first detector. Bias voltage for this tube is established by the plate current returning to the cathode through the 3200 Ohm resistor. This resistor is bypassed with a .01 Mfd. condenser. The bias voltage is influenced to some extent by the oscillatory current and will vary within a small range, depending upon the frequency setting of the receiver.

IF Amplifier

The I. F. amplifier is tuned to a frequency of 262 Kilocycles. A 235 tube is used. Bias voltage for this tube is varied by the action of the automatic volume control.

Second Detector

A 227 detector tube is used and is of the bias type. Bias voltage is obtained by a drop established across the 120,000 Ohm cathode resistor and the portion of the 200,000 Ohm localizer resistance being used. The grid of the second detector is connected to the high potential end of the speaker field and the bias voltage is determined by the difference in potential between the grid and cathode of this tube.

A.V.C. and Localizer

Briefly stated, the A. V. C. reduces the signal strength by increasing the bias voltage on the R. F. and I. F. 235 tube when a signal of given intensity or greater is applied to the grid circuit of the second detector. The localizer regulates the initial A. V. C. bias voltage so that plate current does not start to flow in this tube until a signal of given intensity or greater is applied to the second detector grid circuit. A 224 tube is used as the A. V. C. The importance of the localizer is that it controls the point at which the automatic volume control action commences. Since the second detector plate current will vary with tubes, it is obvious that with a fixed resistor in the cathode circuit, the drop across this resistance will vary, thus changing the A. V. C. grid voltage with resulting change in operating point. The purpose of the localizer is to compensate for different 227 tubes used in the second detector stage so that the A. V. C. will operate at maximum efficiency. To properly adjust the localizer—

1. Turn the knob to the extreme counter-clockwise position. Then turn this knob about a quarter turn in a clockwise direction. Next tune in a fairly strong station and reduce the volume by means of the volume control knob on the front panel to ordinary room volume.

2. Turn localizer knob to extreme clockwise position. In most cases the signal will be cut off entirely.

3. Turn localizer knob in counter-clockwise direction slowly, until the signal is again received with satisfactory volume.

4. The above adjustment is correct and should not be changed. If the localizer knob is adjusted too far in a clockwise direction, the A. V. C. starts to work too soon and cuts down the signal before maximum output is reached. If the localizer is adjusted too far in a counter-clockwise direction, the A. V. C. does not start to work soon enough, and a very strong signal is then necessary in the second detector to cause the A. V. C. to operate.

Servicing

In every instance check the line voltage before installation, and in any cases where the line voltage is found to be over 115 Volts, use one of our line voltage regulators. In servicing, always check the tubes first. In this receiver, the 224 used in the A. V. C. and the 224 used as the detector and oscillator are the most critical. A poor 224 A. V. C. will cause lack of volume, distorted tone and in many cases no control of volume. Always bear in mind that in any superheterodyne that is inoperative, check the oscillator tube first. No signals of any kind will be received if this tube is not oscillating properly.

Poor tone quality is usually due to a defective A. V. C., second detector or audio tube. If changing these tubes does not remedy the condition, check the voice coil of the speaker for proper clearance and alignment.

Hum is usually caused by a defective filter condenser, open .1 Mfd. choke tuning condenser, improperly grounded chassis or shields, mechanical hum due to the vibrating of the core of the power transformer or filter choke, external pickup from the antenna, or an open grid circuit.

Noisy operation is due to noisy tubes, loose connections, leaky filter or bypass condensers, poor aerial and ground connection, aerial grounded on eaves, trees, etc., speaker voice coil off center, broken or cracked resistors, dirt in the variable condenser, or partial short of the trimming condenser.

Oscillation is caused by open bypass condenser, poorly grounded shield or chassis, dirt on the spring contacts connecting to the rotor shaft of the gang condenser, tubes of high mutual conductance, high line voltage or improperly placed grid cap leads.

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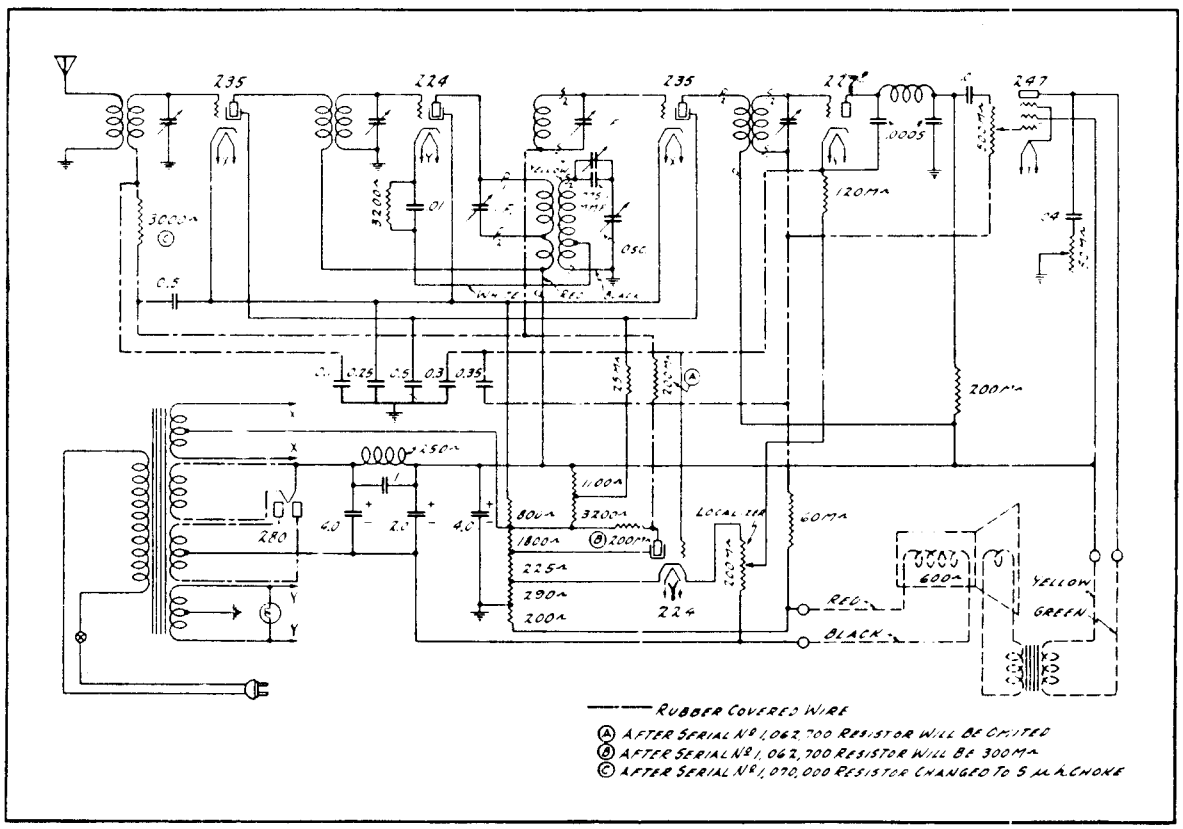

Figure 1

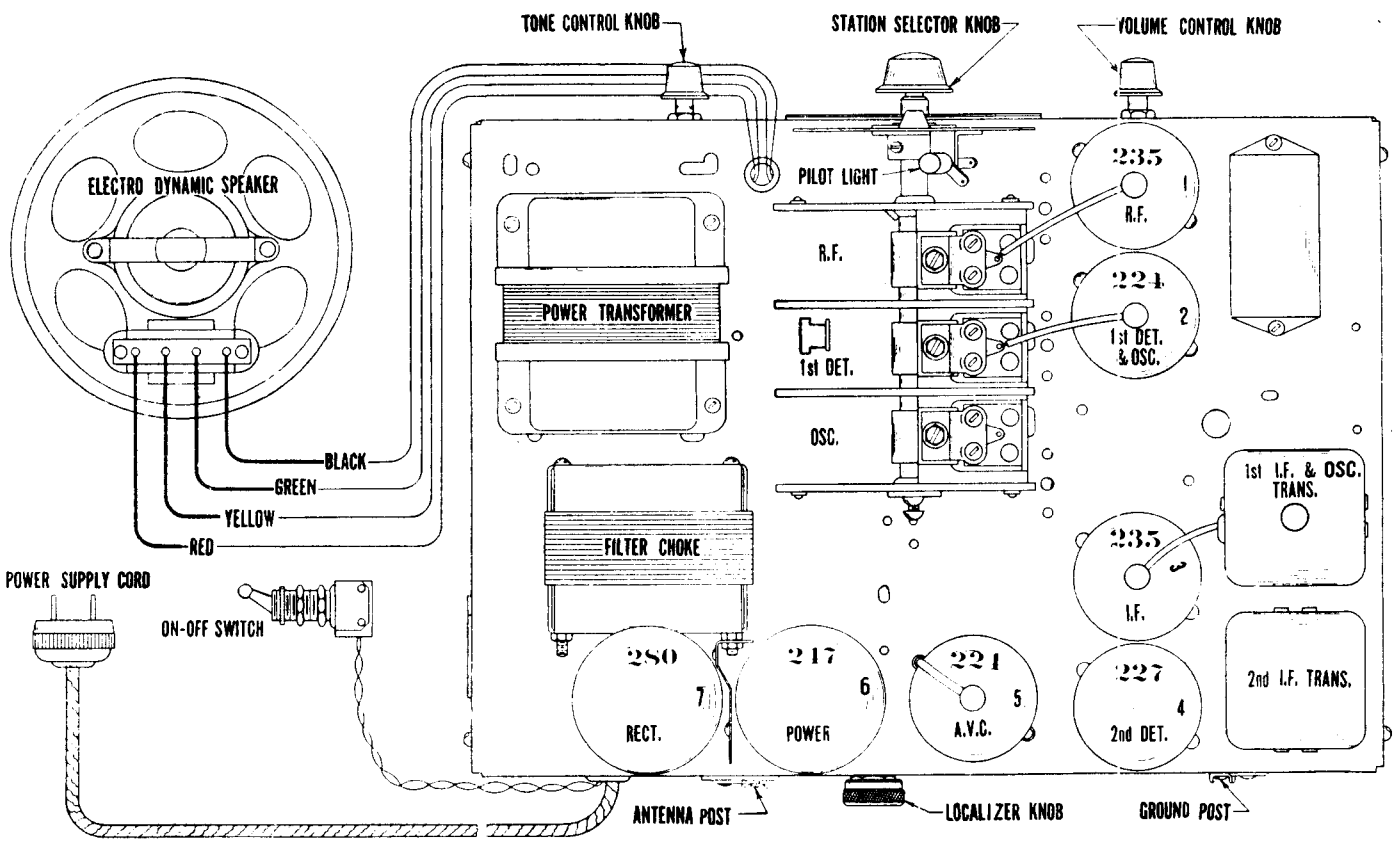

Figure 2—Top View

Aligning

The method of aligning this receiver is fully explained Page 5 of the Grenadier No. 62-14 service manual.

Voltages

To properly read the voltages disconnect the antenna and ground and be sure the tube shield is in place. When reading the voltages of tubes under the shield, the shield should be substantially on to prevent oscillation. The cable to the plug can be brought up under the shield. Care should be taken that the grid connection on the plug is not shorted to the tube shield. All voltages in the chart are taken with a line voltage of 115 Volts. Variations in readings will be introduced by variations in line voltage. All of the readings are taken with the localizer knob in its normal position. Its position will vary somewhat however, and will determine the voltage of the A.V.C. grid and second detector cathode. All voltages associated with these points therefore, will vary and are shown that way in the voltage chart, with the exception of the second detector plate voltage. The 235 and 247 grid voltages cannot satisfactorily be read at the sockets and are therefore taken across the resistors at which they are developed.

25 Cycle Chassis

The 25 cycle chassis uses a 25 cycle power transformer, a 4 Mfd. filter condenser in place of the 2 Mfd. and a .35 Mfd. choke tuning condenser in place of the .1 Mfd. choke condenser used in the 60 cycle chassis. All other parts remain the same.

No. 62-22, 62-30, 62-21 CHASSIS—VOLTAGES AT SOCKETS —LINE VOLTAGE 115 VOLUME CONTROL AT MAXIMUM — LOCALIZER AT NORMAL SETTING

Type of Tube	Position of Tube	Function	Across Filament or Heater	Plate to Cathode	Grid to Cathode	Screen to Cathode	Screen MA	Cathode to Heater	Plate MA	Grid Test MA
235	1	R. F.	2.35	150	4.5(1)	70(2)	.9	4.5	2.7	4.2
224	2	1st Det. & Osc.	2.35	245	6.4	93	.3	6.4	1.8	2.6
235	3	I. F.	2.35	150	4.5(1)	70(2)	.9	4.5	2.7	4.2
227	4	2nd Det.	2.35	150	12—24(3)			0—10(3)	.2—.5(3)	.21—.51(3)
224	5	A.V.C.	2.35	60	0—15(3)	9	0(4)	12	0(4)	0(4)
247	6	Power	2.35	220	16(5)	240	6.4		34	40
280	7	Rect.	4.9						39 Per Plate	

(1)This voltage read across 800 ohm resistor.
(2)Voltage as read with 600,000 ohm meter.
(3)Varies with setting of localizer. Voltages read with high resistance meter.
(4)Current zero with no signal and localizer at normal position.
(5)The voltage read across 200 ohm section of voltage divider.

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General Description

Circuit

This chassis has one stage of radio frequency amplification, a combined detector and oscillator, one stage of intermediate frequency amplification, a second detector, and one stage of audio frequency amplification. The intermediate stage operates at a frequency of 175 K.C. All stages are transformer coupled with the exception of the audio stage which is coupled to the detector by a choke, condenser and resistor network.

The plate choke in the oscillator circuit has been substituted for the 15,000 ohm resistor to allow wider limits on the tube used in this circuit.

The complete chassis is mounted on rubber to prevent any vibration being transmitted to the tubes.

Tubes

Type '32 tubes are used in the R.F., 1st detector, intermediate, and second detector stages. The audio output tube is a type '33 pentode.

Controls

The right hand knob on the panel adjusts the volume control, the center knob controls the tuning and the left hand knob the filament switch.

Output System

The .006 mfd. condenser connected from the plate of the pentode tube to ground is there for two reasons,—one, to prevent any I.F. or harmonic of the intermediate frequency from getting into the speaker and possibly coupling back into the antenna to cause a squeal; two, to put the proper amount of capacity across the speaker winding to produce a pleasing tone quality. This condenser may be varied to any value from .002 mfd. to .006 mfd. without losing its effectiveness in preventing the I.F. from getting into the speaker.

The Filament Rheostat

The filament rheostat is mounted on the back of the chassis and is provided with graduations marked in the chassis around the knob. The red spot at about the half way point on the graduations designates the position of the rheostat for a filament voltage of 2 volts when the "A" battery is fresh. As the "A" battery voltage drops, the rheostat should be advanced in a clockwise direction just enough to bring the voltage up to 2 volts on the filaments. The set should operate very well until the voltage drops below 1.7. **No harm will be done if the filament voltage reaches 2.2 volts, but this is absolutely the upper limit.** If a 2 volt storage cell is substituted for the dry cell "A" battery the rheostat should be turned to the extreme right so that the full voltage of the battery is impressed on the filaments of the tubes.

Oscillator and First Detector

The oscillator first detector tube is important. If this tube fails to oscillate properly no signals will be received. There are four type '32 tubes included in the tube kit with each receiver. Pick out a '32 tube for this socket that will oscillate on any part of the dial.

Poor sensitivity and selectivity are indicative of misalignment, but no attempt should be made to re-align the receiver until you are sure these things are not caused by other defects, such as poor tubes, incorrect voltages or an inefficient aerial and ground system; then if you are thoroughly convinced that the set is out of alignment, proceed as follows:

Very carefully tune in a local broadcasting station at approximately 1400 K.C. and reduce the volume to a point where the signal is just audible. With a small screw driver, adjust the antenna trimming condenser for maximum volume (this may be reached through the hole in the top of the gang shield and is the first trimmer nearest the front of the chassis). Adjust the R.F. trimmer condenser in the same manner. The oscillator trimmer may next be checked by turning the adjustment screw not more than a quarter of a turn in either direction from its present setting.

In the majority of cases these adjustments will be all that is necessary, but in the event the receiver is still insensitive and lacks proper selectivity, the intermediate frequency transformers should be aligned. They are adjusted by inserting a screw driver through the holes in the chassis base, directly below the I.F. transformers. Adjust each of the trimmers in consecutive order for maximum volume. After these adjustments have been made, re-check the oscillator and R. F. trimming condensers. Now tune in a station at 600 K.C. and rotate the adjusting screw on the oscillator 600 K.C. tracking condenser (located on top of the chassis, near the oscillator assembly), at the same time tuning the gang condenser back and forth across the signal. Do this until maximum volume is obtained.

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adjusting the trimming condensers for maximum volume. Or better still, if an output meter is available, connect the output meter across the speaker and in each case adjust the trimming condensers for greatest deflection on the output meter. If the receiver has been badly damaged, or the intermediate frequency adjustments have been tampered with, it will be necessary to re-align the intermediate stages at 175 K.C. To do this, adjust the oscillator to 175 K.C. and connect the output to the grid of the first detector tube, without removing the clip on the tip of the tube. A condenser of .006 mfd. or larger should be inserted in series with this oscillator lead.

This method is essentially the same as explained for aligning with a broadcast signal, with the exception that the output of the oscillator is connected to the antenna post of the receiver. The chassis may then be aligned as explained above, by tuning the oscillator to 1400 K.C. and

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Adjust the four I.F. adjustment screws for maximum volume on the output meter. The oscillator section of the tuning condenser should then be adjusted by means of its compensator for maximum response in the output meter. A very high signal level from the generator may be necessary to locate the signal if the set is badly out of resonance. Reduce immediately when the signal is located. Bring the antenna and first R.F. compensators to resonance next. Remove the output meter and adjust the 600 K.C. tracking condenser on a 600 K.C. signal from the oscillator, in the same manner as explained for adjusting the 600 K.C. tracking condenser on a broadcast signal.

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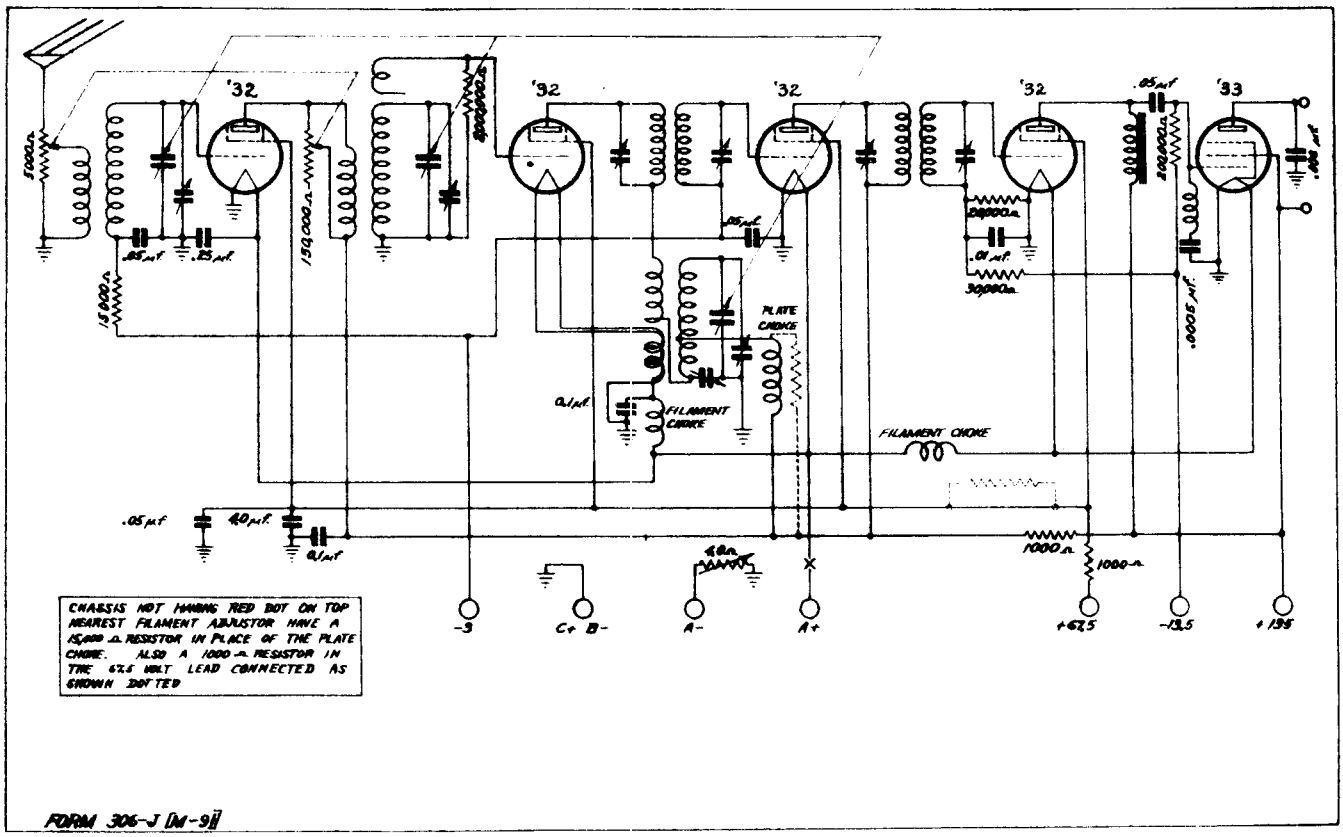

Figure 1. Schematic Diagram

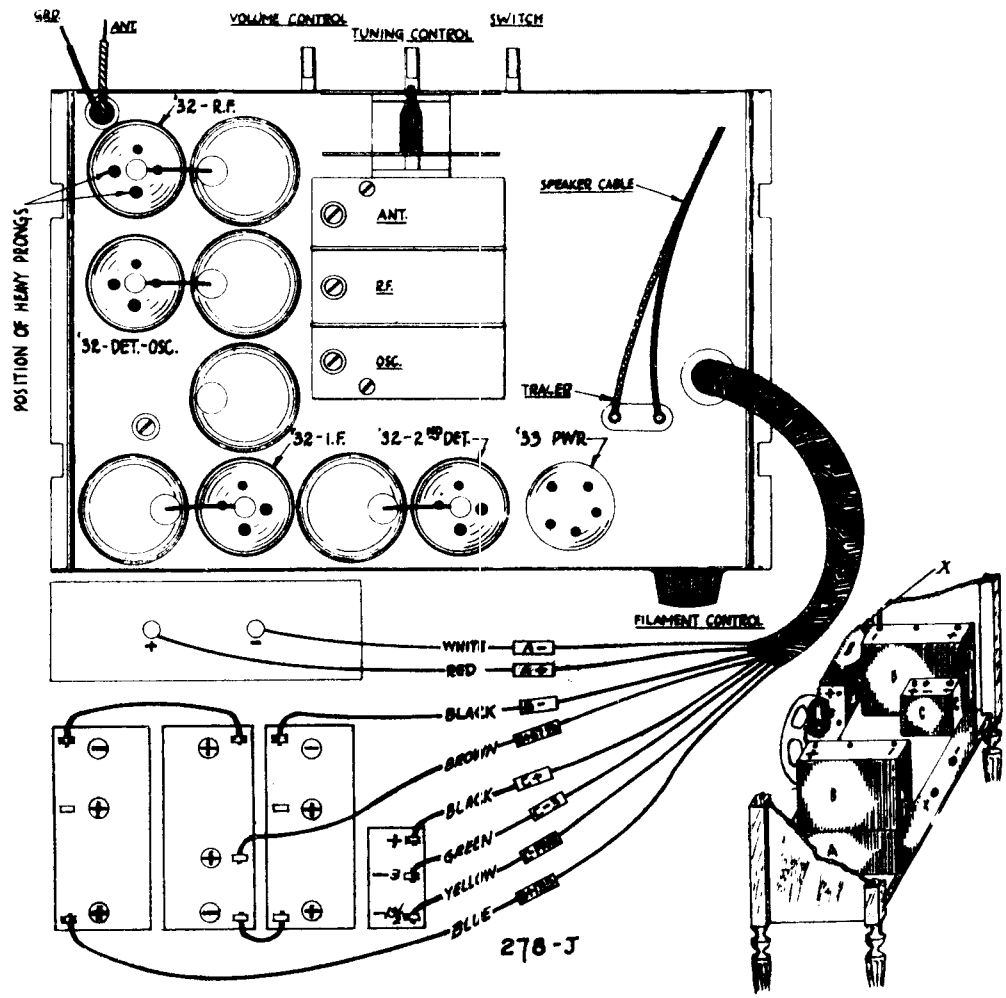

Figure 2. Top View of Chassis

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7 Tube Screen-Grid Super-Heterodyne

No. 62-20 60 cycle
No. 62-20X 25 cycle

(Catalogue No. 62-25)

General Description

Circuit

One stage of radio frequency amplification, a first detector-modulator, one stage of intermediate frequency amplification, a second detector, one stage of audio frequency amplification, an automatic volume control system, and a power supply.

The intermediate stage operates on a frequency of 175 kilocycles.

All stages are transformer coupled with the exception of the audio stage which is resistance coupled to the first detector.

The 25 cycle chassis is described under "POWER SUPPLY."

Tubes

R.F., '35; 1st detector-modulator, '24; I.F., '35; 2nd detector, '24; audio, '47; automatic volume control, '24; rectifier, '80.

Tuning

The R.F. and 1st detector stages and the secondary of the oscillator coil are tuned simultaneously by a three gang condenser. The gang is accurately aligned with trimmer condensers in parallel with the main tuning condensers.

The primary and secondary of both intermediate transformers are tuned with adjustable condensers which remain fixed after the transformers have been tuned to exactly 175 kilocycles.

The oscillator has an adjustable tracking condenser which is adjusted at 600 K.C. and remains fixed thereafter.

Controls

The left hand knob on the panel adjusts the manual volume control, the center knob controls the tuning, and the right hand knob is the tone control. The "ON-OFF" switch is mounted on the side of the cabinet.

The action of the manual volume control is explained below under "Automatic Volume Control."

The tone control consists of a 150,000 ohm variable resistor and a fixed .1 mfd. condenser connected in series and shunted across the primary of the speaker coupling transformer.

The tuning control has a rubber drive, which, through friction on a metal disc mounted on the gang condenser shaft, operates the dial indicator.

I. F. and Oscillator Units

The oscillator 600 K.C. tracking condenser is mounted directly in front of the oscillator coil shield on the right rear corner of the chassis base.

Holes in the chassis base allow the tuning condensers for the intermediate transformers to be adjusted with a screwdriver from the under side of the chassis.

Automatic Volume Control (A.V.C.)

The action of the automatic volume control tube controls the grid bias on the R.F. and I.F. tubes and consequently the amplification of those tubes. The primary of the 2nd I.F. transformer has a tertiary winding which is connected in series in the A.V.C. tube grid circuit.

A signal of sufficient strength reaching the second detector, applies a voltage on the grid of the A.V.C. tube and the voltage thus applied depends upon the signal strength.

The plate of the A.V.C. tube will draw current when the grid voltage of the tube rises in potential and the drop

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in plate current is applied to the grids of the R.F. and I.F. tubes through their grid returns to the A.V.C. tube plate. This results in a control of the amplification of these tubes and a practically constant receiver output.

The manual volume control adjusts the negative biasing on the control grid of the A.V.C. tube, regulating in this manner the level of the input to the second detector at which the A.V.C. action commences. Thus the manual volume control behaves virtually as an output level control.

If the A.V.C. tube is defective or removed from its socket, there will be no control of the volume. Similarly, if the A.V.C. tube grid circuit is open, the plate of the tube applies a high grid bias on the R.F. and I.F. tube grids and practically no amplification is obtained from these tubes and consequently no receiver output.

A signal which is too weak to affect the A.V.C. tube grid voltage will not, of course, produce any change in plate current and the maximum amplification of the R.F. and I.F. tubes will be obtained, depending upon their grid bias as set by the A.V.C. tube plate.

Power-Supply, Condensers and Resistors

The 25 and 60 cycle power transformers are designed for operation on any 95 to 130 volt A.C. supply without adjustment and without overloading.

The 25 cycle chassis has a special power transformer and has two 8 mfd. 450 volt dry electrolytic condensers, in parallel, instead of the one condenser, C14, shown in the schematic diagram. An 8 mfd. 450 volt wet electrolytic condenser is mounted on top of the chassis base and this condenser replaces the condenser, C17, shown in the diagram. The 25 cycle chassis differs in no other way from the 60 cycle chassis.

Tables will be found in the "REPAIR PARTS" section which will identify the condensers and resistors when consulting diagrams or test data.

Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

Tube and Voltage Tests

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

The measurement of grid bias voltages is not recommended, as this causes an abnormal rise in plate current which is injurious to the tube. When the receiver does not function properly, and the trouble is apparently due to incorrect grid bias on any tube or tubes, the cause of the incorrect bias may be determined by applying the proper continuity test.

Comparison of the voltage measurements taken and those shown in the chart below will show any irregularities. The cause of any variation may be determined by applying the proper continuity test. REMEMBER: Voltage measurements will vary slightly with different sets of tubes, and also with different chassis. Unless the voltages are radically different than normal, they may be considered satisfactory.

The voltages shown in the chart were taken with a 1000 ohm per volt voltmeter; voltage measurements taken with a voltmeter having a different resistance will, of course, differ from those shown.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

TUBE	CIRCUIT	LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
R. F. '35	Screen-Grid Plate	70 192	78 213	85 234	92 256	100 277
Det.-Modulator '24	Screen-Grid Plate	70 192	78 213	85 234	92 256	100 277
I. F. '35	Screen-Grid Plate	70 192	78 213	85 234	92 256	100 277
2nd Detector '24	Screen-Grid Plate	70 154	78 171	85 187	92 204	100 221
Audio '47	Accelerating Grid Plate	199 181	221 200	244 220	267 240	289 260
A. V. C. '24	Grid Screen-Grid	12.3 34.5	13.7 38.5	15 1 42	16 5 46	17.8 50
Rectifier '80	Plate to Plate Current (both plates)	308 52.3 MA	342 58.1 MA	376 64 MA	410 69.7 MA	445 75.5 MA

The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

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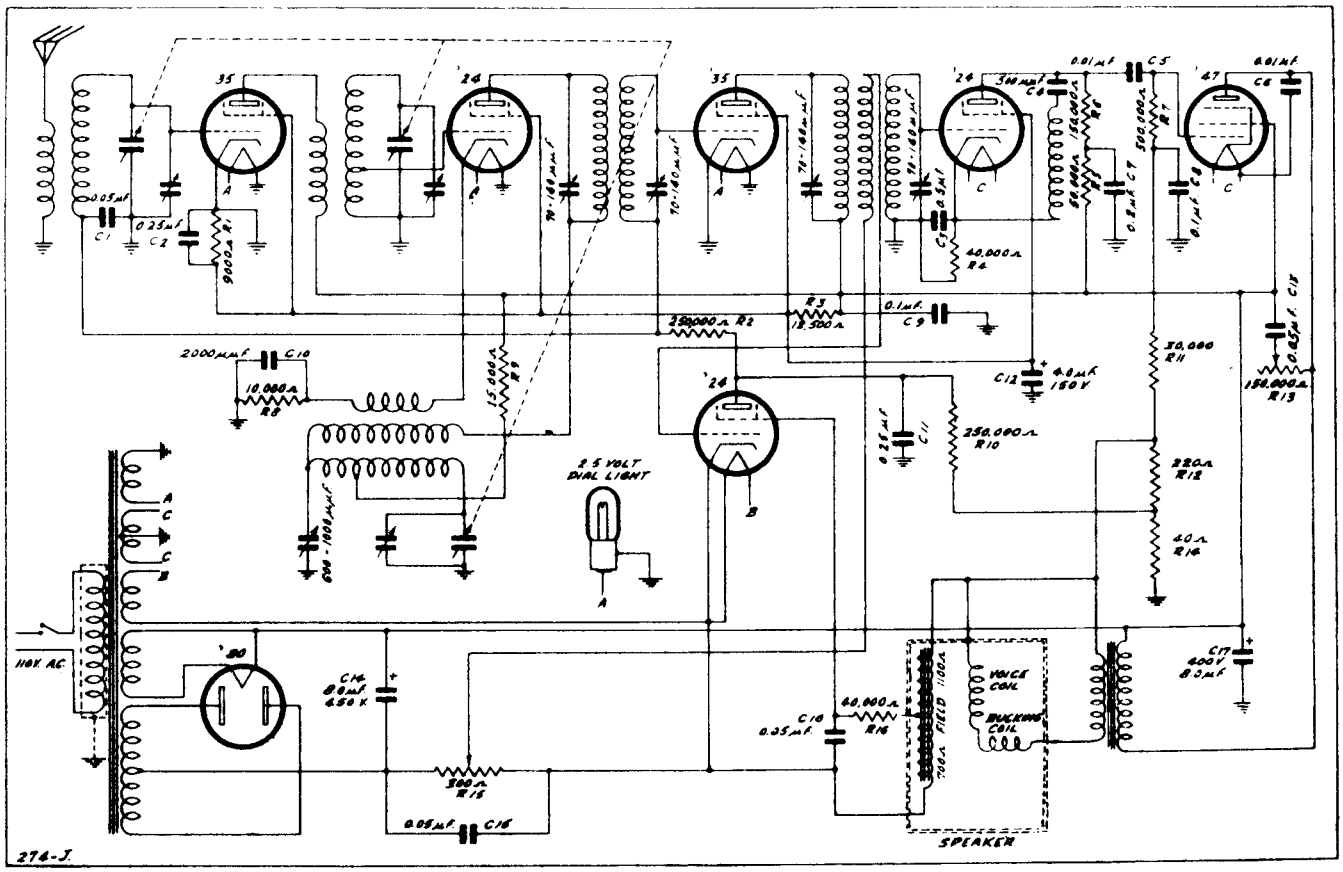

Figure 1. Schematic Diagram

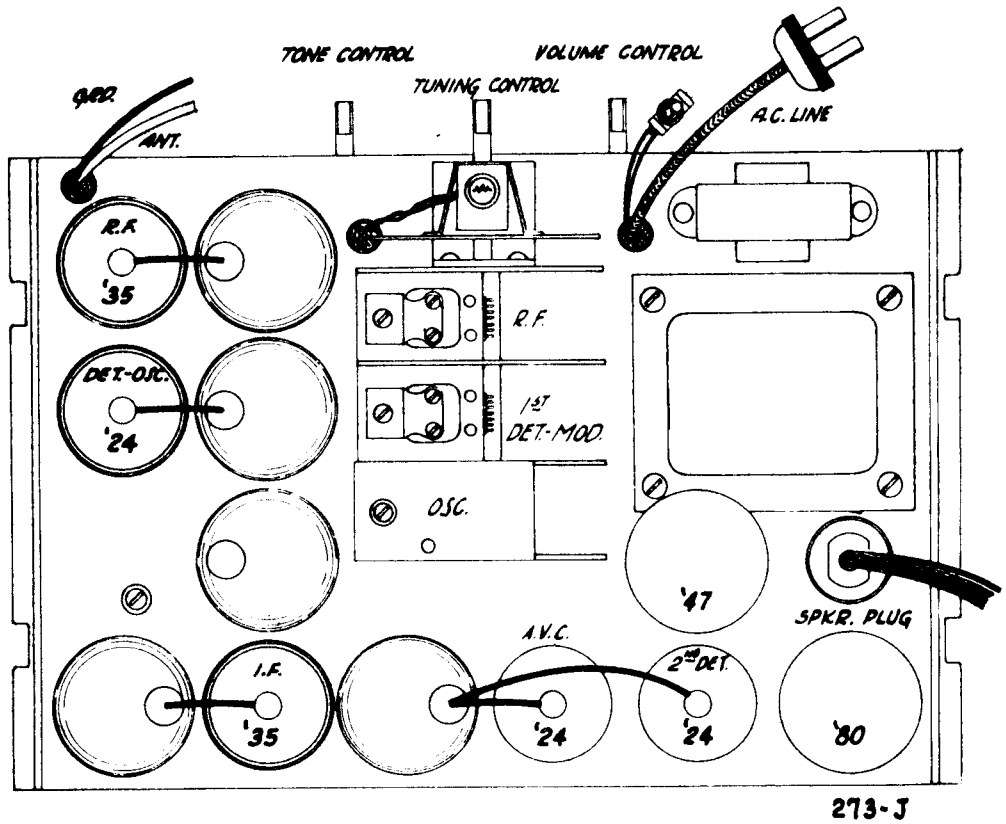

Figure 2. Top View of Chassis.

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SERVICE MANUAL

For 10 Tube Dual Speaker Super-Heterodyne Receiver No. 62-52

MONTGOMERY WARD & CO. CHICAGO, U. S. A.

Circuit

The R.F. amplifier consists of an R.F. transformer with tuned secondary feeding into a 235 amplifier tube followed by another R.F. transformer. This tube and the first I.F. tube are self-biased by means of a 260 ohm resistor connected between cathodes and ground. The automatic volume control, which further affects the bias voltage is discussed later.

A 227 tube functions as the oscillator or local R.F. generator. The oscillating circuit is always resonant at a frequency of 175 kilocycles above the frequency to which the R.F. amplifier is tuned. In order to provide satisfactory tracking with the R.F. and first detector tuned circuits, the oscillator is provided with 600 K.C. and a 1400 K.C. trimmer condensers.

A 224 tube is used as the first detector or mixer. The bias voltage for this tube is obtained by connecting the cathode circuit through a 5,000 ohm resistor to ground.

Two stages of I.F. amplification using 235 tubes are employed. The intermediate or beat frequency is 175 K.C. Bias voltage for the first 235 I.F. tube is the same as the bias voltage as described for the R.F. 235 tube. Bias voltage for the second I.F. 235 tube is obtained by connecting the cathode to the voltage divider resistor as shown in the schematic diagram. The primary and secondary of the first and third I.F. transformers are tuned by small adjustable condensers located in the I.F. assembly cans. The second I.F. transformer is provided with an extra primary winding of low inductance connected to one side of the "Quiet-Power" switch. The purpose of this is to reduce the gain in this stage if desired.

Second Detector and A.V.C. A 227 tube is used as the second detector or demodulator. This tube also functions as the automatic volume control tube. The plate and grid are connected together externally so that it operates as a two-element tube or Diode. During the positive portion of the cycle, current flows in this tube. The voltage drop established by this current flowing through a resistor is applied through isolating resistors to the grid circuits of the R.F. and 1st I.F. tubes, increasing the bias voltage on these tubes and thus reducing the amplification. As the signal voltage increases, the control voltage applied to these tubes increases, resulting in practically uniform output as set by the manual volume control. The audio component is applied through a coupling resistor and condenser to the grid circuit of the first audio tube. A 500,000 ohm grid leak resistor is used. This resistor also serves as the manual volume control. It is connected as a potentiometer, one end going to the coupling condenser and the other end to ground. The movable arm is connected to the control grid of the first A.F. tube, thus varying the audio voltage applied to the A.F. amplifier.

The audio amplifier has two stages. The first stage uses a 224 tube and is coupled to the second detector as explained above. The bias voltage for this tube is obtained by connecting the cathode to the voltage divider resistor at the point shown on the schematic diagram. The second stage is resistance coupled and uses two '47 pentode tubes in parallel. The tone control circuit consists of a .01 mfd. condenser and 0-1 megohm variable resistor connected in series across the input circuit of the second audio stage. Bias voltage for the pentode tubes is obtained by connecting the control grids through a 250,000 ohm resistor to the low potential end of the voltage divider.

The power unit consists of the conventional power transformer, full wave rectifier, filter choke, filter condensers and voltage divider resistor. The field of the speaker serves as an additional filter choke.

Voltages at Sockets

LINE VOLTAGE 115—VOLUME CONTROL AT MAXIMUM—SECOND DETECTOR TUBE REMOVED FROM SOCKET

Type of Tube	Function	Across Filament or Heater	Plate to Cathode	Screen to Cathode	Grid to Cathode	Normal Plate MA
'35	R.F.	2.2	260	103	3.8(1)	6.5
'24	1st. Det.	2.2	252	98	9.	2.2
'27	Osc.	2.2	100		8. (2)	7. (2)
'35	1st. I.F.	2.2	260	103	3.8(1)	6.5
'35	2nd. I.F.	2.2	257	100	4.5	4.7
'24	1st. Audio	2.2	200	97	7. (3)	1.
'47	2nd. Audio	2.2	240	260	18. (4)	31.
'80	Rect.	4.8	725 volts plate to plate			65 per plate

(1) Read from cathode to ground.
(2) Subject to variation with dial setting.
(3) Read across 230 and 185 ohm sections of voltage divider.
(4) Read across 140 ohm section of voltage divider resistor.
NOTE: All readings, except heater, for second detector tube are zero.

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Voltages

Check the voltages at the sockets to see if the power unit is delivering the correct voltages. The antenna and ground should be disconnected and the second detector tube removed from its socket. The reason for removing this tube is that it may affect other normal voltage readings.

All of the D.C. voltage readings as shown on the chart are read with a 1000 ohm per volt meter. As high a range as possible should be used. In general, the higher the resistance of the meter, the more accurate the reading will be. Several of the bias voltages, as indicated in the chart, cannot be read at the socket because of the high resistance in the circuit. The points at which the readings can be made are indicated in the references.

The voltage chart gives the voltages with all tubes in, the speaker connected and the set in operating condition. These voltages are typical of the sets but will vary slightly with variations in individual receivers and variations in tube characteristics. All voltages in the chart are taken with a line voltage of 115. Differences in line voltage as well as differences in test equipment used will introduce other variations in the voltage readings.

Condenser Alignment

Misalignment or mistracking of condensers generally manifests itself in broad tuning and lack of volume at portions or all of the broadcast band. The receivers are all properly aligned at the factory with precision instruments and realignment should not be attempted unless all other possible causes of the faulty operation have first been investigated and unless the service technician has the proper equipment. A signal generator that will provide an accurately calibrated signal of 175 K.C. and accurately calibrated signals over the broadcast band, and an output indicating meter are desirable. The procedure is as follows:

Set the signal generator for 175 K.C. Disconnect the grid cap from the first detector tube. Connect the antenna lead from the signal generator to the grid terminal of this tube. The ground lead goes to the ground connection. Then adjust the four intermediate frequency condensers for maximum output. The adjusting screws for these condensers are reached from the bottom of the chassis.

Next, set the signal generator for a signal of 1400 K.C. The input in this instance is made to the antenna lead of the receiver. Replace the grid cap on the first detector tube. Set the dial pointer on the 1400 K.C. mark on the dial scale and adjust the three trimmer condensers on the gang tuning condenser for maximum output, adjusting the oscillator trimmer first.

Then, set the signal generator for a signal of 600 K.C. The oscillator 600 K. C. trimmer condenser is underneath the chassis but the adjusting screw is reached from the top of the chassis and is adjacent to the oscillator coil can. Adjust this oscillator 600 K.C. trimmer condenser for maximum output, turning the rotor slowly back and forth over the 600 K.C. setting until highest output is obtained. A recheck may then be made of the alignment at 1400 K.C.

Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

Replacing R. F. Transformers and Oscillator Unit

The first and second R.F. transformers and oscillator assembly are matched. If one of these units is replaced, it is essential that the new one be of the correct value. At the bottom of the unit assembly a spot of paint will be seen. Be sure when ordering one of these assemblies to indicate in your order the color of the spot of paint.

Dual Speaker Connections

Two speakers are used in this model, one designed to give best response on the higher audio frequencies and the other designed to give best response on the lower frequencies. The fields of the two speakers are connected in series, and the voice coils in parallel. The resistance of the two fields in series is 450 ohms.

Low Volume

If the volume is below normal there are a number of possible causes in the chassis and accessories as follows:

Probably the most common cause of low volume is defective tubes. In any case of low volume, therefore, procure a new set of tubes that have been tested or have been operating satisfactorily in another receiver. Insert these in the chassis one at a time and note any difference in performance.

Another very common cause of low volume is weak pick-up due to a faulty antenna or the antenna being in a shielded location. The antenna and lead-in system should be inspected for poor connections and grounds. If the antenna is in or near a steel building the pick-up will be weak because of the shielding effect of the steel.

Misalignment or mistracking of variable tuning condensers is another possible cause of low volume. Instructions for realigning are contained in this manual. Do not, however, attempt realignment unless other causes of low volume have first been investigated.

Other causes of low volume are; defective speaker, defective power unit causing low voltages to be supplied, excessively low line voltage, and various opens, grounds and shorts in the receiver assembly.

Excessive Hum

The design of the power unit and arrangement of the filters in this chassis are such that the A.C. hum is scarcely audible. If the hum is excessive there are a number of possible causes.

Defective tubes are very often the cause of excessive hum. Try out a new set of tubes and note any difference. The hum may be due to external pick-up. Disconnect the antenna and ground and see if the hum disappears.

A shorted filter choke or open filter condensers can cause excessive hum. Inspect these items for the defects named. Other causes of hum are; shorted choke tuning condenser, unequal rectifier plate currents, defective hum filter resistors and condensers; defects in grid circuits; and defective power transformers.

Oscillation

There is very little possibility of oscillation on this receiver, as the circuit is exceptionally stable.

Should the set oscillate in being connected it may be due to tubes whose characteristics are very far off from standard. Change the tubes around and try out a new set. See if all the tube shields are on. Check the bypass condensers and leads to them for opens. See if the receiver is properly grounded and if it is, try out a different ground.

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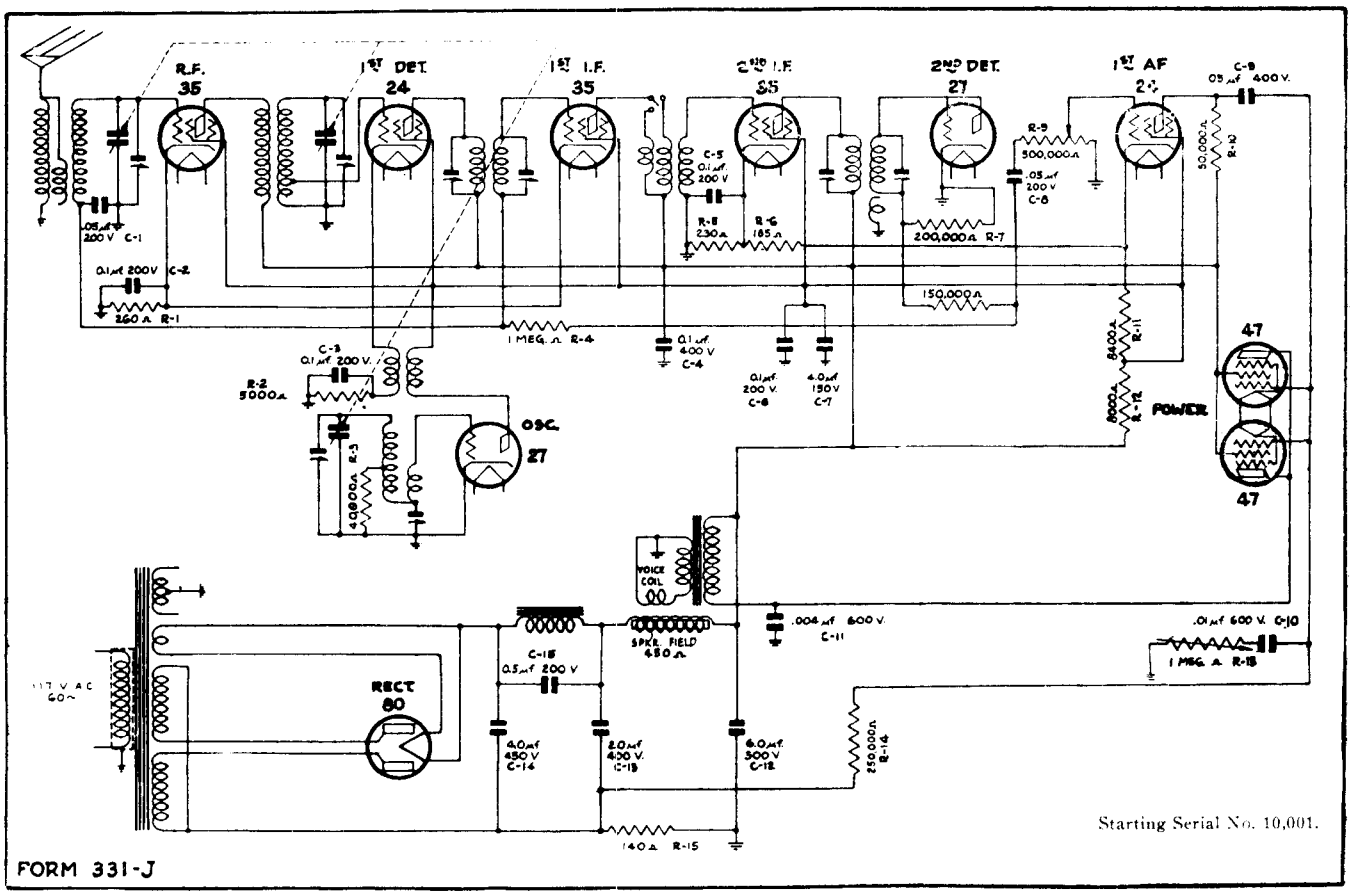

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Figure 1. Schematic Circuit Diagram

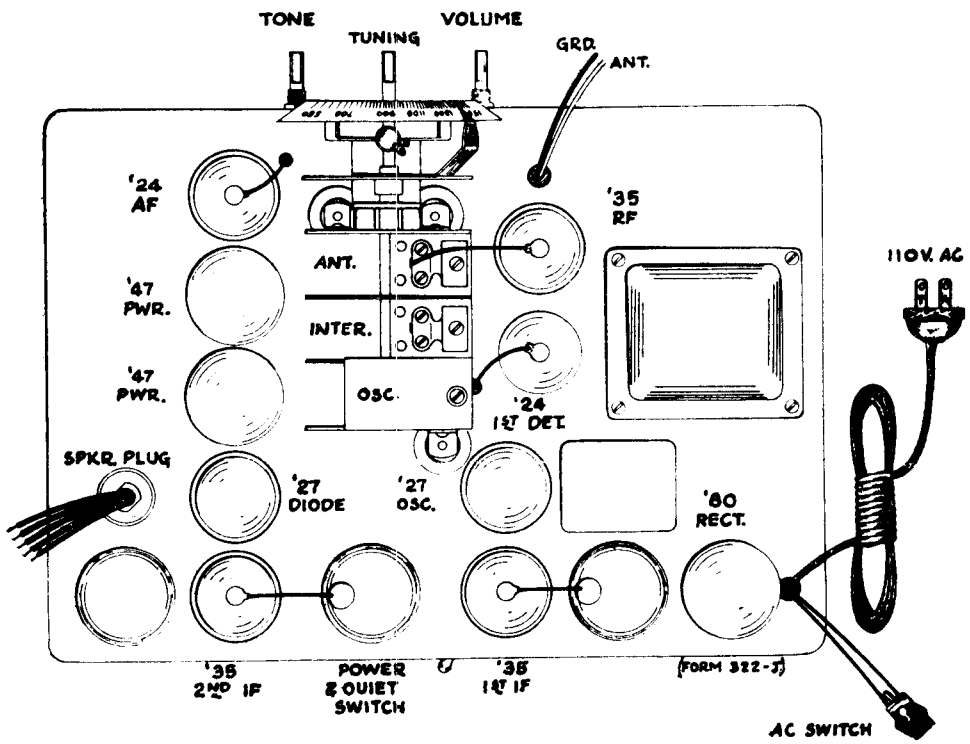

Figure 2. Top View of Chassis

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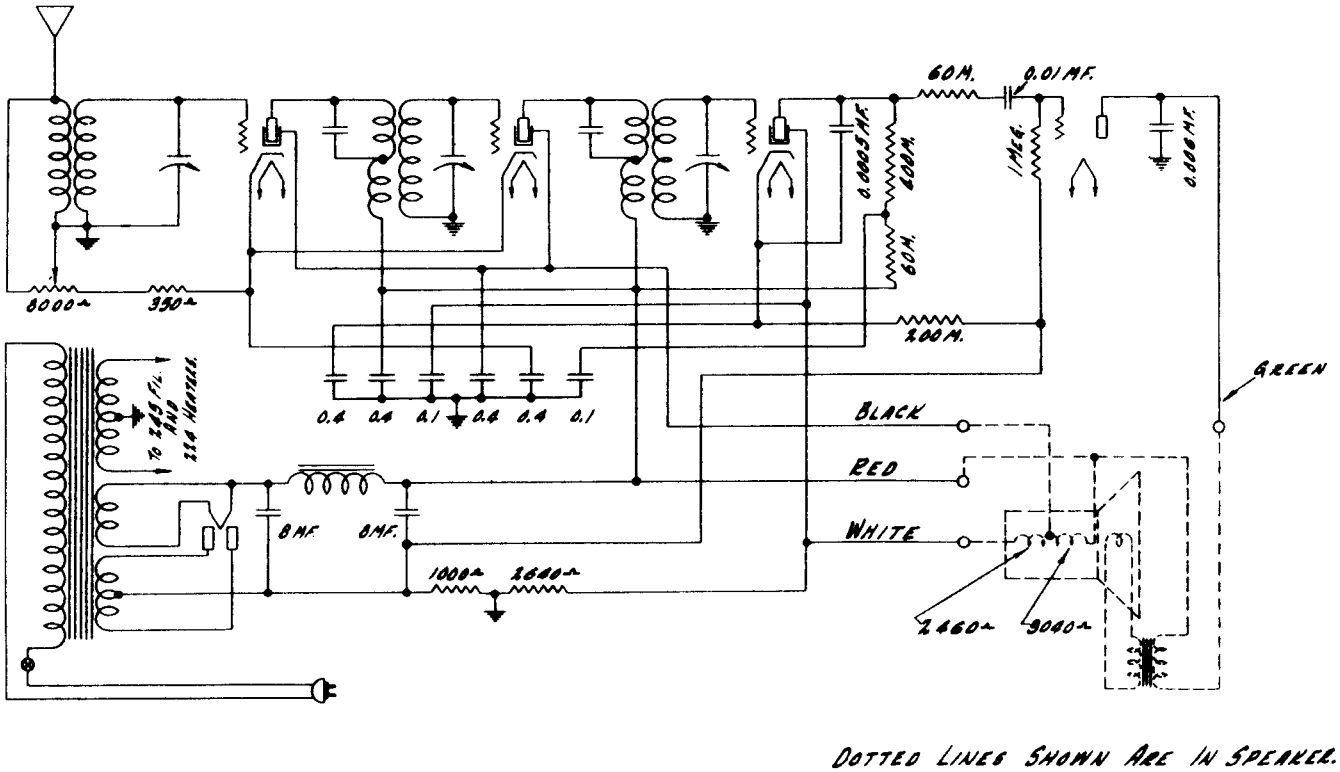

Figure 1

General Description

The Model 26W chassis used in both the Princess and Challenger, Jr., is similar in many respects to the 32W chassis used in the Troubadour. The operating voltages, however, will be found to be different, and also this chassis does not use the band pass filter input circuit, as used in the 32W. Only one 245 tube is used in this chassis, and only one stage of resistance coupled audio.

The speaker is of a new type using a center tap field. The entire field winding being used as a shunt resistor. The center tap supplies the screen grid voltage to the radio frequency tubes. Only two electrolytic filter condensers are used, and a number of the small bypass condensers are eliminated, as shown in the schematic diagram, Figure I.

The general service procedure as described for the Model 32 W chassis can be used in servicing the 26W chassis.

NO. 26 W CHASSIS — VOLTAGES AT SOCKETS — VOLUME CONTROL AT MAXIMUM — LINE VOLTAGE. 115 — PLUG IN SOCKET OF RECEIVER — TUBE IN TEST SET

Type of Tube	Position Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
224	1	1st Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	2	2nd Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	3	Detector	2.2	130	3.	40	.1	3.	.25	.4
245	4	Audio	2.35	245	50.				28.	31.
280	5	Rectifier	4.6						25. Per Plate	

MONTGOMERY WARD & CO.

Seven Tube Screen Grid Receiver, Nos. 62-030 and 62-232

General Description

The 32W is a seven tube screen grid receiver using the following tubes.

2—224 Tubes as R. F. Amplifiers.
1—224 Tube as Detector.
1—227 Tube as First Audio.
2—245 Tube as Second Audio.
1—280 Tube as Rectifier.

The model 32 W chassis used in the Troubadour and Lafayette is similar in many respects to the Commander, Cavalier, Coronado and Cortez. The special differential features of this chassis are the band pass filter and the radio frequency transformers.

A band pass filter is used in the antenna input stage, and consists of two separate tuned circuits which are inductively coupled. The advantages of this filter are an increase in selectivity; elimination of cross talk and improved tone. Incorporated in the filter is a special coil and condenser, which is inductively coupled to the grid coil of the first tube, tending to give this stage a constant gain over the entire frequency band.

Another feature of this set is the tuned radio frequency coils which have two separate primary windings, so connected as to give equal gain throughout the broadcast band. A screen grid power detector is used, giving the advantages of sensitivity with very good overload characteristics. The over-all fidelity response characteristics are especially good, due to the resistance coupling used in the first stage of audio, and the 245 tubes in push pull in the last stage. Sensitivity in this chassis averages 4 Microvolts per meter.

R.F. Coils

The antenna input transformer is of the high impedance type, and is both inductively and capacitively coupled. The primary winding is on a small bobbin inside the coil form, wound concentric with the secondary, allowing inductive coupling. The capacity coupling is obtained by an extra turn of wire connected to the primary and wound on the coil alongside one end of the secondary winding. This antenna coil is coupled to the grid coil of the first tube through three turns of wire wound on the low potential end of the grid coil. Inside of the grid coil is a small bobbin coil shunted by a 100 mmfd. condenser, and being in inductive relation to the grid coil. This small coil with condenser in shunt is tuned to the lower frequency. The 100 mmfd. condenser is a small condenser without any color marking to distinguish it from the 50 M.M.F. condensers with the yellow dot which are used in the other stages of the radio frequency. The primaries of the radio frequency coils proper, are made up of two parts; the inside primary is wound on a bobbin which is inside the coil form, and is shunted with a 50 M.M.F. condenser. The outside primary is wound on the coil form over the secondary winding and is separated by an insulated strip, the two primaries being connected in series. The energy transfer of the inside tuned primary decreases with increase in frequency—the energy transfer of the outside primary increases with increase in frequency; resulting in a net gain that is practically uniform over the broadcast band. Any trouble in the R.F. coils of this receiver will be noted by the lack of sensitivity at either the high or low wave part of the dial.

R.F. Amplifier and Volume Control

Bias for the screen grid tubes is variable and depends on the setting of the volume control arm. As indicated in Figure 1, the volume control will vary the resistance between 350 Ohms and 8350 Ohms, depending on the setting of the arm. The voltage drop of the plate current flowing through this resistance provides the necessary bias voltage.

As the volume control is also connected between the aerial and ground, it is necessary that a good ground be used with this chassis to effectively control the volume in all cases.

The plate voltage for the 224's is obtained from the positive side of the power unit. Screen grid voltage for the 224's is obtained from the 8 M tap of the shunt resistor.

Detector

The detector circuit is a power detector using a 224 screen grid tube. The necessary grid bias for this tube is obtained by the voltage drop across the 25 M cathode resistor. Plate voltage for the detector is obtained by the voltage drop across the 25 M resistor connected in the plate circuit, while the screen grid voltage is obtained through the 500 M resistor, connected in the screen grid circuit. The screen voltage cannot be properly measured with your Weston set checker, but it is of a calculated value of forty volts.

Audio System

The detector is coupled to the first audio stage through a .01 M.F. fixed condenser. A 60 thousand Ohm resistor is connected to one side of this condenser and acts as a R.F. choke. The 100 M.M.F. condenser connected between the grid of the first audio tube and ground is used to bypass any radio frequency. A short in this condenser will short circuit any signals up to this point. A 1 Megohm resistor is connected between the grid and ground of the first audio tube to give the grid the proper bias. The bias is obtained by the voltage drop through the 2500 Ohm cathode resistor, this resistor being bypassed to ground through a 1 M.F. condenser. A short in this condenser will be indicated when there is no voltage drop across the 2500 Ohm resistor. The last stage of audio and tone control are used in the same manner as described for previous chassis, with the exception that the grid bias for these power tubes is obtained by connecting the center tap of the secondary push pull winding to the negative side of the filter system, making this connection more negative than the filaments, due to the voltage drop through the 700 Ohm field resistance.

Electrolytic Filter Condensers

Electrolytic filter condensers have a capacity of 8 M.F. each. They should always be kept in an upright condition, with the rubber vent at the top, otherwise there may be a leakage of electrolyte from some of the units. The electrolytic condenser has the advantages that when an excessive voltage breaks down the dielectric, the condenser action ceases—however, no damage has been done, and upon standing for a few minutes, the condenser will build up a new film of dielectric, and the unit will function as before. The electrolytic condensers will freeze at 18°F. A frozen condenser is not operative, but will become operative at ordinary room temperature in fifteen minutes without damage in any way to the condenser.

The electrolytic condenser can be tested by applying a direct current voltage of 200 to 350 volts to the terminals, the center pole or anode being made positive. After the condensers have been on for five minutes, connect the milliameter of your Weston set checker in series with the condenser and read the leakage current; up to 5 milliamperes per 8 M.F.D. section is normal. On some occasions it may be found that the electrolyte has crystallized around the vent, indicating a slight amount of leakage. This does not indicate that the condenser has been damaged, and it is only necessary to wipe the electrolyte away, and the unit will function normally, provided a large amount of electrolyte has not escaped, in which case the capacity of the condenser will be low. Electrolytic condensers cannot be tested by the ordinary method of using A.C. Another method of testing is to replace a doubtful condenser with a new one, checking them by means of comparison.

Loud Speaker

The loud speaker is of the dynamic type using a 700 Ohm field winding. As the loud speaker is really part of the power pack, no other speaker should be used in this chassis.

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Weak Signals

The most prominent cause of weak signals is defective tubes. Check these by using a new set of tubes that have been tested, or a set of tubes which have been operating satisfactorily in another receiver. Insert these in the chassis, one at a time and note any difference in performance. The antenna may be shielded if the antenna is in or near a steel building, the pick-up will be weak, because of the shielding effect of the steel. In a case of this kind, try out a new antenna in a different location. Check the line voltage. On rare occasions low volume is due to the condensers being out of line. In this case align the condensers as explained in previous service manuals.

Excessive Hum

The most probable cause for excessive A.C. hum is defective tubes. In each case, therefore, try out a new set of tubes and note any difference in performance. The hum may be due to outside pick-up. Disconnect the antenna and ground from the set and see if the hum disappears. Other causes of hum are shorted filter choke, open filter condenser or a filter condenser with a large amount of electrolyte leakage. If the field plate of the power transformer between the primary and secondary winding is not properly grounded, excessive hum will result. A defective 280 tube is another frequent cause of hum. A heater to cathode short on one side of the heater or filament being grounded will cause hum. A grounded speaker cable, open grid circuit or open .4 M.F.D. plate condenser will also cause hum. *It is always essential to have a good 224 in the detector socket—try a number of different tubes in this socket.*

Servicing

Unless you know definitely the exact trouble, proceed in an orderly manner, first testing the tubes, the aerial, ground, etc., as given under servicing in the other parts of the manual.

Oscillation

This set is exceptionally well shielded and few troubles from oscillation should be experienced. Most frequent causes for oscillation are dirty connections to the rotor shaft of the variable condenser, high mutual conductance tubes or high line voltage—the remedies are obvious.

Howling

Howling is invariably caused by a poor detector or first audio tube. Try a number of different tubes in these sockets.

Noisy Speaker

A rattling or blasting noise in the speaker may be due to dirt or iron filings in the gap between the voice coil and the pole base of the magnet, or to the voice coil being out of line and scraping on the pole base. Move the cone backwards and forwards with the fingers and note if it appears to rub. To center the voice coil, loosen the adjusting screw at the center of the spider. Next, loosen the two screws securing the strip to the head. Get three spacers made of paper or metal, three eighths of an inch wide, three inches long and .006 of an inch thick. Put the spacers through the oval holes in the spider and between the voice coil and inner pole base. Then tighten the screws and remove spacers. If the noise is caused by particles in the gap, loosen the adjusting screw at the center of the spider and get the fingers in back of the cone, near the apex. Pull outward on the cone and blow into the gap.

Twenty-Five Cycle Chassis

A twenty-five cycle power transformer and an additional .45 M.F.D. condenser are used in this chassis. In converting a sixty cycle chassis to twenty-five cycle, first remove the .1 M.F.D. condenser across the filter choke and connect it across the .1 M.F.D. screen condenser. This provides additional filtering. Connect the .45 M.F.D. condenser across the filter choke.

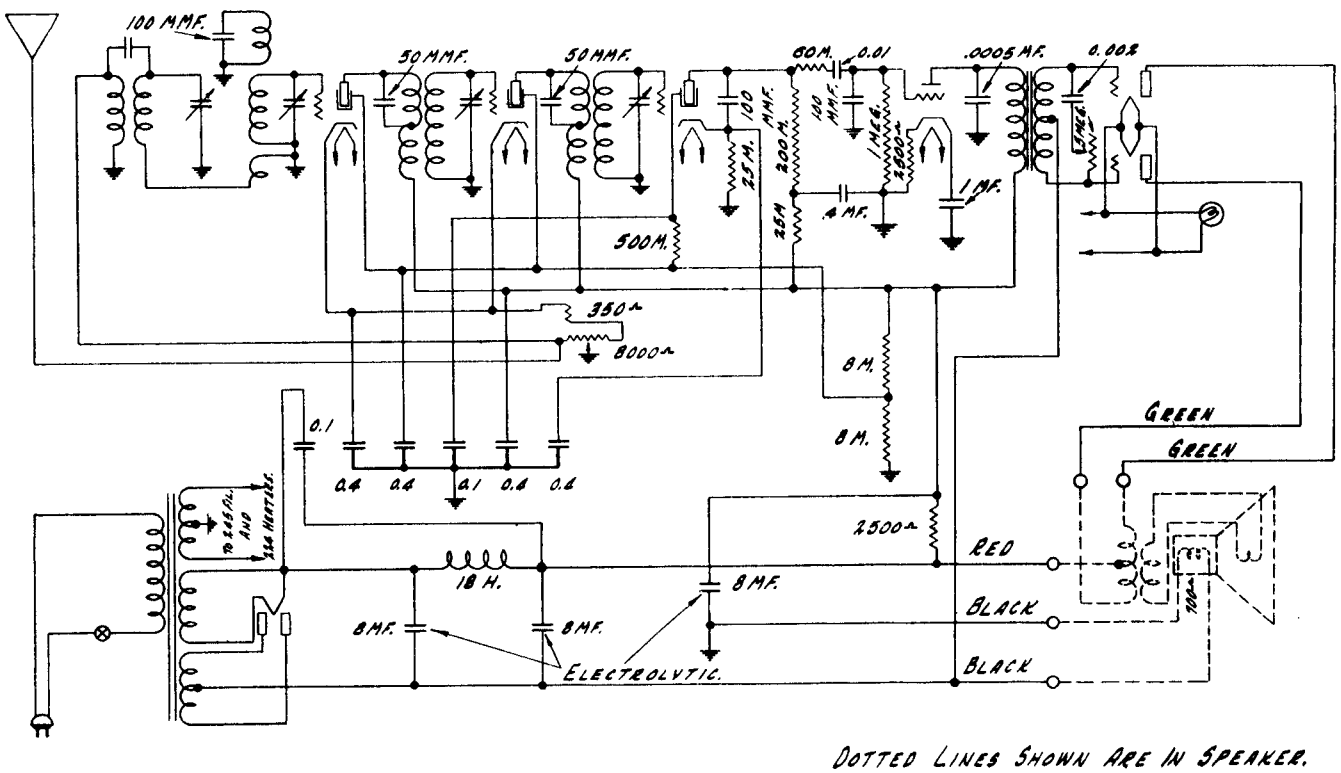

Figure 1

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Recital Eight Tube Super-Heterodyne Receiver, No. 1238

(Catalogue No. 62-1838)

General Description

The complete circucit consists of an R. F. amplifier, the oscillator or local signal generator, the 1st detector or mixer which combines the signals of the R. F. amplifier and the oscillator to form the intermediate frequency, the I. F. amplifier, the 2nd detector or demodulator, the A. F. amplifier, the automatic volume control and the power system from which the required voltages are obtained. Each of these will be discussed.

R. F. Amplifier

The R. F. amplifier consists of a tuned input followed by an additional tuned stage. A 235 tube is used as an R. F. amplifier. The first or antenna input transformer is inductively coupled. It has a high impedance primary resonant to a frequency below the broadcast band, permitting the use of varying antenna lengths. The 2nd R. F. transformer couples the plate circuit of the R. F. 235 tube to the grid circuit of the 235 1st detector and is also inductively coupled. The drop in signal strength at the lower frequencies is compensated for by increased oscillator signal voltage at these frequencies. Sections one and two of the three-gang condenser are used to tune the two tuned circuits in the R. F. amplifier and 1st detector.

The value of the grid bias voltage of the 235 R. F. amplifier is subject to some variable factors including the position of the power level switch and the operation of the automatic volume control. With the power level switch on the "H" power position and with no plate current flowing in the automatic volume control, the bias voltage consists of the drop across the 250 ohm series resistor in the cathode circuit. The action of the A. V. C. and power level switch will be discussed in the paragraphs on these items.

Intermediate Frequency Amplifier

In the I. F. amplifier is obtained the high degree of selectivity and sensitivity of the Super-heterodyne. Four tuned circuits are used as the grid and plate circuits of both I. F. transformers are tuned. This affords a high degree of selectivity as well as high amplification. A 235 tube is used as an I. F. amplifier.

Bias voltage for the 235 I. F. amplifier is the same as the bias voltage described for the 235 R. F. tube.

The I. F. transformers are small universal wound coils mounted on a piece of tubing. The I. F. tuning condensers are small mica condensers. The coil tubing standards and condensers are mounted on porcelain bases and are enclosed in metal cans located on top of the chassis. The adjusting screws of the four I. F. tuning condensers are reached from the bottom of the chassis.

2nd Detector

A 227 tube is used as the 2nd detector or demodulator tube. This detector is also of the bias type. The tube is self-biased, the voltage being obtained by the drop established by the plate current returning to the cathode through the 100,000 ohm resistor. As the grid is above ground potential the bias voltage is determined by the difference above ground between grid and cathode. The R. F. choke in the plate circuit is mounted in a metal can and located directly under the plate terminal of the 2nd detector socket. The reason for shielding this circuit is that certain harmonics of the intermediate frequency fall within the broadcast band and if fed into the R. F. stages would cause audible beats.

Oscillator

The oscillator is of the tuned grid type. This circuit is tuned by the third section of the three-gang tuning condenser. Energy is fed from the plate circuit of the oscillator tube to the grid circuit through a .01 Mfd. condenser. The oscillator signal is 262 K. C. above the R. F. signal in frequency at any setting of the tuning condenser. The oscillator coil is coupled inductively to the cathode of the 1st detector thus introducing the oscillator signal to the grid circuit of this tube.

The drop across the 50,000 ohm resistor brought about by the D. C. component of the grid current establishes the bias voltage. As the signal is greater at the lower frequencies the drop across this resistor is correspondingly greater.

In order to provide satisfactory tracking with the R. F. and 1st detector tuned circuits the oscillator is provided with a 600 K. C. and a 1400 K. C. trimmer condenser. The 1400 K. C. trimmer condenser is located on top of the tuning condenser and is connected across the tuning condenser. The 600 K. C. trimmer condenser is across the 550 Mmf. fixed condenser and the adjusting screw is in front of the first I. F. can on top of the chassis.

1st Detector or Mixer

The 1st detector or mixer is of the bias type. A 235 tube is used. In the grid circuit of this tube are the R. F. signal and the oscillator signal which combine to form the beat or intermediate frequency. The tube is self-biased by means of a 3000 ohm resistor connected in series in the cathode circuit to the ground.

In addition to the intermediate frequency there is also present in the plate circuit of the 1st detector the R. F. signal, the oscillator signal, and the sum frequency signal of the two beating signals. All these frequencies except the intermediate frequency are filtered out in the I. F. amplifier.

Audio System

The audio stage is resistance coupled. A 100,000 ohm resistor in the grid circuit of the 2nd detector provides the necessary impedance so that the A. C. voltage is developed across it and impressed through the .04 Mfd. coupling condenser on the control grid of the 247 Pentode output tube. A zero to 1 Megohm variable grid leak resistor is used which serves as the volume control. It is connected at a potentiometer. One end is connected to the .04 Mfd. coupling condenser and the other end is connected to ground. The control grid of the 247 output tube is connected to the movable arm. As the position of the movable arm is changed the voltage impressed on the 247 grid circuit is varied, thus changing the volume.

Bias voltage for the 247 Pentode tube is provided by the drop established by the plate current returning to the cathode or filament through the 550 ohm series resistor which is connected between the center tap of the filament winding and the ground. This 550 ohm resistor is by-passed by an 8 Mfd. condenser which completes the audio circuit to the filament, thus avoiding the degenerating effect brought about by the plate current flowing through this resistor.

Incorporated in the plate circuit of the 247 tube is a variable impedance, called the tone blender which controls the degree of reproduction of the higher audio frequency notes. This optional limitation in the reproduction of the higher audio frequency is accomplished with a .04 Mfd. condenser and zero to 150,000 ohm variable resistor connected across the primary of the output transformer. With the 150,000 ohms all in series no audio frequencies pass through the filter. With no resistance in the circuit only the .04 condenser is across the primary and the higher audio frequency finding a low impedance path pass through this condenser. By varying the resistance between the two extremes the impedance is varied and the degree to which the high notes are reproduced is accordingly varied.

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Power Supply

The power system consists of the conventional power transformer, filter choke, filter condensers, and voltage divider resistor. The field of the speaker is in series with the voltage divider resistor and is tapped to supply screen voltage for the R. F. and I. F. tubes. The filter choke is tuned with a .06 condenser to offer maximum opposition to the 120 cycle ripple voltage.

Automatic Volume Control

The automatic volume control as used in this receiver varies the signal strength by changing the bias voltage of the R. F. and I. F. 235 tubes. A 227 tube is used as the A. V. C. tube. Plate cathode and grid circuits of this tube are connected to the voltage divider resistor as shown in Fig. 1 to secure the required plate and grid voltage. In the plate circuit of this tube is a 200,000 ohm resistor. The grid circuits of the R. F. and I. F. tubes are connected to the plate of the A. V. C. tube. The cathodes of these two tubes are connected through the 250 ohm biasing resistor to the other end of this 200,000 ohm resistor in the plate circuit (power level switch on "H" power). The grid of the A. V. C. tube is connected to the plate of the I. F. 235 tube through a .0005 condenser. The A. V. C. tube has an initial bias of 40 volts and under conditions of no signal, no plate current flows in this tube. However, when an A. C. voltage of 35 or greater is applied to the grid circuit of the A. V. C. through the .0005 coupling condenser, plate current flows and a drop is established across the 200,000 ohm resistor. This lowers the voltage of the I. F. and R. F. grids, increasing the bias and decreasing the signal strength. The higher the A. C. voltage applied to the A. V. C. grid the greater the drop across the 200,000 ohm resistor and the bias voltage correspondingly increases. For weak signals, therefore, the A. V. C. does not affect the bias and maximum sensitivity is obtained, while for strong signals the bias is increased and a corresponding reduction in volume effected.

Tuning Meter

The visual tuning meter in this receiver is a milliameter connected in series between the positive B and the plate circuits of the R. F. and I. F. 235 tubes. When the On-Off switch of the receiver is turned on, plate current flows in these two tubes and the pointer of the meter swings over. If a signal voltage is applied to the A. V. C. tube of sufficient strength to cause plate current to flow in this tube, the bias voltage of the R. F. and I. F. tubes is increased as explained above. This reduces the plate current of the R. F. and I. F. tubes and causes the pointer of the meter to swing back. At resonance the bias voltage is the greatest and the swing of the pointer will be correspondingly greatest. The action of the visual tuning meter is most satisfactory with the power level switch in the "H" power position. With the switch in this position, the R. F. and I. F. bias voltage is the least and the pointer of the meter swings over the greatest amount. With the power level switch in the "L" power position the pointer of the meter swings back due to the increased bias voltage resulting in lessened plate current.

Power Switch

The power level switch likewise changes the volume by changing the bias voltage of the R. F. and I. F. tubes. With the switch set on the "H" power position the bias voltage consists of the drop across the 250 ohm series resistor (no drop in A. V. C. plate circuit). With the switch set on the "L" power position the bias voltage consists of the drop across the 500 ohm section of the voltage divider resistor in addition to the drop across the 250 ohm resistor.

Voltages

Check the voltages at the sockets to see if the power system is delivering the correct voltages. The antenna and ground should be disconnected. The shield should be on. The tester plug can be inserted in the sockets and the shield placed over it. When the plug is inserted in the oscillator socket the cable must be doubled back over it in order to get the shield back on. When reading the voltages of the 1st detector bring the grid cap and wire through the trimmer condenser hole in the shield. The voltage chart shows the voltages and currents with all tubes in, speaker connected and set in operating condition. The voltages will vary with individual receivers and with variations in tubes. The voltages as shown are with a line voltage of 115.

Several of the voltages as indicated in the chart cannot be satisfactorily read at the socket but should be read across the resistors at which they are developed.

25 Cycle Chassis No. 1238X

For 25 cycle sets remove the .06 Mfd. condenser across the filter choke and use No. U-3084 power transformer instead of U-2783.

8 TUBE CHASSIS—VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM LINE VOLTAGE 115—POWER LEVEL SWITCH HIGH POWER

Type of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
235	R.F.	2.3	190	2.3(1)	68	1.0	0	3.8	6.5
235	1st Det.	2.3	190	6.5	70	.35	14.	2.0	4.9
227	Osc.	2.3	80	15—50(2)			20.	4.7	4.8
235	I.F.	2.3	190	2.3(1)	68	.6	0	3.6	6.0
227	2nd Det.	2.3	150	20.			20.	.4	.4
227	A.V.C.	2.3	65(3)	40.(4)			20.	0.	0.
247	Power	2.35	260	20.(5)	280	7.		32.	36.
280	Rectifier	5.						41. Per plate	

(1) Measured across 250 ohm series resistor.
(2) Bias voltage varies from 15 to 50 between 1500 and 550 K.C. settings of tuning condenser.
(3) Measured across 1000 and 1200 ohm sections of shunt resistor.
(4) Measured across two 660 ohm sections of shunt resistor.
(5) Measured across 550 ohm series resistor.

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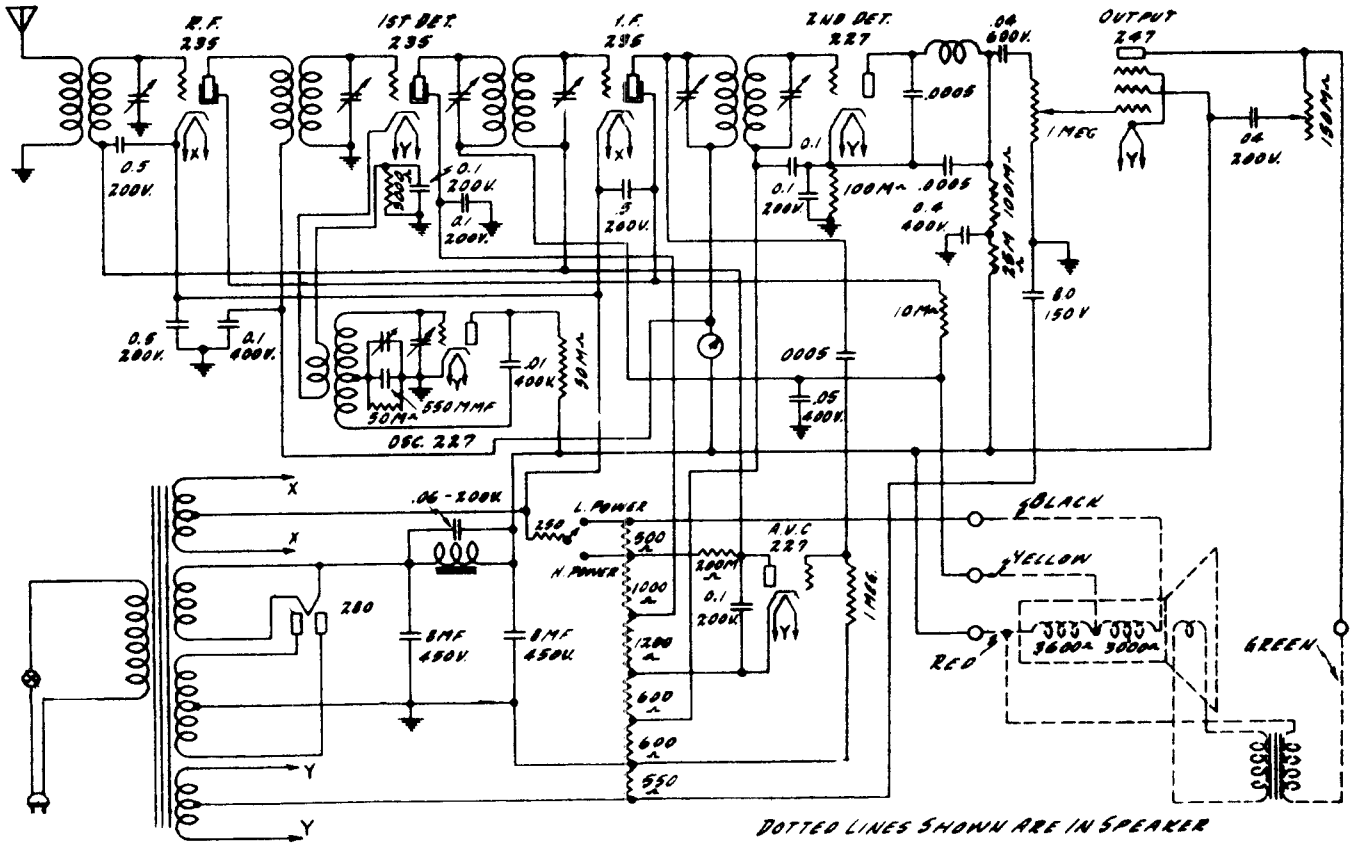


Figure 1

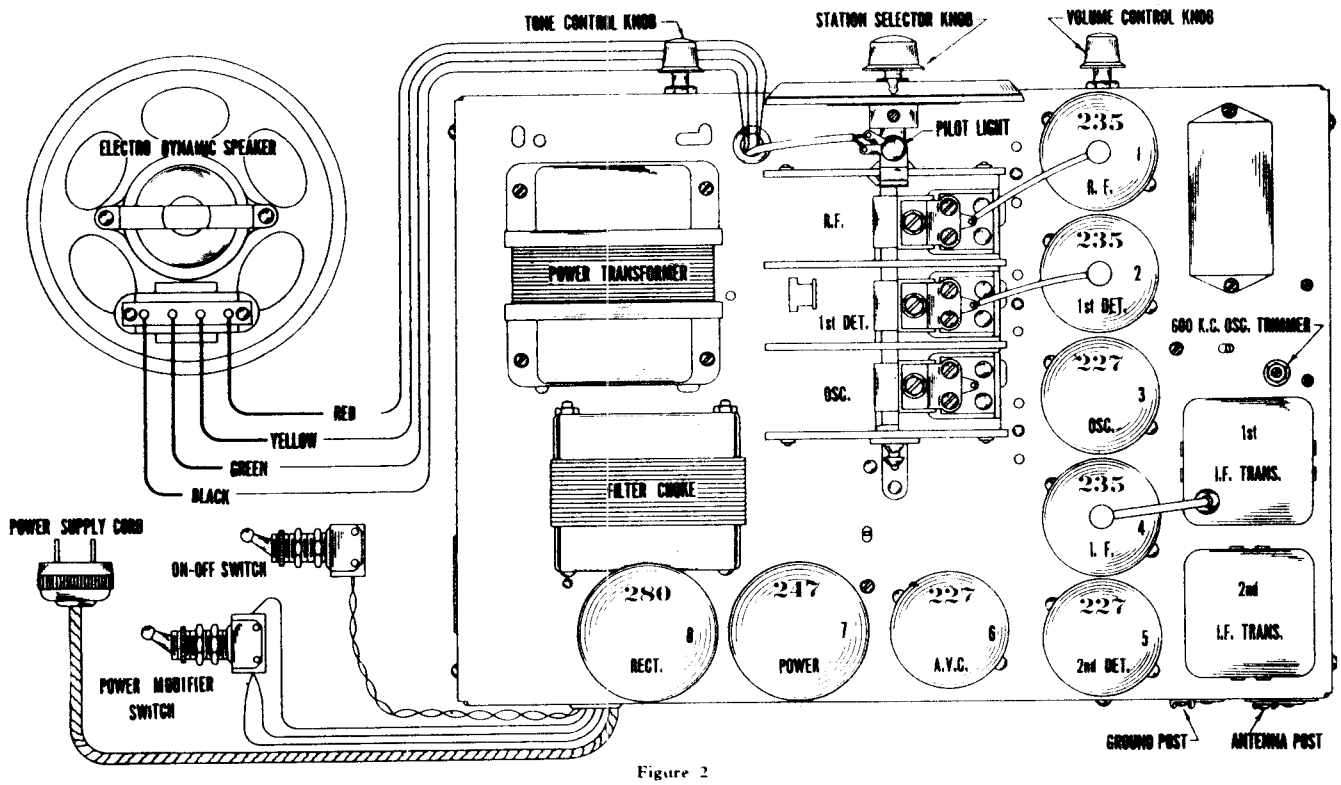


Figure 2

MONTGOMERY WARD & CO.

Challenger Five Tube Mantel Receiver No. 15000 Chassis

(Catalogue No. 1500)

(60-Cycle—27W)

The 27W Chassis uses the following tubes:
2—224's as R.F. Amplifiers,
1—227 as Detector,
1—245 as Audio Amplifier,
1—280 as Rectifier.

The two stages of screen grid R.F. amplification in conjunction with the tuned antenna stage of this chassis give a sensitivity averaging 10 Microvolts per meter while the 227 power detector used with the single stage high gain audio provides good power output, with excellent tone quality.

Volume Control

The 8000 ohm volume control is connected across the antenna and ground of the input stage. The movable arm of the volume control is connected to ground in series with the cathodes of the two 224 R.F. amplifier tubes. This method of connection gives us a dual volume control action, which varies the signal input to the antenna stage as well as the grid bias on the first two R.F. tubes. The volume control may be easily tested by taking the voltage readings from the cathode of the 224's to the ground connection and at the same time, varying the volume control. This will give an indication if the volume control is controlling the grid bias properly.

The R.F. transformers in the R.F. stages are the same as those used in the 32W and 26W chassis. The cathode, screen grid, and plates of the R.F. tubes are bypassed by the 964A bypass condenser.

The Power Detector

The power detector receives its grid bias from the voltage drop across the 50M cathode resistor (Part No. 1892). The plate of the detector is bypassed to ground through the .001 M.F. R.F. plate bypass condenser.

The audio stage consists of a high ratio audio transformer of special design. The secondary of this transformer connects directly to the 245 power tube. The audio transformer may be tested with the continuity meter of your set checker. Disconnect the primary and secondary leads from the chassis before taking continuity measurements. Test the primary and secondary for opens or shorts, and also take continuity readings between the primary and secondary terminals, and ground. There should be no readings between these terminals and the core of the transformer or chassis ground.

The tone control is connected across the primary of the output push pull transformer, and consists of 50M variable resistance in series with a .2 M.F. fixed condenser. A short in this condenser will short circuit the primary of the speaker transformer and no signals will reach the loud speaker.

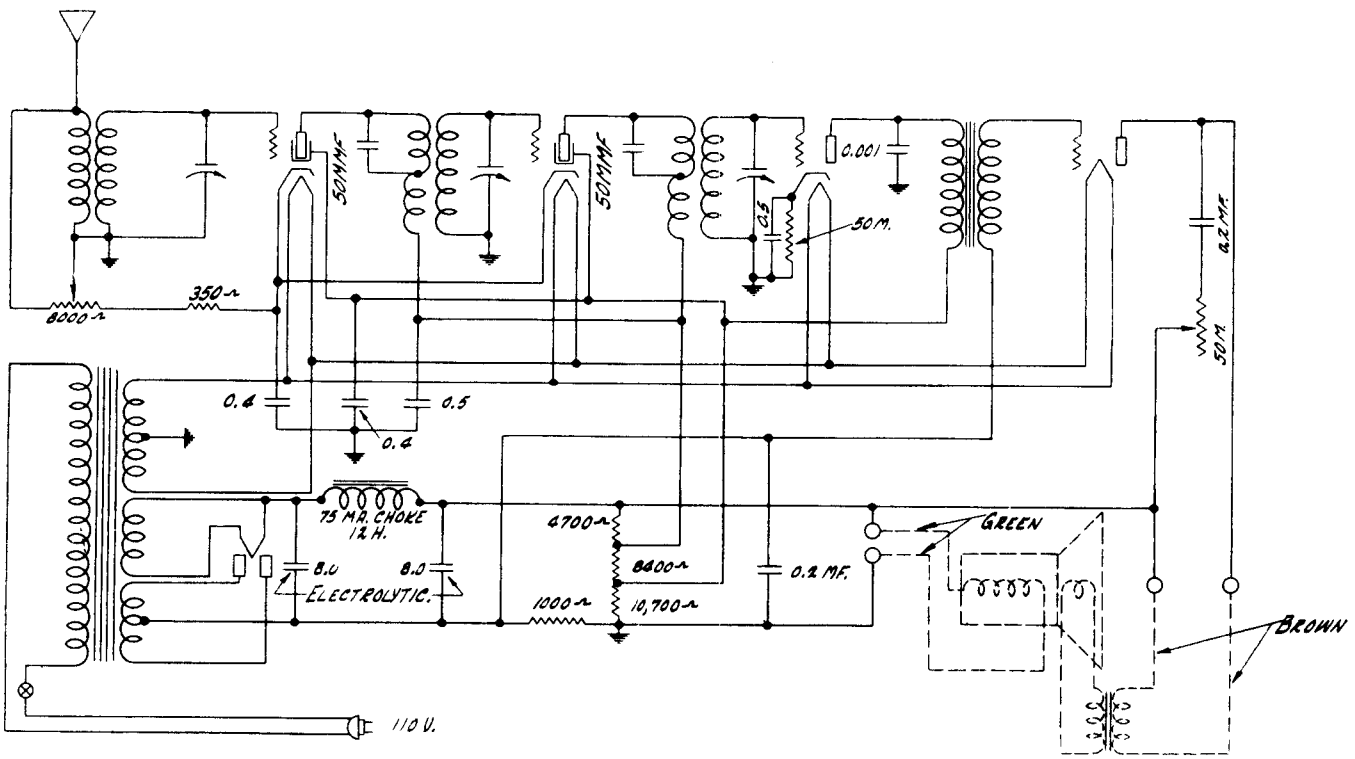
The power supply of the 27W chassis is similar to that used in some of our other chassis previously described.

Two electrolytic condensers are used in the filter circuit and care must be taken that these chassis are always kept in an upright position to prevent any small amount of electrolytic leakage in the filter condensers. It is a good idea to inspect the electrolytic condensers, upon delivery of any sets, and to wipe the top perfectly dry.

(25-Cycle—27WX)

25 Cycle Chassis No. 27WX

This chassis uses a 25 cycle power transformer. Otherwise the constants of the circuit are the same.



DOTTED LINES SHOWN ARE IN SPEAKER.

Figure 1

MONTGOMERY WARD & CO.

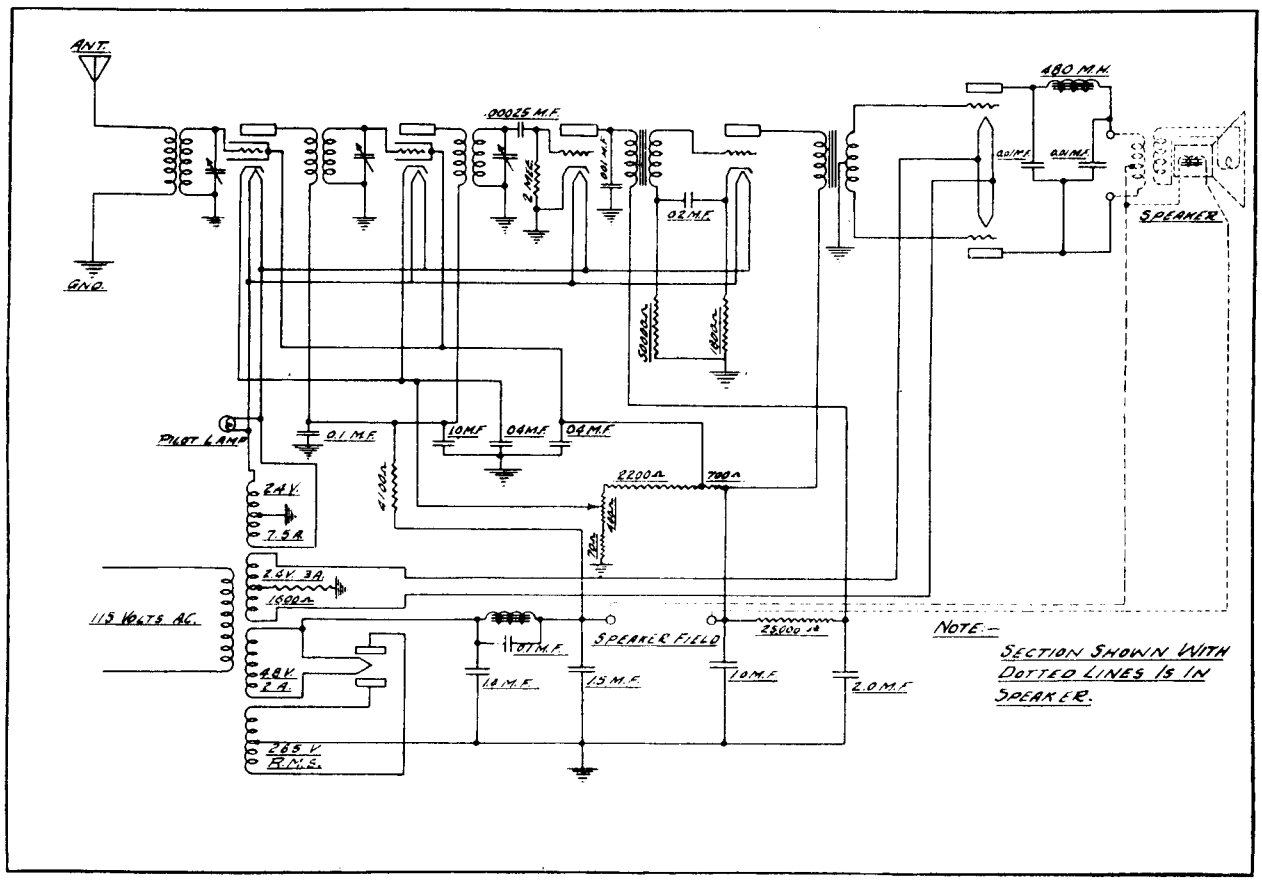
Serenader and Dictator Seven Tube Screen-Grid Receivers No. 10,000 and No. 500

The Serenader and Dictator models use identically the same chassis. The schematic diagram is given in Picture 1. Comparing this diagram with the schematic diagram of the 2800 chassis (Balboa and De Sota) you will note generally the two chassis are the same. Therefore, the service instructions given for the 2800 chassis can be used in servicing the Dictator and Serenader models, with the following changes.

The Serenader and Dictator chassis use a high frequency cut-off filter which is shown in the schematic diagram as the 480 M.H. choke and the two .01 mfd. fixed condensers while the 2800 chassis uses a regulation tone control. In case of a short in either of the two .01 mfd. condensers, no signals will reach the loud speaker. If the .01 mfd. condensers are open the filter will fail to function properly and the tone of the chassis will be of a high pitch.

Another change from the 2800 chassis will be noted in the cathode connections of the first audio stage. A .02 mfd. condenser, a 50,000 ohm resistor and an 1800 ohm resistor are connected in the cathode circuit of this stage. Any defects in the resistor or bypass condenser will give abnormal grid voltage on the first audio tube.

The Serenader and Dictator chassis use an antenna and ground lead wire while the antenna and ground binding posts are provided on the 2800 chassis.



Picture 1. Schematic Diagram of Serenader and Dictator.

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Airline
REG. U.S. PAT. OFF.

"Challenger" 7 Tube Screen-Grid

No. 11,000

Some minor changes were made in the detector circuit of the Challenger set after production was started. Picture 1 shows the original circuit, and Picture 2 shows the changes. The serial numbers of sets are shown beneath each diagram.

The Challenger Seven Tube Screen-Grid Receiver

General Description

The Challenger set is a seven-tube screen grid receiver incorporating the following tubes:

3—224's, 2—245's,
1—227, 1—280.

One of the screen grid 224 tubes is used as the detector. The other two are the radio frequency amplifiers.

R.F. Coils

The antenna coil in particular is a departure from the usual performance of antenna stages in other receivers. With the usual commercial type of antenna circuit, a short antenna will detune the antenna stage and reduce the sensitivity of the set accordingly. The antenna stage in this set is so constructed that it will not be affected by short or long antennas to any appreciable extent. The R.F. coils in each stage are marked with a color, according to the group in which they fall, and three coils of the same color are placed in the chassis. This color marking is a streak of paint inside the secondary coil inside the lugs. In ordering coils for replacement, be sure to mention the color of the paint on the coil so that the replacements will be of the same characteristics. If in doubt, return the coils.

Gang Condensers

The usual method of aligning the condenser by means of a small trimmer on the top of each individual unit is used. Trimmer condensers may be adjusted by inserting a screw driver through the hole in the condenser shield, and adjusting the screws controlling the trimmer plate. The shield should not be removed during the aligning process. At times it may be necessary to oil the drive shaft on the drum dial assembly. To do this, remove the tuning knob from the shaft and insert the tip of the oil can. Use only enough oil to lubricate, otherwise the oil will work into the contacts of the condenser.

Volume Control

The volume control system in this receiver consists of a variable resistor (R1) of 11,500 ohms resistance, connected so that it varies both the radio frequency input to the receiver (by shorting the antenna and ground) and also the grid bias on the R.F. amplifier tubes. This system controls the volume very effectively. If the volume control does not reduce the volume promptly on a strong local signal, be sure the receiver is grounded properly.

Tone Control

The tone control consists of a high variable resistor and a condenser connected across two grids of the push-pull 245 tubes. If the condenser becomes shorted, adjusting the tone control, will not affect the tone, but will act as a volume control, and in such instances, the condenser should be replaced. The variable resistor does not carry any current and therefore should seldom give trouble. If, however, it does become defective, either by a short or by opening up, no control will be obtained over the tone.

Detector Circuit

Probably the most critical portion of the set is the screen grid detector circuit, and it is essential that a good tube be used in this position. The detector circuit is a screen grid power detector. This arrangement is such that considerable sensitivity is obtained and at the same time the overload factor is somewhat higher than the usual 227 tube in other circuits. If a poor tube is used in this socket, the hum from the speaker will immediately become evident. The set will also tend to

MONTGOMERY WARD & CO.

General Troubles

bubble on strong signals. Sometimes a tube which will do this in a set appears perfectly O. K. in the tube checker. Whenever either of these difficulties develop in the set, that is to say, hum or distortion on loud signals, try several detector tubes until the trouble is eliminated.

No Tubes Light

(1) See if radio "on-off" switch is defective, or if power transformer primary is open. (2) Examine attachment cord and plug to see if connections are tight. (3) Make sure that the convenience outlet socket connections are correct, and that there is current at the socket. This test can be made with an A. C. voltmeter. (4) The tubes may all be defective.

One or More Tubes Do Not Light

(1) Examine these tubes and see if they are defective. (2) Check the filament winding on the transformer. Note: If these tests show that the filament terminals on one of the sockets are open, examine the wiring at that socket.

No Reproduction

(Tubes Lighted; Normal Hum in Speaker)

(1) One or more of the tubes may be defective; test the tubes. (2) The antenna circuit may be open. (3) The tuning condenser may be shorted, or the R.F. control grid circuits open.

No Reproduction

(Tubes Lighted; No Hum in the Speaker)

(1) One or more of the tubes may be defective. Test the tubes, especially the 280 tube. (2) The high voltage secondary on the power transformer may be defective. (3) The plate circuit in one of the audio amplifier tubes may be open. (4) The dynamic speaker coils may be open. (5) Filter condenser shorted.

Weak Signals

(1) Some of the tubes may be weak or defective; test the tubes. (2) The power supply may not be of the proper rating, or the line voltage may be low; test the line voltage with a voltmeter, and determine the frequency of the power supply by calling the local power company. (3) The antenna or ground connection may be defective, or the antenna may have been erected in a shielded location. (4) The gang condenser may not be lined up properly. This may readily occur in a set that has been in use over one year, due to normal wear. It would also be well to slightly tighten the end thrust screw on the condenser after one year's use.

If the gang condenser is out of line, that is, if one or two of the single condensers in the gang are not balanced up with the others, it will be necessary to realign the gang. The most efficient method of doing this is to use a modulated oscillator.

If the service man does not possess an oscillator he can line the condensers up by ear. Tune in some weak station around 10 or 15 on the dial (the volume control being turned full on). If no such weak station is available, a strong station may be tuned in and the volume decreased by use of the volume control until the reproduction is inaudible over three feet from the speaker.

Now adjust each individual trimmer condenser until maximum volume on that station is secured. The trimmers may be adjusted by inserting the shank of a screwdriver through the holes in the condenser shield.

Excessive Hum

(1) Excessive hum is most usually caused by a defective tube in the detector or first audio socket. (2) In certain unusual cases, hum may be caused by a defective center tapped resistor across the 224 and 227 filament winding. (3) Excessive hum may also be caused by a shorted or open filter or by-pass condenser; however, this is an extremely rare occurrence due to the high margin of safety in the voltage ratings on our condensers. (4) Hum may also be caused by an open grid circuit in the 1st A.F. This is extremely rare. (5) Try other 224 tubes in the detector socket: Note: In some cases hum may be of a mechanical nature. If the filter choke hums, examine the cardboard wedge between the side of the chassis and the choke coil. If this wedge is loose, the choke may vibrate and cause mechanical hum.

Sputtering or Motor Boating

(1) This may be caused by a defective 245 tube. (2) Sputtering or motor boating may also be caused by one of the 245 tubes not being lighted. (3) Check for an open 245 grid circuit or a defective push-pull input transformer.

Howling

(1) The most usual cause of howling is a defective or microphonic detector tube. Try other 224 tubes in the detector socket. If the 224 is microphonic and yet cannot be replaced, slip a piece of rubber hose (a Ford lower radiator hose is just the right size) down over the tube. (2) Howling is also caused by excess lengths of the antenna and ground wire inside the cabinet. The antenna and ground wires should run straight out from the cabinet, and should not run over or alongside of the chassis. (3) In extremely rare cases, a microphonic 227 tube in the first audio may cause howling.

Distortion

(1) Distortion may be caused by defective tubes, test the tubes. (2) If the grid bias on the tubes is very much higher or lower than normal, distortion may result. Check the voltages with an analyzer. (3) Distortion may also be caused by a defective audio transformer. (4) In very rare cases, distortion may be caused by C12 being open.

Voltage Characteristics

All D. C. voltages taken with a 1,000 ohm per volt voltmeter. Check your line voltage before taking readings. Volume control full on.

TUBE CIRCUIT UNDER TEST		LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
224 R. F.	Fil.	1.75	1.95	2.17	2.3	2.57
	Plate	130	150	169	183	193
	Screen	68	78	86	94	100
	Cathode*	2.0	2.43	2.83	3.2	3.6
224 Detector	Fil.	1.77	1.97	2.19	2.33	2.6
	Plate	35	40.8	45.5	50.5	55
	Screen	37.5	43	48	52	56.8
	Cathode*	2.55	3.1	3.65	4.2	4.8
227 1st A. F.	Fil.	1.79	1.99	2.22	2.34	2.62
	Plate	95	108	118	122	138
	Cathode	5.7	6.7	7.5	8.4	9.3
245 2nd A. F.	Fil.	1.8	2.0	2.23	2.35	2.62
	Plate	180	210	233	255	280
	Grid	—35	—42.3	—49	—55	—62
280 Rect.	Fil.	3.66	4.1	4.55	4.8	5.35
	Plate Current	54 ma	64 ma	73 ma	82 ma	90 ma

*Control grid voltages on the 224 tubes are measured from cathode to ground.

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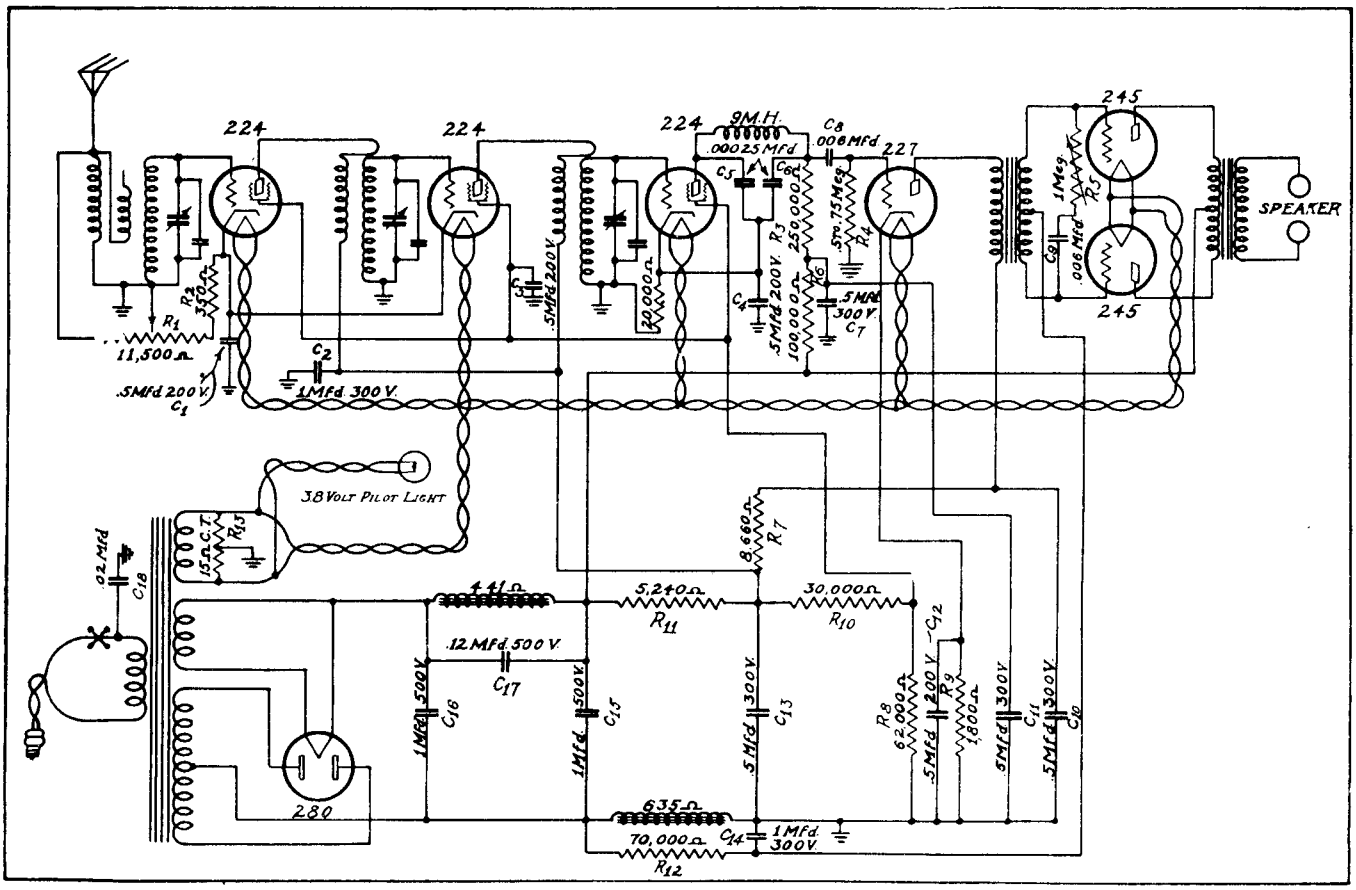
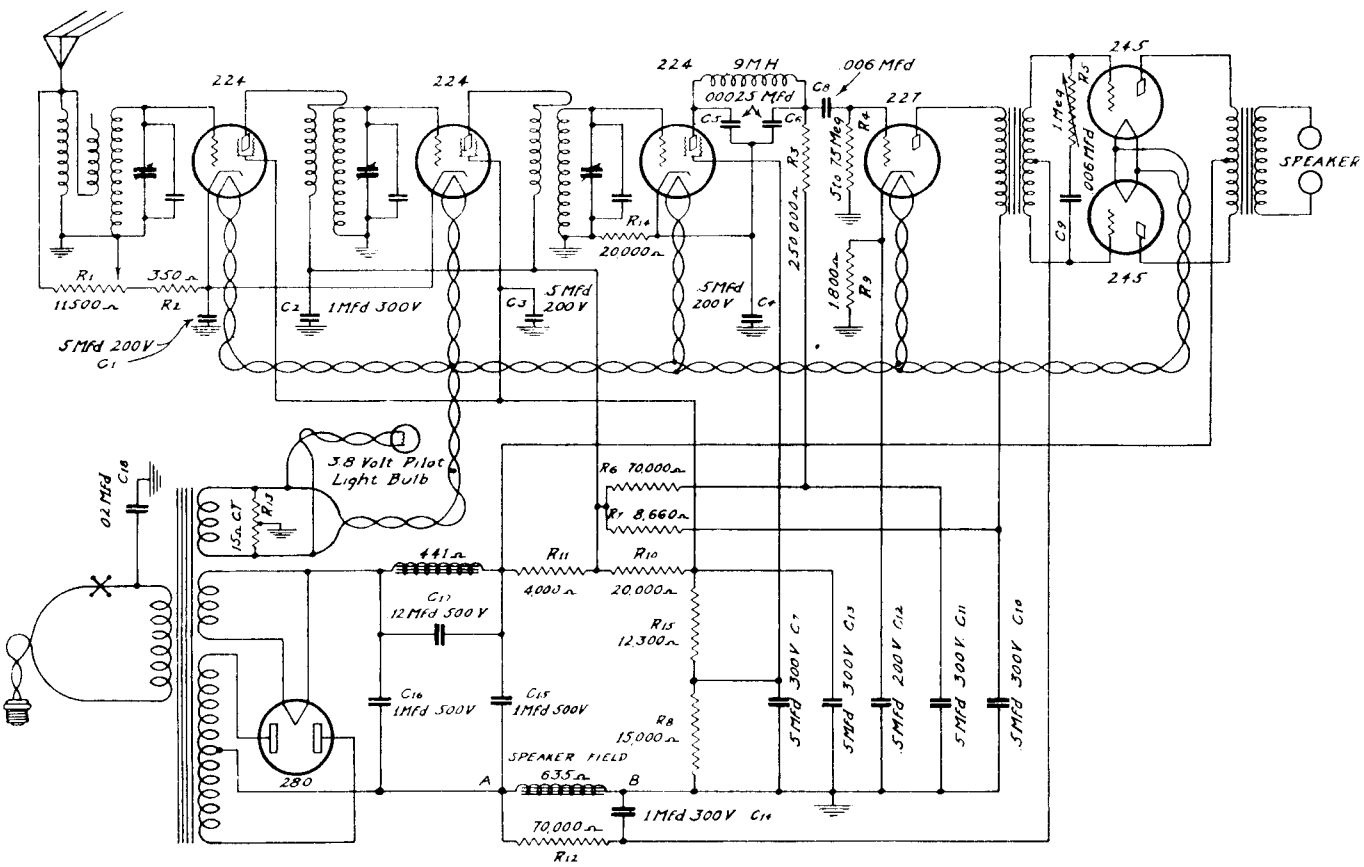


Picture 1. Schematic Diagram of Challengers with Serial Number Below A94313.



Picture 2. Schematic Diagram of Challengers with Serial Number Above A94313.

MONTGOMERY WARD & CO.

Airline
REG. U.S. PAT. OFF.

Commander and Cavalier 8 Tube
(No. 14,000) (No. 62,000)
Screen-Grid Receivers

Model 29 W chassis used in both the Commander and Cavalier sets is similar in all essential respects to the Airline Cortez and Coronado.

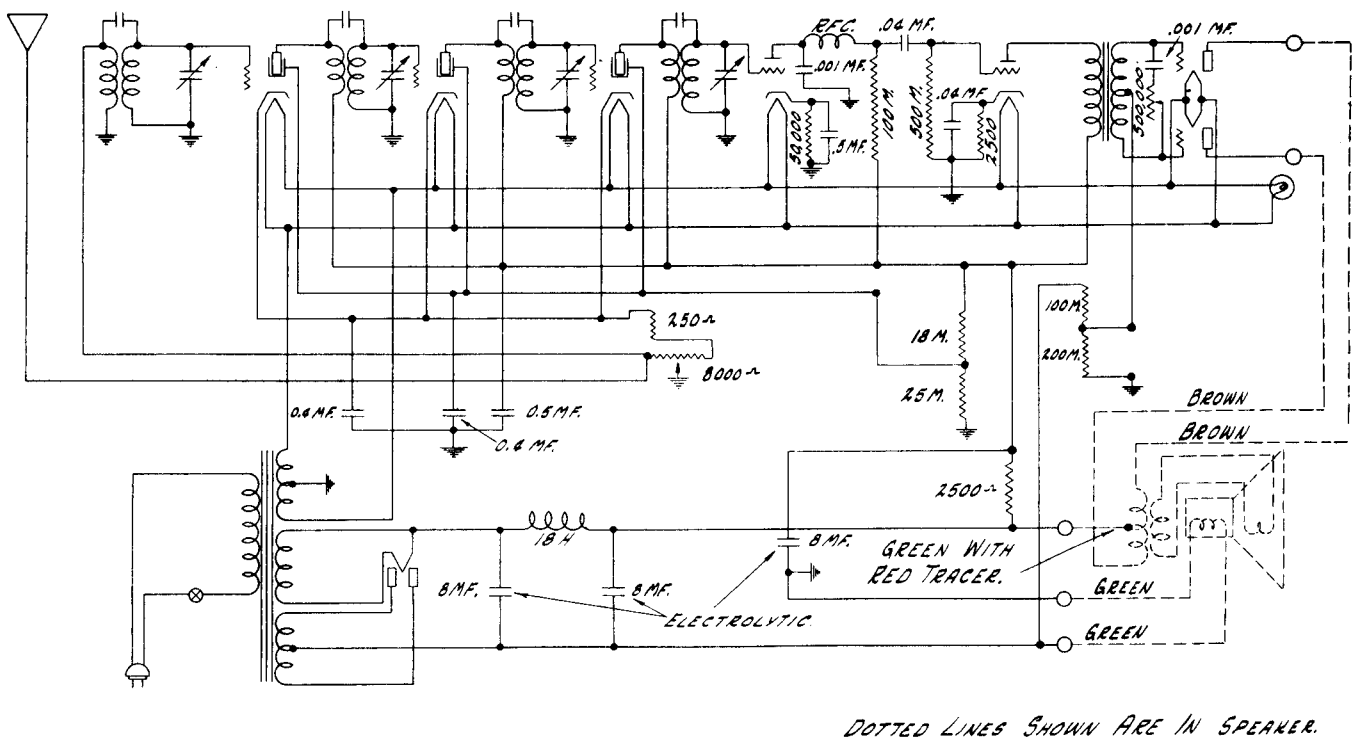
Certain changes have been made, however, which have to do chiefly with the operating voltages. The schematic diagram as compared with the diagram of the Cortez will show clearly where these changes have been made, and the operating voltages chart will show the effect that the changes have had in the voltages at the various tube sockets. In performance this chassis is quite similar to the Cortez, with the exception of slightly less power out-put when operated with the volume control full on.

Servicing instructions which apply to the Cortez also apply in the 29 W chassis. Do not forget, however, that in making any measurements with the set analyzer on the 29 W chassis, that the voltages are widely different from those used in the Cortez.

Operating Voltages

VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM—LINE VOLTAGE, 115 PLUG IN SOCKET OF RECEIVER—TUBE IN TEST SET

Type of Tube	Position of Tube	Function	A Volts	B Volts	Control Grid Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate M.A.	Grid Test M.A.
224	1	1st Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
224	2	2nd Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
224	3	3rd Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
227	4	Detector	2.3	160	17	.....	.....	17	.35	.4
227	5	1st Audio	2.3	223	15	.....	.....	15	5.9	6.9
245	6	2nd Audio	2.25	243	29.2	.....	.....	.....	27.5	32
245	7	2nd Audio	2.25	243	29.2	.....	.....	.....	27.5	32
280	8	Rectifier	4.9	.....	.....	Per	Plate	.....	.....	42.5



Picture 1. Schematic Diagram of Commander and Cavalier Sets

RCA-VICTOR, INC.

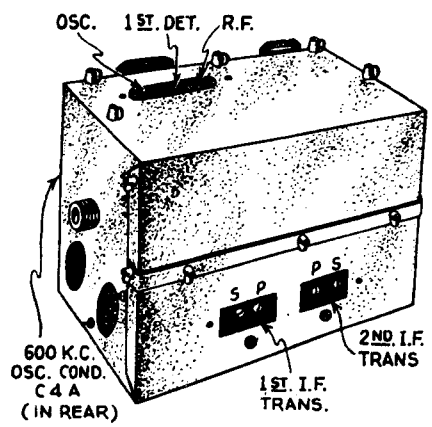
RCA-VICTOR RADIOLA MODEL M-30 AUTOMOTIVE RADIO SET

(Automatic Volume-Control—Push-Push Power Amplification—9 Tubes)

Automotive radio receivers have been undergoing a change, with the primary objective of obtaining in automobiles comparatively the same over-all efficiency which exists in the less mobile "home" installation. A close approach to this degree of perfection is obtained from the Radiola Model M-30 receiver, manufactured by RCA-Victor Co., Camden, N. J.

The values of the components of this receiver model are as follows:

Condensers C1, C2, C3, tuning condensers, 18-325 mmf.; C1A, C2A, C3A, trimmers, 4-50 mmf.; C4, padding condenser, 720 mmf.; C4A, padding trimmer, 10-75 mmf.; C5, trimmers, 15-75 mmf.; C6, trimmers, 140-220 mmf.; C7, 745 mmf.; C8, C10, 0.25-mf.; C9, C11, C12, 0.1-mf.; C13, C14, .0024-mf.; C15, C16, 0.5-mf.; C17, 4 mf.; C18, C19, .018-mf.



Resistor R1, 10,000 ohms; R2, 6,000 ohms; R3, 40,000 ohms; R4, R5, 30,000 ohms; R6, 170 ohms; R7, 0.5-meg.; R8, 28,000 ohms; R9, 0.1-meg.; R10, 1. meg.; R11, 3,500 ohms; R12, 4 ohms; R13, R14, 270 ohms; R15, 1,200 ohms; R16, 70,000 ohms; R17, 50,000 ohms.

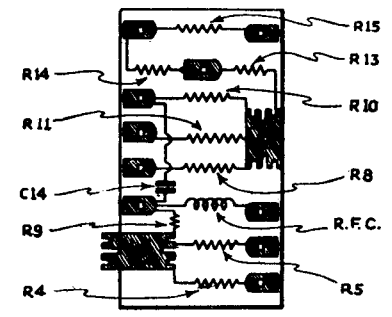
The Model M-30 receiver has been designed with particular regard to ease of installation and service. Properly installed, freedom from interference should be experienced with the receiver operating at full sensitivity. Approximate operating voltage and current values (obtained on a Weston Model 547 test set), taken with the volume control set at the "minimum" and "maximum" (maximum values shown in parentheses) positions are as follows:

Filament potential, V1 to V6, V9, 6 volts; V7, V8, 4.5 volts. Cathode-to-heater potential, V1, V4, 18 volts; V2, 1. volt; V3, 6 volts; V5, 12 volts; V6, 15 volts; V9, 10 (5) volts. Control-grid-to-cathode (or filament) potential, V1, 0.5-volt; V2, 3 volts; V3, zero; V4, 1. (0.5) volt; V5, 10 volts; V6, 2 volts; V7, V8, 20 volts; V9, 1. (9) volts. Screen-grid-to-cathode potential, V1, V4, 100 (70) volts; V2, 42 volts. Plate-to-cathode (or filament) potential, V1, V4, 136 (135) volts; V2, 150 volts; V3, 45 volts; V5, 110 volts; V6, 165 volts; V7, V8, 155 volts; V9, 15 volts. Plate current, V1, V4, zero (4 ma.); V2, 0.25-ma.; V3, V6, 3.5 ma., V5, 0.5-ma.; V7, V8, 1.5 ma.; V9, zero. Screen-grid current, V1, V4, zero (1. ma.); V2, 0.1-ma.

Automatic volume-control tube V9 is connected to the cathode circuit of second-detector V5. The change in the bias voltage of V5, due to fluctuation of the signal, is applied to the control-grid of V9, resulting in a drop across plate resistor R7 which constitutes the control-grid bias for the R.F. and I.F. tubes. As the value of the plate current in a tube is a direct result of the voltage applied to the grid, a greater plate current in V9 gives a greater voltage drop across the resistor in its plate circuit and therefore a higher bias on the I.F. and R.F. stages, resulting in less sensitivity, and vice versa; previous A.V.C. systems have operated on different principles. Manual volume-control resistor R17 varies the bias on the control-grid of V9.

The total "A" current is 2.85 amps.; "B," 12 ma. min., and 25 average max. The power output rating of this receiver is 2 watts. This high rating is a result of "push-push" (or "class B") power output, which has been described in detail in past issues of RADIO-CRAFT; notably, the January and February, 1932 issues.

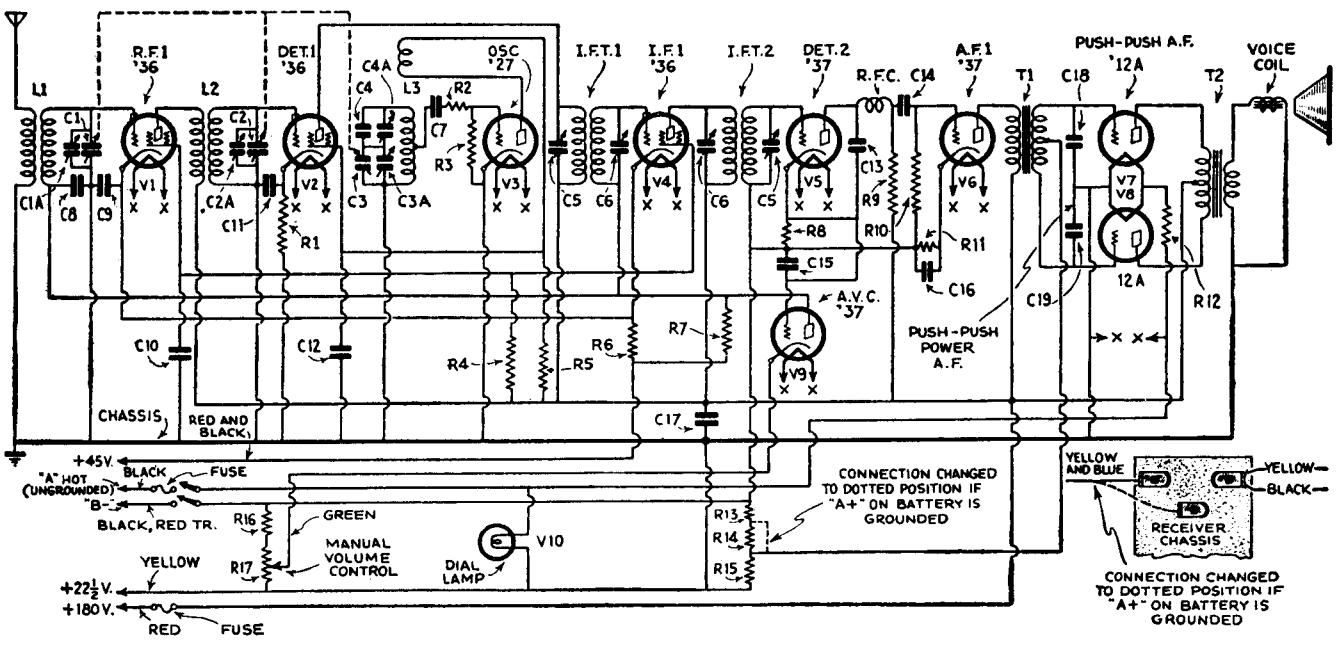
To adjust these circuits, dismount the chassis but do not remove its connections or the flexible cable. Balance the R.F. circuits at 1400 and 600 kc., using a No. 5 Spintite, and an insulated screw driver. When the dial indicates 150, the tuning condensers should be fully meshed. Padding condenser C4 comes into consideration when the 600-kc. adjustments are being made; its trimmer C4A is then adjusted, while the main condenser gang is rocked back and forth for maximum deflection on the output test meter. During these adjustments, V9 must be removed from its socket.



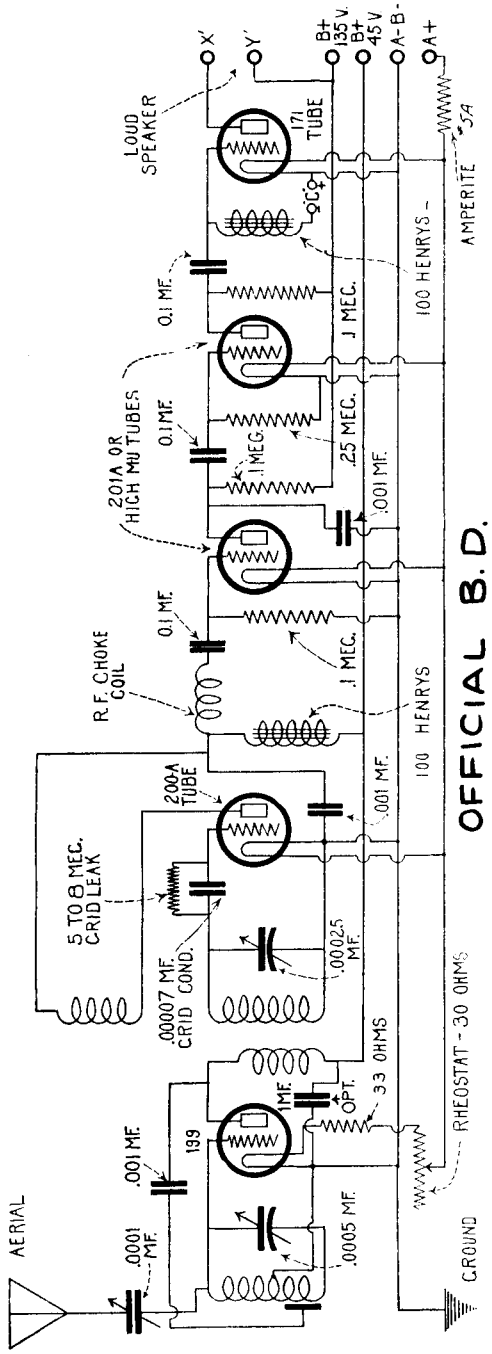
For the I.F. adjustments, at 175 kc., it is also necessary to remove the chassis from its mounting brackets.

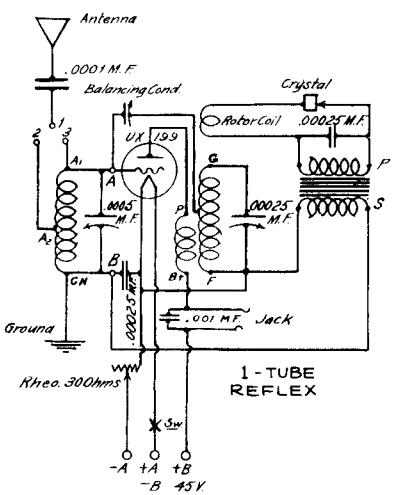
Insufficient volume-control by means of R17 may be due to the use of a tube of wrong constants for V9.

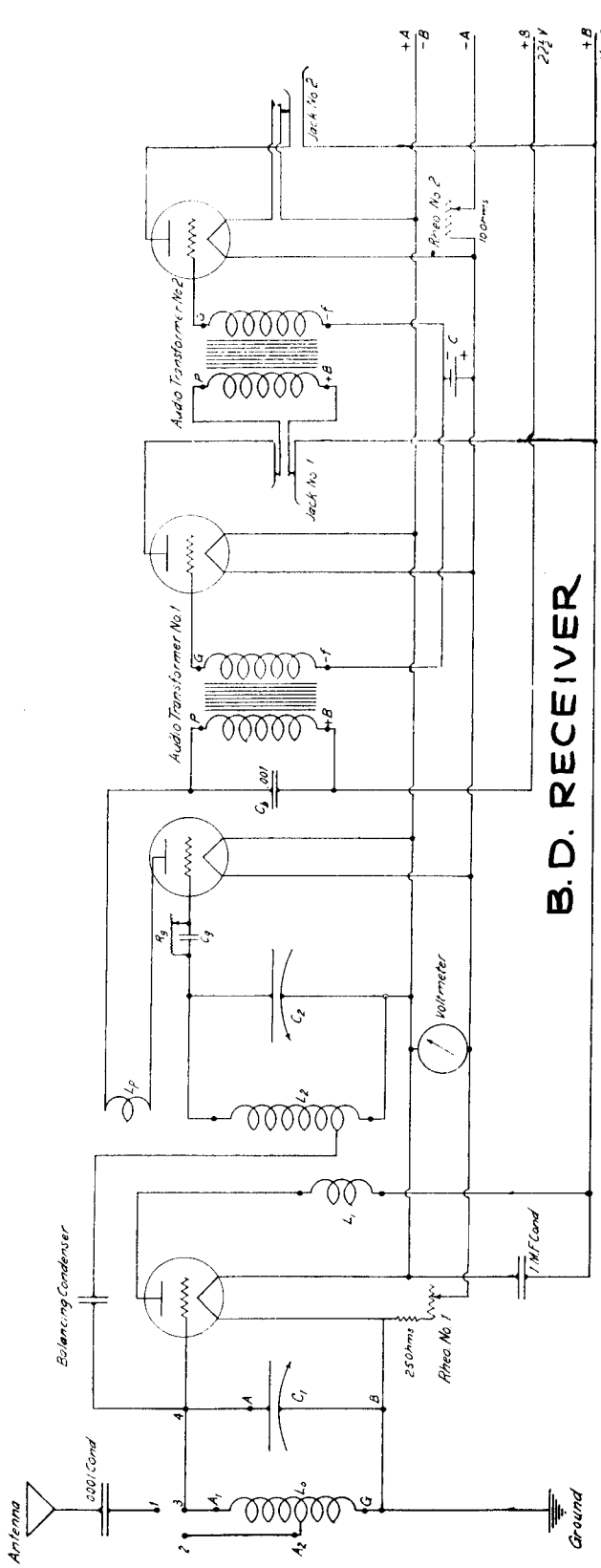
In the receiver, the tubes are arranged in two rows. In one (left to right) they are: V3, V2, V1, V4, V5, V8; in the other: V9, V6, V7.



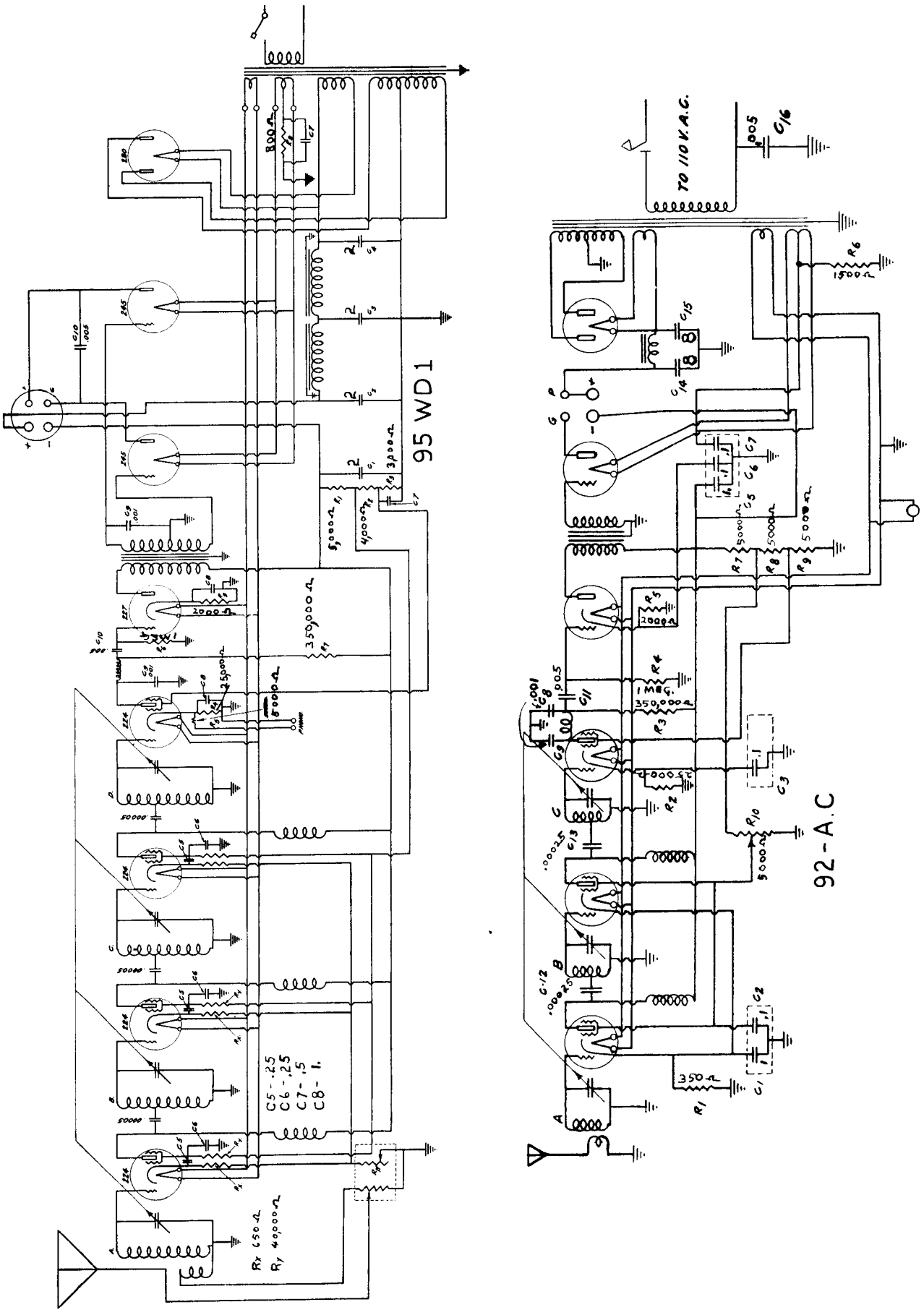
NATIONAL


X'
Y'
B+ 135 V.
B+ 45 V
A- B-
A+
LOUD SPEAKER
171 TUBE
AMPERITE 5A
100 HENRYS
.1 MEG.
.25 MEG.
.1 MEG.
.1 MF.
.001 MF.
201A OR HIGH MU TUBES
.1 MF.
.1 MEG.
R.F. CHOKE COIL
100 HENRYS
200A TUBE
.001 MF.
5 TO 8 MEG. GRID LEAK
.00025 MF.
.00007 MF. GRID COND.
33 OHMS
RHEOSTAT - 30 OHMS
1 MF.
OPT.
.001 MF.
199
.0005 MF.
AERIAL
.0001 MF.
GROUND
OFFICIAL B.D.

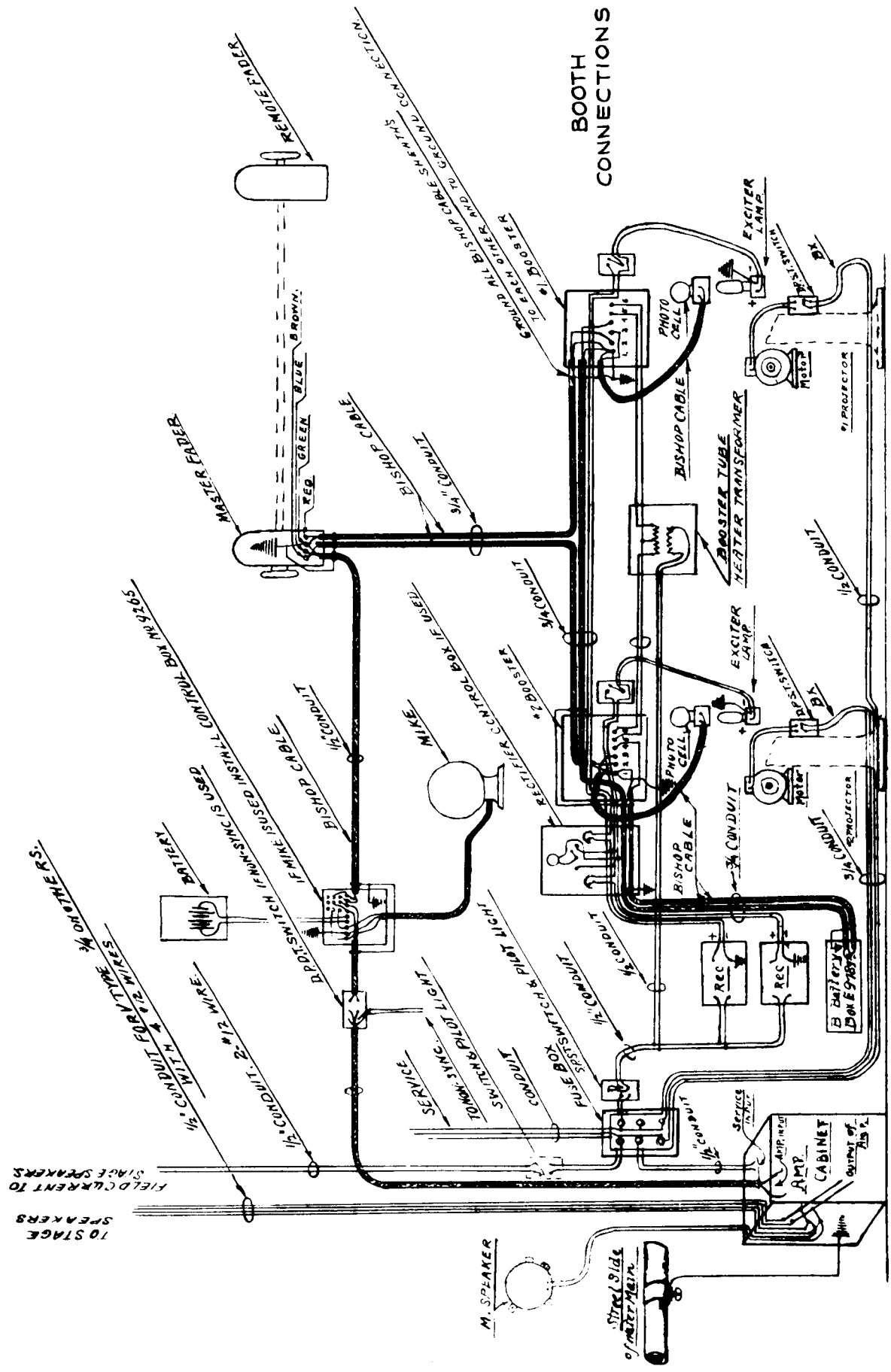

Antenna
.0001 M.F.
Balancing Cond.
Crystal
Rotor Coil
.0005 M.F.
UX 199
.0005 M.F.
.00025 M.F.
.001 M.F.
Jack
Ground
Rheo. 300hms
Sw.
-A +A +B
-B 45V
1-TUBE REFLEX


+A
-B
-A
+B
22½ V
6½ to 90 V
Jack No. 2
Rheo No. 2
100 ohms
Audio Transformer No. 2
Jack No. 1
Audio Transformer No. 1
.001
Voltmeter
Balancing Condenser
.001 Cond.
250 ohms
Rheo No. 1
.1 MF Cond.
Antenna
Ground
B.D. RECEIVER

OZARKA, INC.



PACENT ELECTRIC CO. INC.



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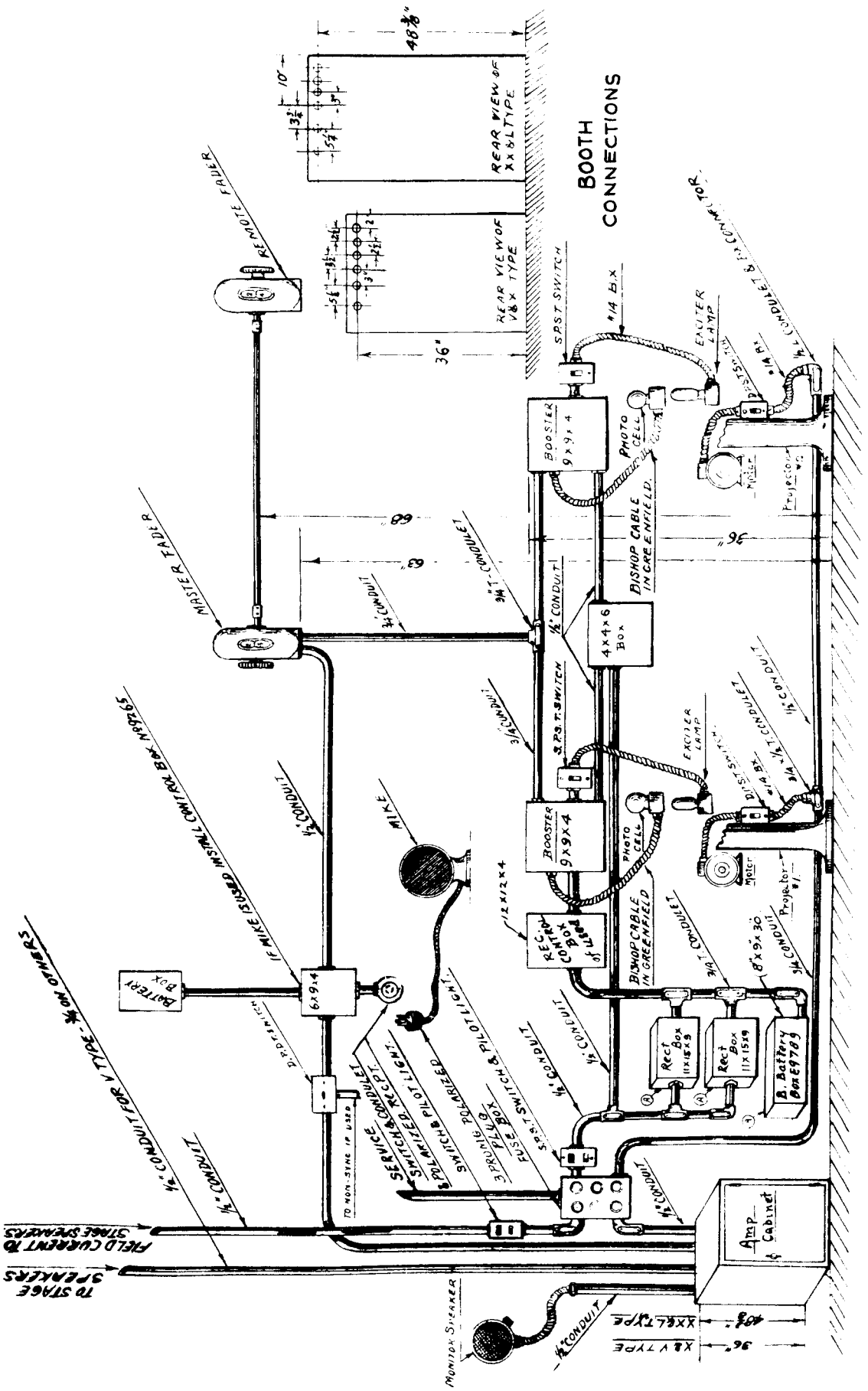

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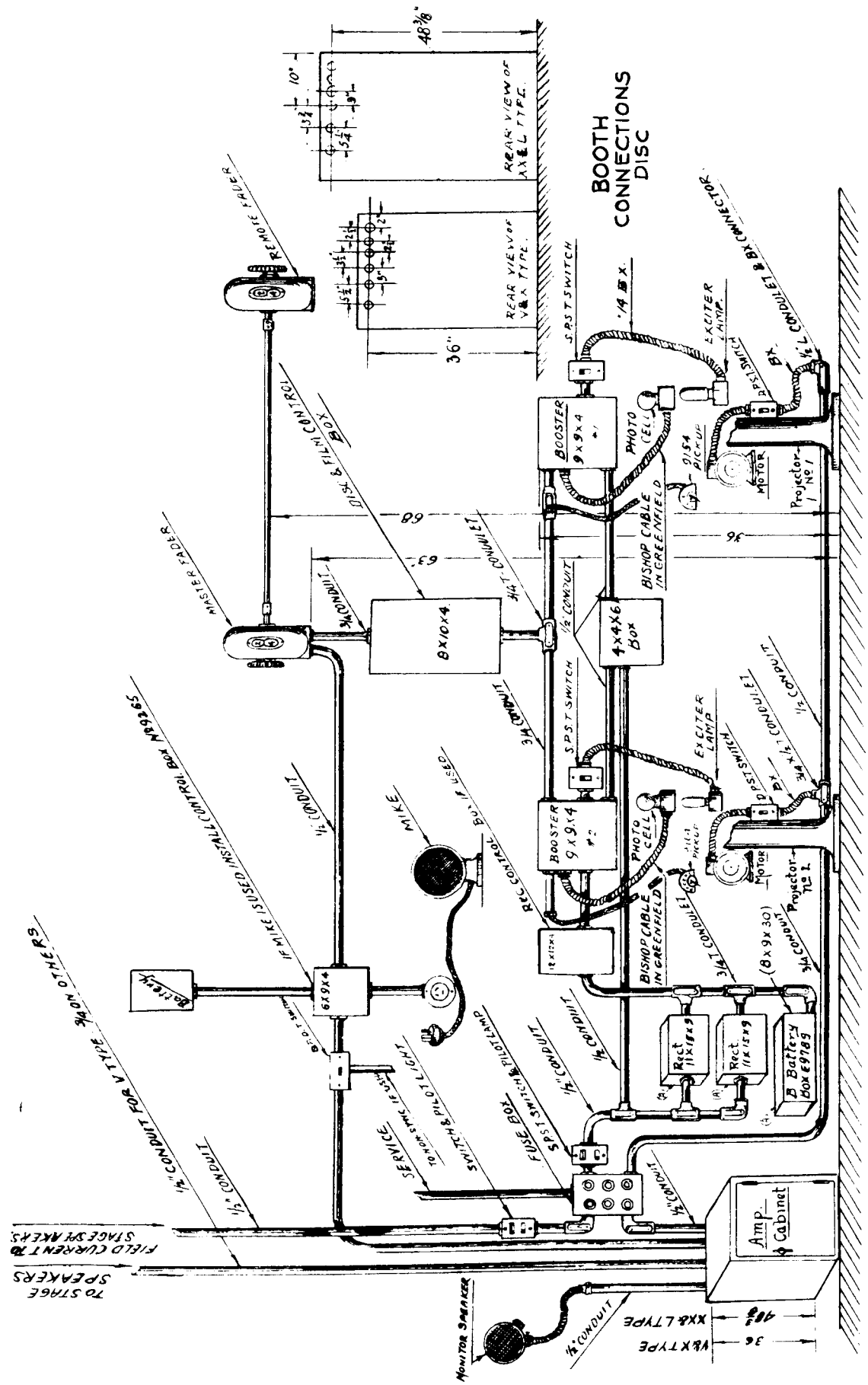


PHILA. STORAGE BATTERY CO.

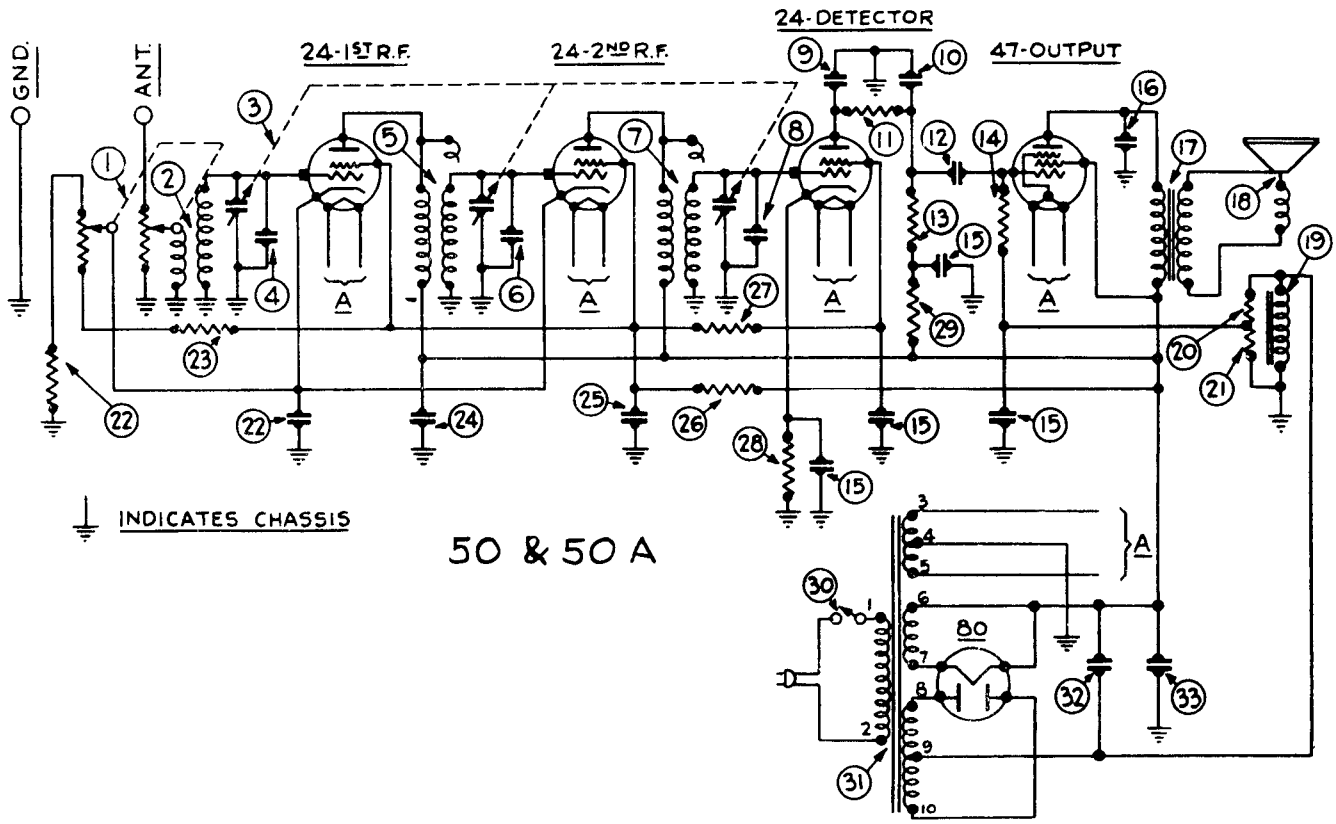


Table 1—Tube Socket Readings Taken with AC Set Tester AC Line—115 volts

Tube		Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts	Plate Milli-amperes
Type	Circuit						
24	1st R.F.	2.4	245	90	2.5	3.0	4.5
24	2nd R.F.	2.4	250	90	2.5	3.0	5.5
24	Det.	2.4	100	12	8.0	8.0	0
47	Output	2.4	175*	190*	1.0*	..	27*
80	Rect.	5.0	..	..	..	..	30

Note Volume Control on full; Station Selector turned to Low Frequency End.

*These readings must be taken from the underside of the chassis, using test prods and leads unless the set checker is specially equipped for testing pentode tubes.

Table 2—Power Transformer Voltages

Terminals	A.C. Volts		Color
1-2	105 to 125	Primary	Black (Small Gauge)
3-5	2.5	Filament of 24 and 47	Black
6-7	5.	Filament of 80	Light Blue
8-10	700.	Plates of 80	Yellow
4	.....	Center Tap of 3-5	Black, Yellow Tracer
9	.....	Center Tap of 8-10	Yellow, Green Tracer

Table 3—Condenser Data

No. on Figs. 2 and 3	Capacity MFD	Container
(9) (10)	.00025	Yellow
(12) (16)	.01	Black Bakelite Container
(25)	.05	Black Bakelite Container
(22)	.05 and 150 Ohm resistor	Black Bakelite Container
(15)	.1, .15, .25, 2-.5 (50-60 cycles)	Metal Container
	.05, .15, .25, 2-.5 (25-40 cycles)	
(24)	.05	
(33)	(50 to 60 cycles) 6.	Electrolytic
	(25 to 40 cycles) 10.	Electrolytic
(34)	6.	Electrolytic

Table 4—Resistor Data

No. on Figs. 3 and 4	Power (Watts)	Resistance	Color		
			Body	Tip	Dot
(22)		150 and .05 Mfd.	Black Bakelite Container		
(11)	.5	10,000	Brown	Black	Orange
(23)	1.	15,000	Brown	Green	Orange
(26)	1.	25,000	Red	Green	Orange
(28)	.5	32,000	Orange	Red	Orange
(27) (29)	.5	99,000	White	White	Orange
(21)	.5	160,000	Brown	Blue	Yellow
(13)	.5	240,000	Red	Yellow	Yellow
(14) (20)	.5	490,000	Yellow	White	Yellow

PHILA. STORAGE BATTERY CO.

"TRANSITONE MODEL 3"

Automotive Battery-Operated Receiver with Automatic Volume Control)

This model, manufactured by Transitone Automobile Radio Corporation, Philadelphia, Pa., bears no resemblance to previous "Transitone" models described in past issues of RADIO-CRAFT.

Of exceptional interest is the inclusion of automatic volume control; a two-element or diode detector is used. "C" bias is obtained by resistor-drop, as in socket-power sets; as the schematic circuit indicates, there are 20 resistors in this battery-model receiver.

The values of the various components are as follows: resistor R1, 10,000 ohms; R2, R7, R8, R13, 0.1-meg.; R3, R4, R6, 250 ohms; R5, R12, R20, 1. meg.; R9, R10, 30 ohms; R11, R15, 0.25-meg.; R14, volume control; R16, 25,000 ohms; R17, 50,000 ohms; R18, 500 ohms; R19, 300 ohms.

Condensers C1, C2, C3 are the usual tuning units; C4, C5, C6, C9, C10, .05-mf.; C7, C18, 1 mf.; C8, C16, 0.25-mf.; C11, C13, C14, .00025-mf.; C12, .0005-mf.; C15, .015-mf.; C17, 2 mf.

Resistors R6, R9, R10 and R20 are contained in one unit; and resistors R18 and R19 in another. Resistors R3 and R4 are combined with condensers C9 and C10.

It should be obvious that the most important single factor in correct operation of this model receiver, aside from tubes of correct characteristic, is the use of resistors of correct constants. The wattage ratings of the resistors are as follows: R1, R5, R7, R8, R11, R13, R15, 0.5-watt; R2, R12, R16, R17, 1 watt. The resistor color code is as follows: R1, black; R2, R7, R8, R13, silver gray, yellow tip; R5, R12, green, white tip; R11, R15, white; R16, brown, yellow tip; R17, orange; R18-R19, and R20, flat wire-wound.

Tube average operating characteristics are as follows: filament potentials, V1, V2, V3, 2 volts; V4, V5, V6, V7, 5 volts. Plate potentials: V1, V2, V3, 150 volts; V4, zero; V5, 45 volts; V6, 140 volts; V7, 142 volts. Control-grid potentials (negative): V5, 1.0 volt; V6, 2.5 volts; V7, 32 volts. Cathode potentials: V1, V2, V3, 2 volts. Screen-grid potentials: V1, V2, V3, 80 volts. Plate currents: V1, V2, V3, 1.5 ma.; V4, zero; V5, 1.0 ma.; V6, 3 ma.; V7, 16 ma.

If it becomes necessary to re-align the tuned circuits to obtain greater selectivity and volume, use a fiber wrench and adjust the trimmers for a signal between 1,000 and 1,200 kc.; starting first at C3.

Noisy operation may be due to a poor bond between the receiver chassis and the car chassis. A partial test for this possible source of trouble is to remove the antenna leads when noise due to this cause will continue unabated.

Lack of sensitivity, or noisy operation, may be due to close proximity of the antenna in the top of the car to the metal-work; the aerial should be spaced from *all* such conductors (for instance, the dome light) by a distance of at least 3 inches.

There is only one "A" lead; it is black, and terminates in a lug. Connect this to one of the ammeter terminals on the instrument panel, so that the current drain of the radio set does not show on the meter. The charging rate of the car storage battery should be increased about 2 amps., to compensate for the average amount of current consumed by the radio set.

After servicing an automotive receiver it is important to see that all metal parts—shielding, cable sheaths, etc.—are well grounded to the chassis of the car. Tubes and batteries after replacement must be securely fastened in place.

If it becomes necessary to replace the flexible tuning shaft, the procedure is as follows: push the free end of the flexible shaft through the bracket on the receiver so that the tip of the shaft is seated in the coupler. Tighten the two set-screws on the coupler, and then tighten the set-screw on the bracket just enough to hold the casing in place. Tune in a station of known frequency, adjusting the receiver exactly. Loosen the two set-screws on the coupler which lock the shaft in place. The flexible tuning shaft can then be turned without affecting the setting of the tuning condenser in the receiver. Set the dial scale accurately to the channel number corresponding to the station frequency, and re-tighten the two set screws on the coupler. Check at several points the relation between dial reading and station frequency.

The best material for an aerial is No. 14 or 16 copper screening, 36 in. wide. It should be used to replace all galvanized iron poultry-screen, where the twisted parts are not bonded; cutting and lacing back the latter to make room for the copper screen. Most car tops are of wooden-bow and cloth construction, with perhaps poultry-screen; but, where steel bows are used, instead, greater sensitivity sometimes is obtained by lacing in an antenna of stranded rubber-covered wire.

Poor tone quality may be due to an air space between the reproducer and the baffle (Part No. 2697-A) which should be used with it.

Standard interference suppression includes the use of standard spark-plug series resistors, a distributor (high-tension-lead) series resistor, and interference bypass condensers on the brush side of the generator cutout, and the battery or ammeter side of the ignition coil.

If this procedure (described in detail in past issues of RADIO-CRAFT magazine) does not result in sufficient suppression, it may be necessary to try the following: move the ignition coil from inside of dash to engine side of partition; shield the high- and low-tension leads from the ignition coil to the dash; and securely ground the shielding, or mount the coil on the engine side of the dash. (In some instances the construction of coil and switch may render this impossible; when it will be necessary to use a separate coil and mount it in the engine compartment). Note particularly that only in rare instances should high-tension leads be shielded; for which purpose "shielded high-tension cable" *must* not be used.

It may be necessary, in some cases, to connect the "A—" black-with-white lead to the battery instead of the battery-side of the ammeter; and perhaps shield the lead, grounding the shield (copper braid over loom) in several places—a procedure which is particularly efficacious. Improved reception then indicates that further correction should be applied: shielding of the speaker cable, and the battery cable between set and control-unit. All shielding should be grounded. (Commercial shielded-cable is preferable to separate shielding.) In some cases it is desirable to shield the lead from antenna to set; using only "shielded high-tension cable."

Interference due to dome-light coupling may be eliminated by connecting bypass condensers where these wires enter the corner post. Dirty distributor contacts may cause noisy operation; over-wide separation of its contacts may cause the same effect. Reversing the ignition coil's primary leads sometimes reduces interference. Rubbing metal parts of the car chassis occasionally require bonding to the body of the car to reduce crackling sounds; cables, rods and pipes unless grounded may act as ignition-noise carriers. Pay particular attention to the temperature-indicator tube and the oil lines.

Fender, seat, and door pads are available, for use to prevent marring the finish of a car when installing or servicing the radio installation.

Dome-light and switch wiring must be run along the side of the top frame, and along the top edge of the side of a bow to the dome-light fixture.

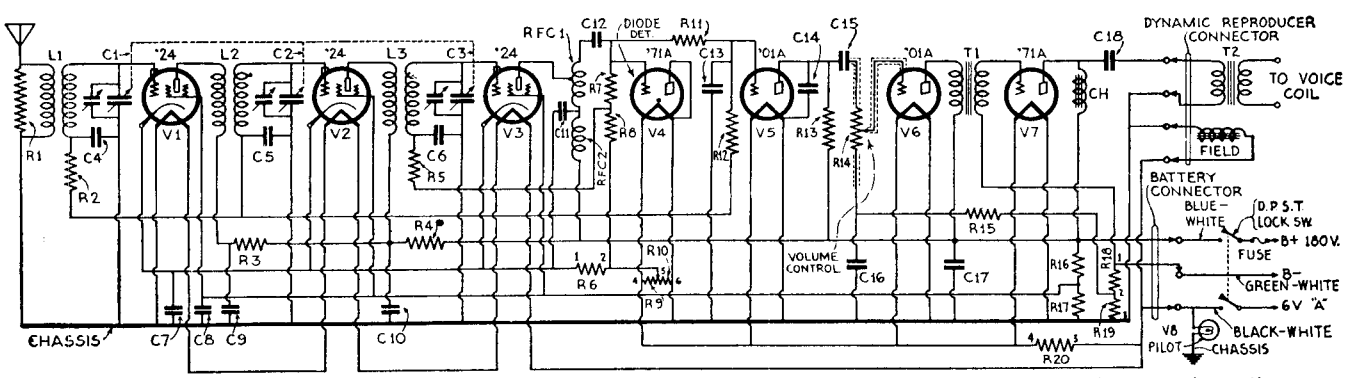
Lack of signals, or weak signals, may be an indication of a grounded antenna.

All conductors should be well insulated from the car chassis, to prevent short-circuit; while fuses in the "B—" and "A" leads adds a safety factor.

It is suggested that a complaint of poor service from the "B" batteries may be checked by reference to the speedometer's mileage indication for the period of the installation of the batteries. This figure, divided by 25, gives approximately the number of hours the radio set has been used; which, divided by the figure for the elapsed time, in days, since the installation of the batteries, indicates the number of hours per day the radio set has been in use. Heavy-duty "B" blocks should last about 600 operating days (1 hour per day), to 150 days (4 hours per day).

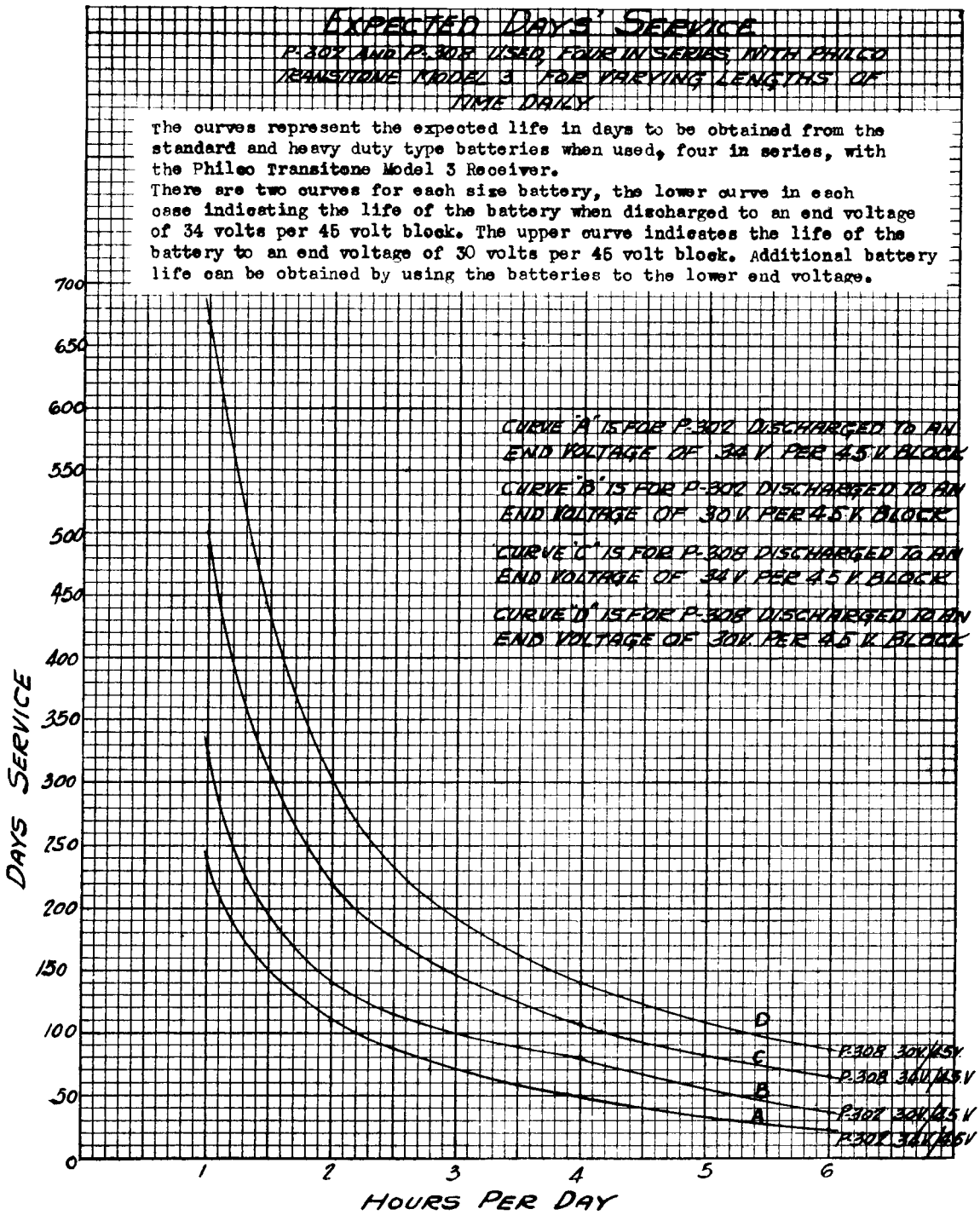
The distributor rotor should just clear all stator contacts (test chalk marks on these contacts should remain undisturbed); file the contacts; or file or peen the rotor, as may be required.

Credit for these data is hereby extended to Messrs. Robert F. Herry and Robert Long, Jr., of the manufacturer's service department.



Schematic circuit of the Philco "Transitone Model 3" receiver, incorporating automatic volume control, a necessity in automotive radio sets to overcome the effects of changing location; the total current consumption is 4 amps. The reproducer is catalogued as the "Transitone Model 3 Dynamic Loud Speaker." Resistor R14 is of standard 0.5-meg. rating.

PHILA. STORAGE BATTERY CO.



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Service Bulletin—No. 141

Model 37

The Philco Model 37 is a five tube battery operated superheterodyne receiver.

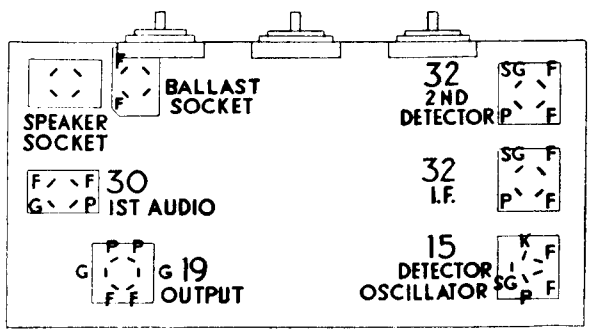
This model contains the new Philco type 15 r.f. pentode tube as detector oscillator, a type 32 screen grid intermediate frequency amplifier, a type 32 screen grid second detector, a type 30 first audio, and the new type 19 push pull (class B amplifier) output tube.

Volume equal to that of most A.C. receivers and economy in B battery operation are highly important features of the circuit. Unlike most receivers, the heavy B battery current drain, necessary to produce loud volume, is present only when such volume is actually coming through the speaker. At all other times, the current drain is small.

The filaments are supplied from the Philco Dry A battery. The chassis is equipped with an automatic voltage regulator tube which affords constant A voltage to the set throughout the life of the battery. The filament current drain from the A battery is 720 milliamperes.

The plates are supplied from standard Philco 45 B batteries. At 135 volts, the B battery current drain varies between 8 and 12 milliamperes.

The intermediate frequency of the superheterodyne circuit in this model is 175 kilocycles.



F—Filament SG—Screen Grid K—Cathode
P—Plate CG—Control Grid

Fig. 1—Tube Sockets, Under Side of Chassis

Caution.—Never connect the chassis to the power supply unless the speaker is connected and all tubes are in place.

Table 1—Tube Socket Data

Tube		Filament Volts F to F	Plate Volts P to F	Screen Grid Volts SG to F	Control Grid Volts CG to F	Cathode Volts K to F
Type	Circuit					
15	Det.-Osc.	1.9	120(P to K)	60(SG to K)	2.5(CG to K)	5.5
32	I.F.	1.9	120	60	2.5	. . .
32	2nd Det.	1.9	2.0	45	2.5	. . .
30	1st Audio	1.9	110	. .	.4	. . .
19	Output	2.0	120/Plate	. .	.4/Grid	. . .

Table 2—Resistor Data

No. in Figs. 3 and 4	Resistance (Ohms)	Color		
		Body	Tip	Dot
(18) (35)	1,000	Brown	Black	Red
(1)	2,900	Red	White	Red
(11)	6,000	Blue	Black	Red
(26)	25,000	Red	Green	Orange
(25)	51,000	Green	Brown	Orange
(27) (29) (32)	99,000	White	White	Orange
(31) (34)	490,000	Yellow	White	Yellow

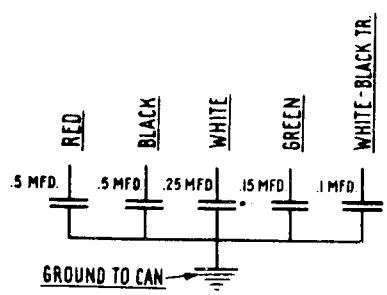


Fig. 2—Internal Connections Filter Condenser Bank

PHILCO RADIO & TELEVISION CORP.

Model 37

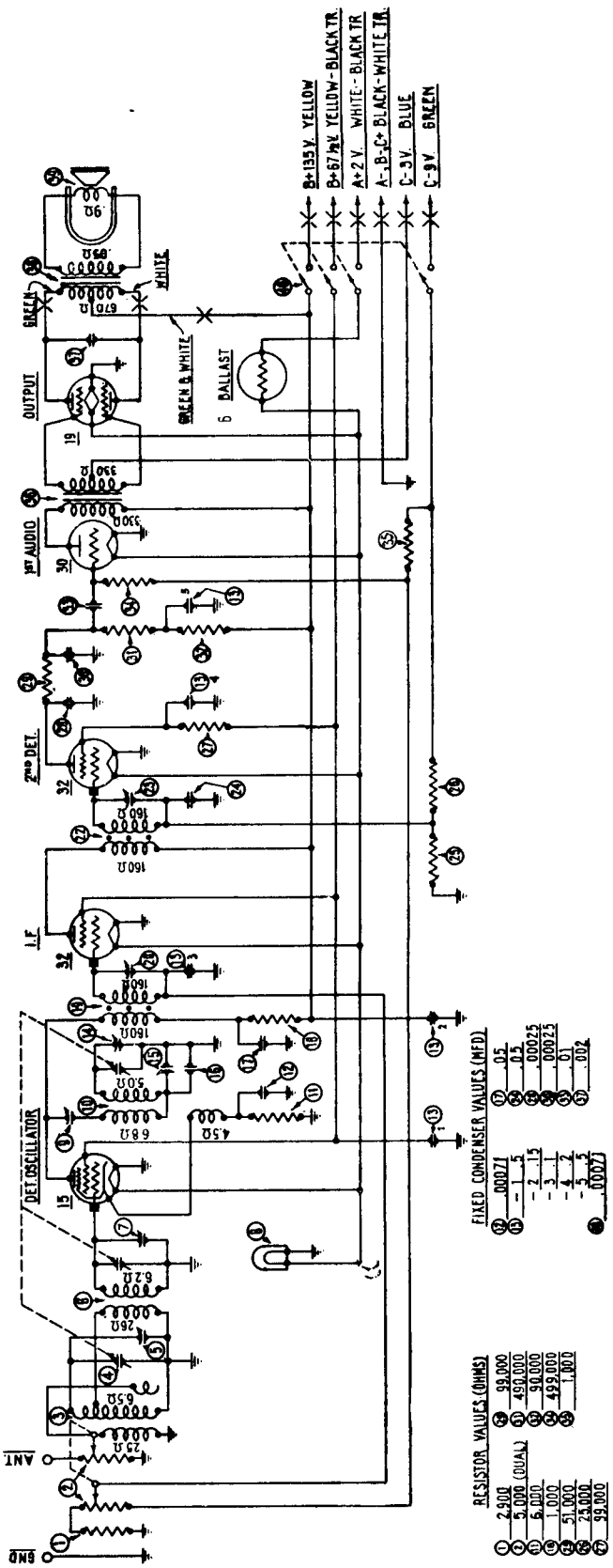


Fig. 3—Schematic Wiring Diagram

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Model 37

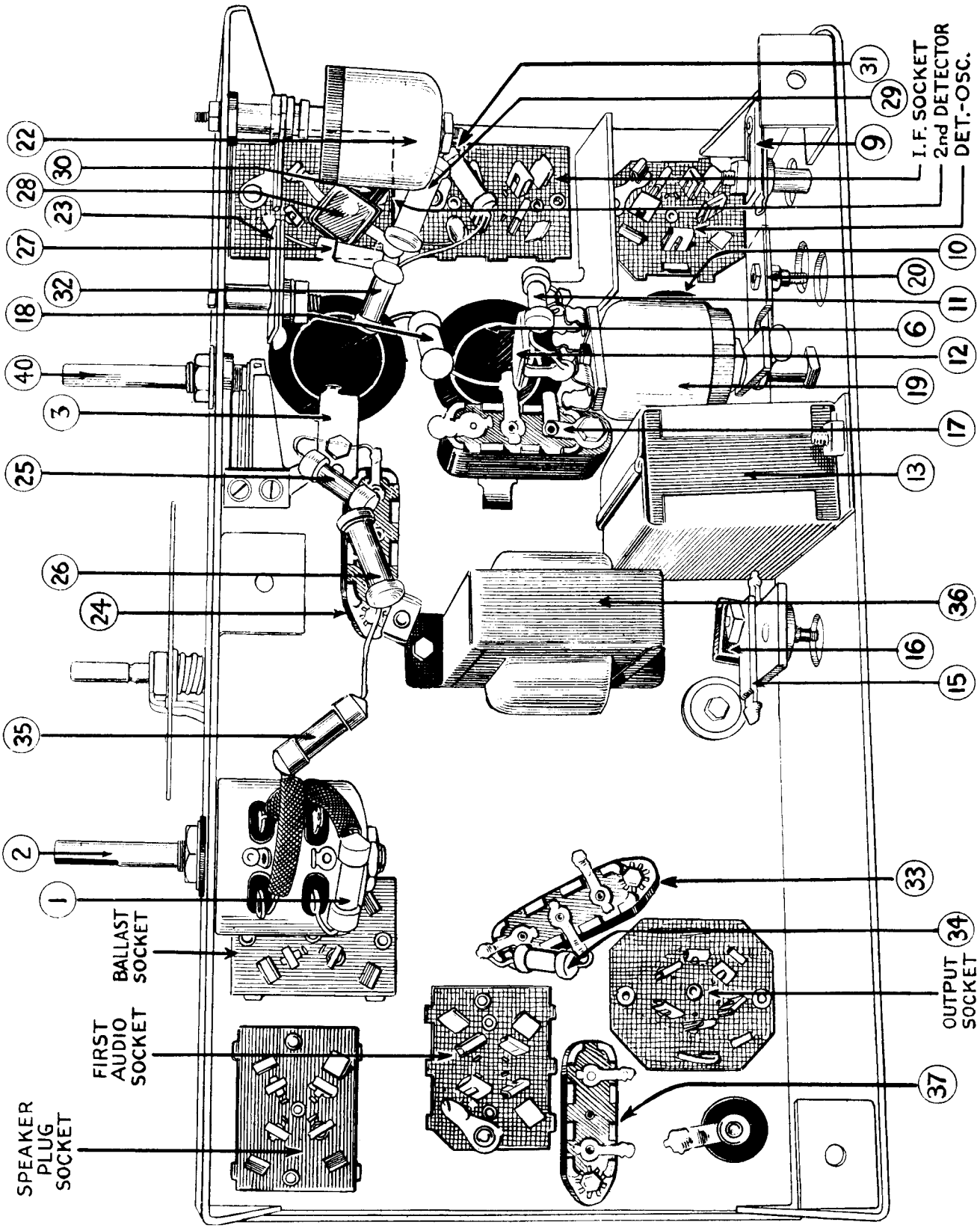

Fig. 4—Parts Diagram

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Service Bulletin—No. 120E

Adjusting Models 80 and 37

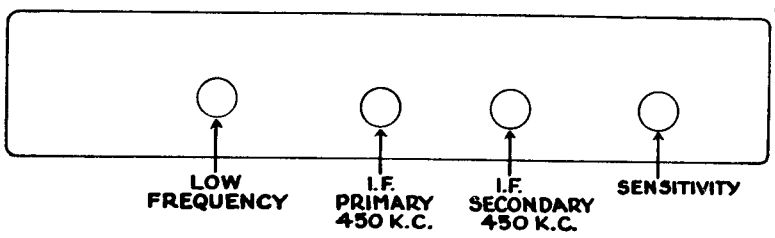

Fig. 1—Back of Model 80 Chassis, Showing Locations of Compensating Condensers.

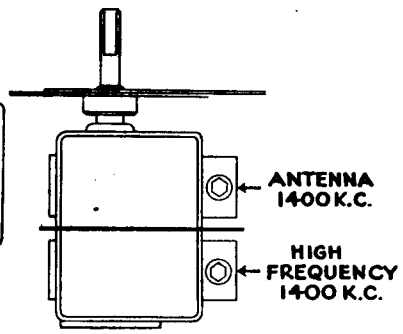

Fig. 2—Tuning Condenser, Model 80 Chassis, Showing Location of Additional Compensating Condensers.

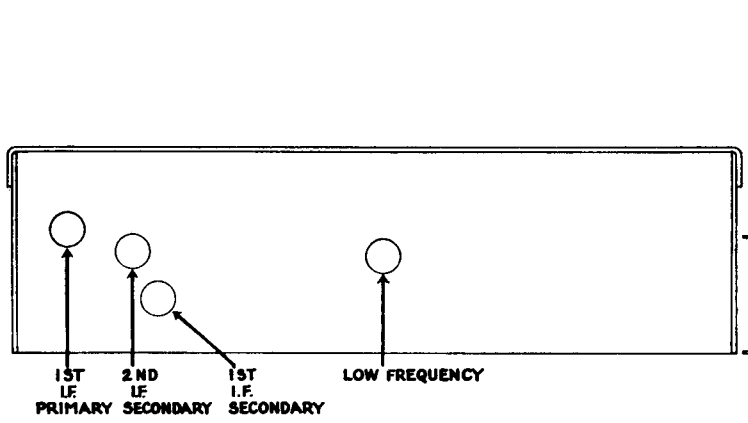

Fig. 3—Back of Model 37 Chassis, Showing Location of Compensating Condensers. The 2nd I. F. secondary condenser is mounted on the front of the chassis, but is accessible through the opening in the back as shown above.

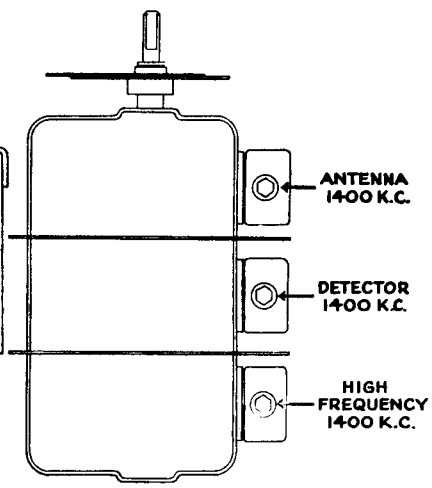

Fig. 4—Tuning Condenser, Model 37 Chassis, Showing Location of Additional Compensating Condensers.

The general method of adjusting the Philco Models 80 and 37 is the same as that for other Philco models as outlined in Service Bulletin No. 120-C. Adjustment of the I. F. compensating condensers is done first. This adjustment is then followed by the adjustment of the antenna and high frequency condensers; and finally the low frequency condenser.

It is necessary to have an accurately calibrated oscillator signal at 450 KC. for adjusting the I. F. compensating condensers in the Model 80. The Philco Model 095B Oscillator has been especially designed for this purpose, and will provide a 450 KC. signal in addition to other intermediate frequencies of 175 KC. and 260 KC. The Philco 095 oscillator can be changed readily so as to make it like the 095B. Complete instructions for this addition are outlined in Service Bulletin No. 139.

The adjustment of the "sensitivity" compensating condenser in the Model 80 should be done at the time of installation in accordance with the instructions accompanying the set.

The model 37 intermediate frequency is adjusted at 175 KC.

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Model 80

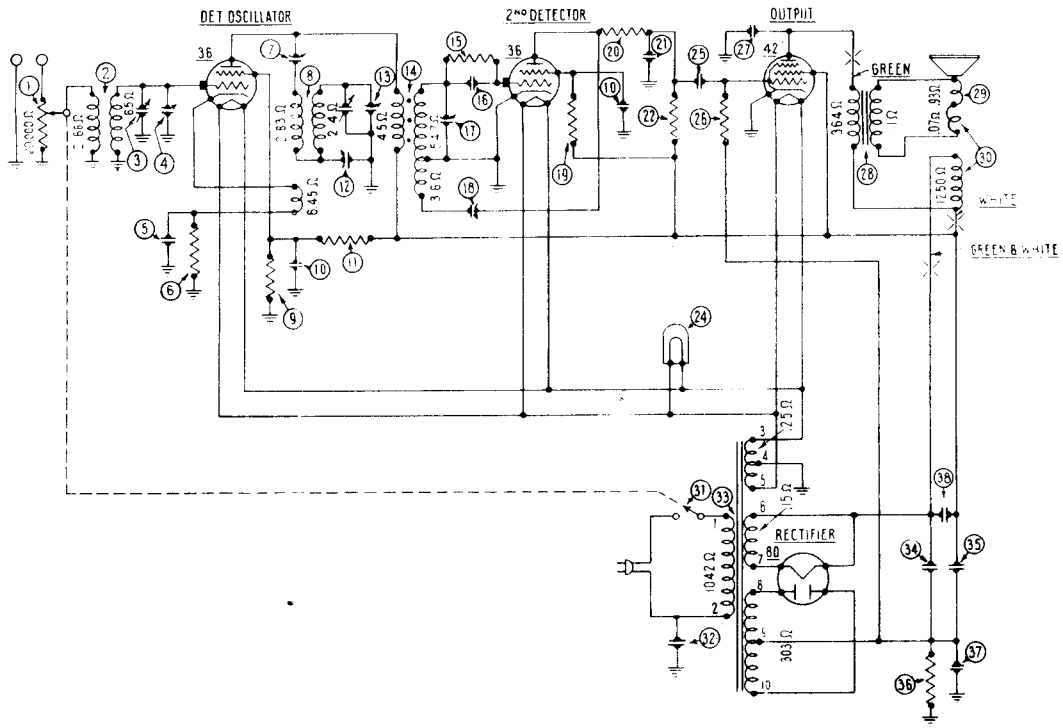

Fig. 2—Schematic Wiring Diagram

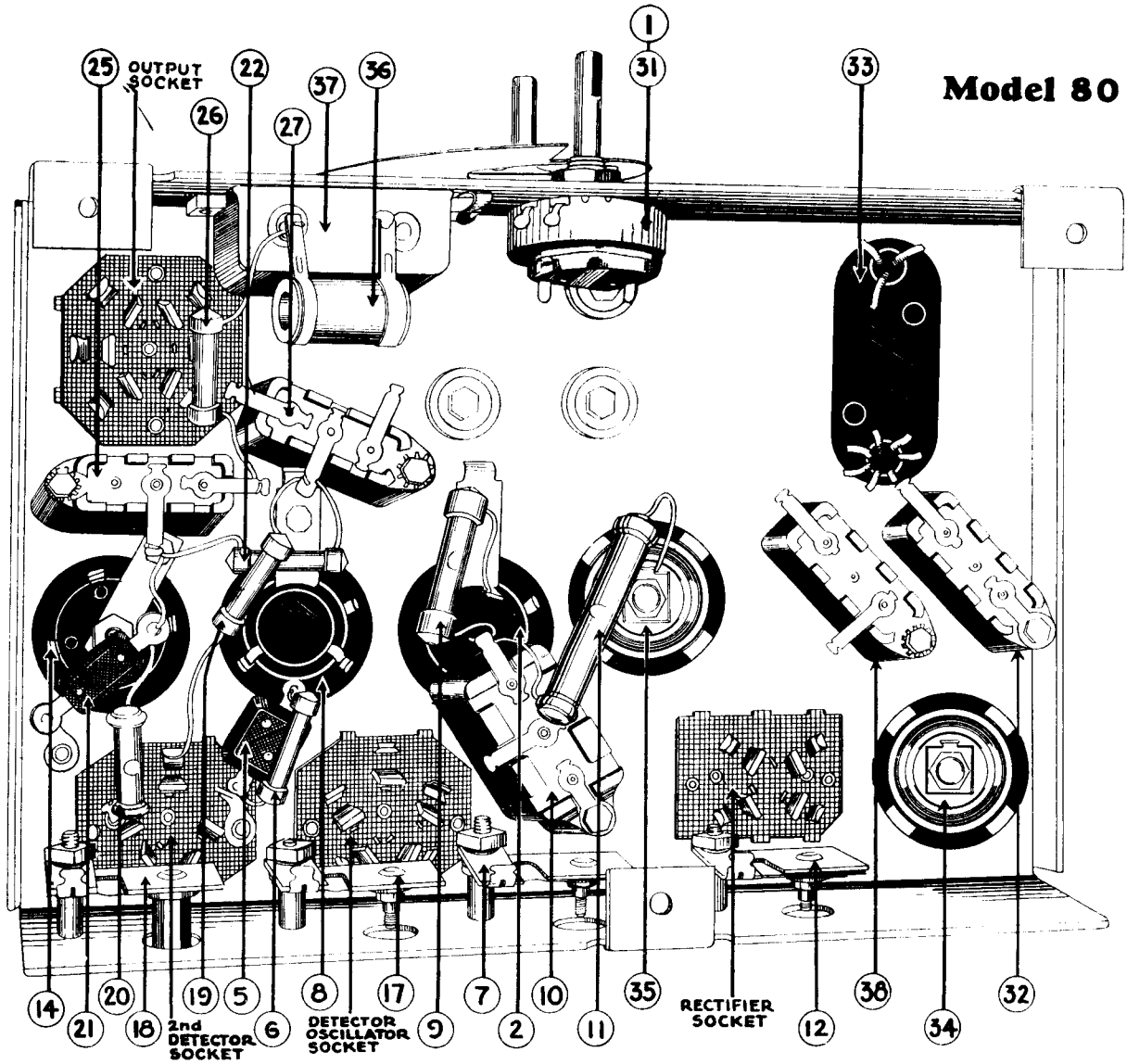

Fig. 3—Bottom View of Chassis, Showing Parts

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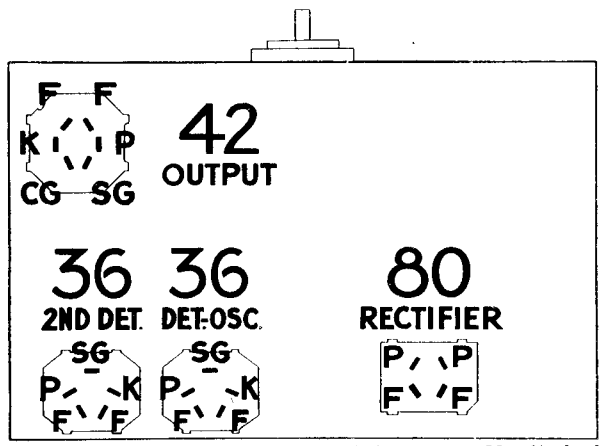
Service Bulletin—No. 140

Model 80

The Philco Radio Model 80 is a four tube superheterodyne, employing the new Philco high efficiency tubes with pentode output and electro dynamic speaker. The set uses a Philco type 36 tube as first detector and oscillator, a type 36 second detector, a type 42 output, and a type 80 rectifier. The intermediate frequency for tuning the I.F. transformer is 450 kilocycles. The power consumption of the Model 80 is 46 watts.



F = Filament SG = Screen Grid K = Cathode
P = Plate CG = Control Grid

Fig. 1—Tube Sockets, Under Side of Chassis

CAUTION: Never connect the chassis to the power supply unless the speaker is connected and all tubes are in place.

Table 1—Tube Socket Data*—Power Line Voltage 115 Volts

Tube		Filament Volts F to F	Plate Volts P to K	Screen Grid Volts SG to K	Control Grid Volts CG to K	Cathode Volts K to F
Type	Circuit					
36	Det.—Osc.	6.3	245	165	6.4	8.4
36	2nd Det.	6.3	40	15	.4	0
42	Output	6.3	240	255	4	0
80	Rectifier	5.0	340/Plate	...	...	...

*All of the above readings were taken from the under side of the chassis, using test prods and leads with a suitable A.C. voltmeter for filament voltages and a high resistance multi-range D.C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end. Readings taken with a radio set tester and plug-in adapter will not be satisfactory.

Table 2—Power Transformer Data

Terminals	A.C. Volts	Circuit	Color
1-2	105 to 125	Primary	White
3-5	6.3	Filament	Black
6-7	5.0	Filament	Blue
		of 80	
8-10	630	Plates of	Yellow
		of 80	
4	...	Center Tap	Black Yellow
		of 3-5	Tracer
9	...	Center Tap	Yellow Green
		of 8-10	Tracer

Table 3—Resistor Data

Nos. on Figs. 2 and 3	Resistance (Ohms)	Power (Watts)	Color		
			Body	Tip	Dot
(36)	325		Wire	Wound	
(9)	9,000	1.	White	Black	Red
(6) (20)	10,000	.5	Brown	Black	Orange
(11)	16,000	5.	Brown	Blue	Orange
(22)	240,000	.5	Red	Yellow	Yellow
(28)	490,000	.5	Yellow	White	Yellow
(19)	1,000,000	.5	Brown	Black	Green
(15)	4,000,000	.5	Yellow	Black	Green

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Service Bulletin No. 120C

THIS BULLETIN SUPERSEDES SERVICE BULLETINS NOS. 120 AND 120 B

Adjusting Philco Superheterodynes

The compensating condensers in every Philco Receiver are carefully adjusted before the set leaves the factory. Under ordinary circumstances they should never have to be re-adjusted in the field. Extremely rough handling during shipment, or a slight change in some of the electrical characteristics of the radio circuit may in some cases make re-adjustment necessary.

The indications that the set may require re-adjustment are poor sensitivity, poor selectivity and dial readings in kilocycles off more than 20 K.C. In some cases, an unstable condition of the set with a tendency to squeal or howl on certain sections of the dial may also be an indication of improper adjustment.

Under no circumstances should a re-adjustment be attempted unless the necessary equipment is available and unless the proper instruction has been received. Your distributor will gladly assist you in both of these matters.

The general method of adjusting the compensating condensers in all Philco superheterodyne receivers is the same. Once this procedure is understood for one model, it can be applied with but little change to the various other Philco models. By means of the instructions below and by reference to the different illustrations, the complete adjustments can be made on all Philco superheterodynes.

EQUIPMENT. The following equipment is needed:

1. Philco Model 095 Intermediate Frequency Oscillator accurately calibrated at 175 K. C. and 260 K. C., equipped with self contained output meter and batteries.
2. Philco fibre wrench, part 3164.

INTERMEDIATE FREQUENCY OR I. F. ADJUSTMENTS. The adjustment of the I. F. compensating condensers should be done in the following manner:

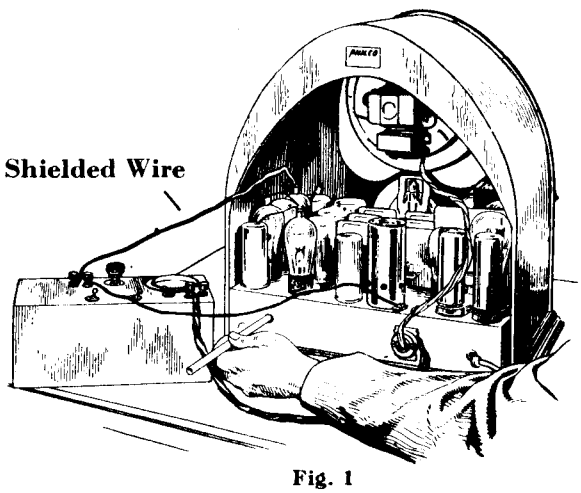

Fig. 1

1. Make the necessary connections between the oscillator and the receiver as shown in the illustration, Fig. 1. The connections consist of (a) the ground wire to the GND. terminal of the radio set and to the G terminal of the oscillator; (b) the A terminal of the oscillator through the necessary length of shielded lead, (shielding grounded) to the grid of the first detector tube (tube shield in place and first detector grid clip removed), (c) output meter terminals to the primary of the output transformer (this connection is obtained at the speaker plug and socket through the Philco plug-in adapter, part 6095); in the Philco models without a speaker plug, this connection is made to the primary of the output transformer, (d) power cord of receiver to the electric power outlet after all other connections have been completed.
2. Turn on the radio set and the oscillator. Place the oscillator switch in the 260 K. C. or 175 K. C. position, depending upon the Philco model being adjusted. See pages 3 and 4 for the intermediate frequency setting. When adjusting sets with a NORMAL-MAXIMUM switch, the switch should be placed in the NORMAL position. Turn the radio volume control to Maximum. Set the dial between 60 and 65 on the Philco scale. Adjust the oscillator control (attenuator) until a reading is obtained on the output meter of approximately ½ the scale deflection.
3. By means of the Philco fibre wrench, part 3164, adjust the various intermediate frequency condensers, one at a time, to obtain maximum reading in the output meter. Locations of all compensating condensers are shown in the illustrations on pages 3 and 4. It is desirable to start with the last I. F. compensating condenser in the circuit (3rd I. F. secondary in the case of the 11 tube models and progress in the adjustments toward the first. It may be necessary while the adjustments are being made, to lower the setting of the oscillator control from time to time so as to keep the output meter reading within the scale range.

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4. After these adjustments have been completed, remove the oscillator connection from the grid terminal of the first detector tube and restore the grid clip connection to this terminal.
5. The adjustment of the first I. F. primary (coupling) condenser may have a slight effect on the adjustment of the low frequency compensating condenser in the Philco models which have a combined oscillator and first detector tube---such as the 51 and 52 series, the latest 70 and 90 series, and the 71, 91, 15 and 47 series. After making the adjustment of the I. F condensers on these models, be sure to make the low frequency adjustment as described below.

HIGH FREQUENCY ADJUSTMENTS. Improper adjustment of the high frequency compensating condenser is characterized by weak reception and poor selectivity at the high frequency end of the dial and by dial readings being off by more than 20 K. C. at this end of the dial. Proceed in the following manner:

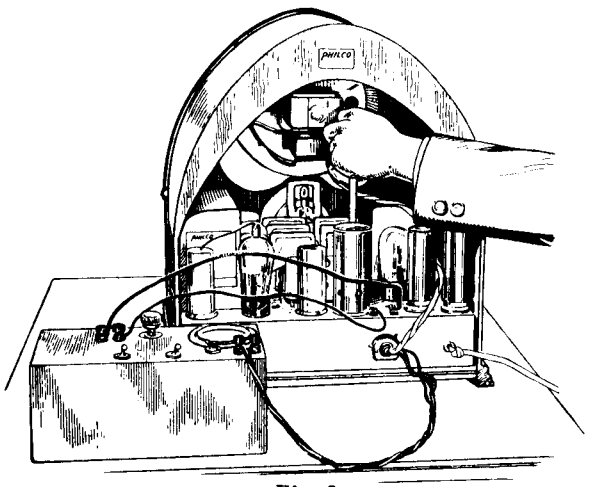

Fig. 2.

1. Connect from the A terminal of the oscillator to the ANT terminal of the broadcast receiver. All other connections remain the same as for adjustment of the I. F. compensating condensers. See Fig. 2 for complete connections.
2. Set the switch on the oscillator to 175 K. C. Set the dial of the receiver to exactly 140 (1400 K. C.). The eighth harmonic of 175 K. C. will be received at this point. Turn the volume control to maximum. Turn on the oscillator and adjust the control until a ½ scale reading is obtained on the output meter. If the receiver is badly out of adjustment, it may not be possible to obtain such a reading, in which case the meter reading must be disregarded temporarily and the adjustments made by ear.
3. Carefully adjust the high frequency compensating condenser for maximum reading in the output meter or for maximum volume if the output is not great enough to be read on the meter.
4. When making this adjustment, it may be found that a given position of the adjusting nut can be obtained at which maximum reading is noted, but that the meter reading decreases when the fibre wrench is lifted from the nut. Allow for this condition by turning slightly beyond the point of maximum reading, then when the wrench is removed the reading will go up instead of down.
5. After making the adjustment, turn the station selector slightly to note if any increase in volume is obtained as the set is being re-tuned. If such an increase is obtained, then the antenna, detector and r. f. condensers should be adjusted as described below. After this adjustment, the high frequency condenser can again be re-adjusted at 1400 K. C.
6. In some cases, when first starting to make the 1400 K. C. adjustment, it may be found that the signal from the oscillator cannot be heard at 140 because the set is so far out of adjustment. In this case, tune the set to the signal, and then adjust the Antenna Detector and R. F. condenser first. Re-adjust the high frequency condenser at 140 on the dial.

ANTENNA, DETECTOR, AND R. F. ADJUSTMENTS:

The adjustment of the antenna, detector, and R. F. compensating condensers is done at 140 on the dial in the same manner and with the same connections as for the high frequency adjustments.

LOW FREQUENCY ADJUSTMENT. The characteristics of improper adjustment of the low frequency condensers are weak reception, poor selectivity and dial calibrations off more than 20 K. C. at the low end of the dial. The low frequency adjustment is made with the same connections as for the high frequency and Antenna condenser adjustments. Proceed in the following manner:

1. With the receiver and the oscillator in operation, the latter at 175 K. C., set the Philco dial at exactly 70 on the scale.
2. With the volume control at maximum, adjust the oscillator output until the output meter reads approximately ½ scale deflection. Adjust the low frequency compensating condenser for maximum reading in the output meter.
3. If the signal comes in stronger at a position off 70 on the Philco scale, adjust for maximum output on the meter at this "Off K. C." position of the dial. Now re-tune the set slightly to obtain any further possible increase, adjusting the compensating condenser and re-tuning the dial each time so as to bring the point of maximum output as near 70 as possible.
4. Re-set the dial to exactly 140, and re-adjust the high frequency condenser. It is possible that the adjustment of the low frequency condenser has affected the high setting of the dial slightly.

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PHILCO
Service Bulletin — No. 134

Changes in Models 71 - 22L - 91 - 23X - 15

A number of changes, made in the various new models since the service bulletins were issued, are listed above. Since these changes represent minor constructional improvements, it will be unnecessary to alter any sets in stock except when difficulty is experienced. It is suggested that you mark up your copies of the bulletins so as to agree with the latest production. The changes noted can be easily understood if a bulletin is marked in this manner. All Philco Radio chasses bear a rubber stamped number on the back of the chassis. This is known as a "run number" and is used to designate minor constructional changes.

Models 71-22L

Refer to Service Bulletins 128—128-A.

Below run No. 4, unsolder top (ungrounded) connection of volume control (28) and substitute in the circuit a 240,000 ohm resistor, part 4410, one end grounded. Disconnect the condenser (32) .01 Mfd., part 3903-J, from the center tap of the volume control and from its common connection with the control grid of the detector amplifier tube and the ungrounded end of (33) resistor 1,000,000 ohms 4409. This resistor is no longer used, and can be removed.

Solder one side of the condenser (32) to top of volume control and other side of condenser to ungrounded end 240,000 ohm resistor. Solder the control grid lead of the detector amplifier tube to the variable arm connection of the volume control tube.

(49)-A Condenser .25 Mfd. part 04997, change to .5 Mfd. part 05150.

(35) Resistor 25,000 ohms 4516 used on both 121 and 221 models.

Dial complete, part 03031, change to part 04832.

Add tuning condenser drive cord, part 04834 and spring 6508

Models 91-121-221 and Model 23X

Refer to Service Bulletins No. 129 and 129-A.

Below run No. 5-91-121-221 and run No. 4 Model 23X change (3) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872. Change (26) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872.

Below run No. 4-91-121-221, run No. 3 Model 23-X, add a 490,000 ohm resistor, part 4517, across the two outside terminals of the volume control.

Below run No. 3-91-121-221, run No. 2 Model 23 X change (47) condenser .001 Mfd. part 6773 to .002 Mfd., part 6853.

Change (54) power transformer 6557 to 6804.

All 91-221 and 23 chassis using power transformer part 6804, use B. C. resistor (46)-A part 6808. Thisnew B. C. resistor does not use section 1-2 in series with center tap of high voltage secondary of power transformer. When replacing 6557 with 6804 use either 6808 B. C. resistor, or 6807 without connecting section 1-2.

Change (46) B.C. resistor part 6071 to part 6702.

(70) Shadow tuning, part 6477 change to part 6497.

Add tuning condenser drive cord, part 04834 and spring 6508

Model 15

Refer to service Bulletin No. 130.

Below run No. 26 interchange the two outside wires of the input transformer secondary.

Below run No. 27 change (47) resistor 490,000 ohms to 1,500,000 ohms, part 7009. Change (26) resistor 1,000,000 ohms to 2,000,000 ohms, part 5872.

Below run No. 25, place a 490,000 ohm resistor, part 4517, across two outside terminals of volume control.

Below run No. 22 add .002 Mfd. condenser part 6853 across the plates of the pentodes.

Add tuning condenser drive cord, part 04916 and spring 6508.

(68) Electrolytic condenser (.6 Mfd.) part 6707 changed to 4916.

(70) Electrolytic condenser (.6 Mfd.) part 6706 changed to 4916.

Model 22L and 23X

Phonograph motor circuit controlled by radio A.C. switch. This is done by changing A.C. power leads to motor from live side of the radio A.C. switch to the transformer side. Change switch indicator 4227 to 4277.

In the Philco Parts Catalogue under Power Transformers change 71-221 part 6454 to 6457. Change 71-A-221 part 6455 to 6458. Change 91-221 part 6557 to 6804. Change 91-A 221 part 6558 to 6805. Under Input Transformers, add part 3241 for Model 3.

PHILCO RADIO & TELEVISION CORP.

PHILCO

Service Bulletin — No. 136

Adjustment of Shadow Tuning

Philco shadow tuning is one of the greatest aides to correct tuning ever developed so it is important that this device be properly adjusted on each set before being placed in operation. There are no adjustments inside the shadow box, but there are a few simple adjustments of the position of the box and the position of the pilot lamp.

INSTALLATION

The shadow tuning box is purposely moved back away from the bezel during shipment so as to avoid breakage. When the set is placed in operation, and after the chassis mounting bolts have been loosened, the two mounting screws at each side of the shadow box should be loosened by means of a short screwdriver, and the box moved forward to the bezel. The position of the box can be adjusted so that the shadow is centered with respect to the bezel opening.

POSITION ADJUSTMENTS

In some cases, it may be found that the position or the intensity of the shadow on the screen is not entirely satisfactory because of slight changes during shipment. The necessary re-adjustments can be made in the manner outlined below, first turning on the radio and removing the type 80 tube.

1. **Shadow too faint.** Move and focus lamp by bending the bracket slightly to obtain a sharp shadow of the smallest possible width exactly in the center of the screen.

2. **Shadow not centered on screen.** Move and focus lamp as described above.

3. **Shadow not sharp on one side.** Pry off the lamp reflector and adjust the lamp position by turning lamp and socket in a clockwise direction until the filament supports are parallel to the back of the shadow tuning box. Ordinary pilot lamps with inverted U shaped filament will not be satisfactory since they do not produce a concentrated light and a sharply defined shadow. The new Philco pilot lamps have a relatively straight filament which gives better light concentration. It may be necessary to make a further adjustment by bending the bracket as described in 1. above.

4. **No light on screen.** Adjust reflector on pilot lamp.

5. **White light between screen and bezel opening.** Loosen shadow tuning box mounting screws, and move box forward against back of bezel. Center shadow properly with respect to bezel opening.

Replace the 80 tube after completing the above adjustments.

RADIO ADJUSTMENTS

After the above adjustments have been made, the shadow tuning box may be checked for operation by tuning in a number of stations. The following suggestions are offered in case of difficulties:

1. **No change in shadow width when tuning in weak signal.** Change first detector and first I. F. tubes in Model 15 and R. F. and I. F. tubes in Models 91 and 23.

2. **Insufficient change in shadow width on all stations.** Look for faulty aerial connection or too small aerial.

3. **Shadow remains at minimum width while dial is turned several divisions.** Compensating condensers out of adjustment, causing set to be broad in tuning; station signal extremely broad

DO NOT ATTEMPT TO MAKE ANY ADJUSTMENTS INSIDE THE SHADOW BOX.

PHILA. STORAGE BATTERY CO.

Model 30

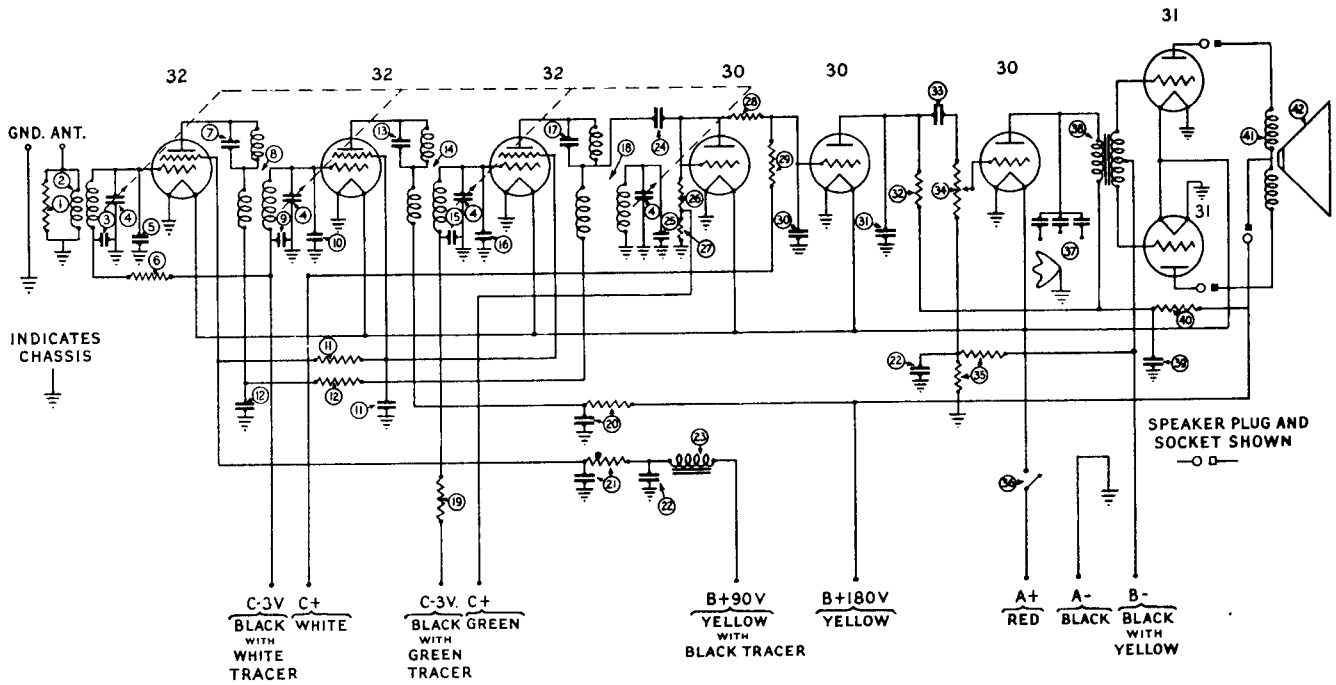


Table 1—Tube Socket Readings Taken with Average Set Checker

Tube	Circuit	Filament Volts	Plate Volts	Grid Volts	Plate Current Milliamperes	Screen Grid Volts
32	1st R. F.	2.0	150	..	.0015	60
32	2d R. F.	2.0	150	..	.0015	58
32	3d R. F.	2.0	150	..	.0015	58
30	Detector Rectifier	2.0	...	..	....	..
30	Detector Amplifier	2.0	15	...	....	..
30	1st Audio	2.0	90	Note 1	.002	..
31	2d Audio	2.0*	150	24	.008	..
31	Push-Pull	2.0*	150	24	.008	..

*These readings reversed with respect to other Filament Voltage readings.

NOTE 1. With volume control in "Off" position, approximately 4 volts; with volume control full on, less than 1 volt.

Always use high-resistance voltmeter, preferably 1000 ohms per volt, when checking voltages in the Receiver. For reading plate and screen voltages, use a 250- or 300-volt scale. Voltage readings taken with meters having less than 250,000 ohms resistance will be lower than voltages given in the table.

When testing a Model 30 Receiver, all tubes must be in their proper sockets. The speaker must be connected and the tube shield must be fastened in place. The readings in Table 1 were taken using "A," "B" and "C" batteries.

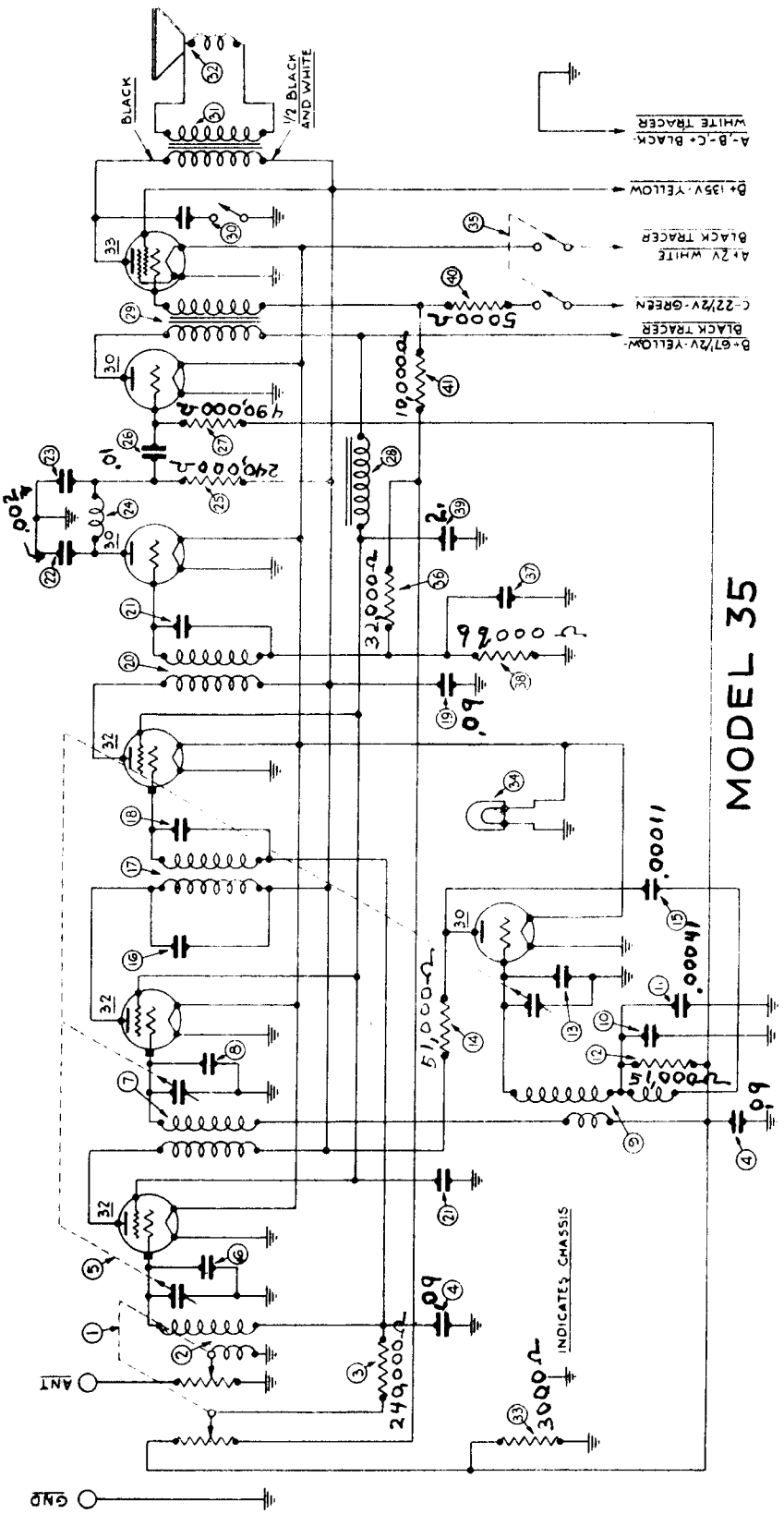
Table 2—Resistor Data

No. on Figs. 1 and 2	Color	Resistance Ohms
(1)	Golden Yellow	5,000
(40)	Auto Buff	25,000
(6)	Jade Green	70,000
(26) (27)	Silver Gray	100,000
(28)	White	250,000
(19) (29) (32)	Battleship Gray	500,000
(35)	Tubular (two section)	250 / 800

Table 3—Condenser Data

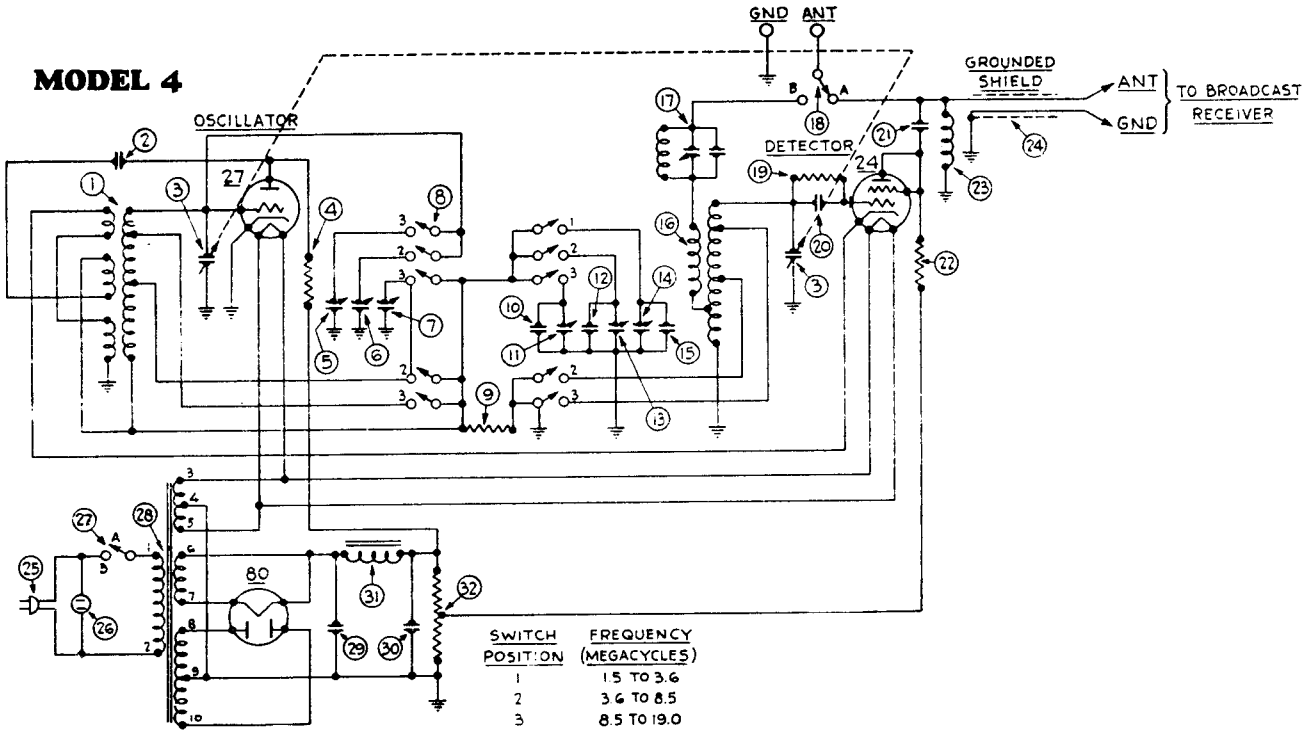
No. on Figs. 1 and 2	Capacity—MFD.
(24)	.00005
(30) (31)	.000250
(33)	.01
(3) (9) (15)	.05
(11) (12) (20) (21)	.05 with 250-ohm resistor winding
(39)	.25 single section
(22)	.25 two sections

PHILA. STORAGE BATTERY CO.



PHILADELPHIA STORAGE BATTERY CO.

MODEL 4



Model 4 Receivers are for operation on 115 volt, 50-60 cycle AC lines

Table 1—Tube Socket Readings—Line Voltage—115 volts

Tube		Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts
Type	Circuit					
27	Oscillator	2.4	110	..	.1	0
24	Detector	2.4	25	25	.3	0
80	Rectifier	5.0	170/170	..	..	..

NOTE: The above voltage readings were taken from the socket terminals on the underside of the chassis, using a Weston multi-range voltmeter, 1000 ohms per volt. The radio set tester cannot be used either for voltage or plate current readings because of the effect of the long leads through the set tester cord.

Table 2—Power Transformer Voltages

Terminals	A. C. Volts		Color
1- 2	105—125	Primary	White
3—5	2.5	Filament of 24 and 27	Black
6—7	5.0	Filament of 80	Light Blue
8—10	340	Plates of 80	Yellow
4	...	Center Tap of 3—5	Black with Yellow Tracer
9	...	Center Tap of 8—10	Yellow with Green Tracer

Table 3—Condenser Data

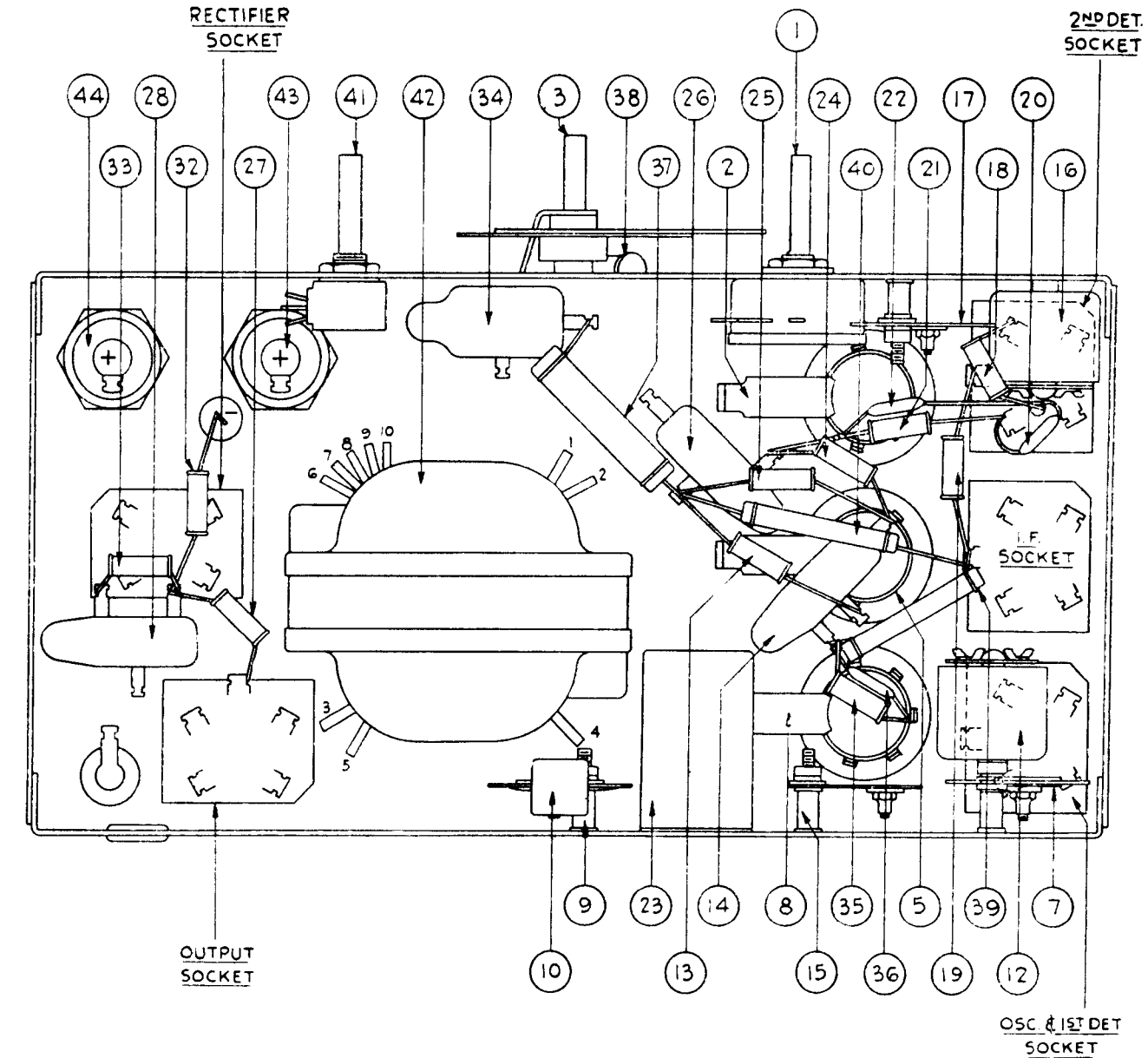
Nos. on Figs. 1 and 2	Capacity Mfd.	Container
(20)	.00011	Blue and Golden Yellow
(12)	.0008	Green and Orange
(10)	.00125	Blue and Orange
(2)	.05	Black Bakelite Container
(29) (30)	6.	Electrolytic

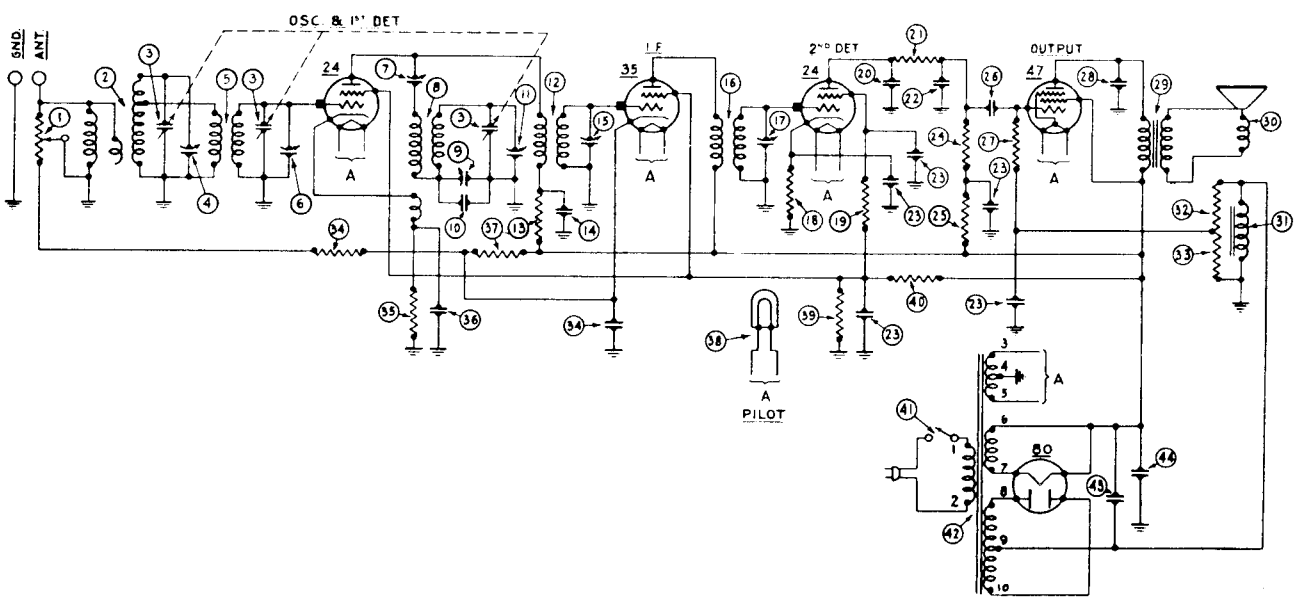
Table 4—Resistor Data

Nos. on Figs. 1 and 2	Power (Watts)	Resistance (Ohms)	COLOR		
			Body	Tip	Dot
(32)		4750 } 4750 }	Long Tubular		
(4)	1.	13000	Brown	Orange	Orange
(22)	1.	99000	White	White	Orange
(9)	.5	240,000	Red	Yellow	Yellow
(19)	.5	2 Megohms	Red	Black	Green

PHILADELPHIA STORAGE BATTERY CO.

PHILCO MODELS 51 AND 51-A





PHILADELPHIA STORAGE BATTERY CO.

Models 51 and 51-A Receivers

Model 51 Receivers are for operation on 100-130 volt, 50-60 cycle AC line
Model 51-A Receivers are for operation on 100-130 volt, 25-40 cycle AC line

Table 1—Tube Socket Readings Taken with AC Set Tester AC Line—115 volts

Tube		Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts	Plate Milli-amperes
Type	Circuit						
24	Osc. & 1st Det.	2.2	220*	85*	9.0*	9.0*	...
35	I.F.	2.2	210	85	3.0	3.0	6.2
24	2nd Det.	2.2	75	54	5.2	5.2	0
47	Output	2.2	210**	240**	0.2**	...	28.**
80	Rect.	5.0	240/Plate	...	...	...	30/ Plate

Note—Volume Control on full; Station Selector turned to Low Frequency End.
*These readings must be taken from the underside of the chassis, using a suitable high resistance D.C. voltmeter equipped with test prods and leads.
**These readings must likewise be taken from the underside of the chassis unless the set tester is especially equipped for testing pentode tubes.

Table 2—Power Transformer Voltages

Terminals	A.C. Volts	Connection	Color
1-2	105 to 125	Primary	Black (Small Gauge)
3-5	2.5	Filament of 24, 35 and 47	Black
6-7	5.	Filament of 80	Light Blue
8-10	700.	Plates of 80	Yellow
4	.....	Center Tap of 3-5	Black, Yellow Tracer
9	.....	Center Tap of 8-10	Yellow, Green Tracer

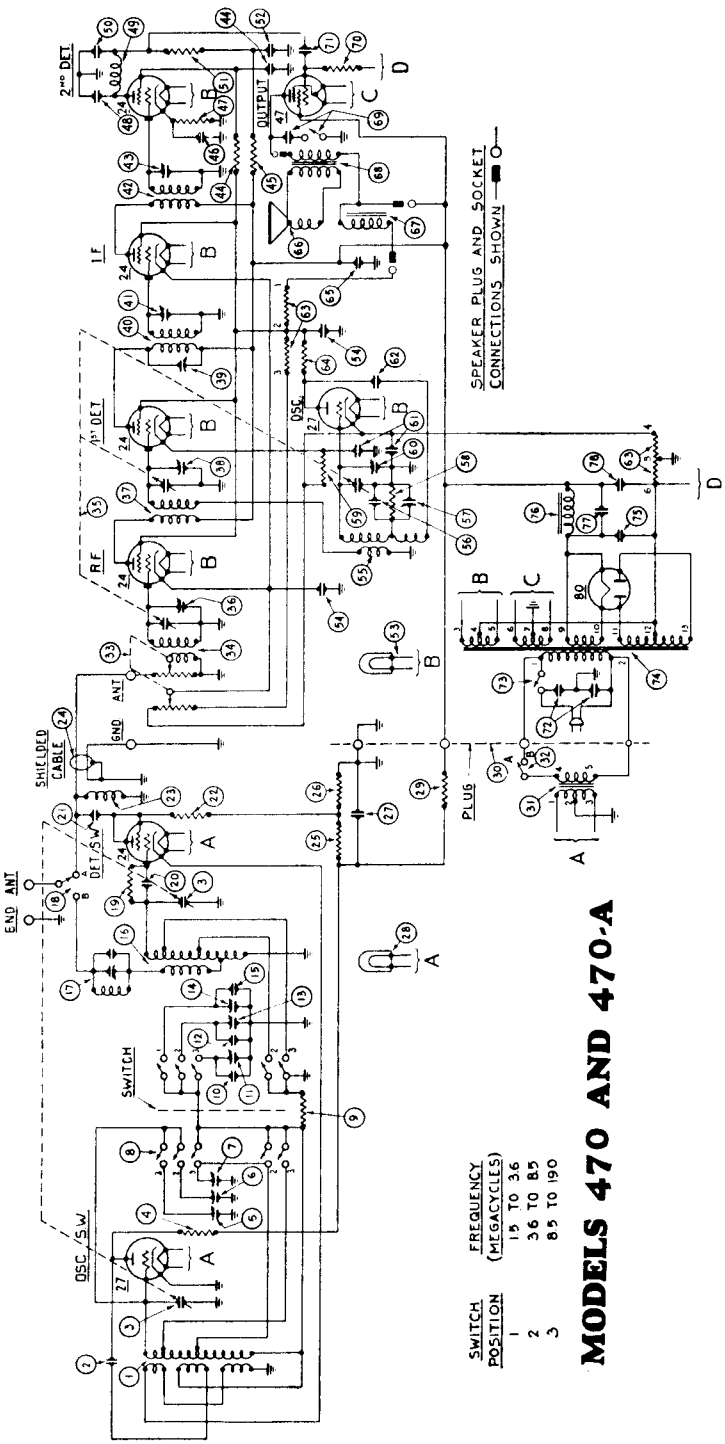
Table 3—Condenser Data

Nos. on Figs. 1 and 2	Capacity Mfd.	Container
(20) (22)	.00025	Yellow
(10) (36)	.00011	Blue and Golden Yellow
(26) (28)	.01	Black Bakelite Container
(14)	.05	Black Bakelite Container
(23)	.1, .15, .25, 2-.5 (50-60 cy.)	Metal Container
	.2, .15, .25, 2-.5 (25-40 cy.)	Metal Container
(43)	6 (50-60 cycles)	Electrolytic
	10 (25-40 cycles)	Electrolytic
(44)	6	Electrolytic

Table 4—Resistor Data

Nos. on Figs. 1 and 2	Power (Watts)	Resistance (Ohms)	Color		
			Body	Tip	Dot
(34)	...	250 and .05 Mfd.	Black Bakelite Container		
(13)	.5	1,000	Brown	Black	Red
(35)	.5	8,000	Grey	Black	Red
(21)	.5	10,000	Brown	Black	Orange
(39)	1.	25,000	Red	Green	Orange
(18)	.5	32,000	Orange	Red	Orange
(40)	1.	32,000	Orange	Red	Orange
(37)	2.	51,000	Green	Brown	Orange
(19) (25)	.5	99,000	White	White	Orange
(33)	.5	160,000	Brown	Blue	Yellow
(24) (27) (32)	.5	490,000	Yellow	White	Yellow

PHILADELPHIA STORAGE BATTERY CO.



SWITCH POSITION	FREQUENCY (MEGACYCLES)
1	1.5 TO 3.6
2	3.6 TO 8.5
3	8.5 TO 19.0

MODELS 470 AND 470-A

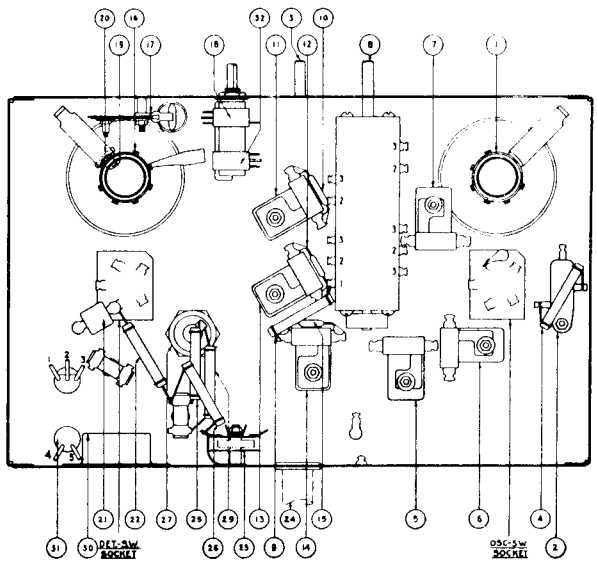


Fig. 2—Short Wave Chassis.

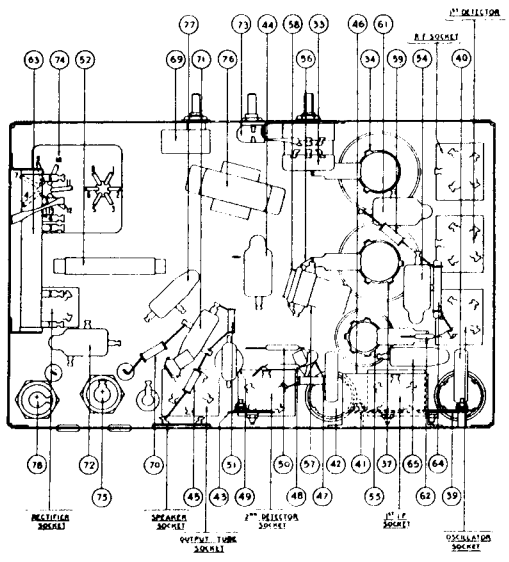


Fig. 3—Broadcast Chassis.

PHILADELPHIA STORAGE BATTERY CO.

Models 470 and 470-A Receivers

Table 1—Tube Socket Data taken with AC Set Tester—AC Line 115 Volts

Tube Type	Tube Circuit	Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts	Plate Milli-amperes
			SHORT WAVE UNIT*				
27	Osc.	2.2	110	...	3.3	0	...
24	Det.	2.2	24	24	5.	0	...
			BROADCAST UNIT				
24	R. F.	2.4	255	50	3.5	25	7.5
24	1st. Det.	2.4	260	60	9	38	...
27	Osc.	2.4	60	...	3.5	25	2.
24	I. F.	2.4	265	50	3	22	3.5
24	2nd Det.	2.4	116	40	7	25	...
47	Output	2.5**	205**	220**	.7**	..	28**
80	Rectifier	4.5	260/Plate				

*The voltage readings of the short wave unit were taken from the under side of the chassis, using a Weston multi-range voltmeter, 1000 Ohms per volt. The radio set tester cannot be used, either for voltage or plate current readings because of the effect of the long leads through the set tester cord.

**These readings must likewise be taken from the socket terminals on the under side of the chassis unless the set tester is especially equipped with an adapter for testing pentode tubes.

All the above readings were taken with volume control at maximum.

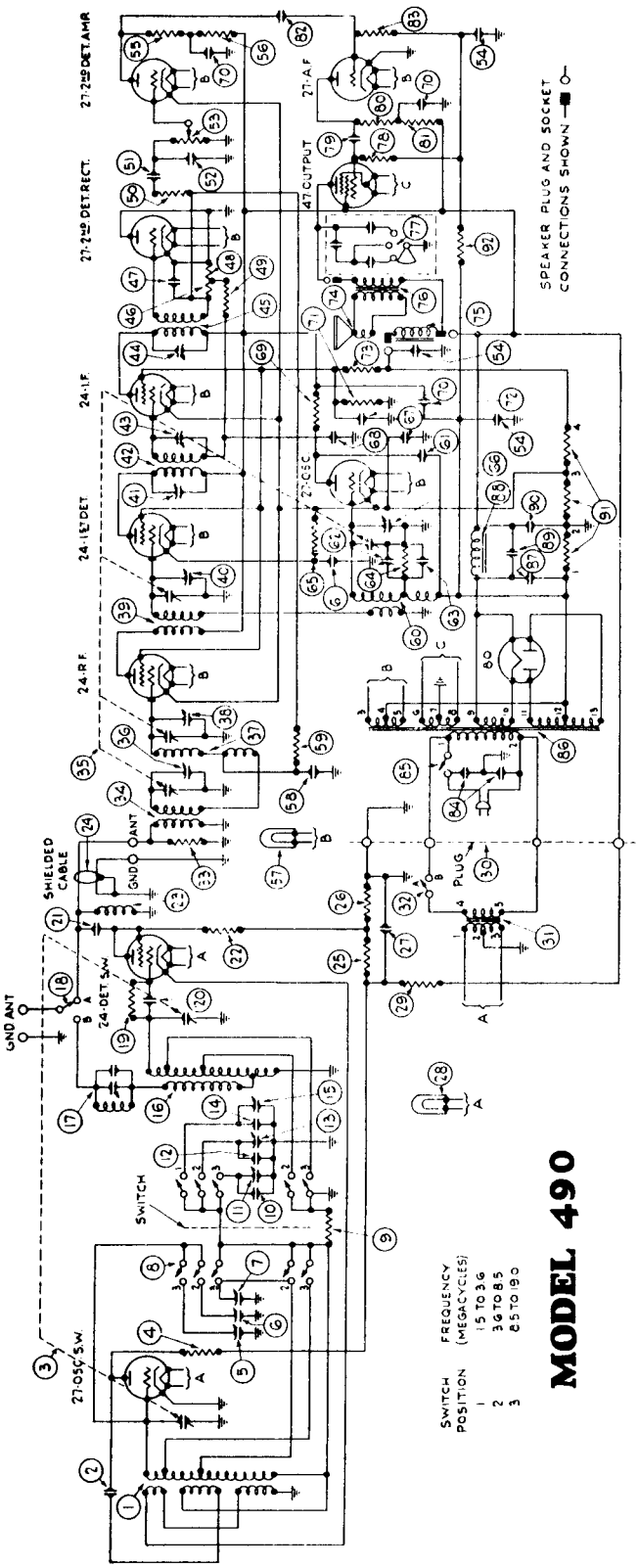
Table 2—Power Transformer Voltage

Terminals	A. C. Volts	Circuit	Color
		SHORT WAVE UNIT	
4–5	105 to 125	Primary	Black
1–3	2.5	Secondary	Yellow
2	...	Center Tap 1–3	Green
		BROADCAST UNIT	
1–2	105 to 125	Primary	White (Small Gauge)
3–5	2.5	Filament of 47	Dark Green
6–8	2.5	Filament of 24	Black (Heavy Gauge)
9–10	5.	Filament of 80	Light Blue
11–13	700	Plate of 80	Yellow
4	...	Center Tap of 3–5	Black, Green Tracer
7	...	Center Tap of 6–8	Black, Yellow Tracer
12	...	Center Tap of 11–13	Yellow, Green Tracer

Table 3—Resistor Data

No. on Figs. 1, 2 and 3	Terminal	Power (Watts)	Resistance (Ohms)	Color		
				Body	Tip	Dot
(44)	....	....	250	.....	Black Bakelite	.....
(63)	1–2	....	1060	.....	Long Tubular	.....
	2–3	....	2300			
	4–5	....	70			
	5–6	....	240			
(29)	....	1	5,000	Green	Black	Red
(59)	....	.5	5,000	Green	Black	Red
(4) (64)	....	1	13,000	Brown	Orange	Orange
(25) (26)	....	1	32,000	Orange	Red	Orange
(45)	(50–60 cycles)	.5	45,000	Yellow	Green	Orange
(47) (58)	....	.5	51,000	Green	Brown	Orange
(22)	....	1	99,000	White	White	Orange
(45)	....	.5	99,000	White	White	Orange
(9)	....	1	240,000	Red	Yellow	Yellow
(51) (70)	....	.5	240,000	Red	Yellow	Yellow
(19)	....	.5	2,000,000	Red	Black	Green

PHILADELPHIA STORAGE BATTERY CO.



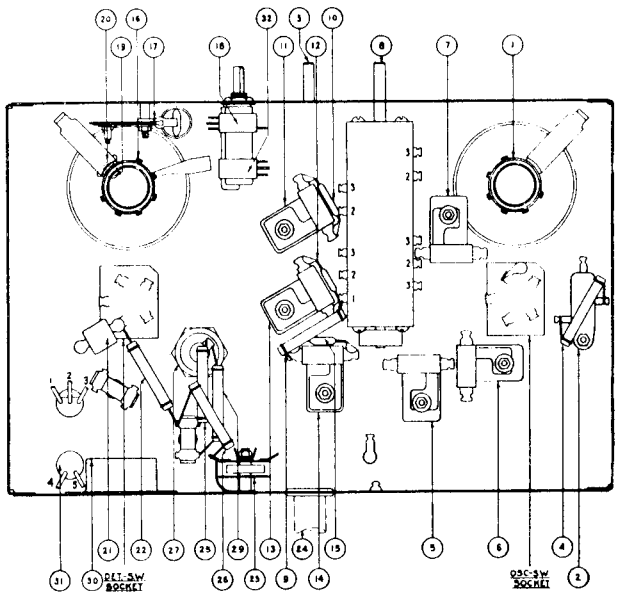


Fig. 2—Short Wave Chassis.

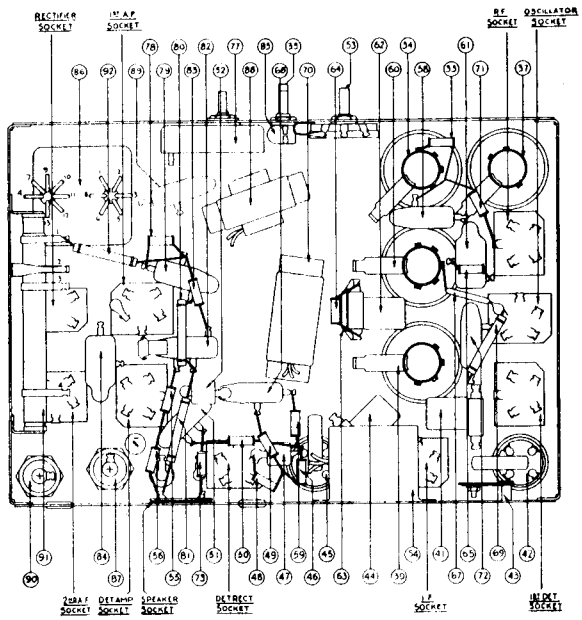


Fig. 3—Broadcast Chassis.

PHILADELPHIA STORAGE BATTERY CO.

Model 490 Receiver

Table 1—Tube Socket Readings—Line Voltage 115 volts

Tube Type	Tube Circuit	Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts	Plate Milli-amperes
			SHORT WAVE UNIT*				
27	Osc.	2.2	110	...	3.3	0	...
24	1st Det.	2.2	24	24	5.	0	...
			BROADCAST UNIT*				
24	R. F.	2.1	220	50	6.	15	2.
27	Osc.	2.1	80	...	6	15	2.3
24	1st Det.	2.1	210	55	5	15	.5
24	I. F.	2.1	220	60	8	15	0
27	Rect. Det.	2.1	...	...	...	14	...
27	Ampl. Det.	2.1	150	...	0	15	1.3
27	1st Audio	2.1	150	...	2	15	1.5
47	Output	2.4**	205**	220**	7**	...	28.**
80	Rectifier	4.5	220/Plate	...	...	...	...

*The voltage readings of the short wave unit were taken from the under side of the chassis, using a Weston Multi-range voltmeter, 1000 ohms per volt. The radio set tester cannot be used, either for voltage or plate current readings because of the effect of the long leads through the set tester cord.
**These readings must likewise be taken from the socket terminals on the under side of the chassis unless the set tester is especially equipped with an adapter for testing pentode tubes.

Table 2—Power Transformer Voltages

Terminals	A.C. Volts	Circuit	Color
		SHORT WAVE UNIT	
4–5	105 to 125	Primary	Black
1–3	2.5	Secondary	Yellow
2	...	Center Tap 1–3	Green
		BROADCAST UNIT	
1–2	105 to 125	Primary	White
3–5	2.5	Heaters of 24 and 27 Tubes	Black
4	...	Center Tap of 3–5	Black with Yellow
6–8	2.5	Filament of 47 Tube	Dark Green
7	...	Center Tap of 6–8	Black with Green
9–10	5.0	Filament of 80 Tube	Light Blue
11–13	650.	Plates of 80 Tube	Yellow
12	...	Center Tap of 11–13	Yellow with Green

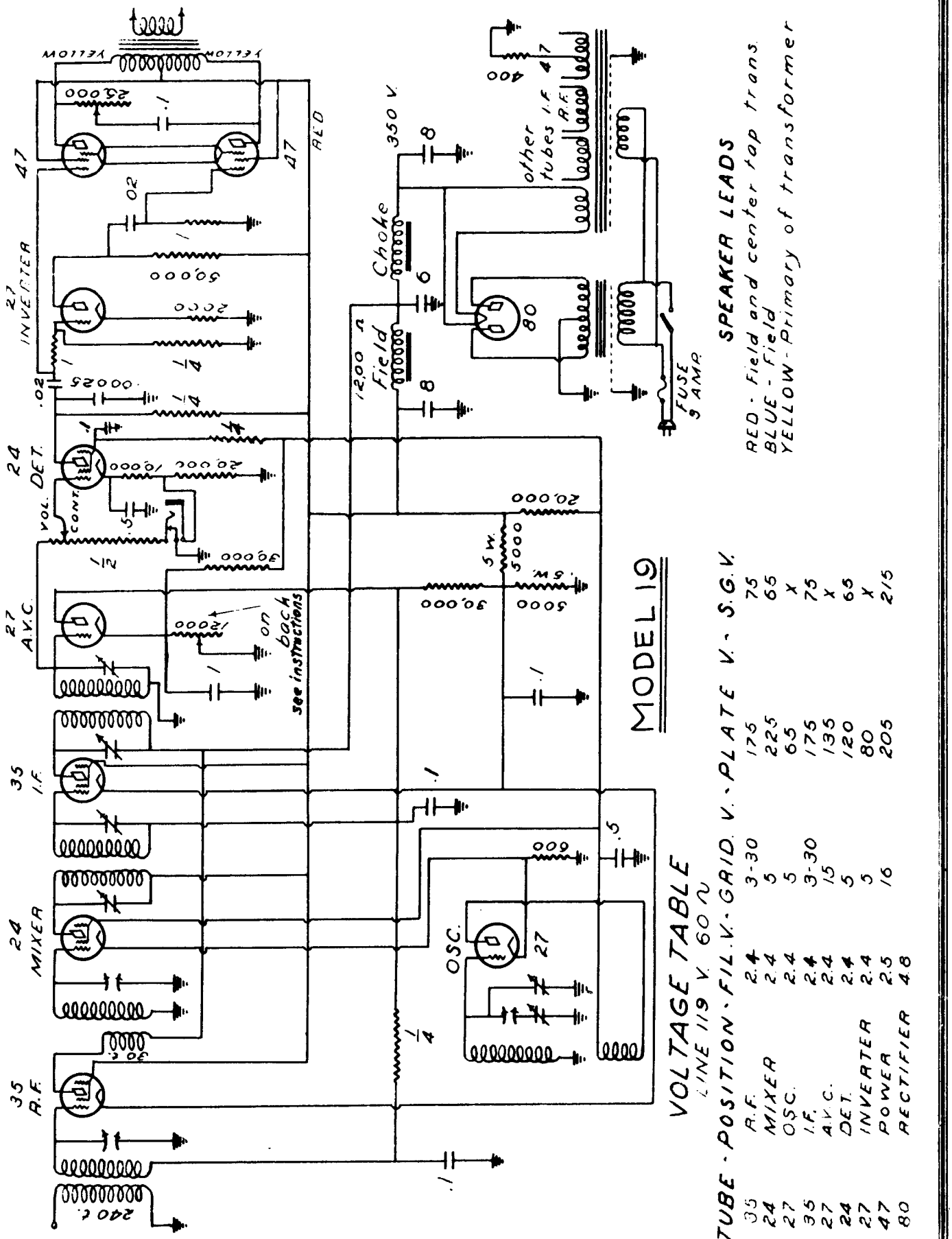
Table 3—Resistor Data

Nos. on Figs. 1, 2 and 3	Terminal	Power (Watts)	Resistance (Ohms)	COLOR Body	COLOR Tip	COLOR Dot
(91)	1–2	..	180		Long Tubular	
	2–3		60			
	3–4		3500			
(29)	.....	1	5,000	Green	Black	Red
(85)	.....	½	5,000	Green	Black	Red
(33)	.....	½	10,000	Brown	Black	Orange
(4)	.....	1	13,000	Brown	Orange	Orange
(73)	.....	½	25,000	Red	Green	Orange
(80) (81)	.....	1	25,000	Red	Green	Orange
(25) (26)	.....	1	32,000	Orange	Red	Orange
(46) (48) (55) (64)	.....	½	51,000	Green	Brown	Orange
(69) (81)	.....	1	51,000	Green	Brown	Orange
(58) (71)	.....	½	70,000	Violet	Black	Orange
(22)	.....	1	99,000	White	White	Orange
(50) (78)	.....	½	99,000	White	White	Orange
(9) (92)	.....	1	240,000	Red	Yellow	Yellow
(78) (83)	.....	½	240,000	Red	Yellow	Yellow
(49) (59)	.....	½	490,000	Yellow	White	Yellow
(92)	.....	1	490,000	Yellow	White	Yellow
(19)	.....	½	2,000,000	Red	Black	Green

Table 4—Condenser Data

Nos. on Figs. 1, 2 and 3	Capacity Mfd.	Container
(20) (47) (67)	.00011	Blue and Golden Yellow
(14) (21) (52)	.00025	Yellow
(63)	.0007	White and Golden Yellow
(12)	.0008	Green and Orange
(10)	.00125	Blue and Orange
(51) (79) (82)	.01	Black Bakelite
(84)	.015 Double	Black Bakelite
(2) (58) (68) (72)	.05	Black Bakelite
(61) (89)	.09 (50-60 cycles)	Black Bakelite
(89)	.18 (25-40 cycles)	Black Bakelite
(54)	3–.25 each	Metal
(70)	1, .25, .1 (50-60 cycles)	Metal
	1, .25, .25 (25-40 cycles)	Metal
(87)	6 (50-60 cycles)	Electrolytic
(90)	6 (50-60 cycles)	Electrolytic
(87)	10 (25-40 cycles)	Electrolytic
(90)	14 (25-40 cycles)	Electrolytic

REMLER COMPANY, LTD.



VOLTAGE TABLE

LINE 119 V. 60 ∿

TUBE - POSITION - FIL. V.	GRID V.	PLATE V.	S.G. V.
35 R.F. 2.4	3-30	175	75
24 MIXER 2.4	5	225	65
27 OSC. 2.4	5	65	X
35 I.F. 2.4	3-30	175	75
27 A.V.C. 2.4	15	135	X
24 DET. 2.4	5	120	65
27 INVERTER 2.4	5	80	X
47 POWER 2.5	16	205	215
80 RECTIFIER 4.8			

PHILADELPHIA STORAGE BATTERY CO.

Service Bulletin — No. 130

Model 15 Series

The Philco Radio of the 15 series is an eleven-tube superheterodyne, employing the high efficiency 6.3-volt filament tubes, automatic volume control, superpower push-pull pentode output, and twin electro-dynamic speakers. Philco shadow tuning and the combination distance switch and power switch on the control panel are additional features. The intermediate frequency used in adjusting the superheterodyne circuit of the 15 series is 175 kilocycles. The total power consumption is approximately 115 watts.

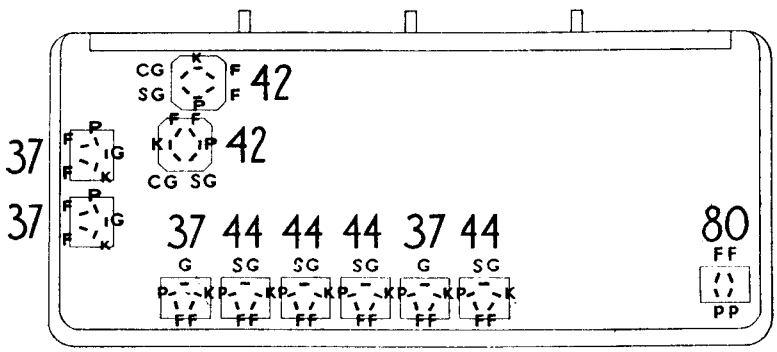


Fig. 1—Tube Sockets

F Filament SG Screen Grid K Cathode
P Plate CG Control Grid

Caution: Never connect the chassis to the power supply unless the speakers are connected and all tubes are in place.

Table 1—Tube Socket Data*—A. C. Line Voltage 115 Volts

Tube		Filament Volts F to F	Plate Volts P to K	Screen Grid Volts SG to K	Control Grid Volts CG to K	Cathode Volts K to F
Type	Circuit					
44	R. F.	6.3	165	55	15	30
44	1st Det.	6.3	250	90	.85	10
37	Osc.	6.3	60	...	15	10
44	1st I. F.	6.3	250	90	.85	10
44	2nd I. F.	6.3	275	90	3.3	10
37	Det.-Rect.	6.3	0	...	.2	10
37	1st Audio	6.3	75	...	.4	10
37	2nd Audio	6.3	100	...	.2	10
42	P. P. Output	6.3	255	270	15	15
42	P. P. Output	6.3	255	270	15	15
80	Rectifier	5.0	320/Plate			

*All of the above readings were taken from the under side of the chassis using test prods and leads with a suitable A. C. volt meter for filament voltages and a high resistance multi-range D. C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end. Power switch in middle position.

Table 2—Power Transformer Data

Terminals on Figs. 3 and 4	A. C. Volts	Circuit
1–2	105 to 125	Primary
3–5	6.3	Filament
6–7	5.0	Filament of 80
8–10	720	Plates of 80
4	...	Center Tap of 3–5
9	...	Center Tap of 8–10

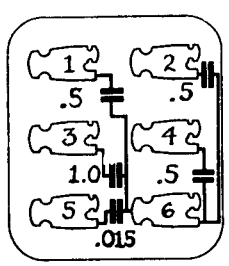


Fig. 2—Internal Connections Filter Condenser

Table 3—Resistor Data

No. on Figs. 3 & 4	Power (Watts)	Resistance (ohms)	Terminals	COLOR		
				Body	Tip	Dot
(66)	..	50	1–2	Long	Tubular	
		50	2–3			
		205	3–4			
(36)	.5	1000	....	Brown	Black	Red
(45) (55)	.5	5000	....	Green	Black	Red
(1) (52)	.5	10,000	....	Green	Black	Orange
(32)	1.	13,000	....	Brown	Orange	Orange
(50)	.5	25,000	....	Red	Green	Orange
(21)	.5	51,000	....	Green	Brown	Orange
(40)	.5	99,000	....	White	White	Orange
(10)	.5	160,000	....	Brown	Blue	Yellow
(57)	.5	240,000	....	Red	Yellow	Yellow
(9) (17) (54) (28) (47)	.5	490,000	....	Yellow	White	Yellow
(51)	.5	1,000,000	....	Brown	Black	Green

PHILADELPHIA STORAGE BATTERY CO.

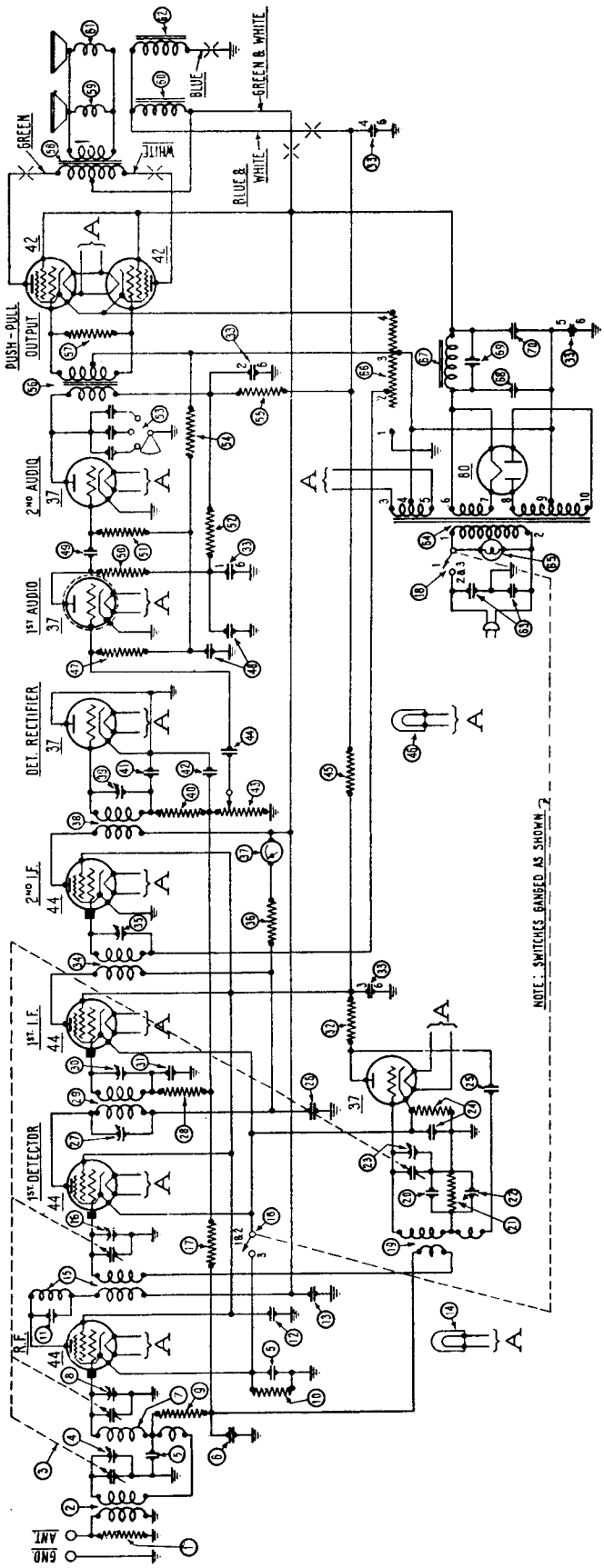


Fig. 3—Schematic Wiring Diagram

PHILADELPHIA STORAGE BATTERY CO.

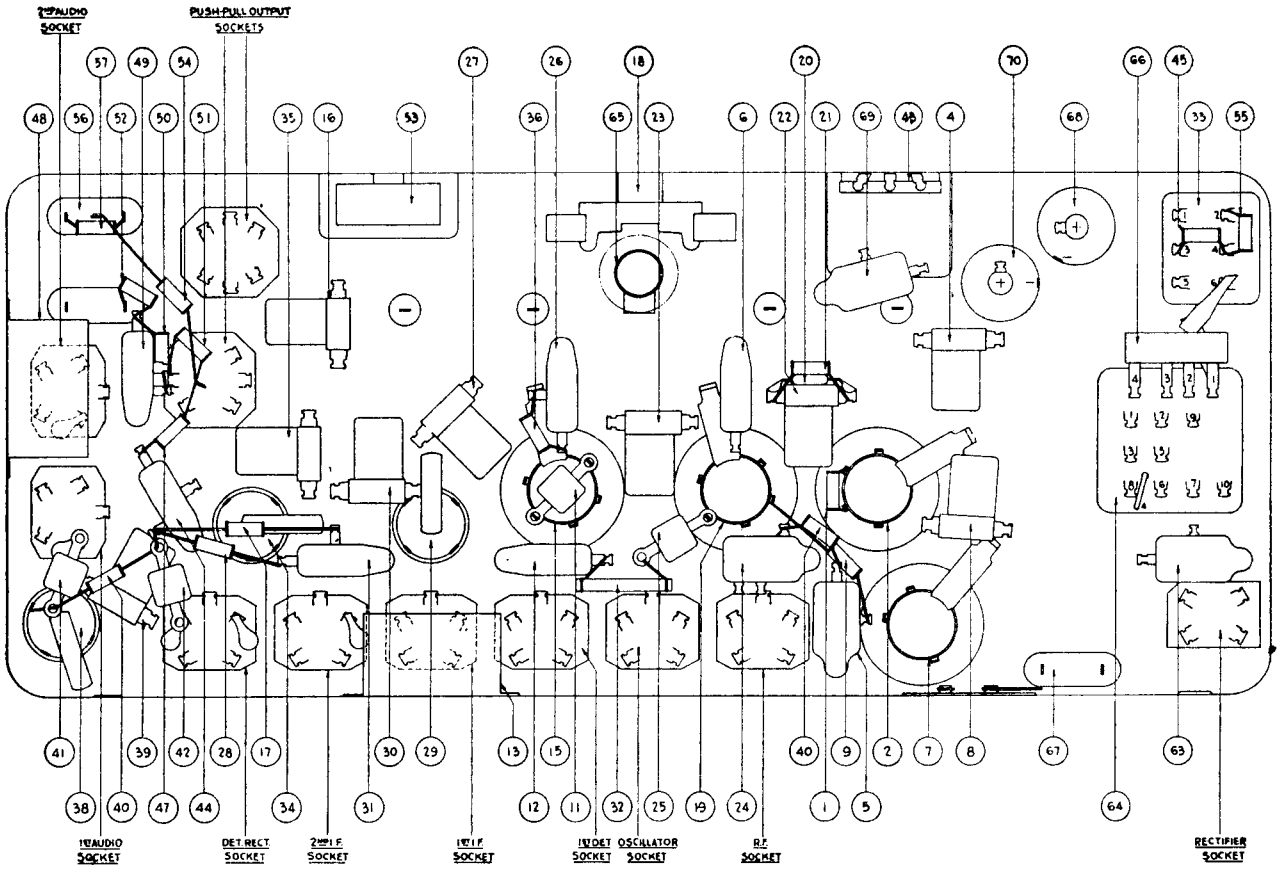


Fig. 4—Parts Diagram

Adjustment of Model 15 Series

These receivers are accurately adjusted at the factory prior to shipment. Under normal conditions it will never be necessary to re-adjust the compensating condensers. If for any reason such adjustment should be required, it should not be attempted without first receiving the proper instruction and equipment from your distributor. The Philco Model 095 Oscillator has been especially designed for use in this work and will be found the most in expensive and most reliable for the purpose.

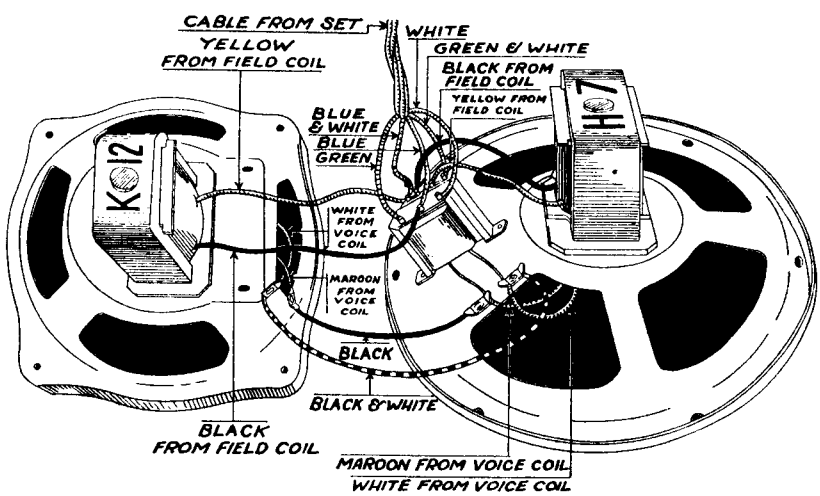


Fig. 5—Speaker Connections

PHILADELPHIA STORAGE BATTERY CO.

PHILCO

REG. U.S. PAT. OFF

Service Bulletin—No. 129

Model 91 Series

The Philco Radio of the 91 series is a nine tube superheterodyne, employing the high efficiency 6.3 volt filament tubes, automatic volume control, shadow tuning, and push-pull pentode output. The chassis is made in two different types, one known as the 121 type, employing a single dynamic speaker and the other known as the 221 type, employing twin dynamic speakers. These type numbers appear on the radio chassis as a part of the model number. Chassis of one type are not interchangeable with those of another. The intermediate frequency used in adjusting the superheterodyne circuit of the 91 series is 260 kilocycles. The power consumption of the various models is as follows:

Model	Volts	Cycles	Watts
91-121	115	50-60	90
91-221	115	50-60	95
91A-121	115	25-40	92
91A-221	115	25-40	97
91E-121	230	50-60	90
91E-221	230	50-60	95

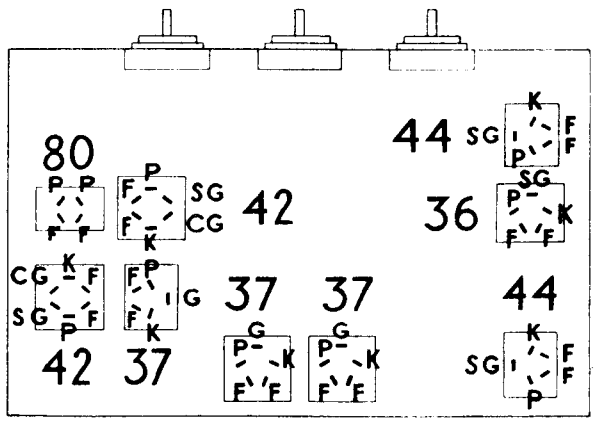


Fig. 1—Tube Sockets

Table 1—Tube Socket Data*—A.C. Line Voltage 115 Volts

Tube Type	Tube Circuit	Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts
44	R.F.	6.3	200	50	.6	25
36	Det.—Osc.	6.3	250	80	10	10
44	I.F.	6.3	250	85	.2	5
37	Det.—Rect.	6.3	0	...	.2	2
37	Det.—Ampl.	6.3	60	...	.2	2
37	Audio	6.3	100	...	0	2
42	Output	6.3	240	250	15	15
42	Output	6.3	240	250	15	15
80	Rectifier	5.0	310/Plate	...	...	..

*All of the above readings were taken from the under side of the chassis, using test prods and leads with a suitable A.C. voltmeter for filament voltages and a multi-range D.C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end.

Table 2—Power Transformer Data

Terminals	A.C. Volts	Circuit	Color
1–2	105 to 125	Primary	White
3–5	6.3	Filament	Black
6–7	5.0	Filament 80	Blue
8–10	670	Plates of 80	Yellow
4	...	Center Tap of 3-5	Black Yellow Tracer
9	...	Center Tap of 8-10	Yellow Green Tracer

Table 3—Resistor Data

Nos. on Figs. 4 & 5	Resistance (ohms)	Power (Watts)	Terminals	Color Body	Color Tip	Color Dot
	900	..	1-2			
(46) Single Speaker	2700	..	2-3	LONG	TUB	ULAR
	95	..	3-4			
	205	..	4-5			
	136	..	1-2			
(46)a Twin Speaker	Blank	..	2-3	LONG	TUB	ULAR
	85	..	3-4			
	205	..	4-5			
(14)	1,000	.5	....	Brown	Black	Red
(1)	10,000	.5	....	Brown	Black	Orange
(21)	15,000	.5	....	Brown	Green	Orange
(40) (41)	25,000	.5	....	Red	Green	Orange
(41)a	13,000	1.	....	Brown	Orange	Orange
(32)	99,000	.5	....	White	White	Orange
(39)	490,000	.5	....	Yellow	White	Yellow
(43) (3) (38)	1,000,000	.5	....	Brown	Black	Green
(26)	1,000,000	1.	....	Brown	Black	Green

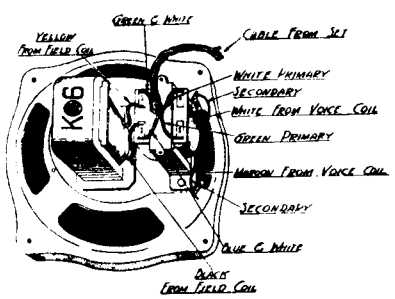


Fig. 2—Speaker Connections—121 Code

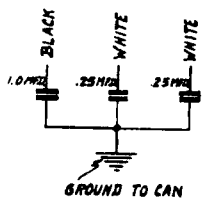


Fig. 3—Internal Connections Filter Condenser

PHILADELPHIA STORAGE BATTERY CO

PHILCO MODEL 91 SERIES

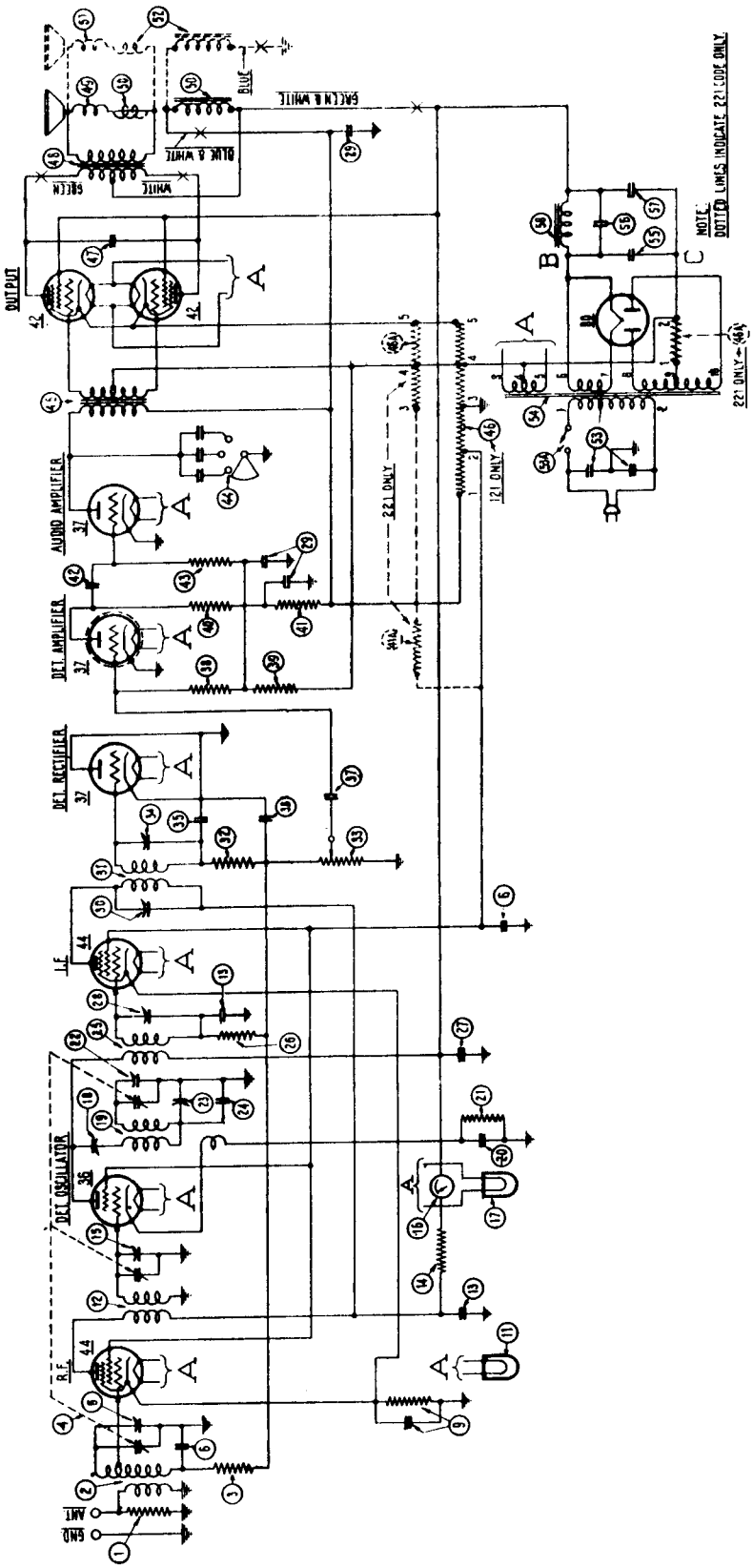


Fig. 4—Schematic Wiring Diagram

PHILADELPHIA STORAGE BATTERY CO.

PHILCO MODEL 91 SERIES

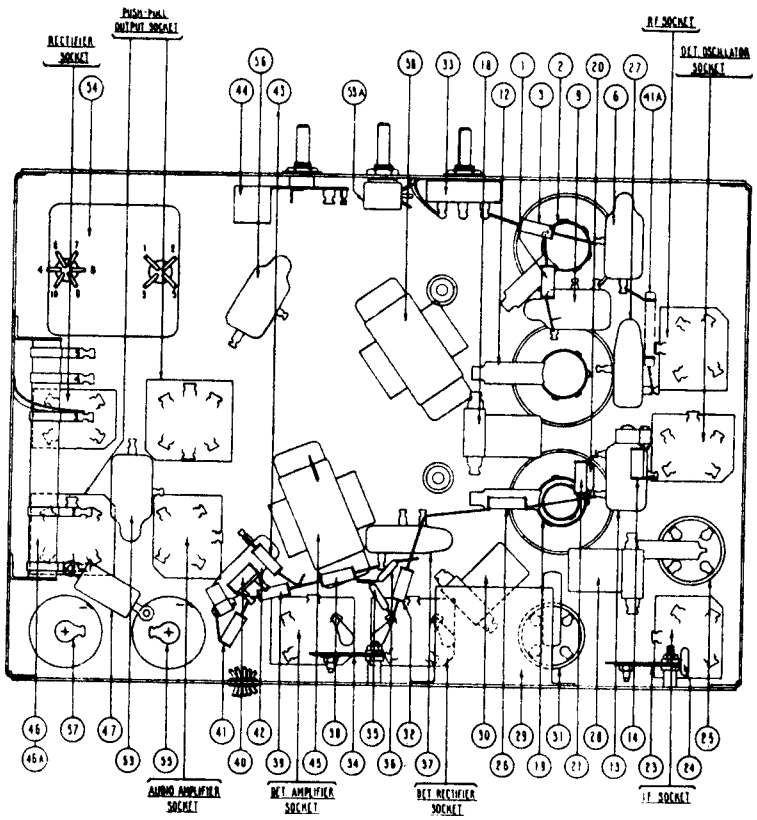


Fig. 5—Parts Diagram

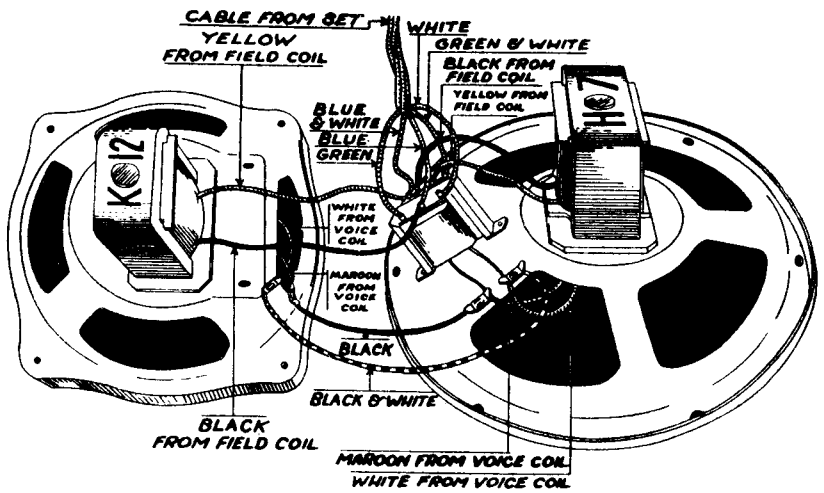


Fig. 6—Speaker Connections—221 Code

ADJUSTMENT OF MODEL 91 SERIES

These receivers are accurately adjusted at the factory prior to shipment. Under normal conditions it will never be necessary to re-adjust the compensating condensers. If for any reason such adjustment should be required, it should not be attempted without first receiving the proper instruction and equipment from your distributor. The Philco Model 095 Oscillator has been especially designed for this work, and will be found the most inexpensive and most reliable for the purpose.

STROMBERG-CARLSON TELEPHONE MFG. CO.

STROMBERG-CARLSON No. 29, 9-TUBE SUPERHETERODYNE RECEIVER

What is probably the first receiver to derive its designation from the number of its design features is the "29" receiver of Stromberg - Carlson Telephone Mfg. Co., Rochester, N. Y. These features, as furnished by the factory, are listed below (where their position in the circuit is not evident from the wording, a more detailed description of the nomenclature is given):

1. Optosynchronic (Visual) Tuning, with sensitive meter for accurate setting of the station-selector dial;
2. Mono-Vision Dial and Tuning Meter, for quick, accurate tuning;
3. Large Baffle Area Cabinet, for full, smooth range of musical and voice tones;
4. Manual Volume-Control, for pre-setting to desired audio volume and for increasing sensitivity on extreme distance;
5. Level-Action Automatic Volume-Control, to maintain the predetermined volume over an extremely wide range of signal strength;
6. Detectomatic (Duo-Diode) Detector, for most efficient demodulation action;
7. Adjustable Automatic Clarifier, to allow hand adjustment of high-frequency reproduction to meet receiving conditions; (R15-C27);
8. Antenna Aligner, for obtaining maximum results with any particular size of antenna;
9. Image Suppressor, for giving a very high discrimination (over 100,000 to 1) against "cross-talk"; C1-C2-C3, L1-L2-L3;
10. Isolated Oscillator Tube and Circuit, for correct control of sensitivity;
11. Bi-Resonator Radio-Frequency Tuning System, for better selectivity; C1-C2, L1-L2, C;
12. Tri-Resonator Intermediate Amplifier, providing high selectivity;
13. Triplex Audio System, employing screen-grid first audio, and push-pull output;
14. Variable-Mu (Super-Control) Screen-Grid Tubes, for long range of action;
15. Triode Push-Pull Output, for best audio quality;
16. Four-Gang Tuning Condensers, for super-selectivity;
17. Non-Glare Dial, with wide-spaced markings for easy and accurate tuning;
18. Phonograph Key, for switching from radio to records;
19. Telephone Cabling, grouping of wires in neat, insulated cables for quiet operation;
20. Full-Size Chassis, avoids crowding units and provides accessibility for servicing;
21. Highly Efficient, Large Size Electro-Dynamic Speaker, to give ample undistorted sound output;
22. Karvart Panel of Airplane Fuselage Construction, giving ornamental carved design of real wood;
23. Precision-Selected Tubes, sealed in sockets, the style of tubes used having been picked for best over-all results;
24. Non-Radiating, avoids disturbing, with heterodyne squeals, neighboring radio receivers;
25. Super-Sensitivity, the highest compatible with clarity of reception;
26. Flexibility of Volume, from a whisper to auditorium volume;
27. Oscillograph Aligned, Tested and Sealed, to assure laboratory performance in every set;
28. Telephone-Built, by a manufacturer with more than 37 years experience;
29. Heavy Genuine Walnut Veneer Cabinet, for beauty and permanence.

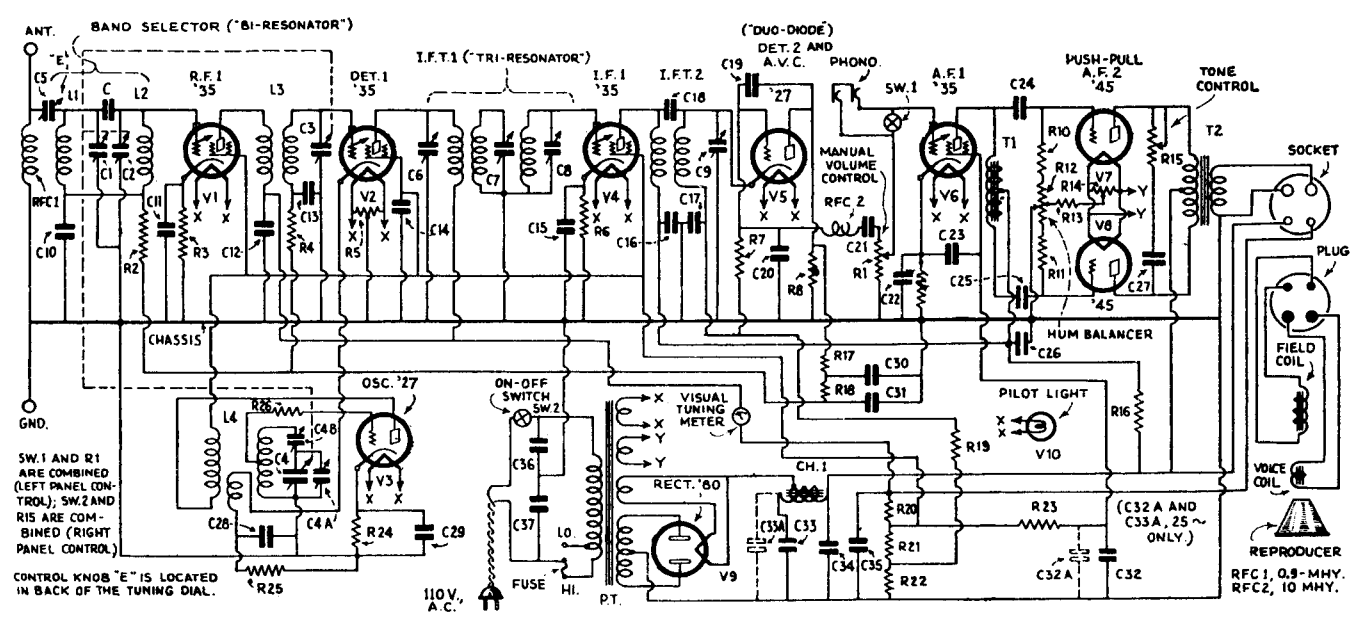
Taking these points in their numerical order, the following comments are made in further explanation. Number 6 refers to the new type detection circuit by which a single type '27 tube is made to function approximately similar to two separate two-element, or diode tubes; here the grid and cathode of V5 function as a diode type of second-detector (or "demodulator"), while its plate and cathode function as a diode type of automatic volume-control detector. Since V5 must serve a dual purpose, it is essential that exceptional care be given to the selection of a tube for this position; for the tube must possess characteristics which will meet the requirements of dual service. The audio output of V5 appears across load resistor R7; the degree of input to the audio system is under control by variation of the setting of the arm of potentiometer R1, the manual volume-control ("No. 4").

The antenna aligner, No. 8, is variable condenser C5 in the diagram; its control knob is located on top of the R.F. coils' shield can, and close to the front edge of the chassis, between the tuning knob and the off-on switch and tone-control combination knob. Tune in a weak signal at the high frequency (1500-kc.) end of the dial, and adjust this antenna condenser knob (marked E in the diagram on the label in the rear of the receiver) until maximum volume is obtained. Leave this knob set at the position of maximum response. If the antenna or ground wires are changed at any future date, this knob must be readjusted. For this purpose a very weak signal should be used, in order to obtain the best over-all sensitivity. If the signal is strong enough to operate the visual tuning meter, adjust the knob E, for greatest swing after tuning the station selector for best reception. The I.F. is 175 kc., peak-tuned.

All resistor and condenser values are as follows: Resistor R1, variable, 0.5-meg.; R2, R4, R18, R19, 0.1-meg.; R3, R6, R9, 600 ohms; R5, 3 ohms; R7, R10, R11, 0.25-meg.; R8, R15 (tone control); R17, 0.5-meg.; R12, hum balancer (center-tapped), 400 ohms; R13, 750 ohms; R14, 10 ohms; R16, R23, 10,000 ohms; R20, 2,174 ohms; R21, 2,080 ohms; R22, 340 ohms; R24, 6,500 ohms; R25, 4,000 ohms; R26, 500 ohms.

Condensers C1 to C9 include the tuning, coupling, and trimming condensers; C10, C19, .04-mf.; C11, C13, C30, C31 .05-mf.; C12, C14, C15, C17, C28, 0.3-mf.; C16, C27, 0.1-mf.; C18, C20, C29, 100 mmf.; C21, C24, C25, C36, C37, .01-mf.; C22, C35, 1. mf.; C23, .45-mf.; C26, C32, C34, 2 mf.; C33, 6 mf.

Operating current and potential values are taken with a line potential of 110 volts and the fuse in the "LO" position. It is necessary to use the meter scales specified (in parentheses) for each reading: (1), 0-4 V., A.C.; (2), 0-8 V., A.C.; (3), 0-10 V., D.C.; (4), 0-250 V., D.C.; (5), 0-750 V., D.C. Filament potential, V1 to V8, and V10, 2.48 V., (1); V9, 4.9 V., (2). Cathode-to-chassis potential, V1, V4, V6, 3 V., (3); V3, 16 V., (4). Control-grid bias, V7, V8, 50 V., across R13, (4). Plate-to-chassis potential, V1, V2, 170 V., (4); V3, 87 V., (4); V4, 220 V., (4); V6, 192 V., (4). Plate potential, V5 (measured as the voltage drop across resistor R22), 12.5 V., (4). Plate potential, V7, V8 (measured between either tube plate and the center-tap of resistor R14), 250 V., (5). Screen-grid potential, V1, V2, V3, 87 V., (4). The potential across the field coil is 127.5 V., (4); the A.C. plate-to-chassis potential of V9 is 340 V.



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GERNSBACK PUBLICATIONS, INC.

98-D PARK PLACE

NEW YORK, N. Y.

SPARKS WITHINGTON CO.

SPARTON MODEL 40 6-TUBE T.R.F. AUTOMOTIVE RECEIVER

(Lafoy-type Automatic Volume Control; Remote Tuning Control; Electro-Dynamic Reproducer)

To maintain constant signal output, regardless of the intensity of the incoming signal (within practical limits), to overcome the reduction in signal intensity which will occur in a given locality (due to metallic structures, ore deposits, etc.) it is necessary to incorporate some form of volume control which will operate to vary the gain in the amplification of the receiver in proportion to the loss in carrier signal strength. Most automatic volume controls or A.V.C. circuits operate to vary the control-grid of the amplifier tubes, in accordance with *the A.F. modulation* of the station's carrier; the "Lafoy" system, however, varies the control-grid bias more nearly in accord with the intensity variations of the station's carrier itself, the A.V.C., tube V6 in the diagram, functioning more nearly as an R.F. amplifier than as a detector.

High amplification in this set is obtained through the use of a three-stage R.F. amplifier incorporating screen-grid tubes of the "automotive" type, the output of this section feeding a screen-grid detector. The audio circuit comprises a single pentode, which is impedance- and resistance-capacity-coupled to the detector.

The values of the components are as follows: Condensers C1, C2, C3, C4, tuning units; C5, antenna compensator; C6, C8, C10, C12, 0.2-mf.; C7A, 0.3-mf.; B, 0.2-mf. C, 0.3-mf.; C9A, 0.3-mf., B, 0.2-mf., C, 0.3-mf.; C11A, 0.3-mf., C, 0.3-mf.; C13, C14, .00025-mf.; C15A, 0.3-mf., B, 0.2-mf.; C16, coupling condenser, .01-mf.; C17, .0005-mf.; C18, .006-mf.; C19, 1. mf.; C20, 0.1-mf.

Resistors R1, R2, R5, R7, 20,000 ohms; R3, R4, R6, 5,000 ohms; R8, 30,000 ohms; R9, manual volume control, ¼-meg.; R10, ¼-meg.; R11, 160 ohms; R12, 350 ohms.

Correct methods for installing and servicing antennas and interference suppressors have been described in past issues of RADIO-CRAFT. However, a little additional data is available.

For the aerial in collapsible type tops, we recommend that the "false top" type be employed. This type of aerial is constructed in the following manner:

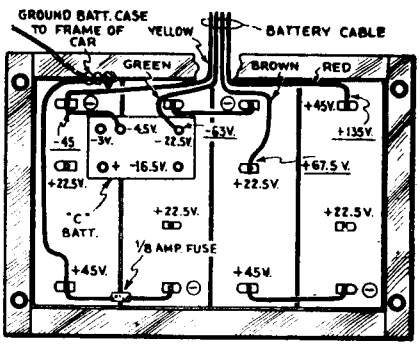
Fashion two pieces of drill cloth that are the same color as the top material, as long as, and approximately six inches narrower than the roof. On one section, lay a piece of light weight felt of the same dimensions, and then lay on top of the felt a piece of 16-mesh copper screen wire the same size On top of this wire, lay another piece of light weight felt and over this the second section of drill cloth, then sew the edges of the combination together.

The top deck is removed from the roof bows and the aerial is placed on top of them. The top decking is then placed back over the aerial.

Where it is desired to let the top down, it is advisable to connect the aerial lead-in wire to the aerial at the rear, and let the shielding on this wire, extend only for a distance of about three feet from the receiver end. In such cases, the lead-in wire is run through the floor boards back of the seat underneath the car, up to the receiver.

Note that in this receiver there are two fuses; one of them is of ⅛-A. rating, and is connected in the "B" battery jumper wire, while the other is a 5 A unit located in the receiving unit near the ground binding post.

Interference may be distinguished by the sound: Generator noises (eliminated by bypassing the commutator) are tone frequencies quite different from the staccato tapping sound of high-tension spark interference; high-tension interference is a sharp, raspy sound and can be eliminated practically 100 percent by means of spark suppressors (on the distributor and spark plugs); low-tension breaker point noise is not readily distinguished from high-tension interference, but will be the sound remaining after spark suppressors have been installed. Low-tension breaker interference is difficult to eliminate. Try reversing the two primary leads to the coil; install a bypass condenser connected from the engine to the ammeter and switch lead.



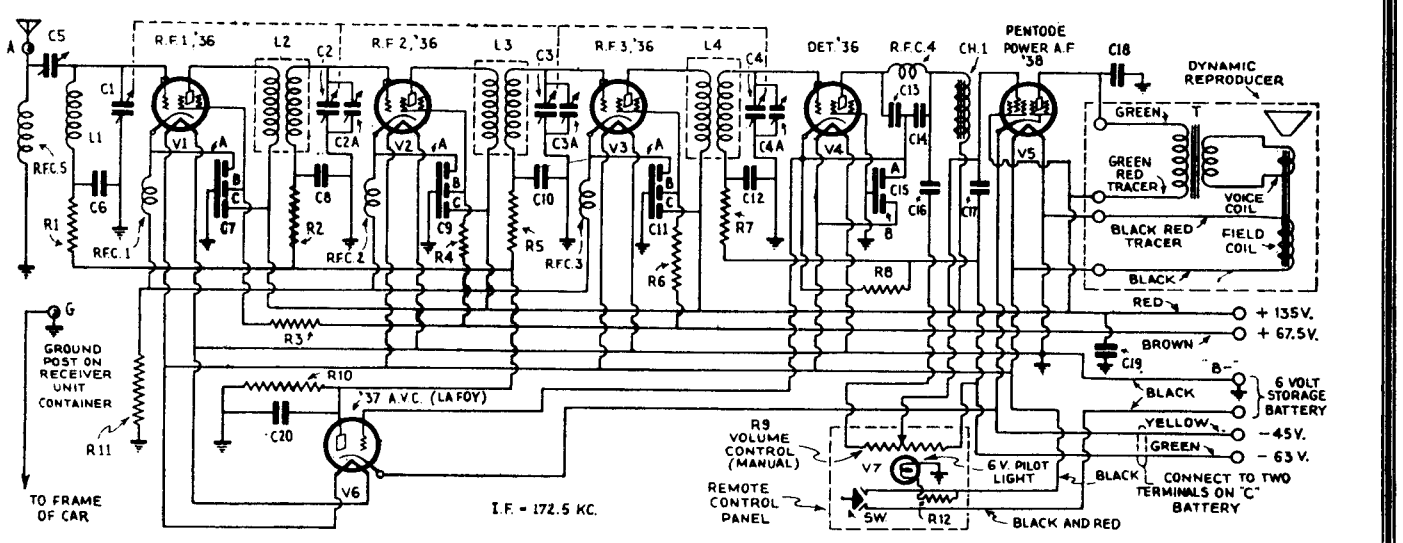
Sketch of the battery box showing the location of the cable and the battery.

Circuit oscillation can be caused either by tubes or the receiver itself. Check the contact surfaces between the partitions and the rotor shaft, making sure that a good ground is obtained. *Do not under any conditions* oil the shaft under the contacts. Make sure that the receiver chassis is well grounded.

For best results it is essential that the receiver unit be located so that the remote control flexible-shaft runs direct (that is, without sharp bends).

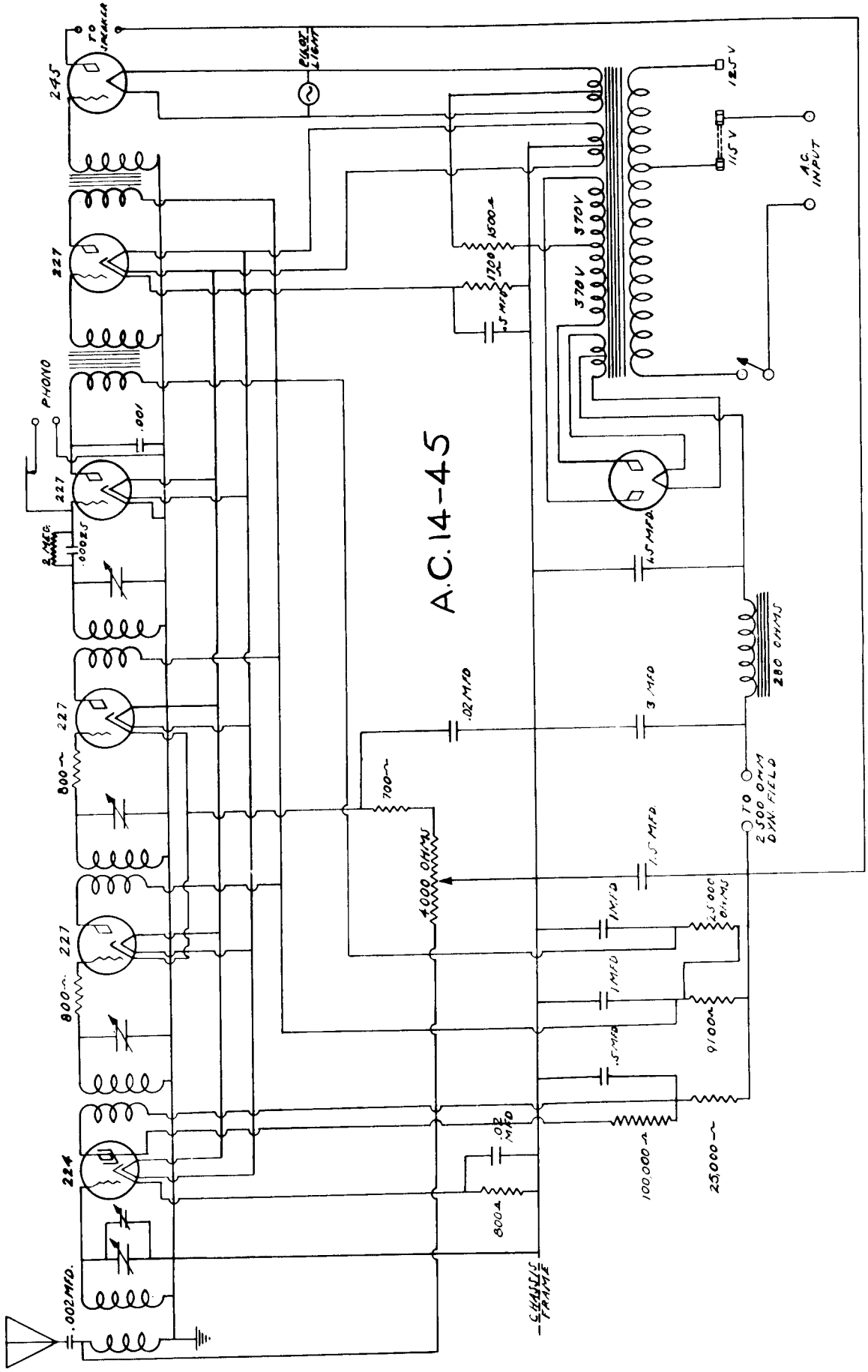
The battery circuit for this receiver is unusual, as indicated in the diagram; an additional figure illustrates the connections.

The "A" battery consumption of this set is about 2½ A.; the "B" requirements, about 20 ma.



Complete schematic circuit of the Sparton model 40 receiver using the new Lafoy system of automatic volume control.

PIERCE AIRO, INC.



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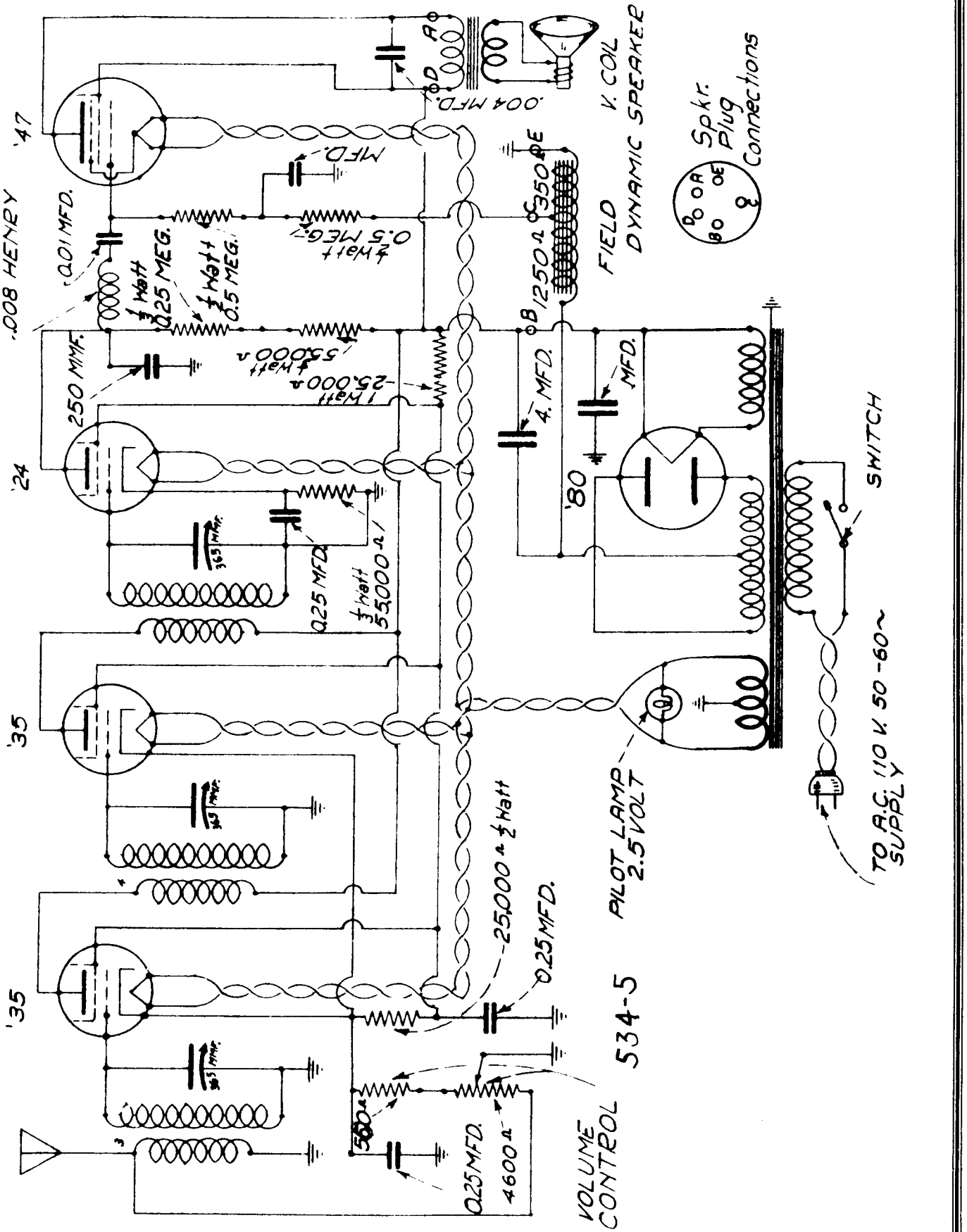

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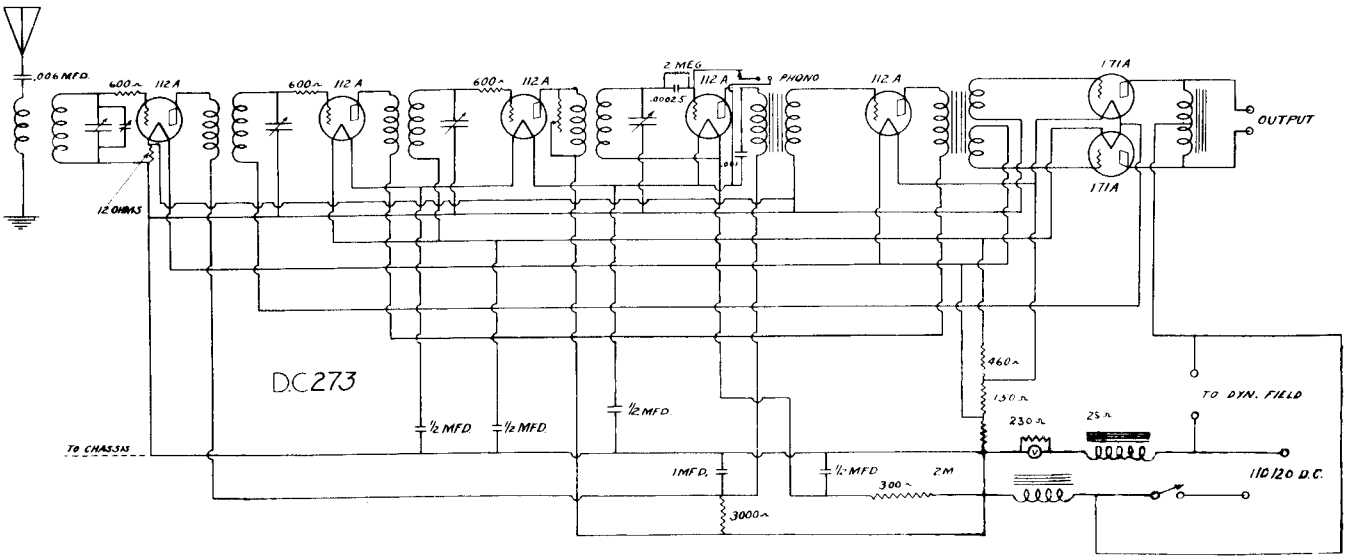

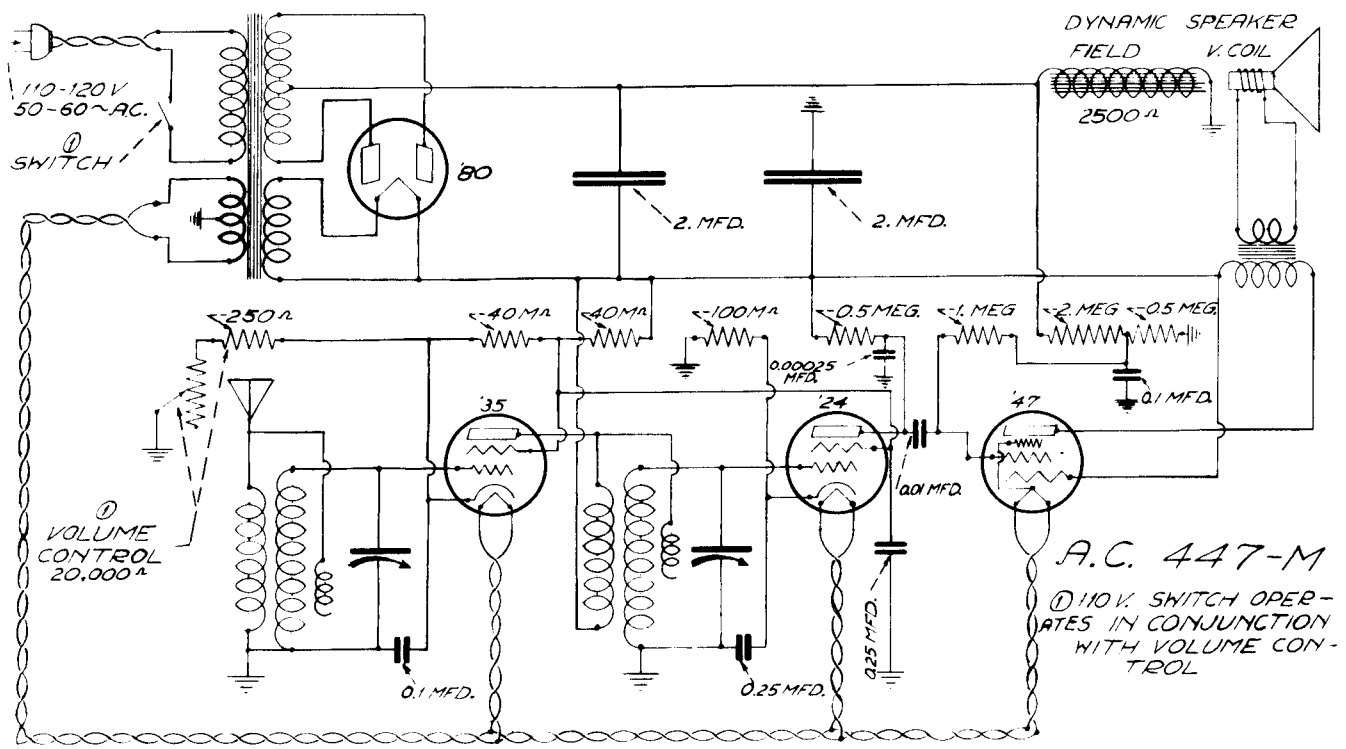

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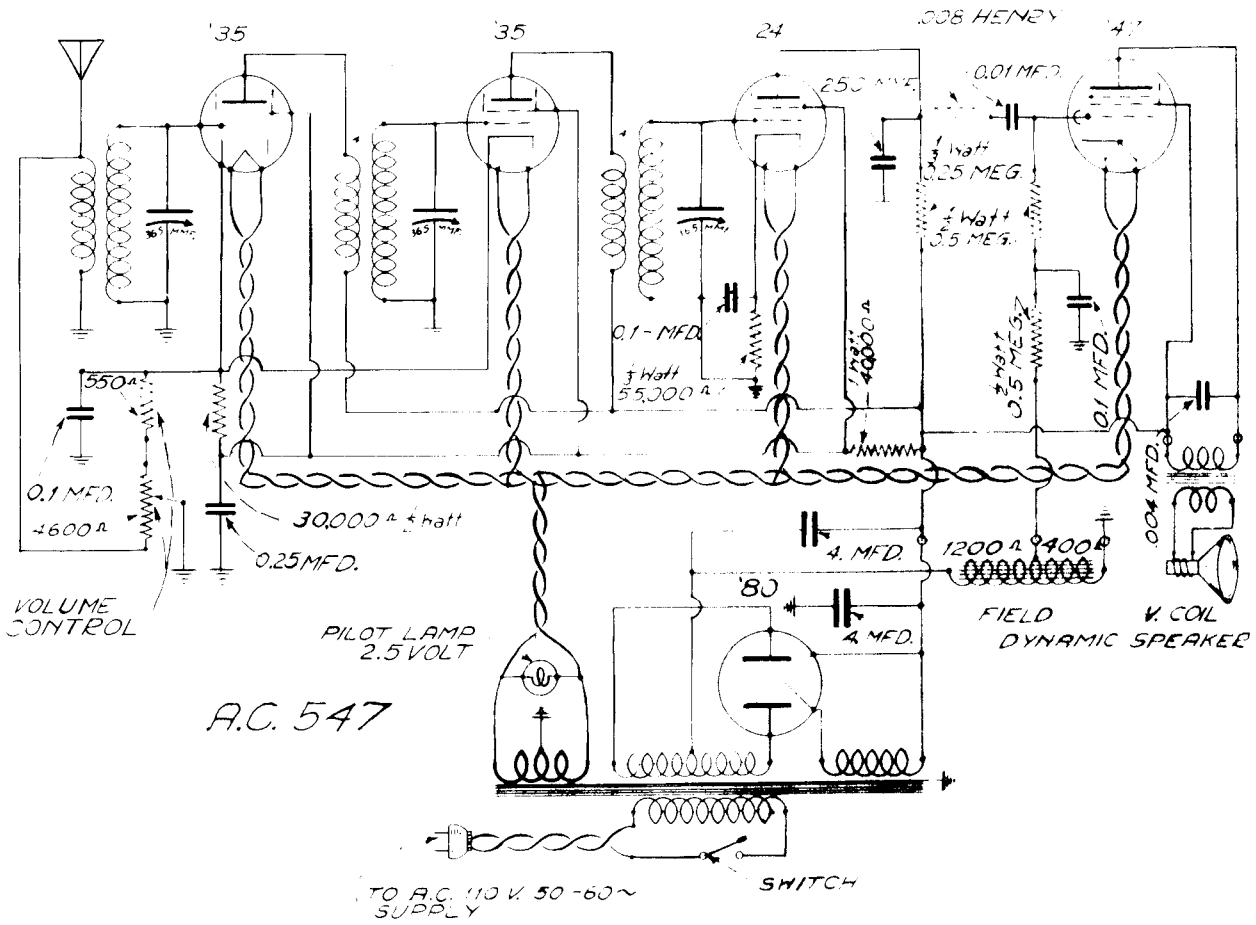

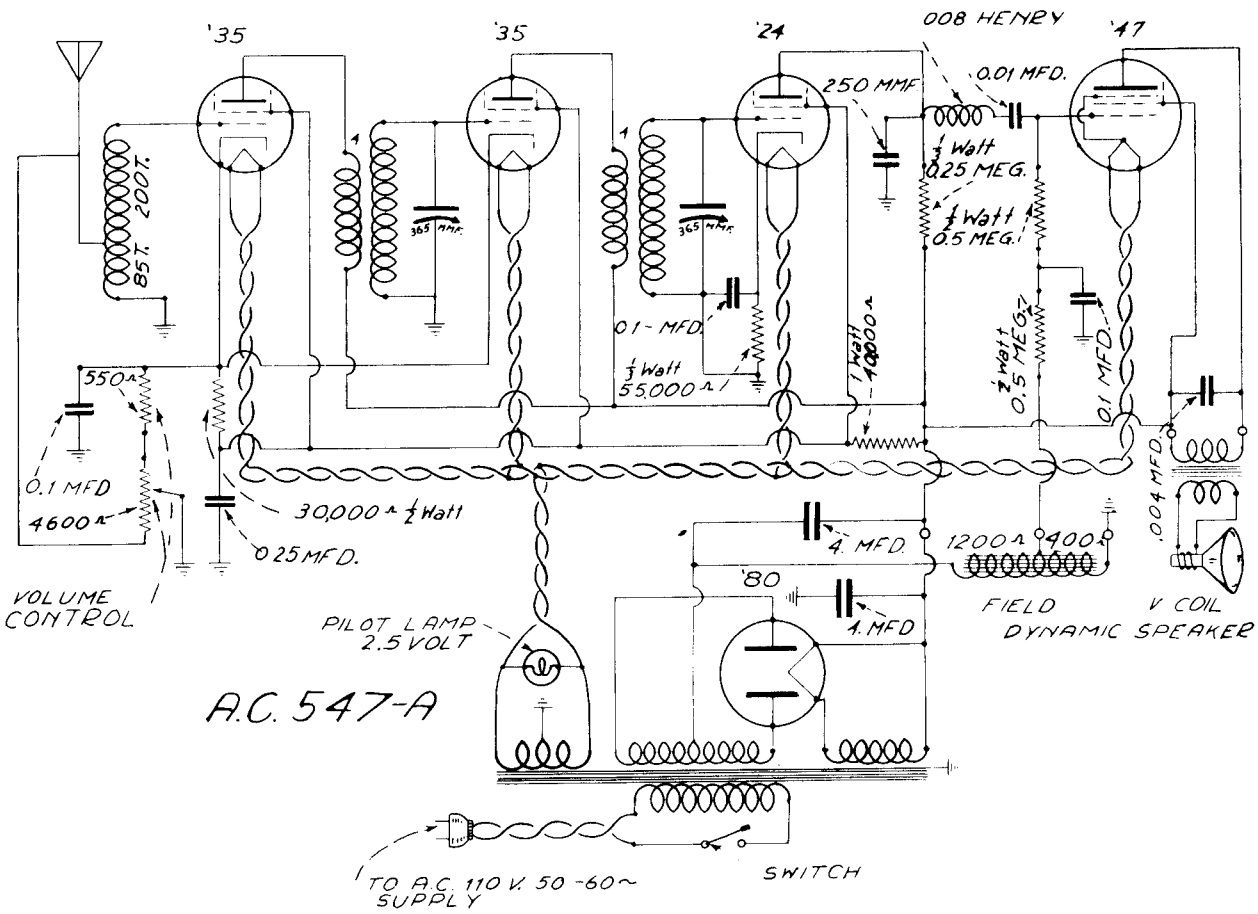

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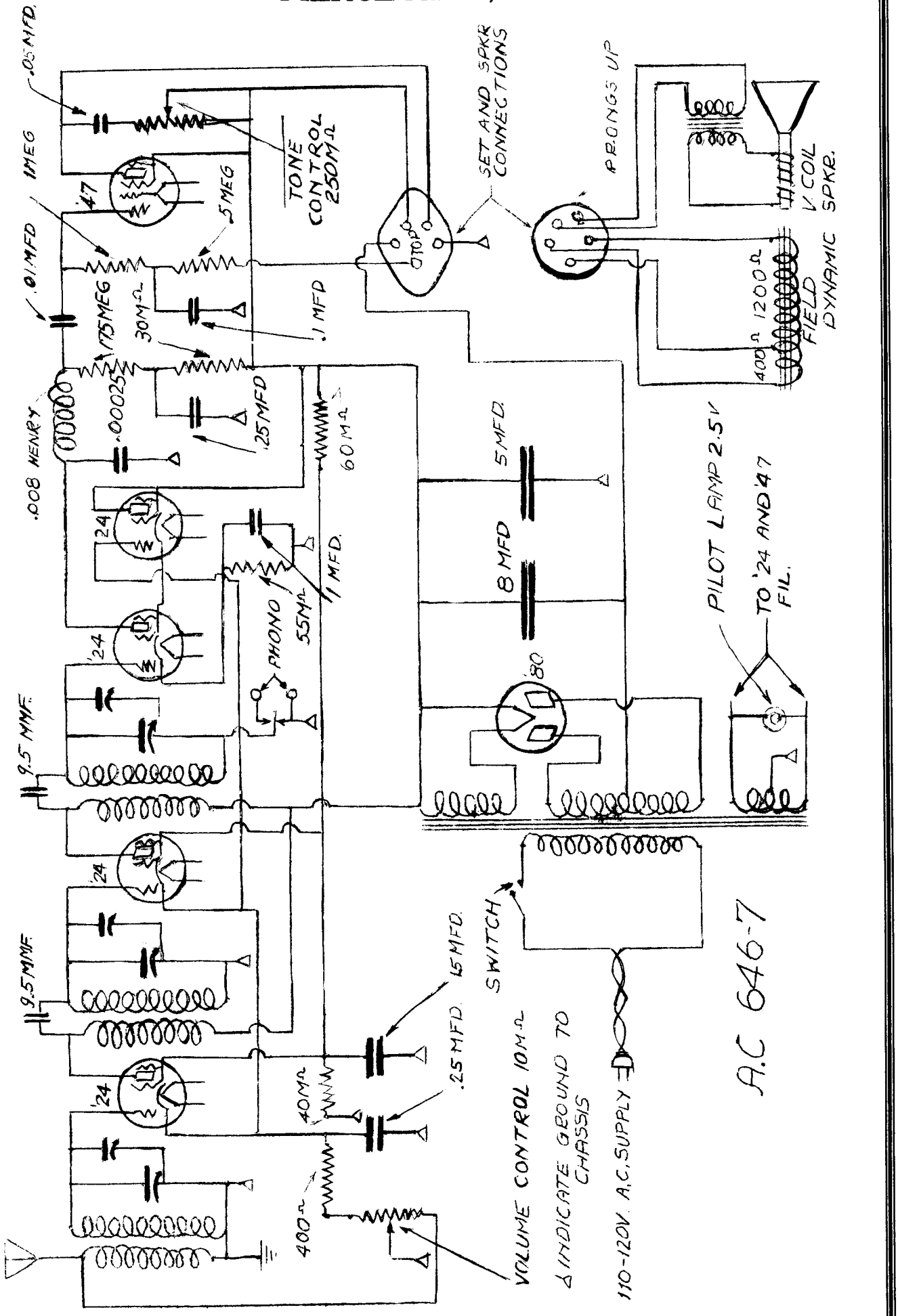
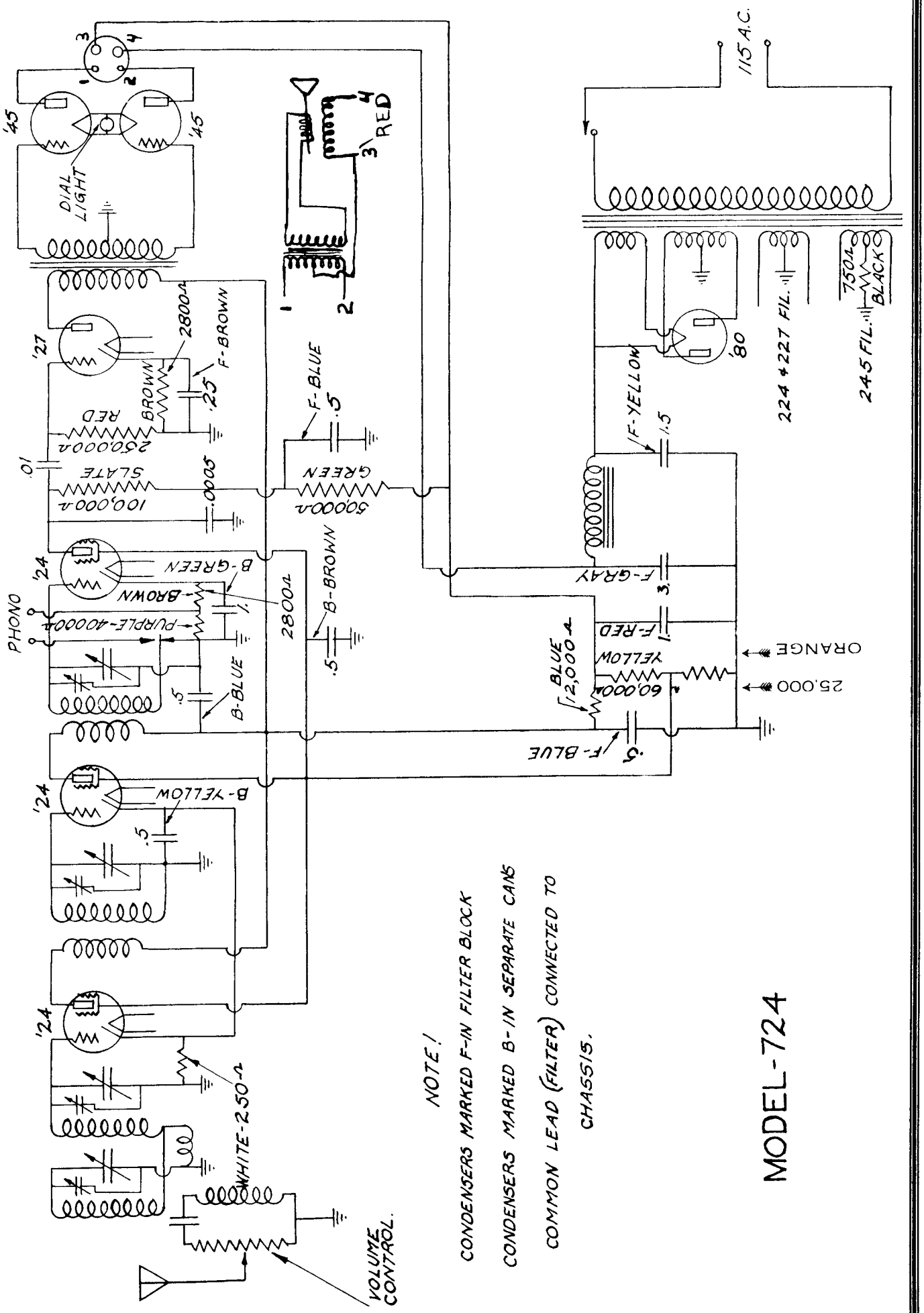


PIERCE AIRO, INC.



NOTE!

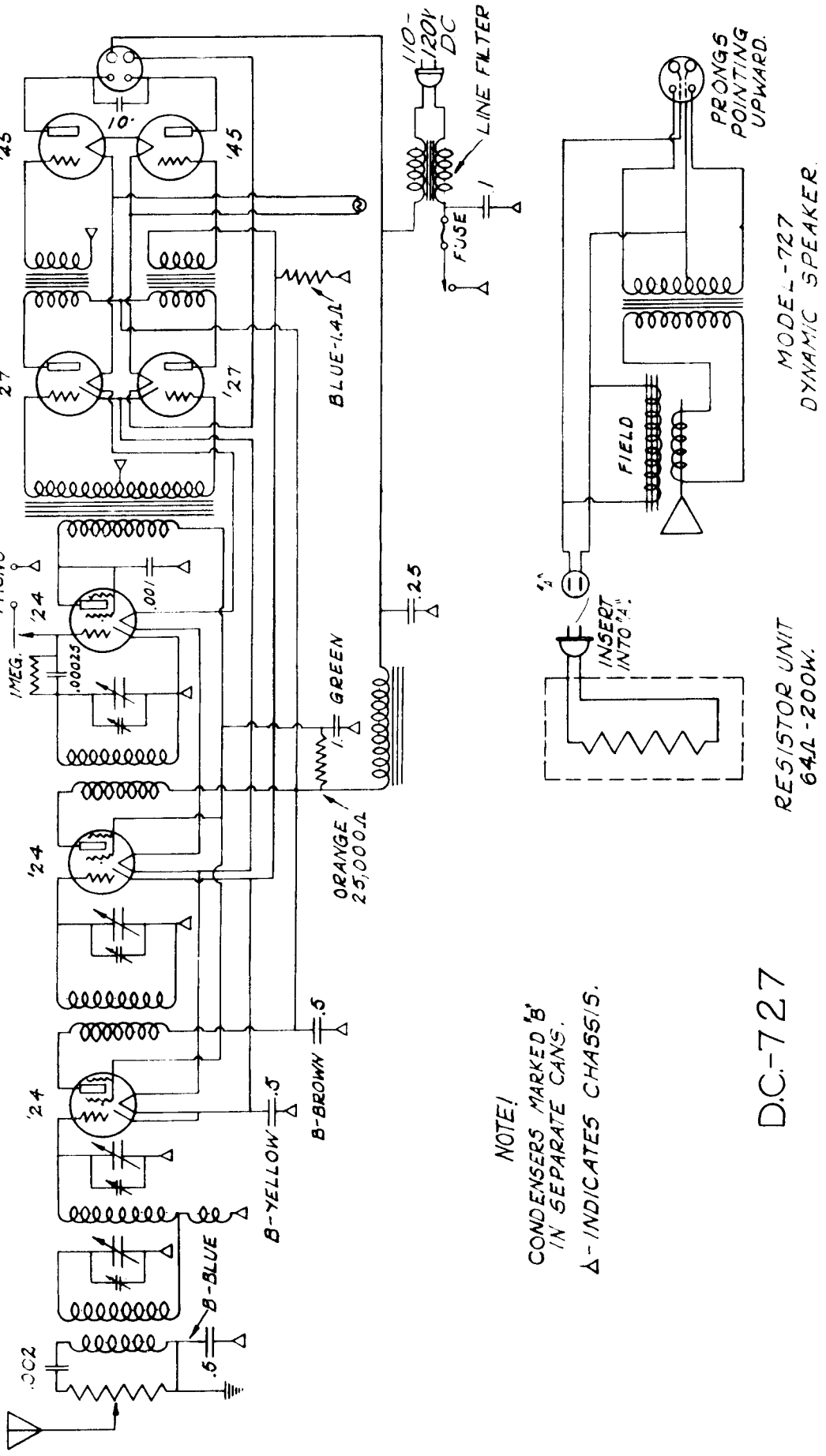
CONDENSERS MARKED F-IN FILTER BLOCK

CONDENSERS MARKED B-IN SEPARATE CANS

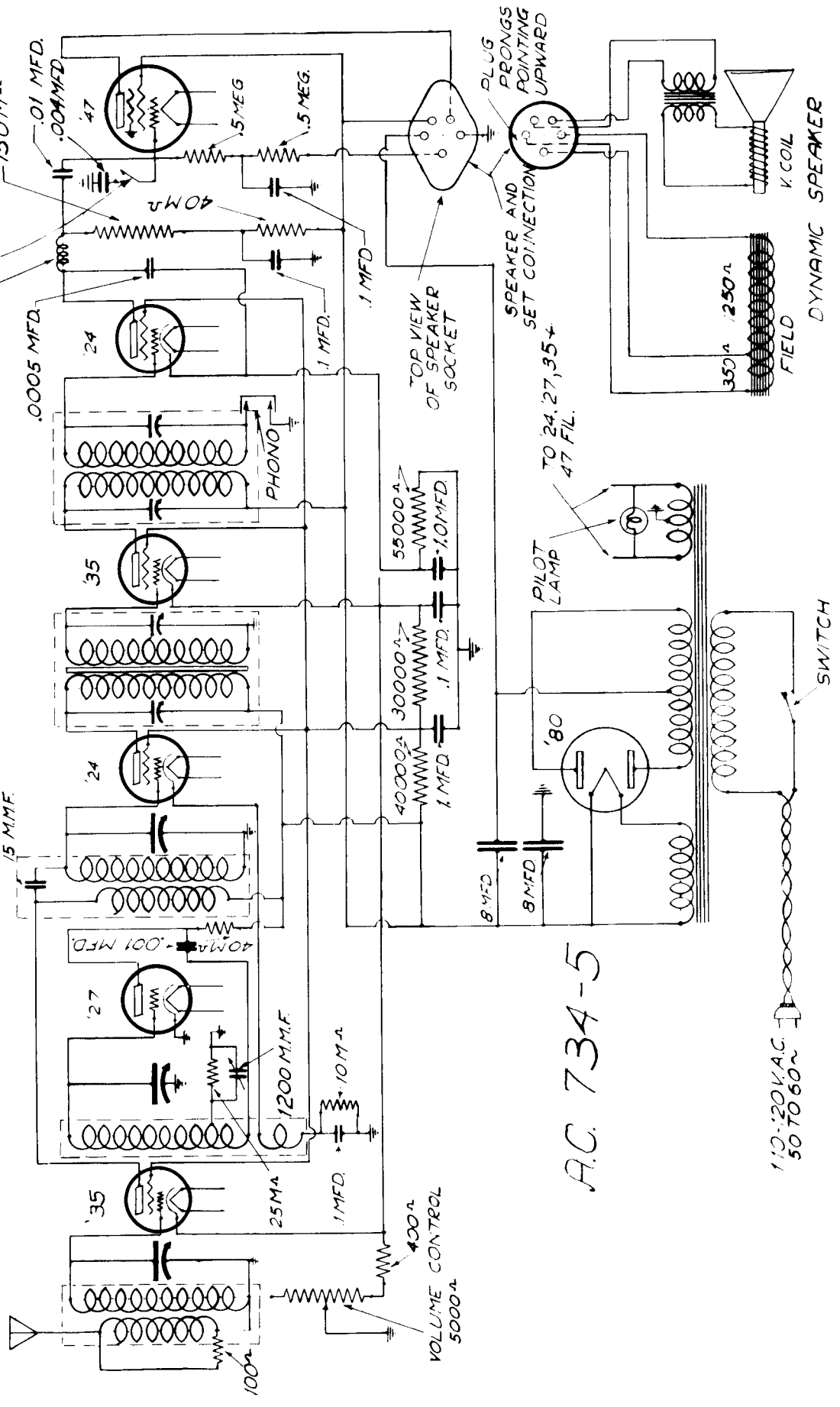
COMMON LEAD (FILTER) CONNECTED TO CHASSIS.

MODEL-724

PIERCE AIRO, INC.



PIERCE AIRO, INC.



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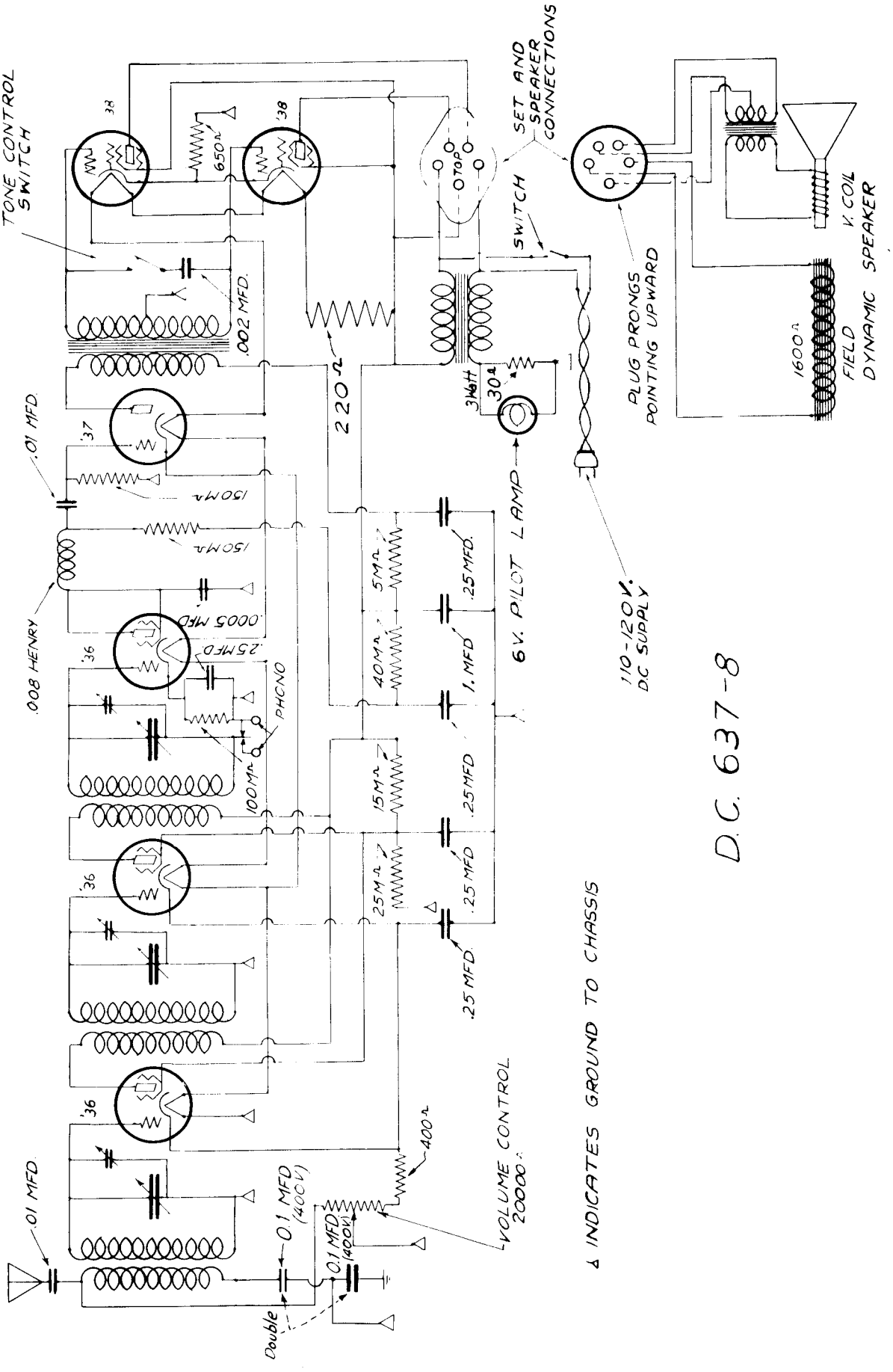
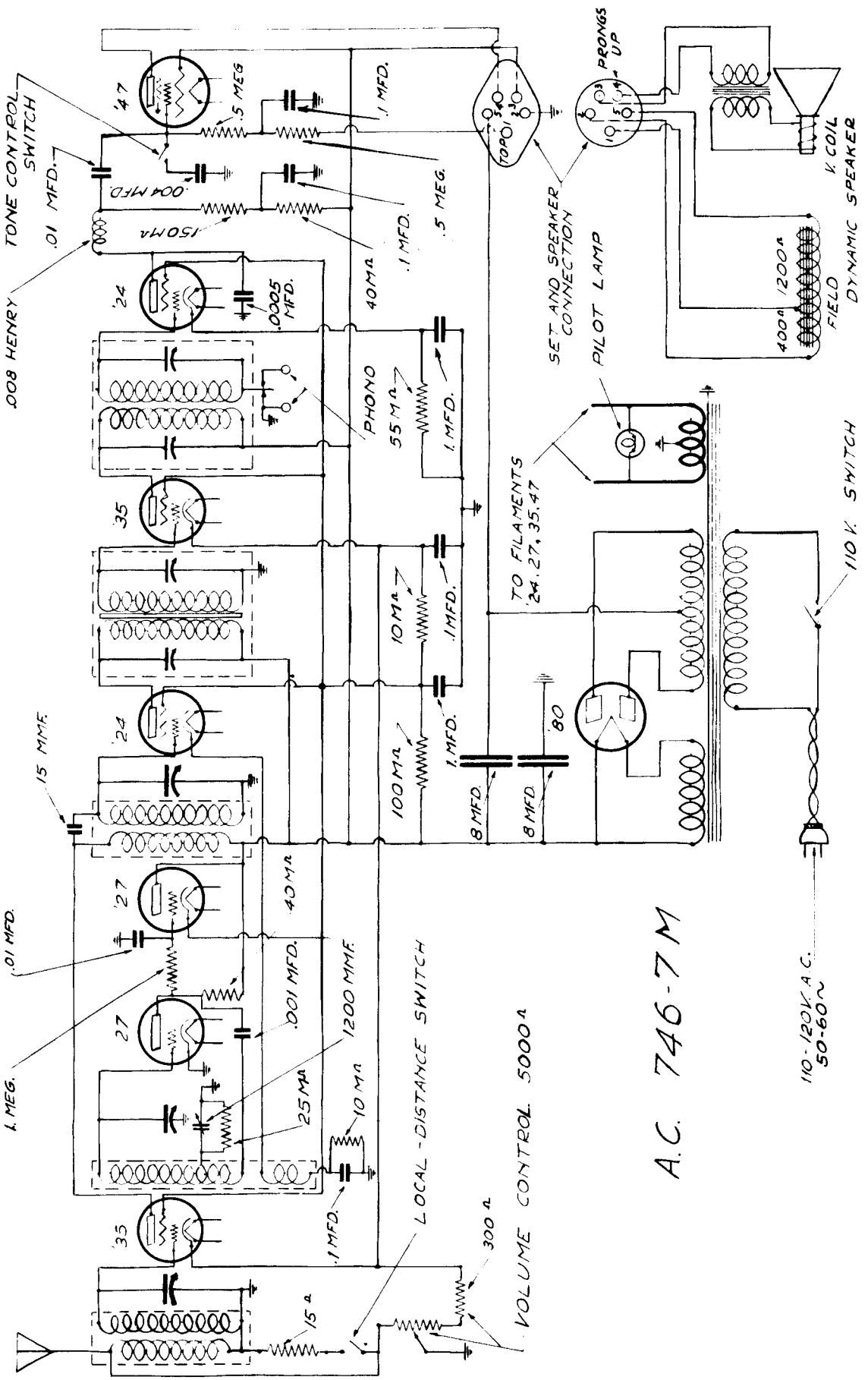
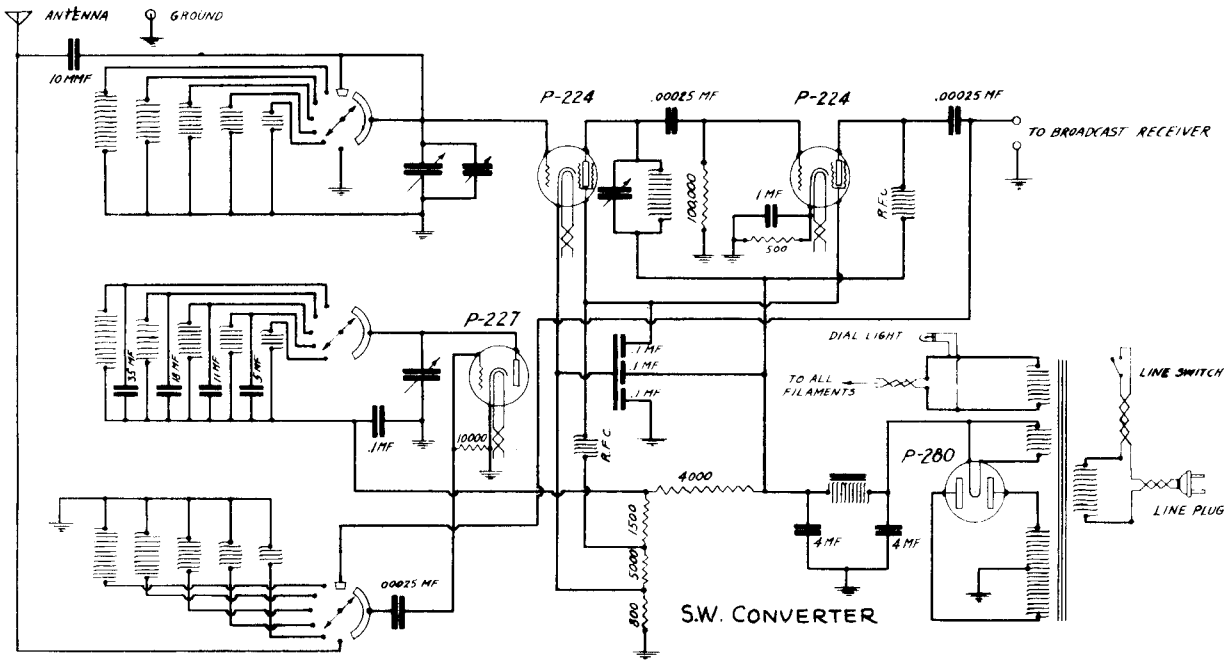
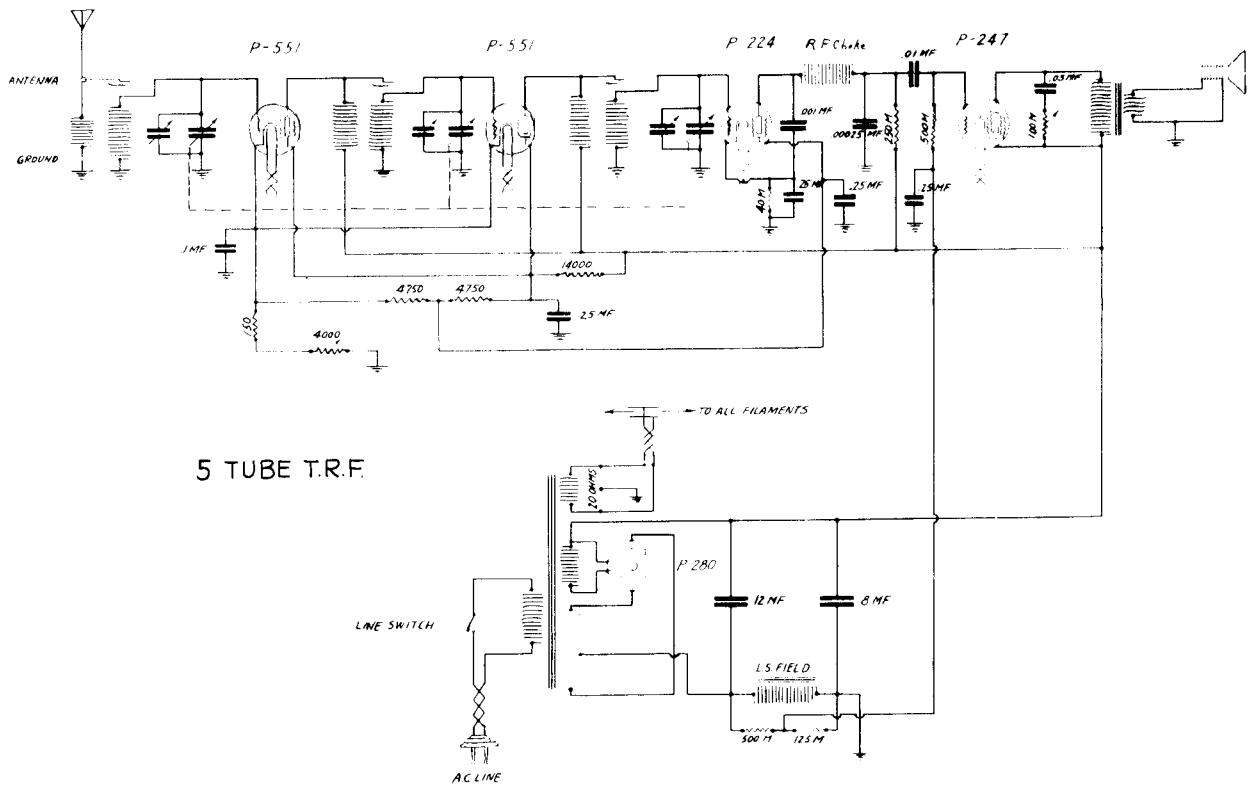


PIERCE AIRO, INC.



PILOT RADIO & TUBE CORP.





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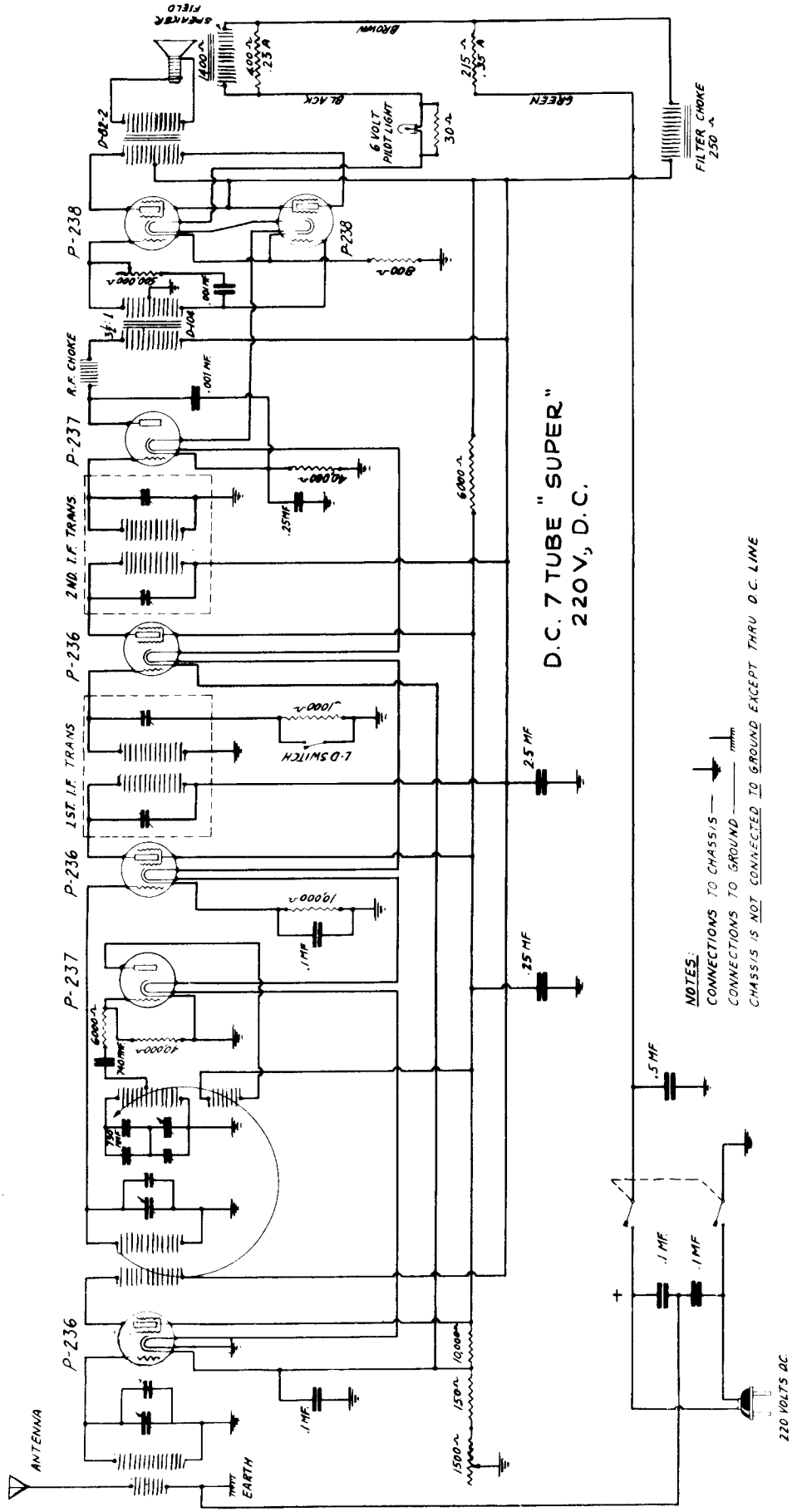

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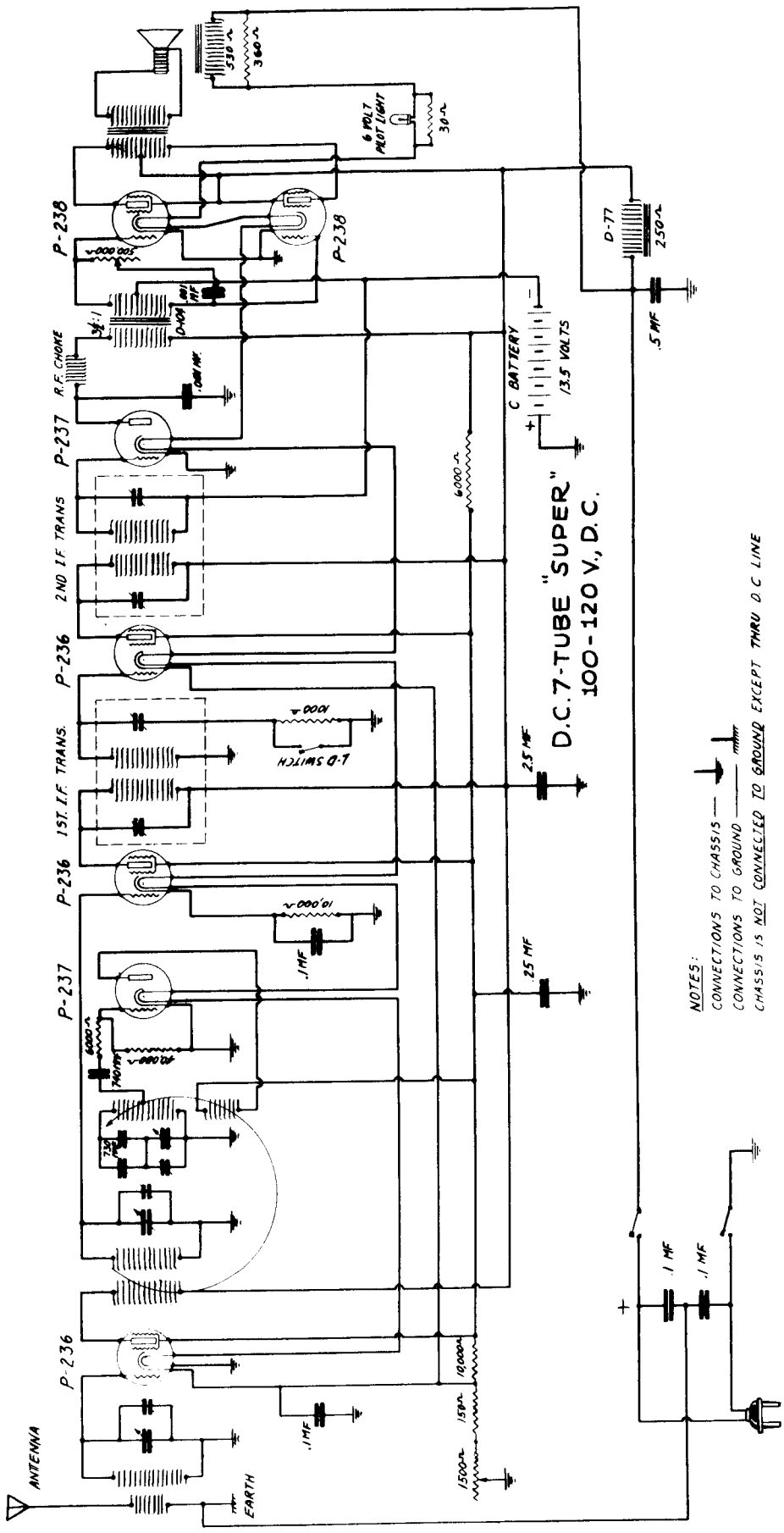


RCA VICTOR CO., INC.

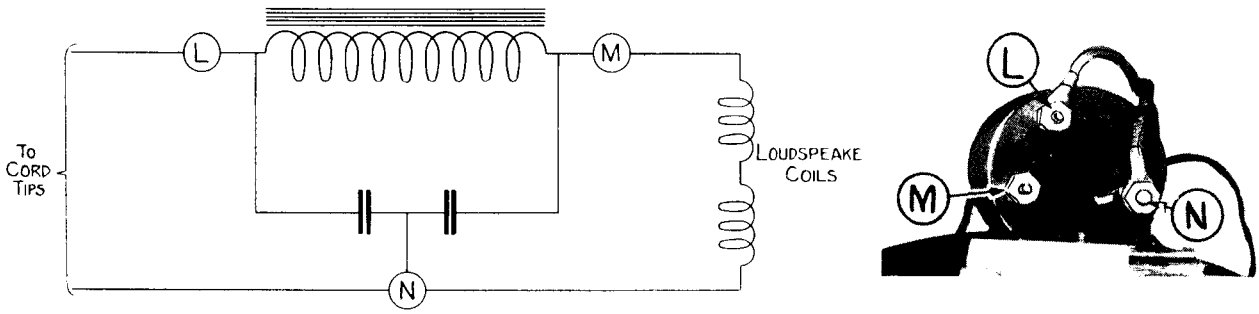
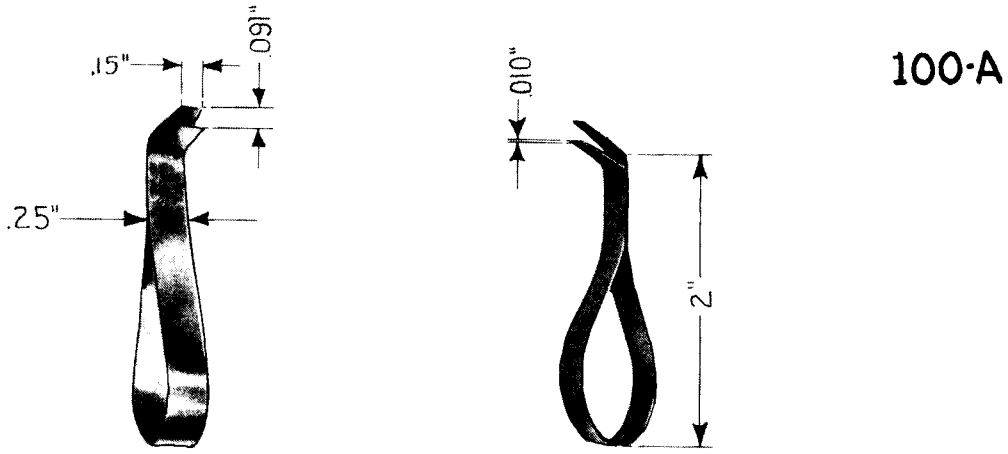


Figure 8—Schematic circuit diagram of RCA Loudspeaker Model 100A and photo of the filter unit



General appearance and correct dimensions of armature spacing tools

FILTER UNIT CONTINUITY TEST

Disconnect Magnet Coils and Loudspeaker Cord

Test	*Correct Effect*	*Incorrect Effect Caused by*
L to M	Closed	Open filter coil
L to N	Open	Shorted filter condenser
M to N	Open	Shorted filter condenser

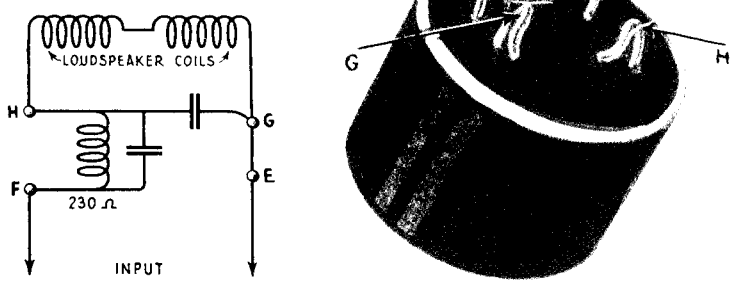
CONTINUITY TEST FOR MAGNET COILS AND LOUDSPEAKER CORD

Connect Magnet Coils and Loudspeaker Cord

Magnet coils may be tested as indicated below. A click test from one lead to the other while they are completely disconnected from the rest of the circuit is also a simple and effective method of testing.

Test	*Correct Effect*	*Incorrect Effect Caused by*
Jack tip to L or N	Closed	Open cord
Jack sleeve to L or N	Closed	Open cord
M to N	Closed	Open magnet coils or coil leads

RCA VICTOR CO., INC.



—Schematic circuit of Loudspeaker 100B coils and filter and photo of filter unit

100-B
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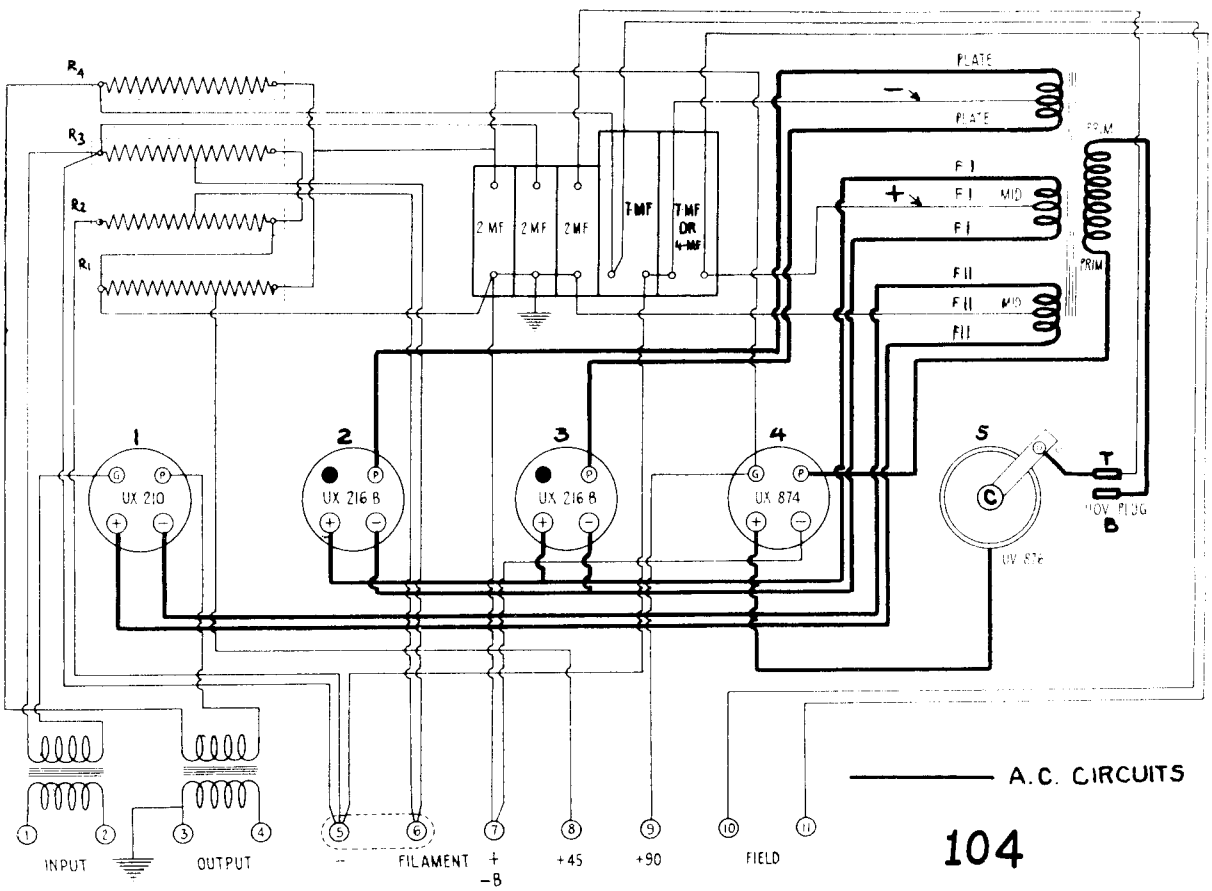
FILTER UNIT CONTINUITY TEST

Test	*Correct Effect*	*Incorrect Effect Caused By*
G to *H*	Open	Shorted Condenser
F to *H*	Closed	Open Coil



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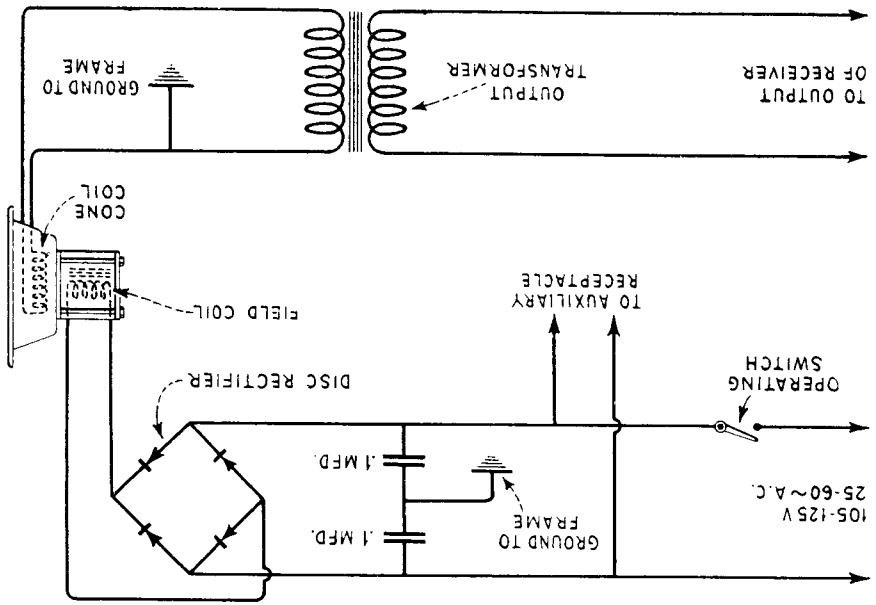
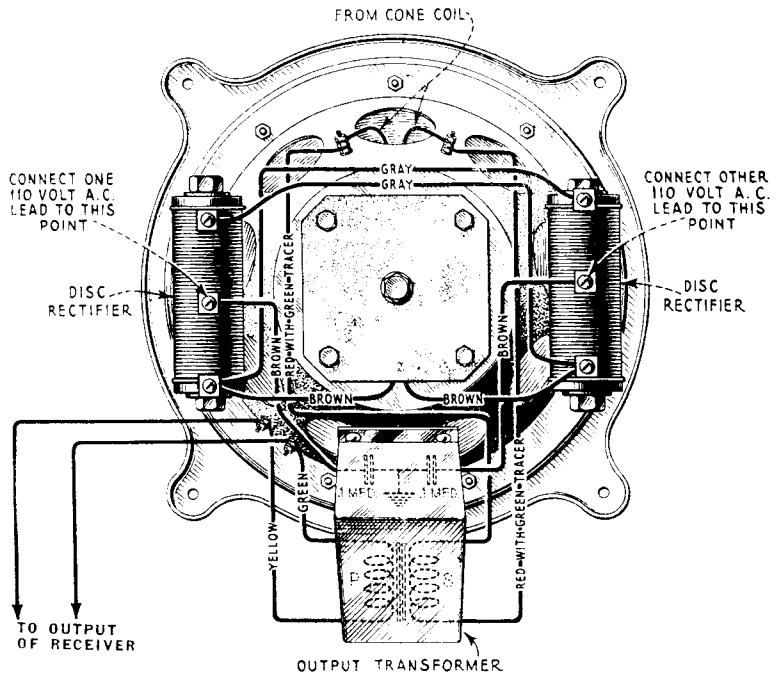
Indication	*Cause*
No Reproduction	No output from receiver Defective cone coil Defective output transformer Defective cord Loose or broken connections
Weak Reproduction	Weak receiver output Improperly centered cone Open field coil Defective rectifier Faulty connections
Distorted or noisy Reproduction (Rattle)	Distorted output from receiver Improperly centered cone Cone leads broken from side of cone Open or shorted line condensers Loose parts in cabinet assembly
Hum	Faulty receiver output Defective disc rectifier





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PHILADELPHIA STORAGE BATTERY CO.

Models 70 and 70-A Receivers

(Above Serial No. B-22,000)

Model 70 Receivers are for operation on 100-130 volt, 50-60 cycle AC lines
Model 70A Receivers are for operation on 100-130 volt, 25-60 cycle AC lines

Table 1—Tube Socket Readings Taken with A.C. Set Tester—AC Line—115 volts

Tube		Filament Volts	Plate Volts	Control Grid Volts	Screen Grid Volts	Cathode Volts	Plate Milli-amperes
Type	Circuit						
35	R. F.	2.25	250	5	70	6	4.3
24	OSC & 1st Det.	2.25	250	8	12	8	.5
35	I. F.	2.25	250	20	70	0	1.7
27	Rectifier Detector	2.25	...	0	0	0	0
35	Audio Amplifier	2.25	50	0	60	0	1.0
47	Output	2.25	240*	4*	255*	.	28*
80	Rectifier	4.70	260/plate	..	...	.	...

*These readings must be taken from the underside of the chassis, using test prods and leads unless the set checker is specially equipped for testing pentode tubes.

Table 2—Power Transformer Voltages

Terminals	A.C. Volts	Circuit	Color
1–2	105 to 125	Primary	White
3–5	2.5	Filament of 24 and 35's	Black
6–8	2.5	Filament of 47	Dark Green
9–10	5.	Filament of 80	Blue
11–13	700	Plates of 80	Yellow
4	...	Center Tap of 3–5	Black, Yellow Tracer
7	..	Center Tap of 6–8	Black, Green Tracer
12	...	Center Tap of 11–13	Yellow, Green Tracer

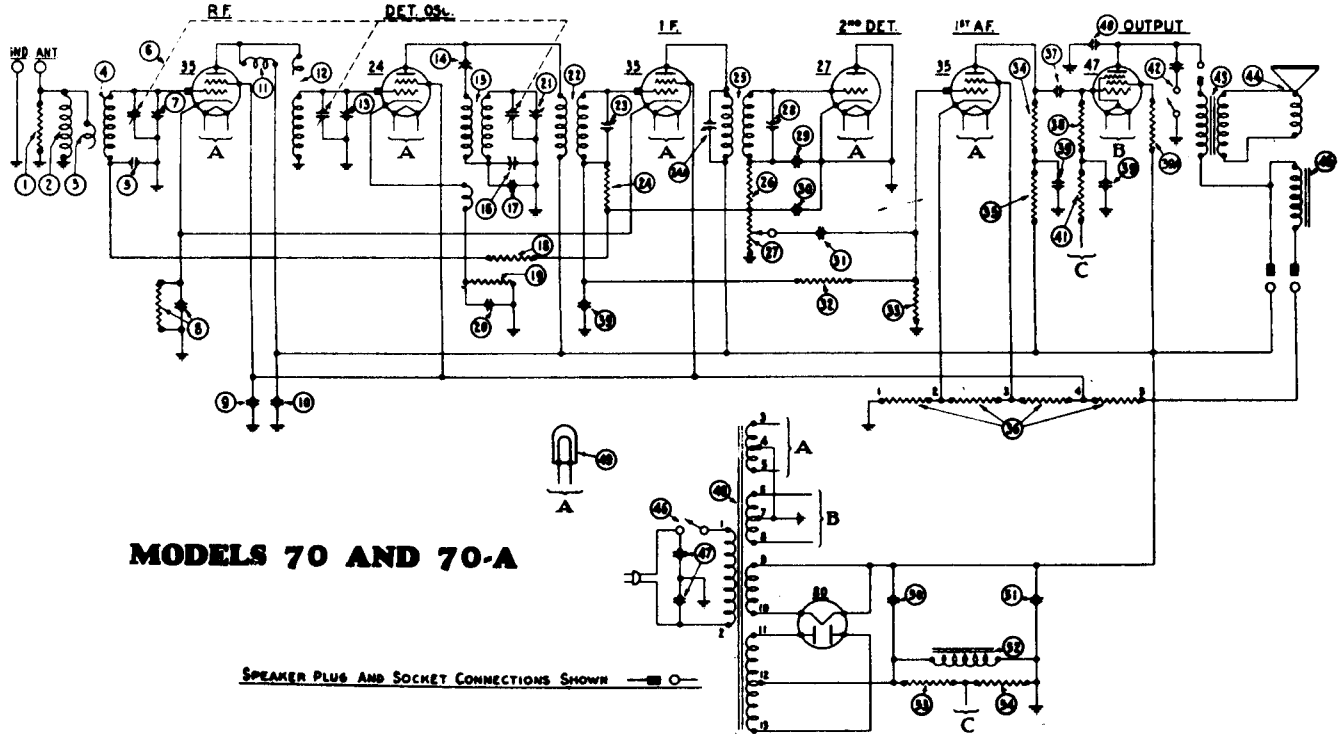
Table 3—Condenser Data

Nos. on Figs. 1 and 2	Capacity (mfd.)	Container
(29) (30)	.00011	Blue and Yellow
(17)	.00041	Yellow and Orange
(20)	.0007	White and Yellow
(5)	.003	Orange and White
(31) (37) (40)	.01	Black Bakelite
(47)	.015 (Double)	Black Bakelite
(6) (10)	.05	Black Bakelite
(39)	.05, .25, 1.5	Metal
(8)	.09 & 200 Ohms	Black Bakelite
(9)	.5	Metal
(50) (51) (50-60 cycles)	6	Electrolytic
(51) (25-40 cycles)	10	Electrolytic
(50) (25-40 cycles)	14	Electrolytic

Table 4—Resistor Data

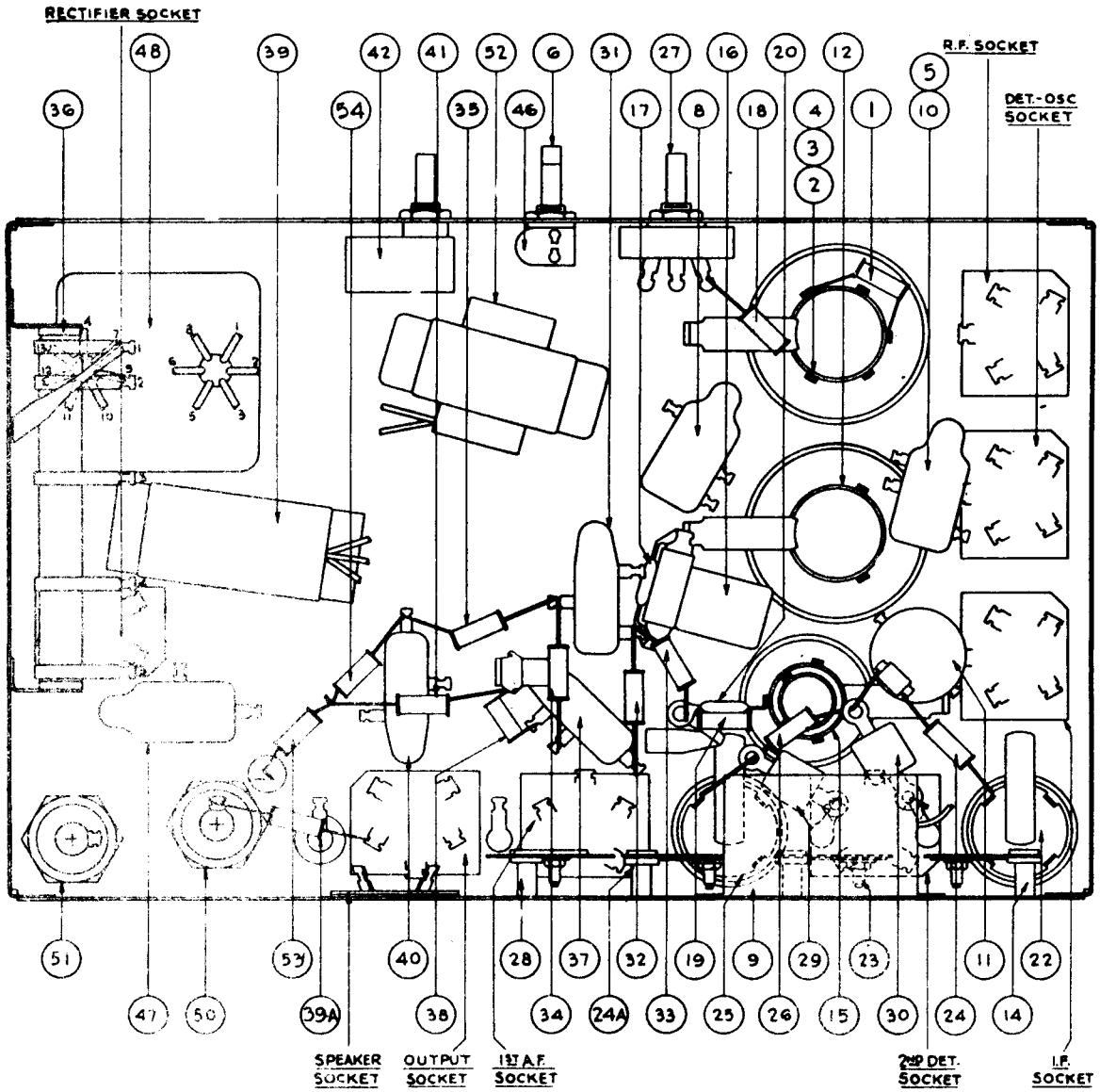
Nos. on Figs. 1 and 2	Power (watts)	Resistance (ohms)	Color		
			Body	Tip	Dot
(36)	Terminals 1–2	26	Long Tubular		
	Terminals 2–3	850			
	Terminals 3–4	1650			
	Terminals 4–5	1060			
(2)	.5	1,000	Brown	Black	Red
(39)A	.5	2,900	Red	White	Red
(1) (19)	.5	10,000	Brown	Black	Orange
(35)	.5	25,000	Red	Green	Orange
(53)	.5	51,000	Green	Brown	Orange
(34)	.5	70,000	Violet	Black	Orange
(26)	.5	99,000	White	White	Orange
(41)	.5	330,000	Red	Yellow	Yellow
(38) (54)	.5	490,000	Yellow	White	Yellow
(33)	.5	1,000,000	Brown	Black	Green
(18) (24)	.5	2,000,000	Red	Black	Green
(32)	.5	4,000,000	Yellow	Black	Green

PHILADELPHIA STORAGE BATTERY CO.



MODELS 70 AND 70-A

SPEAKER PLUG AND SOCKET CONNECTIONS SHOWN



PHILADELPHIA STORAGE BATTERY CO.

Model 90

(Serial Nos. B-32,001 to B-35,000 and Above B-53,100)

Model 90 receivers are for operation on 100 to 130 volt, 50-60 cycle AC lines. This receiver is a nine tube superheterodyne with push-pull pentode output. Automatic volume control, 4 point tone control, super control screen grid tubes and combination first detector and oscillator tube are some of the additional features. The maximum power consumption is 100 watts.

Table 1—Tube Socket Readings Taken with A.C. Set Tester—A.C. Line 115 Volts

Tube		Filament Volts	Plate Volts	Control Grid Volts	Screen Grid Volts	Cathode Volts	Plate Milli-Amperes
Type	Circuit						
35	R.F.	2.5	225	0	38	6	4.2
24	Det.-Osc.	2.5	215	12	40	22	.5
35	I.F.	2.5	235	10	38	10	1.0
27	Det. Rectifier	2.5	...	...	...	10	...
27	Det. Amplifier	2.5	50	0	...	1.	1.0
27	1st Audio	2.5	90	0	...	1.	5.0
47	Output	2.5	210	10	225	...	31.
47	Output	2.5	210	10	225	...	31.
80	Rectifier	5.0	225/plate	...	...	...	...

Above readings taken with volume control at maximum and dial turned to low frequnecy end.

Table 2—Power Transformer Voltages

Terminals Figs. 1 and 2	A.C. Volts	Circuit	Color
1–2	115	Primary	White
4	...	Center Tap Heater	Black, Yellow Tracer
3–5	2.5	Heater	Black
6–8	2.5	Filament 47's	Dark Green
7	...	Center Tap Filament 47's	Black, Green Tracer
9–10	5.0	Filament 80	Light Blue
11–13	665	Plates 80	Yellow
12	...	Center Tap Plates 80	Yellow, Green Tracer

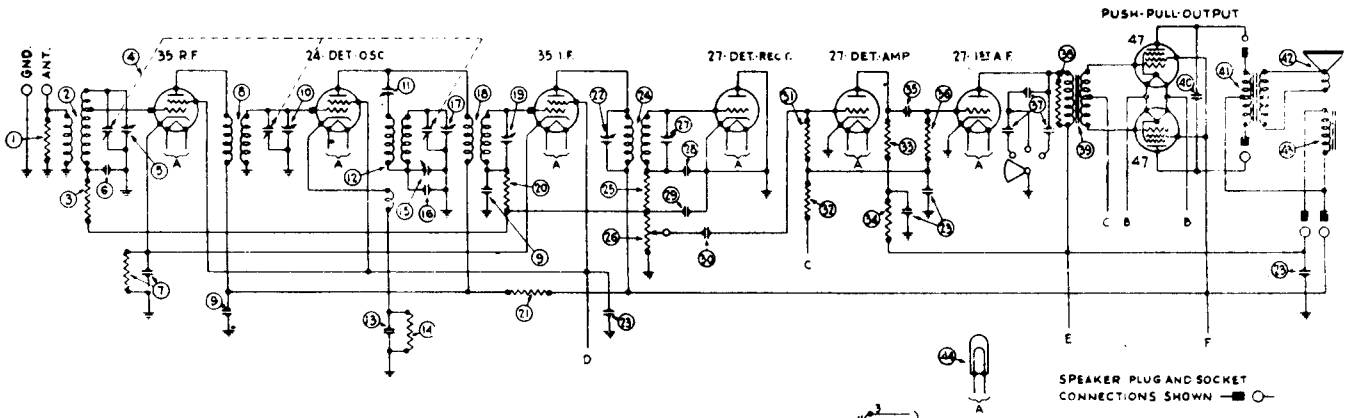
Table 3—Condenser Data

Nos. on Figs. 1 and 2	Capacity (Mfd.)	Container
(28) (29)	.00011	Blue and Golden Yellow
(16)	.00041	Yellow and Orange
(13)	.0007	White and Gold Yellow
(40)	.001	Green and White
(30) (35)	.01	Black Bakelite
(45)	.015	Black Bakelite
(6)	.05	Black Bakelite
(9)	.09	Black Bakelite
(7)	.09 & 200 Ohms	Black Bakelite
(50)	.15	Black Bakelite
(28)	2-.25, 2-.5	Metal
(46)	6.	Electrolytic
(51)	6.	Electrolytic

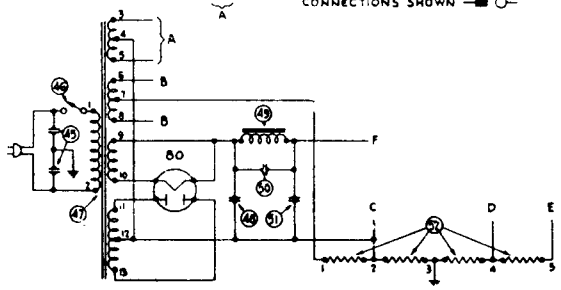
Table 4—Resistor Data

Nos. on Figs. 1 and 2	Power (Watts)	Resistance (Ohms)	Color		
			Body	Dot	Dot
	(Terminals)				
	1–2	205			
	2–3	95			
(32)	3–4	2,400	Gray	Red	Red
	4–5	1,200			
(21)	1.	1,000	Brown	Black	Red
(1)	.5	10,000	Brown	Black	Orange
(14)	.5	15,000	Brown	Green	Orange
(33) (34)	.5	25,000	Red	Green	Orange
(38)	.5	51,000	Green	Brown	Orange
(25)	.5	99,000	White	White	Orange
(32)	.5	490,000	Yellow	White	Green
(3) (20) (31) (36)	.5	1,000,000	Brown	Black	Green

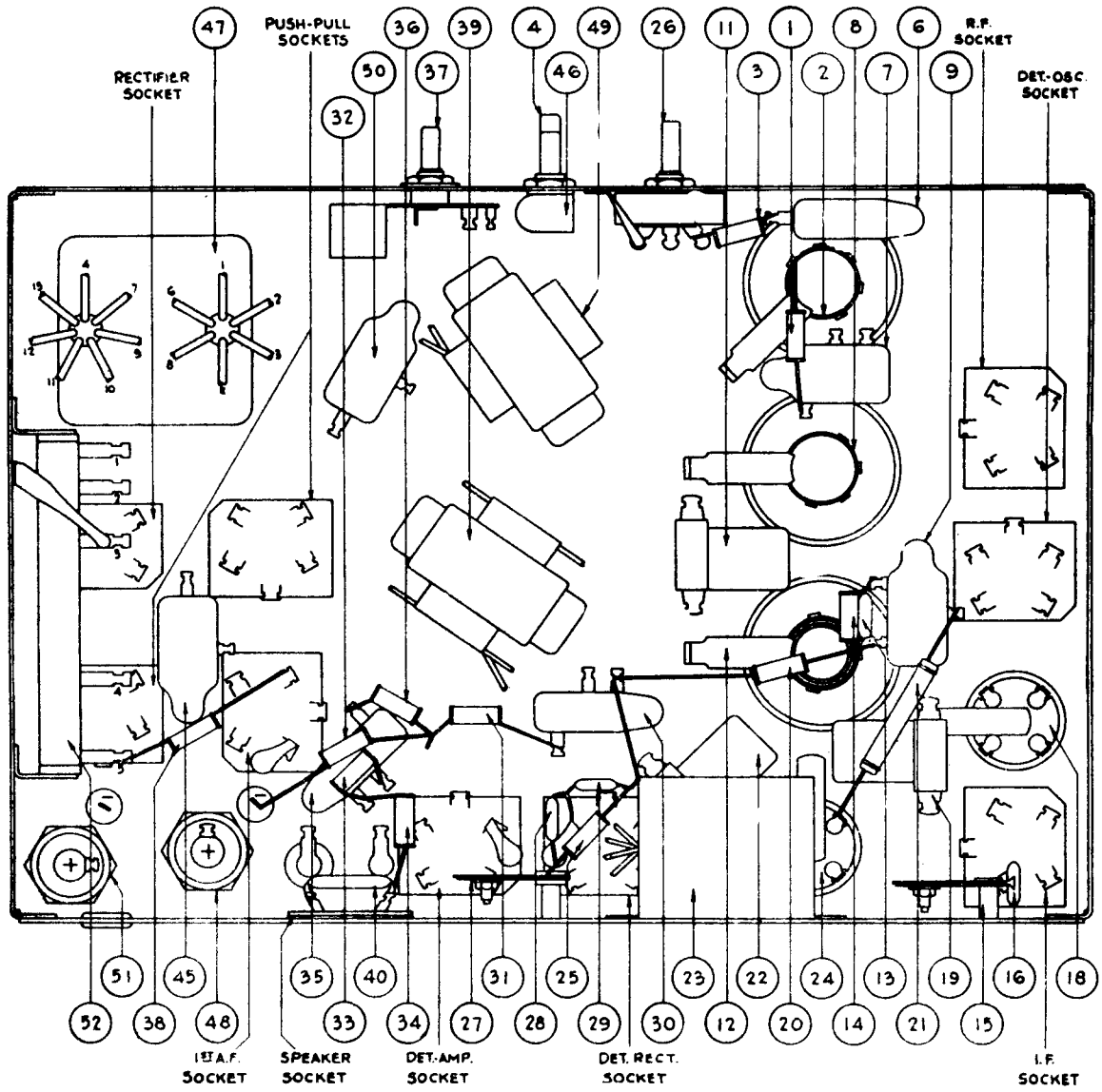
PHILADELPHIA STORAGE BATTERY CO.



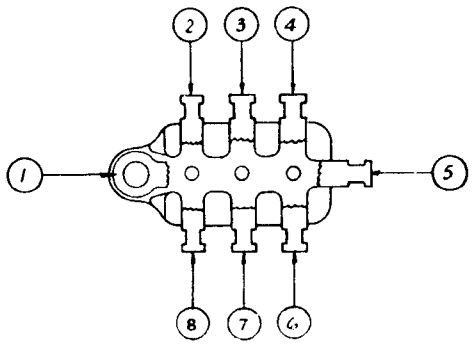
SPEAKER PLUG AND SOCKET CONNECTIONS SHOWN



PHILCO MODEL 90



PHILADELPHIA STORAGE BATTERY CO.



Standard By-Pass Condenser Data

The tables below list the various Philco standard by-pass condensers in black bakelite containers. The drawing shows all possible lug arrangements and the tables list the lug numbers.

Condenser 3615 .05 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3615-B	.05	1-3-5	250	3-5	1-5
3615-C	.05	1-5-7	250	5-7	1-5
3615-D	.05	1-3-5	...	...	1-5
3615-E	.05	2-5	...	...	...
3615-F	.05	2-3-5	...	...	3-5
3615-G	.05	5-8	...	...	...
3615-H	.05	3-5-8	...	...	5-8
3615-J	.05	1-5-7	...	...	1-5
3615-K	.05	3-5-8	250	3-5	5-8
3615-L	.05	1-5	...	...	...
3615-M	.05	2-5-7	...	...	2-5
3615-N	.05	1-4-7	...	...	1-4
3615-P	.05	1-4-7	250	4-7	1-4
3615-R	.05	1-5-7	250	5-7	1-5
3615-S	.05	1-4	...	...	...
3615-T	.05	1-5-7	150	1-7	1-5
3615-U	.05	1-5-7	...	...	1-7
3615-W	.05	1-2-5	...	...	1-5
3615-X	.05	1-2-5-7	150	1-7	1-5
3615-Y	.05	1-2-5-7	150	1-5	1-7
3615-AA	.05	1-3-5-8	...	...	1-5
3615-AB	.05	1-4-7-8	...	...	1-4
3615-AC	.05	1-5-7-8	...	...	1-7
3615-AD	.05	3-5-8	...	...	3-5
3615-AE	.05	1-7-8	...	...	7-8
3615-AF	Twin .05	4-7-8	...	...	4-8 & 7-8
3615-AG	.05	1-3-5	...	...	1-5
3615-AH	.05	1-5	...	...	1-5
3615-AJ	Twin .05	1-3-6-8	...	...	1-3 & 1-6
3615-AK	.05	1-5-7-8	...	...	1-7

Condenser 3793 .015 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3793-B	.015	5-7	...	...	...
3793-C	.015	2-4	...	...	...
3793-D	.015	2-6	...	...	...
3793-E	Twin .015	1-5-7	...	...	1-5 & 1-7
3793-F	.015	5-7-8	...	...	7-8
3793-G	.015	2-3-6	...	...	2-6
3793-H	Twin .015	1-3-5	...	...	3 & 1-5
3793-J	.015	2-5-7	...	...	2-5
3793-K	Twin .015	1-3-5-8	...	...	1-3 & 1-5
3793-L	Twin .015	5-7-8	...	...	7-8
3793-M	Twin .015	5-7-8	...	.	5-8 & 7-8

Condenser 3903 .01 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3903-F	.01	3-5	...	...	...
3903-G	.01	2-4-7	...	...	2-4
3903-H	.01	5-8	...	...	...
3903-J	.01	2-5-7	...	...	2-5
3903-K	.01	1-2-4-7	...	...	1-7
3903-L	.01	3-5-8	...	...	3-5
3903-M	.01	4-7-8	...	...	4-8
3903-N	.01	3-5-8	...	...	5-8
3903-P	.01	2-5-7	...	...	2-7
3903-R	.01	4-7-8	...	...	4-7
3903-S	Twin .01	1-5-7	...	...	1-5 & 1-7
3903-T	.01	5-7-8	...	...	7-8
3903-U	.01	1-2-5-7	...	...	1-7
3903-W	.01	2-4-7	...	...	2-7
3903-X	.01	3-5-8	...	...	3-8
3903-Y	.01	3-5	...	...	3 5

Condenser 4989 .09 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
4989-B	Twin .09	1-3-5	...	...	1-3 & 1-5
4989-C	Twin .09	1-5-7	...	...	1-5 & 1-7
4989-D	.09	1-5	...	...	...
4989-E	.09	1-5-7	250	7-5	1-5
4989-F	.09	1-5-7	...	...	1-5
4989-G	Twin .09	1-4-7	...	...	1-4 & 1-7
4989-H	Twin .09	1-5	...	...	1-5 & 1-5
4989-J	.09	3-5	...	...	3-5
4989-K	Twin .09	3-5	...	...	3-5
4989-L	.09	3-4-8	200	3-8	4-8
4989-M	Twin .09	4-7-8	...	...	4-8 & 7-8

PHILCO RADIO CHASSIS DATA

	MODEL	TUBES														SPEAKER				VOLUME CONTROL		TONE CONTROL				POWER TRANSFORMER		
		27	24	35	47	45	80	14	17	32	33	30	2	3	71A	Type	Cone Assembly	Field Assembly	Output Transformer	Part No.	Resistance (Ohms)	Part No.	2 Point	4 Point	Capacity (Mfd.)	50–60 Cycles	25–40 Cycles	50–60 230 Volts
Early Models	70 B.G.	1	4		1		1									K-3	02996	02987	2673	5039	5000 & 210	03140	√		2–.01	5117	5118	5119
	70 H.B.	1	4		1		1									K-3	02996	02987	2673	5039	5000 & 210	03140	√		2–.01	5117	5118	5119
	270	1	4		1		1									K-3	02996	02987	2673	5039	5000 & 210	03140	√		2–.01	5117	5118	5119
	370	1	4		1		1									K-3	02996	02987	2673	5056	5000 & 210	03168	√		2–.01	5117	5118	5119
	470	2	5		1		1									K-4	02996	02987	2673	5039	5000 & 210	03140	√		2–.01	5117 5906	5118 5923	5119 5924
	570	1	4		1		1									K-3	02996	02987	2673	5039	5000 & 210	03140	√		2–.01	5117	5118	5119
Automatic Volume Control	70 B.G.	1	1	3	1		1									K-3	02996	02987	2673	6015	1,000,000	03637	√		.01	5117	5118	5119
	70 H.B.	1	1	3	1		1									K-3	02996	02987	2673	6015	1,000,000	03637	√		.01	5117	5118	5119
	270	1	1	3	1		1									K-3	02996	02987	2673	6015	1,000,000	03637	√		.01	5117	5118	5119
	370	1	1	3	1		1									K-3	02996	02987	2673	6307	1,000,000	04652	√		.01	5117	5118	5119
	470	2	2	3	1		1									K-4	02996	02987	2673	6015	1,000,000	03637	√		.01	5117 5906	5118 5923	5119 5924
	570	1	1	3	1		1									K-3	02996	02987	2673	6015	1,000,000	03637	√		.01	5117	5118	5119
Push Pull 45's	90 B.G.	2	4			2	1									K-2	02996	02987	2766	5039	5000 & 210	03137		√	.015, 2–.01	4938	4939	4940
	90 L.B.	2	4			2	1									H-2	02874	02988	2766	5039	5000 & 210	03137		√	.015, 2–.01	4938	4939	4940
	90 H.B.	2	4			2	1									H-2	02874	02988	2766	5039	5000 & 210	03137		√	.015, 2–.01	4938	4939	4940
Single Pentode	90 B.G.	4	3		1		1									K-3	02996	02987	2673	5724	500,000	03137		√	.015, 2–.01	5362	5363	5364
	90 L.B.	4	3		1		1									H-3	02874	02988	2673	5724	500,000	03137		√	.015, 2–.01	5362	5363	5364
	90 H.B.	4	3		1		1									H-3	02874	02988	2673	5724	500,000	03137		√	.015, 2–.01	5362	5363	5364
	490	5	4		1		1									K-4	02996	02987	2673	5724	500,000	03137		√	.015, 2–.01	5362 5906	5363 5923	5364 5924
Push Pull Pentode	90 B.G.	3	1	2	2		1									K-5	02996	02987	2635	6015	1,000,000	03137		√	.015, 2–.01	6072	6073	6074
	90X	3	1	2	2		1									H-6	02874	02988	2635	6015	1,000,000	03137		√	.015, 2–.01	6072	6073	6074
	490	4	2	2	2		1									K-8	02996	02987	2635	6015	1,000,000	03137		√	.015, 2–.01	6072 5906	6073 5923	6074 5924
Push Pull 45's	112	4	4			2	1									H-2	02874	02988	2766	4093	500,000	03137		√	.015, 2–.01	4446	4447	4595
	212	4	4			2	1									H-2	02874	02988	2766	4093	500,000	03137		√	.015, 2–.01	4446	4447	4595
Push Pull Pentodes	112	4	4		2		1									H-6	02874	02988	2635	4093	500,000	03137		√	.015, 2–.01	5594	5595	5596
	112X	4	4		2		1									H-6	02874	02988	2635	4093	500,000	03137		√	.015, 2–.01	5594	5595	5596
	212	4	4		2		1									H-6	02874	02988	2635	4093	500,000	03137		√	.015, 2–.01	5594	5595	5596
	50 B.G.		3		1		1									P-2	02861*	02942	2660	5232	1750					5266	5267	5268
	50 L.B.		3		1		1									S-2	02887**	02942	2660	5232	1750					5266	5267	5268
	51 B.G.		2	1	1		1									P-2	02861	02942	2660	5839	5000					5266	5267	5268
	51 L.B.		2	1	1		1									S-2	02887	02942	2660	5839	5000					5266	5267	5268
	551		2	1	1		1									P-2	02861*	02942	2660	5839	5000					5266	5267	5268
	4	1	1				1																			5785	5786	5787
	46 B.G.							3	1				1	1 (E)	2	N-2	02996	02924	2766	4141	1750							
	46 H.B.							3	1				1	1 (E)	2	N-2	02996	02924	2766	4141	1750							
	35 B.G.									3	1	3				R-2	02887**		2646	5317	5000 (Dual)	03637	√		.01			
	35 H.B.									3	1	3				R-2	02887**		2646	5317	5000 (Dual)	03637	√		.01			

*Used with spacer washer 3316 and mounting screw W-161 when replacing cone assembly 02970.
**Used with spacer washer 2616 and mounting screw W-161 when replacing cone assembly 02949.

PHILADELPHIA STORAGE BATTERY CO.

Checking I. F. Oscillator Calibration

Any oscillator which is not crystal controlled particularly those which are battery operated and portable, should be checked from time to time for correct frequency calibration. The calibration can be appreciably affected by rough handling of the oscillator while it is being moved about, and by the condition of the tubes and batteries. If an oscillator is in constant daily use, it should be checked two or three times a week and any necessary adjustment made to correct errors in calibration.

One of the most accurate and convenient methods of making this check is through the use of the signals from reliable broadcasting stations. Most of the better class stations have accurate crystal controlled frequency regulation which assures broadcasting on the assigned frequency. Intermediate frequency oscillators can be checked with the aid of broadcast signals in the following manner:

175 KC Intermediate Frequency Oscillator Check—Place radio set in operation, and tune it accurately to a station broadcasting on any of the following frequencies: 700, 1050, or 1400 KC. When a station is heard at any one of these three points, disconnect the antenna and substitute a connection to the output of the oscillator. Place the oscillator in operation at 175 KC. If the oscillator is calibrated correctly, its signal should be heard on the receiver without changing the tuning of the broadcast receiver in any way. If it is necessary to re-tune the set before the oscillator signal can be heard at maximum volume for the particular setting of the attenuator and the radio set volume control, the oscillator is off calibration. Its compensating condenser should be re-adjusted until the signal is heard at exactly 700, 1050, and 1400 KC. (These frequencies are the fourth, sixth, and eighth harmonics of 175 KC.) In the Philco Oscillator Model 095, this compensating condenser is the one nearer the 175 KC switch position.

260 KC Intermediate Frequency Oscillator Check—Proceed in the same manner as for the 175 KC check described above, but tune the broadcast receiver to a signal at 780, 1040, or 1300 KC. Remove the antenna and substitute the connection from the oscillator, the latter being in operation at 260 KC. Check in the same manner as for 175 KC, making any necessary adjustments of the 260 KC compensating condenser so as to make the oscillator signal heard at 780, 1040, or 1300 KC. (Third, fourth, and fifth harmonics, respectively of 260 KC). In the Philco 095 oscillator, this compensating condenser is nearer the 260 KC switch position.

POWER CONSUMPTION OF PHILCO MODELS

A number of requests have been received for information on the power consumption of various Philco Receivers. The table below lists the different instruments with the power consumption in watts of each.

Model	Watts		Model	Watts
511	75 A.C.		211	135 "
65	95 "		70	80 "
86	90 "	The power consumption of the 25 cycle models is the same as that of the 60 cycle models. Instruments rated at 250 volts consume the same power as those rated at 110 volts.	90	95 "
87	95 "		112	105 "
76	95 "		212	135 "
77	95 "		270	100 "
95	105 "		40	210 D.C.
96	105 "		41	210 D.C.
296	145 "		41-E	420 "
20	75 "		42	210 "
220	100 "		42-E	420 "
111	105 "		46	42 "

RCA-VICTOR, INC.

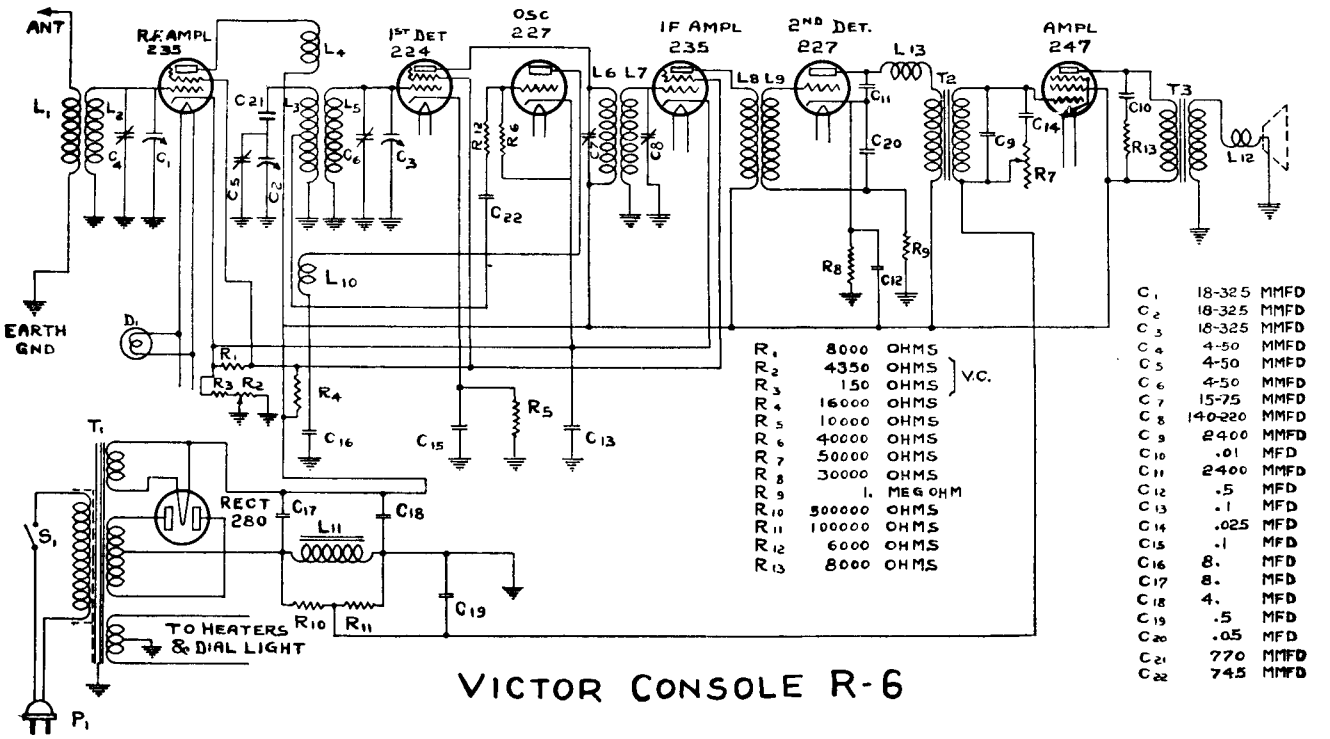


Figure 1—Schematic Diagram for 7-tube Receiver

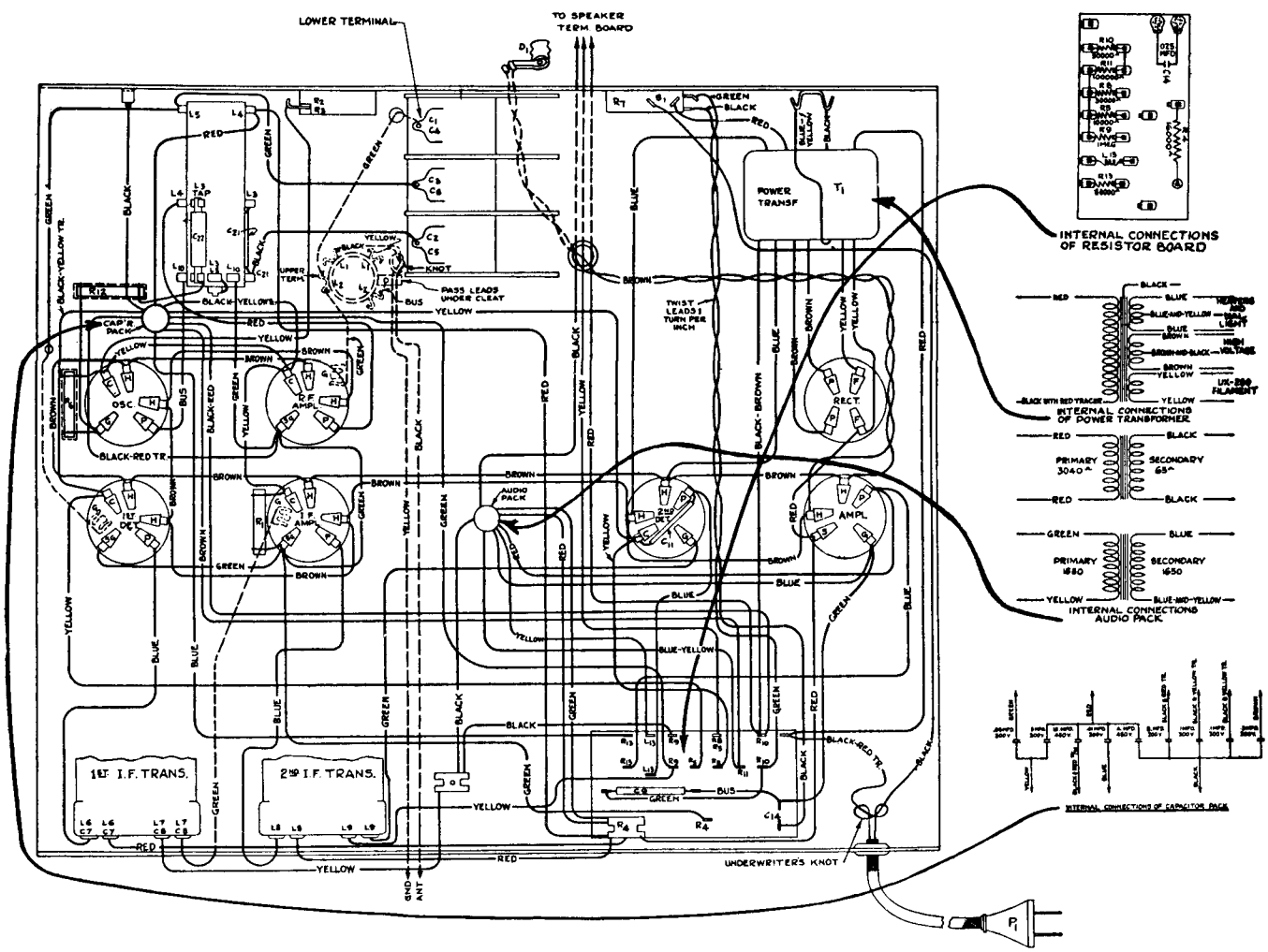


Figure 2.—Wiring Diagram for 7-tube Receiver

RCA-VICTOR, INC.
SERVICE NOTES
for
Victor Radio R-12

Victor Console, R-12 is a nine tube Super-Heterodyne Radio Receiver providing excellent performance in all the features incorporated in modern radio broadcast receivers.

Automatic volume control, push-pull Pentode output stage, tone control, calibrated kilocycle dial, acoustically correct cabinets and the inherent sensitivity, selectivity and tone quality of the Super-Heterodyne are some of the features of this receiver. Referring to Figure 1, the schematic circuit diagram, and tracing a signal through the various stages, we find the following action taking place.

The first tube is the tuned R. F. stage. This is the new Super Control Screen Grid Radiotron, UY-235. The outstanding feature of this Radiotron is that due to its grid potential plate current curve having a constant rate of curvature, cross modulation, modulation distortion, and hum modulation effects are eliminated from the receiver. Also it is very adaptable to automatic volume control action due to its characteristics that preclude the necessity of a local distant switch. The control grid bias for this Radiotron is varied by means of the automatic volume control tube.

The output of this circuit is coupled inductively to the grid coil of the first detector. At this point the oscillator should be considered as its output is also coupled inductively to the grid coil of the first detector. This is a tuned grid circuit oscillator using a Radiotron UY-227, and having a closely coupled plate coil that gives sufficient feed-back to provide stable operation. The grid circuit is so designed that by means of a correct combination of capacity and inductance a constant frequency difference between the oscillator and the tuned R. F. circuits throughout the tuning range of the receiver is obtained.

The next circuit to examine is the first detector. The circuit is tuned by means of one of the gang condensers to the frequency of the incoming signal. Radiotron UY-224 is used in this stage. In the grid circuit there is present the incoming signal and the oscillator signal, the latter being at a 175 K. C. difference from the former. The first detector is biased so as to operate as a plate rectification detector and its purpose is to extract the difference or beat frequency, produced by combining the signal and oscillator frequencies. The beat frequency 175 K. C. appears in the plate circuit of the first detector which is accurately tuned to 175 K. C.

The next stage is that of the I. F. amplifier. A single stage is used, requiring two I. F. transformers, consisting of four tuned circuits. The plate circuit of the first detector, the grid and plate circuit of the I. F. amplifier and the grid circuit of the second detector are all tuned to 175 K. C. Radiotron UY-235 is used in this stage and its control grid voltage is also varied by means of the automatic volume control tube.

At this point it is well to consider the action of the automatic volume control tube as it controls the R. F. and I. F. amplifiers of the receiver. The automatic volume control functions in the usual manner in that the signal voltage is applied to its grid and the voltage drop across a resistor in the plate circuit is the grid voltage applied to the I. F. and R. F. stages. As the value of the plate current is a direct result of the signal voltage applied to the grid, a greater plate current gives a greater voltage drop across the resistor in its plate circuit and therefore a higher bias on the I. F. and R. F. stage. This results in less sensitivity and vice versa. The signal output of the I. F. stage is always maintained at a constant value.

The volume control should now be considered as its position in the circuit has a large bearing on the quiet and smooth action of this receiver.

In previous automatic volume control receivers, the volume control was placed in the grid circuit of the automatic volume control tube, its action being to vary the control grid voltage of this tube. When operating sets of this character, the receiver jumped to full sensitivity when not tuned to a signal and if in a noisy location, this noise was very objectionable.

In this instrument, however, the volume control is not in the automatic volume control tube circuit, but in the grid circuit of the second detector. By means of it the signal voltage applied to the second detector is controlled and under no conditions can noise or other signals exceed the level for which it has been set. Electrically, the primary and secondary of the second I. F. transformer are shielded from each other so that there is no transference of energy except by means of a small pickup coil. The volume control is a potentiometer shunted across this coil which determines the amount of pickup that will be used. As a further means of controlling a strong signal, a second section is provided which places up to 10,000 ohms (R-21) in series with the tuned circuit of second detector grid. This effectively reduces even the most powerful signals received.

The second detector is a high-plate voltage, grid-biased type, using Radiotron UY-227, which gives sufficient output to drive two Radiotrons UY-247 connected in push-pull without an intermediate audio stage. The purpose of the second detector is to extract the audio frequency component of the R. F. signal which represents the voice or musical modulations produced in the studio of the broadcasting station. The audio component is extracted and used to drive the power tubes while the R. F. current is by-passed and not further used.

A grid filter consisting of a 1 megohm resistor (R-13) in the second detector circuit and a 0.5 megohm resistor (R-4) in the R.F. circuit helps to reduce any possible hum in these stages. The power A. F. stage consists of two Radiotrons UY-247 connected in push-pull. Transformer coupling is used between the detector and the grids of the Radiotrons UY-247 as well as from the plates to the cone coil of the reproducer unit.

A tone control, consisting of a 0.008 mfd. condenser in series with a 200,000 ohm variable resistor connected across the two grids of Radiotrons UY-247 is incorporated in this stage. The tone control functions to reduce the high frequency output as the resistance is reduced. At the extreme low position, the condenser and secondary of the A. F. transformer resonate at a low frequency and thereby further accentuate the bass response. The two 0.0004 mfd. condensers, connected in series with their mid-point grounded are connected across the secondary of the input transformer. The purpose of these condensers is to prevent audio oscillations and provide a high frequency audio cut-off.

A 0.005 mfd. condenser connected in series with a 10,000 ohm resistor is placed across the primary of the output transformer. This functions to reduce the third harmonic distortion, an inherent characteristic of the Pentode output tube. The direct plate and grid voltages are supplied from high voltage alternating current which is rectified by means of Radiotron UX-280. The filter is of the tapped reactor type which gives an output of well filtered D. C. The bias voltage for the Radiotrons UY-247 is obtained by using a portion of the drop across the reproducer field. One 190,000 ohm and one 40,000 ohm resistors act as the voltage dividing resistors.

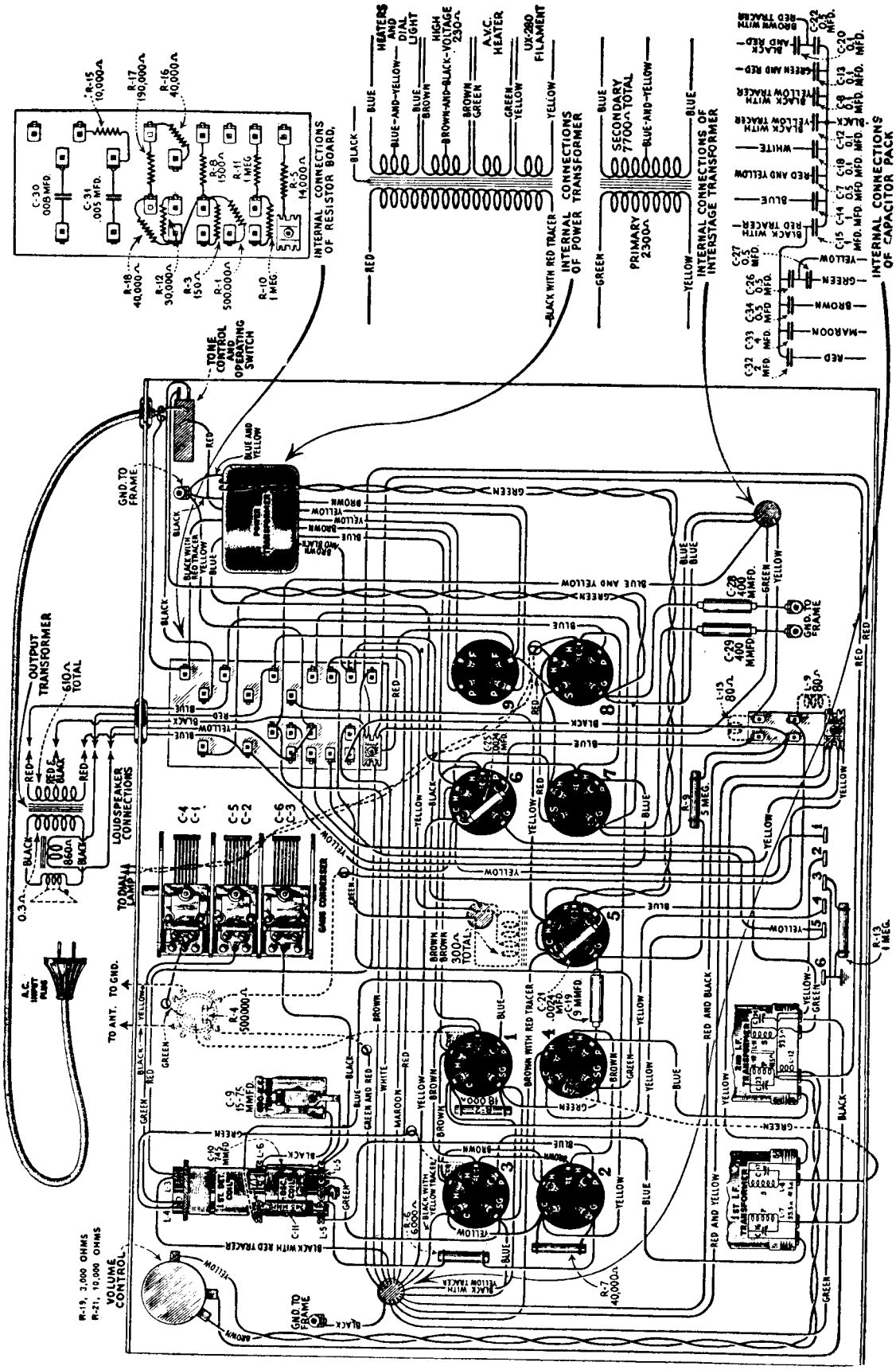
SERVICE DATA

Information pertaining to general service data for this type receiver may be obtained from the Service Notes already issued on the Victor Radio Superette. Figure 1 shows the schematic diagram, Figure 2 the proper connections for attaching a magnetic pickup to the R-12 and Figure 3 the wiring diagram. The voltage readings and replacement parts are shown on page 3.

R. F. OSCILLATOR AND I. F. ADJUSTMENTS

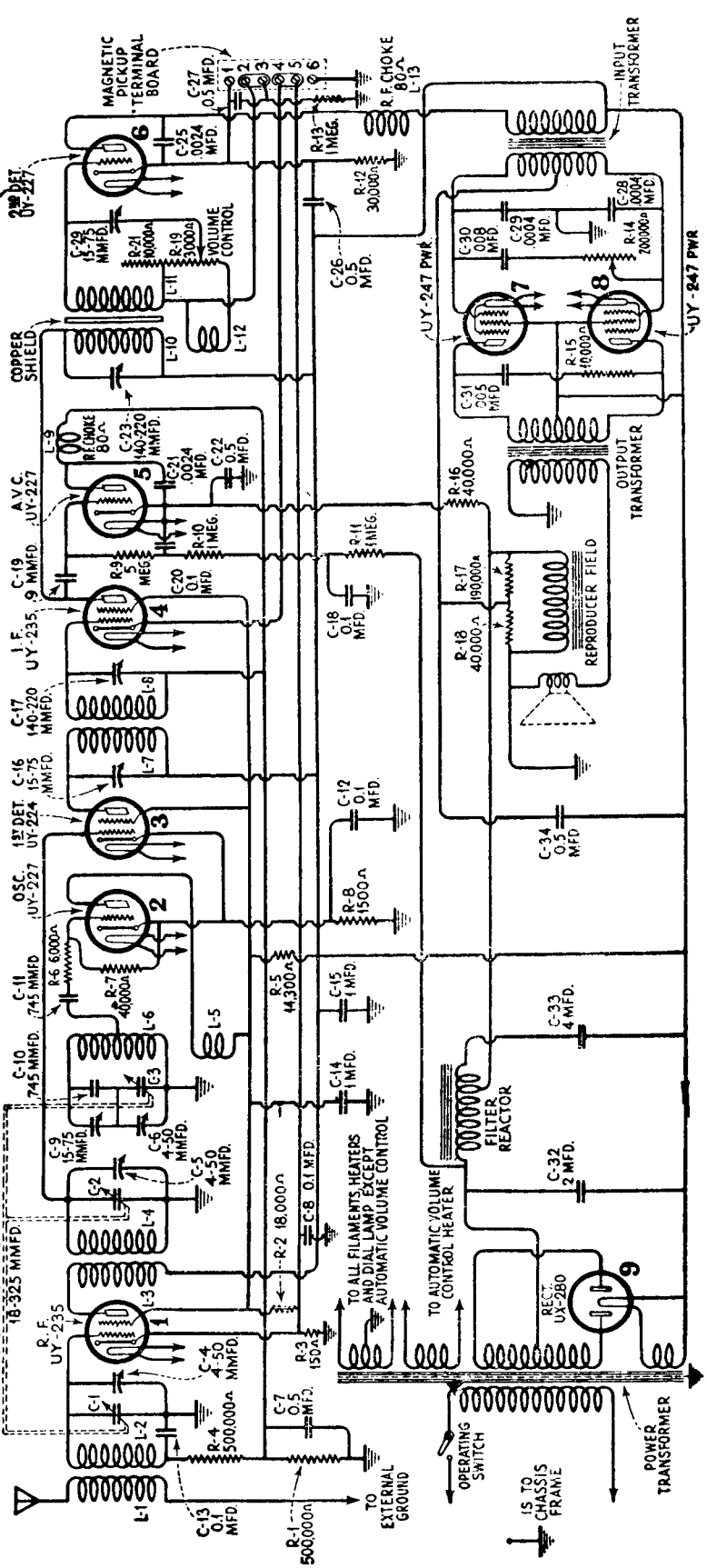
A reference to the Victor Radio Superette Service Notes will give the details for making correct R. F., I. F. and Oscillator adjustments. However, due to the use of an automatic volume control tube, its action will defeat the use of an output meter. To overcome this, a "dummy" Radiotron UY-227 (one that has one heater prong removed but is otherwise O.K.) should be substituted for the tube in the automatic volume control socket. *Do not make any adjustments with this tube removed from the socket.* While apparently everything functions in the normal manner, the lack of tube capacity in the circuits will cause an incorrect alignment to be made.

RCA-VICTOR, INC.



Wiring Diagram of Model R-12.

RCA-VICTOR, INC.



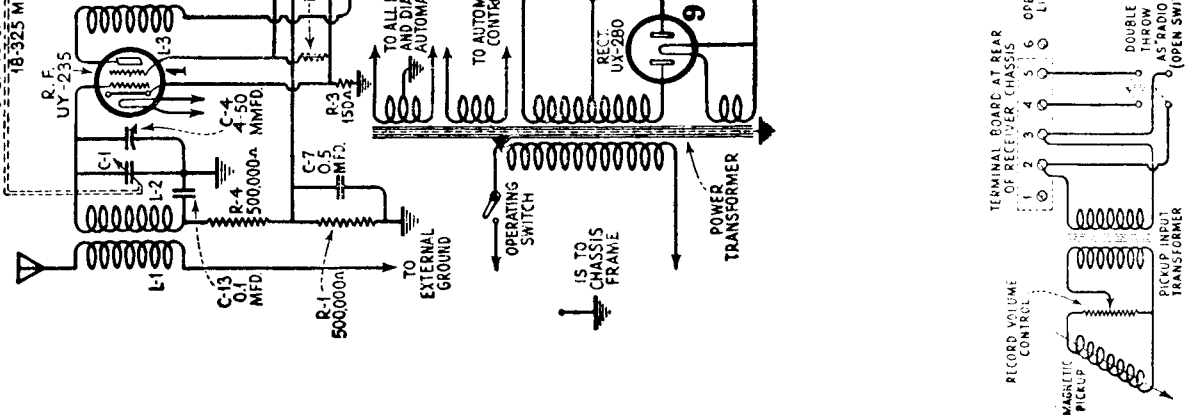
RADIOTRON SOCKET VOLTAGES

110 VOLT A.C. LINE

(Volume Control Setting Does Not Effect Voltages)

Radiotron No.	Cathode to Heater Volts D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1	2	*0.1	75	205	5.0	0.5	2.2
2	8	0	—	60	5.0	—	2.2
3	7	7.0	70	200	0.5	0.1	2.2
4	2	*0.1	75	205	5.0	0.5	2.2
5	0	0	—	25	0	—	2.2
6	20	*8.0	—	180	0.5	—	2.2
7	—	10	210	205	25	—	2.2
8	—	10	210	205	25	—	2.2

*Not true reading due to resistance in circuit.



Magnetic Pickup Connections.

RCA-VICTOR, INC.

SUPPLEMENT

to

VICTOR RADIO R-12 SERVICE NOTES

Late production of the Victor Radio R-12 has a slight change in the wiring, two changes in capacitor values and the addition of a 0.5 megohm resistor (R-20). Capacitor C-7 has been changed from 0.5 mfd. to 0.1 mfd. and C-13 from 0.1 mfd. to 0.05 mfd. Resistor R-20 has been added.

Figure 1 shows the revised schematic diagram and Figure 2 the wiring diagram.

The replacement parts listed and supplied are entirely interchangeable with either the old or new models. In the case of the older models, however, the additional black lead supplied in the new capacitor pack should be joined to the old black ground lead. All other capacitor leads are exactly the same and are soldered to the same points.

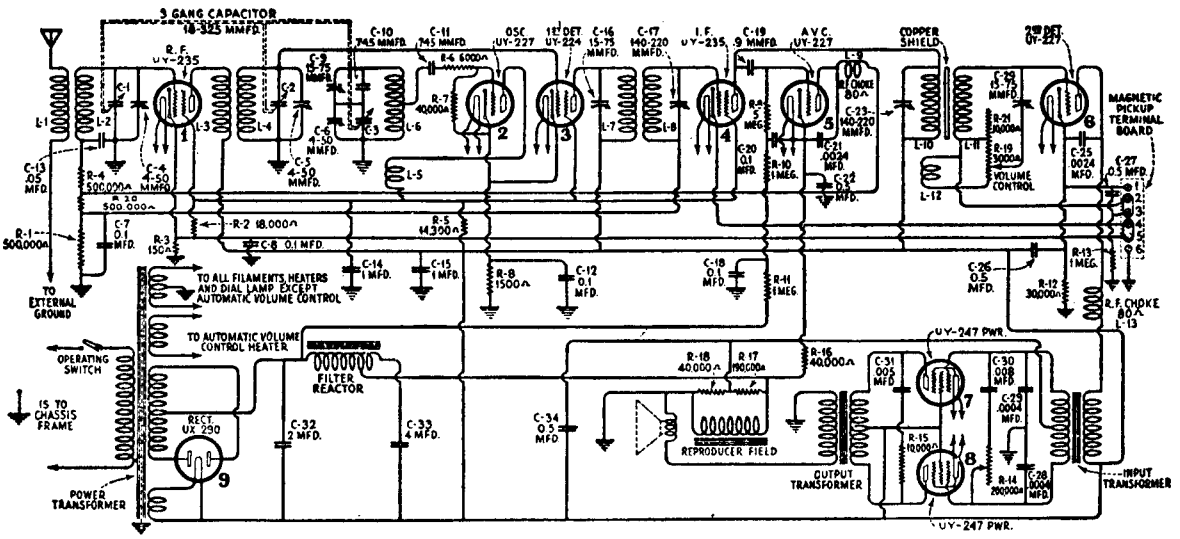


Figure 1—Revised Schematic diagram of late production R-12

RCA-VICTOR, INC.

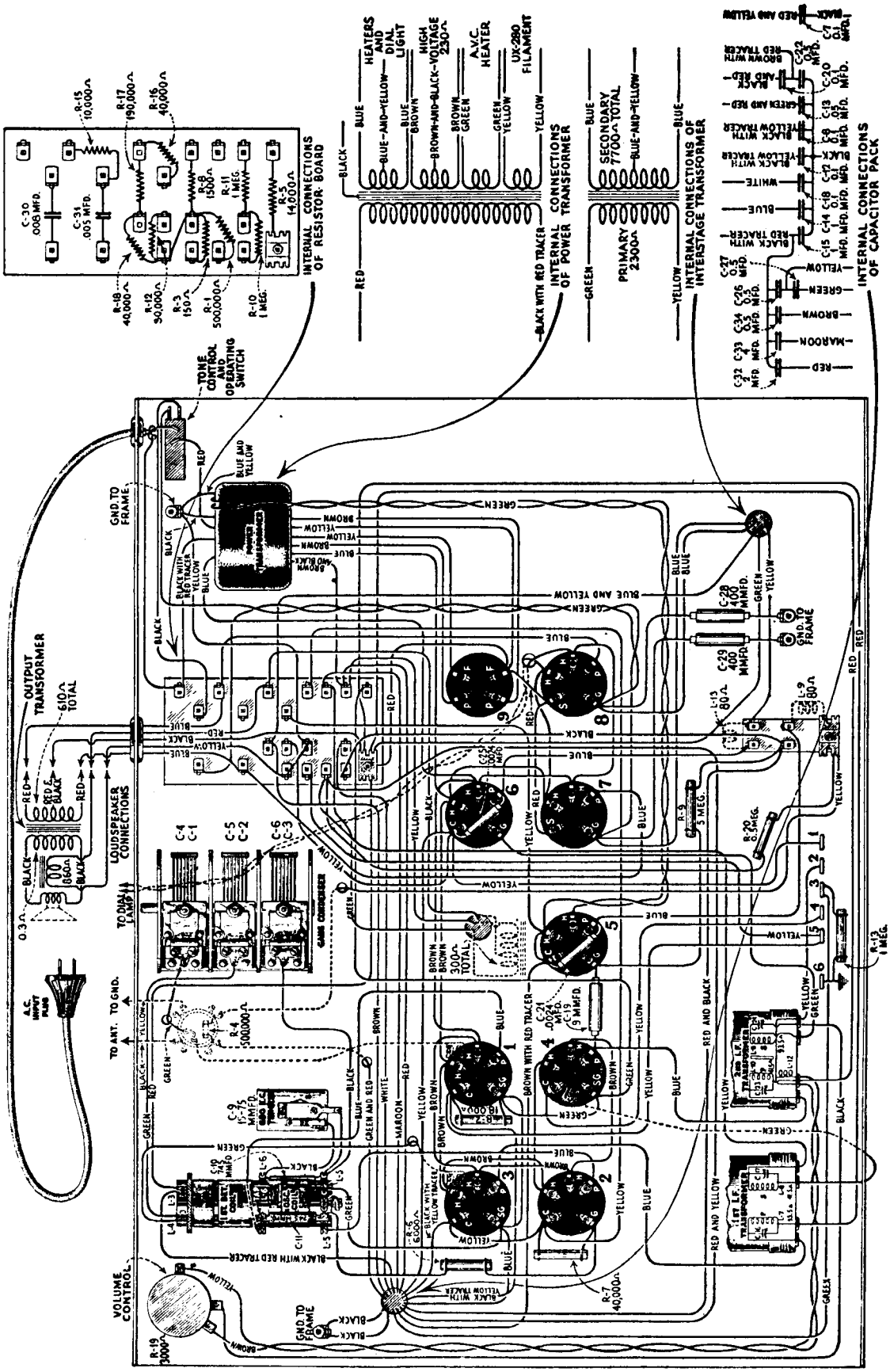


Figure 2—Wiring diagram of late production R-12

RCA-VICTOR, INC.

SERVICE NOTES
for
VICTOR RADIO R-20 and R-21

The Victor Radio R-20 and R-21 are ten tube screen grid automatic volume control Super-Heterodyne radio receivers. With the exception of the Audio Transformer, Speaker and Cabinet both models are identical.

Features of these Models are. Super Control Screen Grid Radiotrons in the R. F. and I. F. stages, automatic volume control so arranged in the circuit to reduce noise between channels, push-pull Pentode output stage, accurately calibrated dial reading directly in kilocycles, totally shielded chassis and sensitivity, selectivity and fidelity superior to any previous Victor receiver.

Referring to Figure 1 and tracing a signal through the various stages, we find the following action taking place.

The signal voltage, induced into the antenna system, is coupled by means of the antenna coil to the tuned circuit of the "link circuit." The link circuit tunes exactly with the tuned R. F. and first detector circuits. There is no gain in the circuit, it being merely a selection circuit.

A tuned R. F. stage follows which uses Radiotron UY-235. The control grid bias for this tube is a function of the automatic volume control tube. The output is coupled inductively to the first detector grid circuit together with the output from the oscillator.

The first detector is tuned by one unit of the gang condenser. In its grid circuit, there is present the incoming signal and the oscillator signal, the latter being at a 175 K. C. higher than the former. The tube is biased so as to operate as a plate rectification detector and its purpose is to extract the difference or beat frequency, produced by combining the signal and oscillator frequencies. The beat frequency—175 K. C.—appears in the plate circuit of the first detector which is accurately tuned to 175 K. C. The tube used as a first detector is Radiotron UY-224.

The next circuit is that of the first I. F. stage. It is a high gain Amplifier having both its grid and plate circuits tuned to 175 K. C. Its grid voltage is controlled by the automatic volume control tube.

At this point the automatic volume control tube should be considered as its grid is controlled by the output from the first I. F. Stage.

The automatic volume control tube functions in the usual manner in that the signal voltage is applied to its grid and the voltage drop across a resistor in its plate circuit is the grid voltage applied to the R. F. and first I. F. amplifier. As the value of the plate current is a direct result of the signal voltage applied to the grid, a greater plate current gives a greater voltage drop across the resistor in its plate circuit and therefore a higher bias on the R. F. and I. F. stage. This results in less sensitivity and vice versa. The signal output of the first I. F. stage is always maintained at a constant value.

The volume control should now be considered as its position in the circuit has a large bearing on the quiet and smooth action of the receiver.

In previous automatic volume control receivers, the volume control was placed in the grid circuit of the automatic volume control tube, its action being to vary the control grid voltage of this tube. When operating sets of this character, the receiver jumped to full sensitivity when not tuned to a signal and if in a noisy location, this noise was very objectionable.

In this instrument, however, the volume control is not in the automatic volume control tube circuit, but in the grid circuit of the second I. F. Amplifier. By means of it the signal voltage applied to the second I. F. amplifier is controlled and under no conditions can noise or other signals exceed the level for which it has been set. Electrically, the primary and secondary of the second I. F. transformer are placed so that there is no transference of energy except by means of a small pickup coil. The volume control is a potentiometer shunted across this coil which determines the amount of pickup that will be used.

The second detector is a high-plate voltage, grid-biased type, using Radiotron UY-227, which gives sufficient output to drive two Radiotrons UY-247 connected in push-pull without an intermediate audio stage. The purpose of the second detector is to extract the audio frequency component of the R. F. signal which represents the voice or musical modulations produced in the studio of the broadcasting station. The audio component is extracted and used to drive the power tubes while the R. F. current is by-passed and not further used.

A grid filter consisting of a 1 megohm resistor in the second detector circuit helps to reduce any possible hum in these stages. The power A. F. Stage consists of two Radiotrons UY-247 connected in push-pull. Transformer coupling is used between the detector and the grids of the Radiotron UY-247 as well as from the plates to the cone coil of the reproducer unit.

A tone control, consisting of an inductor .01 mfd. Capacitor and a 0.5 meg. variable resistor is in the plate circuit of the second detector. The tone control functions to reduce the high frequency output as the resistance is reduced, without accentuating the bass response. The two 0.0004 mfd. condensers, connected in series with their mid-point grounded are connected across the secondary of the imput transformer. The purpose of these condensers is to prevent audio oscillations and provide a high frequency audio cut-off.

A 0.005 mfd. condenser connected in series with an 18,000 ohm resistor is placed across the primary of the output transformer. This functions to reduce the third harmonic distortion an inherent characteristic of the Pentode output tube. The direct plate and grid voltages are supplied from high voltage alternating current which is rectified by means of Radiotron UX-280. The filter is of the tapped reactor type which gives an output of well filtered D. C. The bias voltage of Radiotrons UY-247 is obtained by using a portion of the drop across the reproducer field. One 100,000 and 20,000 ohm resistors act as the voltage dividing resistors.

SERVICE DATA

Information pertaining to R. F., oscillator and I. F. adjustments together with general service data for this type receiver may be obtained from the Service Notes already issued. Figure 1 shows the schematic diagram.

R. F. OSCILLATOR AND I. F. ADJUSTMENTS

A reference to the Victor Radio Superette Service Notes will give the details for making correct R. F., I. F. and Oscillator adjustments. However, due to the use of an automatic volume control tube, its action will defeat the use of an output meter. To overcome this, a "dummy" Radiotron UY-227 (one that has one heater prong removed but is otherwise O. K.) should be substituted for the tube in the automatic volume control socket. Do not make any adjustments with this tube removed from the socket. While apparently everything functions in the normal manner, the lack of tube capacity in the circuits will cause an incorrect alignment to be made.

In the Model R-20 and R-21 the I. F. transformers are adjusted for maximum output and no attempt at band pass tuning should be made when these adjustments are made.

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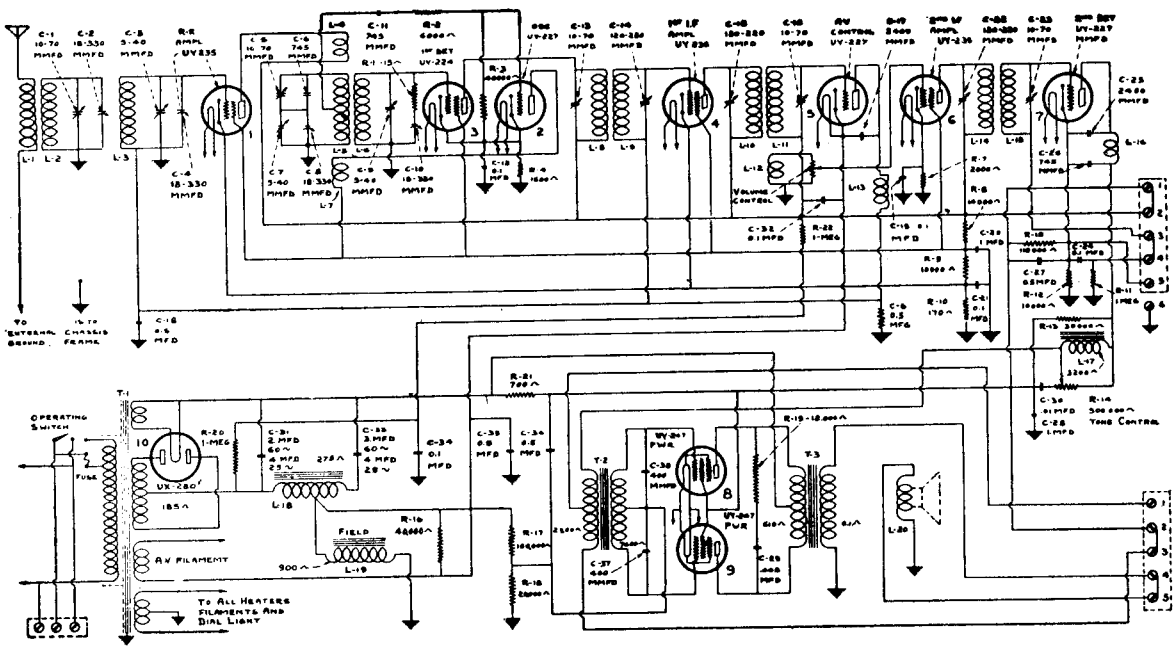
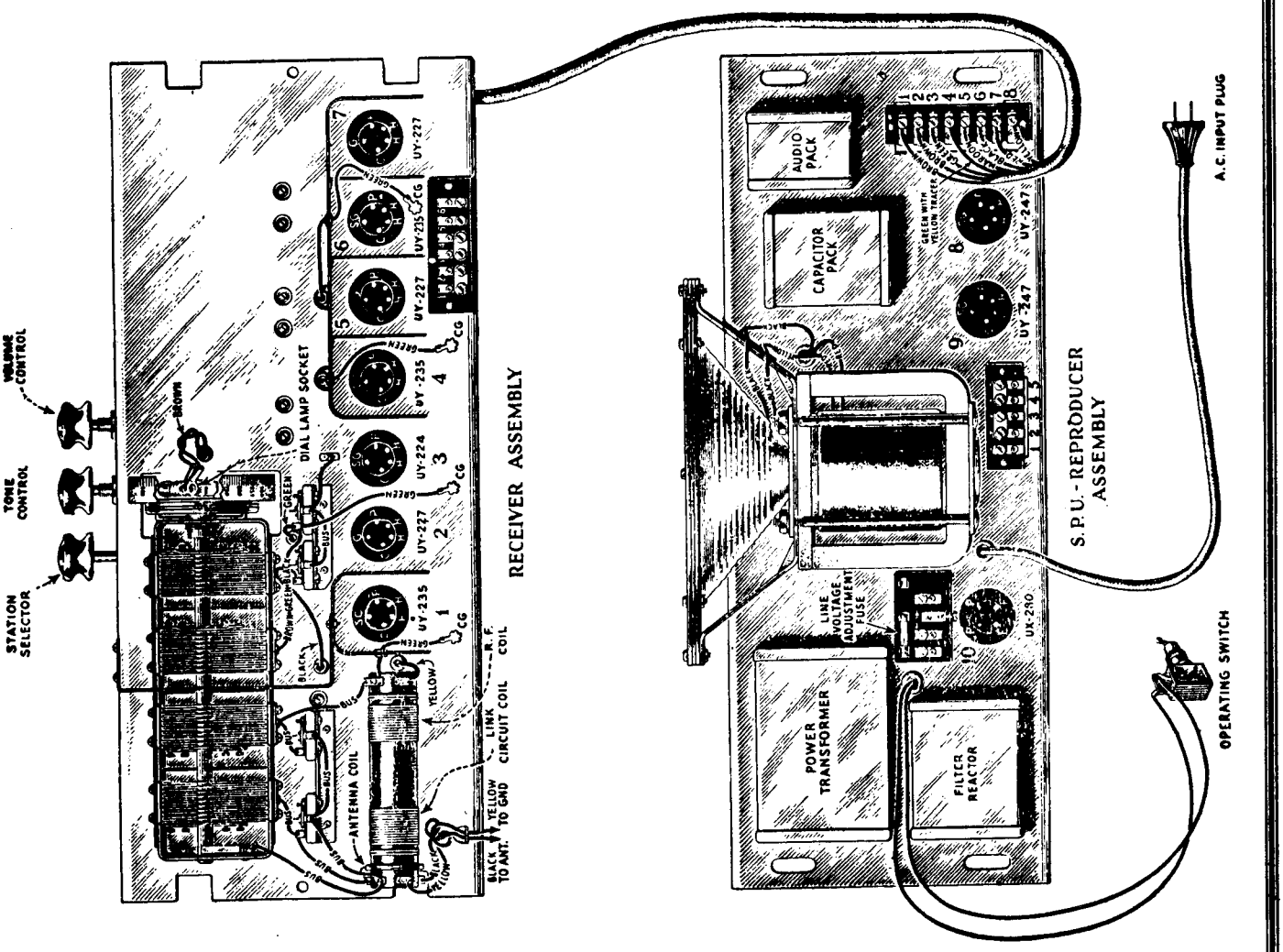


FIGURE 1 - SCHEMATIC WIRING DIAGRAM.



RCA-VICTOR, INC.

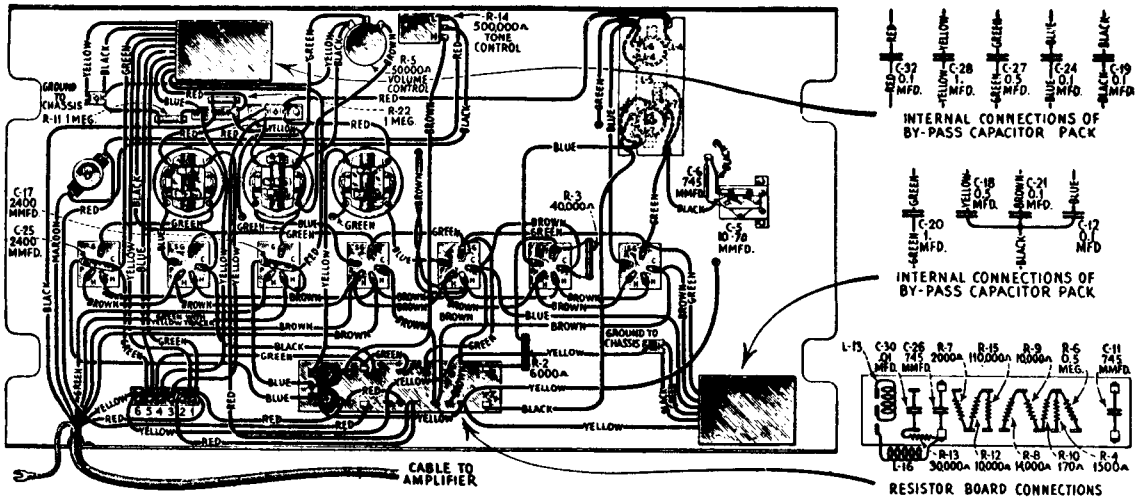


Figure 2—Receiver Assembly Wiring Diagram

RADIOTRON SOCKET VOLTAGES

VOLTAGES ARE THE SAME AT EITHER POSITION OF THE VOLUME CONTROL

110 VOLT LINE

Radiotron No.	Heater to Cathode Volts	Cathode or Filament or Control Grid Volts	Cathode or Filament to Screen Grid Volts	Cathode or Filament to Plate Volts	Plate Current M. A.	Heater Volts
1—R.F.	2.0	*0.2	58	210	3.0	2.5
2—Osc.	5.0	0	—	50	3.5	2.5
3—1st Det.	4.0	3.5	55	210	1.1	2.5
4—1st I.F.	2.0	*0.2	58	210	3.0	2.5
5—A.V.C.	0	0	—	30	0.1	2.5
6—2nd I.F.	2.0	3.5	55	210	2.0	2.5
7—2nd Det.	20.0	*8.0	—	190	0.5	2.5
8—Pwr.	—	*10.0	230	215	25.0	2.5
9—Pwr.	—	*10.0	230	215	25.0	2.5

*These readings are not correct due to the resistance in the circuits.

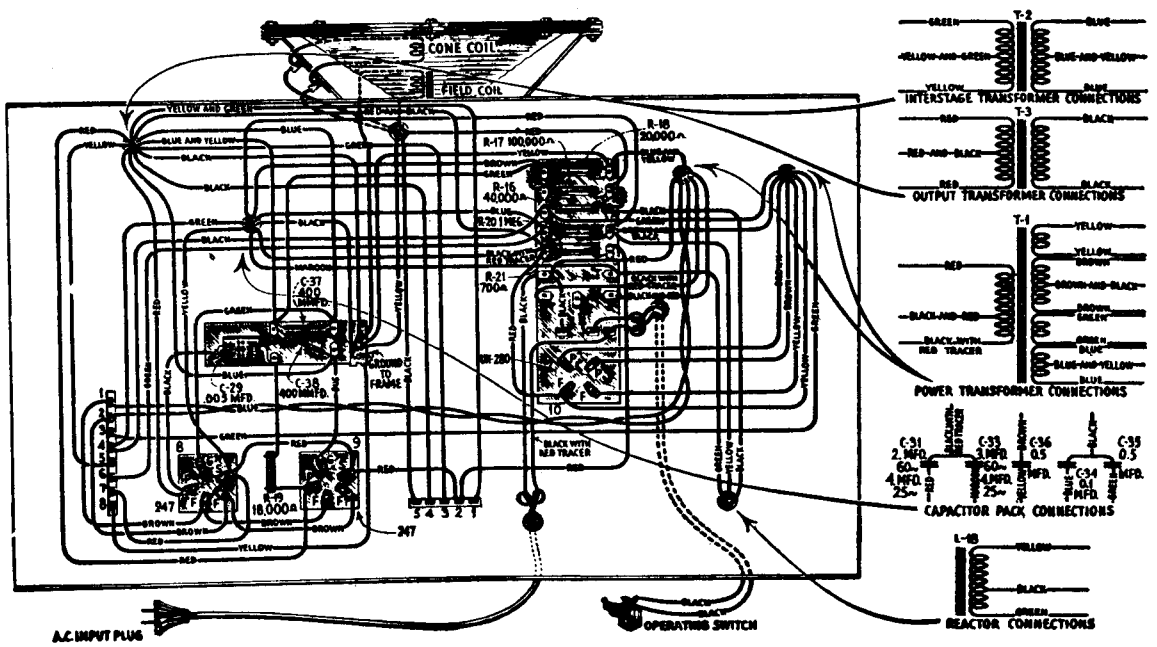
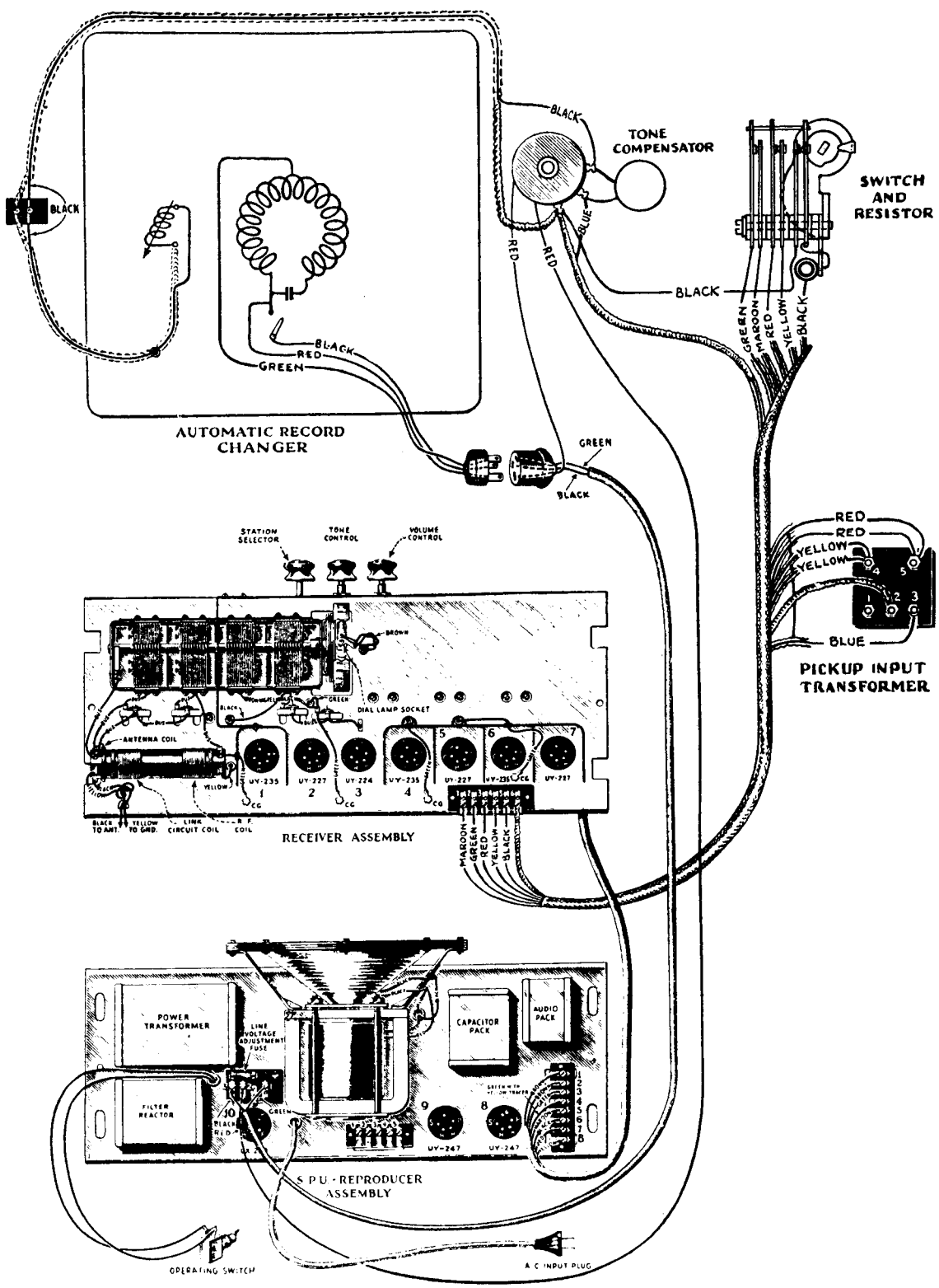


Figure 3—S.P.U. Reproducer Assembly Wiring

RCA-VICTOR, INC.



RCA-VICTOR, INC.

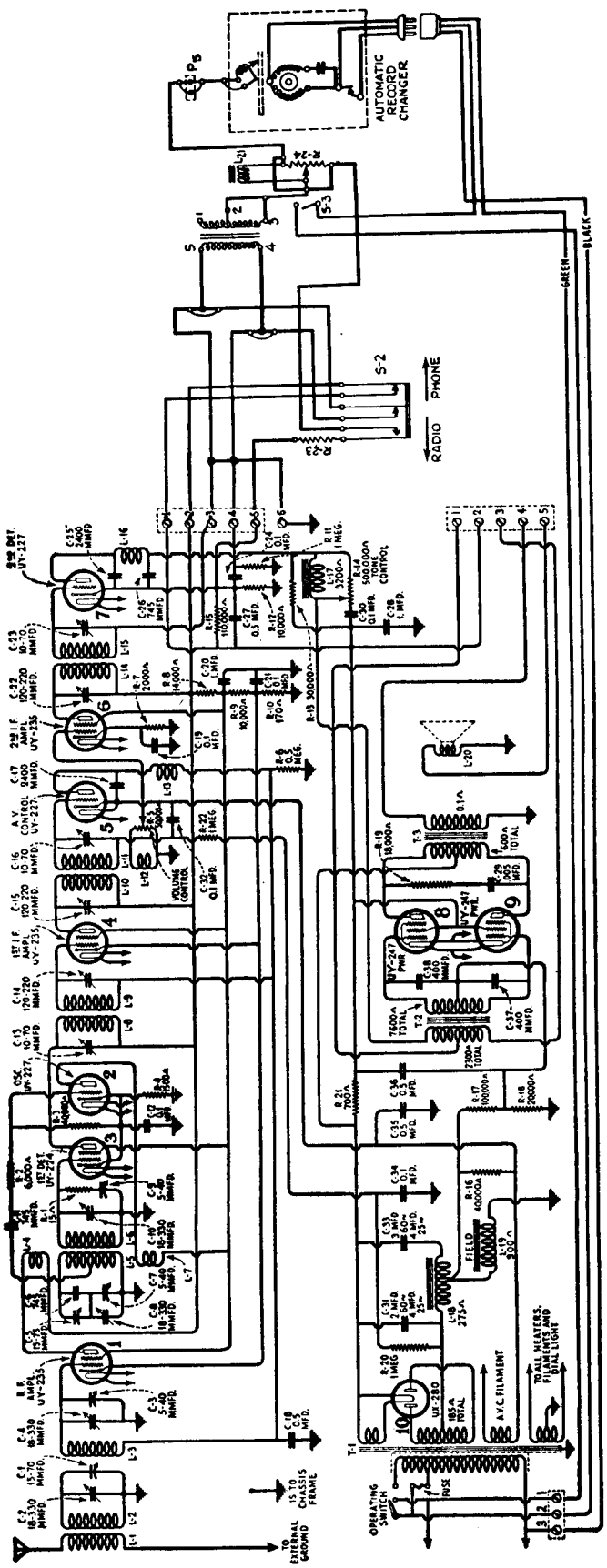
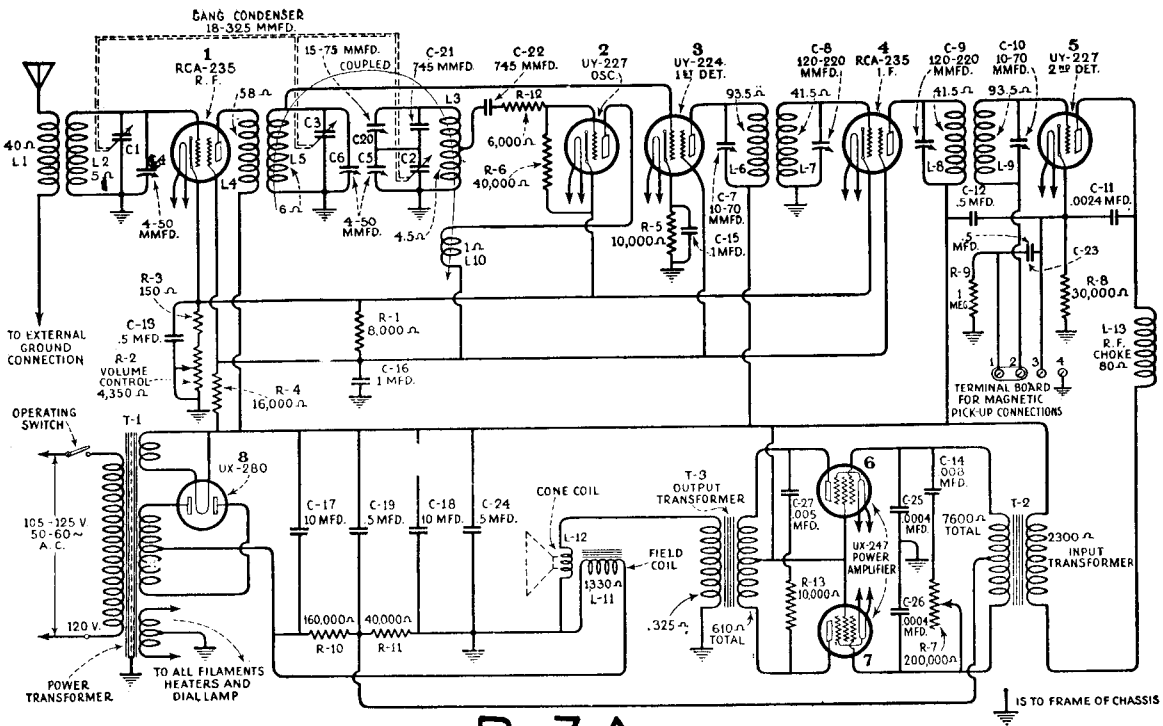


Figure 1—Schematic Wiring Diagram of Model RAE-59

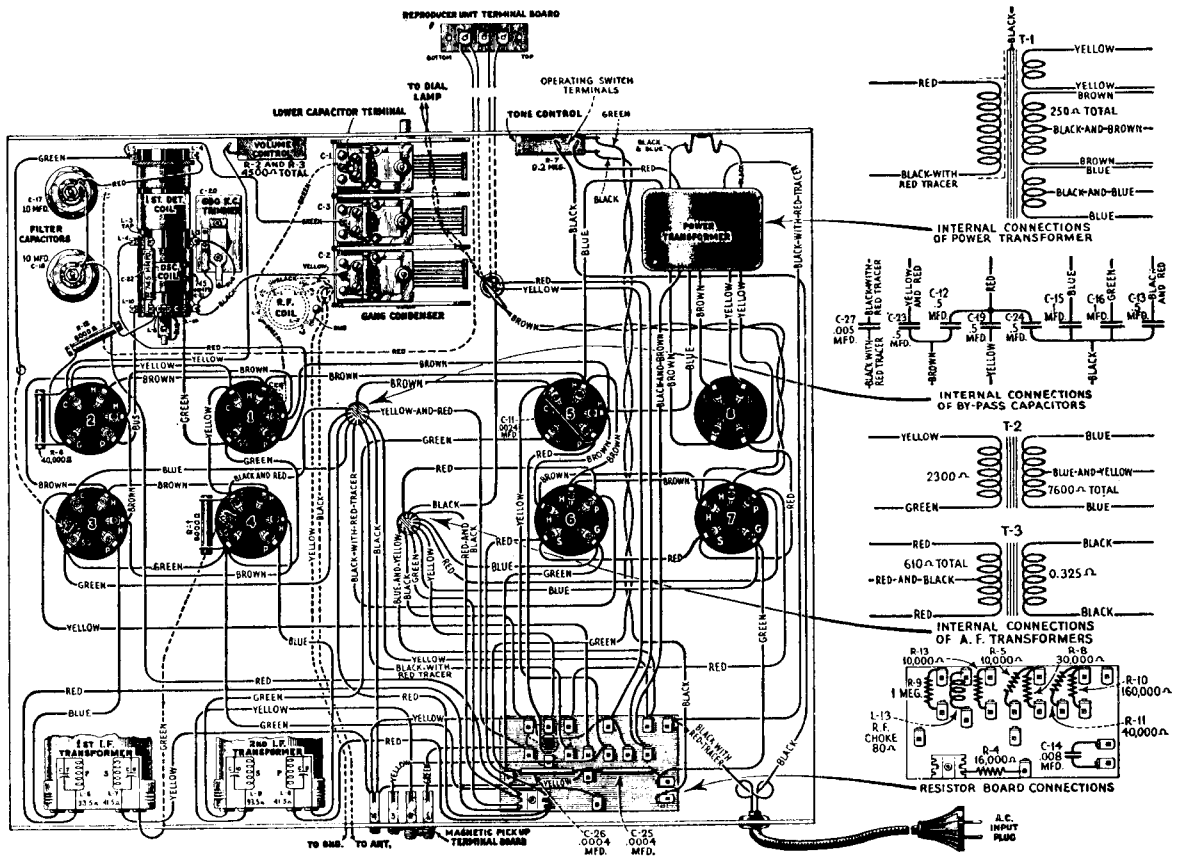
The Victor RAE-59 is a Combination DeLuxe Radio and Automatic Phonograph instrument that provides a large variety of home entertainment features. The radio receiver, amplifier and loudspeaker are identical with those used in Model R-21. The automatic record changing mechanism is of simple, sturdy design and may be operated at 33⅓ R.P.M. as well as 78 R.P.M.

RCA VICTOR CO., INC.

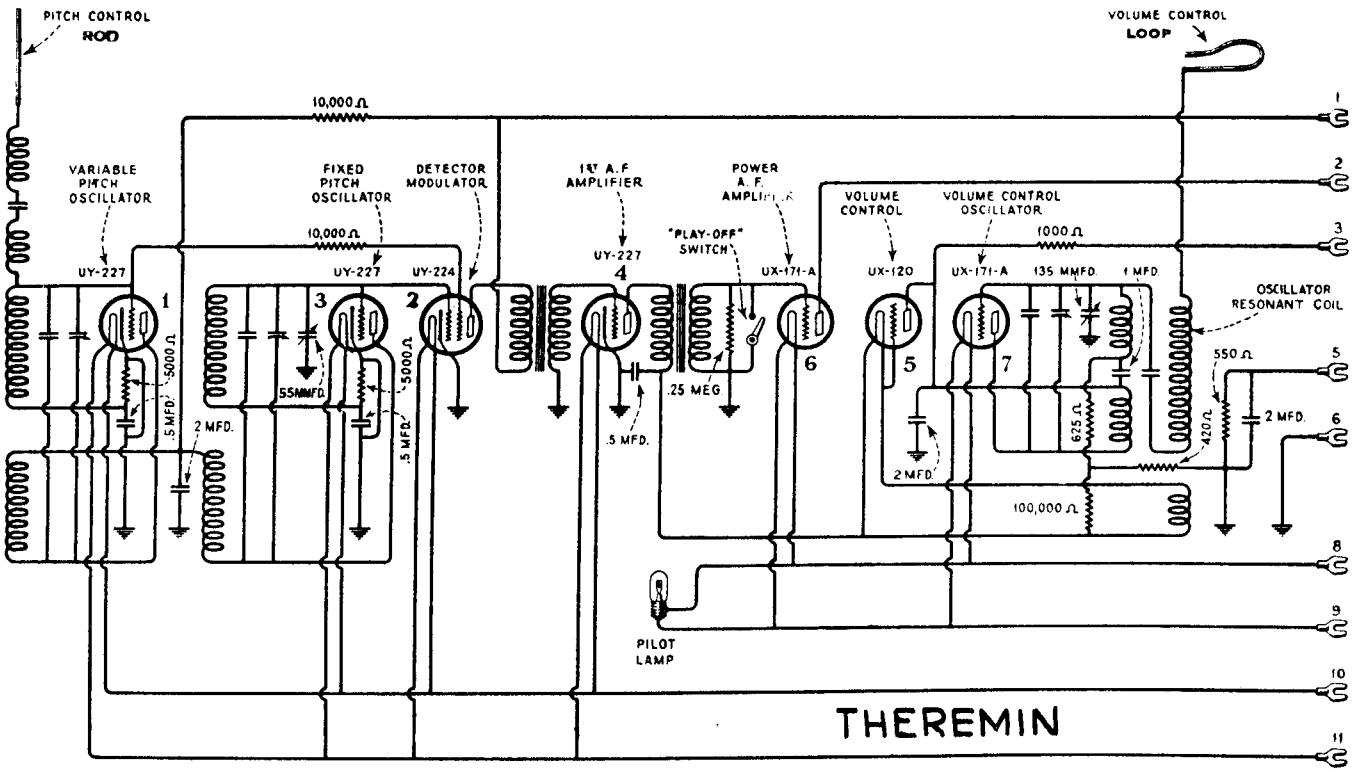


R-7 A

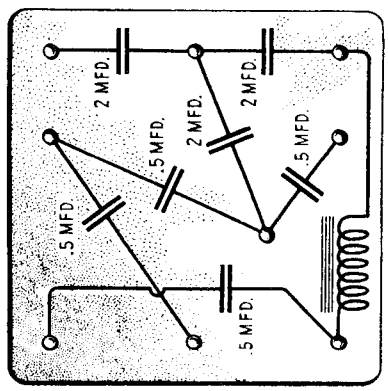
Radiotron No.	Cathode to Heater Volts D. C.	Cathode or Filament to Control Grid Volts D. C.	Cathode to Screen Grid Volts D. C.	Cathode or Filament to Plate Volts D.C.	Plate Current M. A.	Heater or Filament Volts A. C.	Radiotron No.	Cathode to Heater Volts D. C.	Cathode or Filament to Control Grid Volts D. C.	Cathode to Screen Grid Volts D. C.	Cathode or Filament to Plate Volts D.C.	Plate Current M. A.	Heater or Filament Volts A. C.
VOLUME CONTROL AT MINIMUM							VOLUME CONTROL AT MAXIMUM						
1	38	35	50	200	.0	2.2	1	2.0	2.5	60	235	3.5	2.2
2	38	0	—	50	3.5	2.2	2	2.0	.0	—	50	4.5	2.2
3	7	6	80	235	0.5	2.2	3	4.0	4.0	55	230	0.5	2.2
4	38	35	50	200	.0	2.2	4	2.0	2.5	58	235	3.5	2.2
5	22	8	—	210	0.7	2.2	5	22	8	—	210	0.7	2.2
6	—	12	225	220	30	2.2	6	—	12	225	220	30	2.2
7	—	12	225	220	30	2.2	7	—	12	225	220	30	2.2



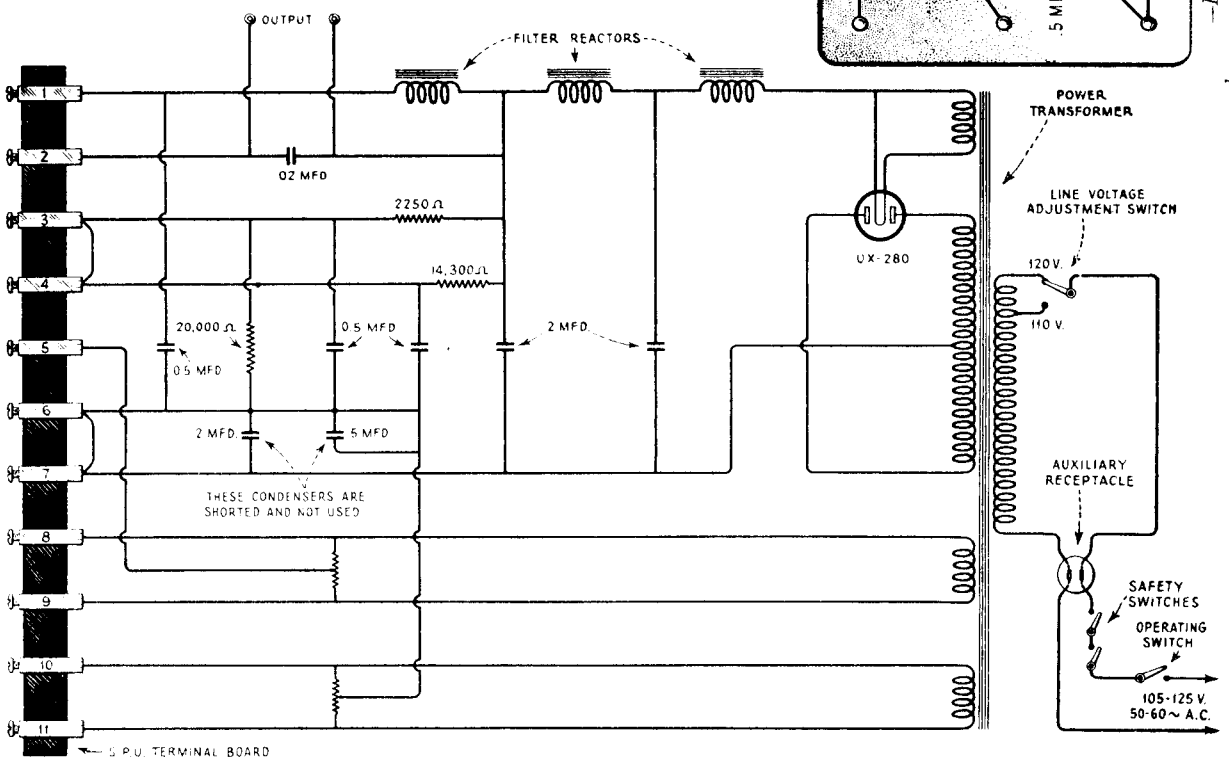
RCA VICTOR CO., INC.



Terminals Nos.	Cable on Tubes Lighted Volts	Cable Off Volts
1 to 6 (D.C.)	190	260
2 to 6*	190	260
3 to 6	140	230
5 to 6	29.0	0
8 to 9 (A.C.) rms	2.5	2.8
10 to 11 (A.C.) rms	4.7	5.0



Internal connections of filter and by-pass condensers, and filter reactor



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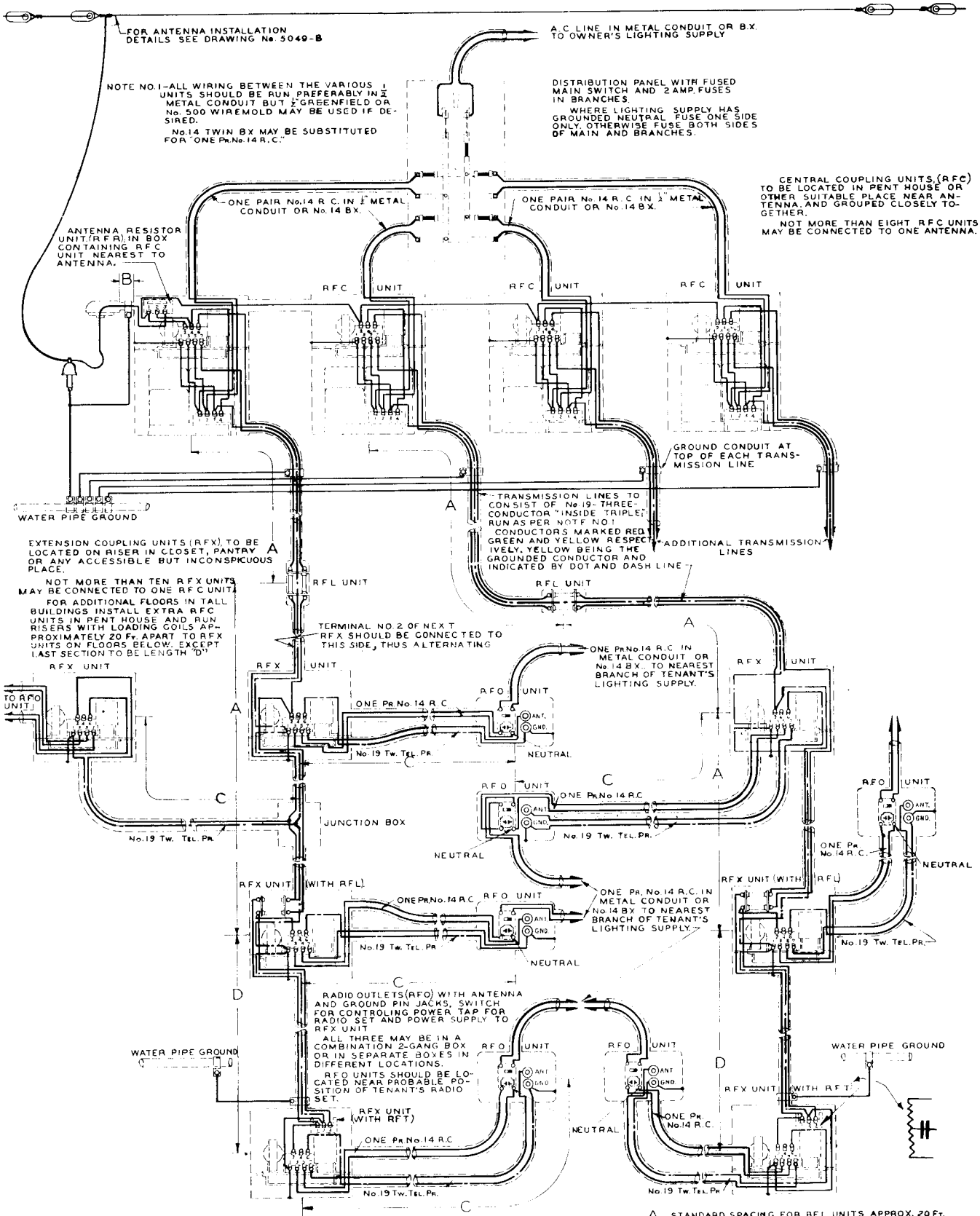
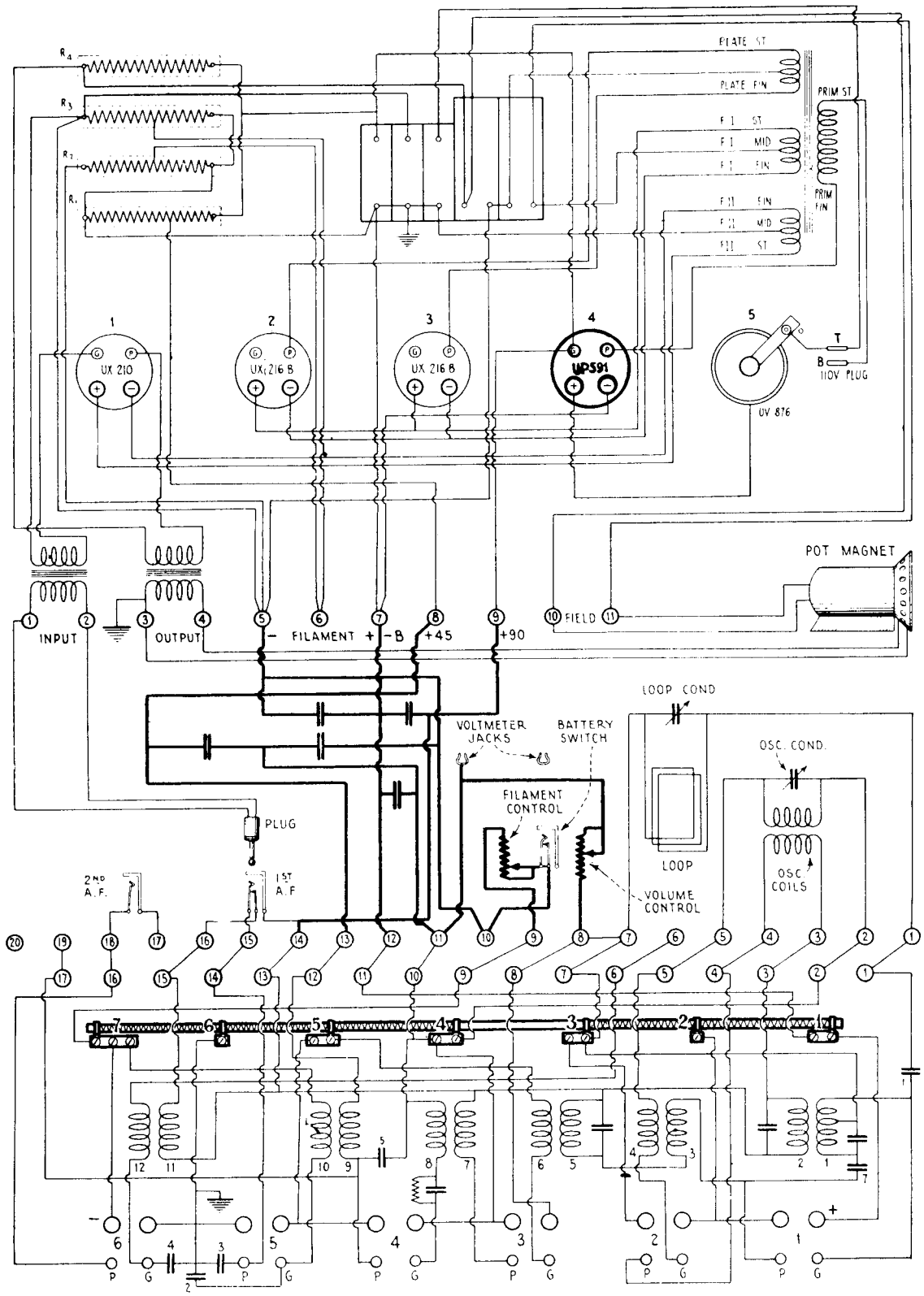


CENTRALIZED RADIO

WIRING DIAGRAM
R.F. DISTRIBUTION SYSTEM FOR ALTERNATING CURRENT

RADIO-VICTOR CORPORATION OF AMERICA

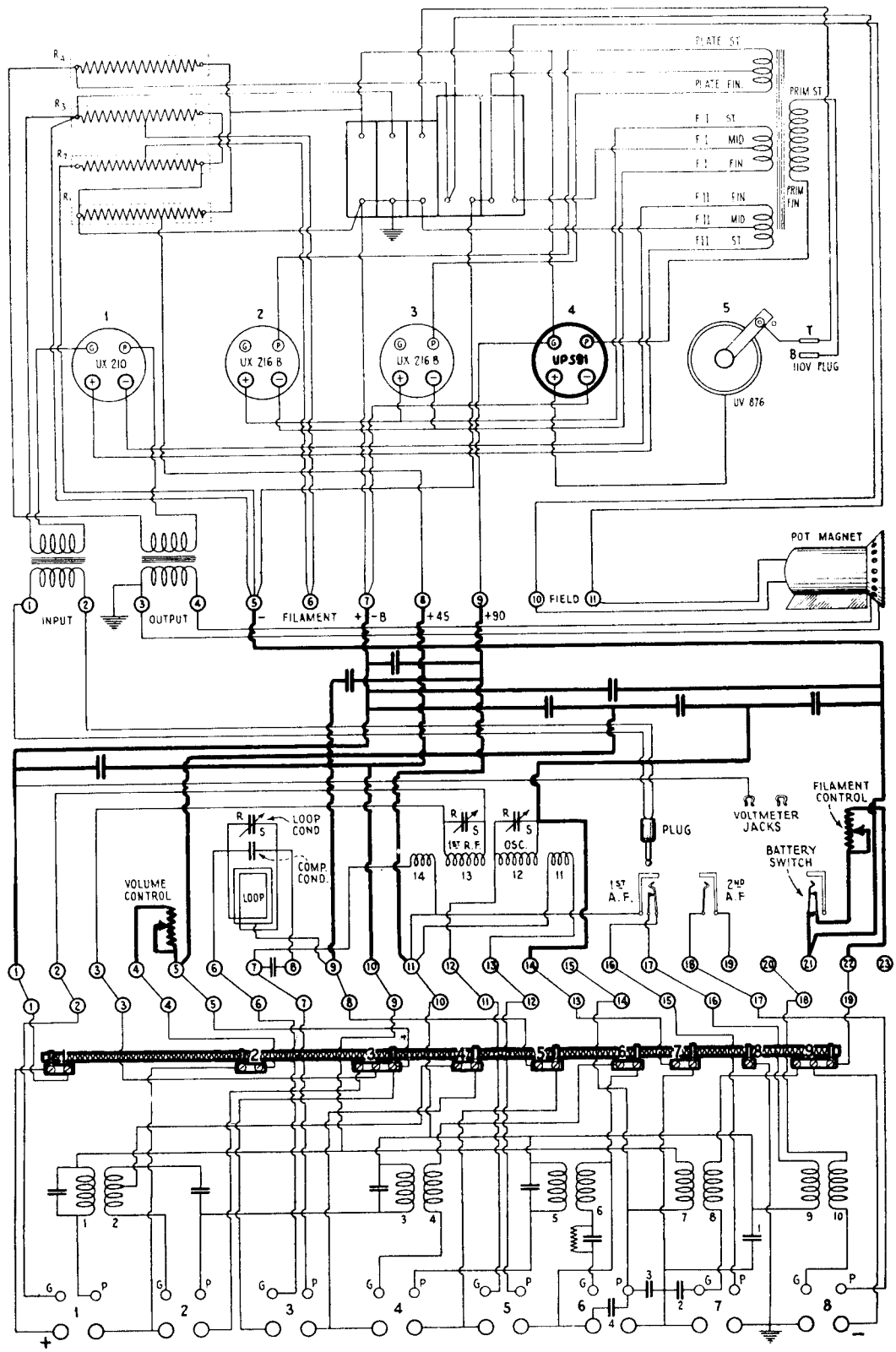
RCA VICTOR CO., INC.



A.C. PACKAGE CHANGES

25 A.C.

RCA VICTOR CO., INC.



A.C. PACKAGE CHANGES

28 A. C.

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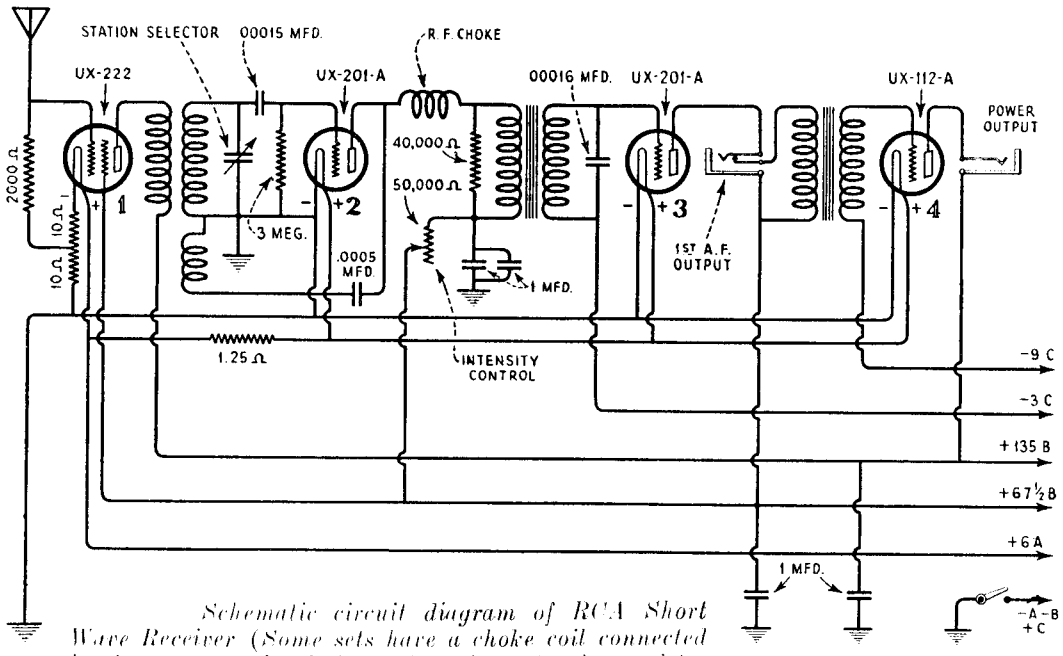


Schematic circuit diagram of RCA Short Wave Receiver (Some sets have a choke coil connected in the antenna circuit instead of the 2000-ohm resistor shown)

AR-1145

The ratings of the different coils are as follows:

Coil No.	*Frequency Range*		*Wavelength Range*
	Megacycles	*Kilocycles*	*Meters*
1	20 —12	20,000—12,000	15— 25
2	12—7.2	12,000— 7,200	25— 42
3	7.2—4	7,200— 4,000	42— 75
6	.....	1,500— 940	200—320
7	.....	940— 550	320—545

Radiotron	*Fil. Volt.*	*Grid Volt.*	*Plate Volt.*	*Plate Current*
Coupling UX-222	3.2	*Control grid 1.5 *Screen grid 67.5	130.0	Plate 3.5 mil. amp. *Screen 0.5 mil. amp.
Detector UX-201A	5.0	....	30-60 (Depending on position of intensity control)	0.65 to 1.5 mil. amp.
1st Audio Amp. UX-201A	5.0	3.0	65	1.1 mil. amp.
2d Audio Amp. (Power) UX-112A	5.0	9.0	130.0	1.0 mil. amp.

* These readings cannot be measured by ordinary methods as with the Weston Model 537 test set.

RCA VICTOR CO., INC.

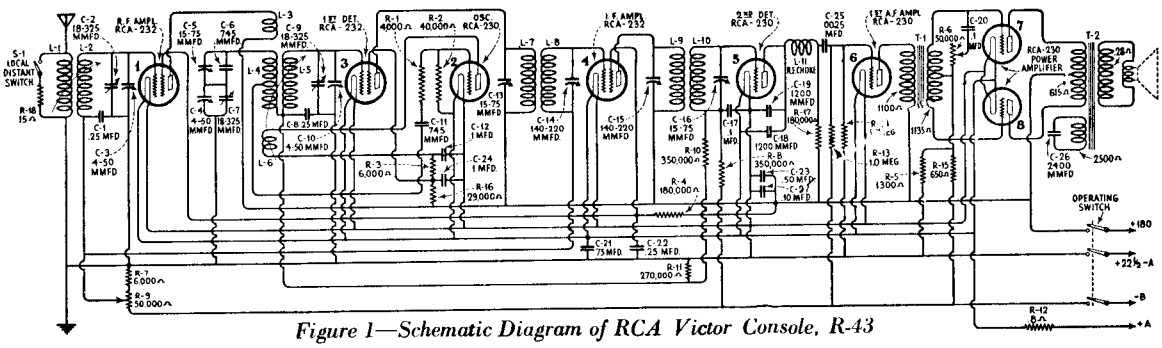


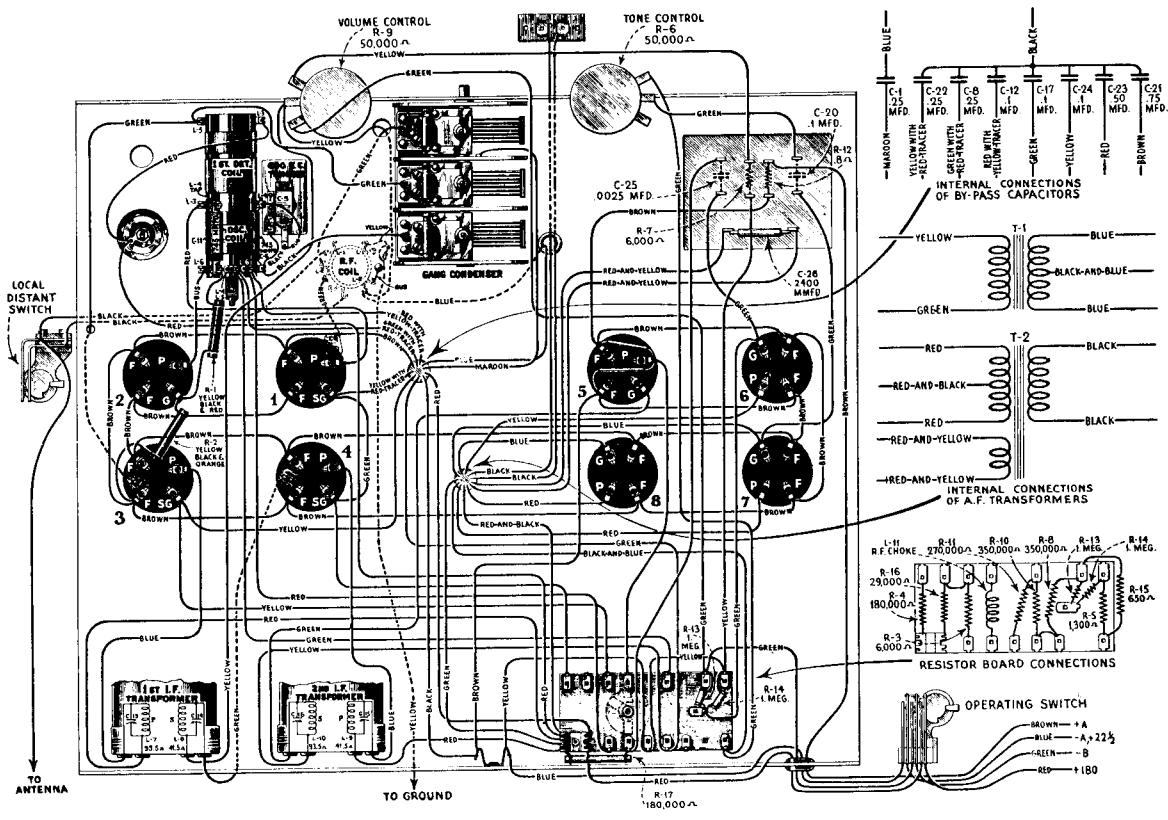
Figure 1—Schematic Diagram of RCA Victor Console, R-43

RADIOTRON SOCKET VOLTAGE

BATTERIES AT FULL VOLTAGE—NO SIGNAL BEING RECEIVED

These voltages are those obtained with one of the usual set analyzers. The values indicated, therefore, are not necessarily the voltages that actually appear at the Radiotron Sockets when the voltmeter is not connected.

Tube No.	Filament to Control Grid Volts	Filament to Screen Grid Volts	Filament to Plate Volts	Plate Current M. A.	Filament Volts
VOLUME CONTROL AT MINIMUM					
1	22	55	155	0	2.0
2	—	—	50	3.0	2.0
3	0.5	65	150	0.5	2.0
4	22	55	155	0	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	2.5	2.0
7	15.0	—	150	0.5	2.0
8	15.0		150	0.5	2.0
VOLUME CONTROL AT MAXIMUM					
1	1.5	45	150	2.5	2.0
2	—	—	50	3.0	2.0
3	0.5	60	150	0.5	2.0
4	1.5	45	150	2.5	2.0
5	5.0	—	90	0	2.0
6	2.0	—	150	2.5	2.0
7	15.0	—	150	0.5	2.0
8	15.0	—	150	0.5	2.0



RCA VICTOR CO., INC.

"MODEL R-5" RADIOLETTE

Also Graybar "Model 4 Graybarette;" Westinghouse "Model WR-14;" General Electric Model "G. E. T-12"

In this smallest RCA-Victor receiver, the following are the condenser and resistor values. Condensers C1, C2, 14- to 320-mmf. tuning condensers, shunted by 4- to 26-mmf. trimmers; C3, .00013-mf.; C4, C5, C6, 0.1-mf.; C7, .001-mf.; C8, C12, 0.25-mf.; C9, .02-mf.; C10, 320 mmf.; C11, .005-mf.; C13, 10. mf., (electrolytic); C14, C16, 0.5-mf.; C15, .05-mf.; C17, 2 mf.

Resistor R1, 20,000 ohms (volume control); R2, 600 ohms; R3, 28,000 ohms; R4, 8,000 ohms; R5, ¼-meg.; R6, 45,000 ohms; R7, ½-meg.; R8, 20,000 ohms; R9, 13,000 ohms; R10, 280,000 ohms; R11, 50,000 ohms.

Operating values are as follows. Filament potentials: V1, V2, V3, 2.2 volts. Plate currents: V1, 4 ma.; V2, 0.25-ma.; V3, 30 ma. Control-grid potentials: V1, 3 volts; V2, 7 volts; V3, 2 volts. Screen-grid potentials: V1, 85 volts; V2, 65 volts; V3, 225 volts. Plate potentials: V1, 225 volts; V2, 100 volts; V3, 215 volts. Heater-to-cathode potentials: V1, 3 volts; V2, 7 volts.

The only volume control in this receiver is by variation of potentiometer R1; the regeneration which exists in the circuit of detector V2, through feedback between the secondary and tickler coils of L2, being non-adjustable. The tickler coil is wound in two sections (high- and low-wave) to obtain even regeneration over the broadcast band. The output of the detector is resistance-capacity coupled to the single stage of A.F. amplification—pentode V3.

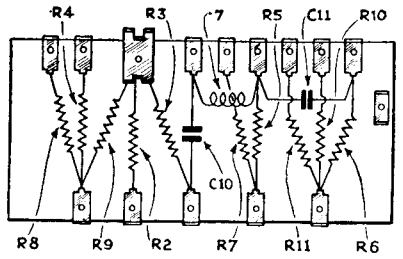
Grid bias for the pentode is obtained from a portion of the voltage drop across the field coil; due mostly to the plate current of V3, which is a considerable portion of the total drain. Consequently, increased current through this choke coil, due to a strong incoming signal, causes an increase in the grid bias; thus obtaining automatically a certain degree of compensation which prevents overload.

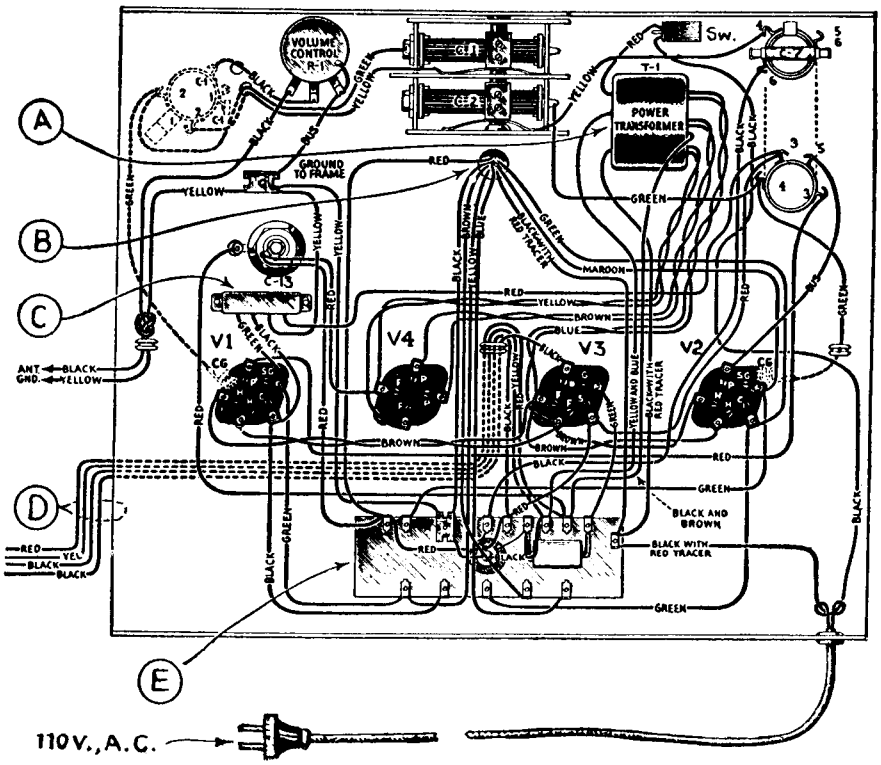
One filter condenser is of the electrolytic type, and the other is of standard paper type.

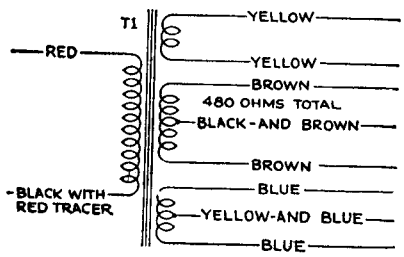
Align the R.F. circuits at 1400 kc. It is advisable to use an audio-modulated service oscillator, connected to the input of the receiver, and a thermo-galvanometer connected to the secondary of the output transformer (in place of the voice coil of the dynamic reproducer), to obtain accurate alignment of the tuned circuits.

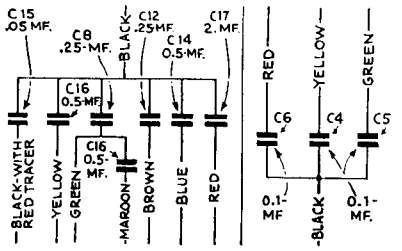
The first step, in resonating the tuner of the "Model R-5," is to turn the station selector's knob until the reading is exactly 0, and then remove the chassis from the cabinet; being careful not to disturb the setting of the dial. The gang condenser plates should be fully meshed with the stators; otherwise, the dial drum must be adjusted until they are. Having made certain of the positions of the condenser plates, replace the chassis in the cabinet.

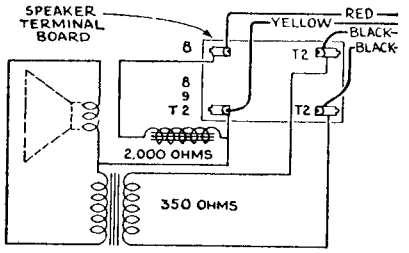
With the oscillator working at 1400 kc., and coupled to the input of the radio set, set the dial scale at 85 and put the receiver in operation. Place a soft pad on the service bench and turn the receiver on its side. It is now convenient to adjust the trimmers; a special wrench is required. A second alignment compensates for any interlocking of adjustments.

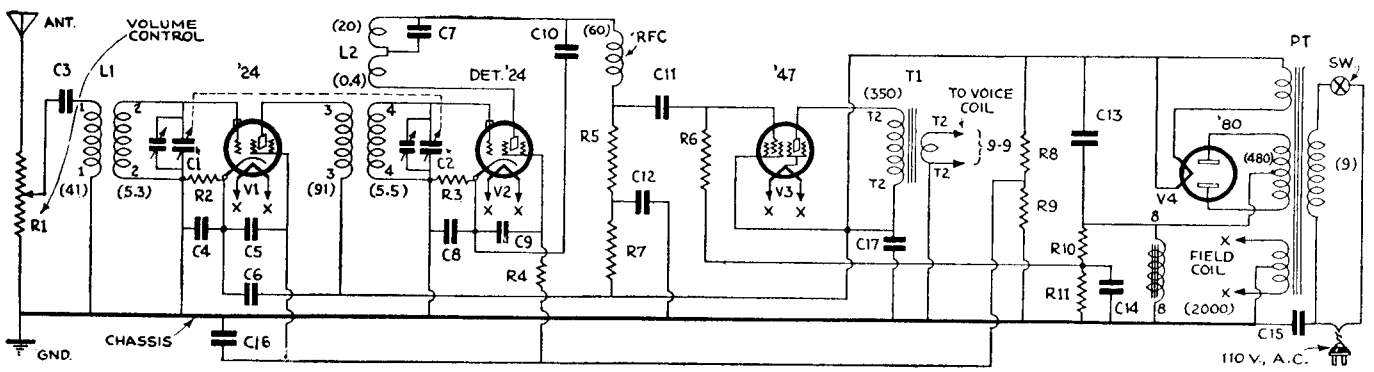












Figures in parentheses are resistances (in ohms); coil terminals correspond to the layout. Other details are shown in sketches above.

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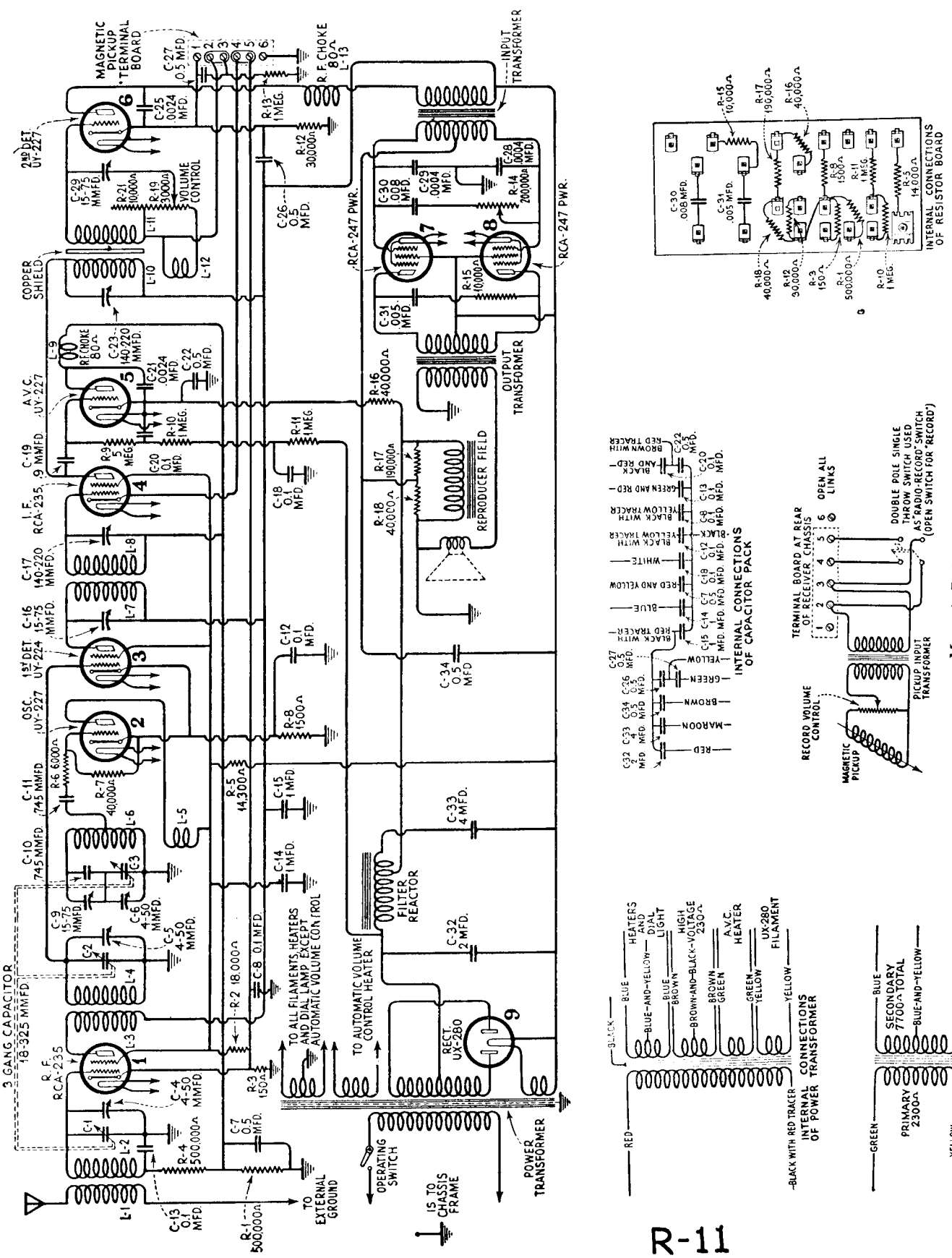
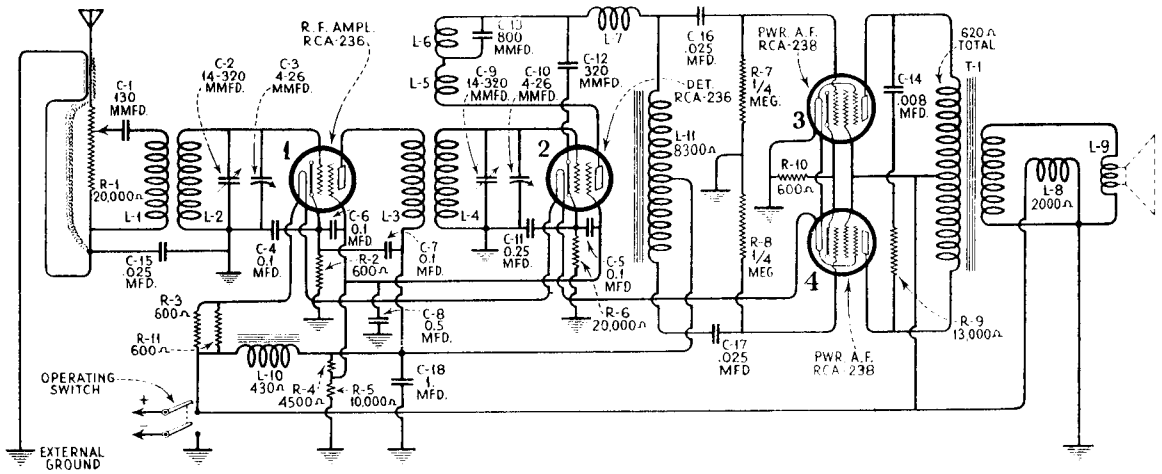


R-11

RCA VICTOR CO., INC.



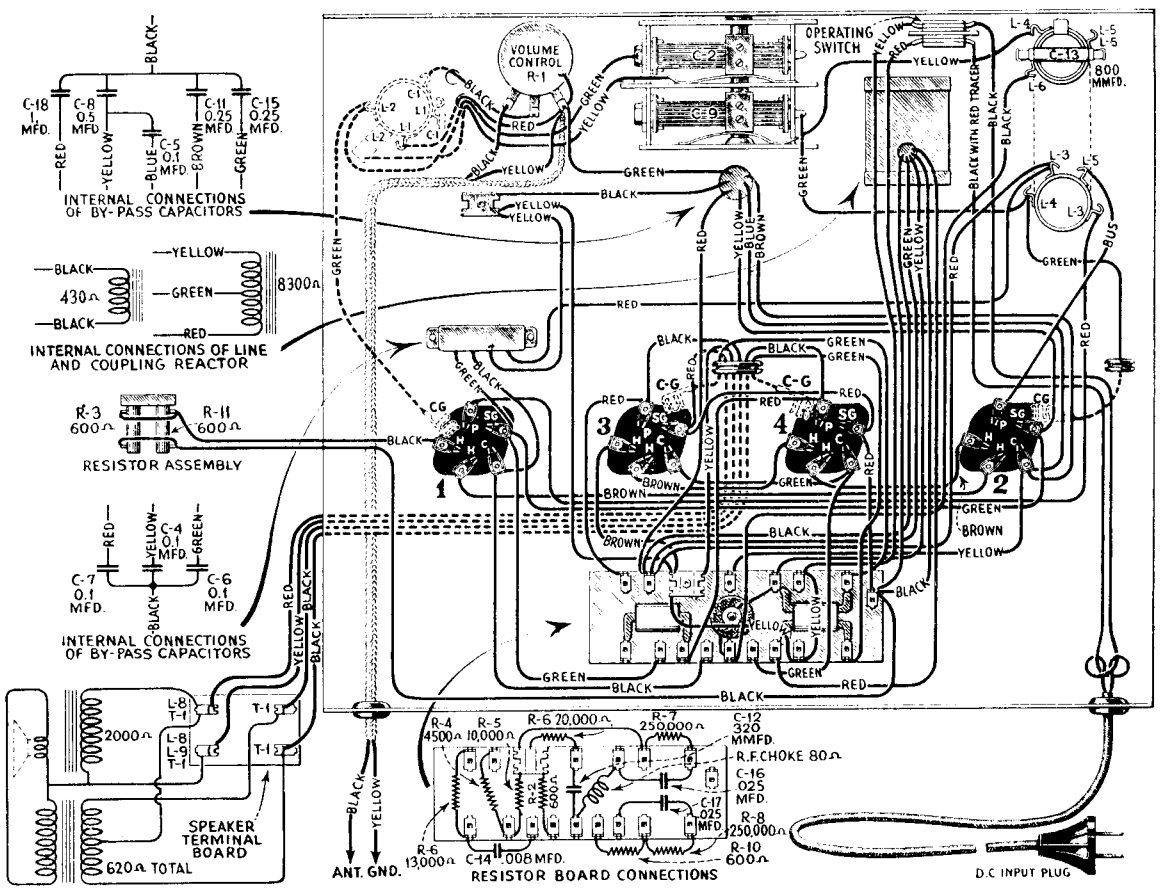
R-5 D. C.

RADIOTRON SOCKET VOLTAGE

110 VOLT D. C. LINE

These readings are obtained with the usual set analyzers and are not true readings of the voltage at which the Radiotrons operate.

Radiotron No.	Cathode to to Control Grid Volts	Cathode to Screen Grid Volts	Cathode to Plate Volts	Plate Current M. A.	Heater Volts
1	1.5	62	98	2.0	6.0
2	3.2	51	92	0.2	6.0
3	0.3	99	95	5.5	6.0
4	0.3	99	95	5.5	6.0



RCA VICTOR CO., INC.

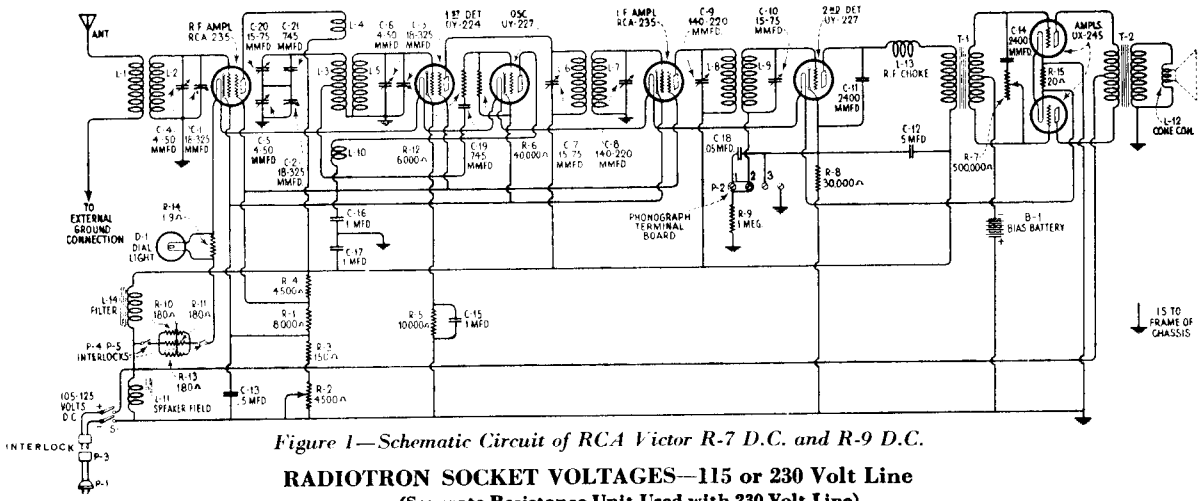


Figure 1—Schematic Circuit of RCA Victor R-7 D.C. and R-9 D.C.

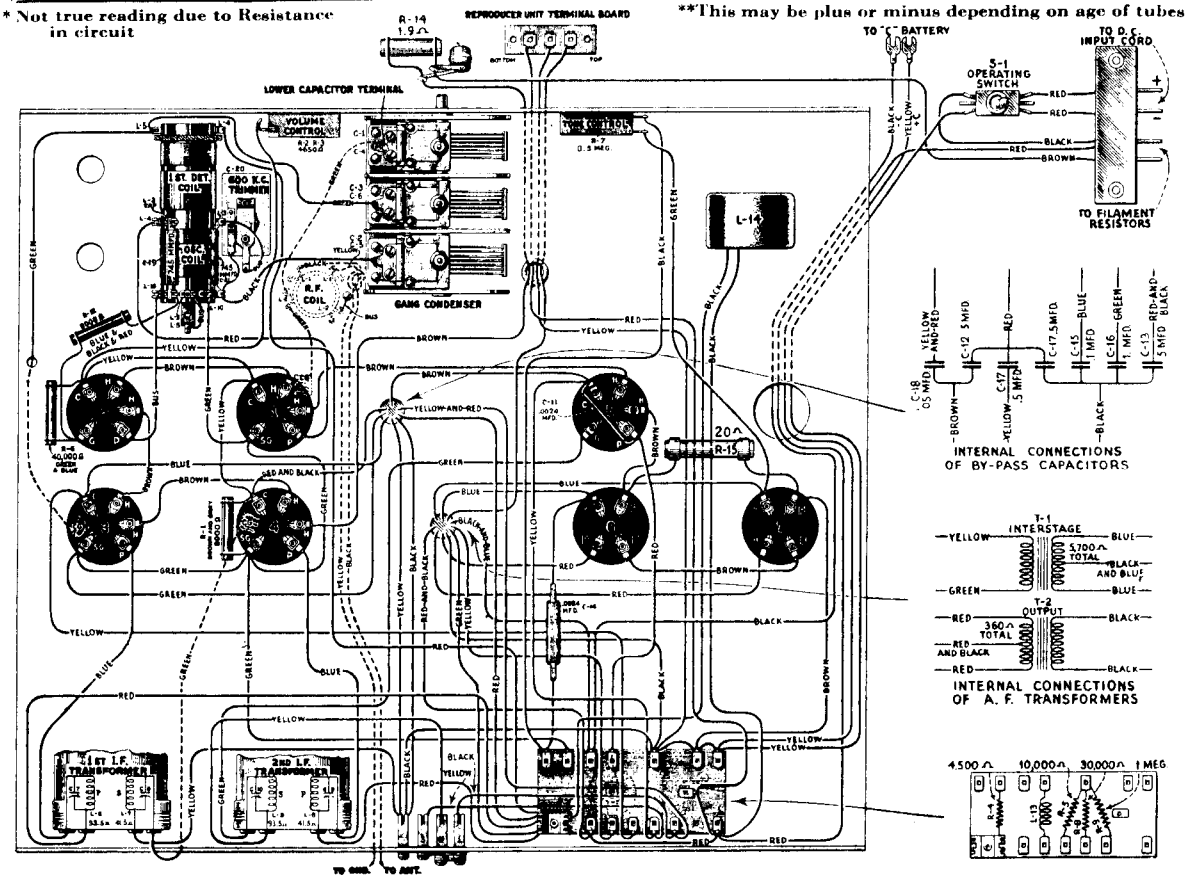
RADIOTRON SOCKET VOLTAGES—115 or 230 Volt Line

(Separate Resistance Unit Used with 230 Volt Line)

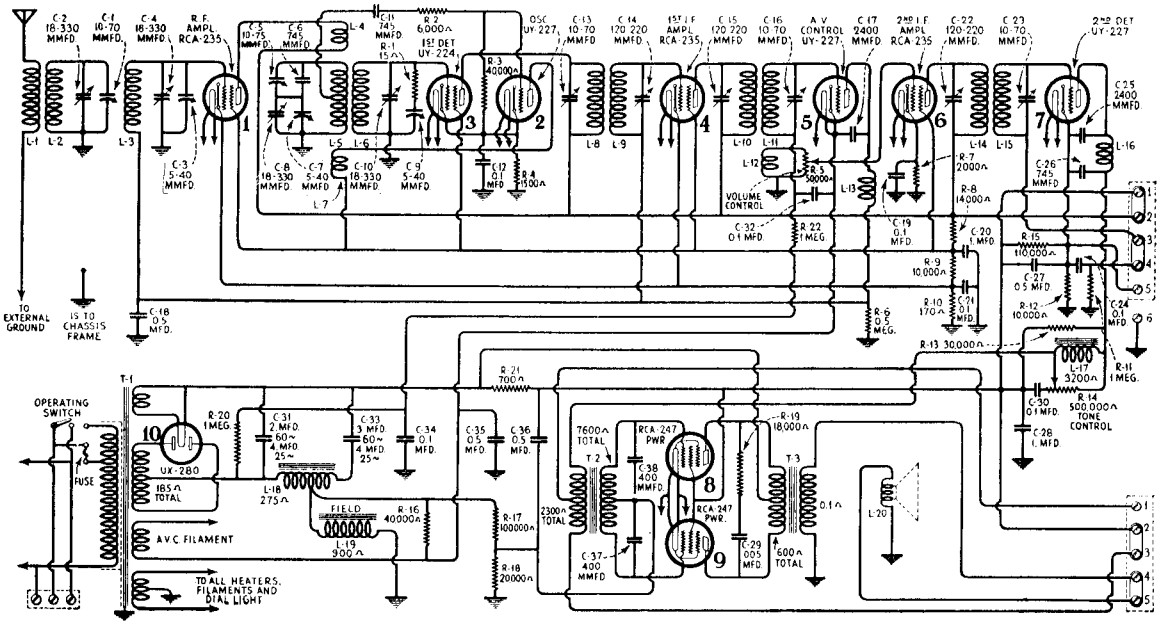
Tube No.	Cathode to Heater Volts, D.C.	Cathode or Filament to Control Grid Volts, D.C.	Cathode to Screen Grid Volts, D.C.	Cathode or Filament to Plate Volts, D.C.	Plate Current M. A.	Screen Grid Current M. A.	Heater or Filament Volts, A.C.
VOLUME CONTROL AT MINIMUM							
1	40	30	40	75	0	0	2.3
2	20	0	—	40	2.0	—	2.3
3	6.0	3.5	65	100	.25		2.3
4	17.0	26	40	75	.0	0	2.3
5	2.0	*2.0	—	90	.23	—	2.3
6	—	25.0	—	100	4.0	—	2.3
7	—	*25.0	—	100	4.0	—	2.3
VOLUME CONTROL AT MAXIMUM							
1	10.0	2.0	50	100	3.5	**0.5	2.3
2	6.0	.0		50	3.0	—	2.3
3	8.0	5.0	50	100	0.5	.0	2.3
4	10.0	2.0	50	100	2.5	**1.0	2.3
5	2.0	*2.0	—	90	.25	0	2.3
6	—	*25.0	—	100	4.0	—	2.3
7	—	*25.0	—	100	4.0	—	2.3

* Not true reading due to Resistance in circuit

**This may be plus or minus depending on age of tubes



RCA VICTOR CO., INC.



R-50, R-55

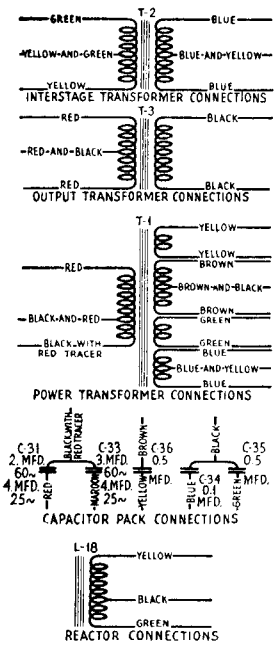
RADIOTRON SOCKET VOLTAGES

VOLTAGES ARE THE SAME AT EITHER POSITION OF THE VOLUME CONTROL

110 VOLT LINE

Radiotron No.	Heater to Cathode Volts	Cathode or Filament or Control Grid Volts	Cathode or Filament to Screen Grid Volts	Cathode or Filament to Plate Volts	Plate Current M. A.	Heater Volts
1. R.F.	2.0	*0.2	60	230	3.5	2.5
2. Osc.	5.0	0	—	50	4.0	2.5
3. 1st Det.	4.0	3.5	60	230	0.5	2.5
4. 1st I.F.	2.0	*0.2	60	230	3.5	2.5
5. A.V.C.	0	0	—	30	0.1	2.5
6. 2nd I.F.	2.0	3.5	60	230	2.5	2.5
7. 2nd Det.	20.0	*8.0	—	210	0.5	2.5
8. Pwr.	—	*10.0	250	235	25.0	2.5
9. Pwr.	—	*10.0	250	235	25.0	2.5

*These readings are not correct due to the resistance in the circuits



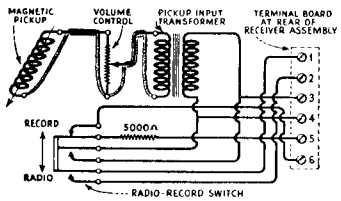
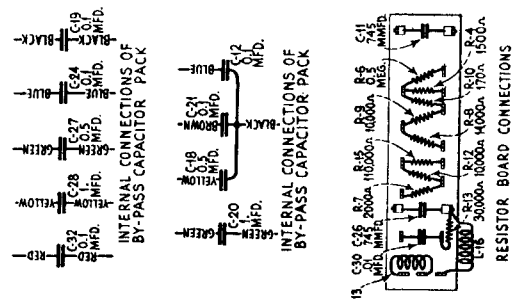
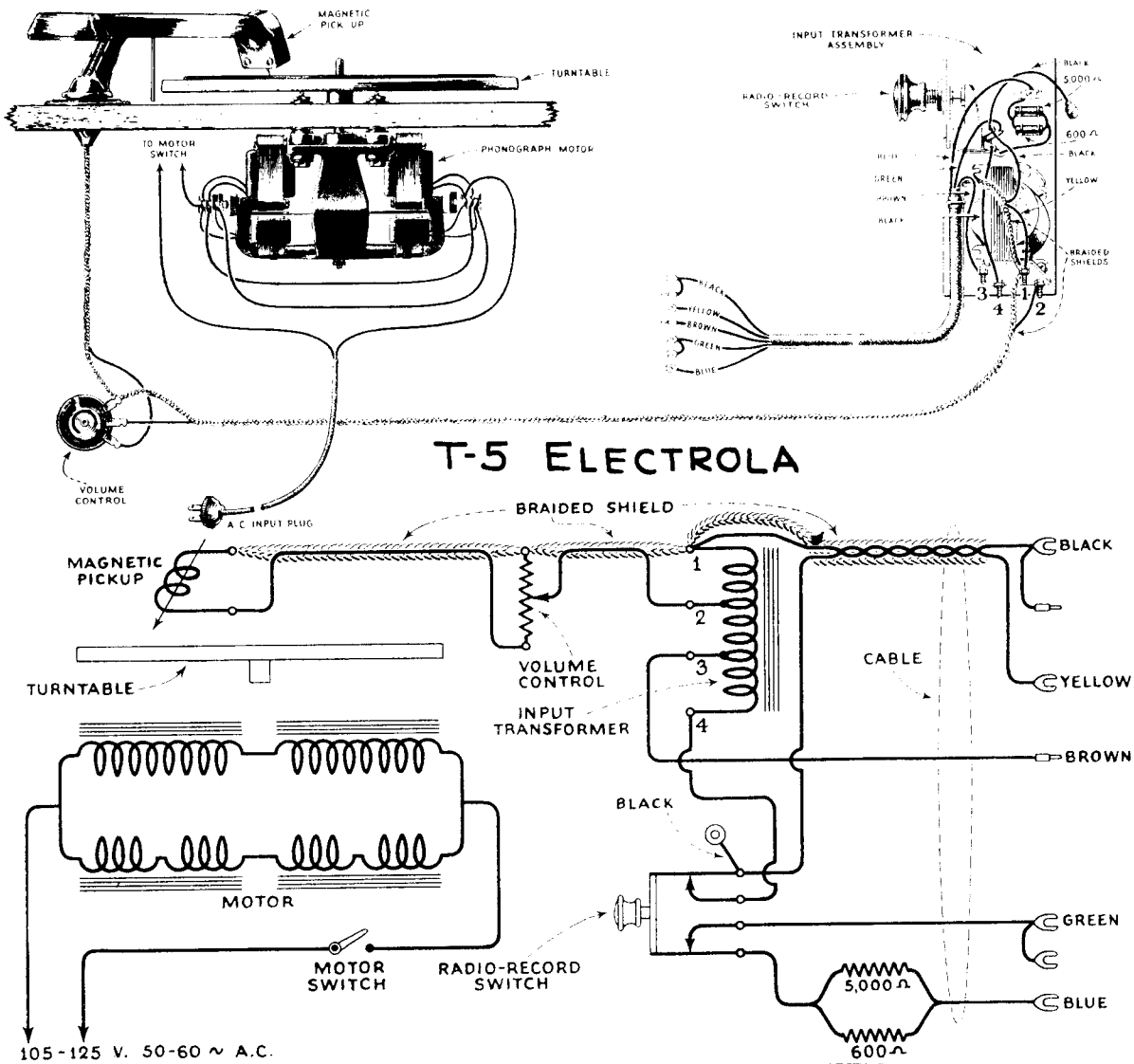


Figure 3—Magnetic Pickup connections

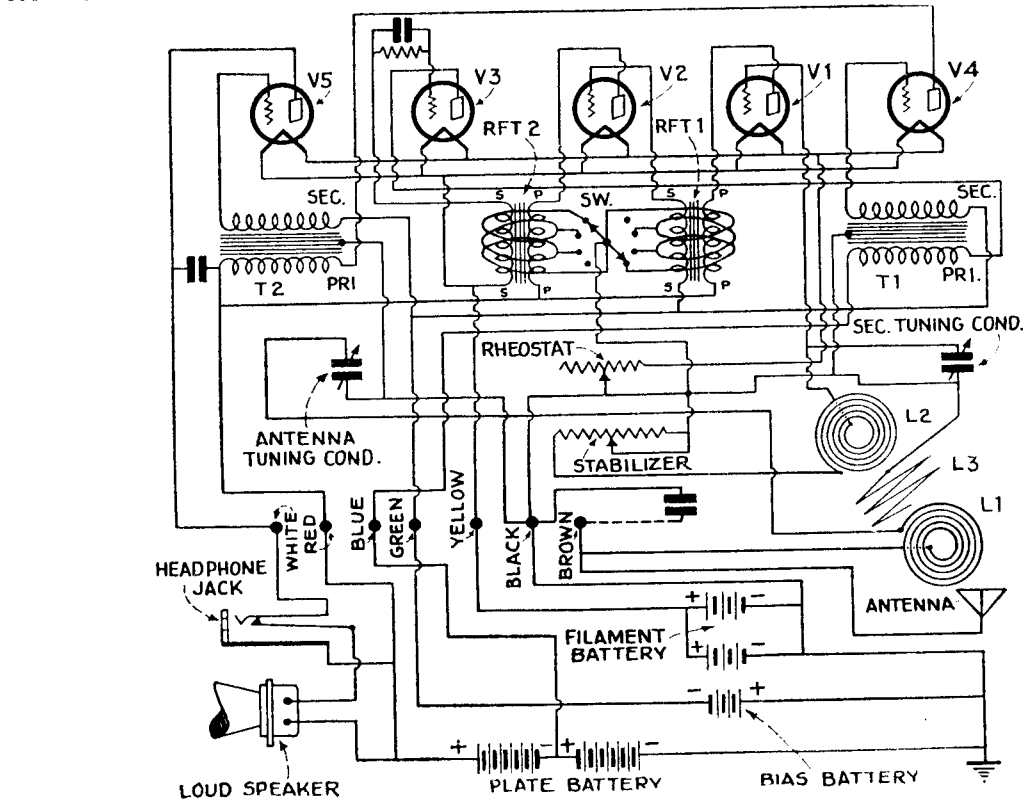
Note: Place the Radio-Record switch and input transformer in the receiver cabinet. Try connecting a wire from receiver terminal No. 6 to input transformer frame or braided shield to pickup and use connection that gives minimum hum.



RCA VICTOR CO., INC.

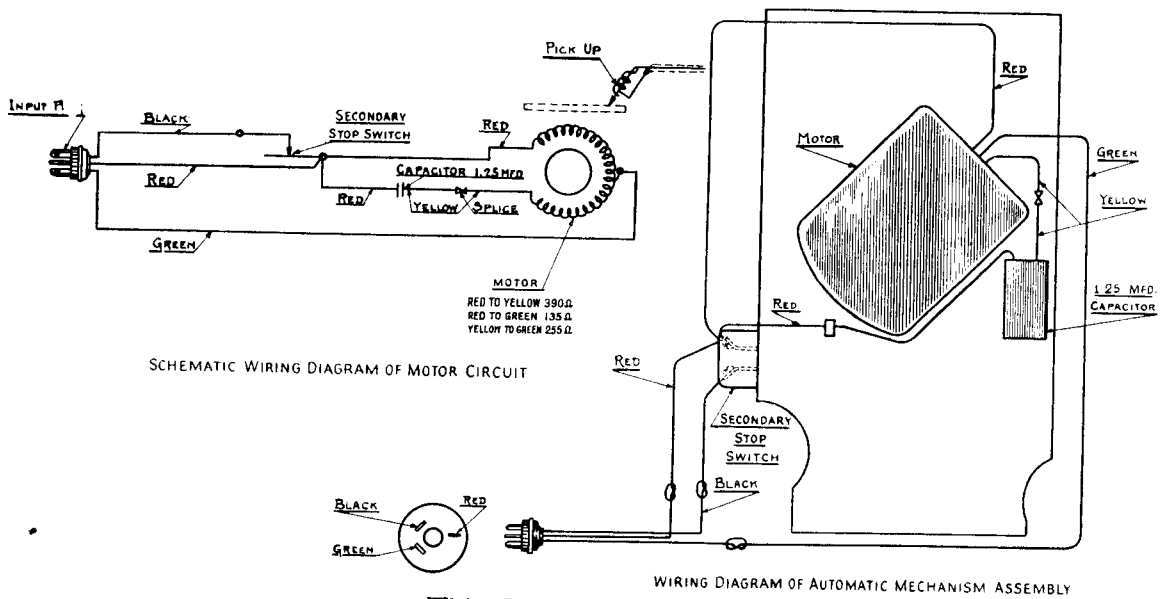


T-5 ELECTROLA



VII - B

RCA VICTOR CO., INC.

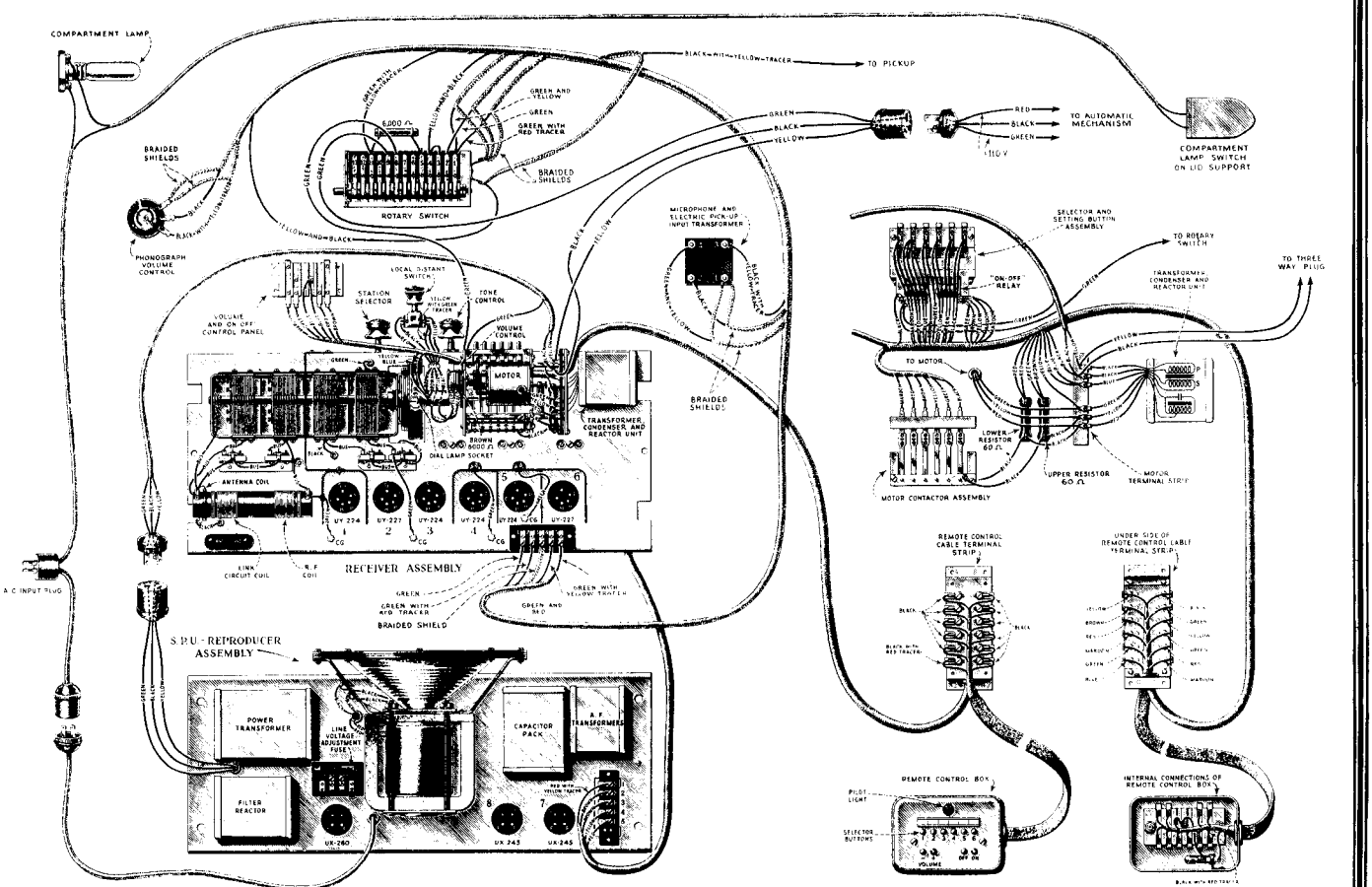


SCHEMATIC WIRING DIAGRAM OF MOTOR CIRCUIT

WIRING DIAGRAM OF AUTOMATIC MECHANISM ASSEMBLY

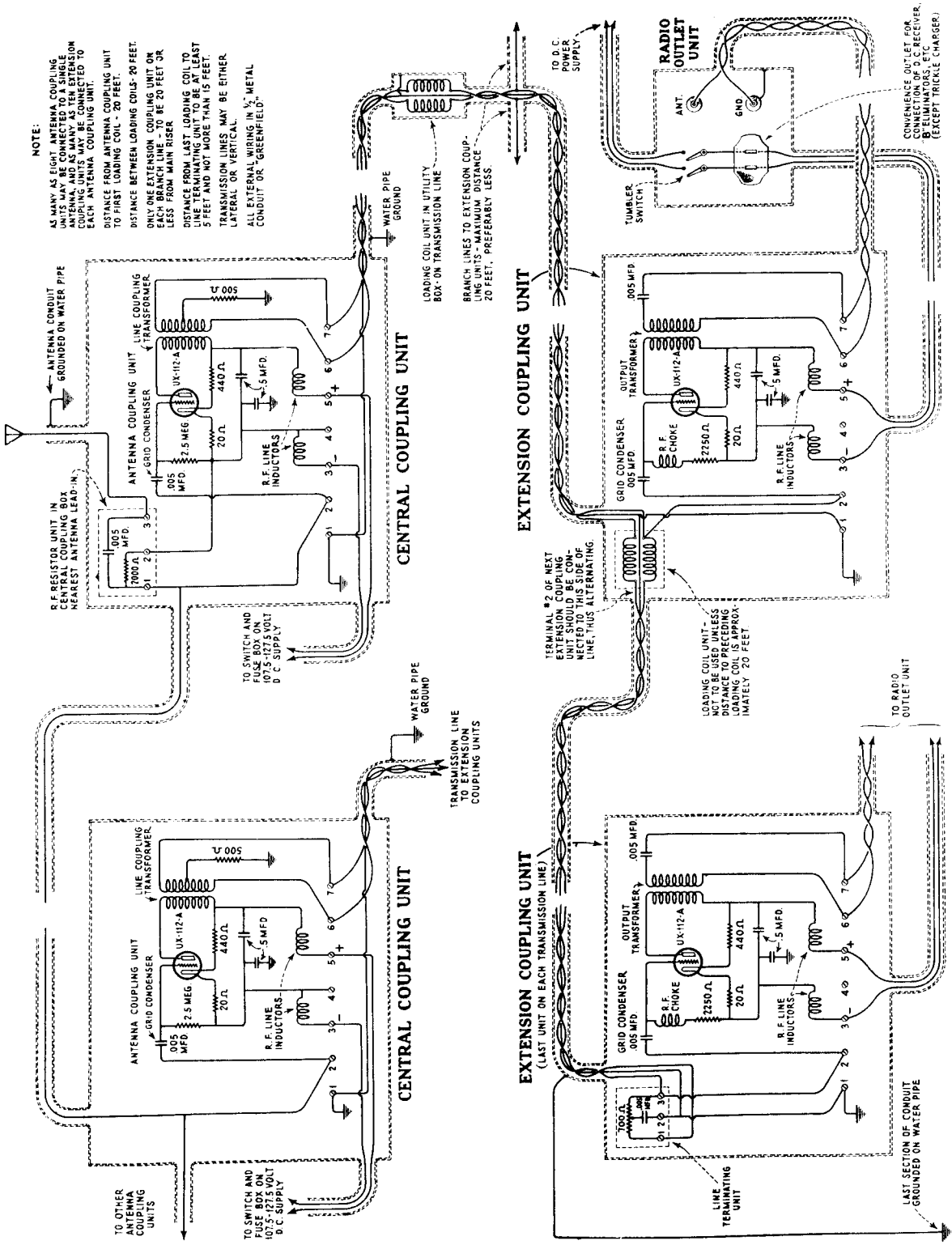
Wiring Diagram of Automatic Mechanism

RAE-68



R. C. A. VICTOR, INC.

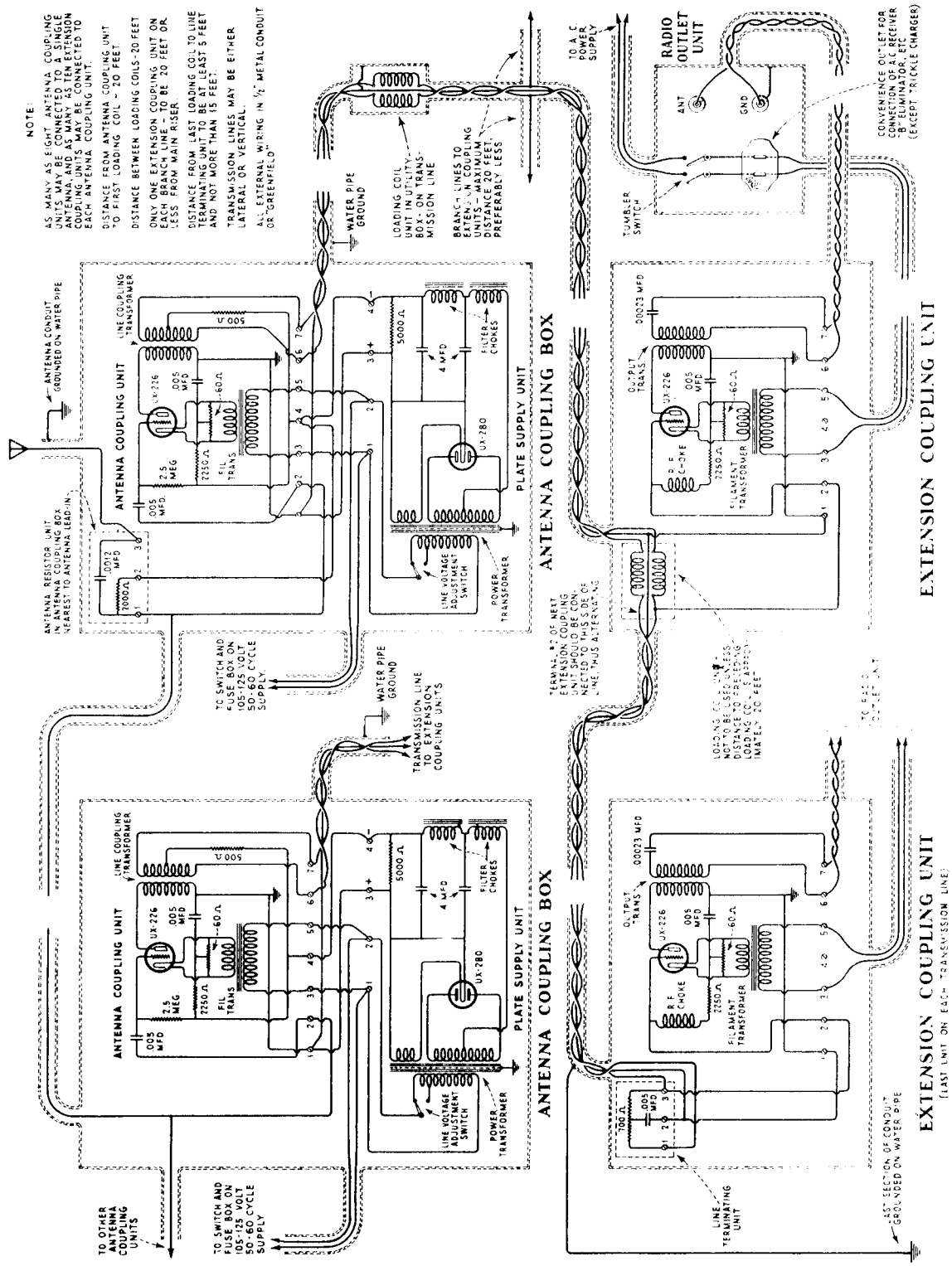
ANTENNA SYSTEM MODEL RF-5100 (D.C.)



Schematic circuit diagram of RCA antenna system for multiple receivers

R. C. A. VICTOR, INC.

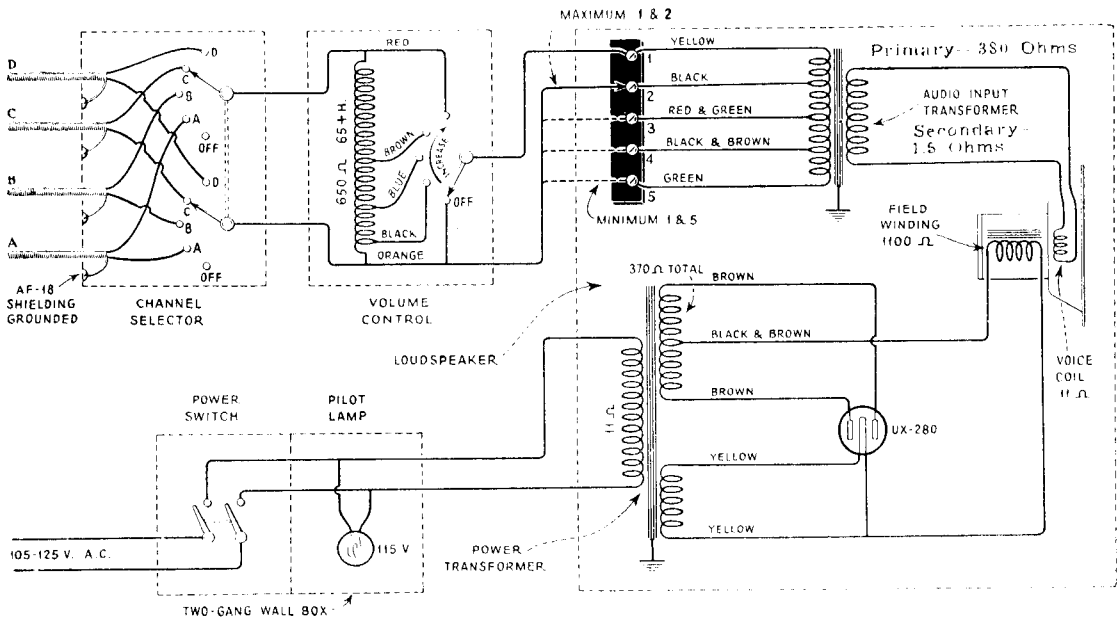
ANTENNA SYSTEM MODEL RF-5600



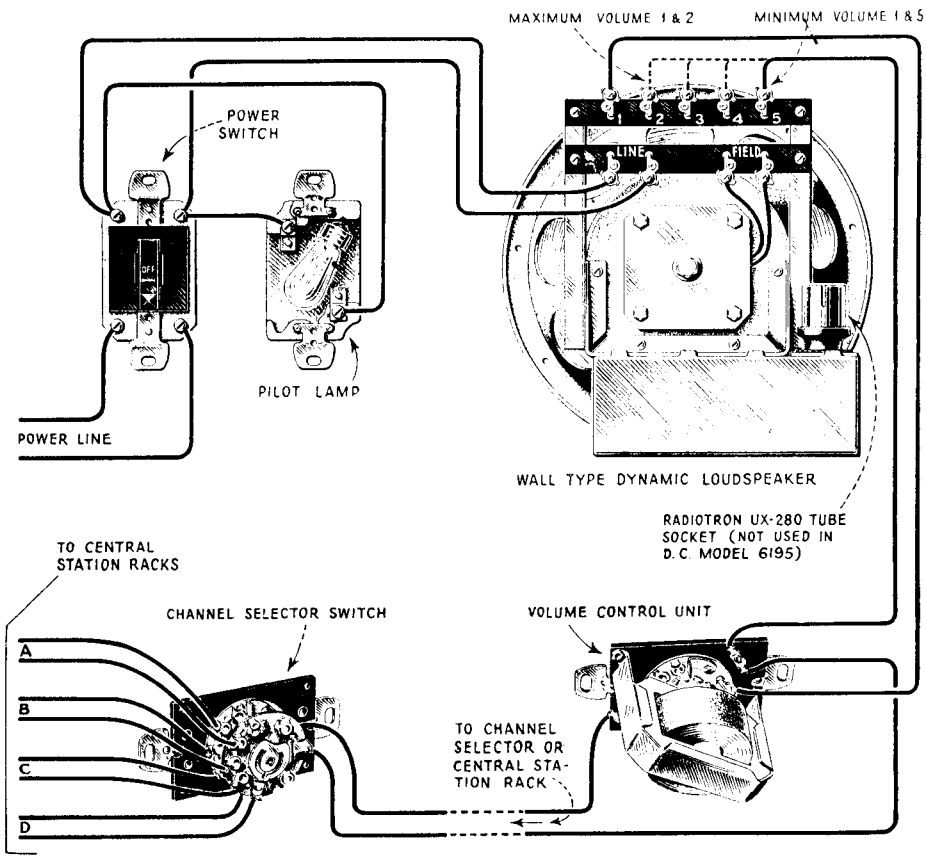
Schematic circuit diagram of the RCA antenna system for multiple receivers

R. C. A. VICTOR, INC.

WALL TYPE SPEAKER MODEL AF-6175



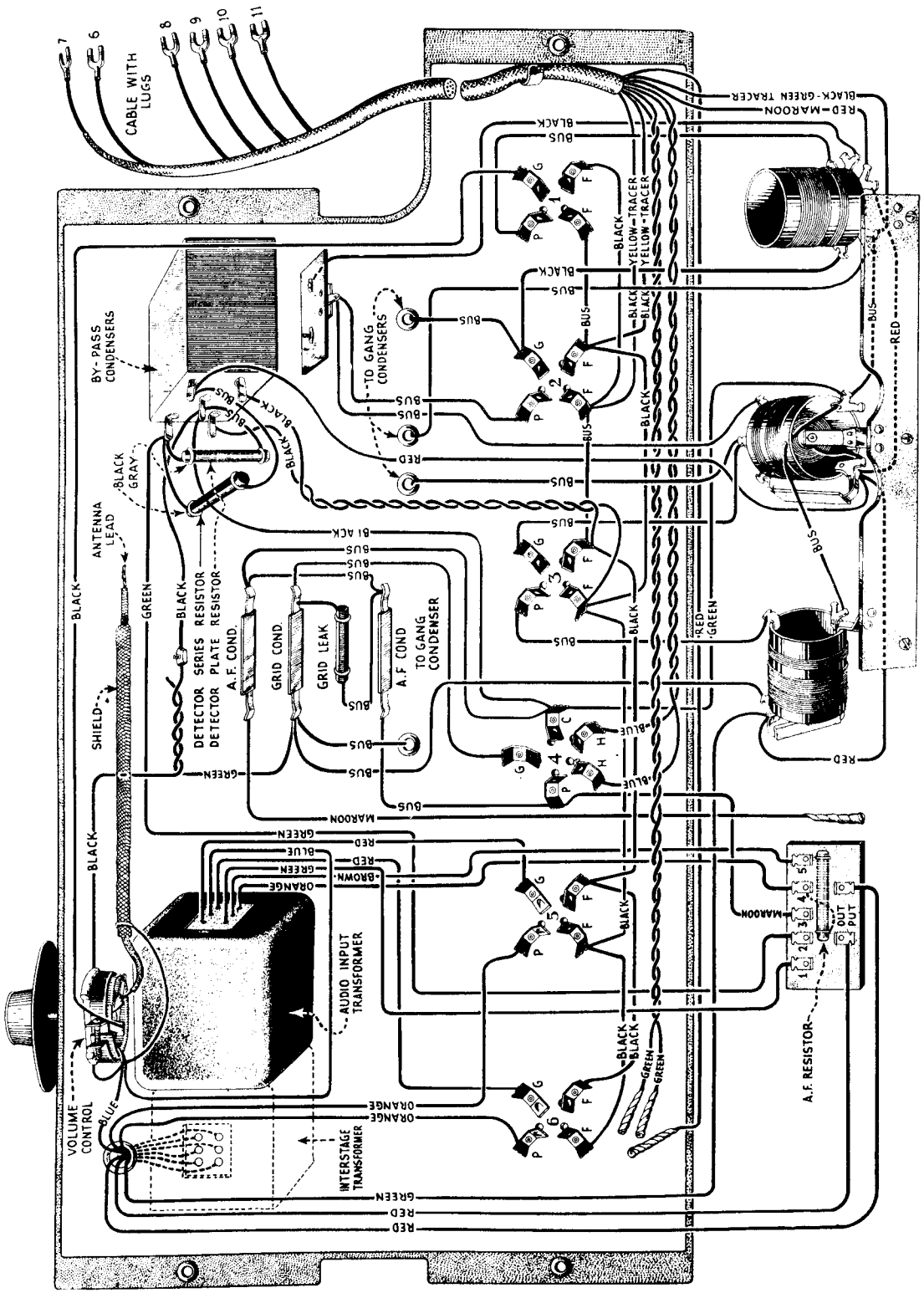
Wall type dynamic loudspeaker and associated equipment—
D. C. resistances given



Assembly wiring diagram showing connections to speaker, volume control, channel selector and power switch

R. C. A. VICTOR, INC.

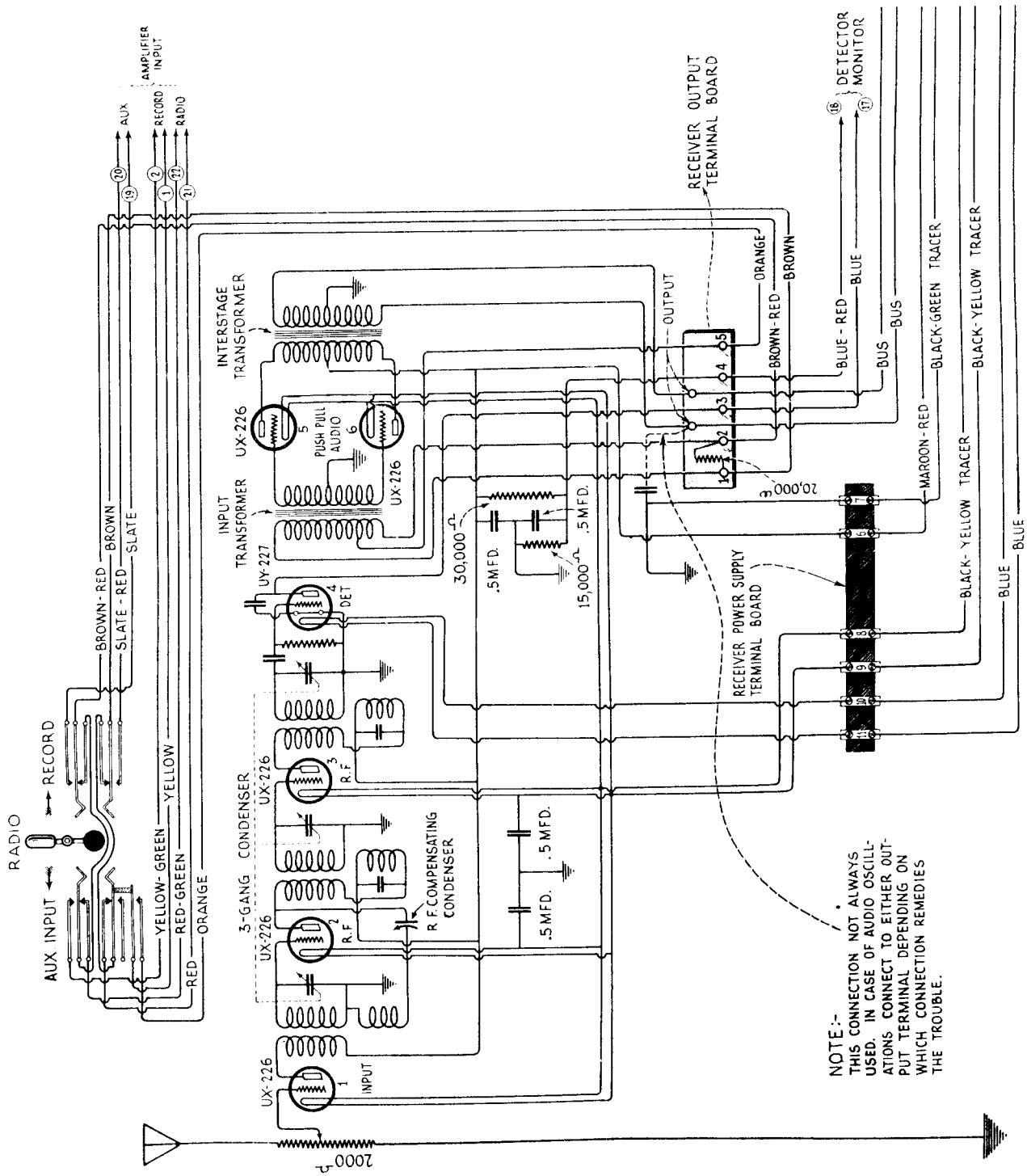
CENTRALIZED RADIO MODEL ER-1240



Wiring diagram of receiver

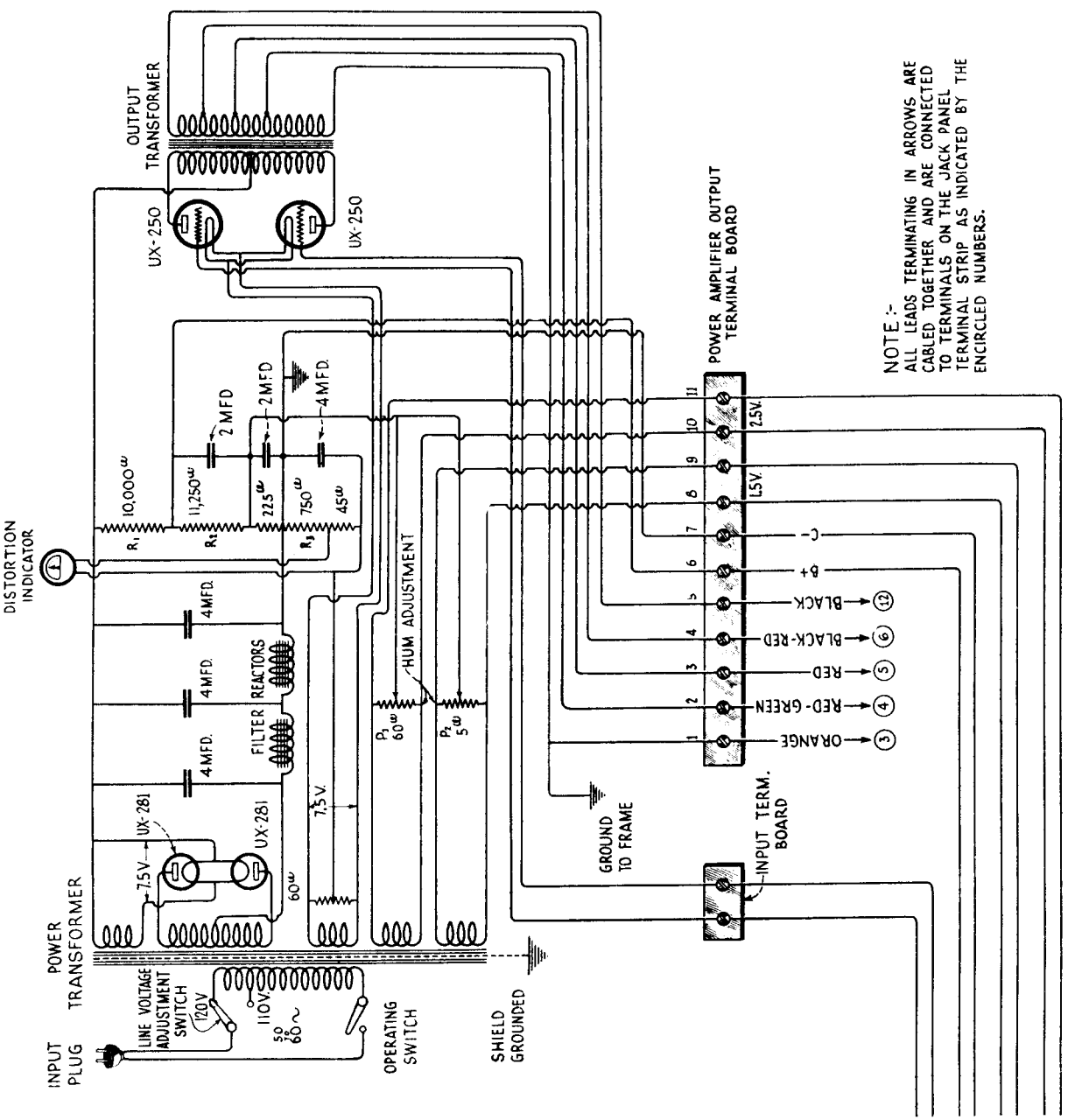
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL ER-1240



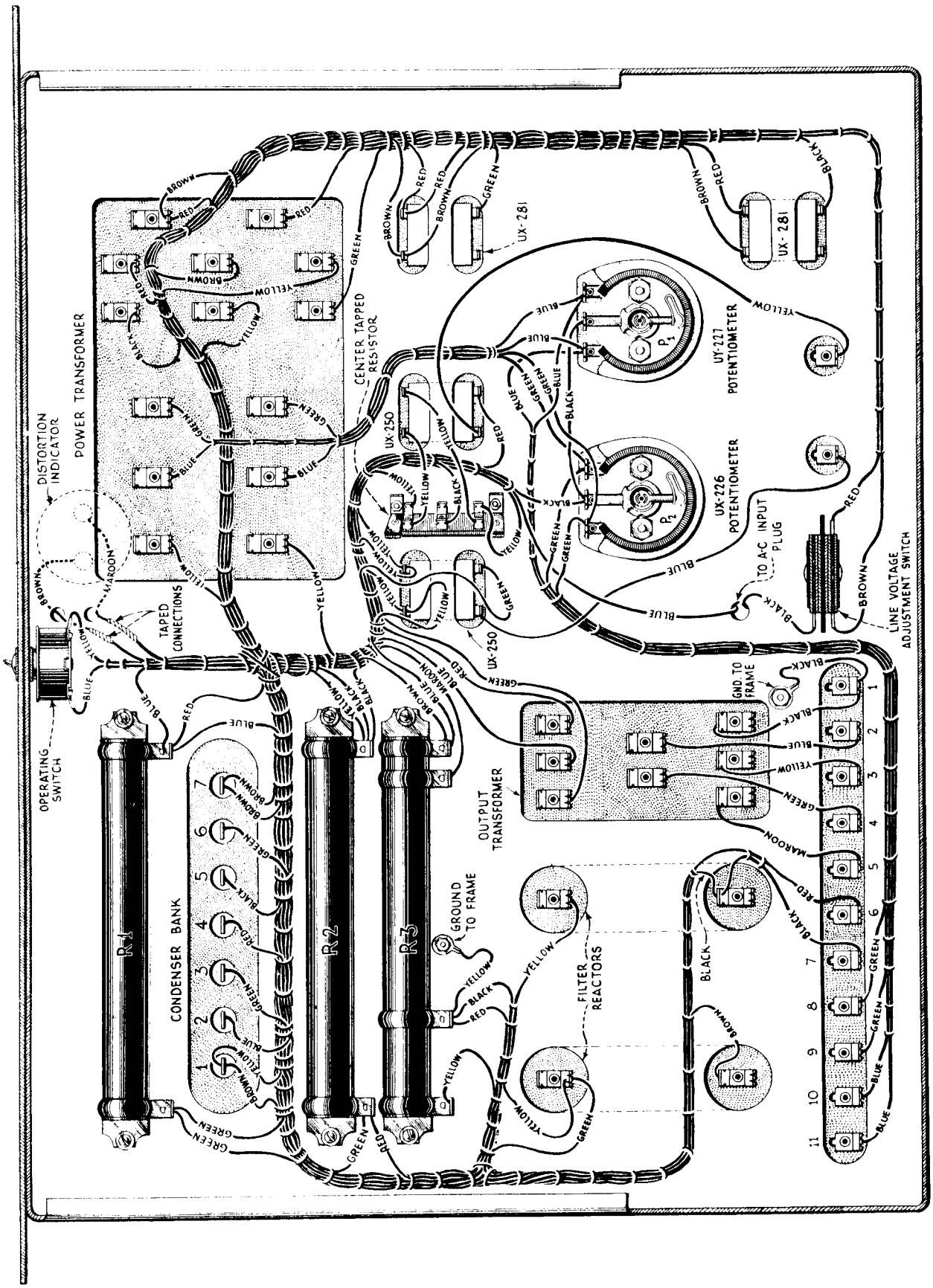
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL ER-1240



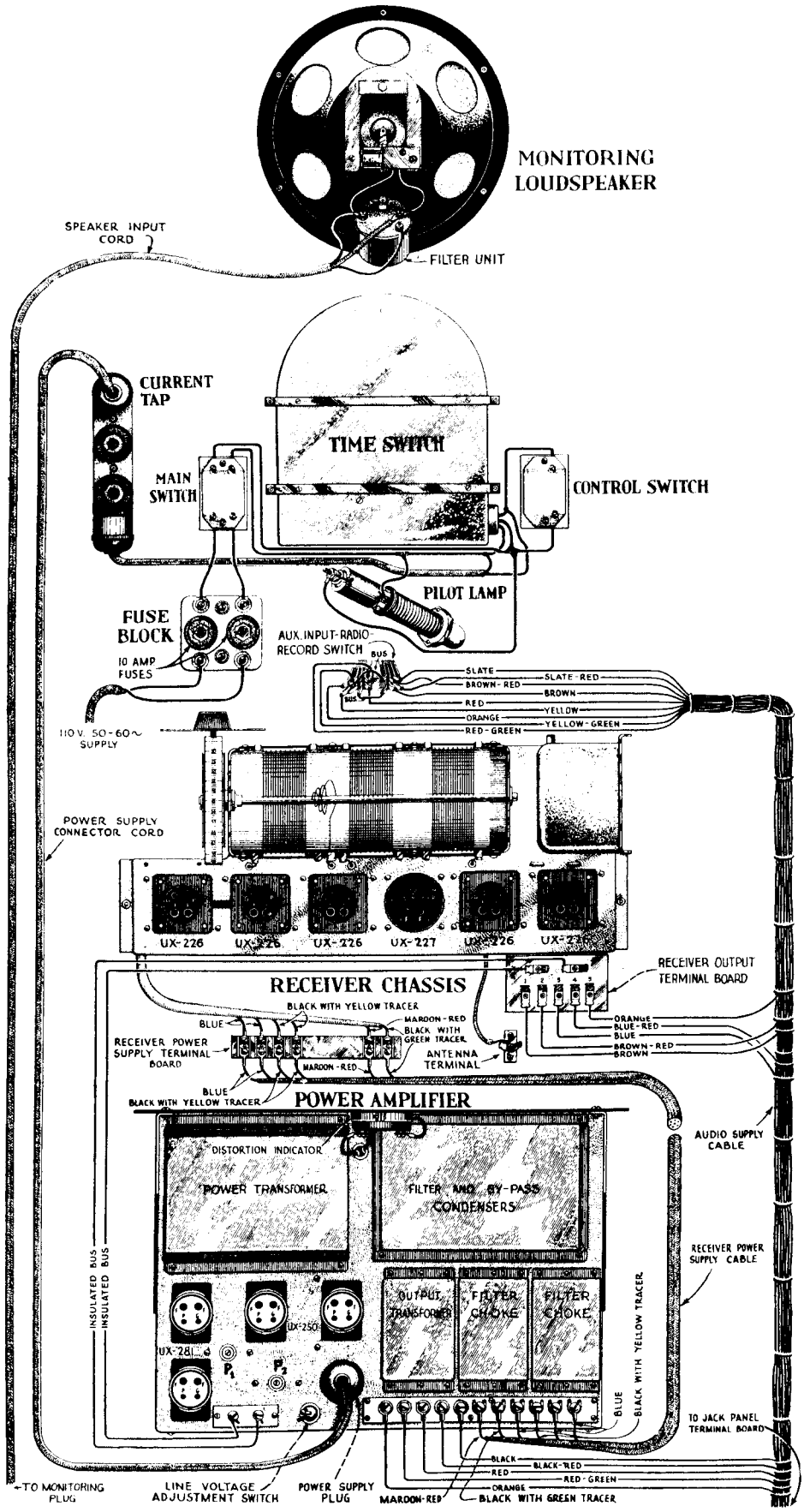
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL ER 1240



Wiring diagram of power amplifier

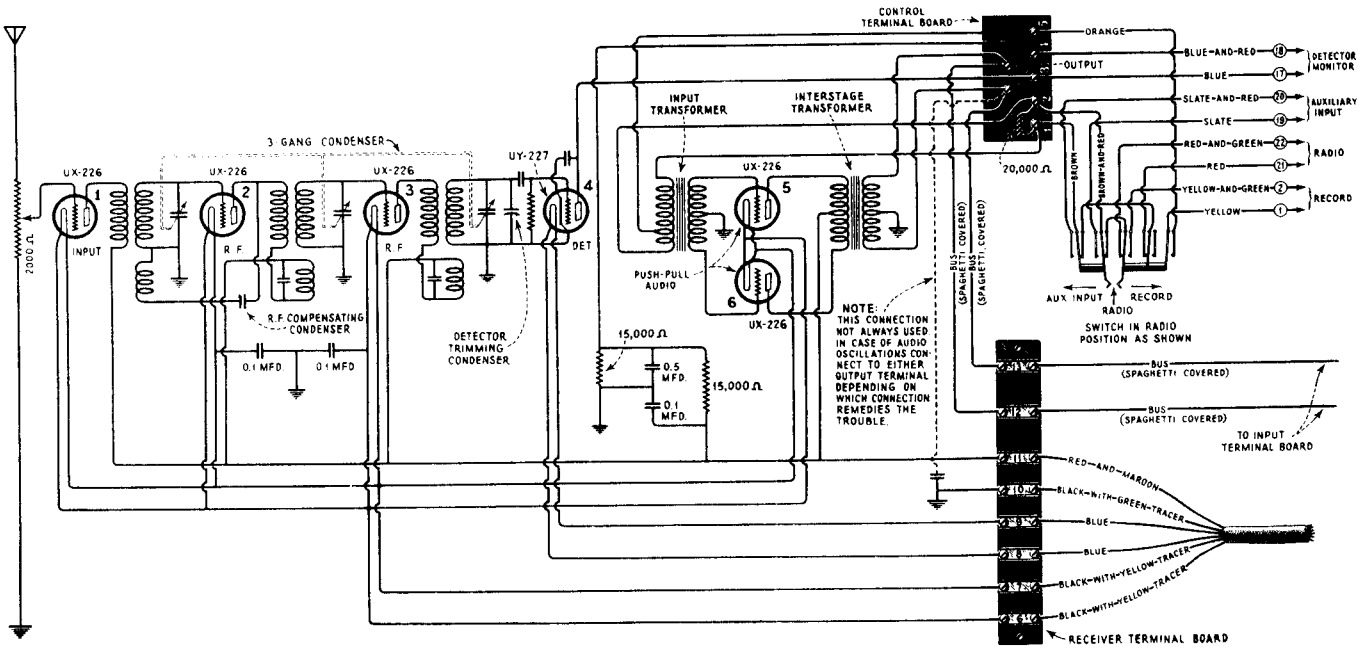
R. C. A. VICTOR, INC.
CENTRALIZED RADIO MODEL ER-1240

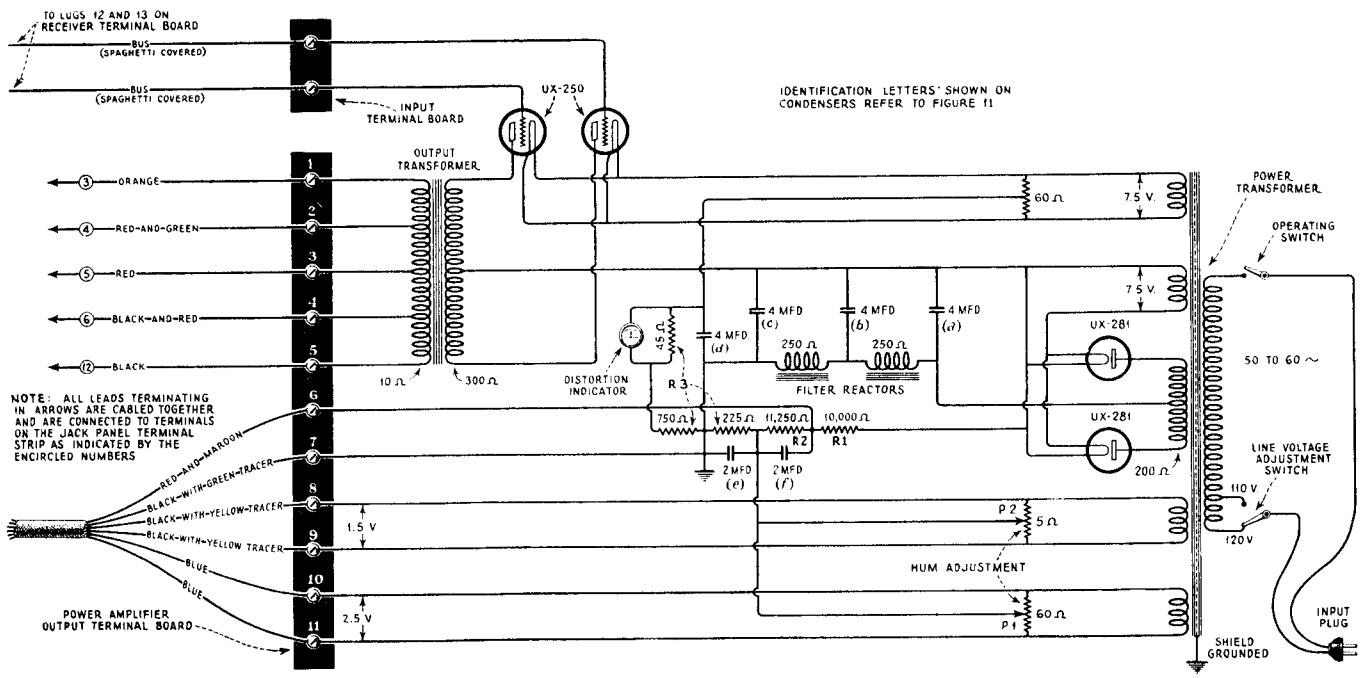


Layout showing main units with cable connections

R. C. A. VICTOR, INC.

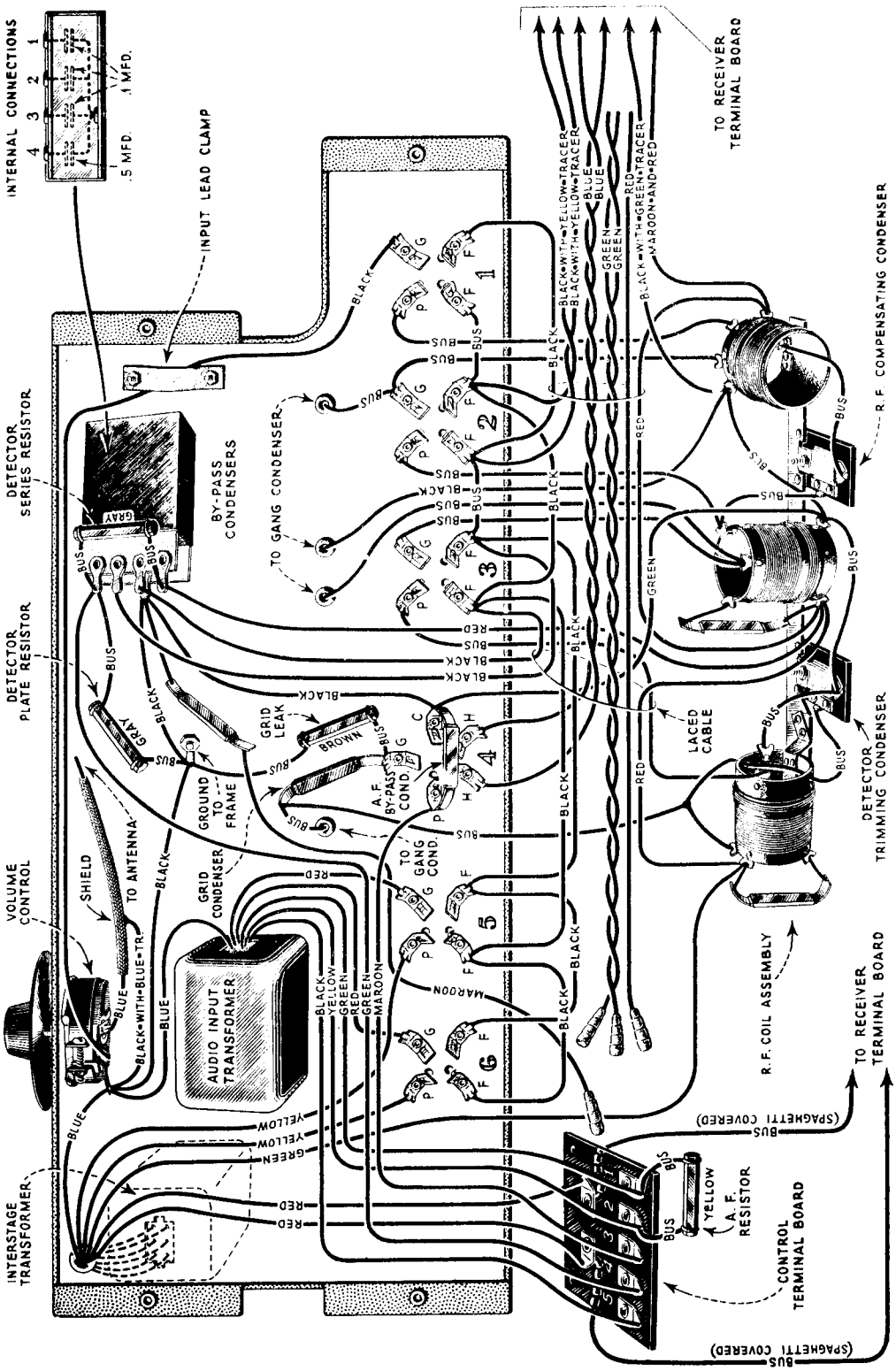
CENTRALIZED RADIO MODEL ER-1240A





R. C. A. VICTOR, INC.

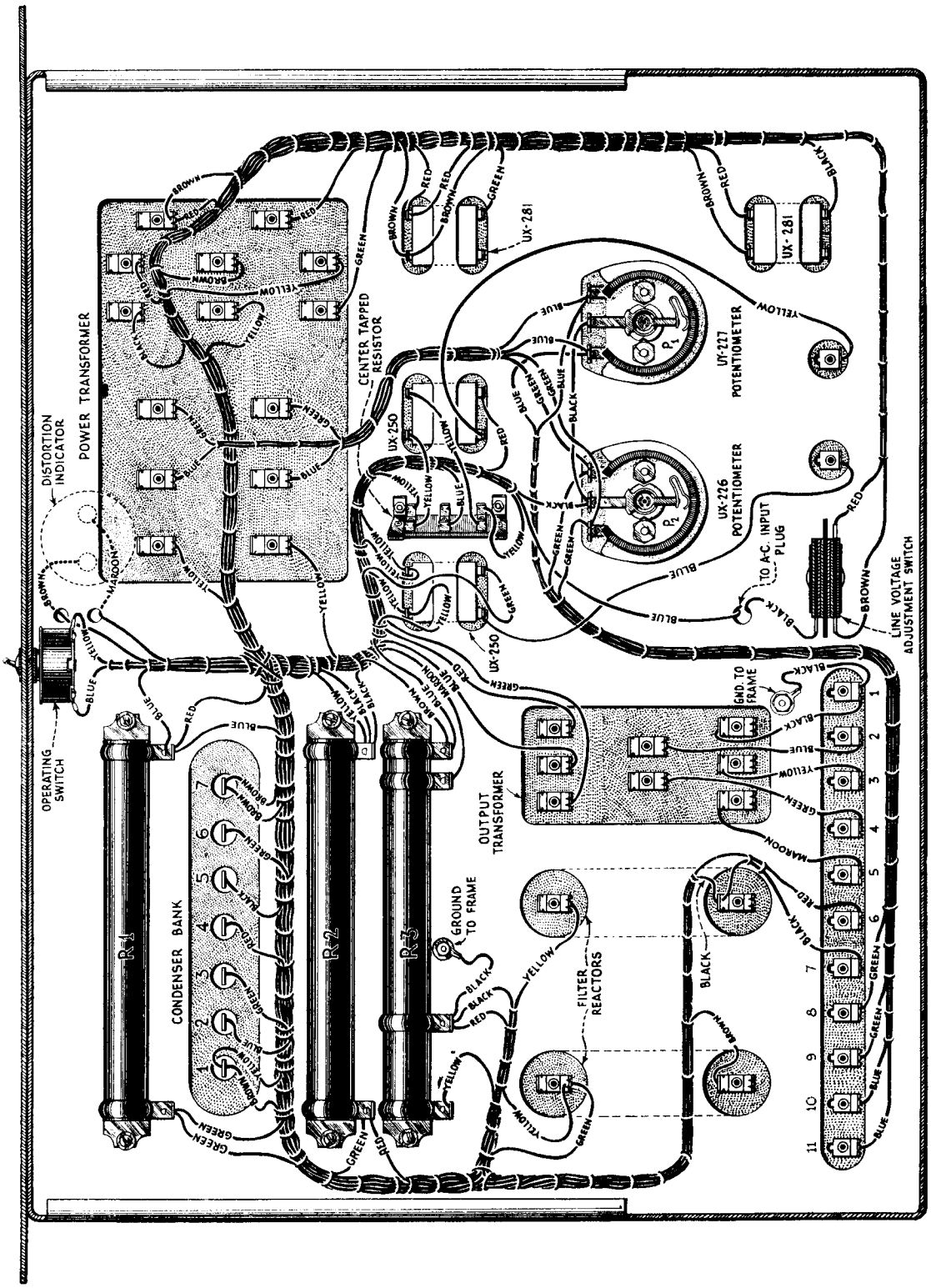
CENTRALIZED RADIO MODEL ER-1240A



Wiring diagram of receiver

R. C. A. VICTOR, INC.

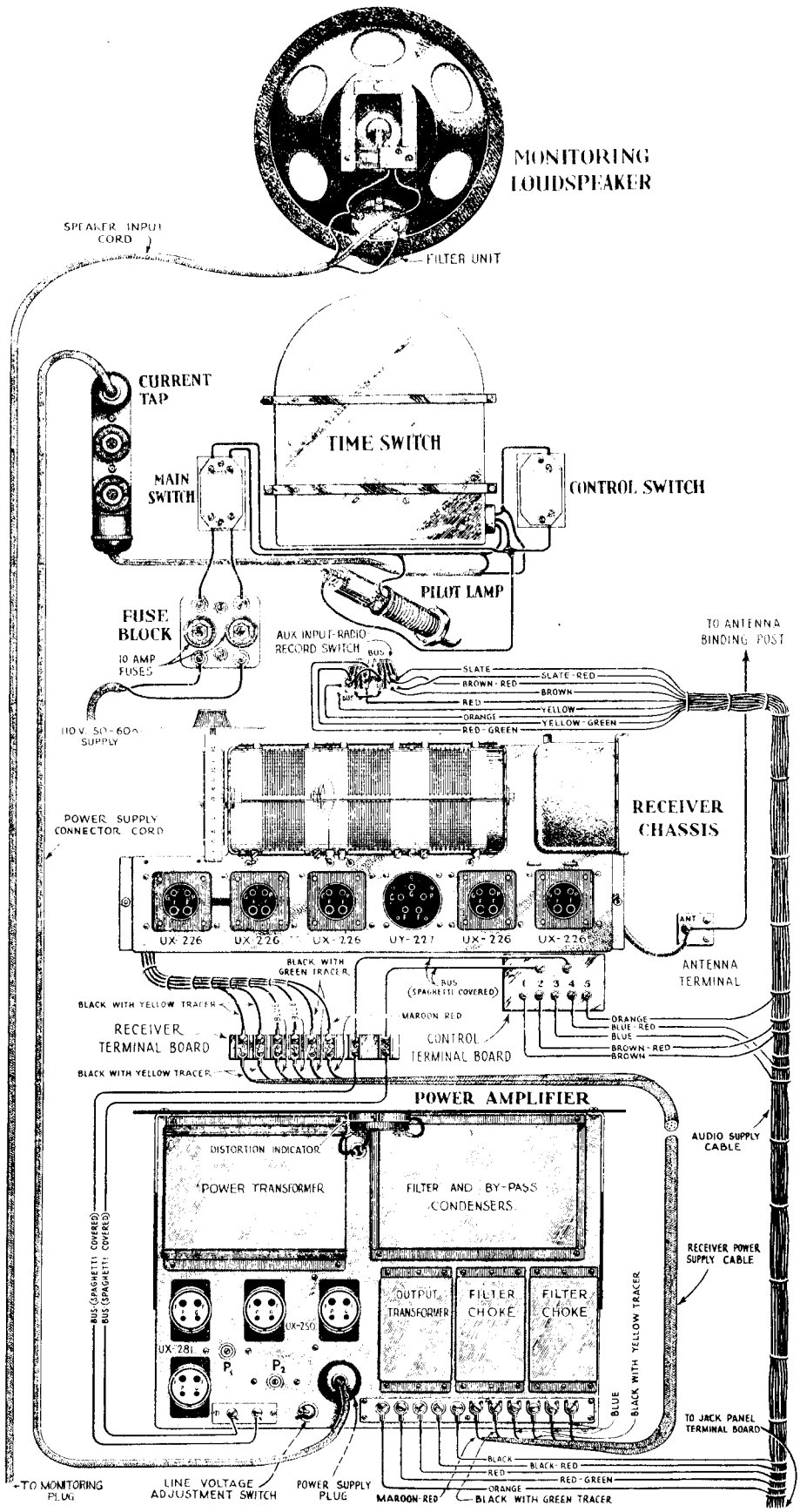
CENTRALIZED RADIO MODEL ER 1240 A



Wiring diagram of power amplifier

R. C. A. VICTOR, INC.

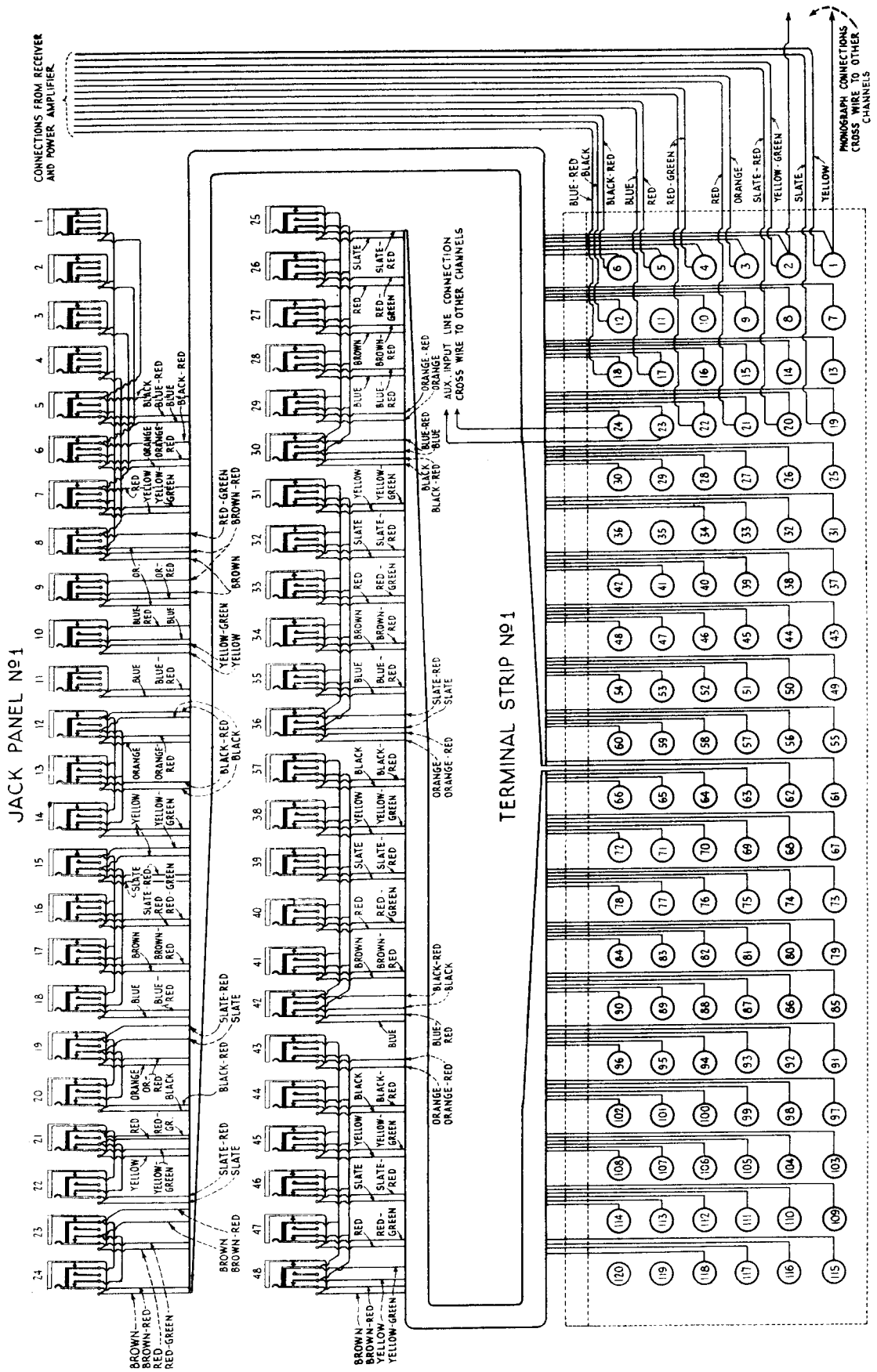
CENTRALIZED RADIO MODEL ER-1240A



Layout showing main units with cable connections

R. C. A. VICTOR, INC.

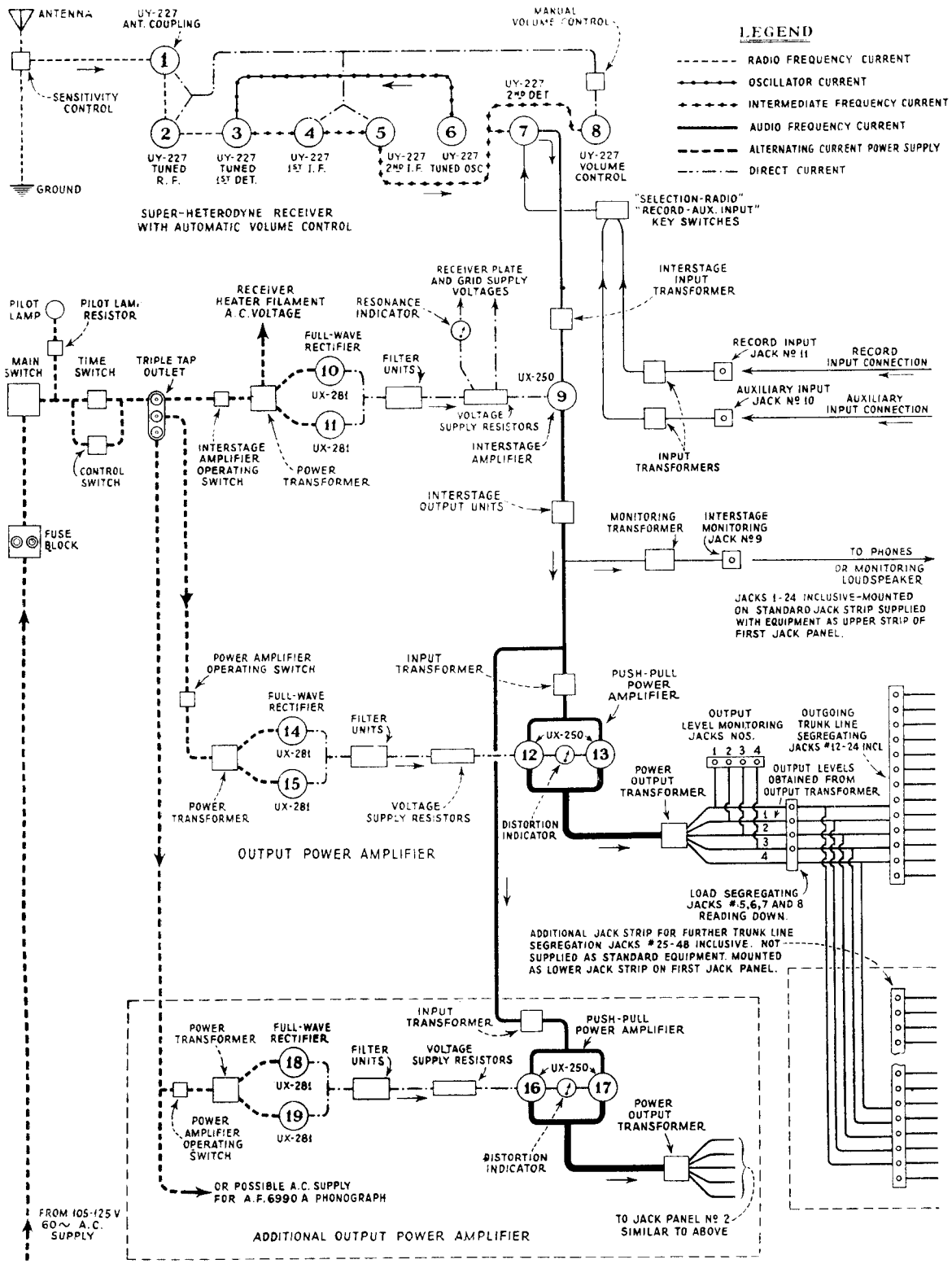
CENTRALIZED RADIO MODEL ER-1240 A



Schematic diagram of jack panel

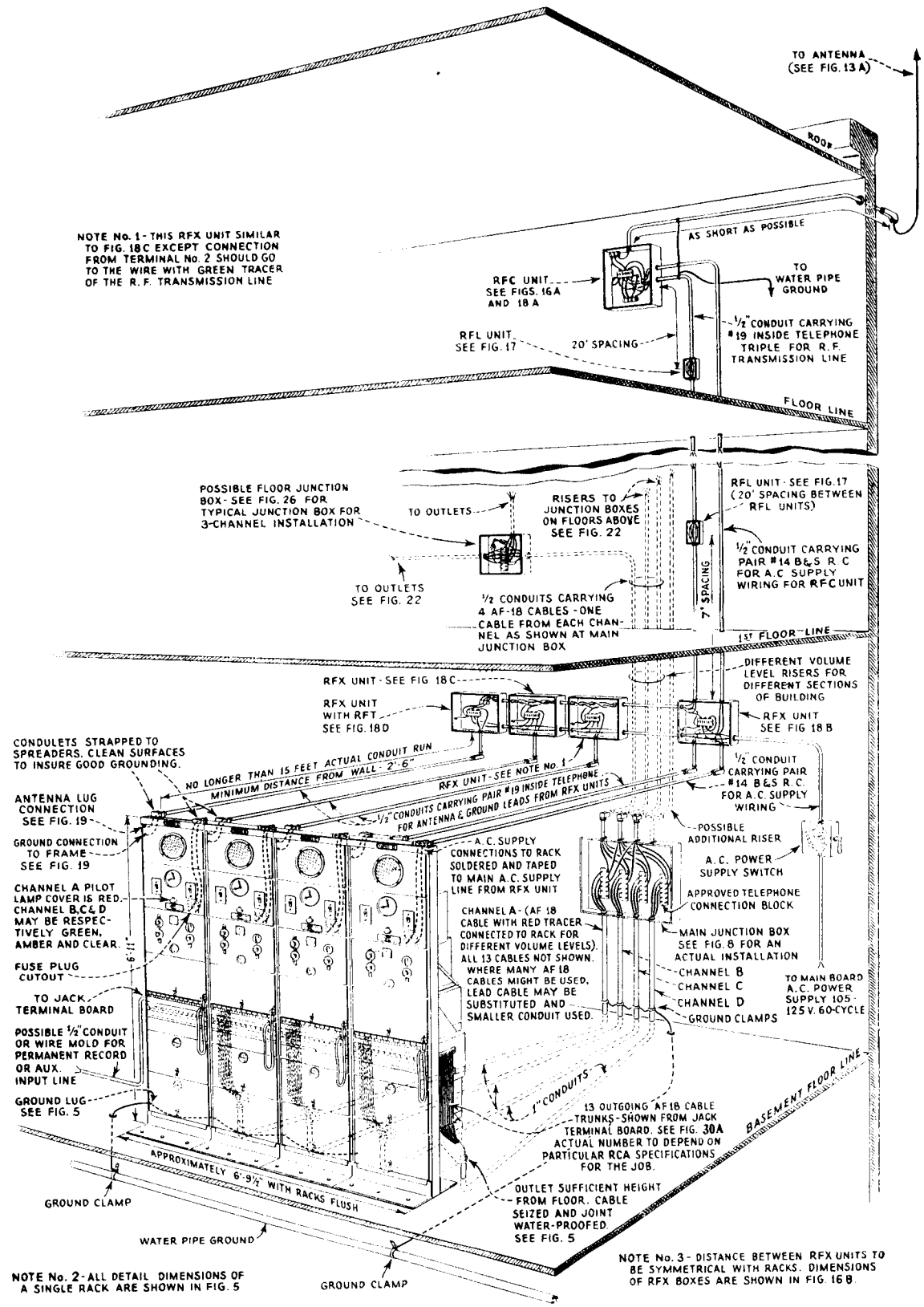
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL AF-6100



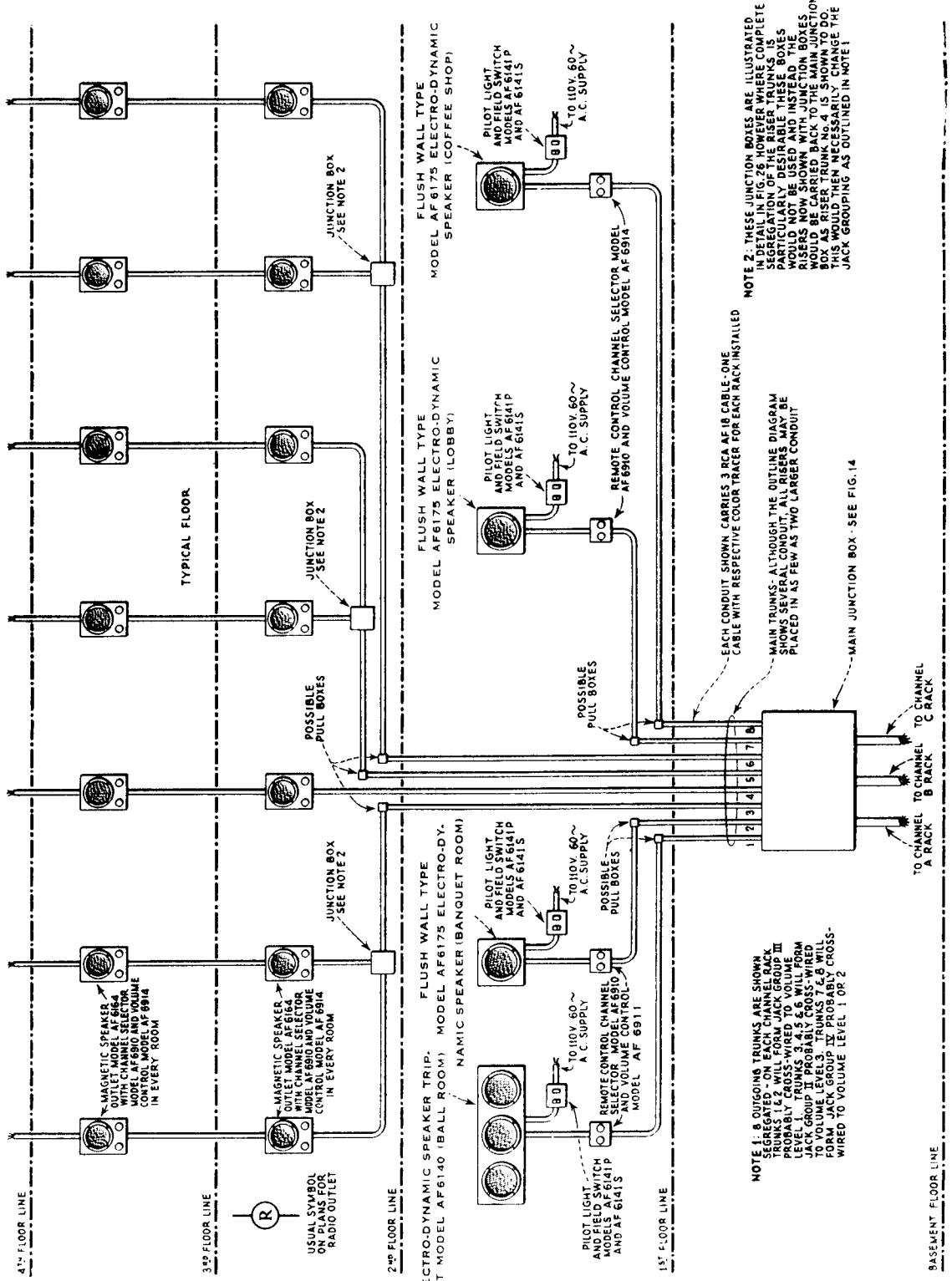
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL AF-6100



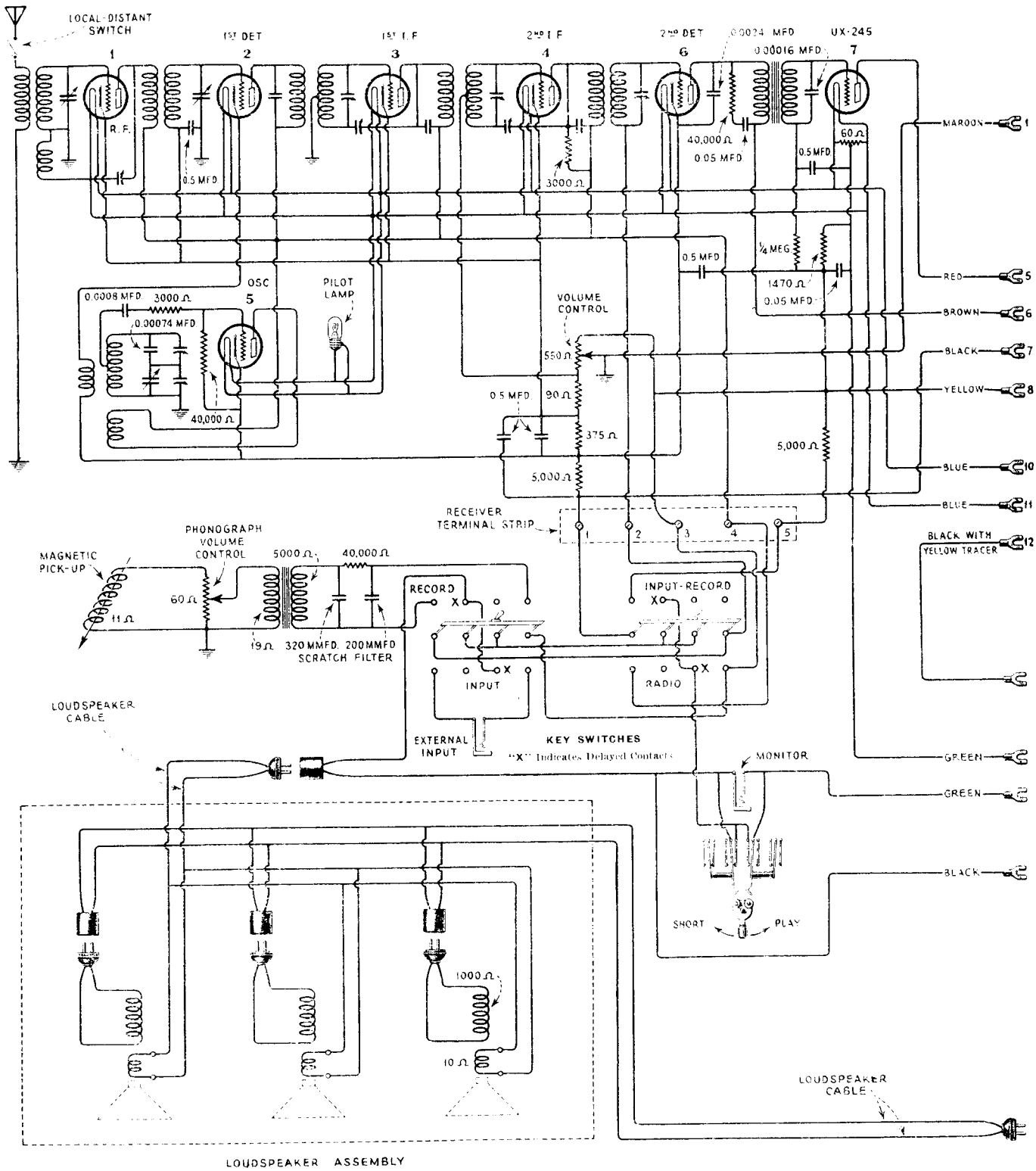
R. C. A. VICTOR, INC.

CENTRALIZED RADIO MODEL AF-6100



R. C. A. VICTOR, INC.

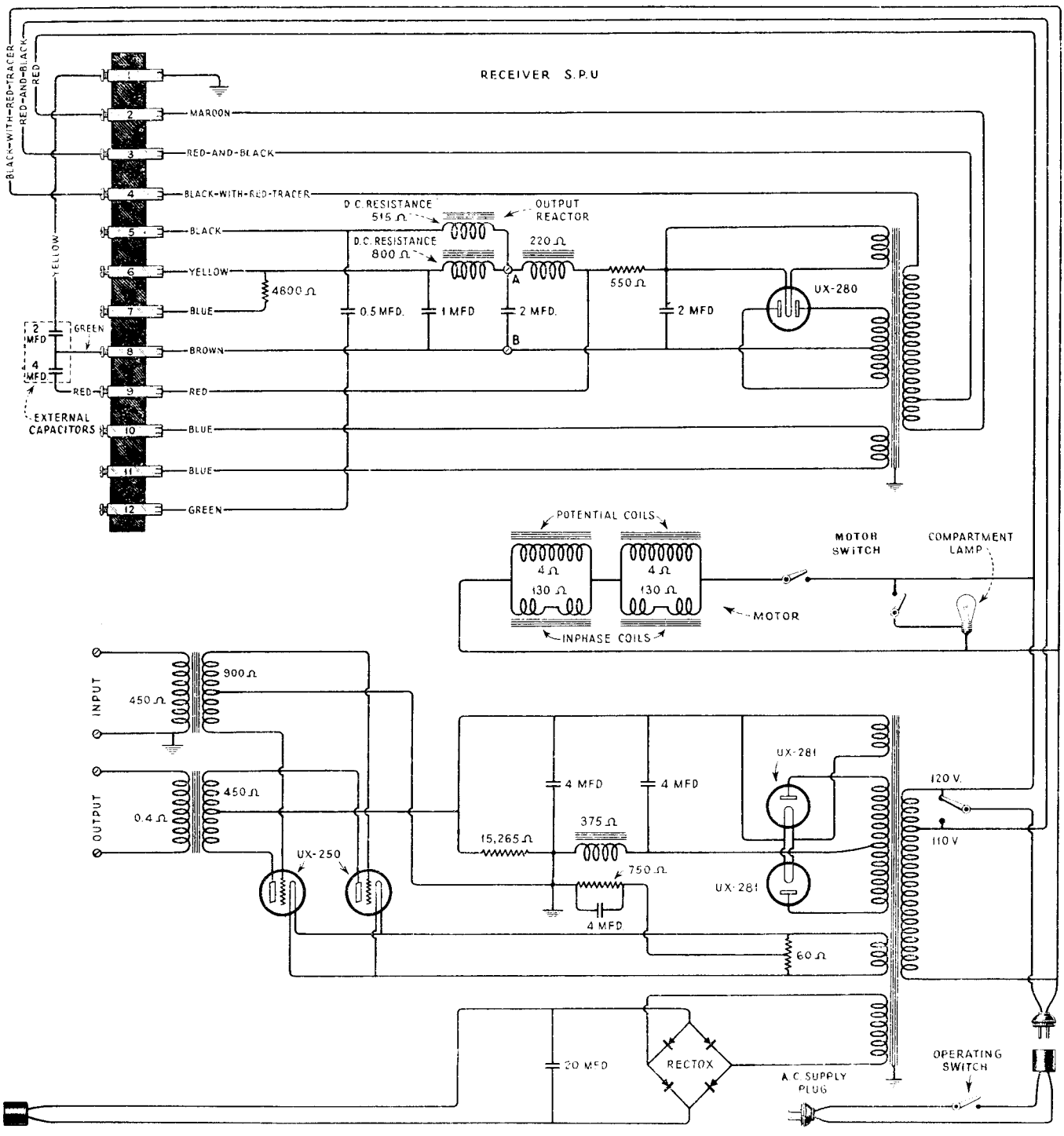
AUDITORIUM RADIOLA PHONOGRAPH



ARP

R. C. A. VICTOR, INC.

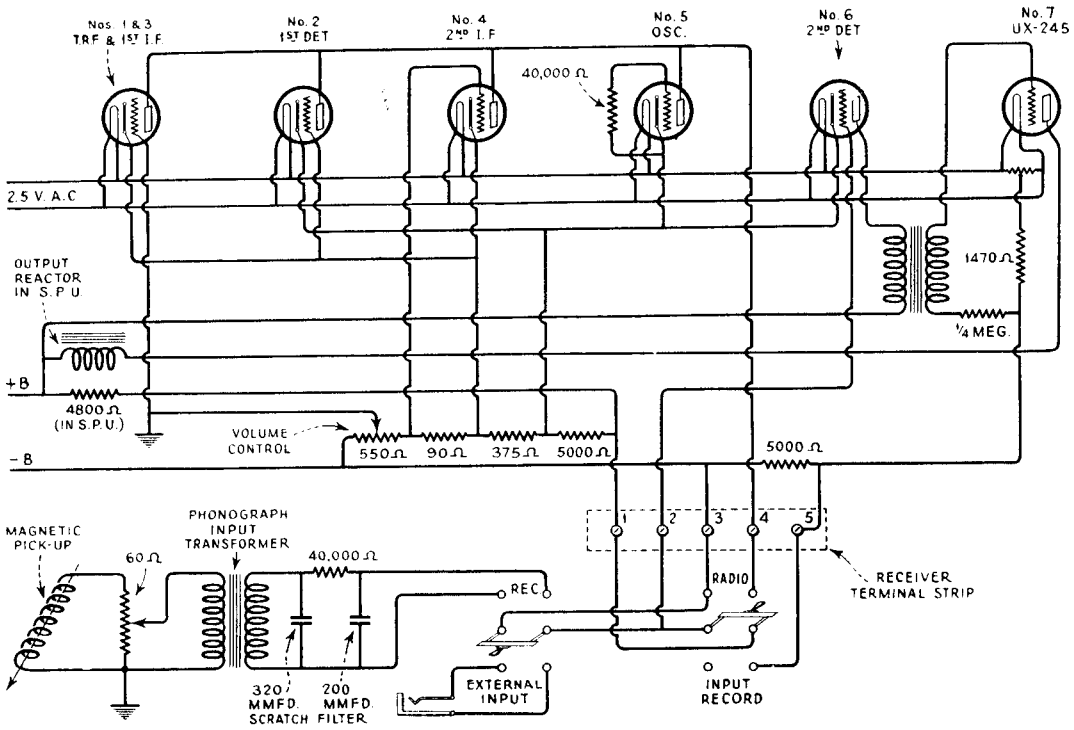
AUDITORIUM RADIOLA PHONOGRAPH



RECTIFIER PUSH-PULL AMPLIFIER UNIT

R. C. A. VICTOR, INC.

AUDITORIUM RADIOLA PHONOGRAPH



VOLTAGE READINGS AT RADIOTRON SOCKETS

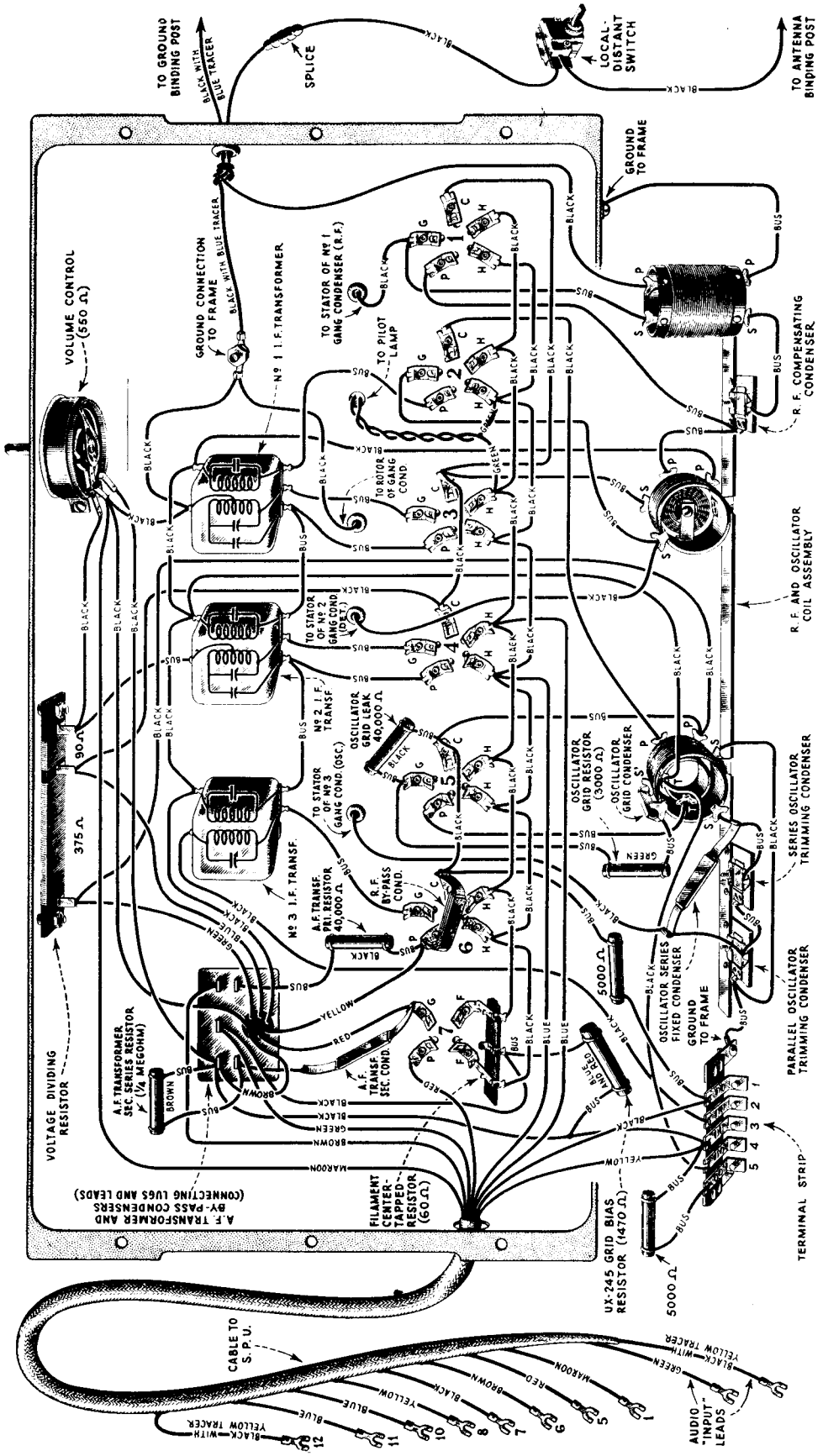
"Radio-Input-Record" Switch in Radio Position
Volume Control at Minimum

Socket No.	Cathode to Heater Volts	Cathode to Grid Volts	Cathode to Plate Volts	Plate Current Milamps	Filament or Heater Volts (rms.)
1 (RF)	−22	−20	100	0	2.3
2 (1st Det)	−13	− 8.5	90.	1.5	2.3
3 (1st IF)	−22	−20.	100.	0	2.3
4 (2nd IF)	−22	− 3.0	100.	7.0	2.3
5 (Osc)	−13	0	85.	8.2	2.3
6 (2nd Det)	−13	−29.	230.	0.5	2.3
UX-245	-	−14.*	225.	30.	2.4
UX-250's	-	−72.	420.	55.	7.2
Volume Control at Maximum					
1 (RF)	−20	− 3.0	78.	4.5	2.3
2 (1st Det)	−12	− 6.5	74.	1.3	2.3
3 (1st IF)	−20	− 3.0	78.	5.0	2.3
4 (2nd IF)	−20	− 3.0	78.	4.5	2.3
5 (Osc)	−12	0	70.	6.5	2.3
6 (2nd Det)	−12	−28.	225.	0.5	2.3
UX-245	-	−13.*	220.	29.5	2.4
UX-250's	-	−72.	420.	55.	7.2
Radio-Input-Record Switch in Record Position					
No. 6	−20	−12	218.	5.0	2.3
UX-250	-	−73	425.	55.	7.2

* The actual bias on the UX-245 Radiotron is approximately −40 volts. The low reading is caused by the one-quarter megohm resistor in series with the voltmeter.

R. C. A. VICTOR, INC.

AUDITORIUM RADIOLA PHONOGRAPH



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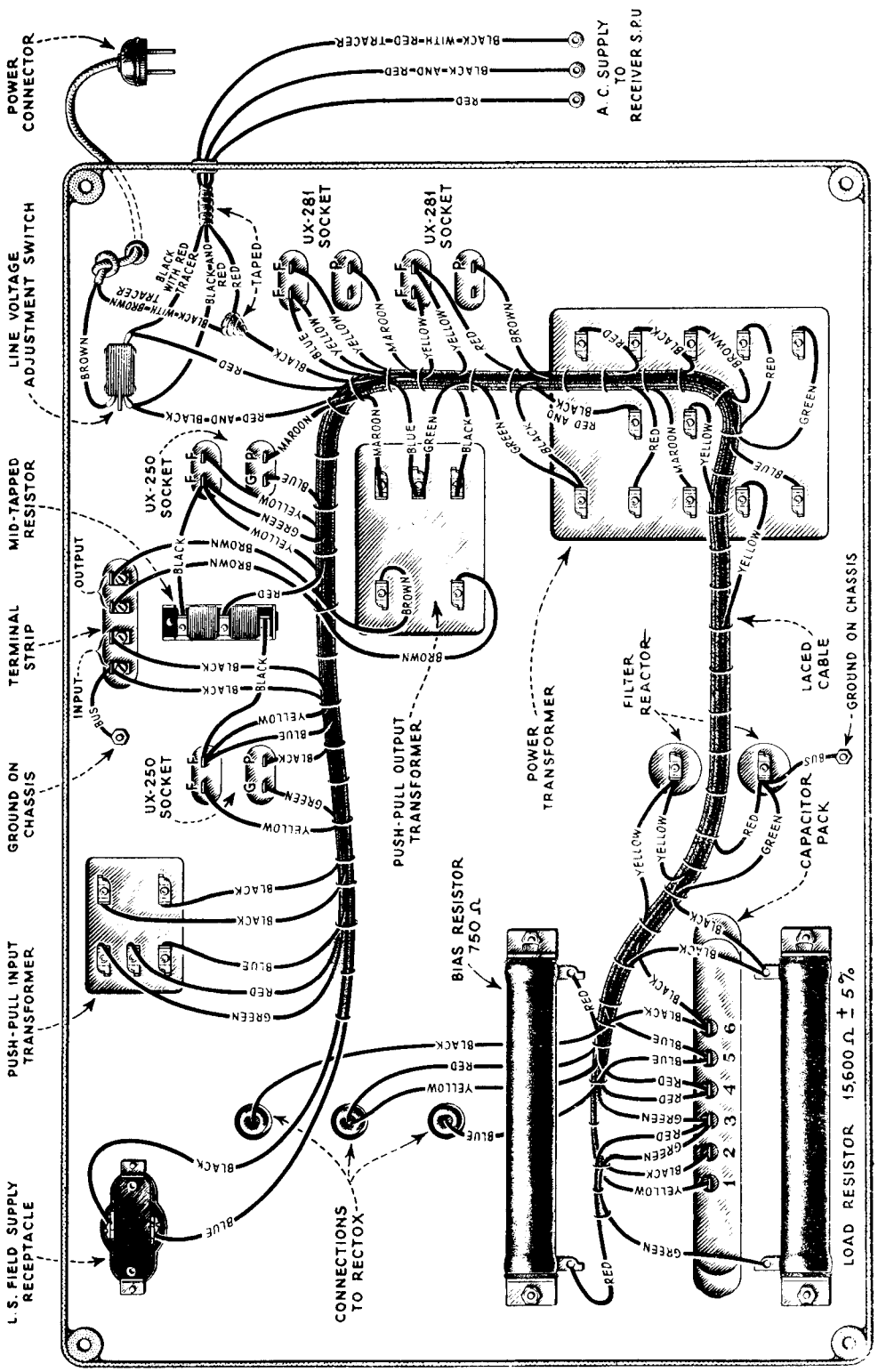

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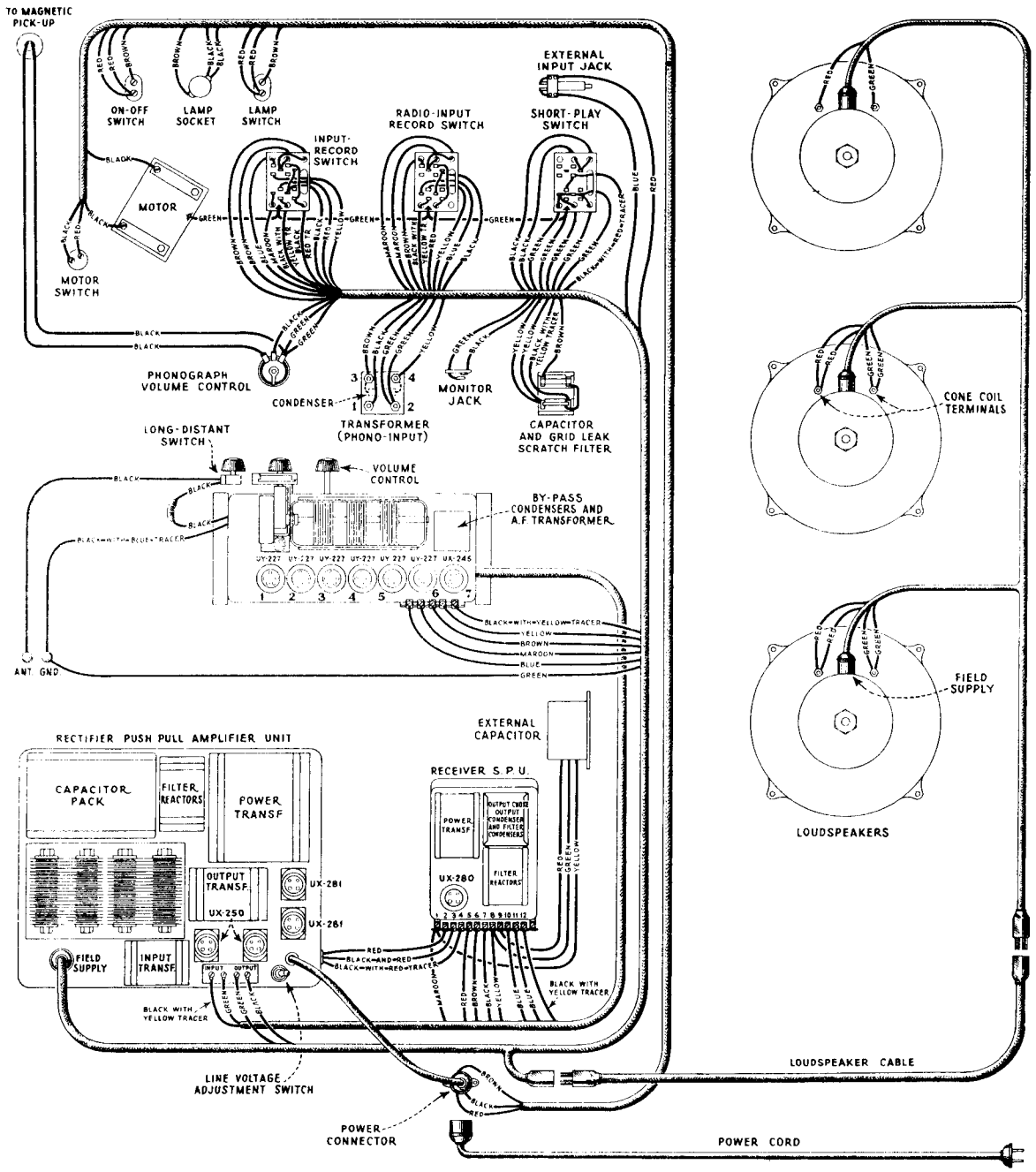

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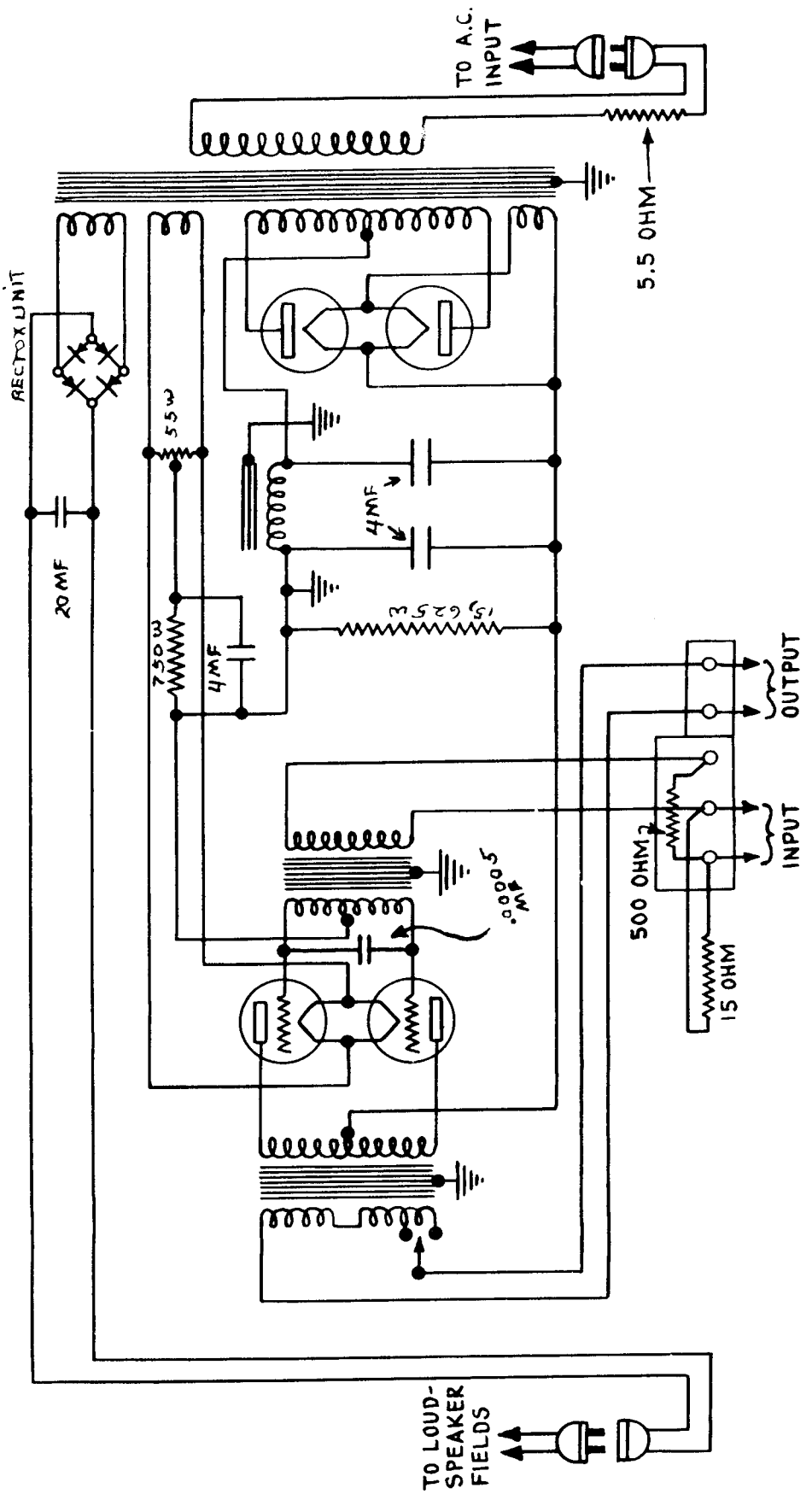
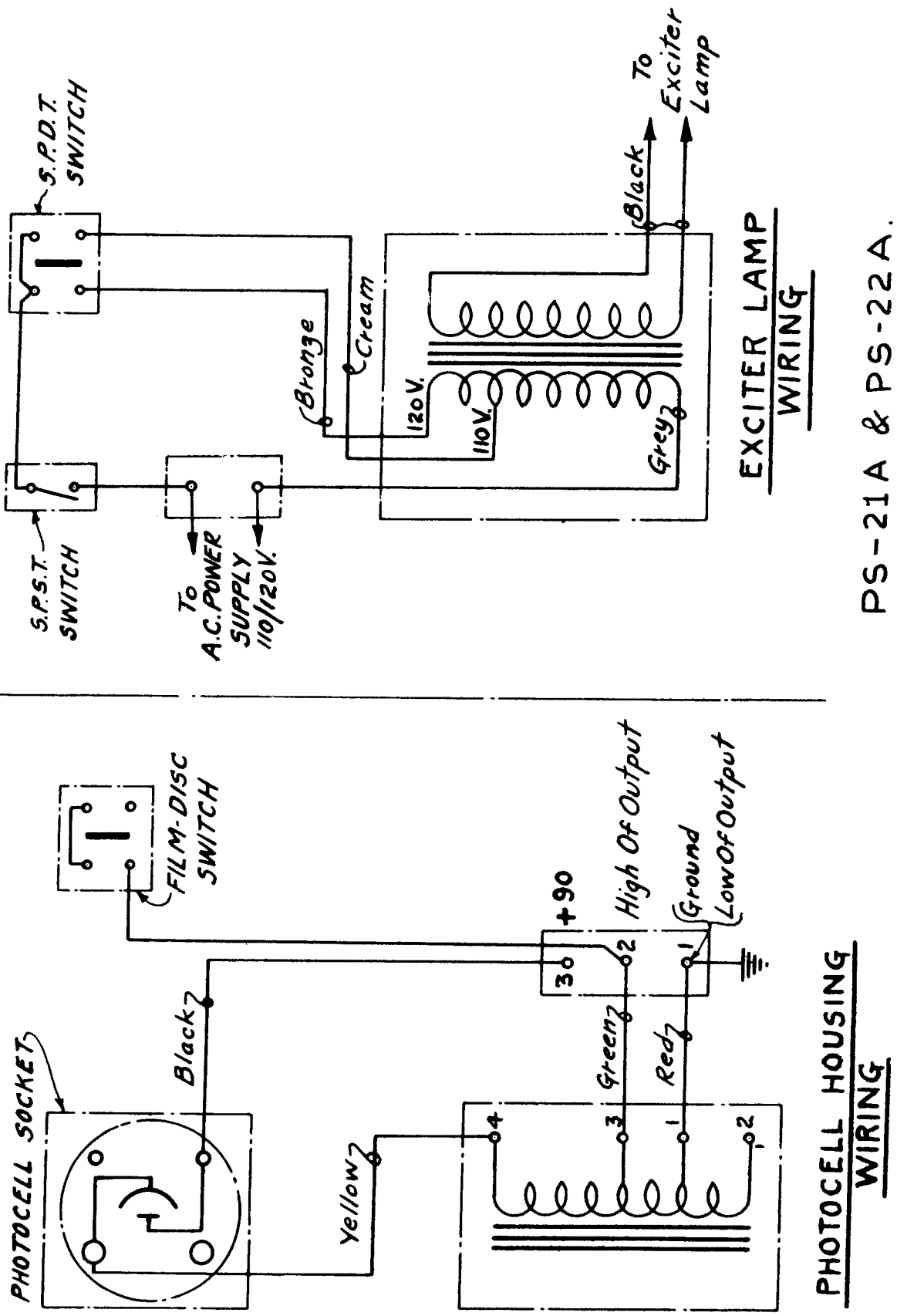
RCA.-PHOTOPHONE, INC.

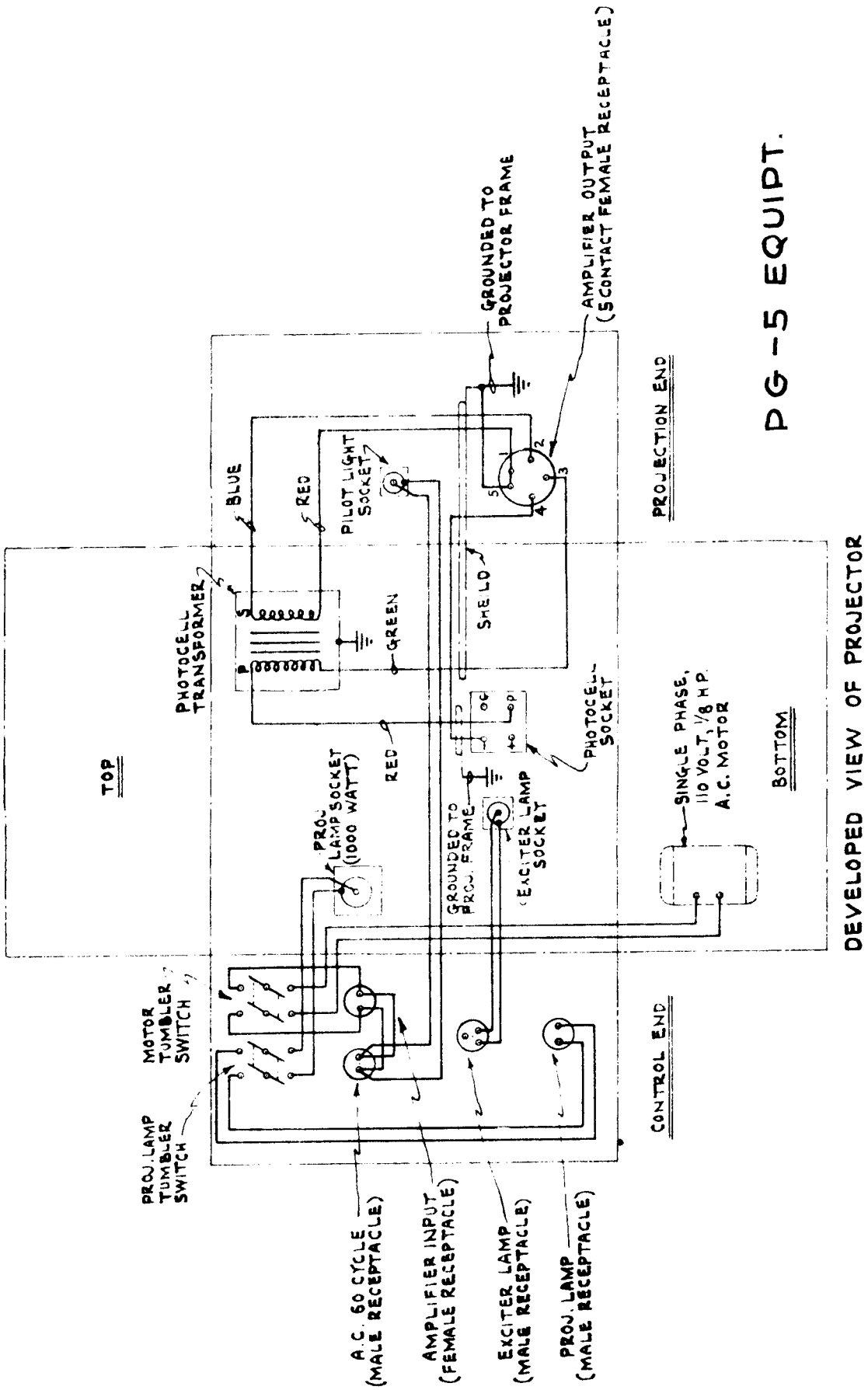


RCA.-PHOTOPHONE, INC.



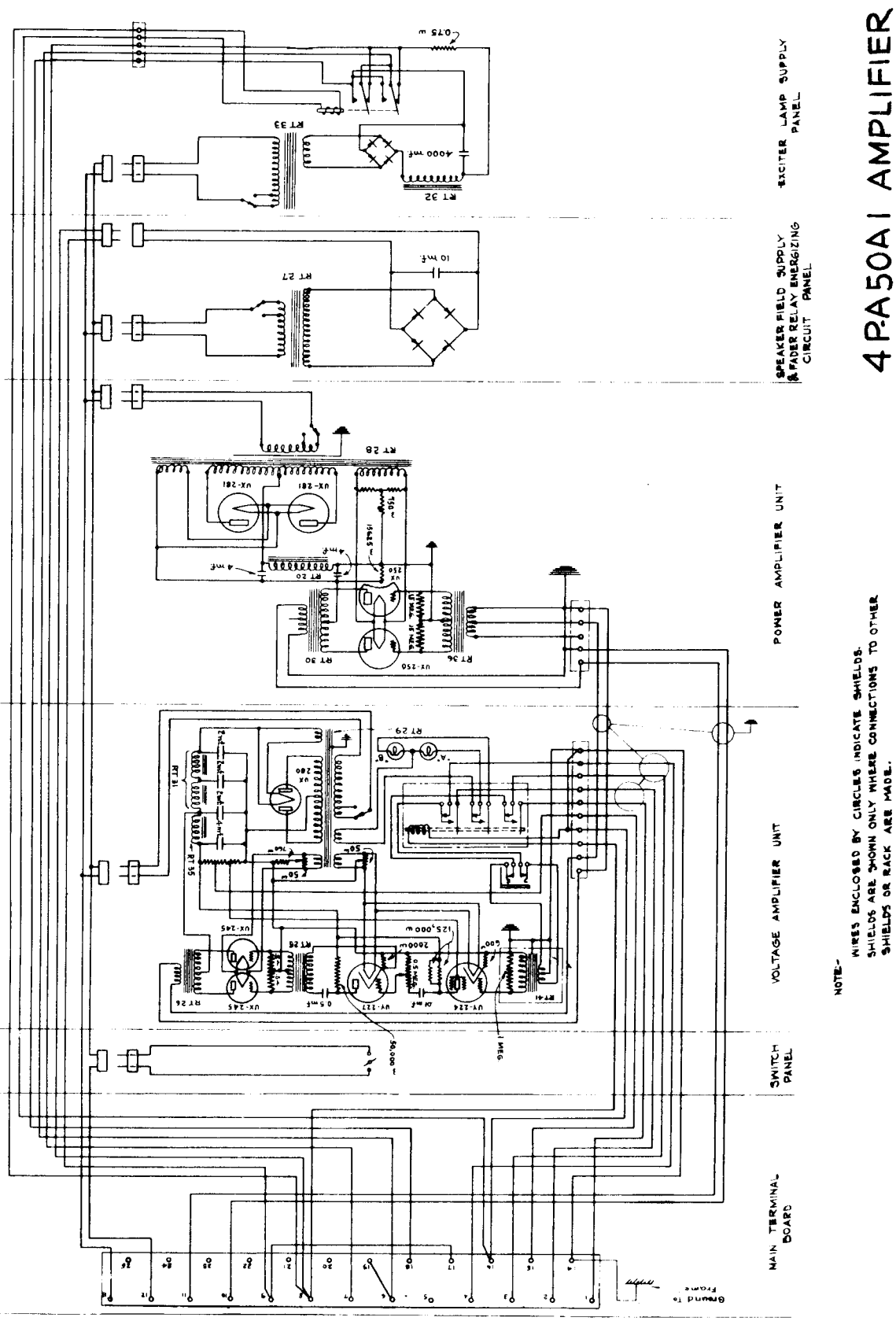
RCA.-PHOTOPHONE, INC.

PG-5 EQUIPT.

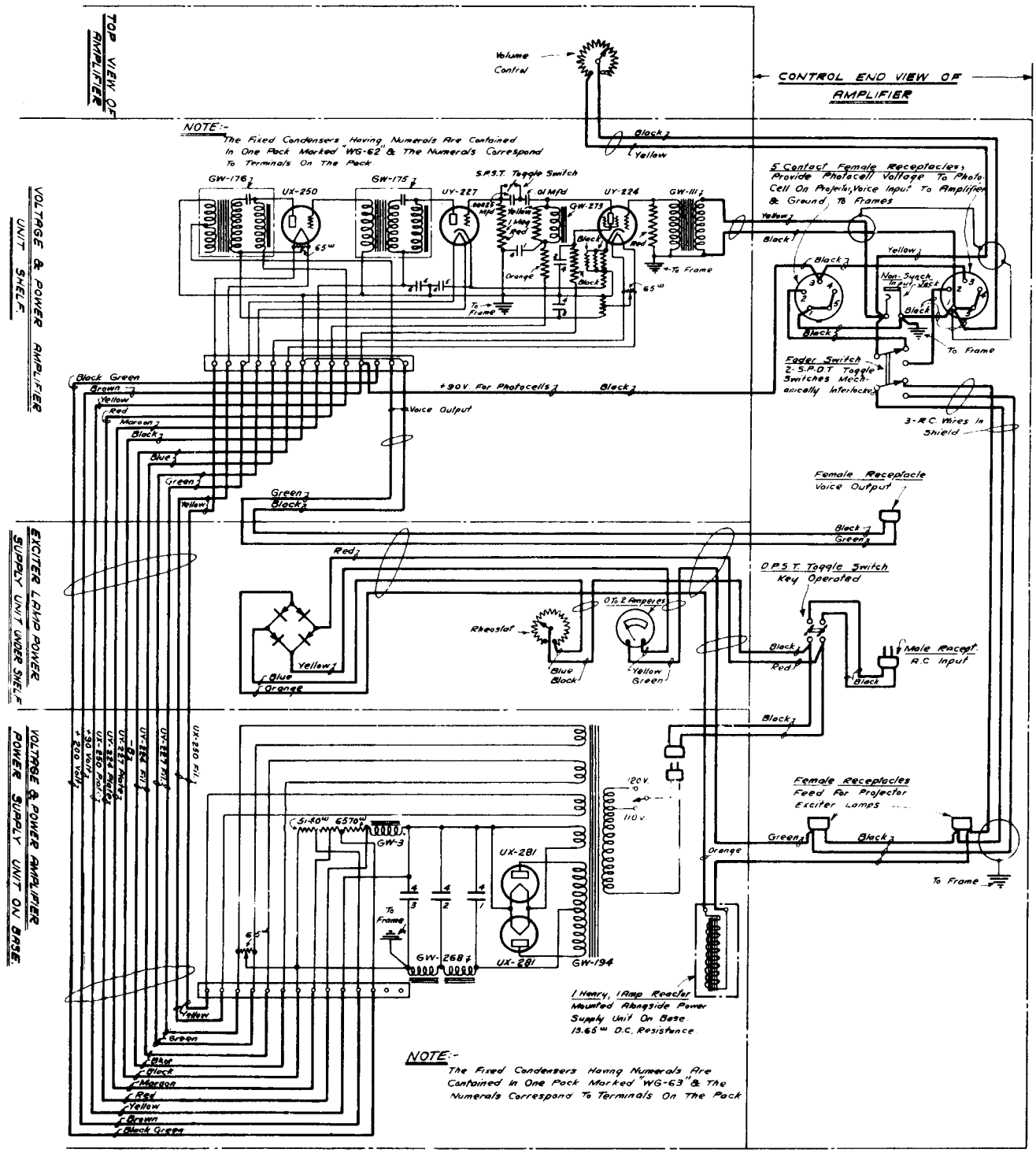


DEVELOPED VIEW OF PROJECTOR

RCA.-PHOTOPHONE, INC.



RCA.-PHOTOPHONE, INC.

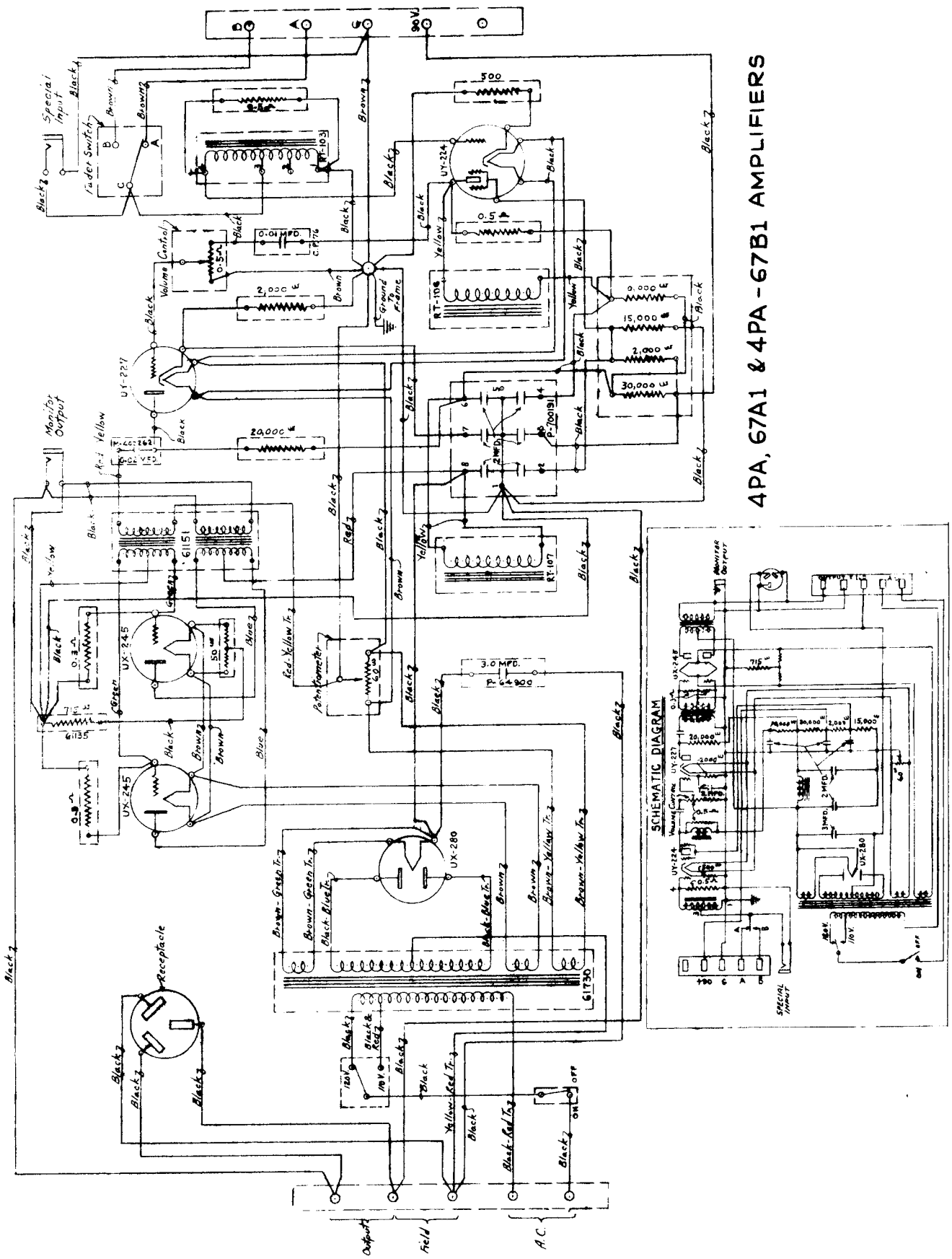


FRONT, PLAN, DEVELOPED VIEW.

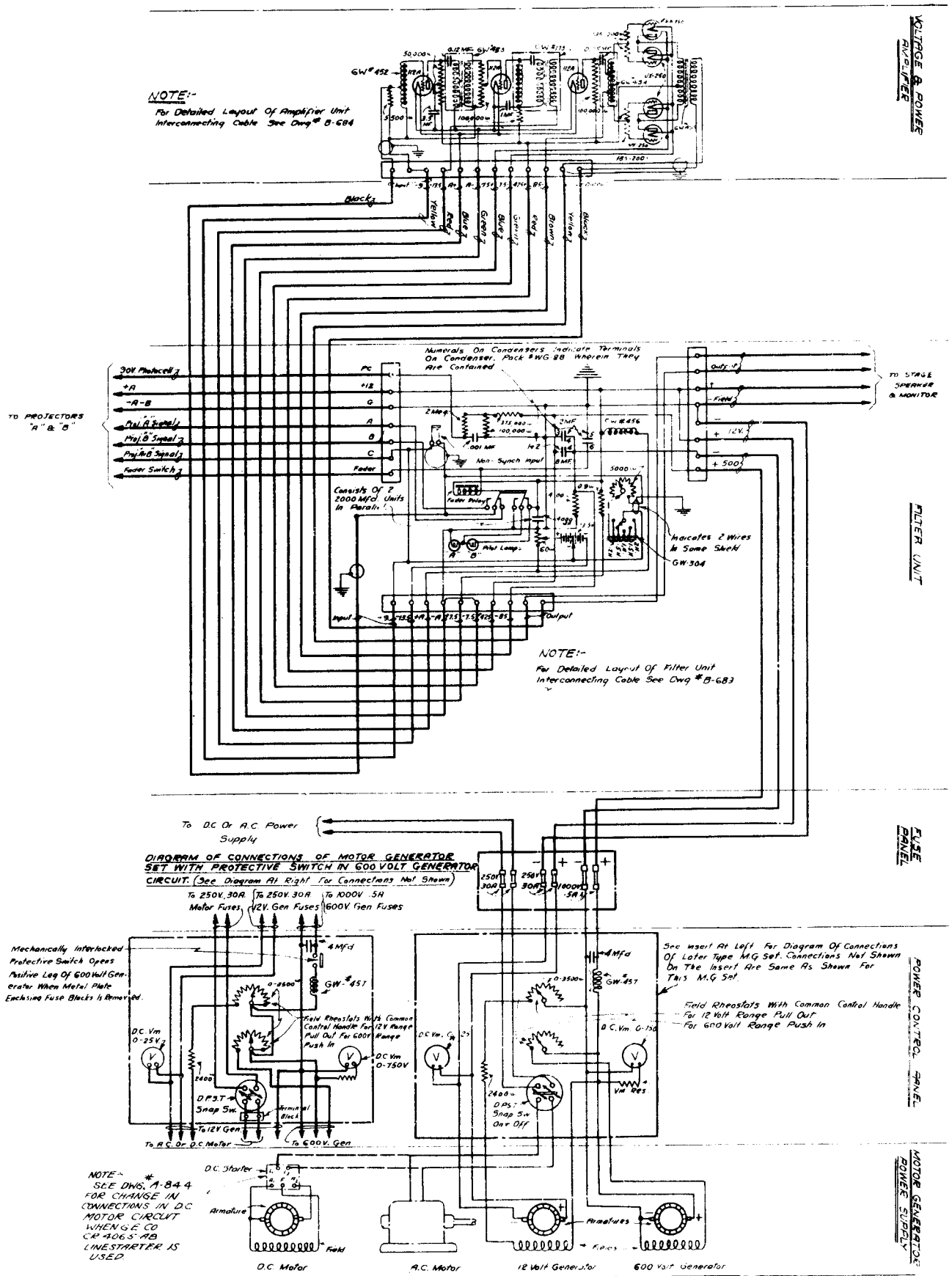
PG-5

RCA.-PHOTOPHONE, INC.

4PA, 67A1 & 4PA-67B1 AMPLIFIERS

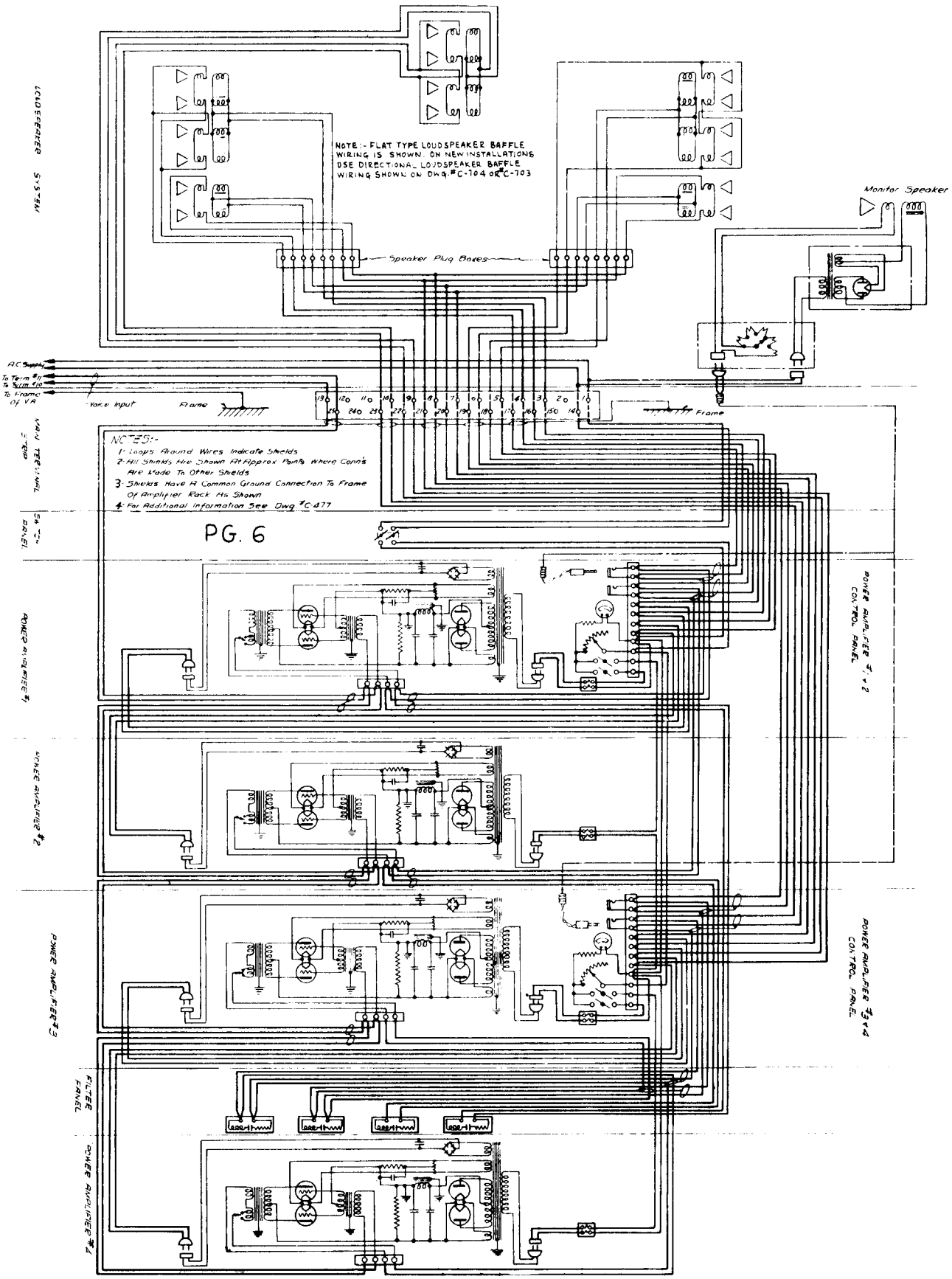


RCA.-PHOTOPHONE, INC.



PG-13

RCA.-PHOTOPHONE, INC.



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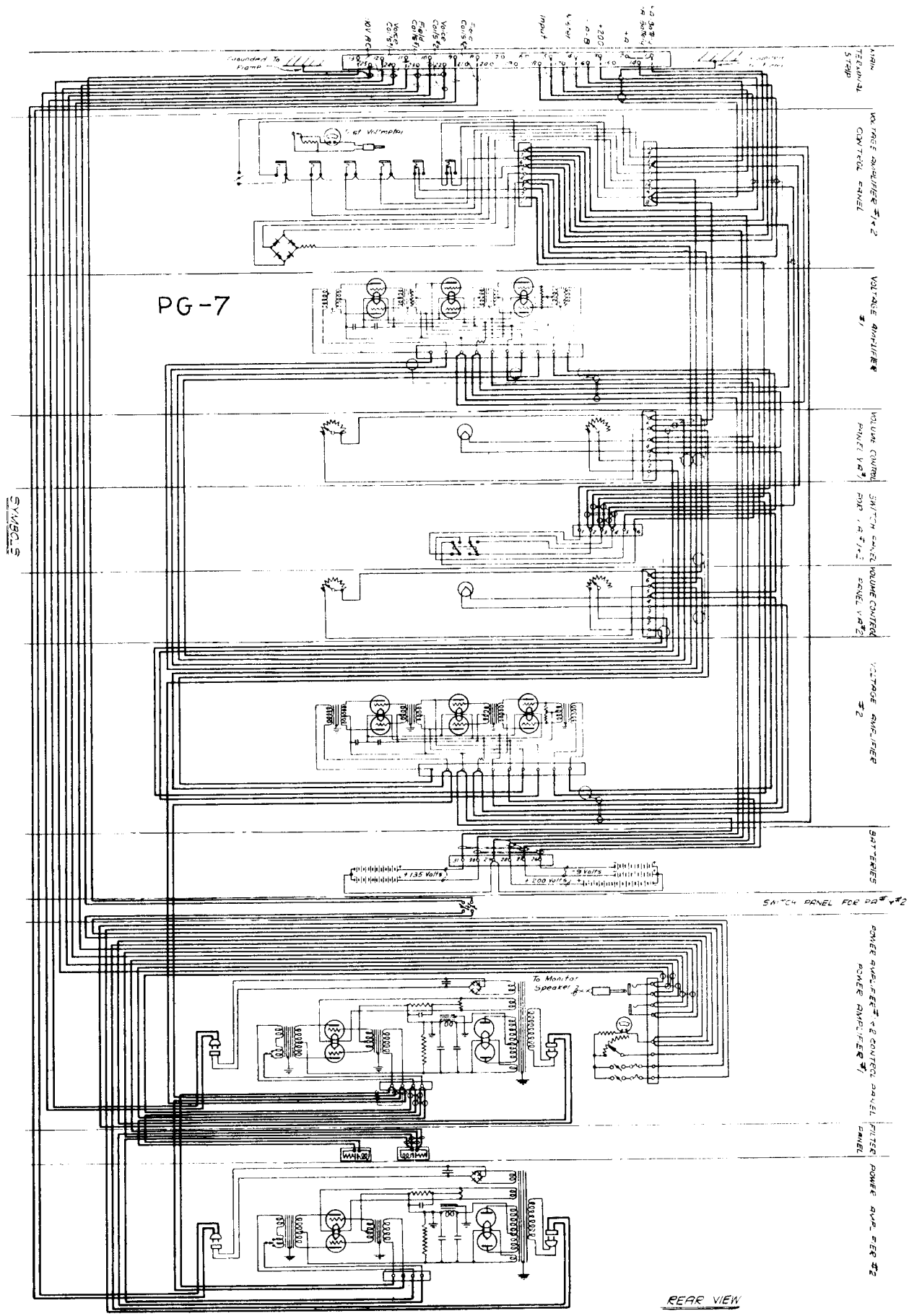

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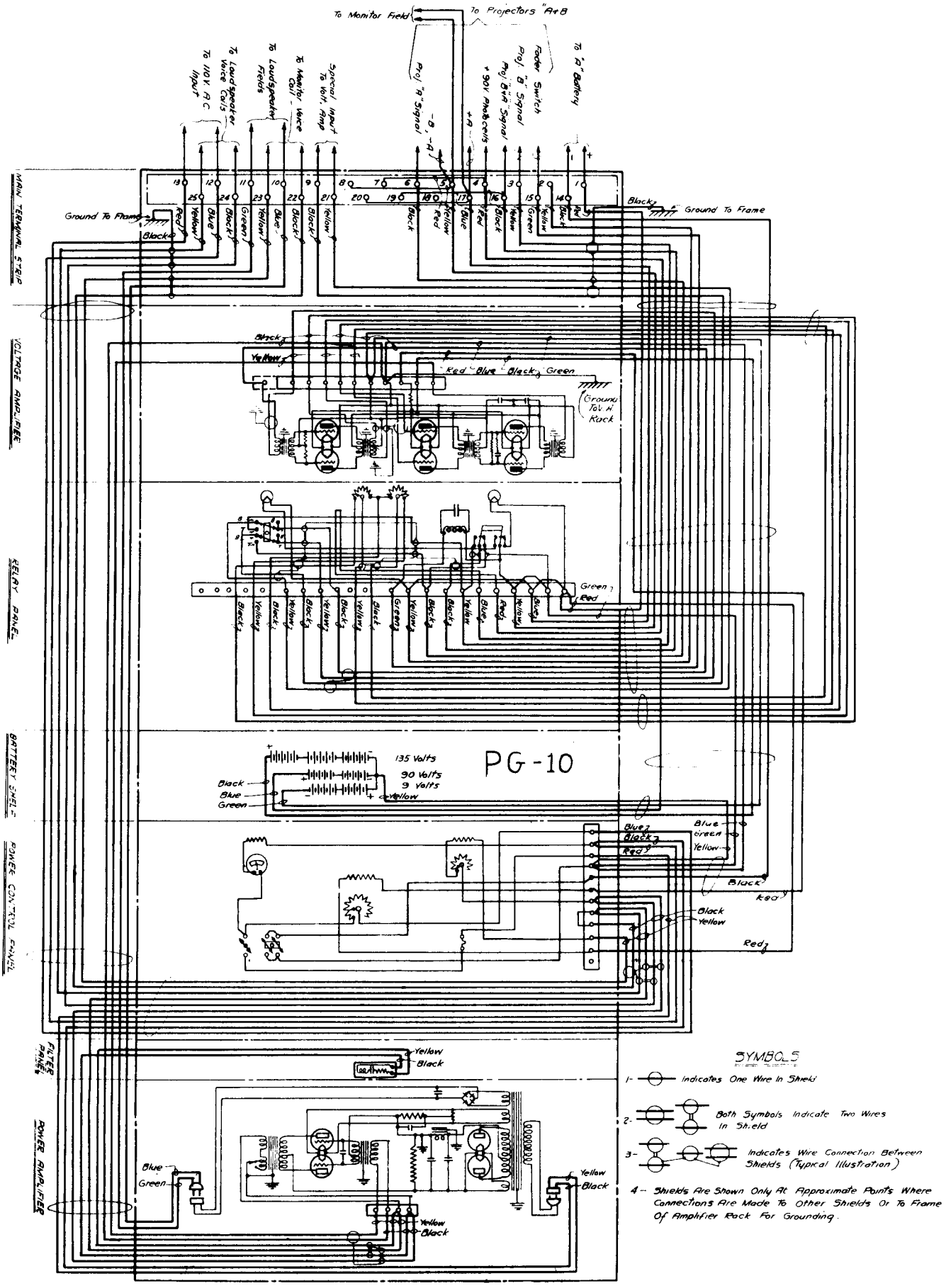
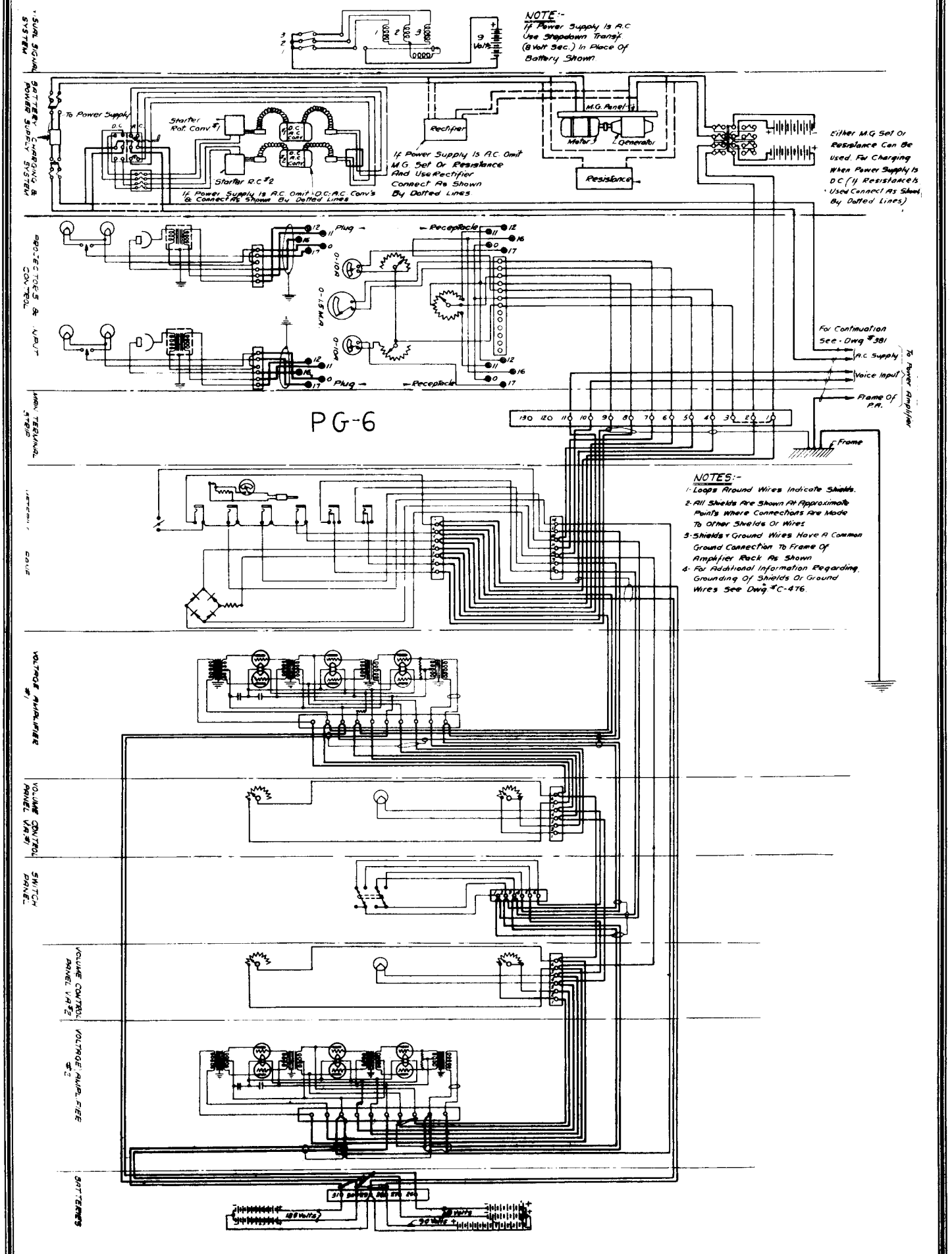
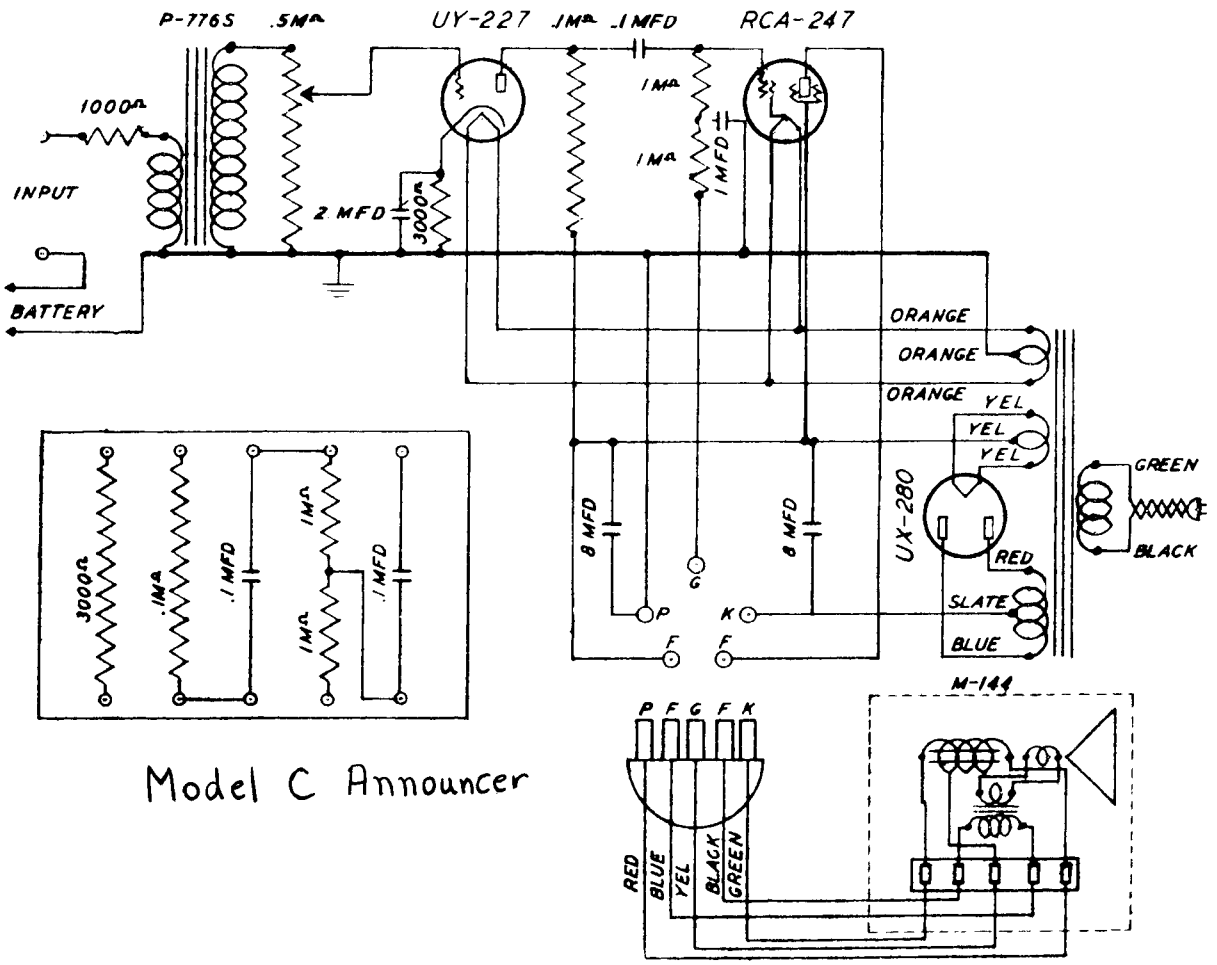


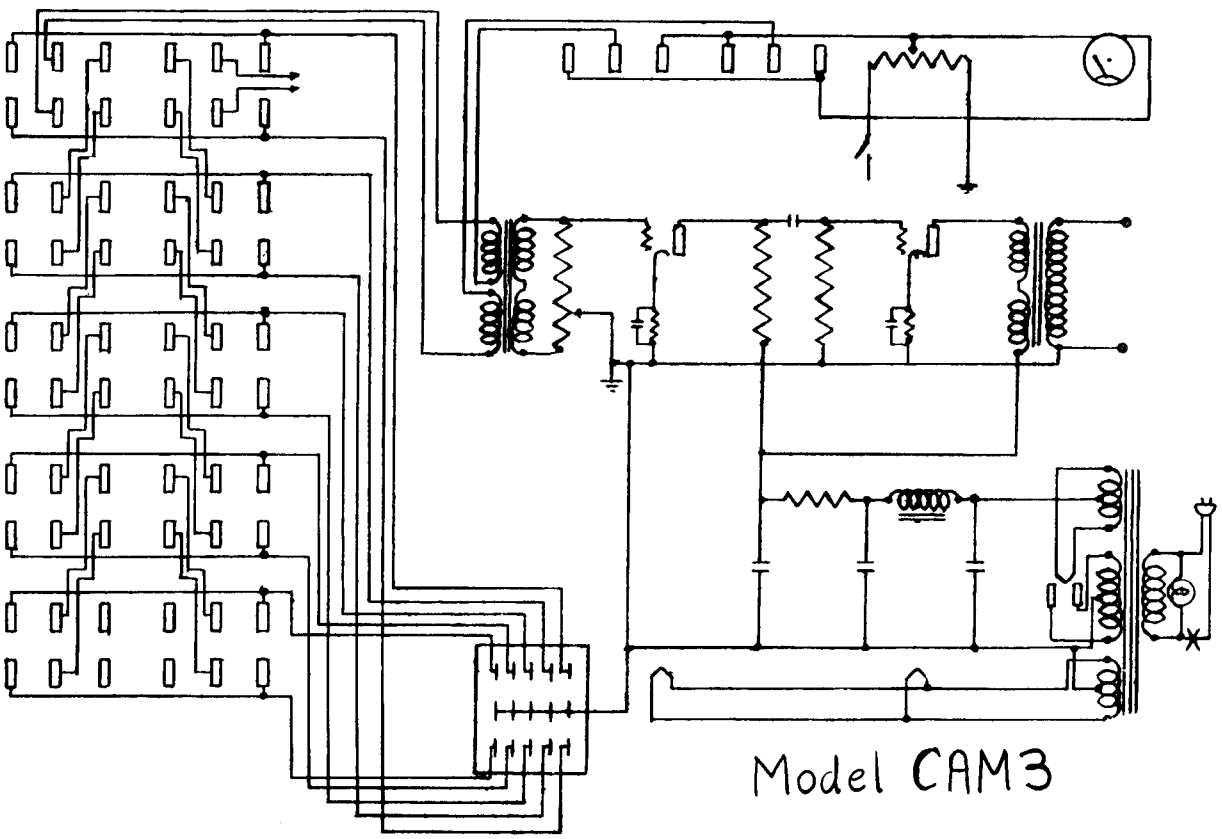
RCA.-PHOTOPHONE, INC.



RADIO RECEPTOR, INC.

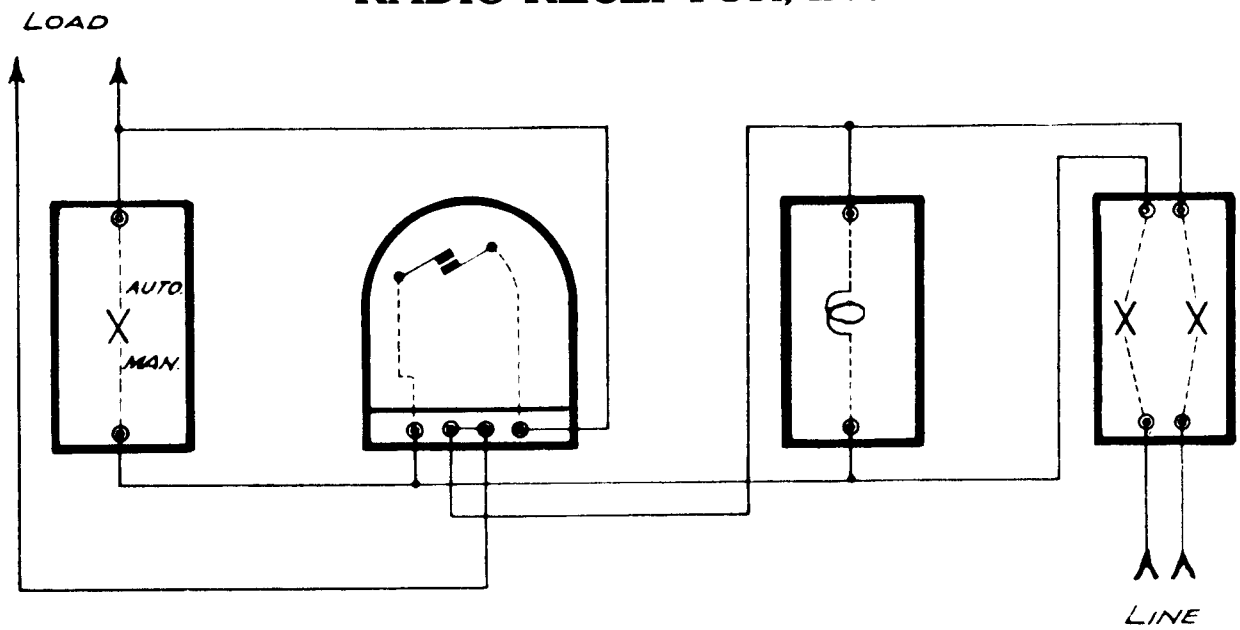


Model C Announcer



Model CAM3

RADIO RECEPTOR, INC.



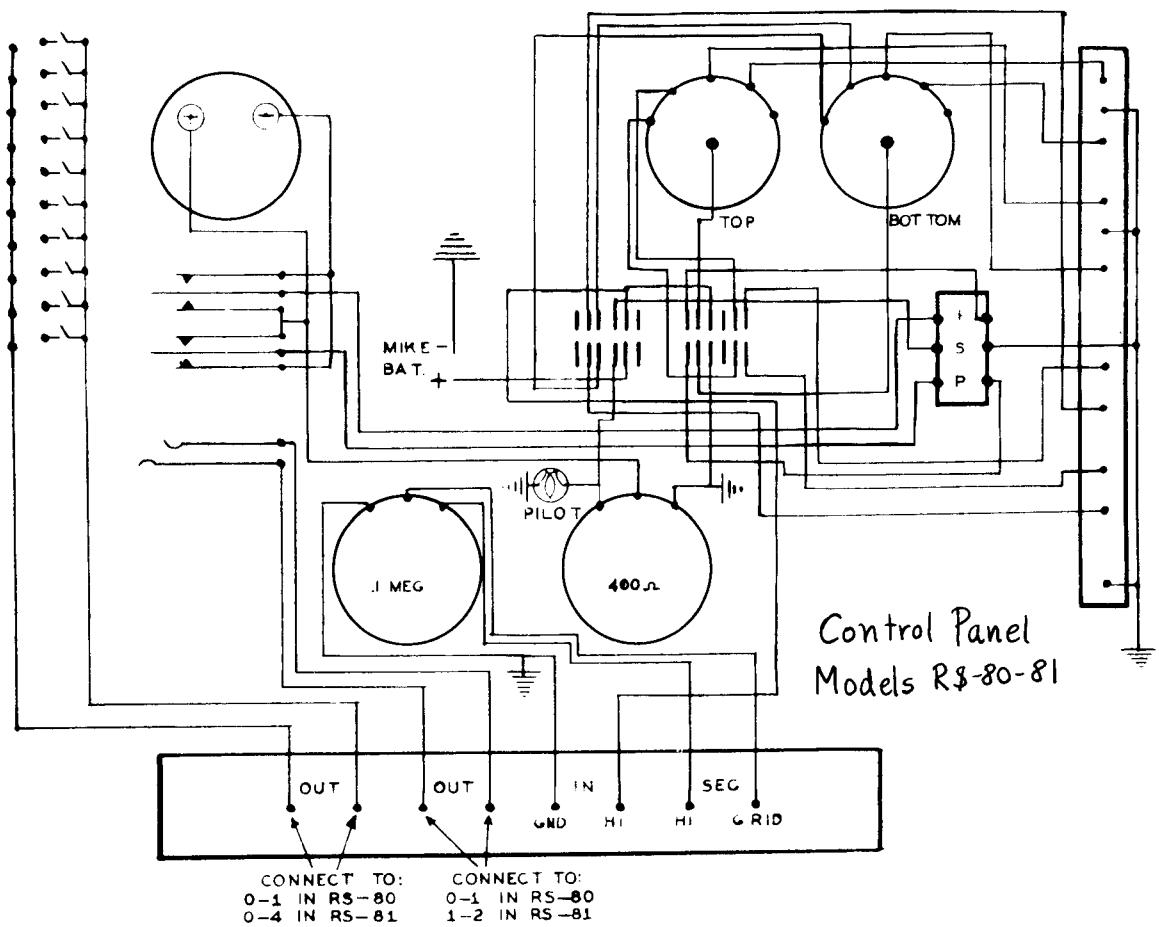
AUTOMATIC OR MANUAL OPERATION.

AUTOMATIC TIME SWITCH.

MAIN PILOT AND SWITCH.

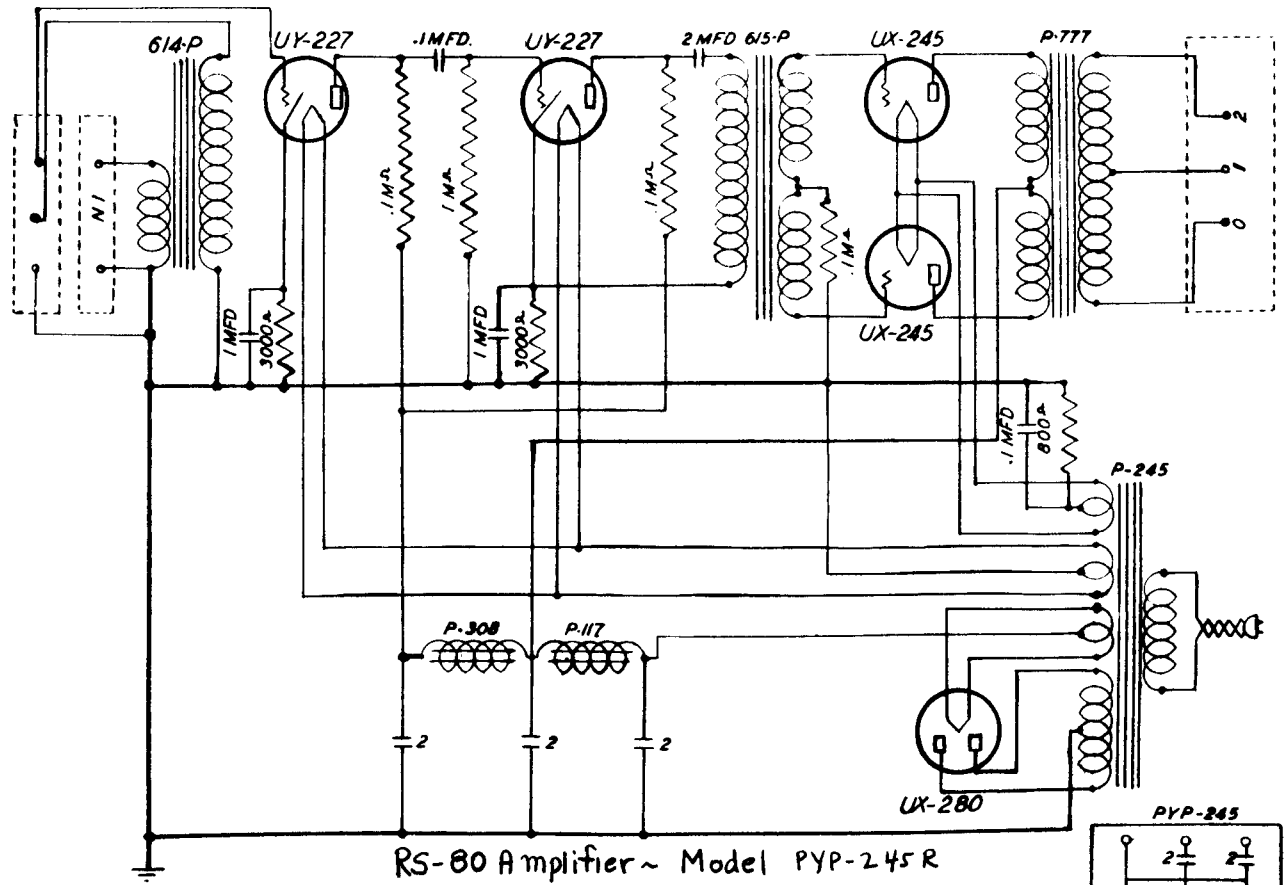
Time Clock Control Panel

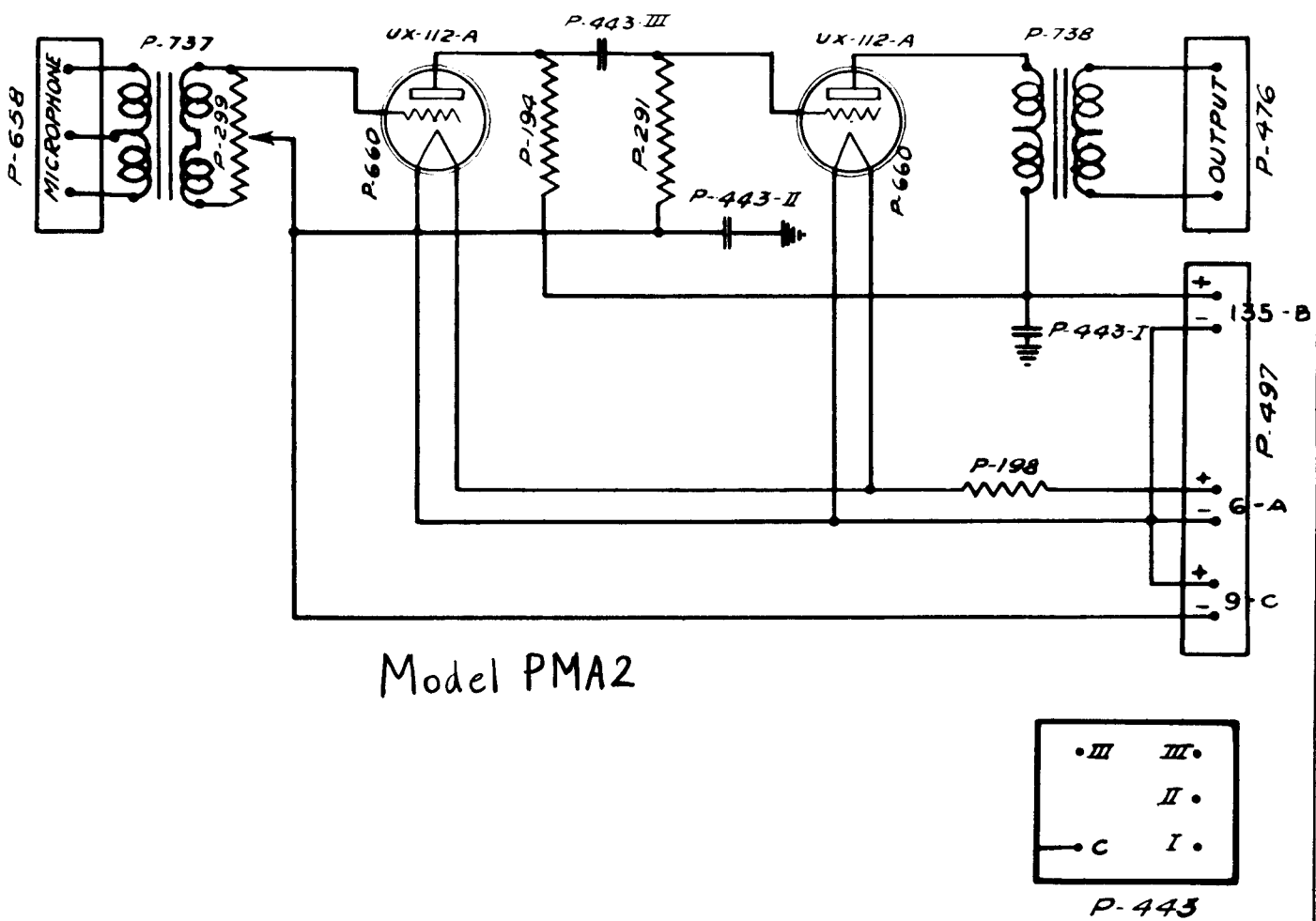
REAR VIEW.



Control Panel
Models RS-80-81

RADIO RECEPTOR, INC.





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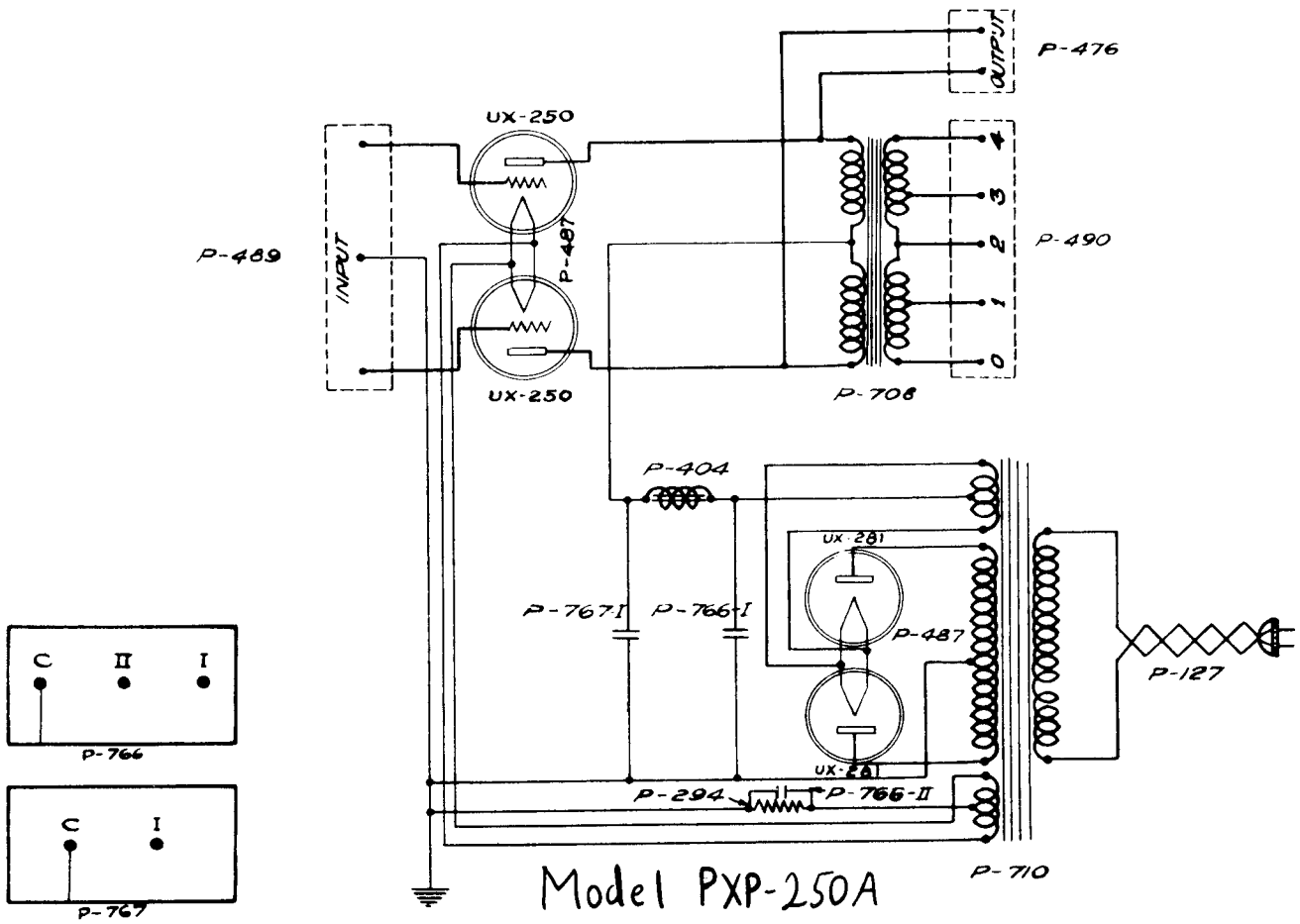
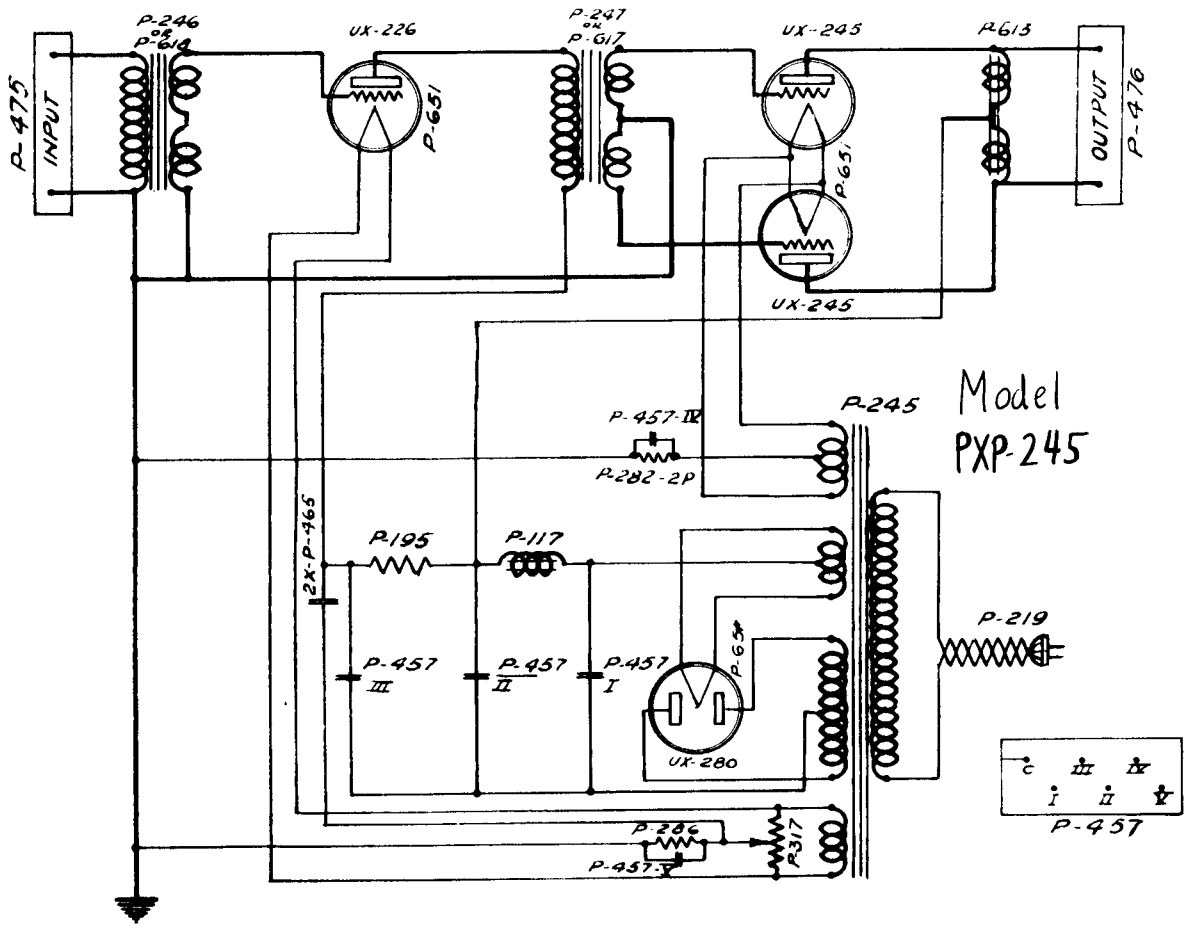
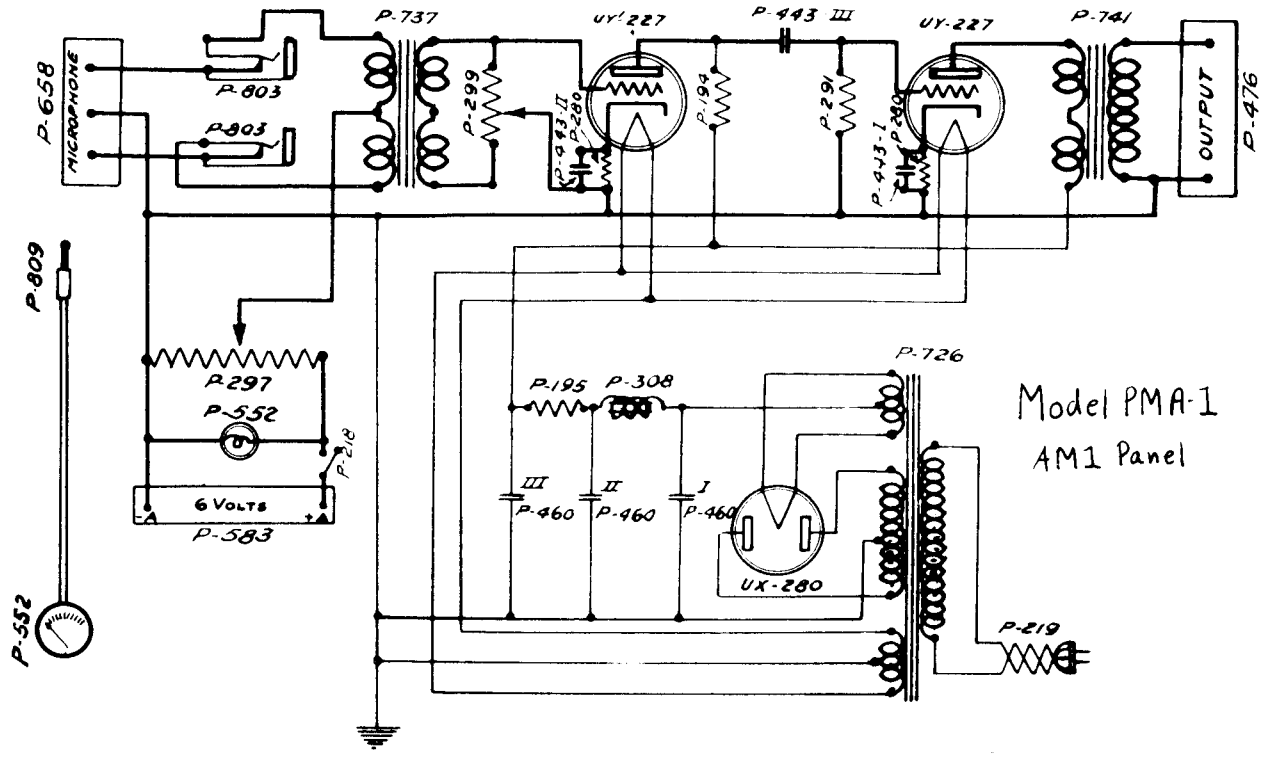
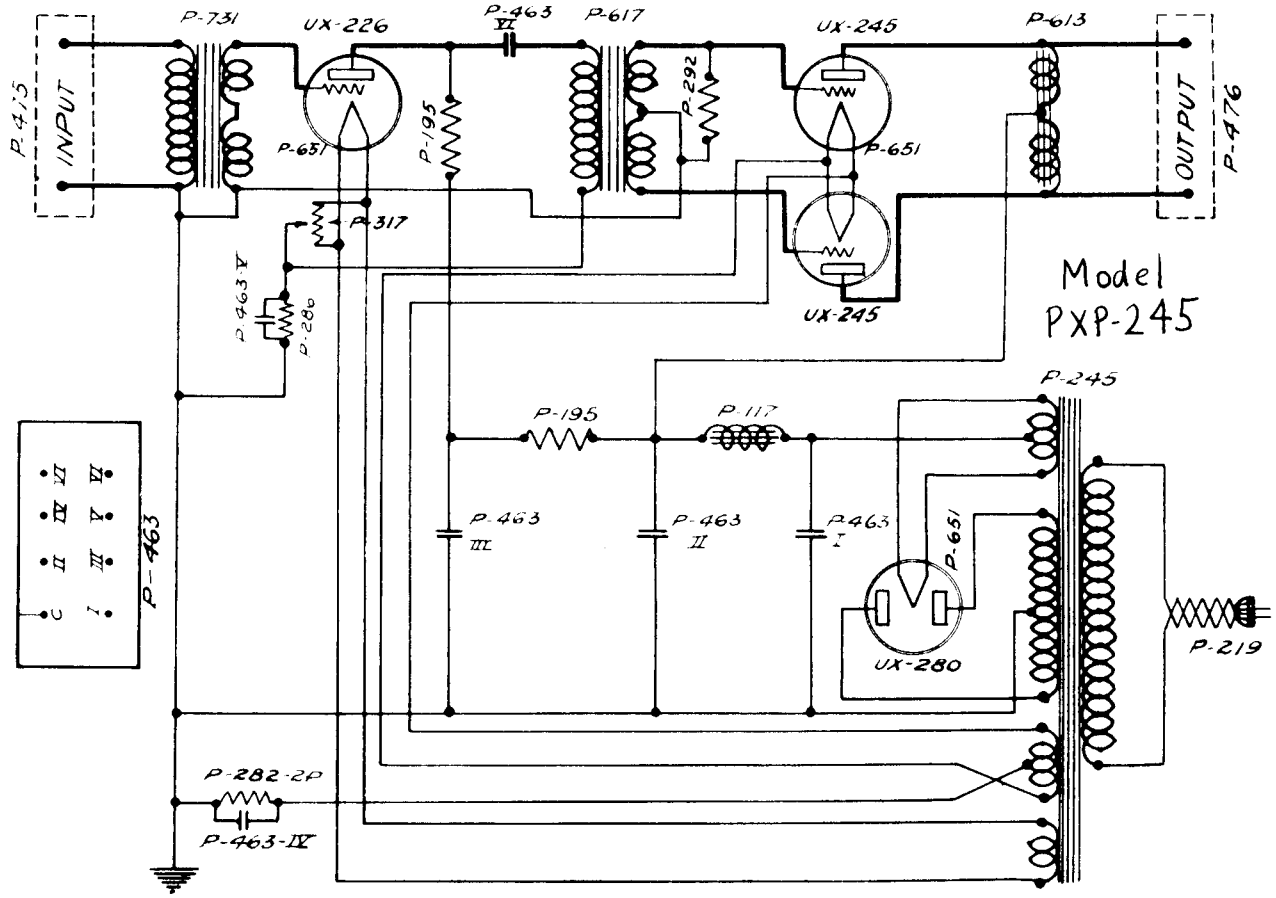




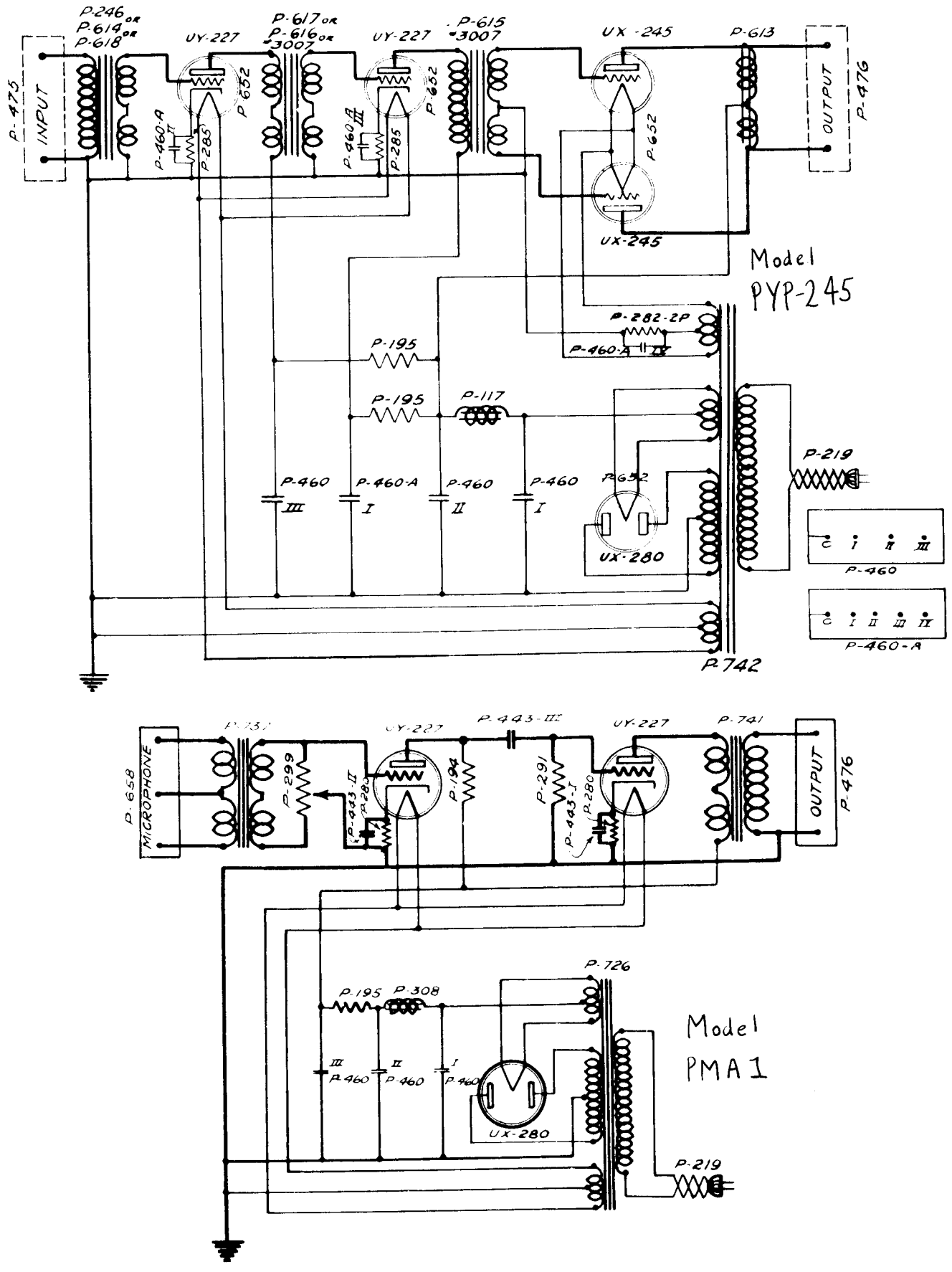
RADIO RECEPTOR, INC.



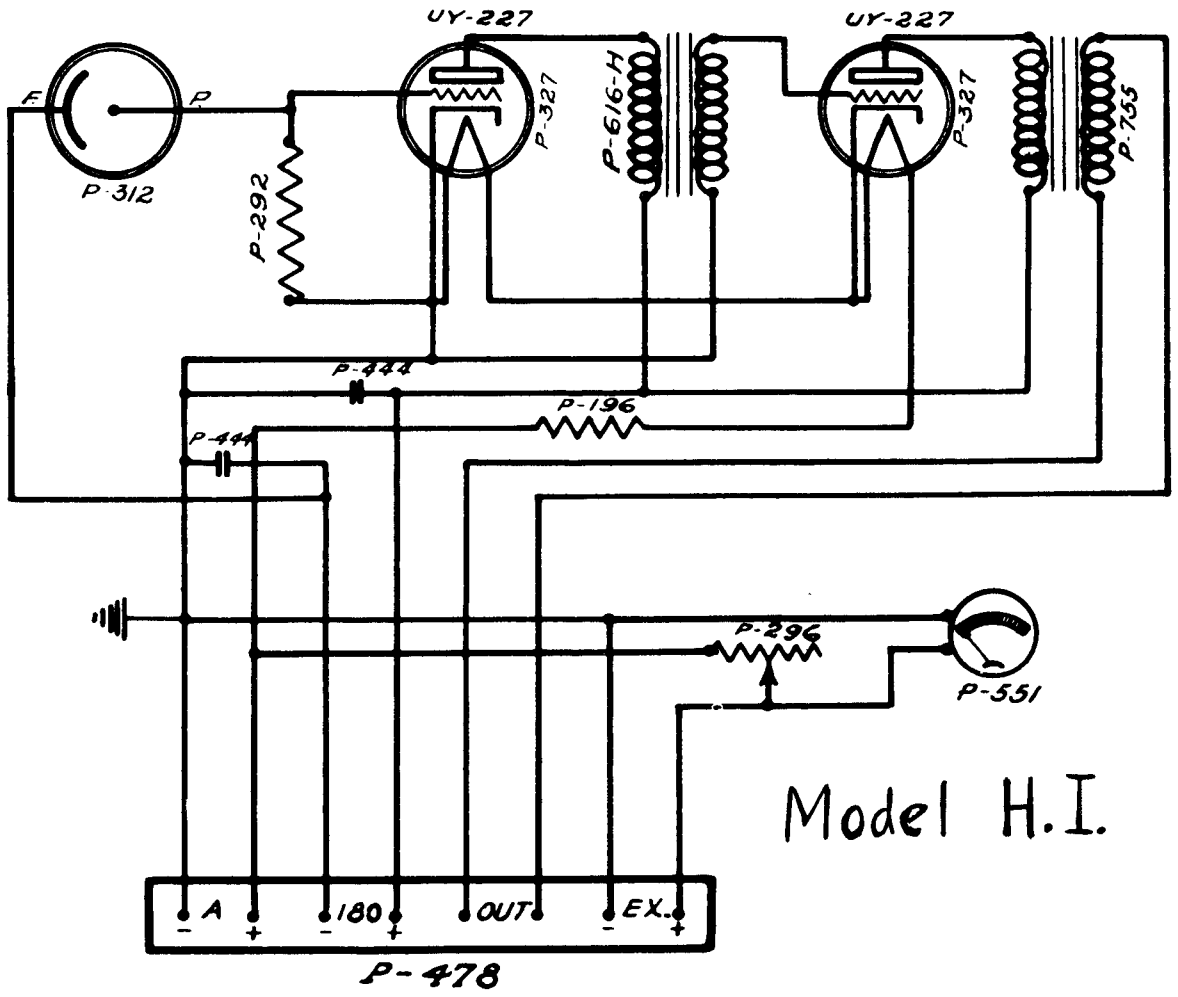
SOCKET PANEL P-491-A ENGRAVED.
SOCKET PANEL P-491-B SOCKET CONTACTS.



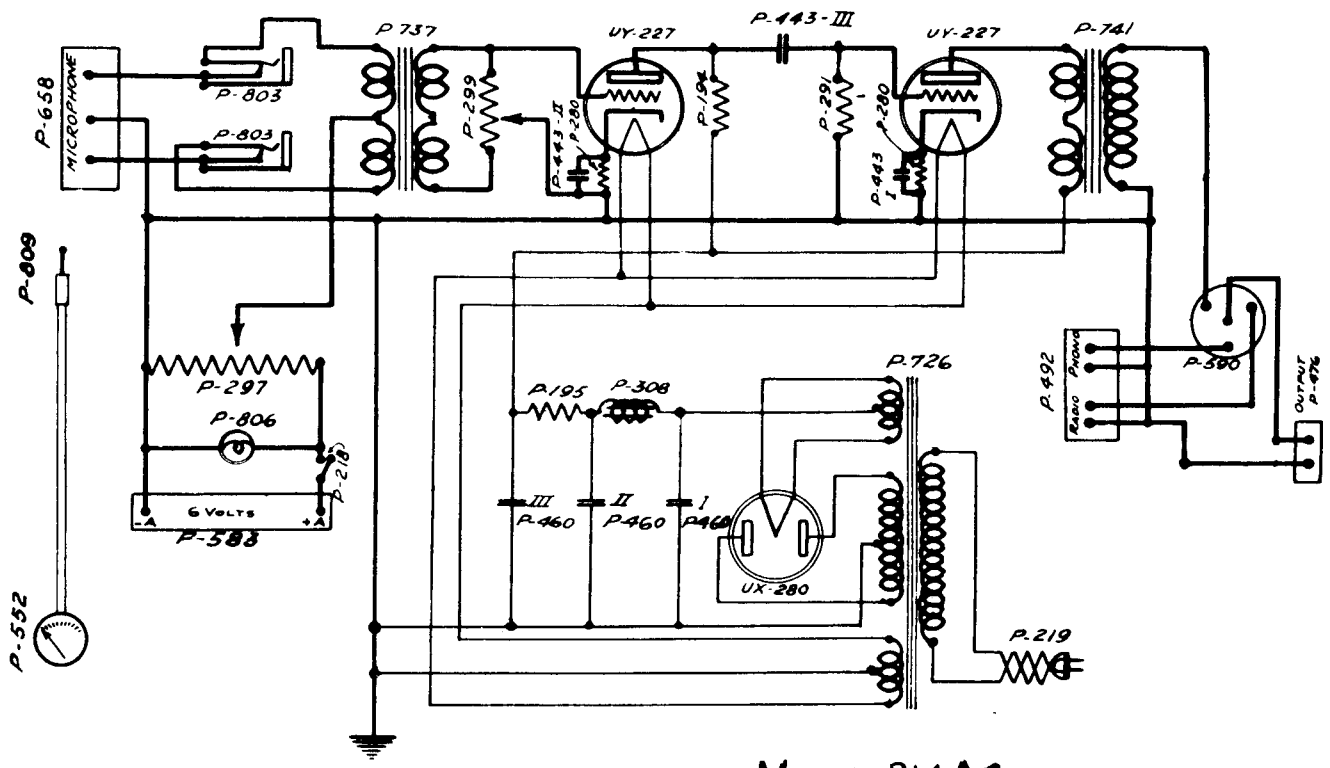
RADIO RECEPTOR. INC.



RADIO RECEPTOR, INC.

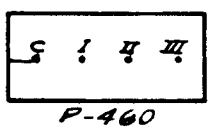


Model H.I.

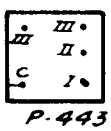


Model PMA1

AX-2 Panel



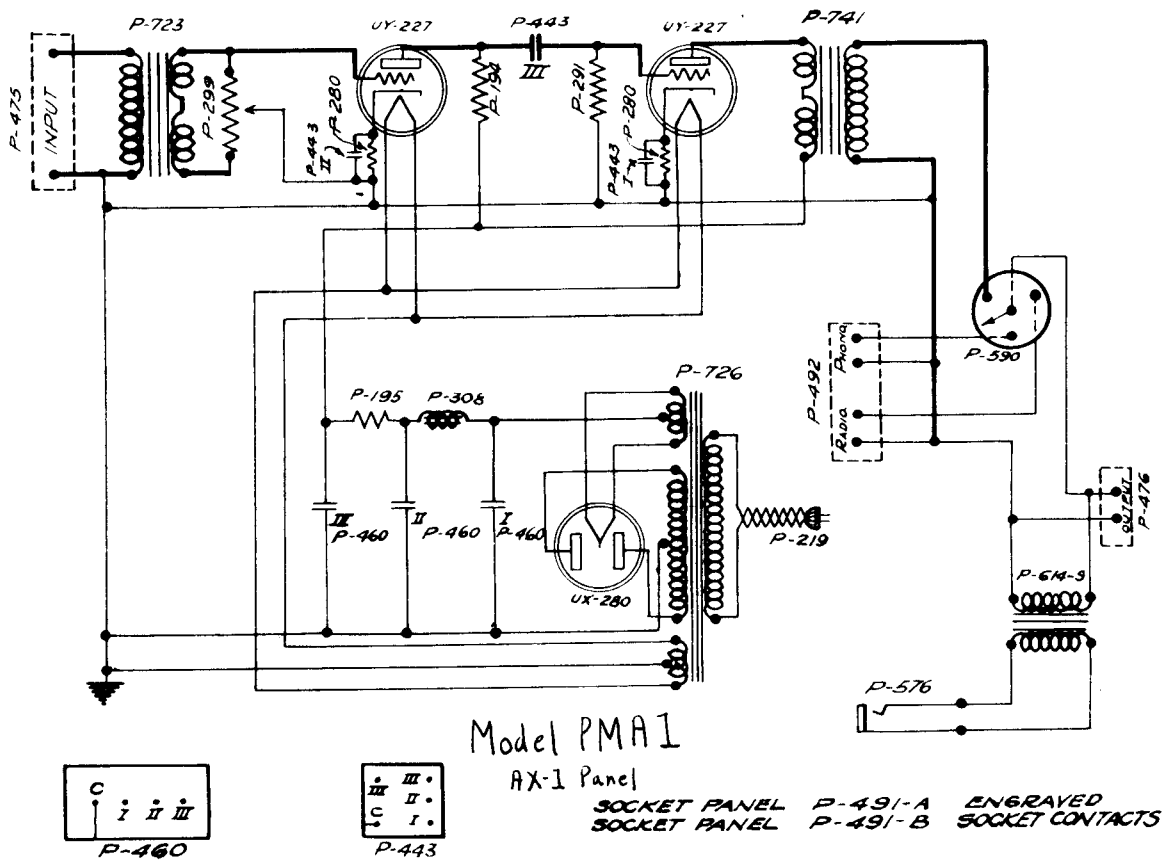
P-460



P-443

SOCKET PANEL P-491-A - ENGRAVED
SOCKET PANEL P-491-B - SOCKET CONTACTS

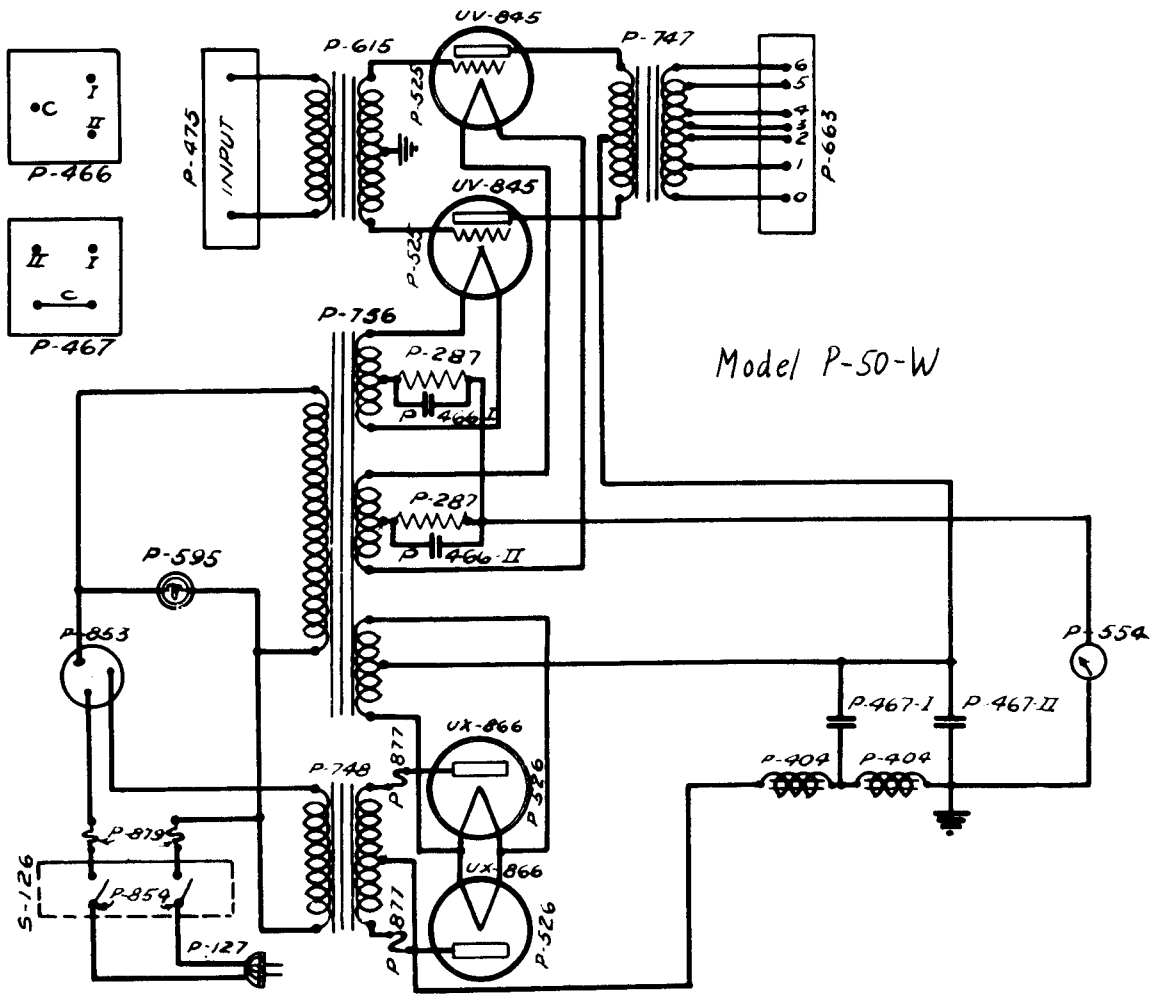
RADIO RECEPTOR, INC.



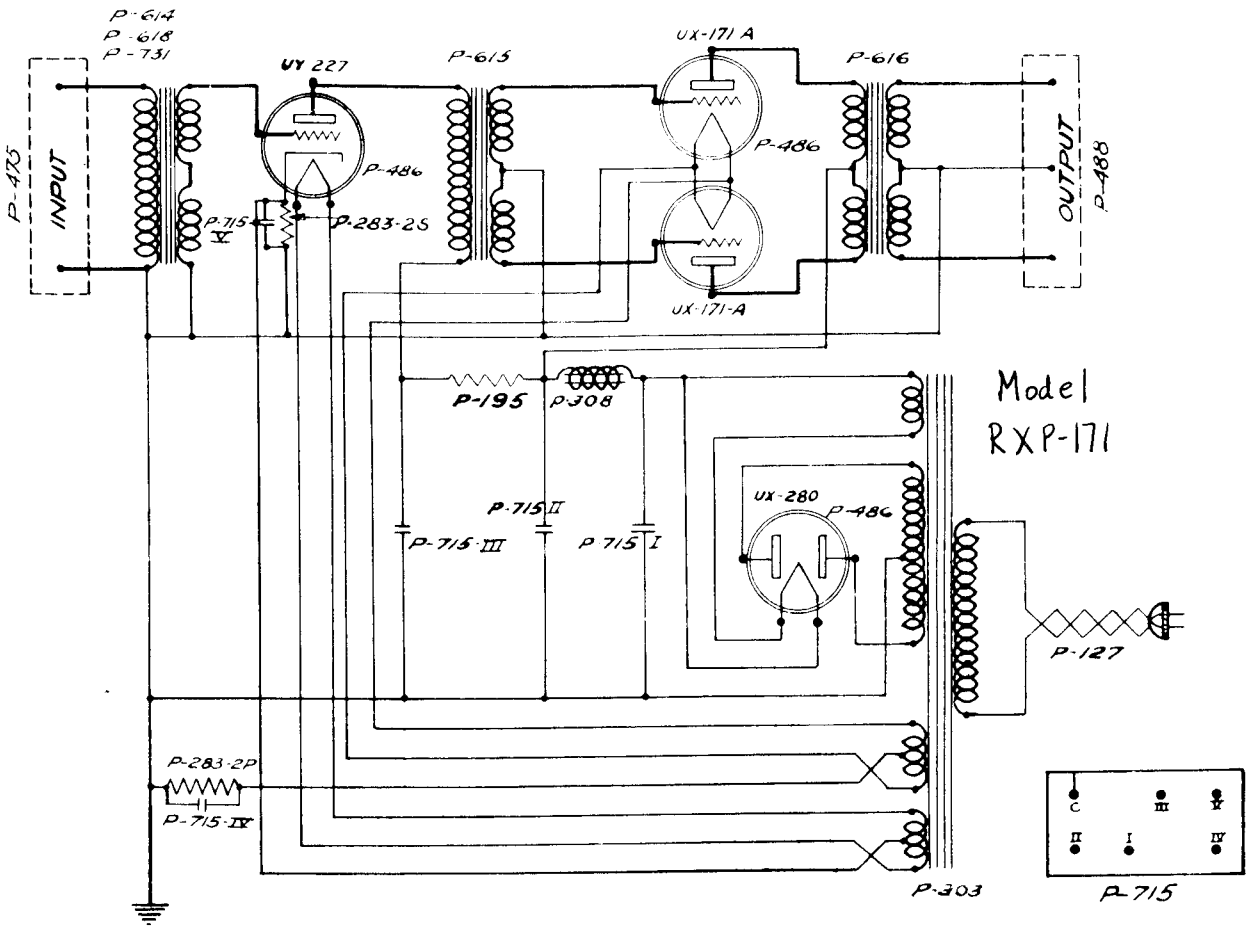
Model PMA1

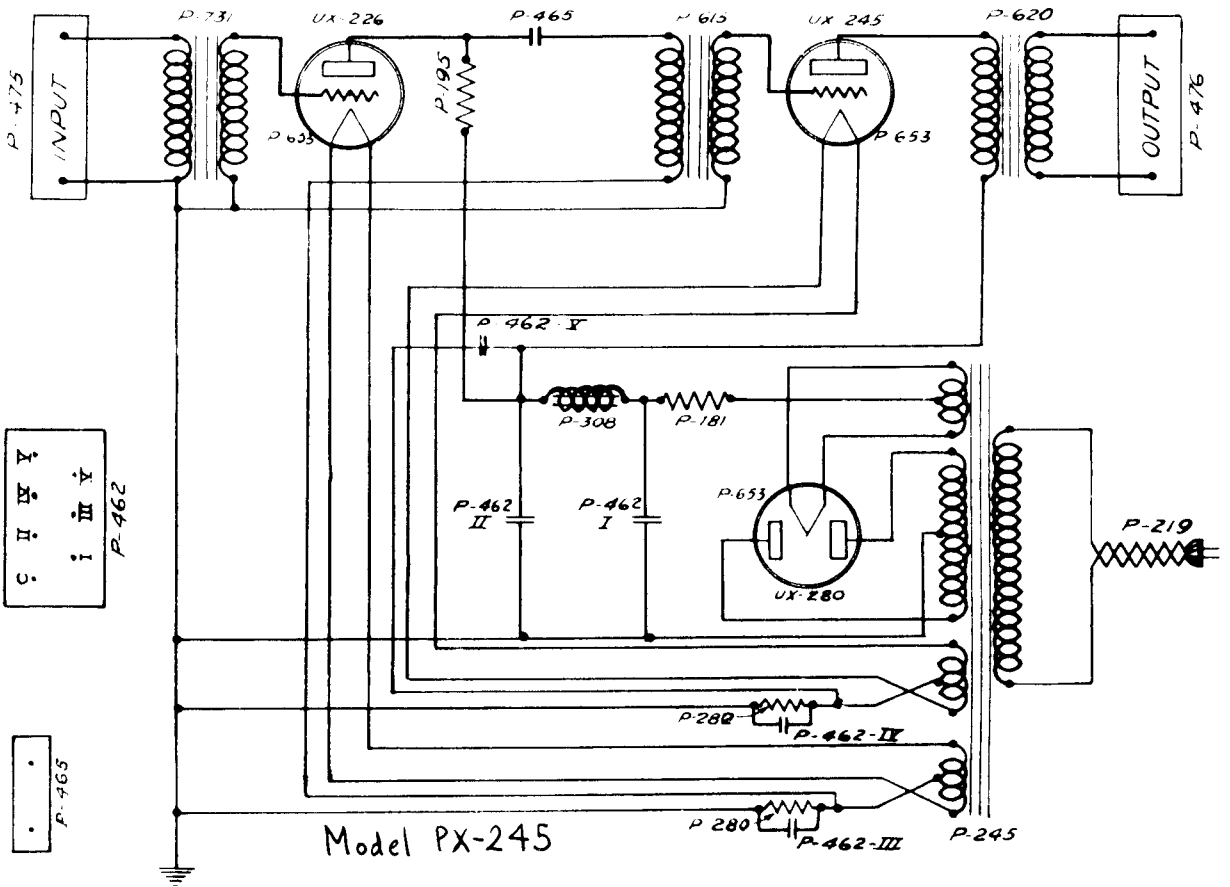
AX-1 Panel

SOCKET PANEL P-491-A ENGRAVED
SOCKET PANEL P-491-B SOCKET CONTACTS

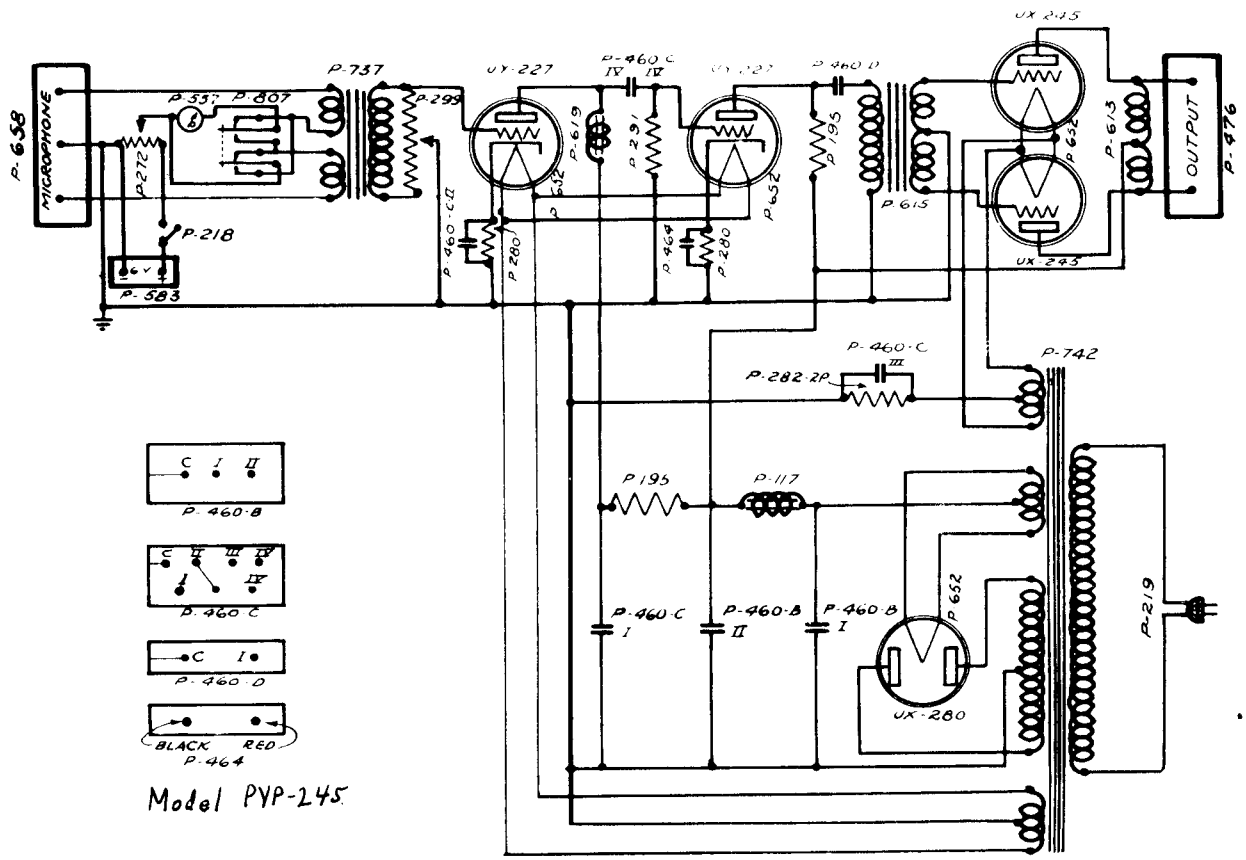


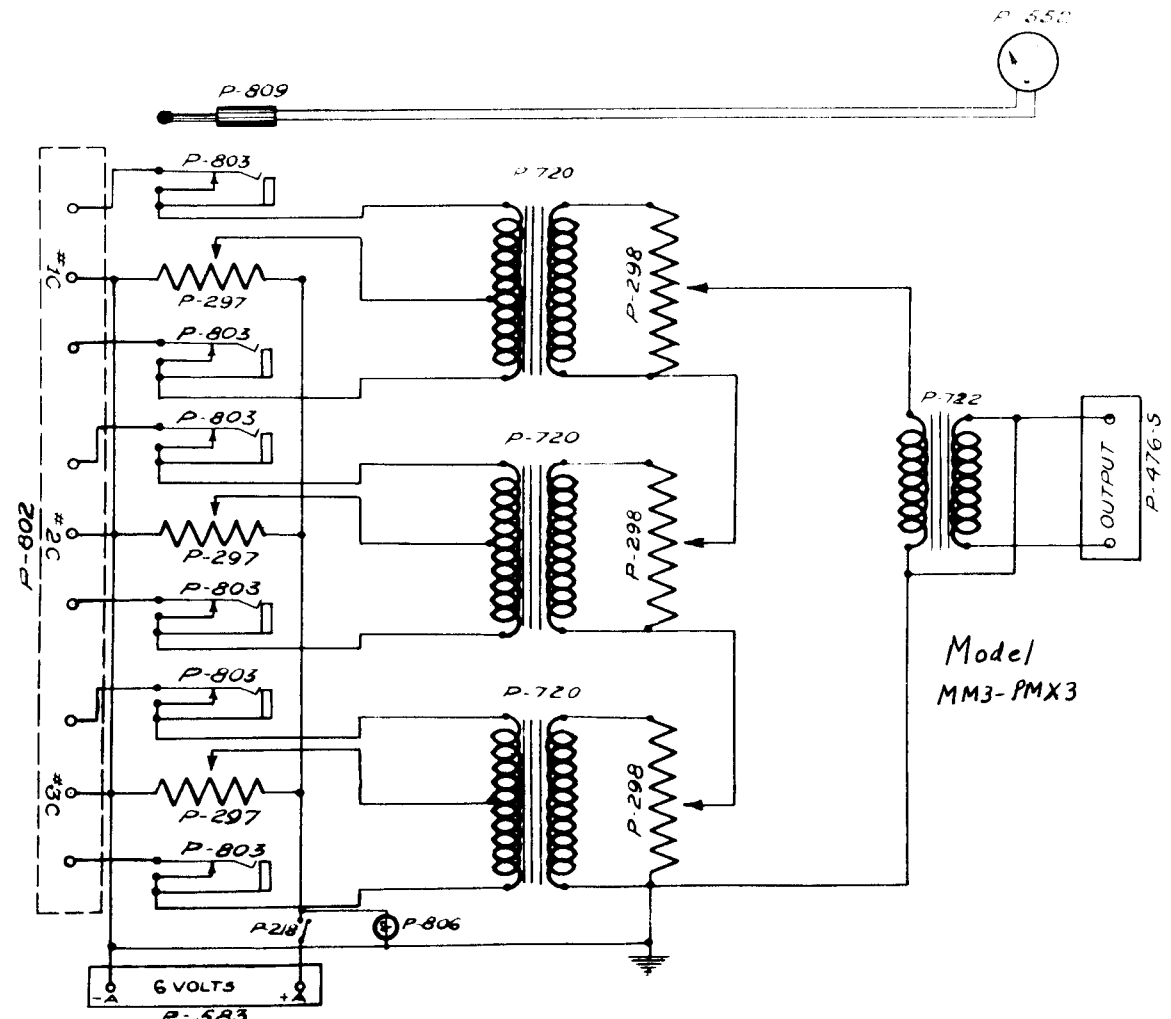
RADIO RECEPTOR, INC.



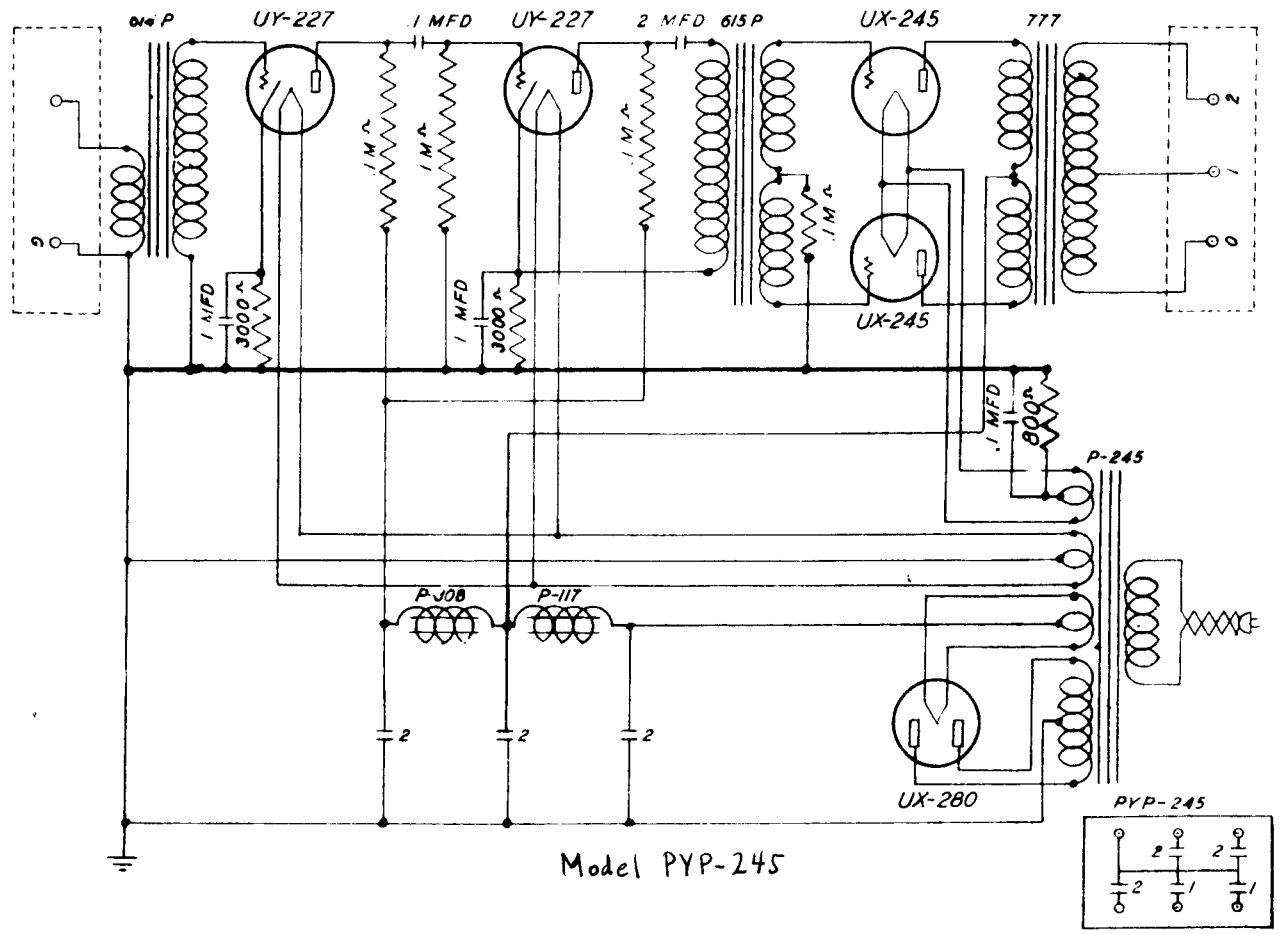


RADIO RECEPTOR, INC.

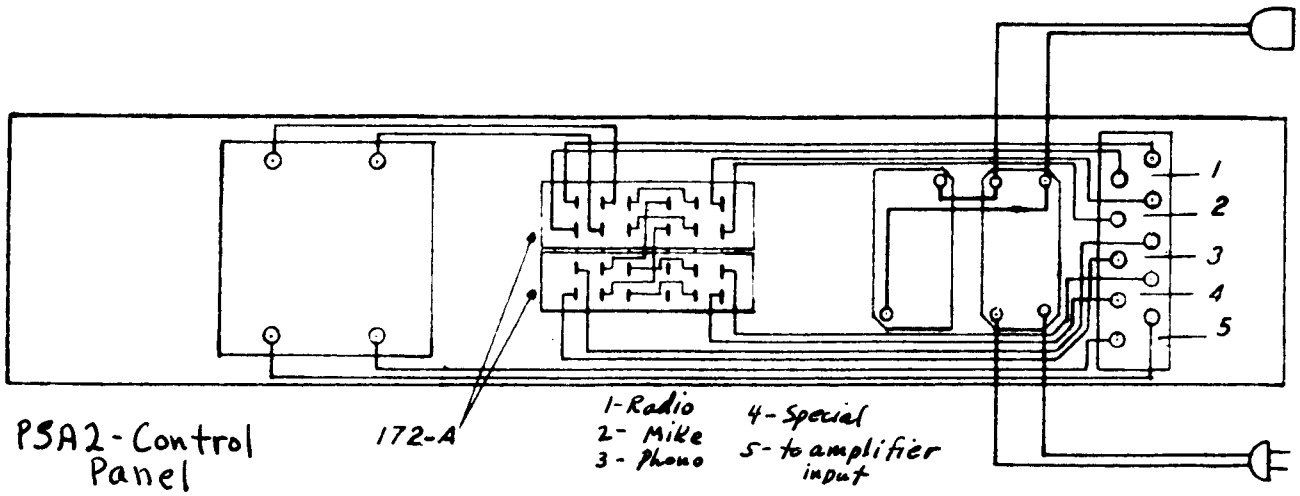




RADIO RECEPTOR, INC.



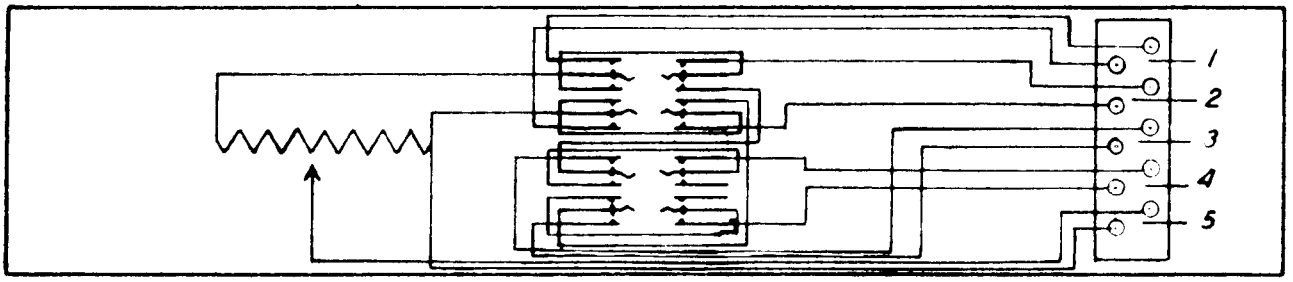
Model PYP-245



PSA2-Control Panel

172-A

1-Radio
2-Mike
3-Phono
4-Special
5-to amplifier input



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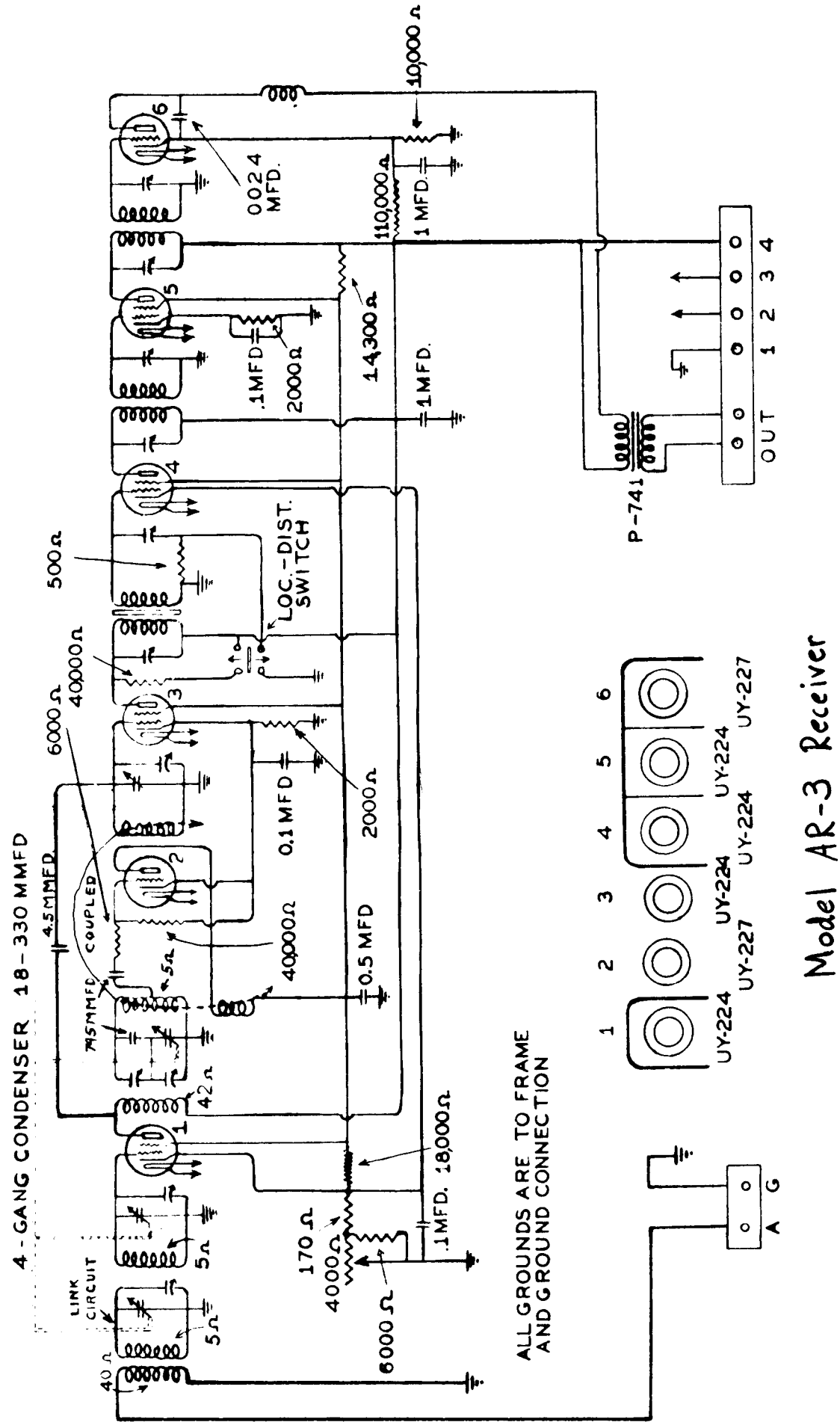

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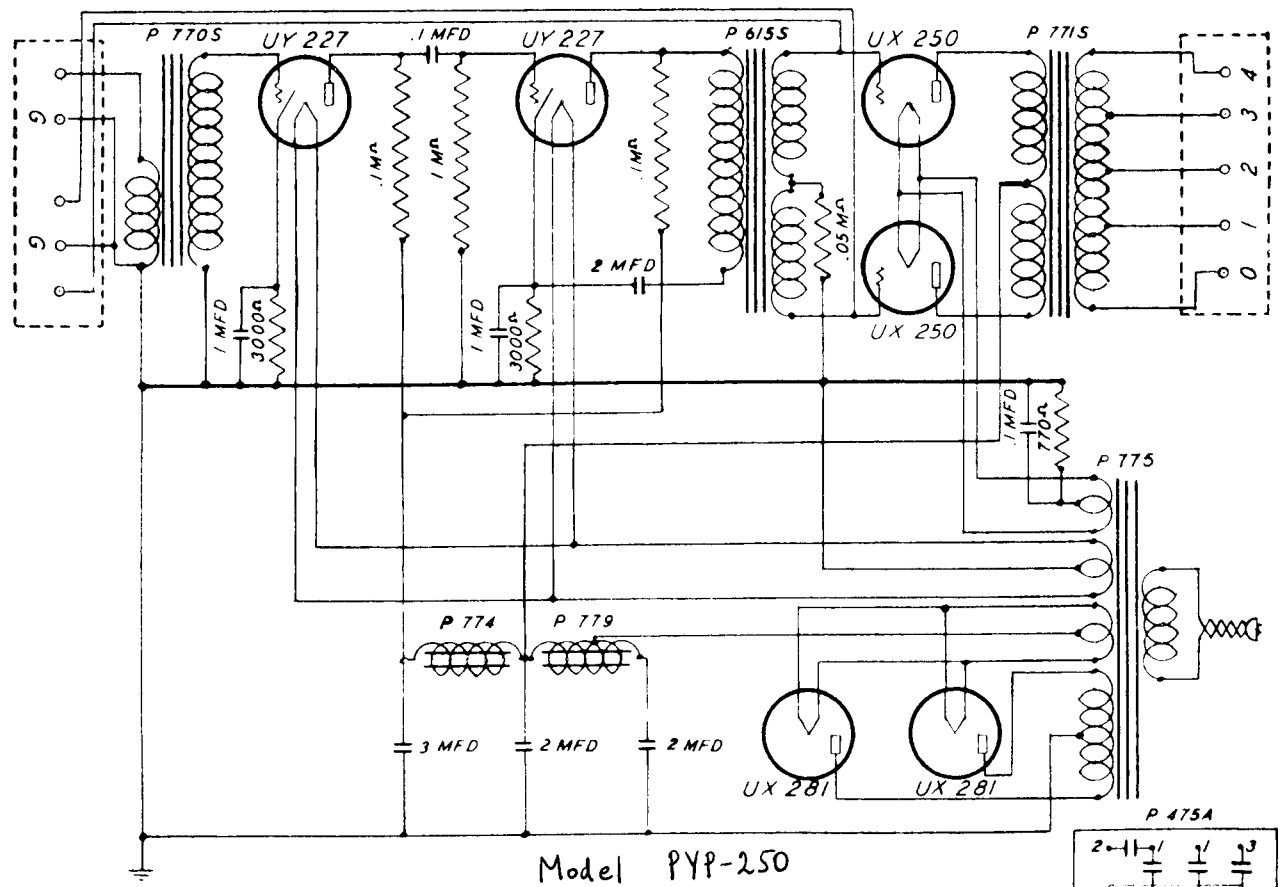
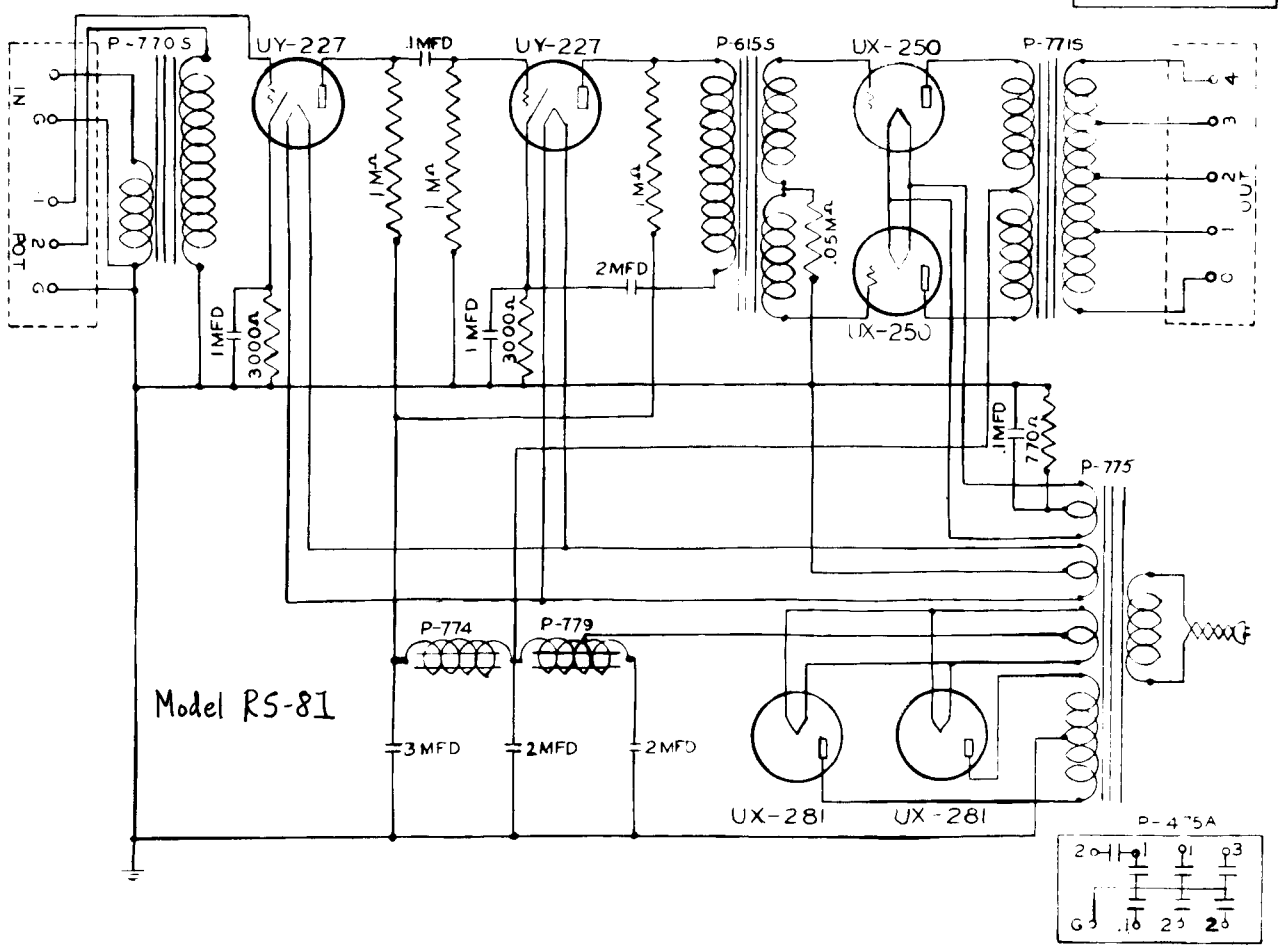
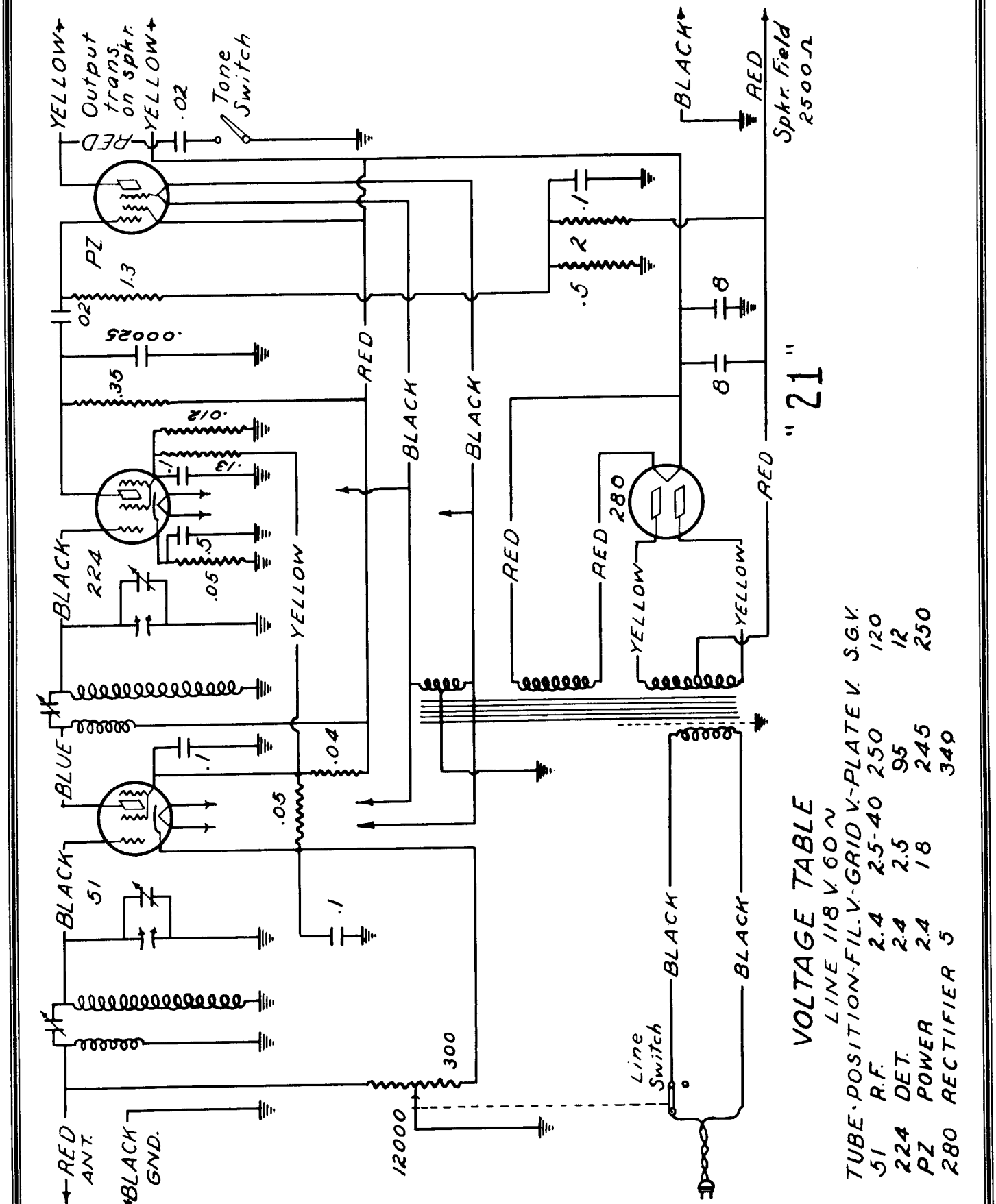
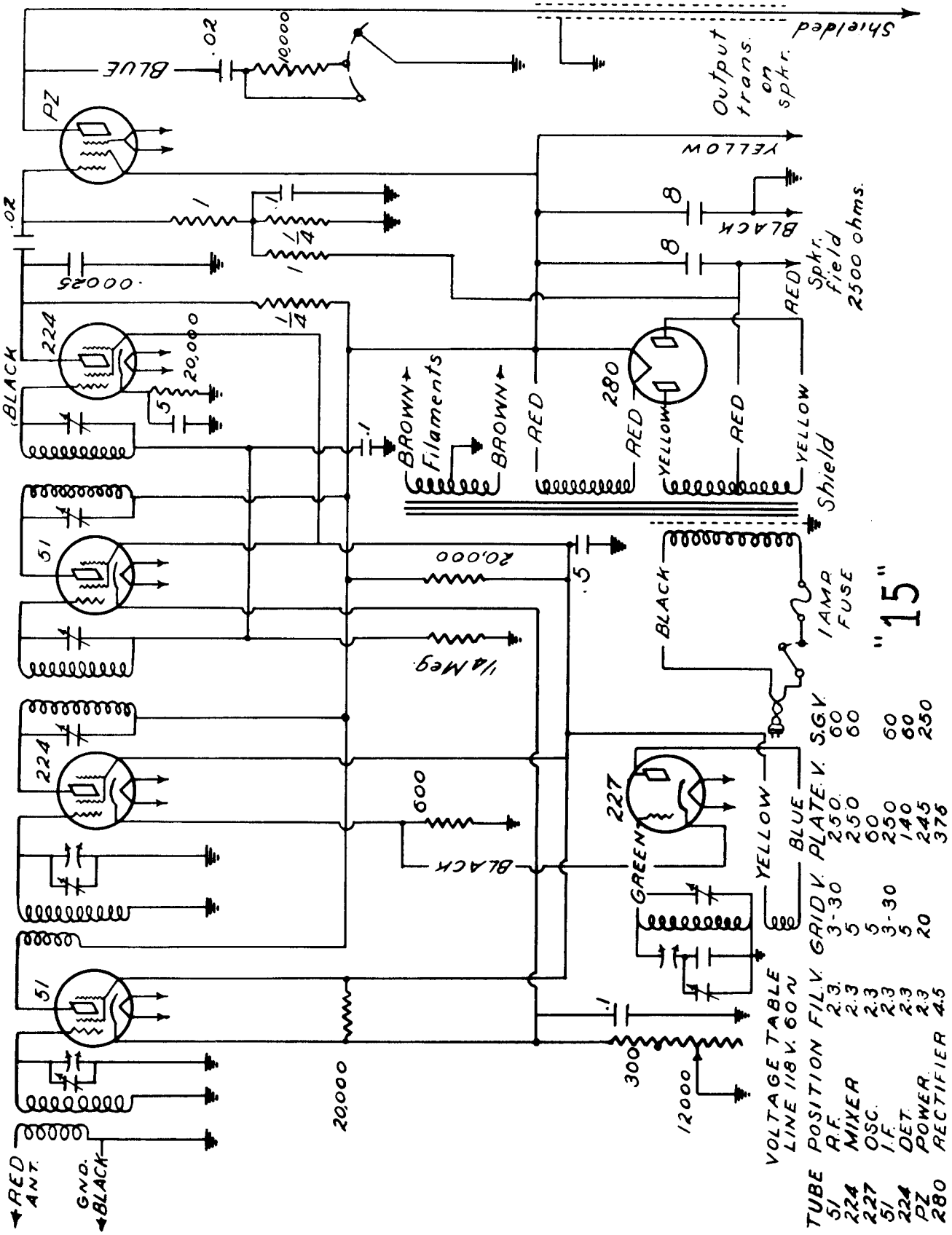




REMLER CO., LTD.

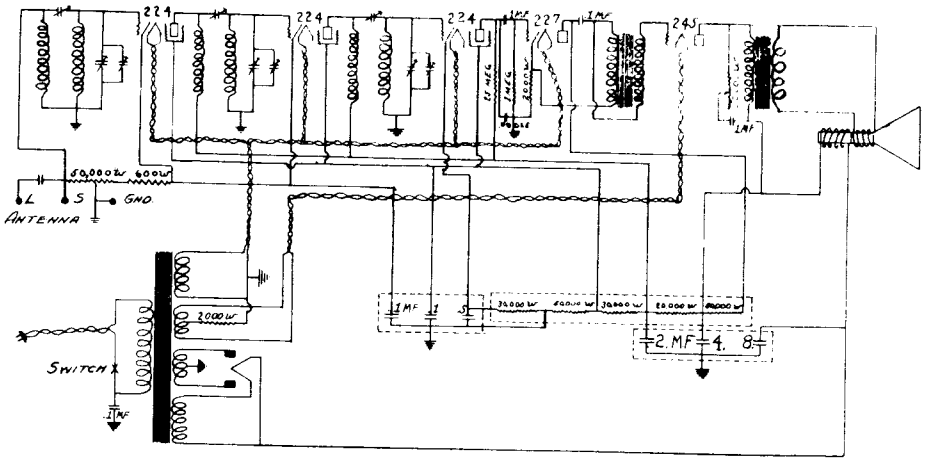


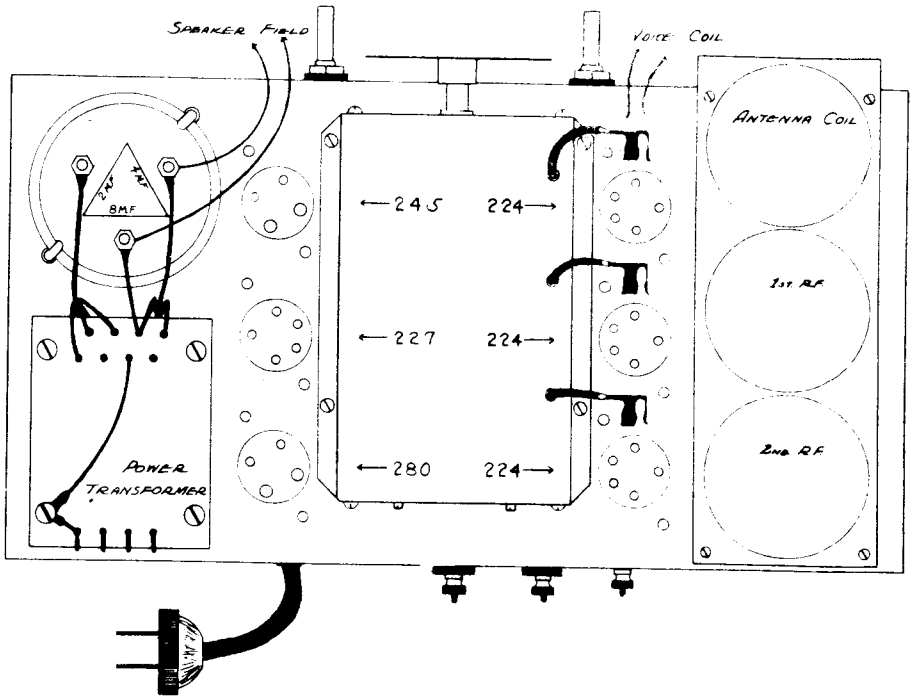
REMLER CO., LTD.



VOLTAGE TABLE
LINE 118 V. 60 ~

TUBE	POSITION	FIL V.	GRID V.	PLATE V.	S.G.V.	
51	R.F.	2.3	3-30	250	60	
224	MIXER	2.3	5	250	60	
227	OSC.	2.3	5	60		
51	I.F.	2.3	3-30	250	60	
224	DET.	2.3	5	140	60	
PZ	POWER	2.3	20	245	250	
280	RECTIFIER	4.5		375		





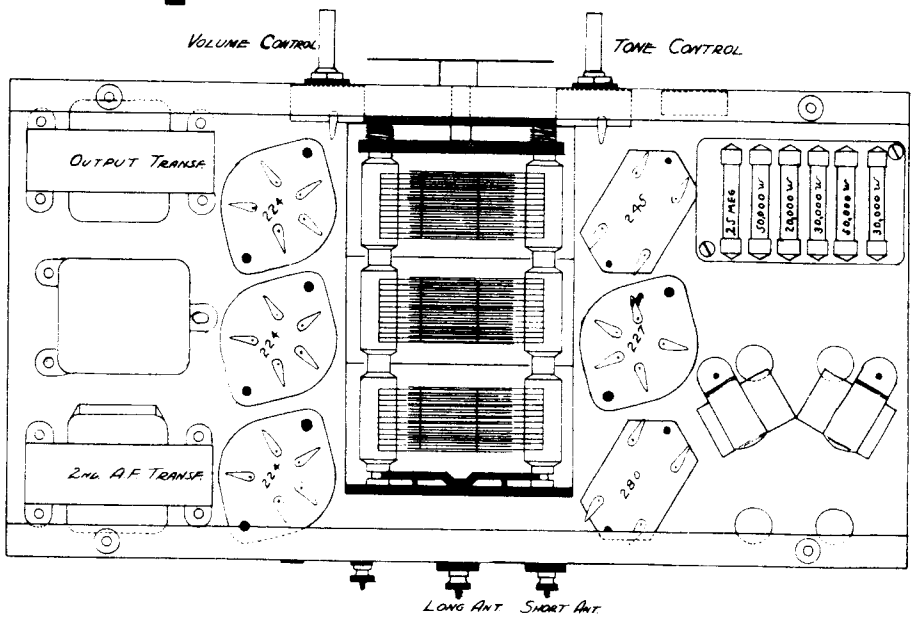
WIRE COLOR CODE

RED - FILAMENT RECTIFIER - KATHODE A.F. - PLATE R.F. - PLATE POWER TUBE - SPEAKER FIELD
BLUE - FILAMENT POWER TUBE - PLATE DETECTOR - +B R.F.
GREEN - KATHODE DETECTOR - GRID POWER TUBE
BROWN - FILAMENT R.F. TUBES AND DETECTOR
BLACK - FILAMENT 1ST A.F. TUBE - DETECTOR KATHODE - SPEAKER VOICE COIL
YELLOW - SHIELD GRID - PLATE 1ST A.F. - PLATE RECTIFIER

VOLTAGE TABLE

LINE 115 V. 60 CYCLES

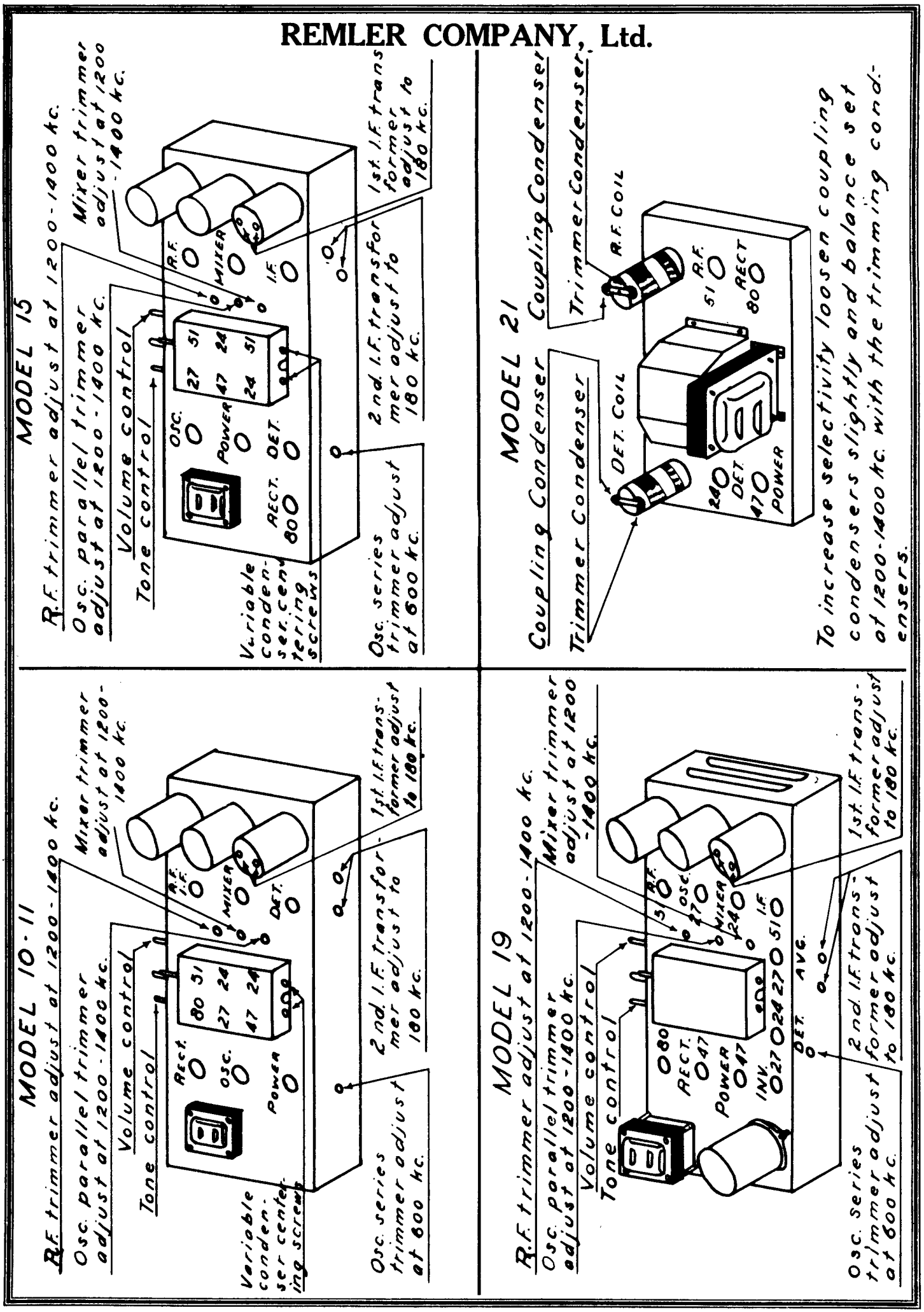
TUBE	POSITION	FIL. V.	GRID V.	PLATE V.	SG VOLTS
224	1ST R.F.	2.3	3-9	160-185	85-125
224	2ND R.F.	2.3	3-9	160-185	85-125
224	DET.	2.3	4.8-8	75-115	85-125
227	1ST A.F.	2.3	7	110	
245	POWER	2.4	47	235	
280	RECTIFIER	4.9		400	



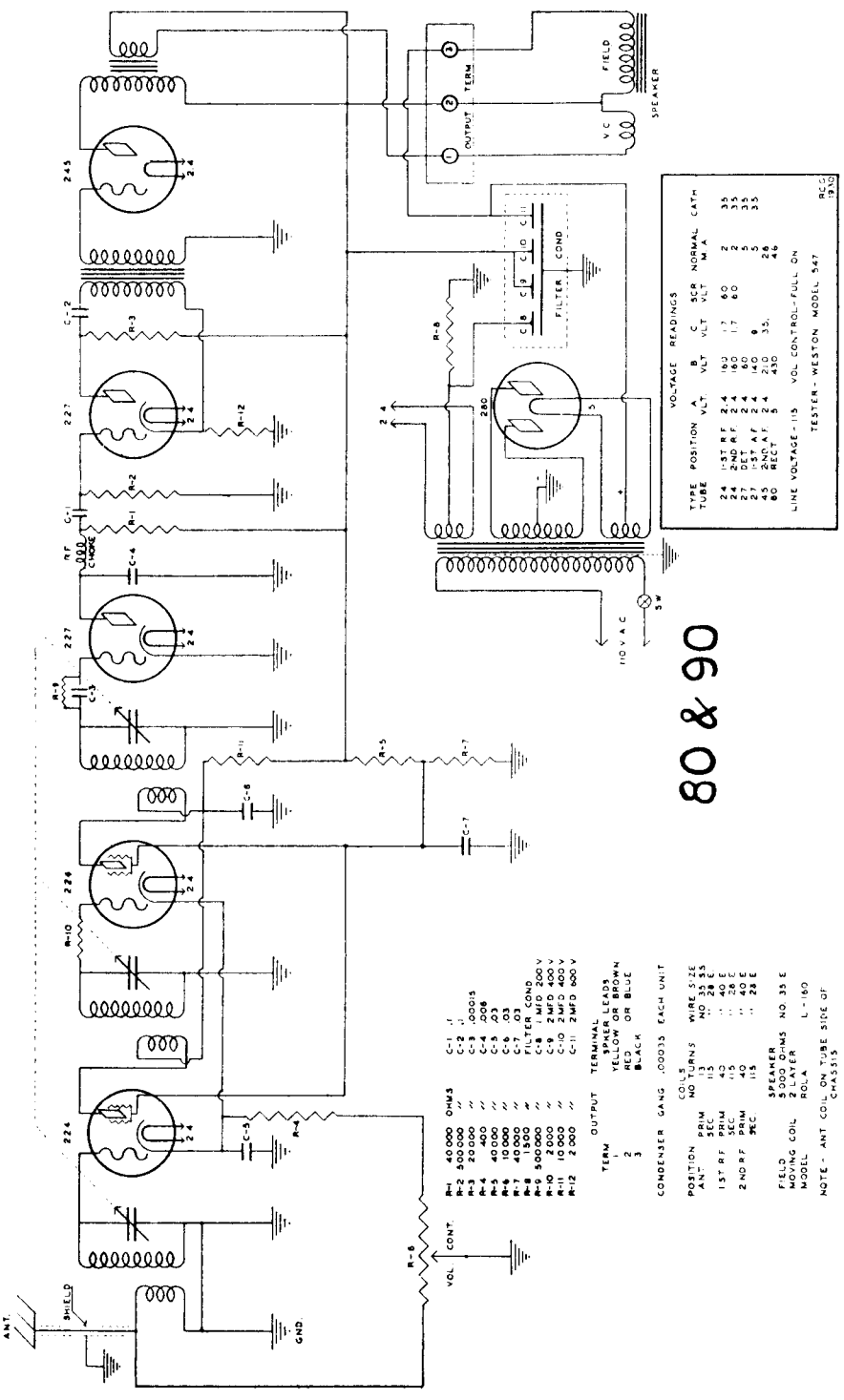
"CAMEO"

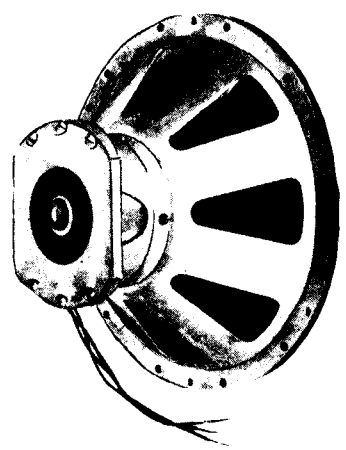
REMLER COMPANY, Ltd.

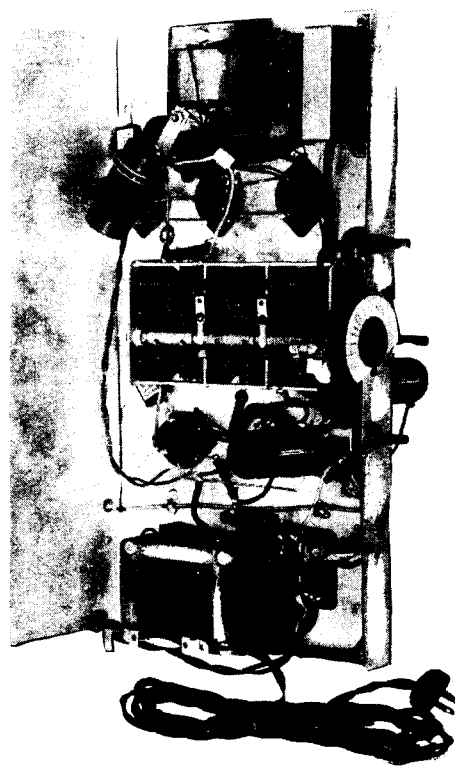
REMLER COMPANY, Ltd.



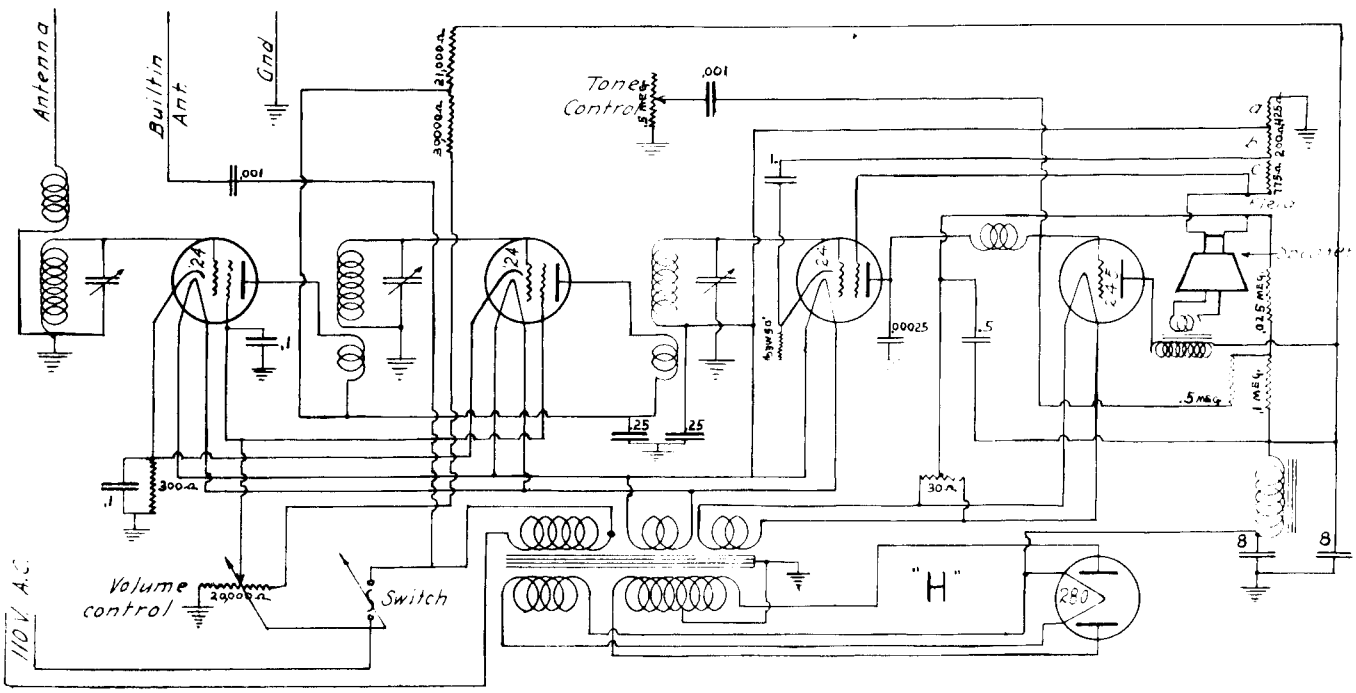
ROLA CO.

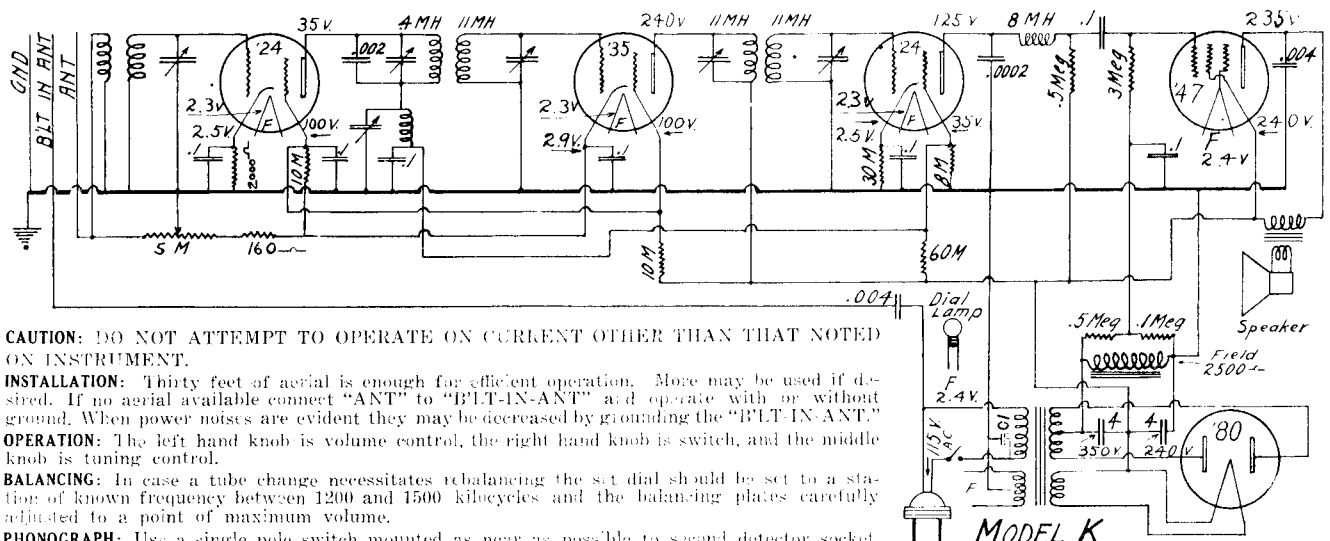

80 & 90
VOLTAGE READINGS
TYPE TUBE
POSITION
A VLT
B VLT
C VLT
SCR VLT
NORMAL MA
CATH
24 1ST R F 2.4 160 1.7 60 2 35
24 2ND A F 2.4 160 1.7 60 2 35
27 DET 2.4 60 0 5 35
27 1ST A F 2.4 160 2.0 5 35
45 2ND A F 2.4 210 35. 25
80 RECT 5 430 46
LINE VOLTAGE-115 VOL CONTROL-FULL ON
TESTER - WESTON MODEL 547
R-1 40,000 OHMS
R-2 500,000 "
R-3 20,000 "
R-4 400 "
R-5 40,000 "
R-6 10,000 "
R-7 40,000 "
R-8 500,000 "
R-9 500,000 "
R-10 2000 "
R-11 10,000 "
R-12 2,000 "
C-1 .1
C-2 .0005
C-3 .0005
C-4 .006
C-5 .03
C-6 .03
C-7 .03
FILTER COND
C-8 2 MFD 200 V
C-9 2 MFD 400 V
C-10 2 MFD 400 V
C-11 2 MFD 600 V
CONDENSER GANG .00035 EACH UNIT
OUTPUT TERMINAL
TERM 1 SPKR LEADS YELLOW OR BROWN
2 RED OR BLUE
3 BLACK
COILS
POSITION NO TURNS WIRE SIZE
ANT PRIM 113 NO 35 S S C
SEC 113 " 28 E
1ST R F PRIM 40 " 40 E
SEC 115 " 28 E
2ND R F PRIM 40 " 40 E
SEC 115 " 28 E
FIELD SPEAKER 5,000 OHMS NO 35 E
MOVING COIL SPEAKER
MODEL ROLA L-160
NOTE - ANT COIL ON TUBE SIDE OF CHASSIS
ANT.
SHIELD
GND
VOL CONT
OUTPUT
TERM
FIELD
V C
SPEAKER
FILTER COND
RF CHOKE
110 V A C
SW





SIMPLEX RADIO CO.





CAUTION: DO NOT ATTEMPT TO OPERATE ON CURRENT OTHER THAN THAT NOTED ON INSTRUMENT.

INSTALLATION: Thirty feet of aerial is enough for efficient operation. More may be used if desired. If no aerial available connect "ANT" to "B'LT-IN-ANT" and operate with or without ground. When power noises are evident they may be decreased by grounding the "B'LT-IN-ANT."

OPERATION: The left hand knob is volume control, the right hand knob is switch, and the middle knob is tuning control.

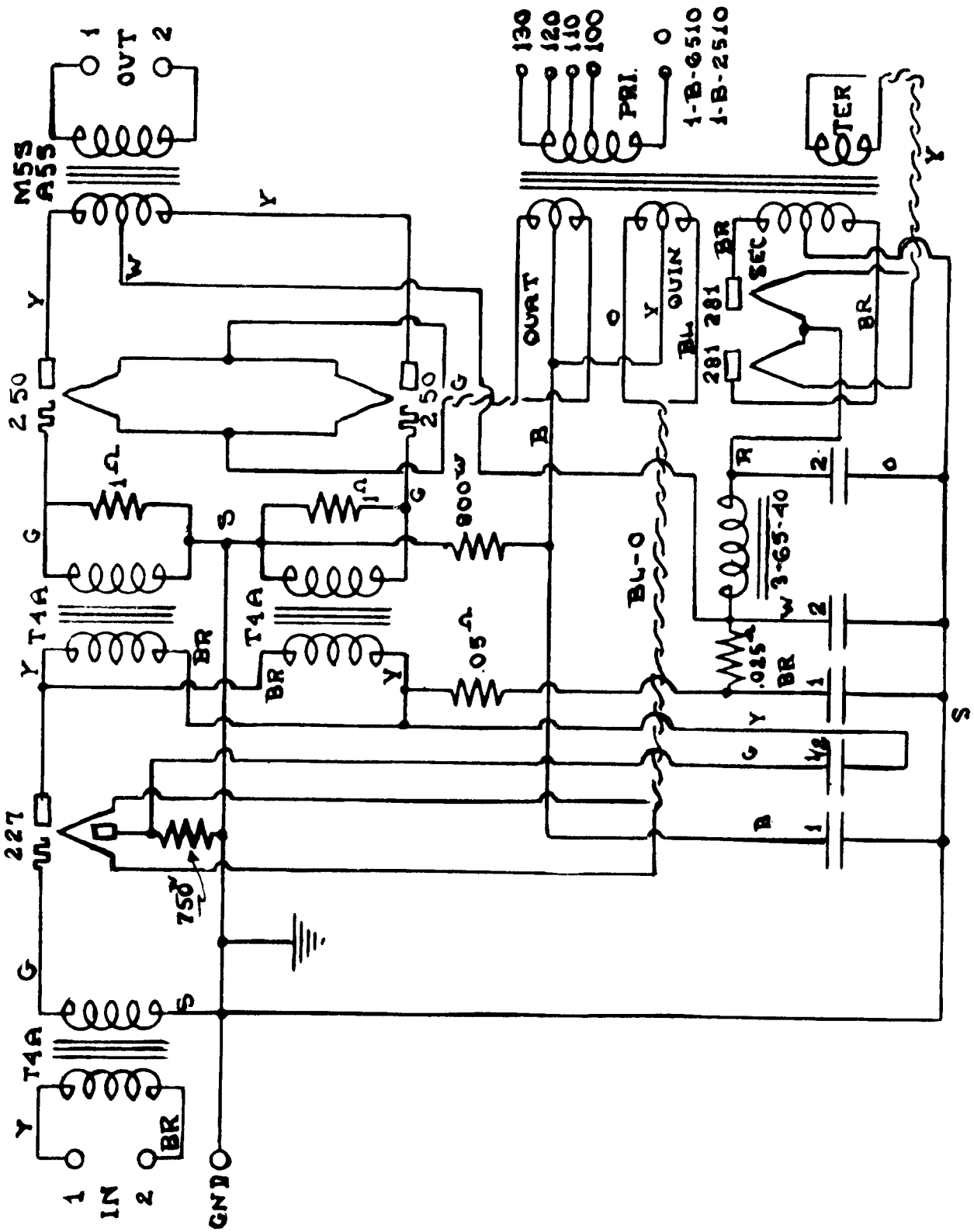
BALANCING: In case a tube change necessitates rebalancing the set dial should be set to a station of known frequency between 1200 and 1500 kilocycles and the balancing plates carefully adjusted to a point of maximum volume.

PHONOGRAPH: Use a single pole switch mounted as near as possible to second detector socket, connect in series with lead from ground end of grid coil of second detector tube. Solder phonograph pickup leads to switch terminals.

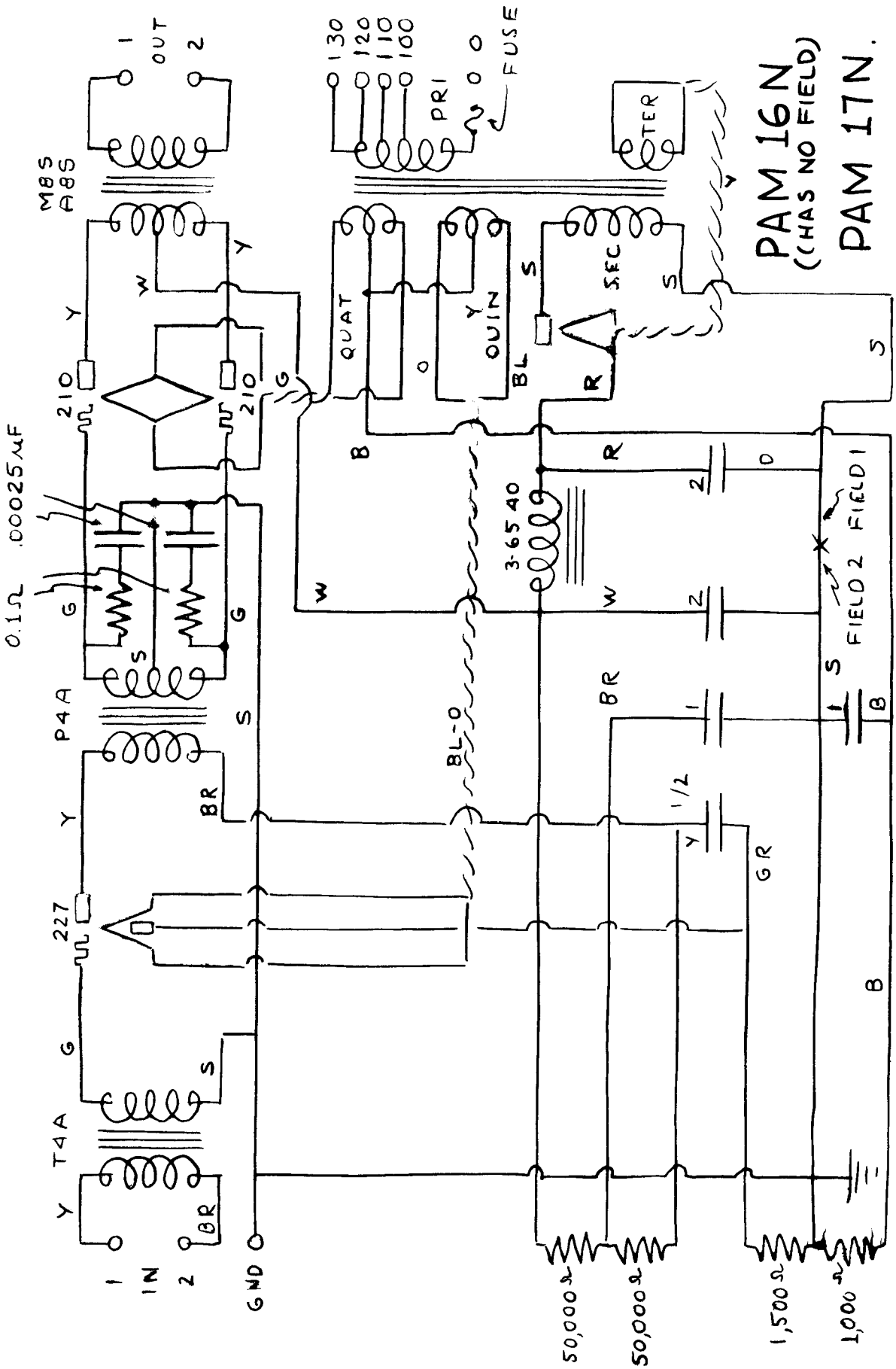
GUARANTEE: This instrument is guaranteed for ninety days, within which period any part showing electrical or mechanical defect will be replaced without charge when returned prepaid to the factory, but if the complete instrument is returned a nominal charge will be made for such labor as may be necessary to install the defective part.

SAMSON ELECTRIC CO.

PAM-9

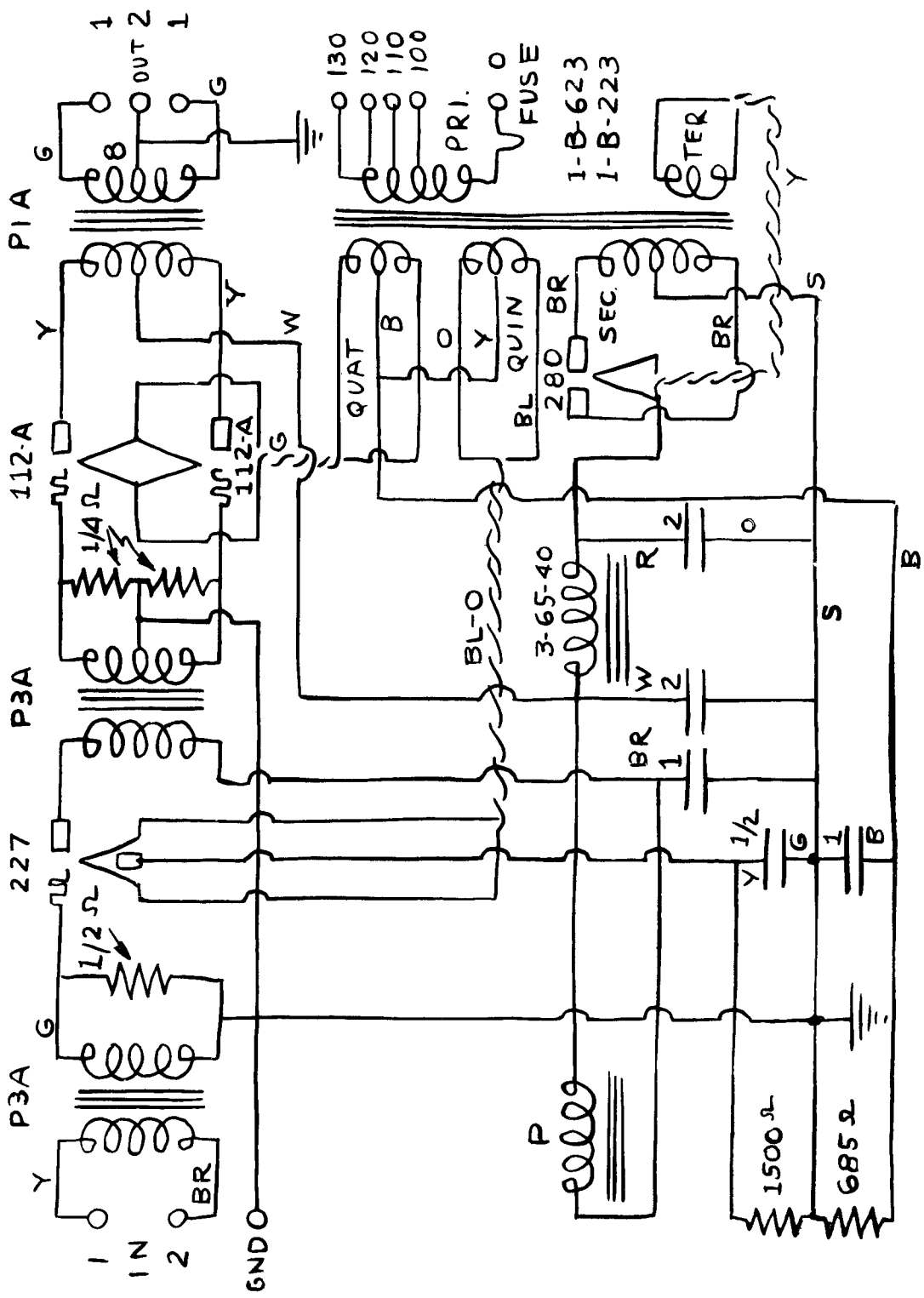


SAMSON ELECTRIC CO.



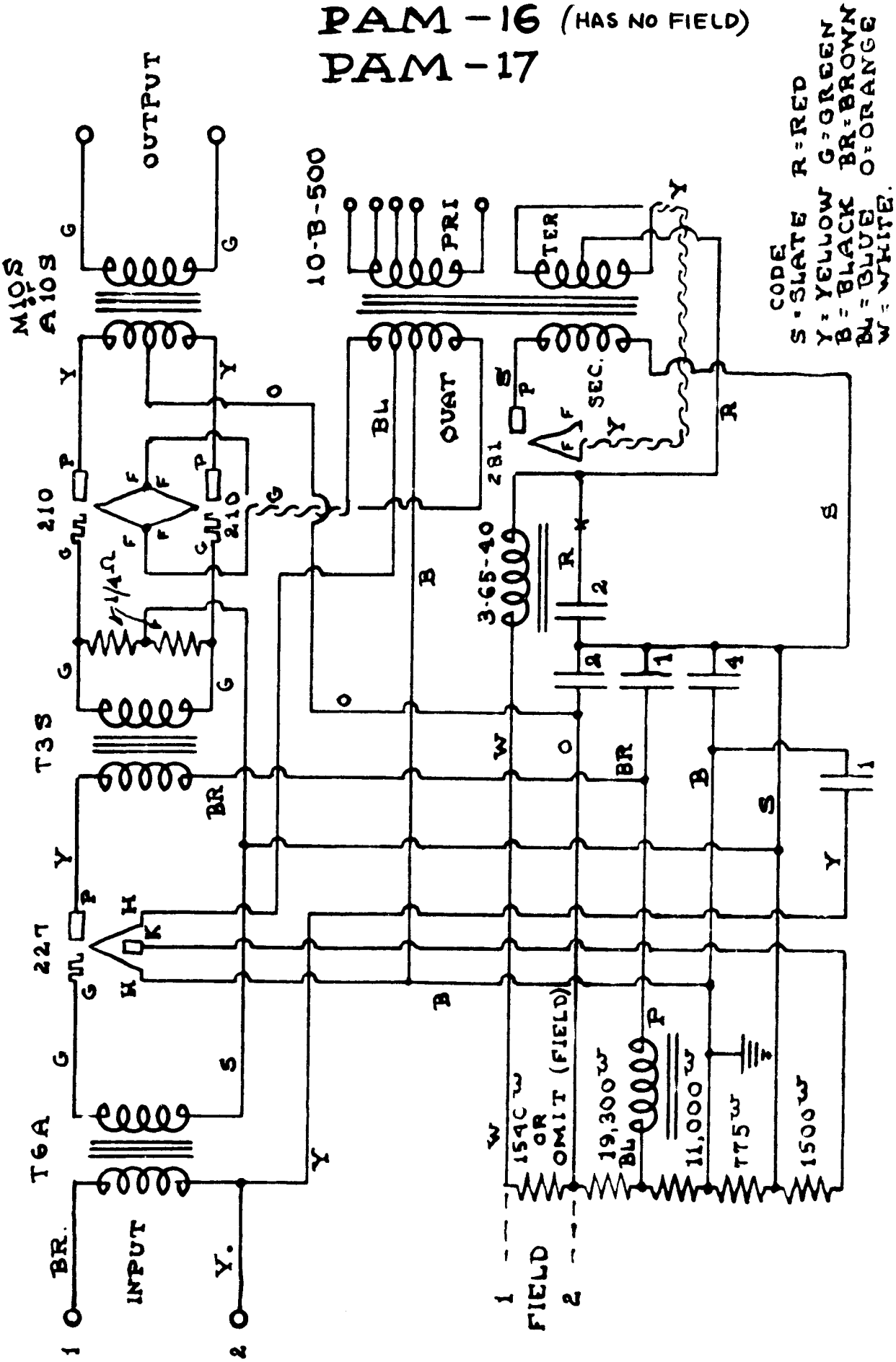
SAMSON ELECTRIC CO.

PAM - 5



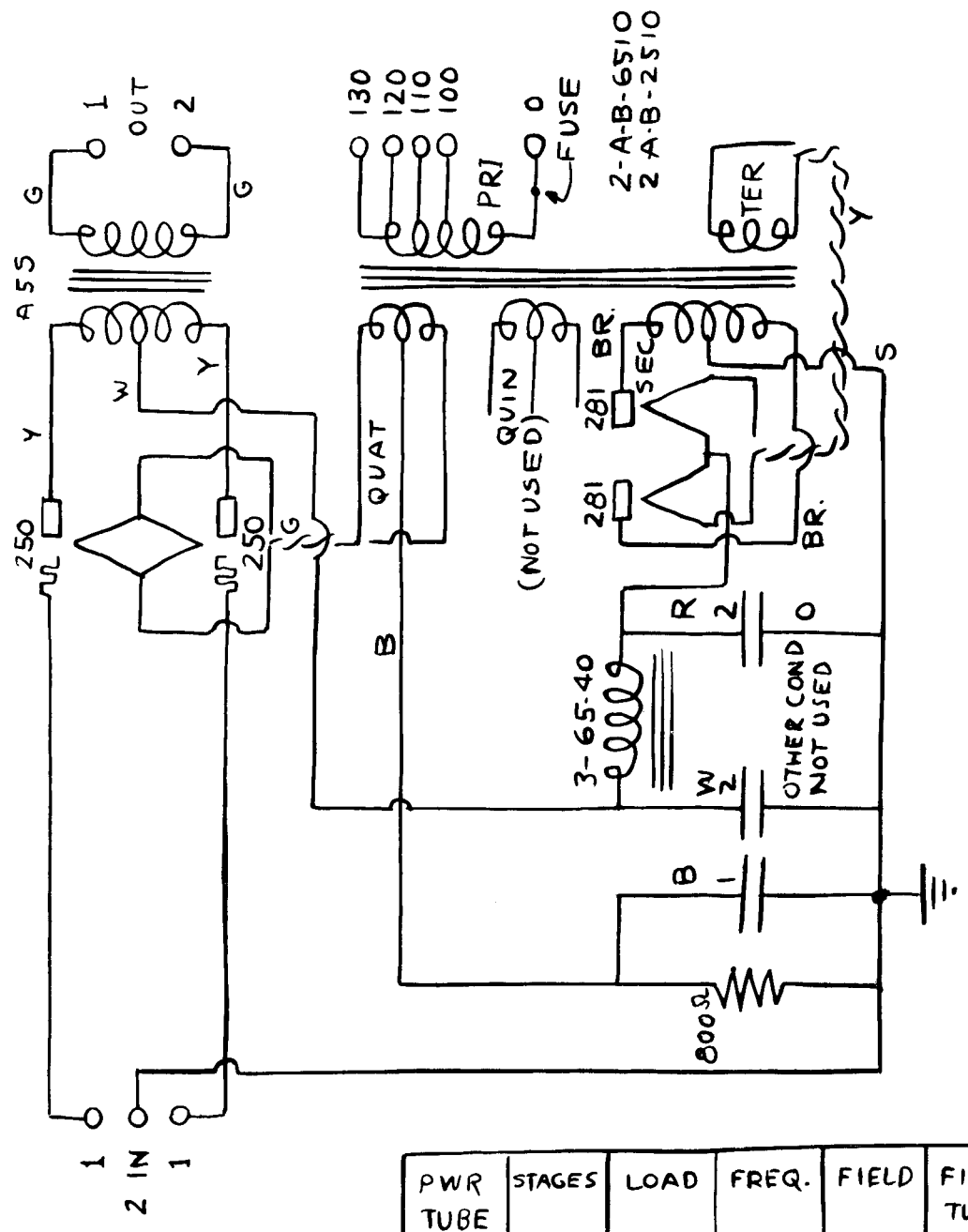
SAMSON ELECTRIC CO.

PAM-16 (HAS NO FIELD)
PAM-17



SAMSON ELECTRIC CO.

PAM-25

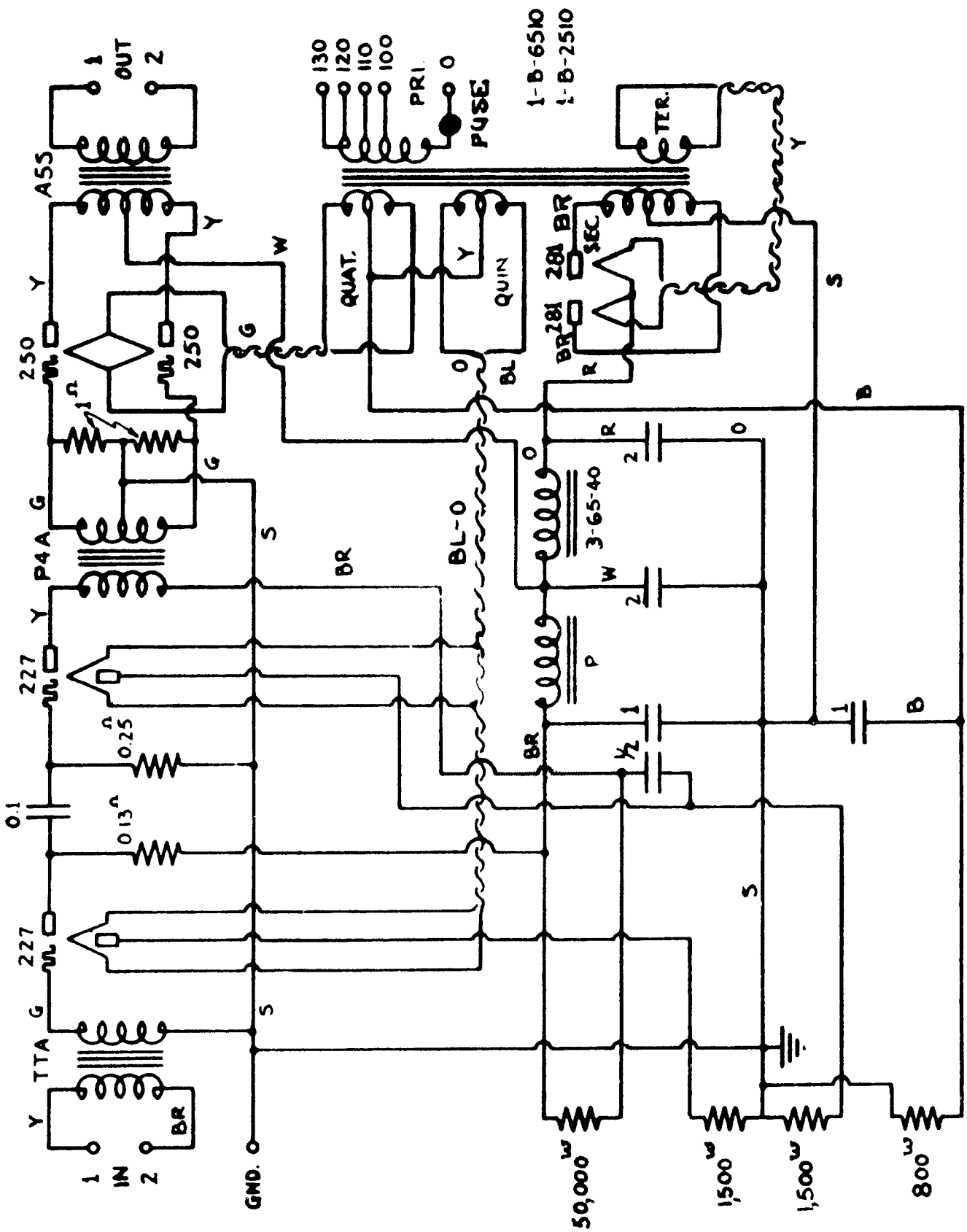


PWR TUBE *	STAGES	LOAD	FREQ.	FIELD	FIRST TUBE
50	1	*	6 2	0	0

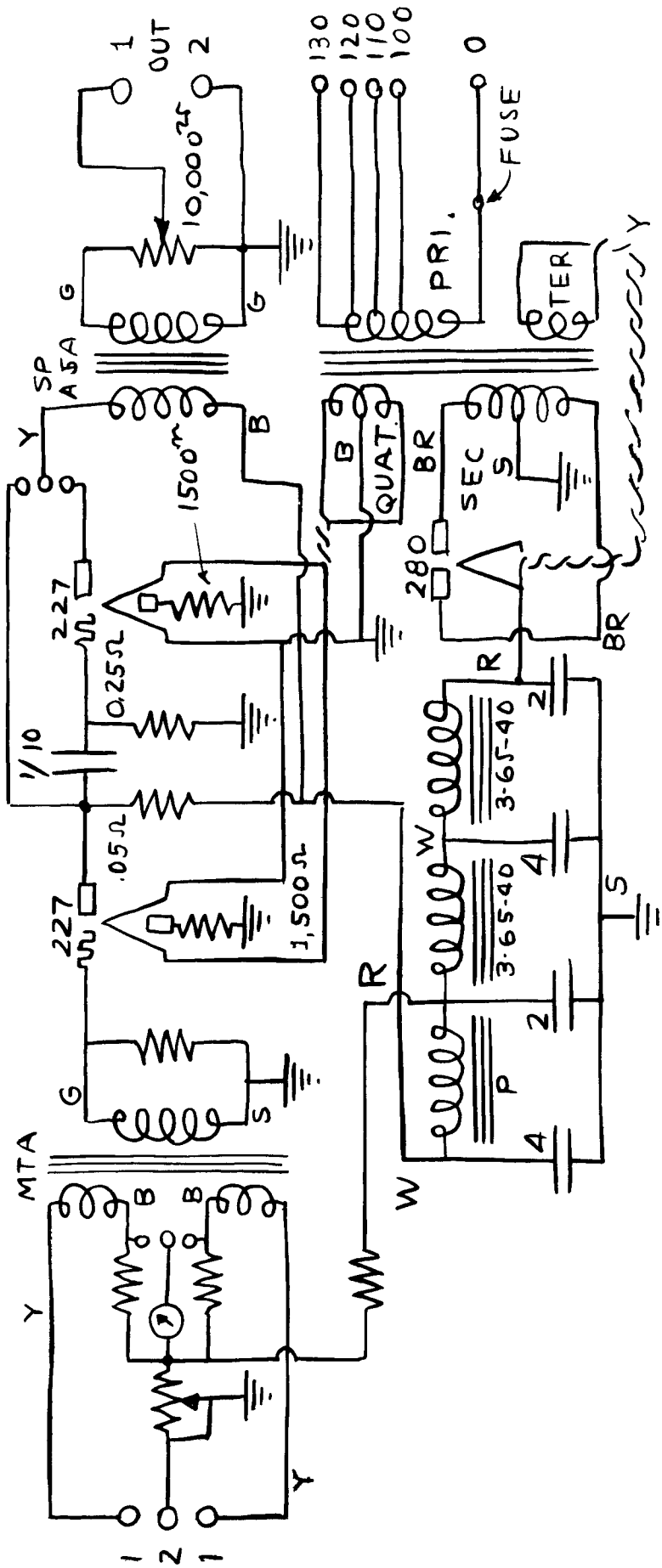
* PUSH-PULL UNLESS OTHERWISE STATED

SAMSON ELECTRIC CO.

PAM-19

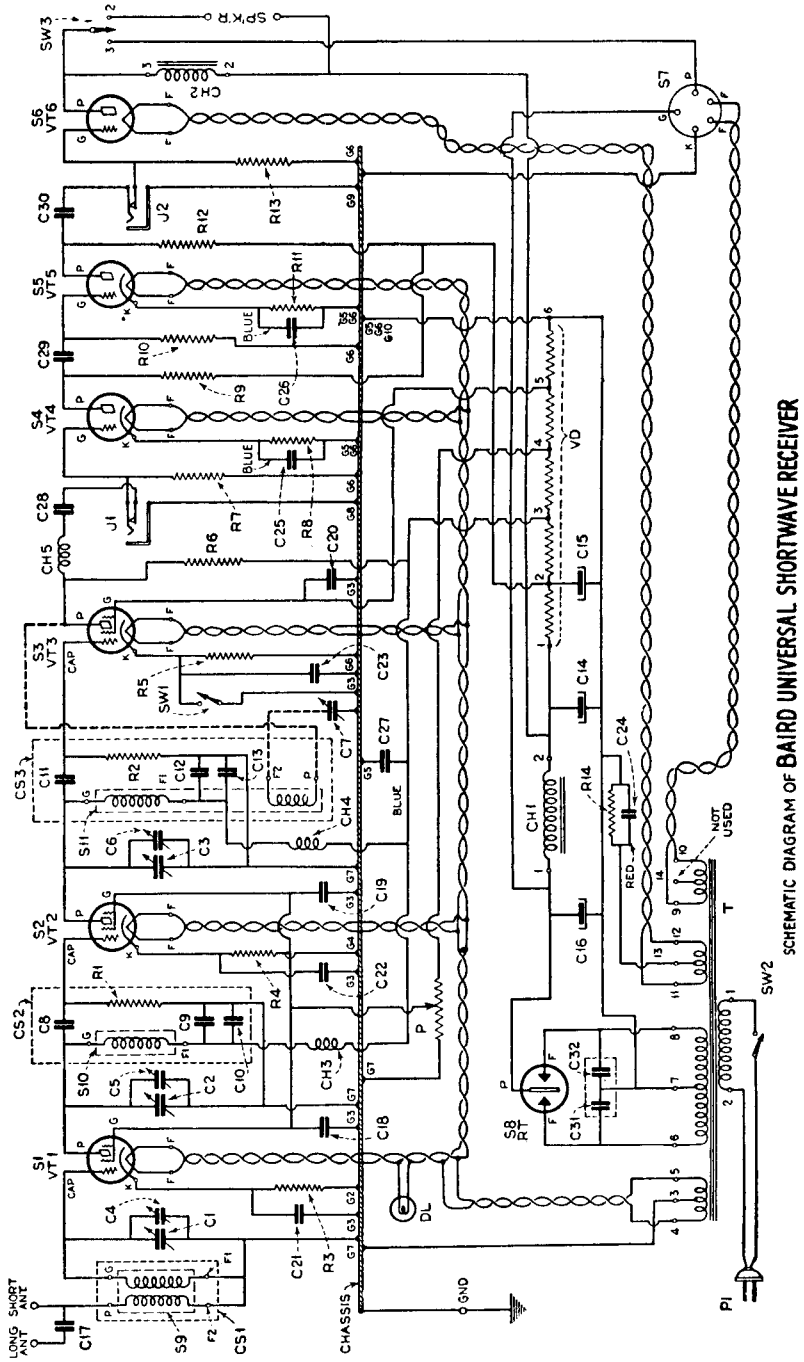


SAMSON ELECTRIC CO.



MIKI AMPLIFIER

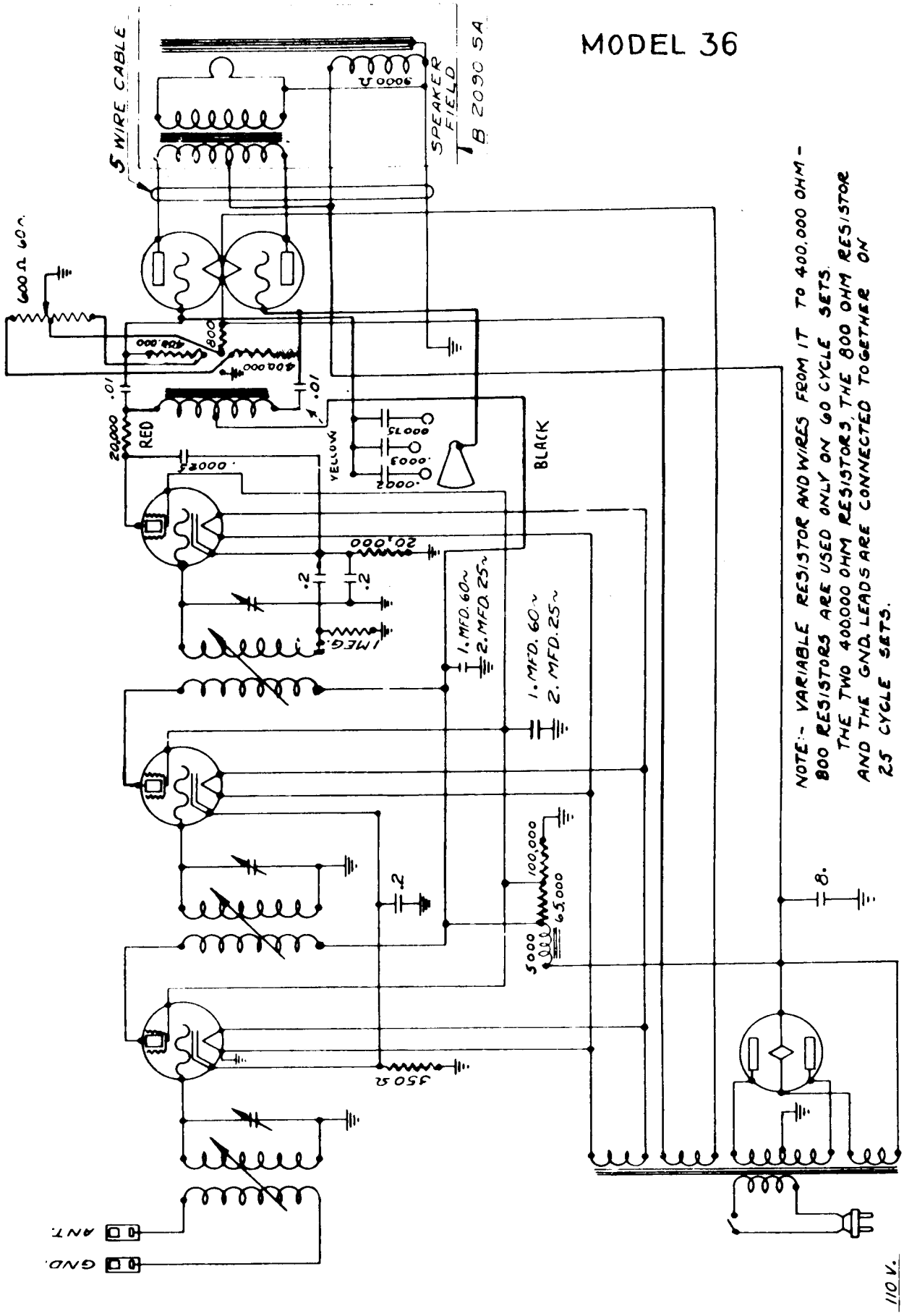
SHORT WAVE AND TELEVISION LABORATORY



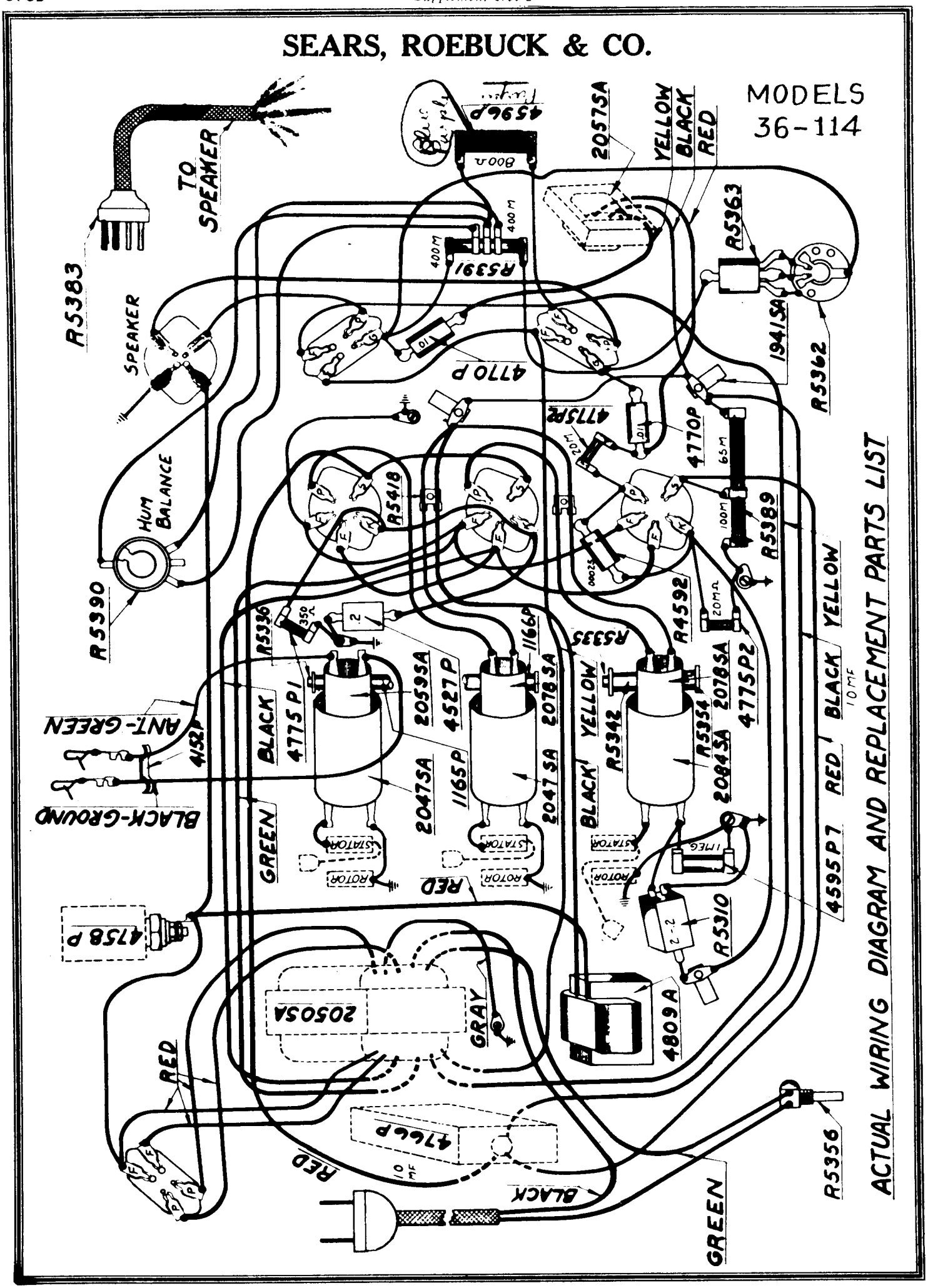
Parts Required for Baird Receiver

Stock No.	*Quan.*	*Part and Type*	*No. on Diagram*
51	1	Chassis, all mounted, with 8 sockets riveted	*S1, S2, S3, S4, S5, S6, S7, S8*
		3 coil shields	*CS1, CS2, CS3*
		3 tube shields	*TS1, TS2, TS3*
		2 condensers	*C10, C13*
		and 1 3-post binding strip	*Gnd., Short Ant., Long Ant.*
52	3	Coil Sockets	*S9, S10, S11*
53	2	Pig-tail Resistors	*R1, R2*
54	3	.0001 Mfd. Condensers	*C8, C11, C17*
55	3	Screen Grid Clips	
56	2	.02Mfd. Moulded Condensers	*C9, C12*
57	2	Jacks	*J1, J2*
58	1	Block Condenser	*C18, C19, C20, C21, C22, C23*
59	1	Block Condenser	*C24, C25, C26, C27*
60	3	R. F. Chokes	*CH3, CH4, CH5*
61	1	3-Gang Baird Variable Condenser	*C1, C2, C3, C5, C6*
62	3	Electrolytic Condensers	*C14, C15, C16*
63	1	Baird Power Transformer	*T*
64	1	Baird Power Choke	*CH1, CH2*
65	1	Baird Gang Resistor	*R5, R6, R7, R8, R9, R10, R11, R12, R13, R14*
66	1	3-Condenser Strip	*C28, C29, C30*
67	4	Knobs	
68	1	Toggle Switch—2 pole	*SW1*
69	1	Speaker Terminal	*Speaker*
70	1	Combination Potentiometer and Switch	*P, SW2*
71	1	No. 9 Baird Midget Condenser	*C4*
72	1	No. 15 Baird Midget Condenser	*C7*
73	1	Buffer Condenser	*C31, C32*
74	1	Voltage Divider	*VD*
75	1	Baird Dial and Escutcheon	
76	1	Baird Front Panel	
77	2	Grid Resistors	*R3, R4*
78		40′ Wire	
79		3-Pole Switch	*SW3*
80	1	Dial Bracket and Lamp	*DL*
81		AC Cord and Plug	*P1*
500		Hardware Assembly	
	15	Octocoils 15-520 meters Wave-	

SEARS, ROEBUCK & CO.

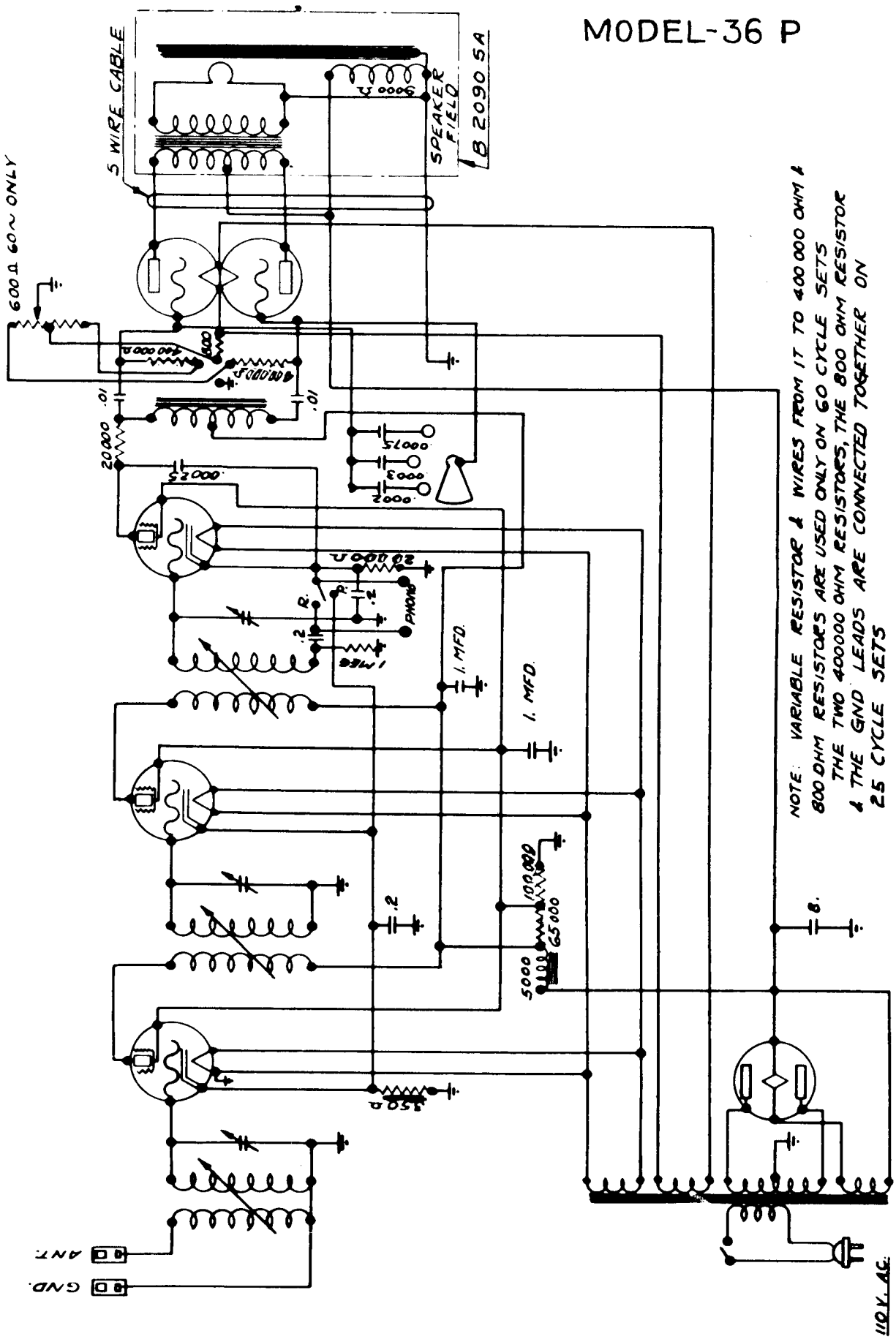


SEARS, ROEBUCK & CO.

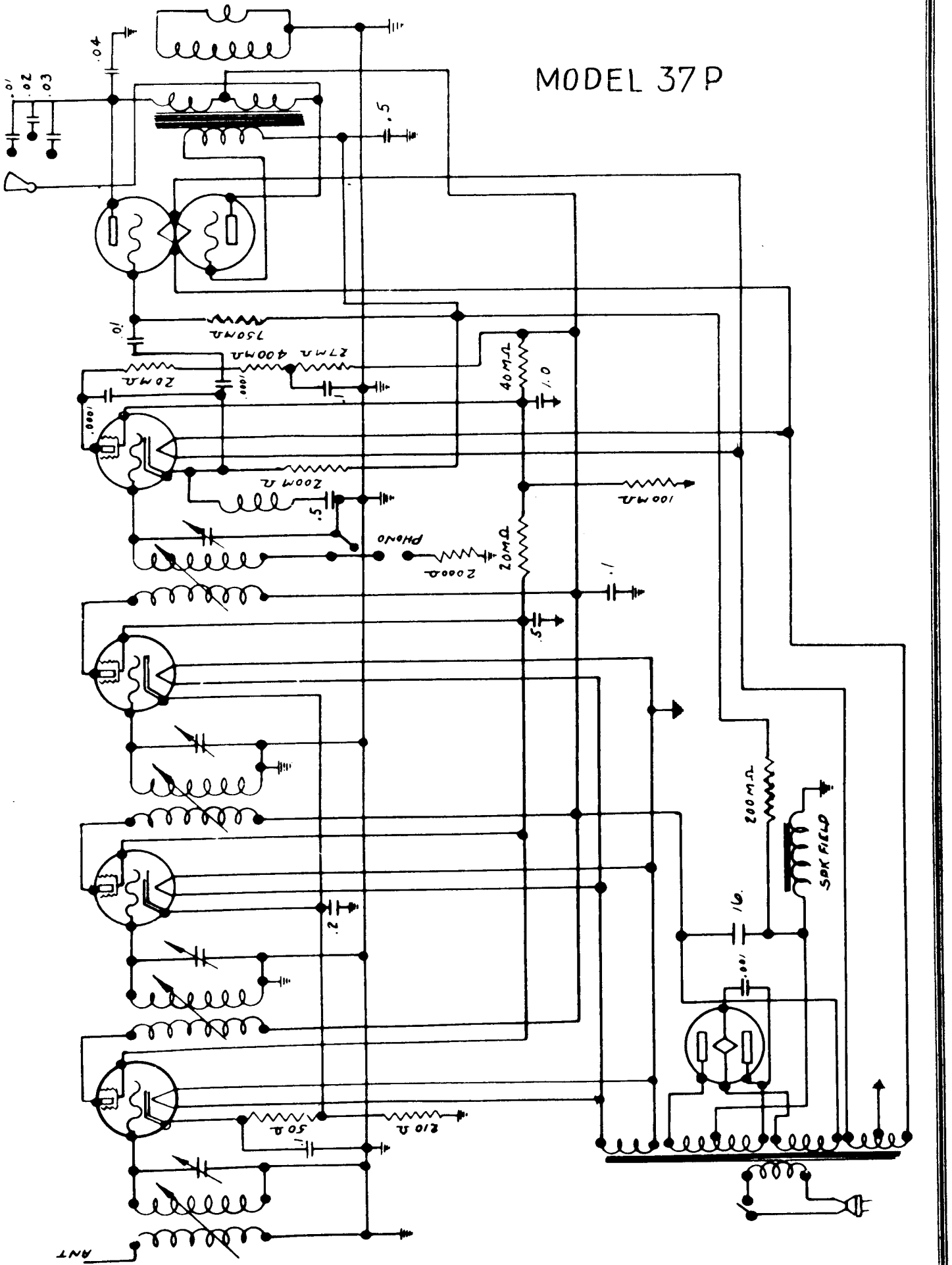


SEARS, ROEBUCK & CO.

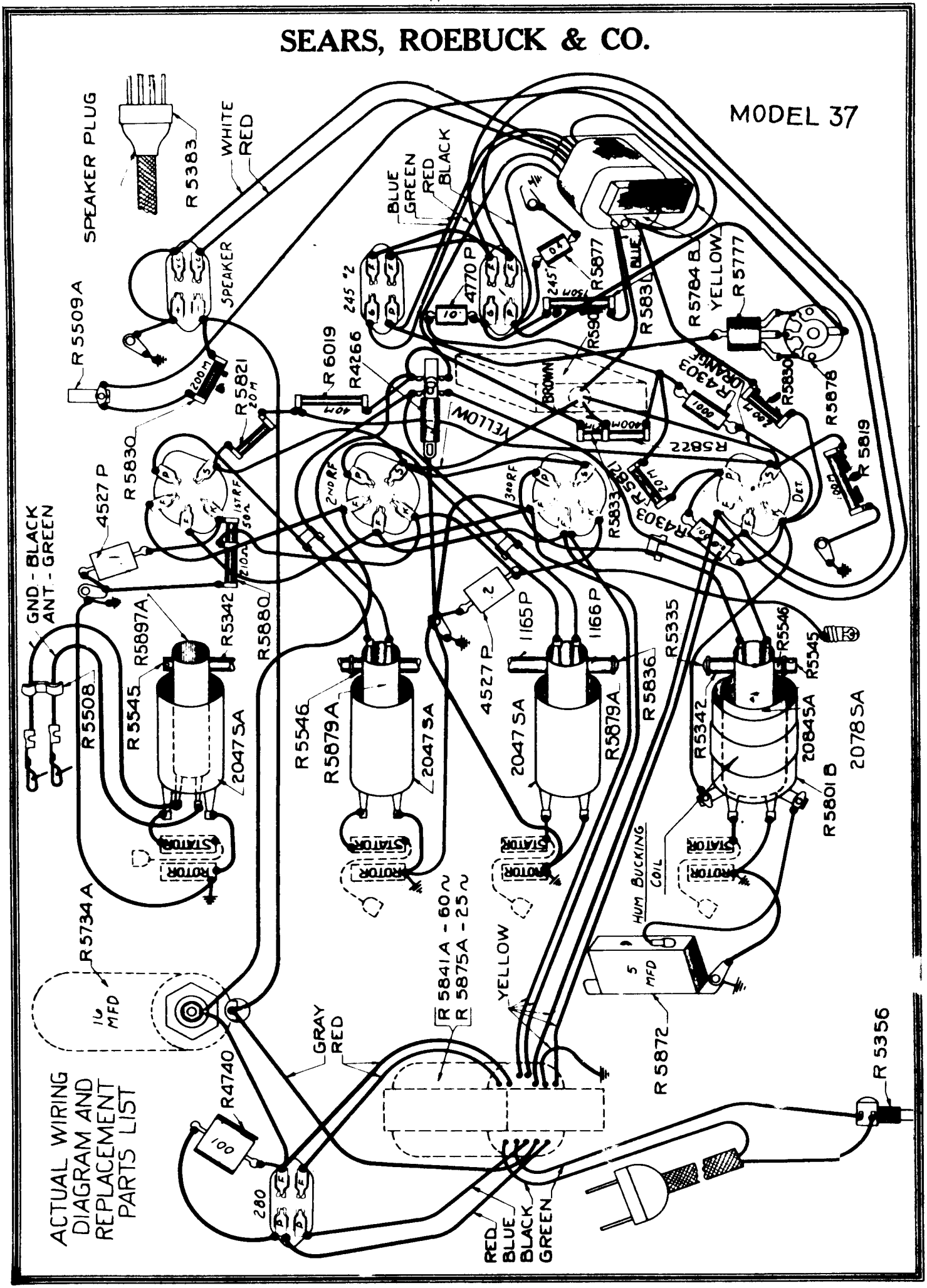
MODEL-36 P



SEARS, ROEBUCK & CO.

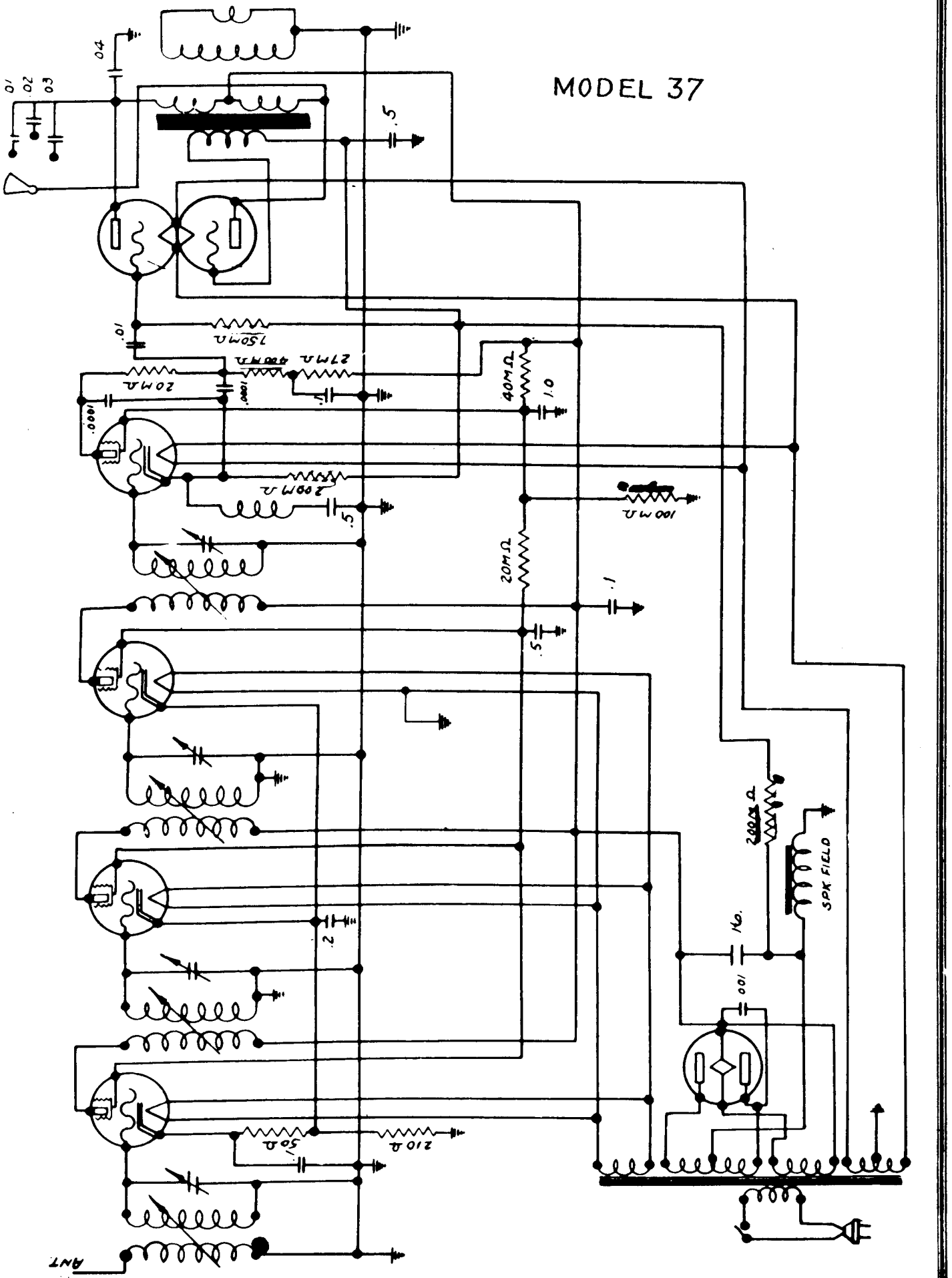


SEARS, ROEBUCK & CO.

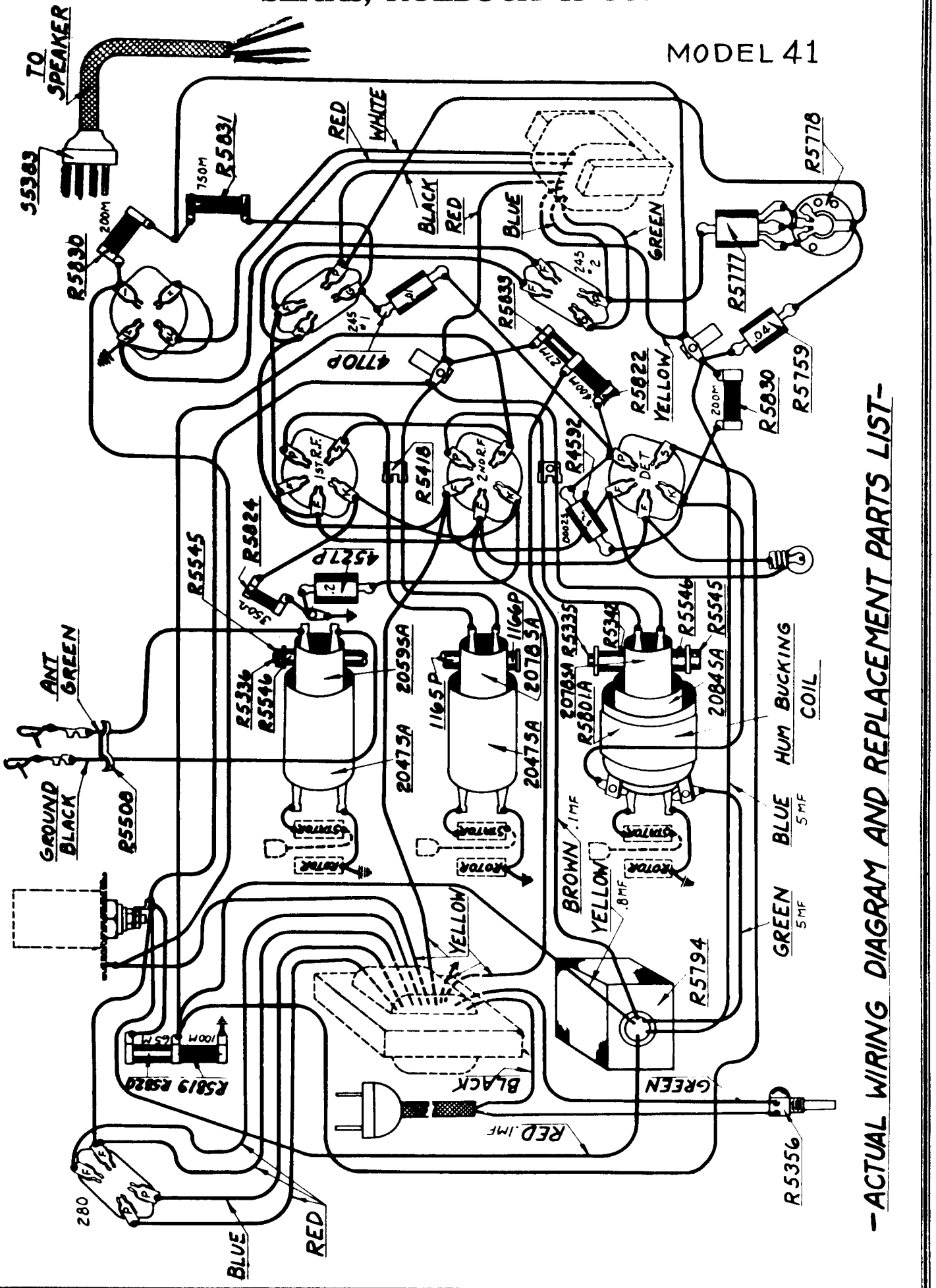


SEARS, ROEBUCK & CO.

MODEL 37

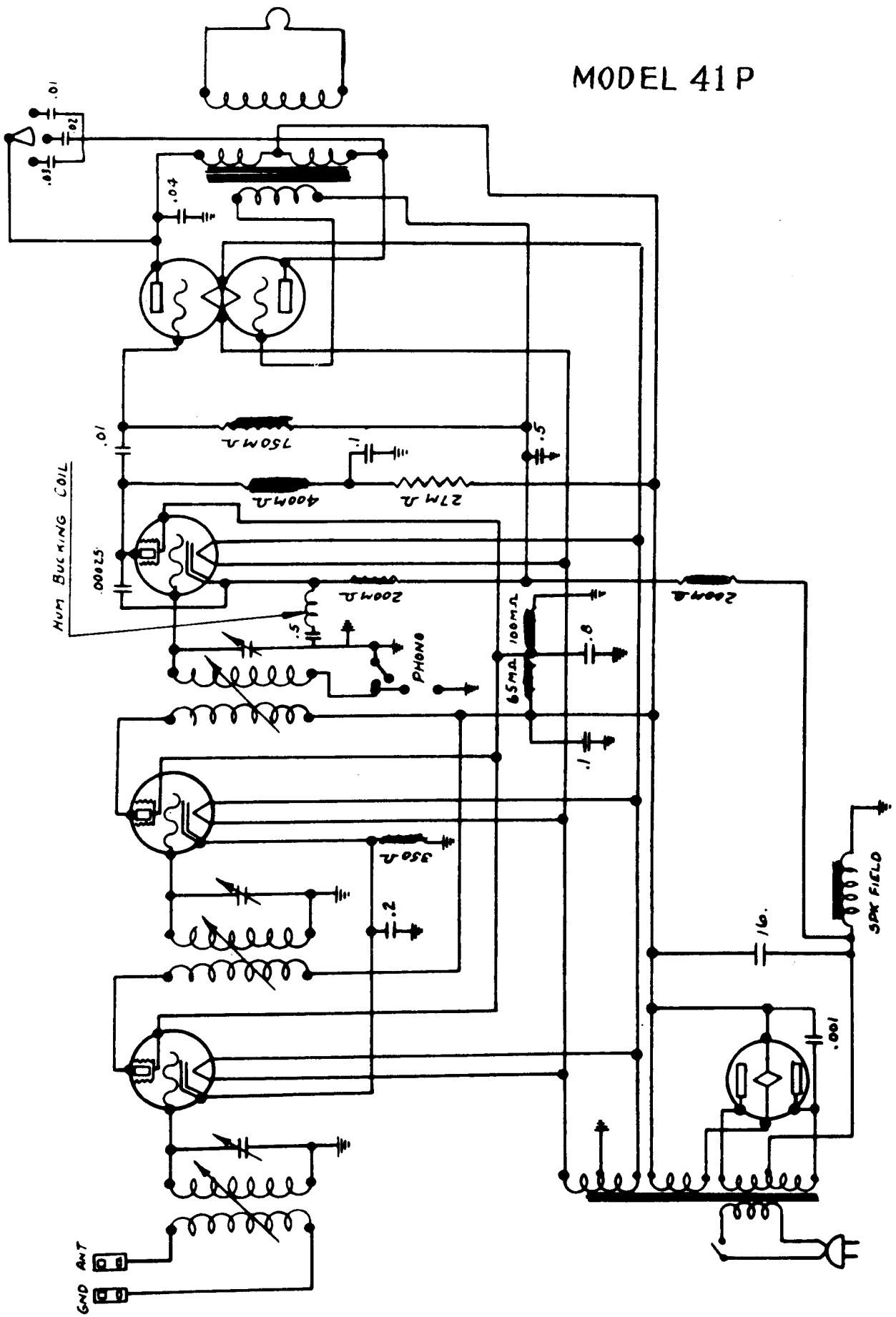


SEARS, ROEBUCK & CO.



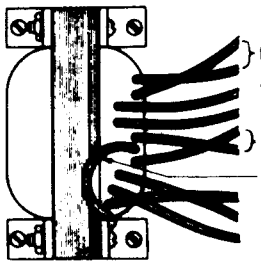
-ACTUAL WIRING DIAGRAM AND REPLACEMENT PARTS LIST-

SEARS, ROEBUCK & CO.

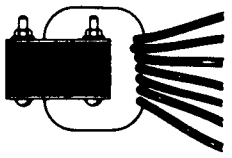


SEARS, ROEBUCK & CO.

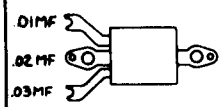
MODEL 41



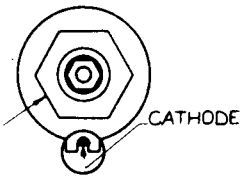
POWER TRANSFORMER
R 5779 A - 60 ~
R 5826 A - 25 ~



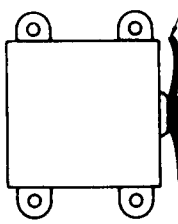
AUDIO, INPUT-OUTPUT TRANSFORMER
R 5784 A



TONE CONTROL CONDENSER
R 5777



ELECTROLYTIC CONDENSER
R 5734 A



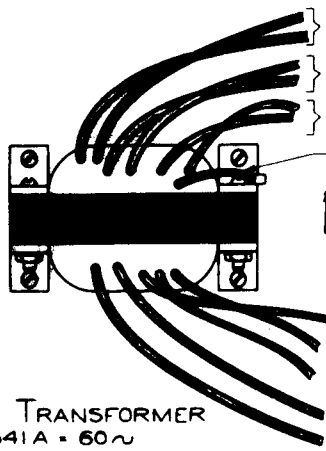
FILTER CONDENSER
R 5794 - 60 CYCLE
25 CYCLE

SECONDARY COIL
DET. SEC COIL = D 2084 SA (YELLOW SPOT)
R.F. SEC COIL = D 2047 SA (PLAIN)

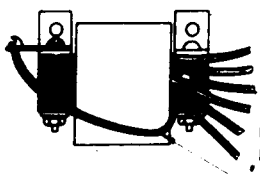
PRIMARY COIL
ANT PRIM COIL = D-2059-SA (YELLOW SPOT)
RF PRIM COIL = D-2078-SA (PLAIN)

LEAD DETAILS OF POWER & AUDIO TRANSFORMER, FILTER, TONE CONTROL & ELECTROLYTIC CONDENSERS, PRIMARY & SECONDARY R F COILS

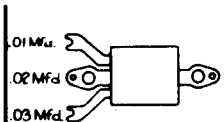
MODEL 37



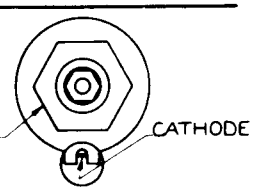
POWER TRANSFORMER
R 5841 A - 60 ~
R 5875 A - 25 ~



AUDIO, INPUT-OUTPUT TRANSFORMER
R 5784 B

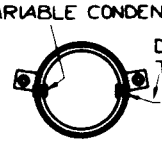


TONE CONTROL CONDENSER
R 5777



ELECTROLYTIC CONDENSER
R 5734 A

FILTER CONDENSER
R 5901 - 60 CYCLE
25 CYCLE

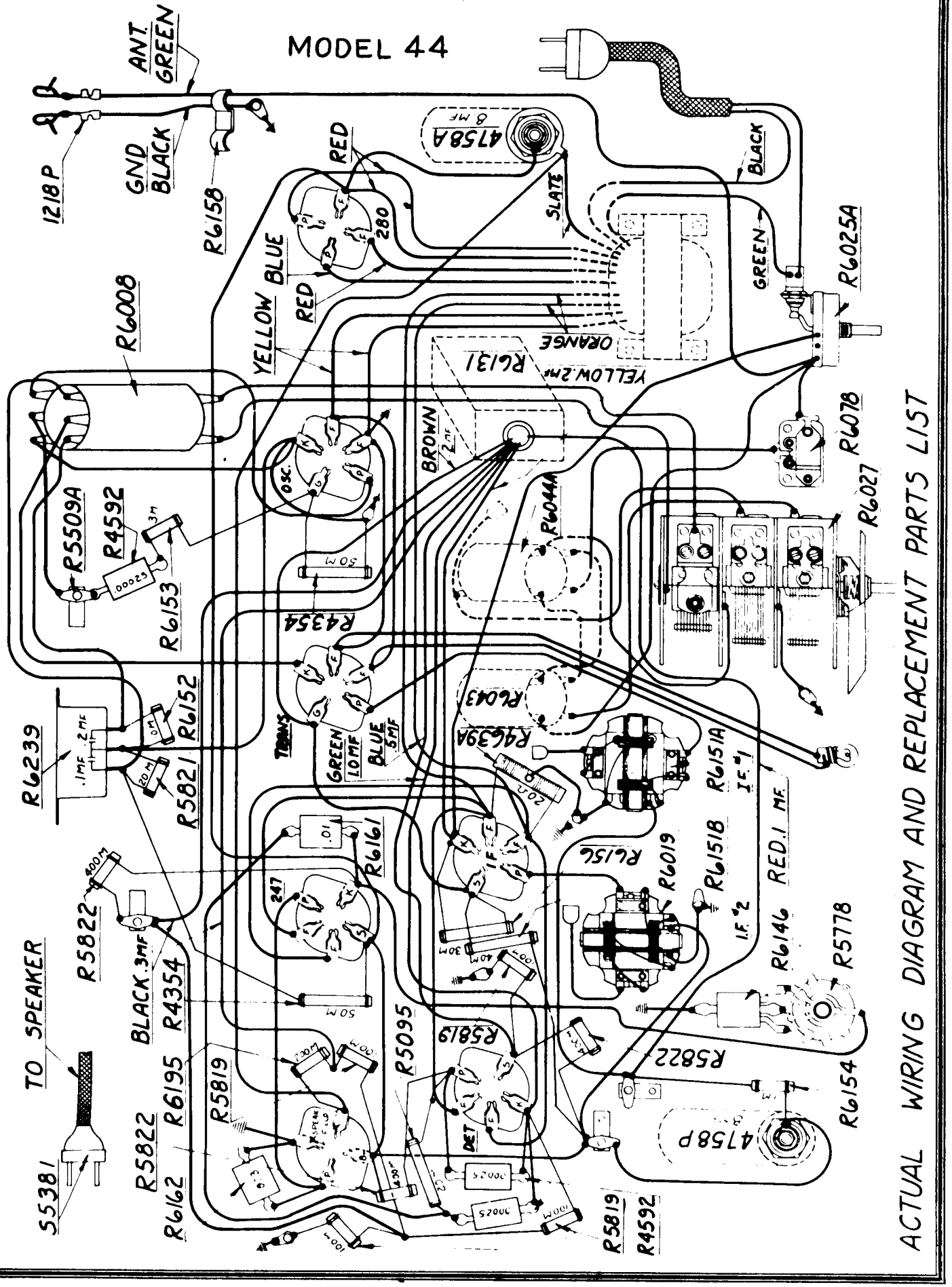


SECONDARY COIL
DET. SEC COIL = D-2084-SA (YELLOW SPOT)
RF SEC COIL = D-2047-SA (PLAIN)

PRIMARY COIL
1-ANT PRI COIL R 5897A
2-R F PRI COIL R 5879 A (GREEN SPOT)
1-R F PRI COIL D 2078 SA (DET)

LEAD DETAILS OF POWER & AUDIO TRANSFORMER, FILTER, TONE CONTROL & ELECTROLYTIC CONDENSERS, PRIMARY & SECONDARY R F COILS.

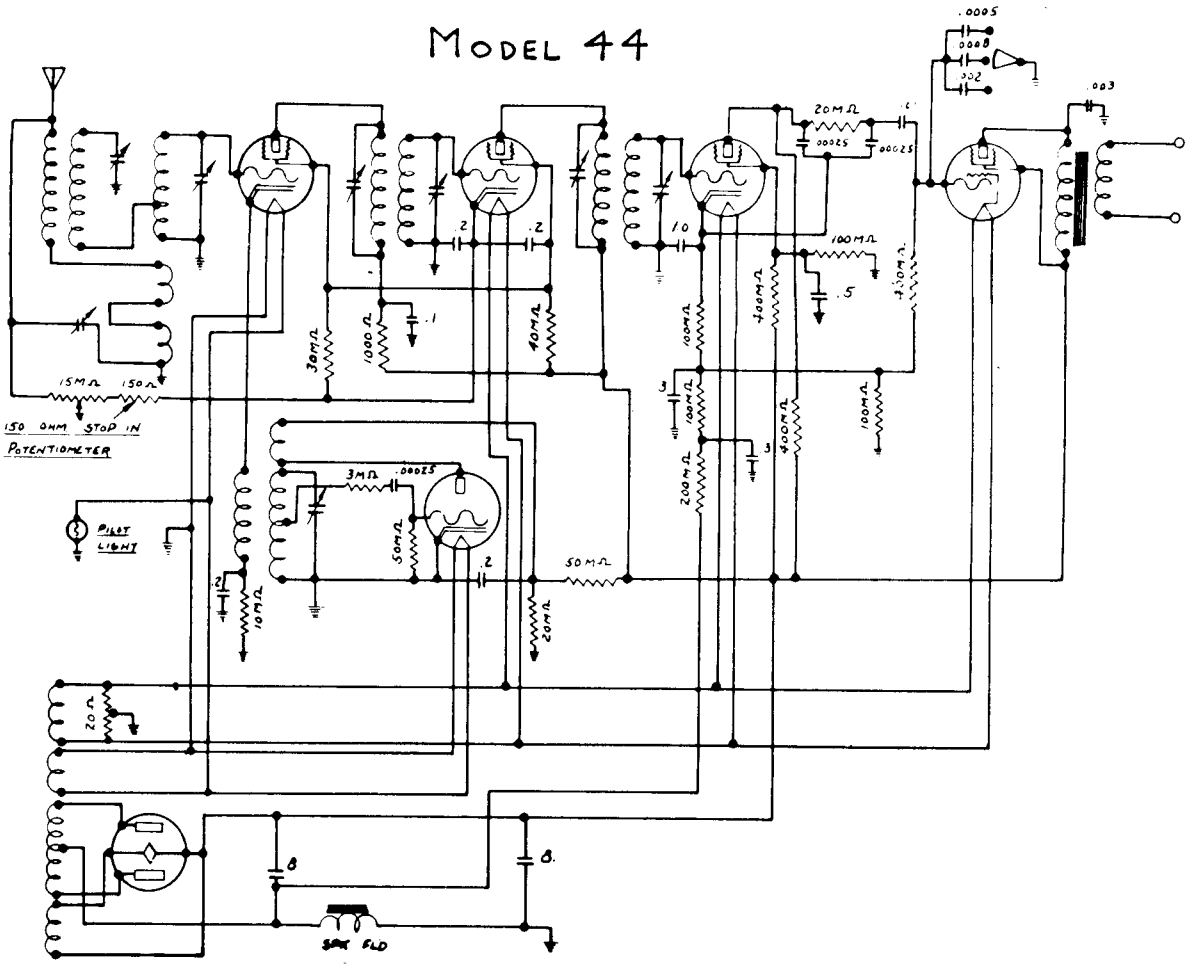
SEARS, ROEBUCK & CO.

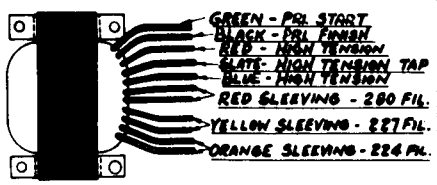


ACTUAL WIRING DIAGRAM AND REPLACEMENT PARTS LIST

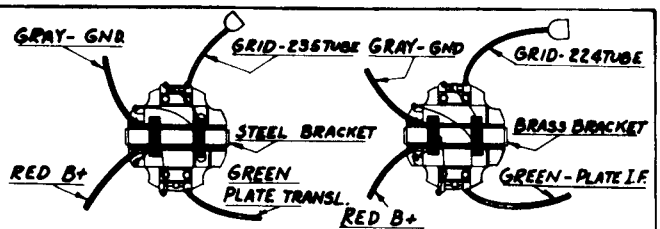
SEARS, ROEBUCK & CO.

MODEL 44

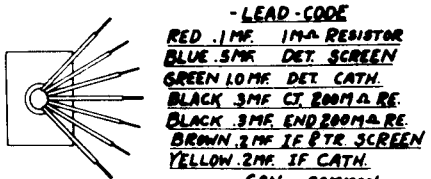




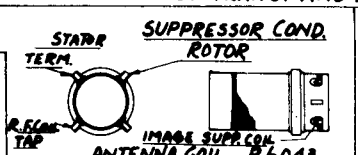
POWER TRANSFORMER
60 CYCLE R6160
25 CYCLE R 6085



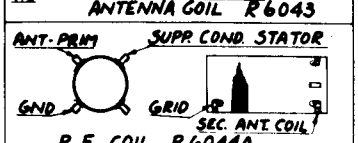
R6151A R6151B
ASSEM I.F. TRANS. AND I.F. TUNING CONDENSERS



FILTER CONDENSER
R6131

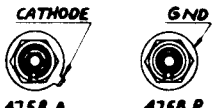


ANTENNA COIL R6043

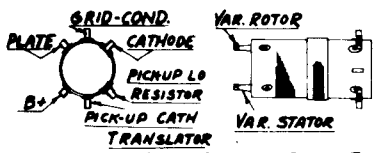


R.F. COIL R6044A

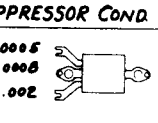
SUPPRESSOR COND. R6218



ELECTROLYTIC CONDENSERS



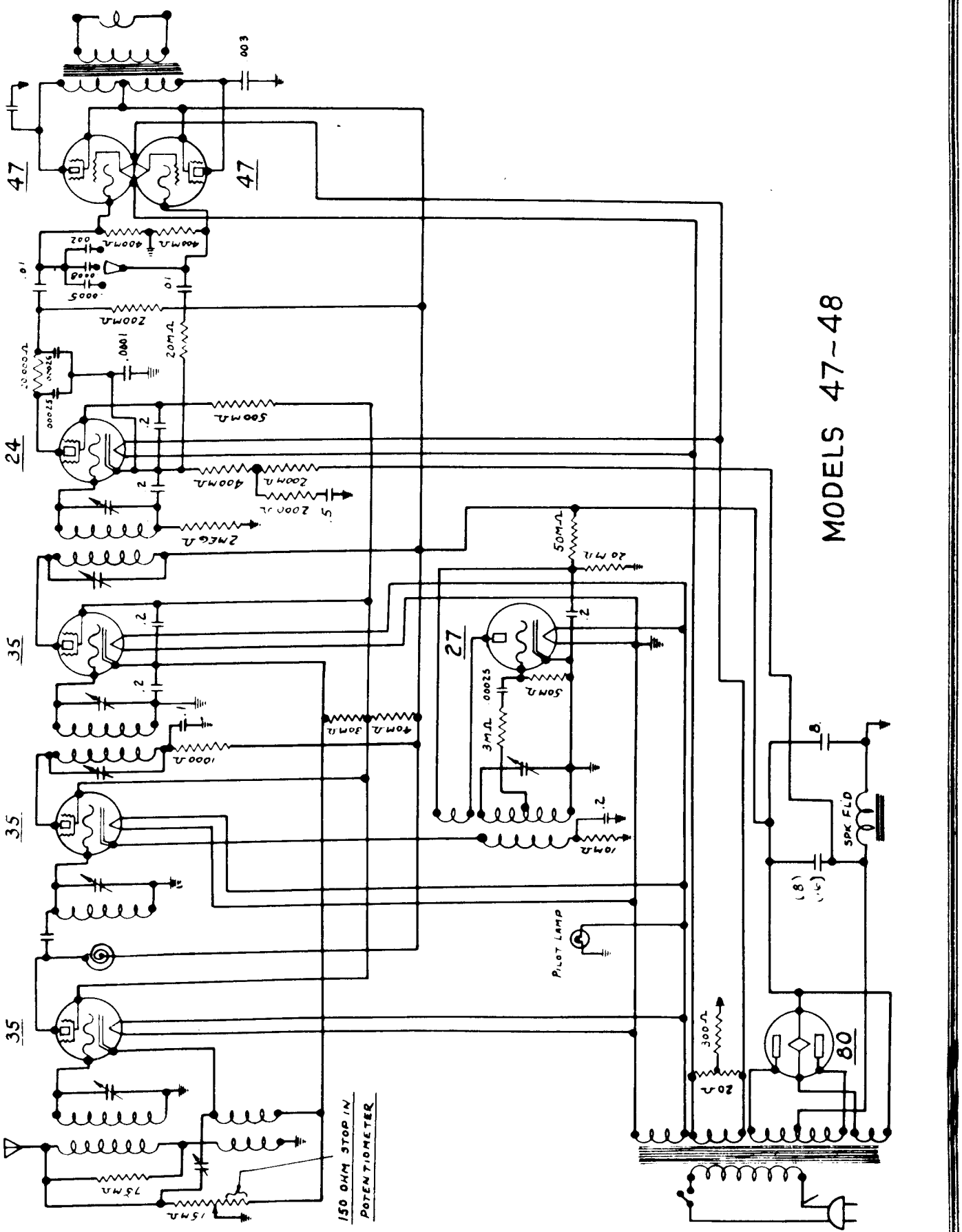
OSCILLATOR COIL R6008



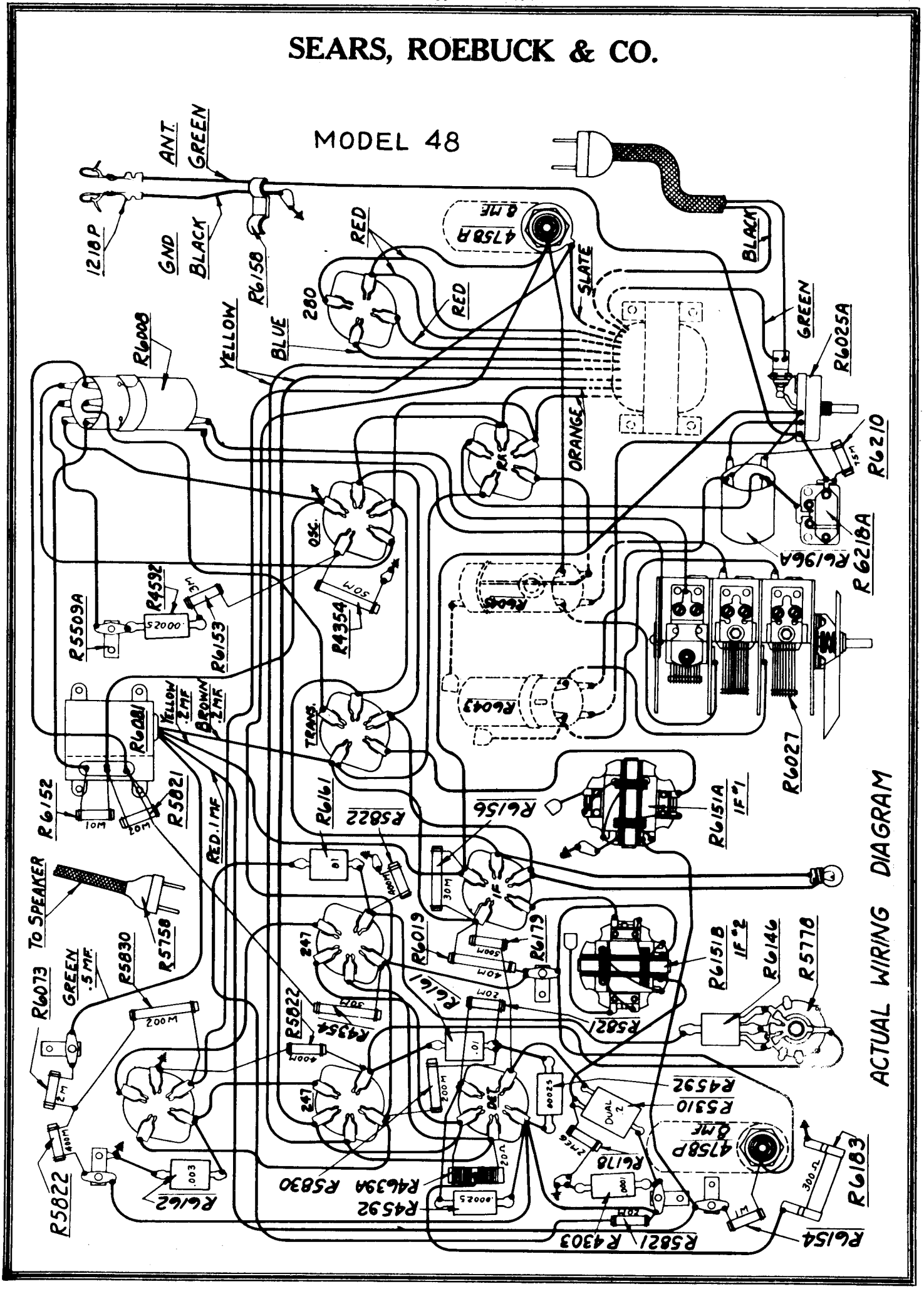
TONE CONTROL CONDENSER R6146

LEAD DETAILS OF POWER TRANSFORMER - I.F. TRANS. - I.F. TUNING COND - FILTER. TONE CONTROL ELECTROLYTIC & SUPPRESSOR CONDENSERS - R.F. - ANT & OSCILLATOR COILS MODEL 44

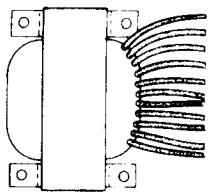
SEARS, ROEBUCK & CO.



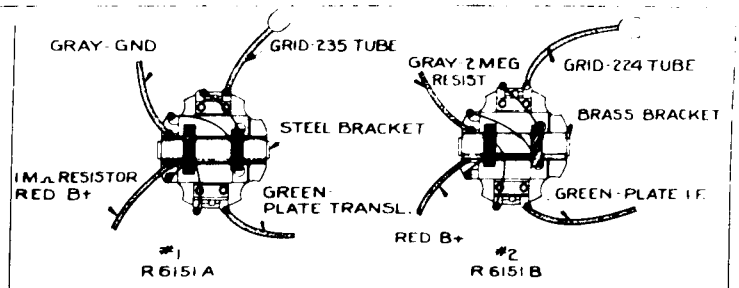
SEARS, ROEBUCK & CO.



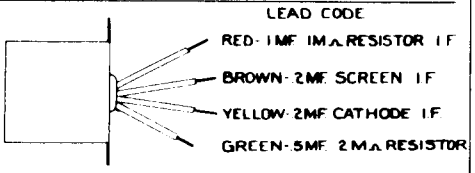
SEARS, ROEBUCK & CO.



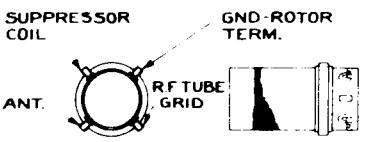
POWER TRANSFORMER
R 6080A - 60 ~
R 6185A - 25 ~



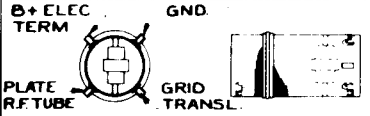
ASSEM. I.F. TRANS & I.F. TUNING CONDENSERS



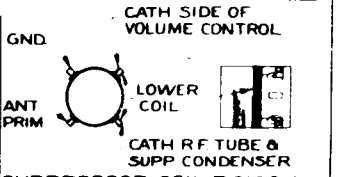
FILTER CONDENSER - R6072



ANTENNA COIL R6043



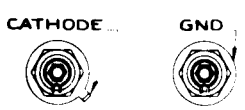
R.F. COIL R6045



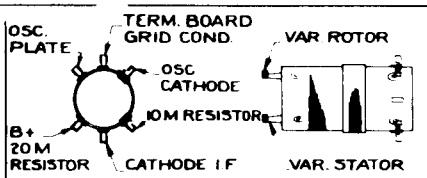
SUPPRESSOR COIL R6196A

SUPPRESSOR COND R6218

TONE CONTROL CONDENSER R6146

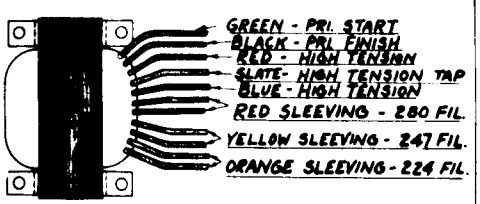


ELECTROLYTIC CONDENSERS

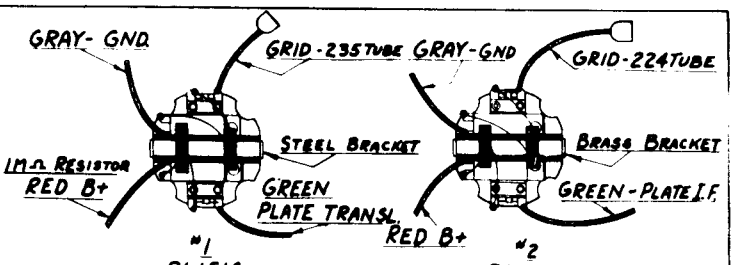


OSCILLATOR COIL R6008

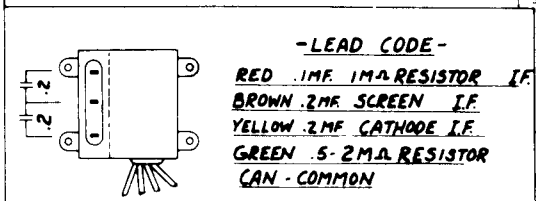
LEAD DETAILS OF POWER TRANSFORMER - I.F. TRANS. - I.F. TUNING COND. - FILTER, TONE CONTROL ELECTROLYTIC & SUPPRESSOR CONDENSERS - R.F. ANT - OSCILL. & SUPPRESSOR COILS. MODEL 47



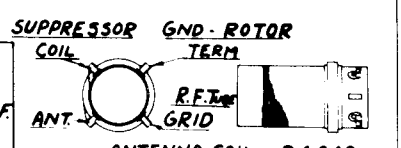
POWER TRANSFORMER
60 CYCLE R6085
25 CYCLE R6181



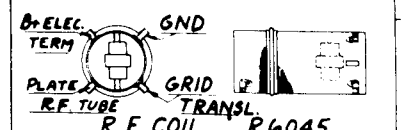
ASSEM I.F. TRANS. AND I.F. TUNING CONDENSERS



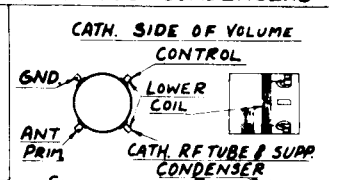
FILTER CONDENSER
R6081



ANTENNA COIL R6043

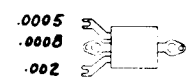


R.F. COIL R6045

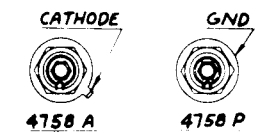


SUPPRESSOR COIL R6196A

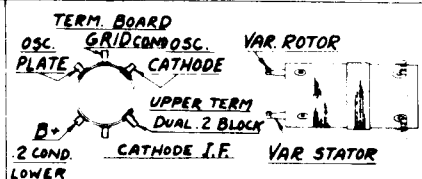
SUPPRESSOR COND. R6218



TONE CONTROL CONDENSER R6146



ELECTROLYTIC CONDENSERS

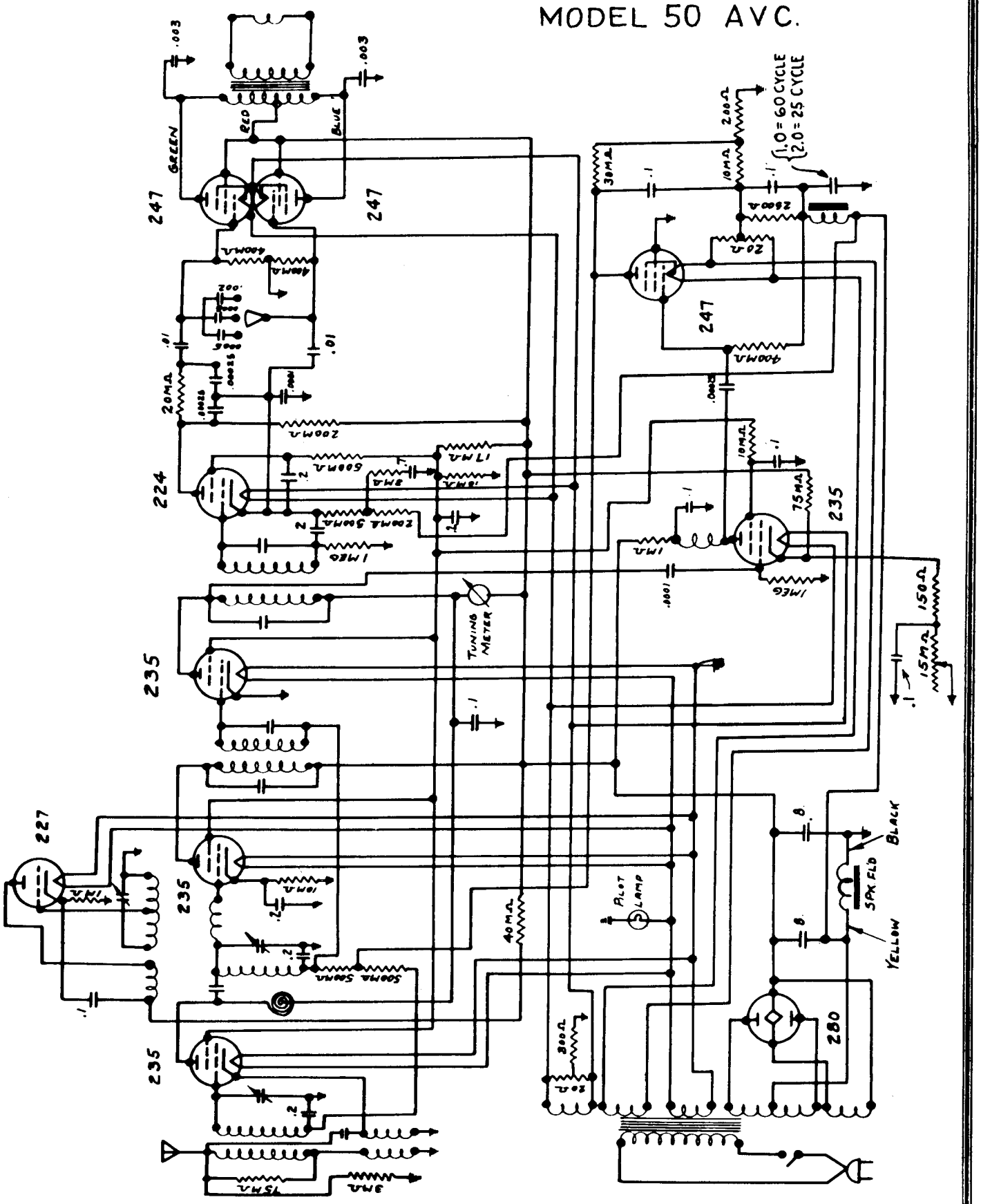


OSCILLATOR COIL R6008

LEAD DETAILS OF POWER TRANSFORMER - I.F. TRANS - I.F. TUNING COND - FILTER, TONE CONTROL ELECTROLYTIC & SUPPRESSOR CONDENSERS - R.F - ANT - OSCILL. & SUPPRESSOR COILS - MODEL 48

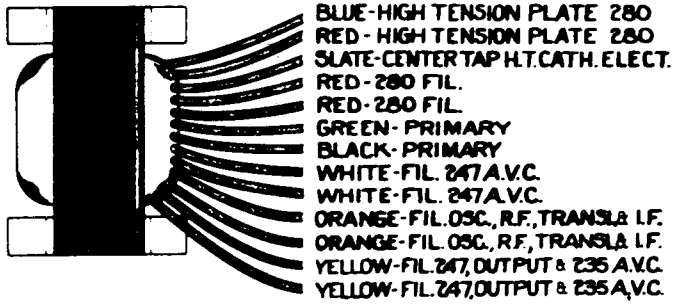
SEARS, ROEBUCK & CO.

MODEL 50 AVC.

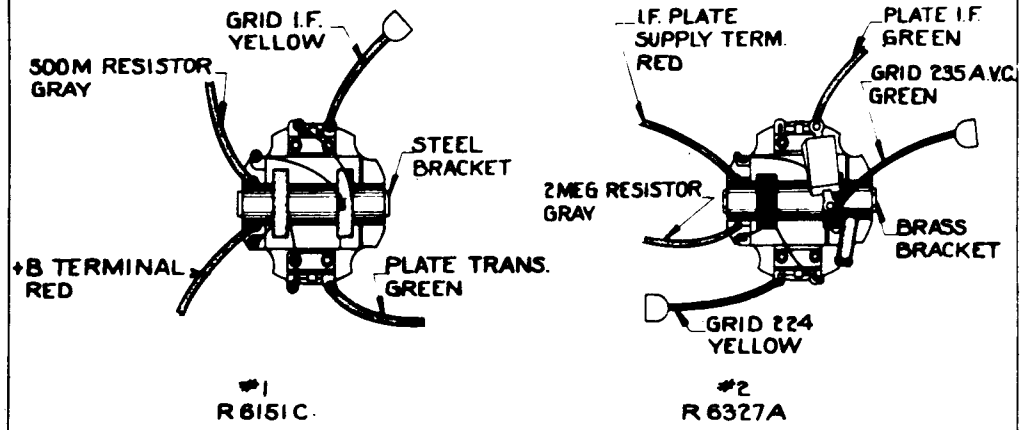


SEARS, ROEBUCK & CO.

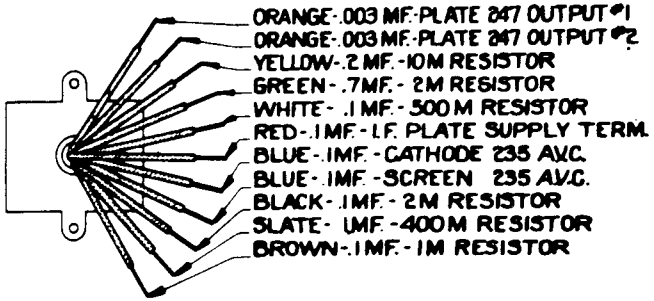
MODEL 50 AVC.



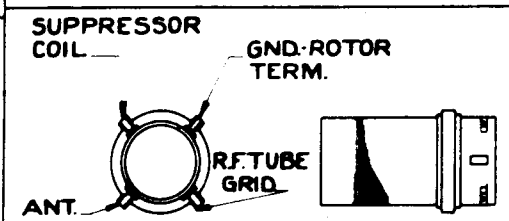
POWER TRANSFORMER
R 6248 A - 60 ~
R 6249 A - 25 ~



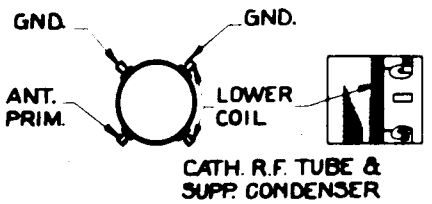
ASSEM. I.F. TRANS & I.F. TUNING CONDENSERS



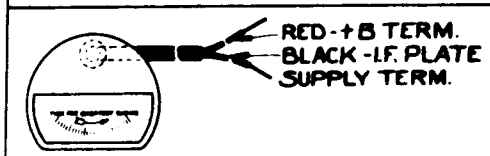
FILTER CONDENSER-R 6238



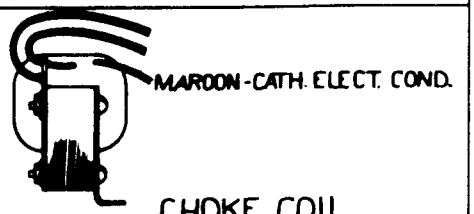
ANTENNA COIL R 6043



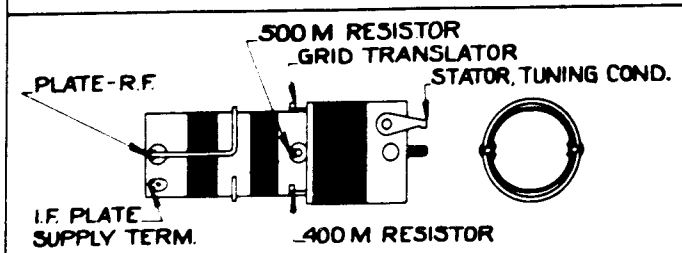
SUPPRESSOR COIL R 6196 A



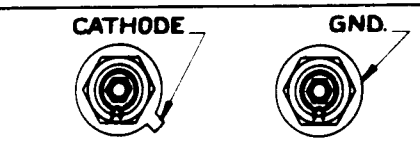
TUNING METER
R 6241



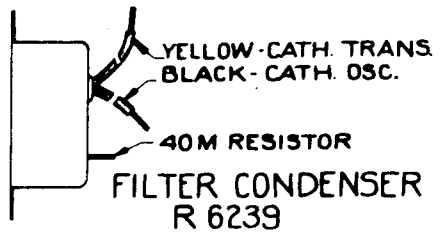
CHOKE COIL
R 6245 A



TRANSLATOR COIL R 6252 B



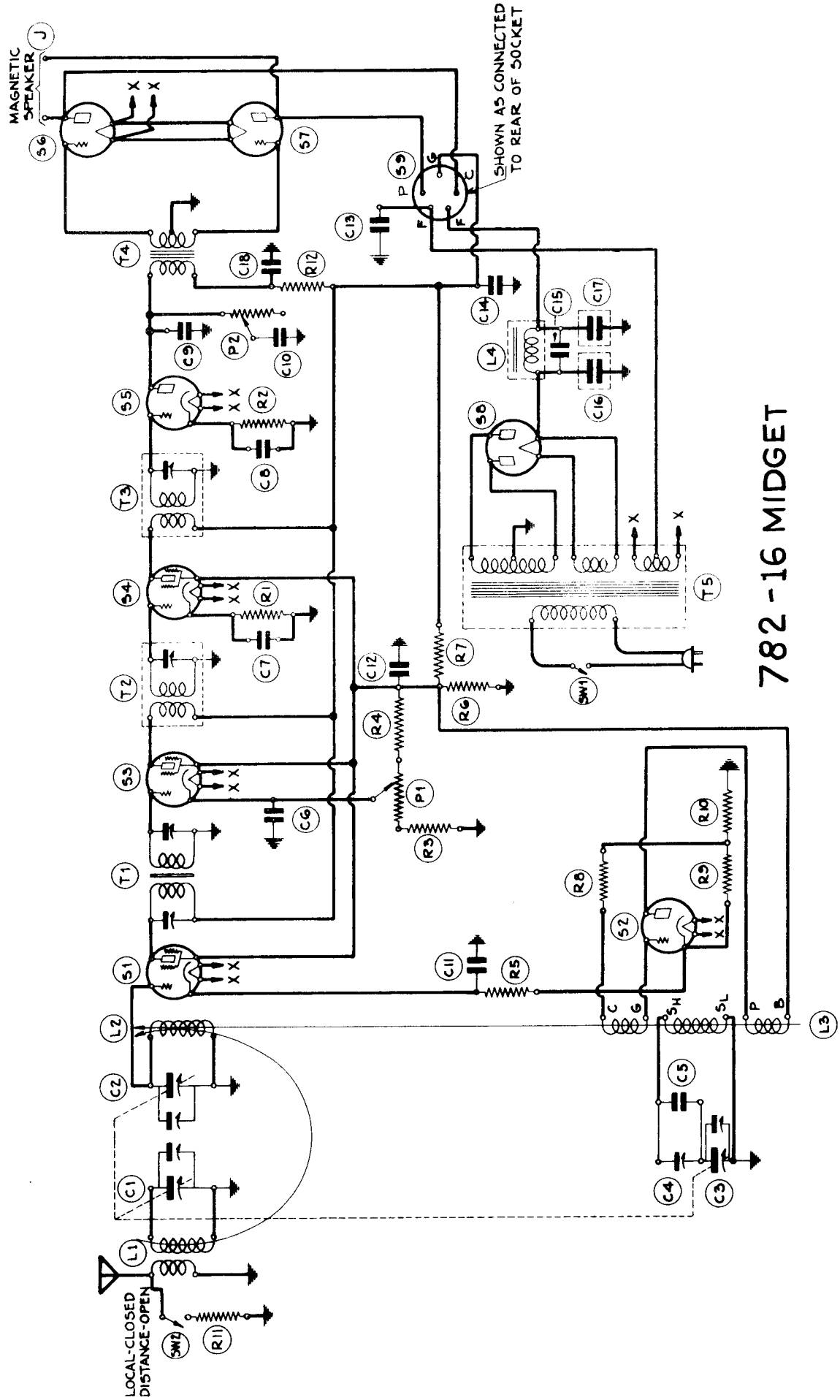
ELECTROLYTIC CONDENSERS



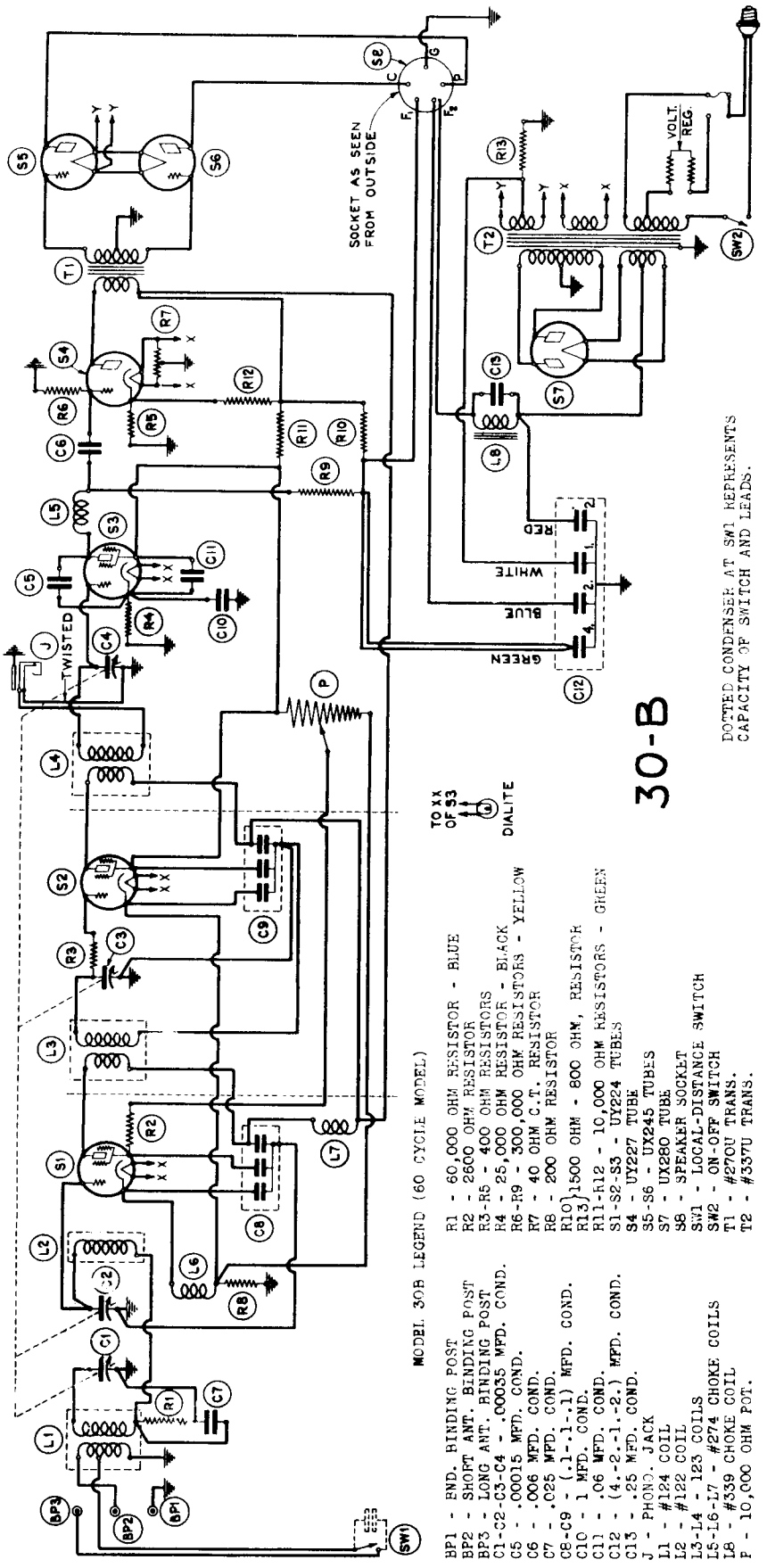
FILTER CONDENSER
R 6239

LEAD DETAILS OF POWER TRANSFORMER-I.F. TRANS.-I.F. TUNING COND.-FILTER COND.-ELECTROLYTIC COND.-ANTENNA, SUPPRESSOR, TRANSLATOR AND CHOKE COILS - TUNING METER.

SILVER-MARSHALL INC.



SILVER-MARSHALL INC.



MODEL 30B LEGEND (60 CYCLE MODEL)

BP1 - END. BINDING POST
BP2 - SHORT ANT. BINDING POST
BP3 - LONG ANT. BINDING POST
C1-C2-C3-C4 - .00035 MFD. COND.
C5 - .00015 MFD. COND.
C6 - .006 MFD. COND.
C7 - .025 MFD. COND.
C8-C9 - (.1-.1-.1) MFD. COND.
C10 - 1 MFD. COND.
C11 - .06 MFD. COND.
C12 - (4.-2.-1.-2.) MFD. COND.
C13 - .25 MFD. COND.
J - PHONO. JACK
L1 - #124 COIL
L2 - #122 COIL
L3-L4 - 123 COILS
L5-L6-L7 - #274 CHOKE COILS
L8 - #339 CHOKE COIL
P - 10,000 OHM POT.
R1 - 60,000 OHM RESISTOR - BLUE
R2 - 2600 OHM RESISTOR
R3-R5 - 400 OHM RESISTORS
R4 - 25,000 OHM RESISTOR - BLACK
R6-R9 - 300,000 OHM RESISTORS - YELLOW
R7 - 40 OHM C.T. RESISTOR
R8 - 200 OHM RESISTOR
R10, R13 } 1500 OHM - 800 OHM, RESISTOR
R11-R12 - 10,000 OHM RESISTORS - GREEN
S1-S2-S3 - UY224 TUBES
S4 - UY227 TUBE
S5-S6 - UX245 TUBES
S7 - UX280 TUBE
S8 - SPEAKER SOCKET
SW1 - LOCAL-DISTANCE SWITCH
SW2 - ON-OFF SWITCH
T1 - #270U TRANS.
T2 - #337U TRANS.

LEGEND FOR 25 CYCLE MODEL
SAME AS 60 CYCLE MODEL EXCEPT

C11 - .04 MFD. COND. ADD 1. MFD. CONDENSER
C13 - 2. MFD. COND. ACROSS TERMINALS OF R12
T2 - #337-25U TRANS.

SILVER-MARSHALL INC.

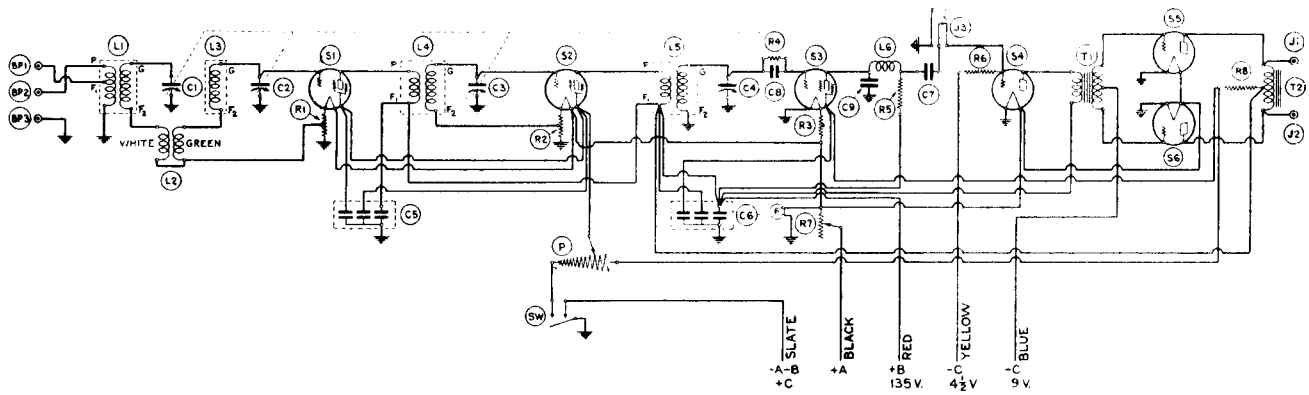
782 AC MIDGET SUPERHETERODYNE

VOLUME CONTROL MAXIMUM

Tube Number	Type of Tube	Shield Volts	"A" Volts	"B" Volts	"C" Volts	Cathode Volts	Normal Plate MA
1st Det.	224	68	2.16	200		6	3.2
Oscillator	227		2.14	68		5	5
1st I.F.	224	68	2.18	200		1.6	5.7
2nd I.F.	224	68	2.19	200		2.3	5.6
2nd Det.	227		2.20	200		20	0.8
Audio	245		2.25	245	47		29
Audio	245		2.25	243	46		28

(280 Filament to ground, 400 volts)
(280 Filament, 5.1 volts AC)

C5 - 750 Mmfd.		R1 - 750 Ohms	Wire wound
C6 - 0.1 Mfd.		R2 - 25,000 ohms	1 Watt
C7 - 0.1 Mfd.		R3 - 200 ohms	Wire wound
C8 - 1.0 Mfd.	150 V.	R4 - 25,000 ohms	1 Watt
C9 - .001 Mfd.	Mica	R5 - 10000 ohms	1 Watt
C10 - .025 Mfd.		R6 - 10,000 ohms	1 Watt
C11 - 0.1 Mfd.		R7 - 10,000 ohms	3 Watt
C12 - 1.0 Mfd.	150 V.	R8 - 400 ohms	Wire wound
C13 - 0.1 Mfd.		R9 - 100 ohms	Wire wound, tapped at 100 ohms
C14 - 1.0 Mfd.	300 V.	R10 - 1000 ohms	
C15 - .25 Mfd.			
C16 - 8.0 Mfd.	Electrolytic		
C17 - 8.0 Mfd.	Electrolytic		

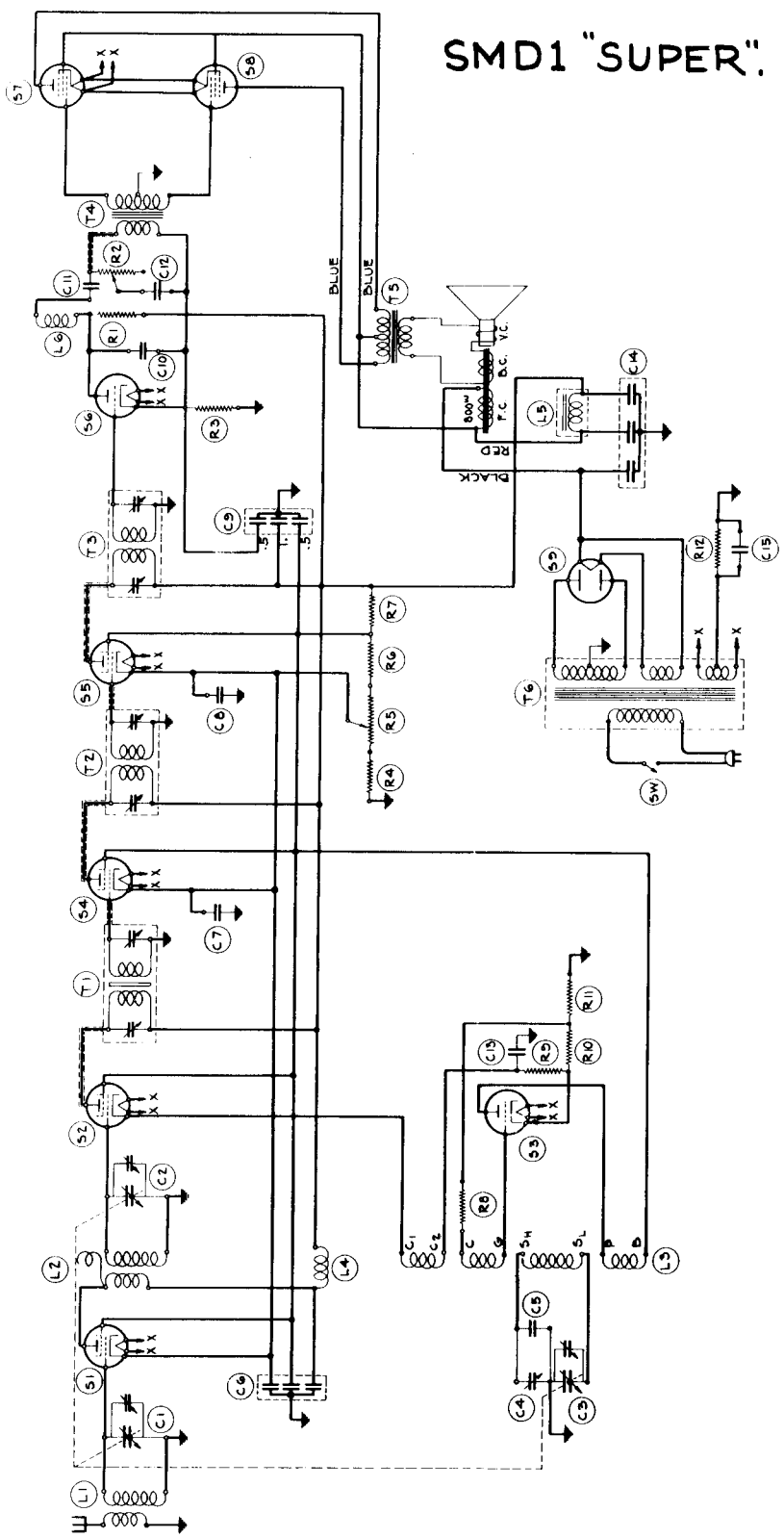


722 D.C.

C5, C6	2	Potter 30B condenser blocks
C7	1	Polymet .006 large moulded condenser
C8	1	Polymet .00015 condenser
C9	1	Polymet .0005 condenser
P	1	Yaxley 10-MJP 10,000 ohm potentiometer
J1, J2	2	Yaxley 422 Insulated tip-jacks
J3	1	Carter 2A closed circuit jack
R1, R2, R3	3	Yaxley 815C 15-ohm center-tapped resistor
R4, R6	2	Durham 2-megohm 1-watt resistors (red)
R5	1	Durham 60,000 ohm 1-watt resistor (blue)
R7	1	Carter Sub-base rheostat
R8	1	Durham 20,000 ohm 1-watt resistor (orange)

SILVER-MARSHALL INC.

SMD1 "SUPER".

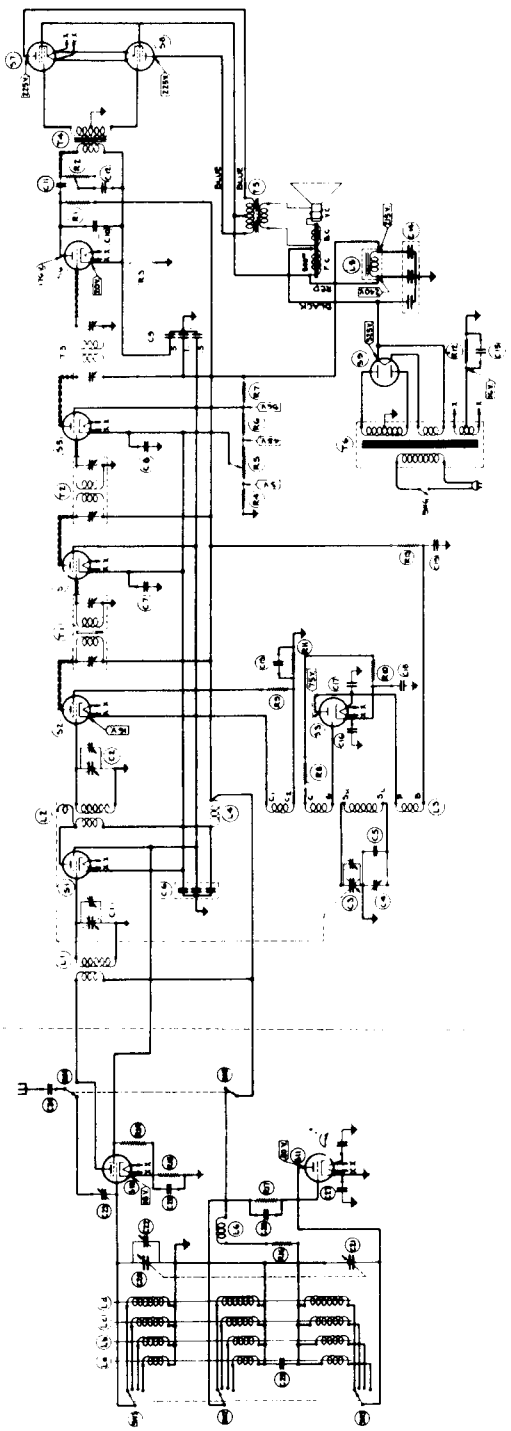


R1 - 30,000 ohms 1 watt
R2 - 1/2 megohm tapered variable resistor
R3 - 60,000 ohms 1 watt
R4 - 200 ohms wire wound
R5 - 4500 ohms volume control (tapered)
R6 - 13,000 ohms 1 watt
R7 - 15,000 ohms 2 watt
R8 - 400 ohms wire wound
R9 - 10,000 ohms 1 watt
R10 - 100 ohms) -1100 ohm tapped resistor
R11 - 1000 ohms)
R12 - 220 ohms 2 watt

C5 - 750 Mmfd. ± 10% (Mica)
C6 - Triple .1 Mfd. Cond.
C7 - .1 Mfd.
C8 - .1 Mfd.
C9 - .5, .5, 1. Mfd. Con.
C10 - .001 Mfd. (Mica)
C11 - 0.15 Mfd.
C12 - .025 Mfd.
C13 - .1 Mfd.
C14 - Three 4 mfd. units (dry electrolytic)
C15 - .1 Mfd.

SILVER-MARSHALL INC.

726 S.W.



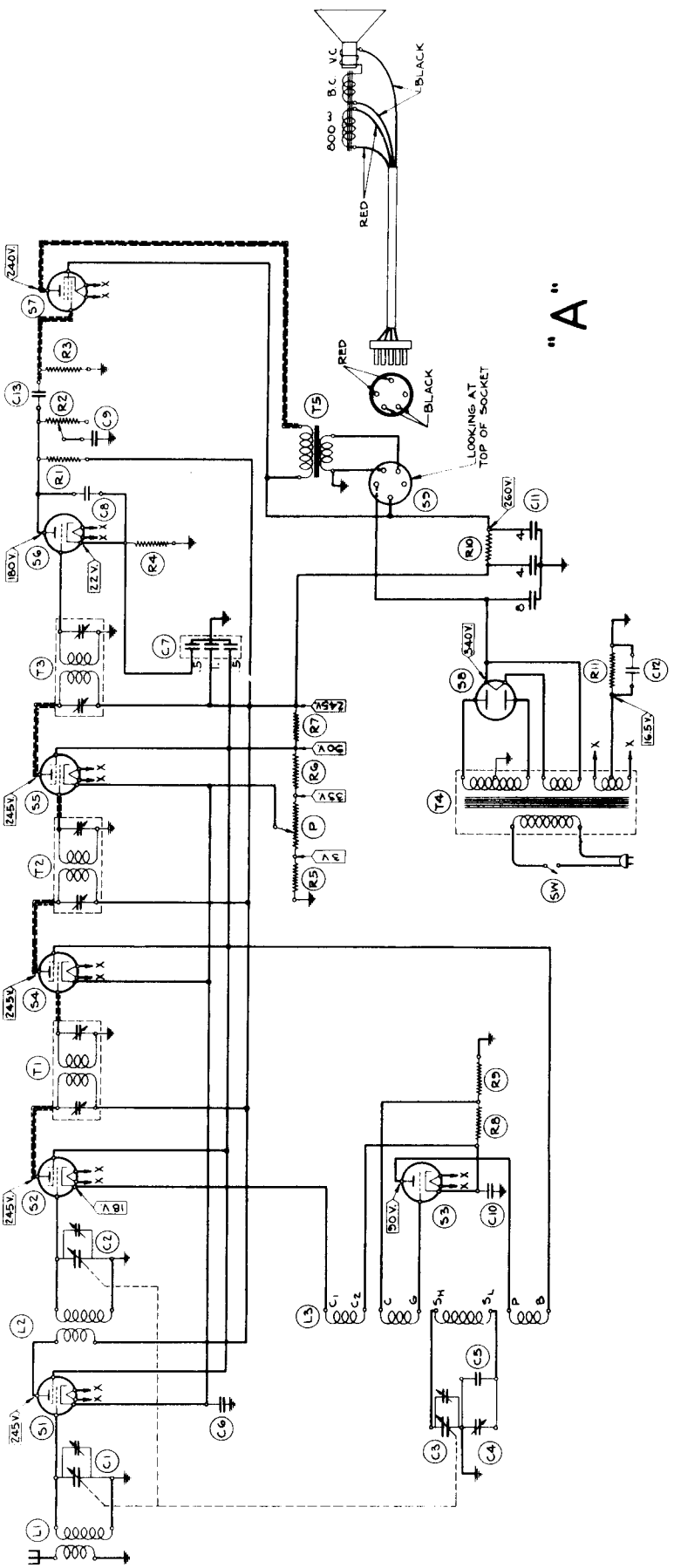
C1-C2-C3 - 407 Mmfd. Max. (3-gang variable)
C4 - Variable 250-600 Mmfd.
C5 - 750 Mmfd. ± 10% (Mica)
C6 - Triple 0.1 Mfd.
C7 - .1 Mfd.
C8 - .1 Mfd.
C9 - .5, .5, 1.0 Mfd.
C10 - .001 Mfd. (Mica)
C11 - 0.15 Mfd.
C12 - .025 Mfd.
C13 - .1 Mfd.
C14 - Three 4 Mfd. units (dry Electrolytic) Potter
C15 - .1 Mfd.
C16 - .006 Mfd.
C17 - .006 Mfd.
C18 - .1 Mfd.
C19 - .1 Mfd.
C20-C21 - 140 Mmfd. (2-gang variable)
C22 - 80 Mmfd. (variable)
C23 - Compensating Cond.
C24 - .006 Mfd.
C25 - .006 Mfd.
C26 - .001 Mfd. (Mica)
C27 - .006 Mfd.
C28 - .006 Mfd.

R1 - 30,000 ohms 1 watt
R2 - 1/2 megohm tapered variable resistor
R3 - 60,000 ohms 1 watt
R4 - 100 ohms wire wound
R5 - 4,500 ohms volume control (tapered)
R6 - 13,500 ohms 1 watt
R7 - 15,000 ohms 2 watt
R8 - 400 ohms wire wound
R9 - 60,000 ohms 1 watt
R10- 100 ohms wire wound
R11- 10,000 ohms 1 watt
R12- 220 ohms 2 watt
R13- 10,000 ohms 2 watt
R14- 60,000 ohms 1 watt
R15- 6,500 ohms 1 watt
R16- 10,000 ohms 2 watt
R17- 10,000 ohms 1 watt

VOLTAGES WITH VOLUME CONTROL AT MAXIMUM

Tube Number		Type of Tube	"A" Volts	"B" Volts	Screen Volts	"C" Volts	Normal Plate Current Mills
S.W. Det	(S10)	'24	2.2	216	96	18	.08
S.W. Osc.	(S11)	'27	2.25	80	....	0	8.
R.F.	(S1)	'51	2.25	216	96	3	6.
1st Det	(S2)	'24	2.35	216	96	16	.1
Osc.	(S3)	'27	2.35	75	....	1.1	10.
1st I.F.	(S4)	'51	2.3	216	96	3	6.
2nd I.F.	(S5)	'51	2.35	216	96	3	6.
2nd Det.	(S6)	'27	2.35	178	....	20	.1
Audio (right)	(S7)	'47	2.4	224	240	16	32.
Audio (left)	(S8)	'47	2.4	220	240	16	32.
Rectifier	(S9)	'80	5.1	.....	....	....	.....

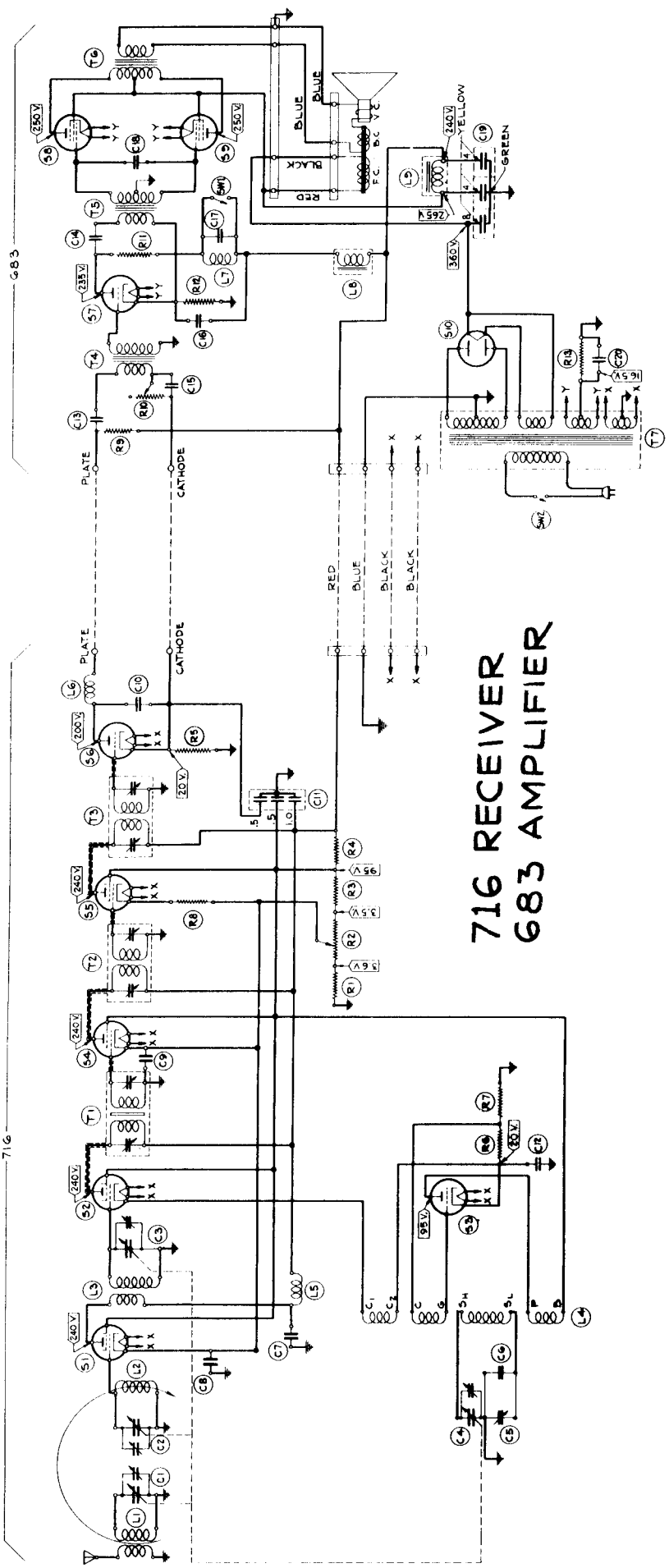
SILVER-MARSHALL INC.



P - 4500 ohm Potentiometer (comb. with switch)

C6 - 1.0 Mfd. Cond. - 250 V. Rating	R1 - 60,000 ohm Resistor -	1 watt, Carbon
C7 - 1.0 Mfd. 300 V., 0.5 - 0.5 Mfd. 200 V.	R2 - 1/2 megohm Variable Resistor	
C8 - .001 Mfd. Cond. (Mica)	R3 - 100,000 ohm Resistor	1 watt, Carbon
C9 - .025 Mfd. Paper Cond. - 400 V. Rating	R4 - 60,000 ohm "	1 watt, Carbon
C10 - 0.1 Mfd. Cond. 200 V. "	R5 - 120 ohm "	wire wound
C11 - One 8 Mfd. Cond. 450 V. "	R6 - 10,000 ohm "	1 watt, Carbon
Two 4 Mfd. Cond. 450 V. "	R7 - 10,000 ohm "	3 watt, Carbon
C12 - 0.1 Mfd. Cond. 200 V. "	R8 - 100 ohm "	)
C13 - .02 Mfd. Cond. 500 V. "	R9 - 1700 ohm "	} wire wound, tapped unit
	R10 - 425 ohm "	1 watt, Carbon
	R11 - 425 ohm "	1 watt, Carbon

SILVER-MARSHALL INC.



R1 - 100 Ohm Resistor - wire wound
R2 - 4500 Ohm Volume Control
R3 - 13,000 Ohm Resistor - 1 Watt, Carbon
R4 - 10,000 Ohm Resistor - 2 Watt, Carbon
R5 - 60,000 Ohm Resistor - 1 Watt, Carbon
R6 - 100 Ohms) Wire wound tapped resistor
R7 - 1700 Ohms)
R8 - 750 Ohms Wire wound resistor
R9 - 30,000 Ohm Resistor - 1 Watt, Carbon
R10 - 1 Megohm riable Resistor
R11 - 1000 Ohm Resistor - 1 Watt, Carbon
R12 - 2,600 Ohm Resistor - 1 Watt, Carbon
R13 - 220 Ohm Resistor - 2 Watt, Carbon

C7 - .1 Mfd. Cond. 200V.
C8 - .1 Mfd. Cond. 200V.
C9 - .1 Mfd. Cond. 200V.
C10 - .001 Mfd. Cond. Mica
C11 - .5,.5,1.0 Mfd. Cond.(.5-200V.) (1.0-300V)
C12 - .1 Mfd. Cond. 200V.
C13 - .02 Mfd. Cond. 500V.
C14 - .04 Mfd. Cond.
C15 - .001 Mfd. Cond. Mica
C16 - 2 Mfd. Cond.
C17 - .01 Mfd. Cond.
C18 - .00075 Mfd. Cond.
C19 - 2 4mfd. Cond.
1 8Mfd. Cond.
C20 - .1 Mfd. Cond. 200V.

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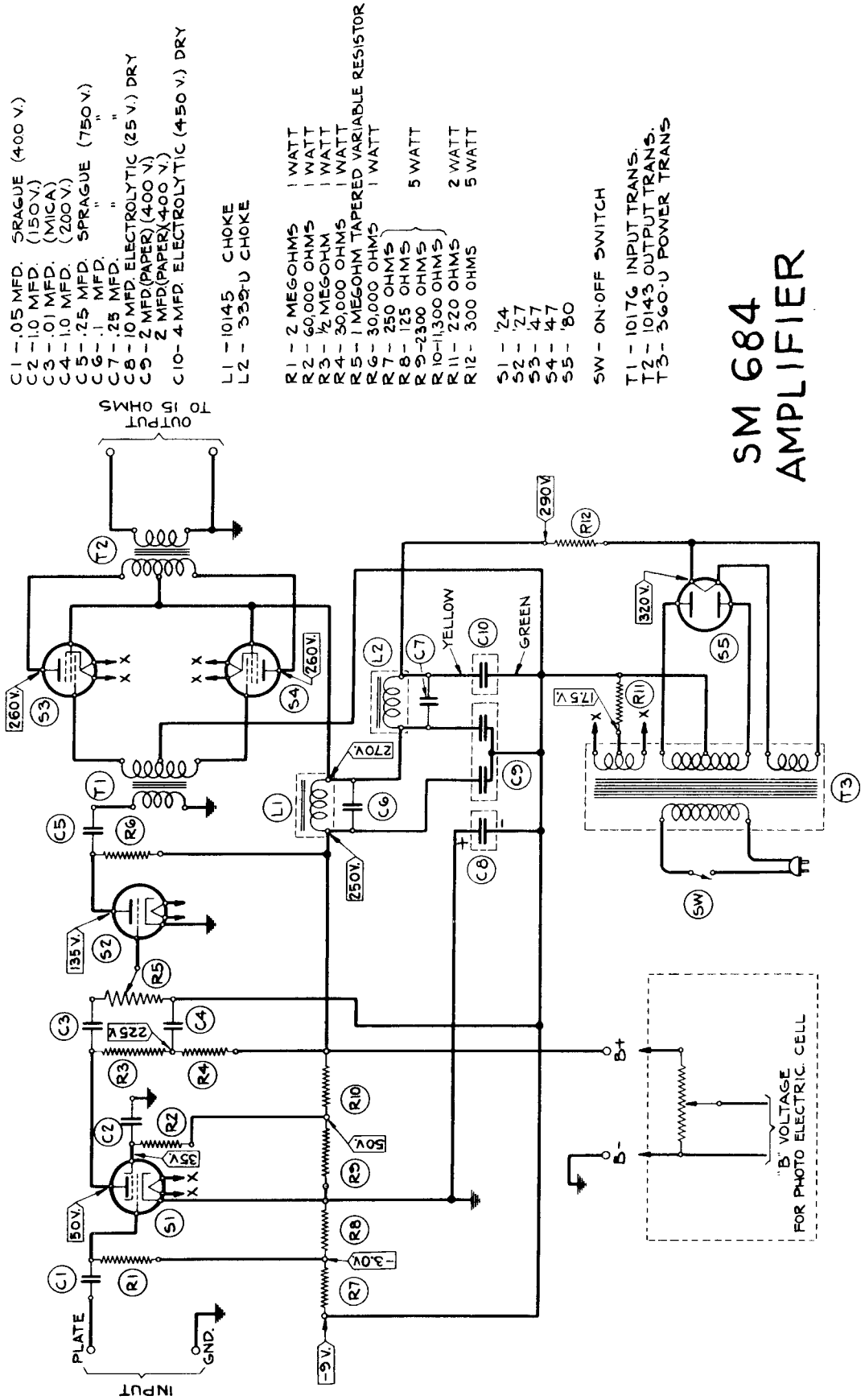
SM 684 AMPLIFIER



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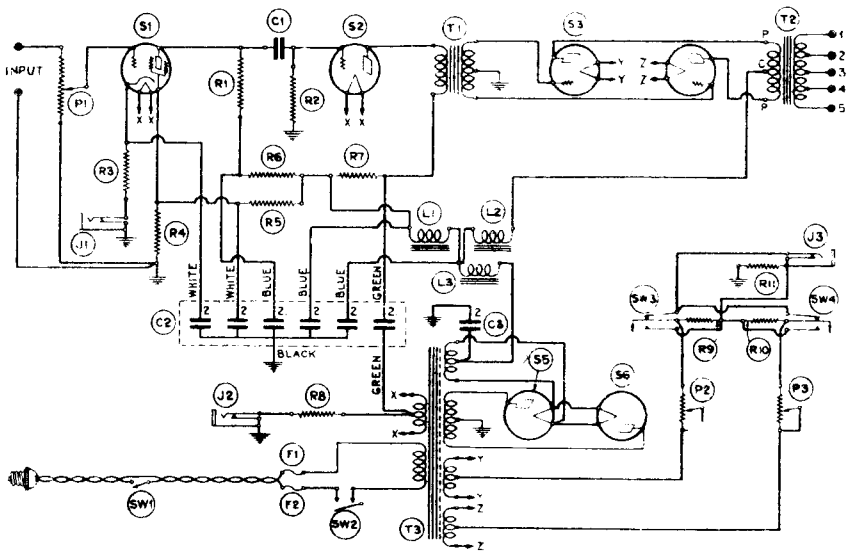
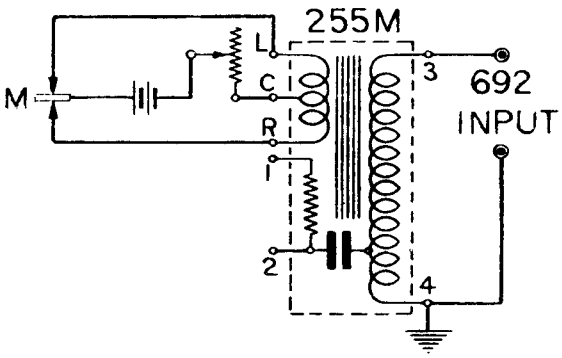


Schematic diagram of the 692.

692



Showing use of 255 series input transformers. For radio input connect (1) to B+ 90-135 of tuner, (2) to plate of det. or one side pickup. The 255, 255P, 255R and 256 are similarly connected neglecting microphone winding. Where switching arrangement for pickup, radio and microphone is wanted, see schematic of 690 amplifier input.

REPLACEMENT PARTS LIST

C1	No. 7047—Condenser
C2	No. 7202—Condenser Bank
C3	No. 7201—Condenser
F1, F2	No. 3501—3 Amp. Fuses
J1, J2, J3	No. 3731—2A Jacks
L1	No. 338U—Choke
L2	No. 339U—Choke
L3	No. 10065—Choke
P1	No. 4491—Potentiometer
P2, P3	No. 4490—Potentiometer
R1	No. 4772—Resistor
R2	No. 4700—Resistor
R3	No. 4730—Resistor
R4	No. 4771—Resistor
R5	No. 4685—Resistor
R6	No. 4698—Resistor
R7	No. 4726—Resistor
R8	No. 4689—Resistor
R9, R10	No. 4723—Resistor
R11	No. 4776—Resistor
SW1	No. 3389—Switch Assembly
SW2	No. 5195—Momentary Contact Switch
SW3, SW4	No. 7100—Push Button Contacts
T1	No. 10075B—Transformer
T2	No. 234—Transformer
T3	No. 10081—Transformer
1	Input plug
1	Output plug

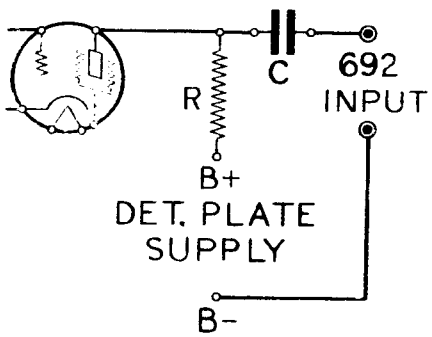
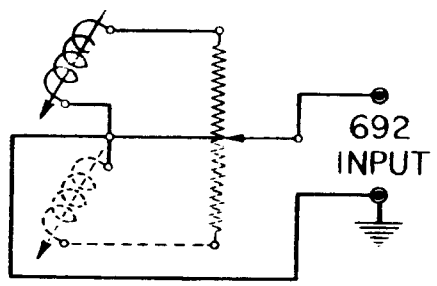


Diagram showing circuit for resistance coupling radio tuner to 692 amplifier where tuner is placed close to amplifier. Where tuner is to be operated at some distance from amplifier see Figure 6. Resistance R should be about 100,000 ohms (.1meg-ohm) and C about .01 mfd. Either a '27 or '24 detector may be used, though the former is preferable.

Showing use of one or two pick-ups with 692. Where two pickups are used and a smooth change-over is wanted ("fader effect") use center tapped (preferably double tapered) potentiometer and connect slider and center tap to 692 input, as shown at right. The resistance per side depends on pickup, but 25,000 ohms is generally used for high impedance pickups and about 4000-5000 ohms for 500 ohm pickup.



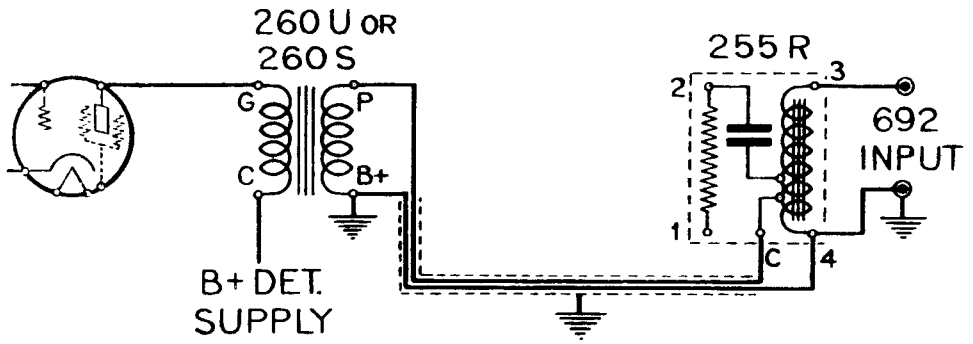


Diagram showing coupling o radio input to 692 where radio is to be operated at some distance from amplifier. The 260U or S transformer, connected "step down", couples tube to a line giving fairly low impedance for running to "distant" amplifier. 255R couples this line to 692 as shown. If switching arrangement is desired for radio and record pickup, the switch should be connected between 255R and amplifier input so that pickup is coupled direct. The line between 260U and 255R should be about No. 18 wire with heavy insulation and shielded.

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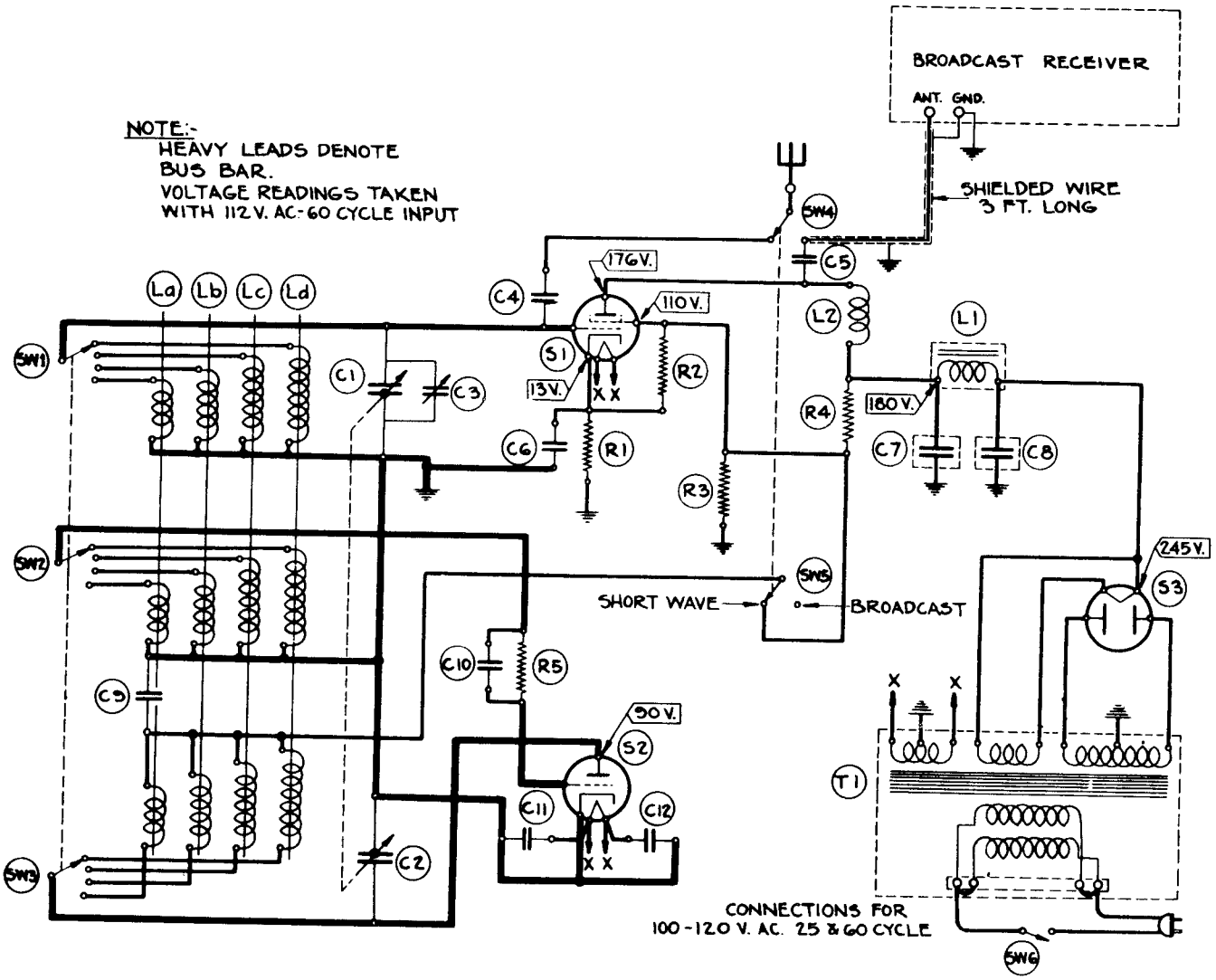


NOTE:-
PRIMARY NORMALLY WIRED & SHIPPED FOR 100-120V. OPERATION

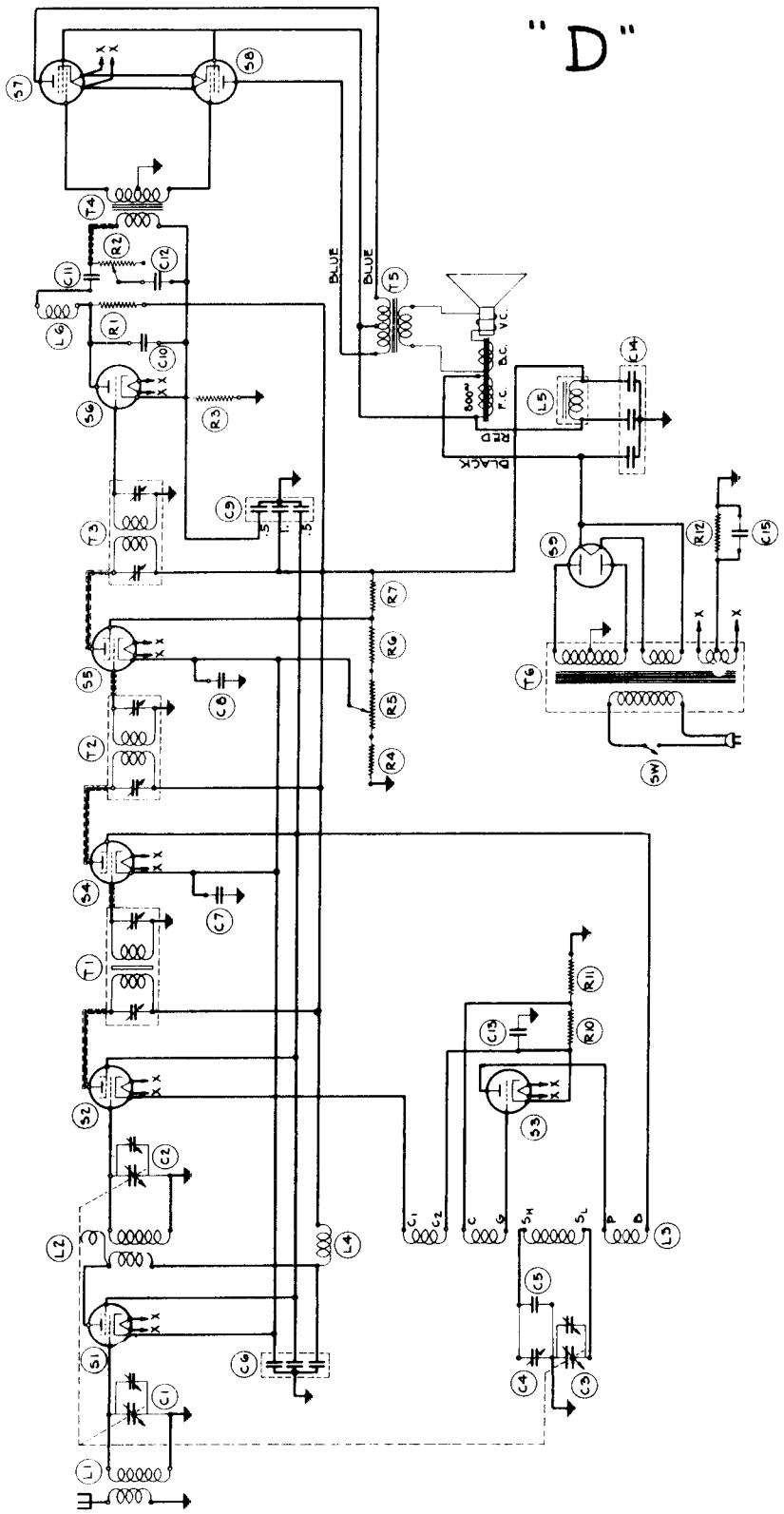
739 Parts List

Quantity		Description
	1	S-M 739 Chassis & Shield Assembly...
C1, C2	1	S-M 318 Two-gang midget condenser...
C4	1	S-M 3335 Compensating condenser.....
La to Ld	1	S-M 133 Short wave coil assembly....
	1	S-M 13454 Escutcheon.....
	1	S-M 13449 wave length name plate....
	1	S-M 13450 switch name plate.....
SW4, SW5	1	S-M SW-Broadcast switch.....
C3	1	S-M 345 Condenser.....
	1	S-M 819 Knob.....
	2	S-M 820 " @ .30.....
	1	S-M 818 Hookup wire.....
C6,C11,C12	3	Polymet .006 condenser @ .60.....
C5,C10	2	Polymet .0001 " @ .30.....
C9	1	Sprague .1 mfd. condenser.....
R5	1	Durham 10,000 ohm resistor.....
R2	1	Durham 60,000 ohm resistor.....
R1	1	Durham 6500 ohm resistor.....
R3	1	Durham 6000 ohm resistor 2 watt.....
R4	1	Durham 3500 ohm resistor, 2 watt....
	1	Antenna binding post.....
SW6	1	5174 H & H on-off switch.....
	1	10' cord & plug.....
	1	Set of hardware.....

739
S.W. ADAPTER

SILVER-MARSHALL INC.

"D"



C1-C2-C3 - 365 Mmfd. Max.
C4 - Variable
C5 - 500 Mmfd. ± 10% Mica
C6 - Triple .1 Mfd. Cond.
C7 - .1 Mfd.
C8 - .1 Mfd.
C9 - .5, .5, 1. Mfd. Cond.
C10 - .001 Mfd. (Mica)
C11 - 0.15 Mfd.
C12 - .025 Mfd.
C13 - .1 Mfd.
C14 - Three 4 mfd. units (dry electrolytic)
C15 - .1 Mfd.

R1 - 30,000 ohms 1 watt
R2 - 1/2 megohm tapered variable resistor
R3 - 60,000 ohms 1 watt
R4 - 200 ohms wire wound
R5 - 4500 ohms volume control (tapered)
R6 - 13,000 ohms 1 watt
R7 - 15,000 ohms 2 watts
R8 - 400 ohms wire wound
R9 - 10,000 ohms 1 watt
R10 - 100 ohms)
R11 - 1000 ohms (1100 ohm tapped resistor
R12 - 220 ohms 2 watt

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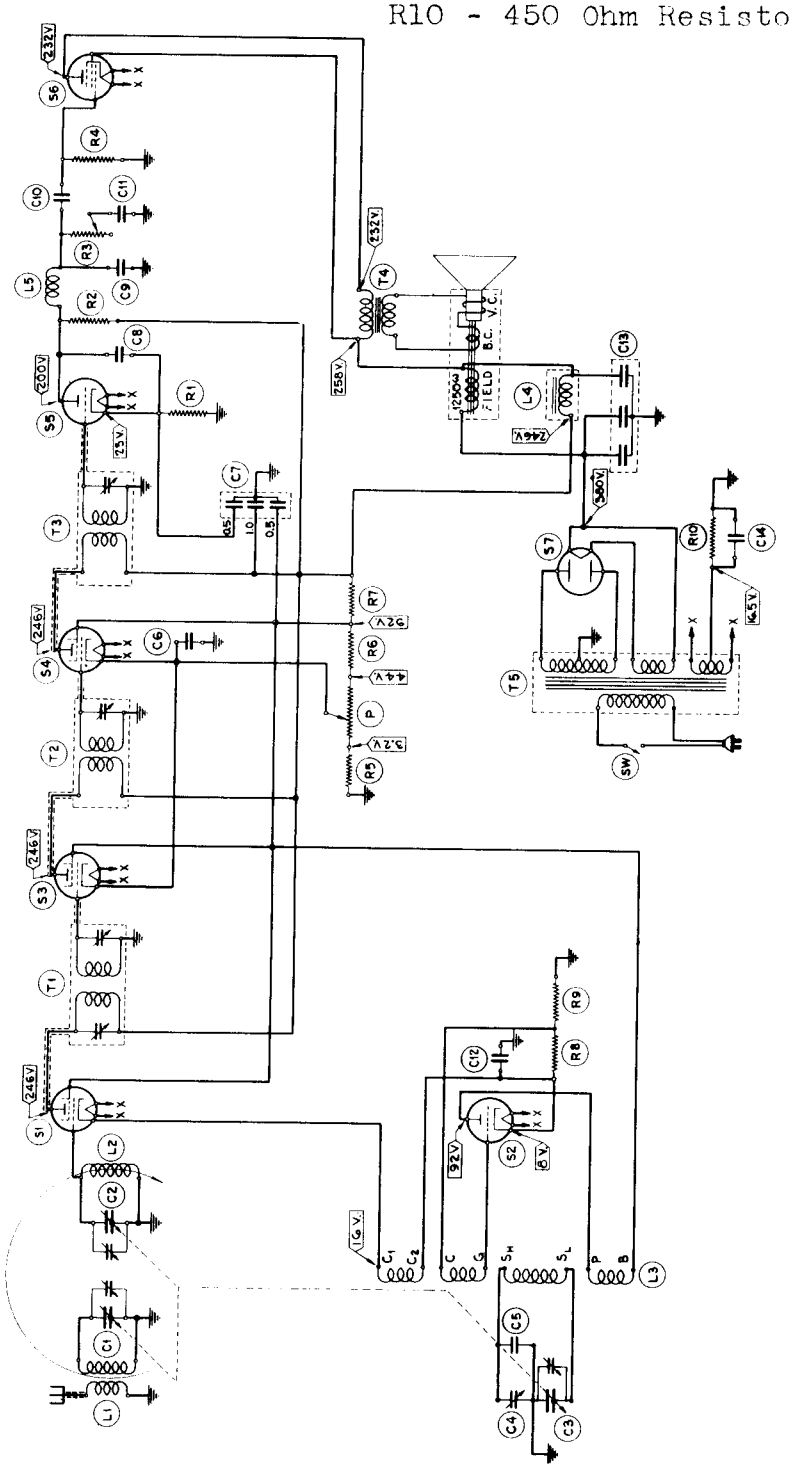
P - 4500 Ohm Potentiometer

R1 - 60,000 Ohm Resistor - 1 Watt, Carbon
R2 - 30,000 Ohm " - 1 Watt, "
R3 - 1/2 Megohm Variable Resistor
R4 - 250,000 Ohm Resistor- 1 Watt, Carbon
R5 - 100 Ohm Resistor - Wire wound
R6 - 6000 Ohm Resistor - 1 Watt, Carbon
R7 - 10,000 Ohm " - 2 Watt, Carbon
R8 - 100 Ohm Resistor)
R9 - 1700 Ohm Resistor) - Wire wound,tapped unit
R10 - 450 Ohm Resistor - 2 Watt, Carbon

"F"



C1-C2-C3 - Variable cond. 407 Mmfd. Max.
C4 - Osc. Trimmer Cond. 600 Mmfd. max.
C5 - 750 Mmfd. Cond. - Mica
C6 - .1 Mfd. Cond. - 200 Volts
C7 - 1. Mfd. 300 Volts, .5-.5 Mfd. - 200 Volts
C8-C9 - .001 Mfd. Mica Cond.
C10-C11 - .025 Paper Cond. - 200 Volts
C13 - Electrolytic Filter Cond. - Three 4 mfd. units - 450 v
C14 - .1 Mfd. Cond. - 200 Volts

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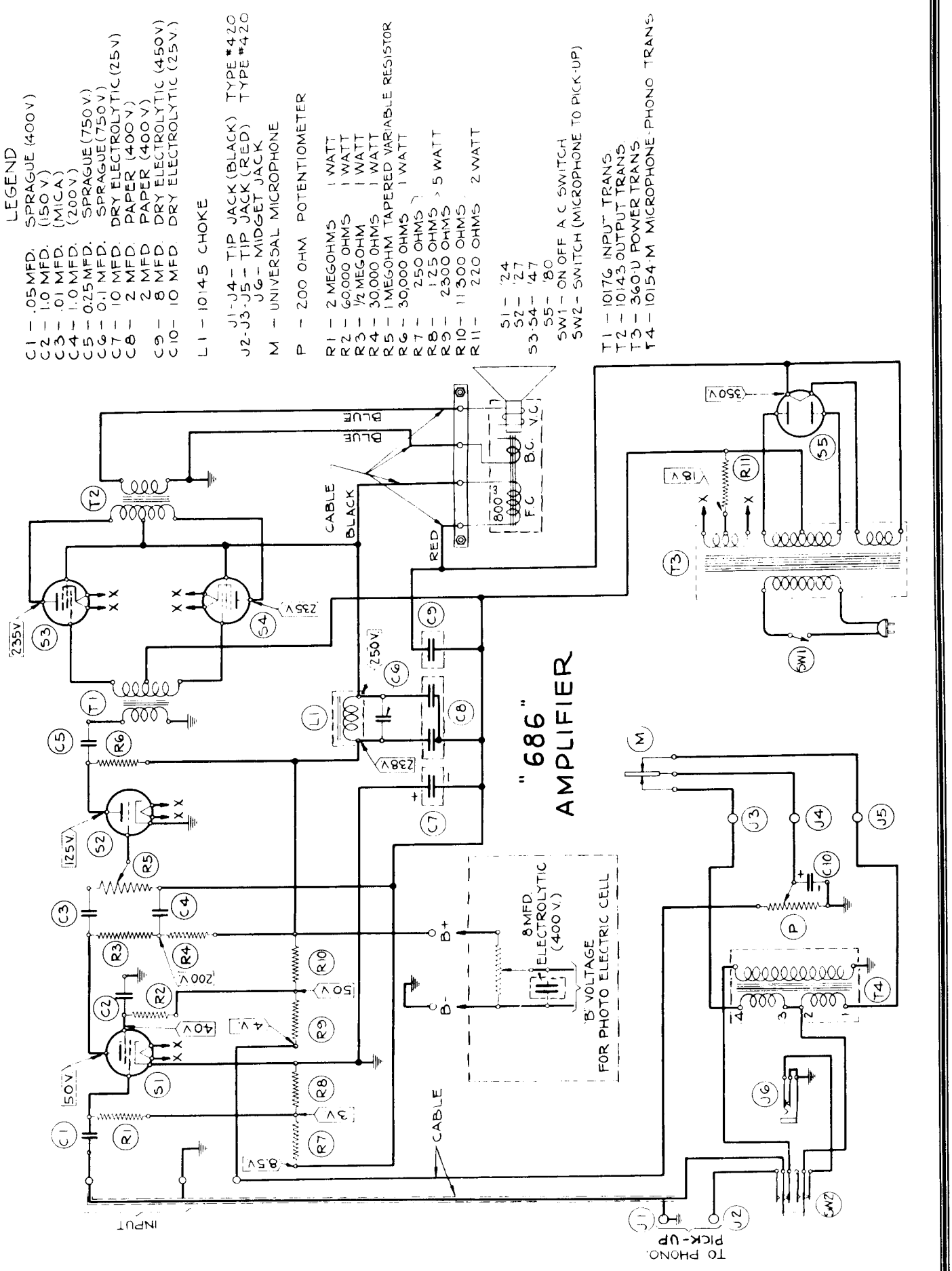
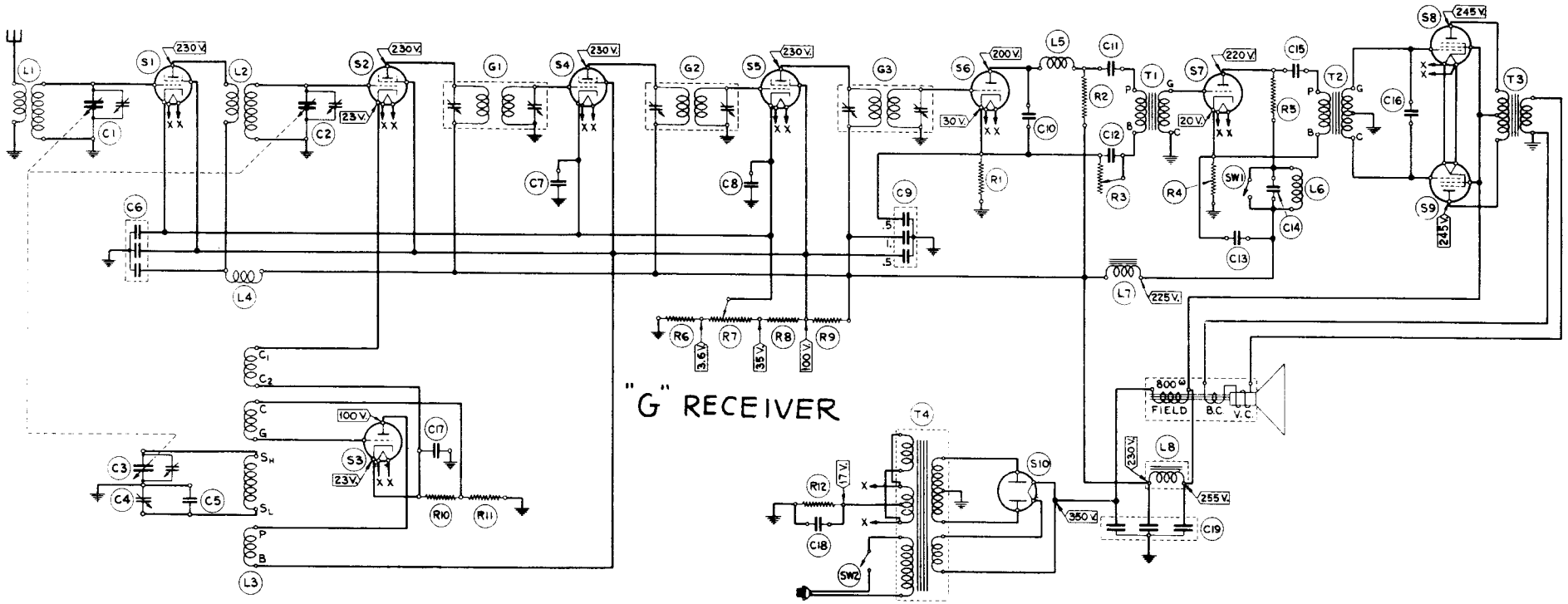


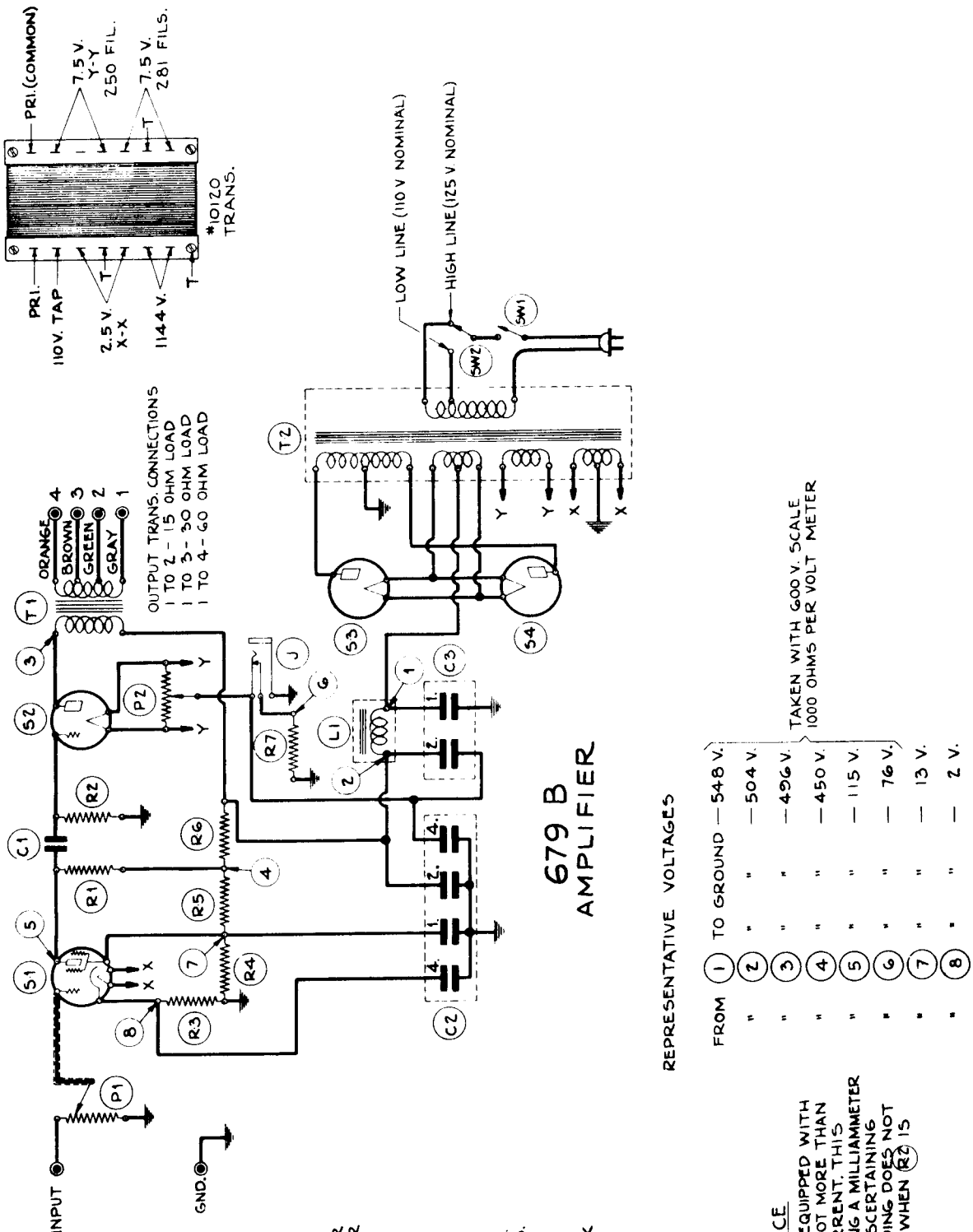
SILVER-MARSHALL INC.



C1-C2-C3 - 365 Mfd. Condenser
C4 - Variable 250-600 Mmfd.)
C5 - 500 Mmfd. Cond. (Mica))
C6 - Triple .1 Mfd. Cond.
C7-C8 - .1 Mfd. Cond. 200 V Rating
C9 - .5 - .5 - 1. Mfd. Cond.
C10 - .001 Mfd. Cond. Mica
C11 - .02 Mfd. Cond.
C12 - .001 Mfd. Cond. Mica
C13 - 4 Mfd. Cond. - 450V Rating
C14 - .01 Mfd. Cond.
C15 - .06 Mfd. Cond.
C16 - .00075 Mfd. Cond. Mica
C17-C18 - .1 Mfd. Cond. - 200V Rating
C19 - Three 4 Mfd. Units 450V Rating

R1 - 60,000 ohm resistor 1 watt
R2 - 30,000 ohm " 1 watt
R3 - 1 Megohm variable resistor
R4 - 2600 ohm resistor 1 watt
R5 - 1000 ohm resistor 1 watt
R6 - 300 ohm resistor wire wound
R7 - 4500 ohm potentiometer with on-off switch
R8 - 13,500 ohm resistor 1 watt
R9 - 10,000 ohm resistor 2 watt
R10 - 100 ohm resistor) wire wound
R11 - 1700 ohm resistor)
R12 - 210 ohm resistor 2 watt - carbon

SILVER-MARSHALL INC.



LEGEND

C1 - .025 MFD COND. (750 V.)
C2 - *7149 COND. BANK
C3 - *7148 COND. BANK

R1 - 1.0 MEGOHM RESISTOR
R2 - 0.5 MEGOHM RESISTOR
R3 - 2600 OHM "
R4 - 10.0 MEGOHM "
R5 - 0.3 MEGOHM "
R6 - 20.0 MEGOHM "
R7 - 1500 OHM "

L1 - *10119 CHOKE

T1 - *10121 OUTPUT TRANS.
T2 - *10120 POWER TRANS.

P1 - 100,000 OHM POT.
P2 - 20 OHM POT.
J. - SPEAKER FIELD JACK
SW1 - ON-OFF SWITCH
SW2 - HIGH-LOW SWITCH
S1 - '24
S2 - '50
S3 - '81
S4 - '81

REPRESENTATIVE VOLTAGES

TAKEN WITH 600 V. SCALE 1000 OHMS PER VOLT METER

FROM		TO GROUND	
	(1)	"	— 548 V.
	(2)	"	— 504 V.
	(3)	"	— 496 V.
	(4)	"	— 450 V.
	(5)	"	— 115 V.
	(6)	"	— 76 V.
	(7)	"	— 13 V.
	(8)	"	— 2 V.

IMPORTANT NOTICE

THIS AMPLIFIER MUST BE EQUIPPED WITH 250 TYPE TUBE SHOWING NOT MORE THAN 5 MICRO AMPERES GAS CURRENT. THIS MAY BE CHECKED BY PLACING A MILLIAMMETER IN THE PLATE CIRCUIT AND ASCERTAINING THAT PLATE CURRENT READING DOES NOT CHANGE MORE THAN 5 MA WHEN (R2) IS SHORTED

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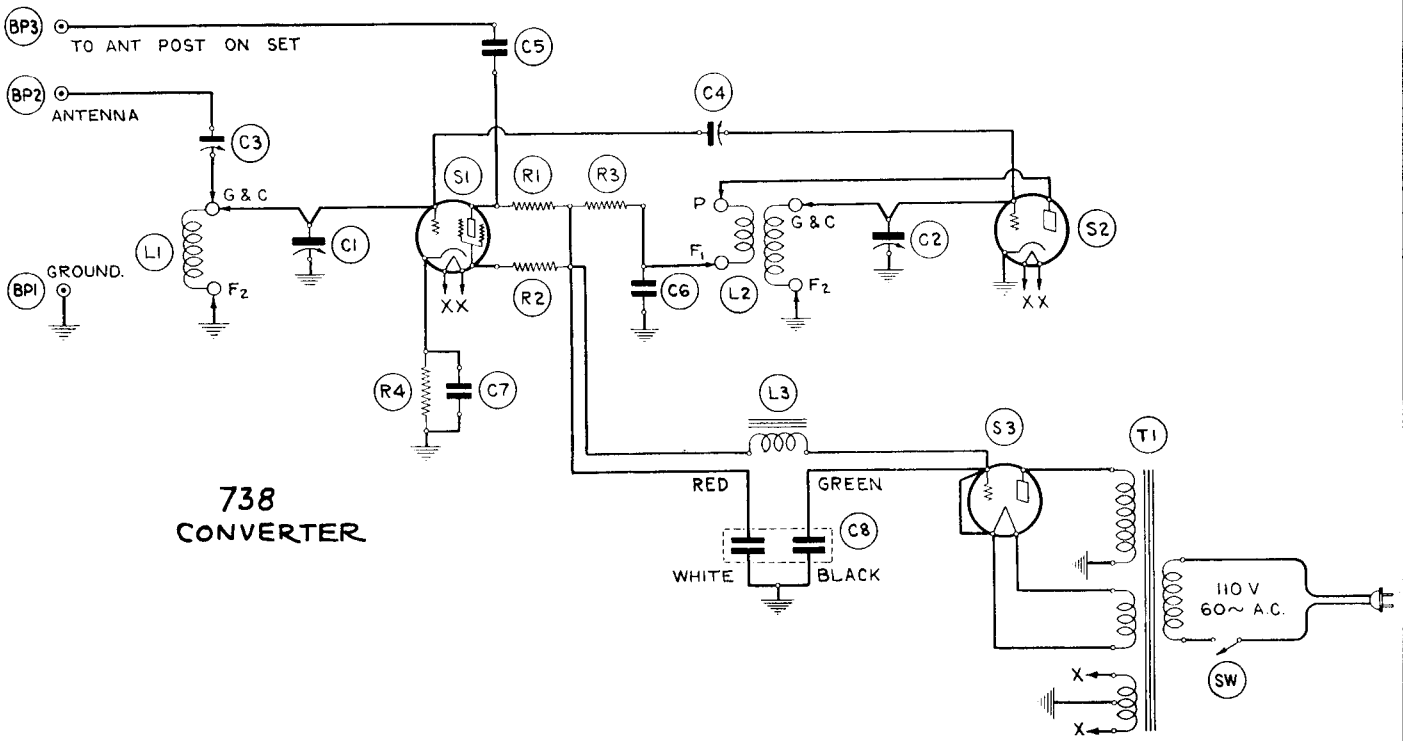
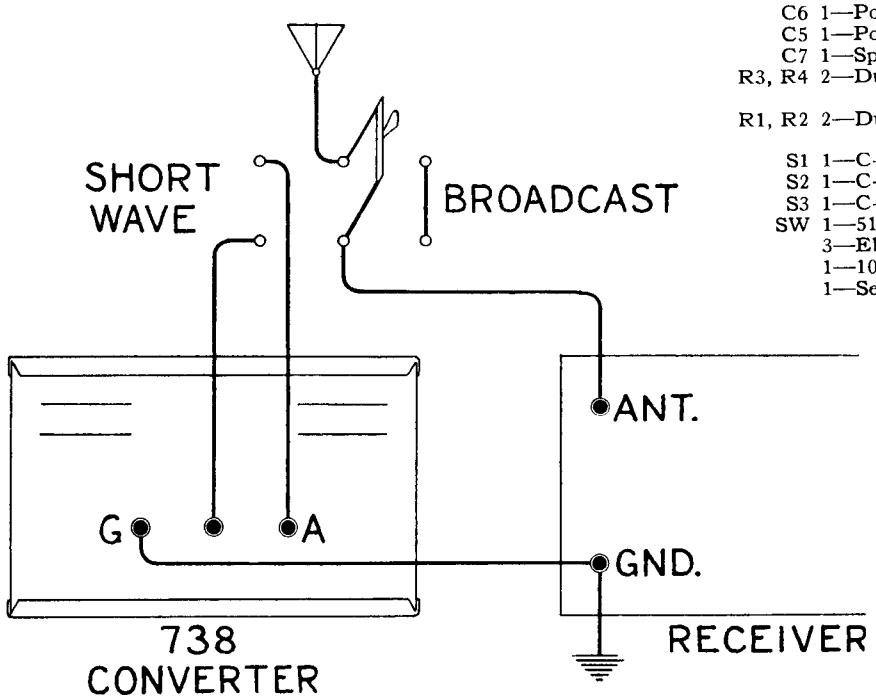
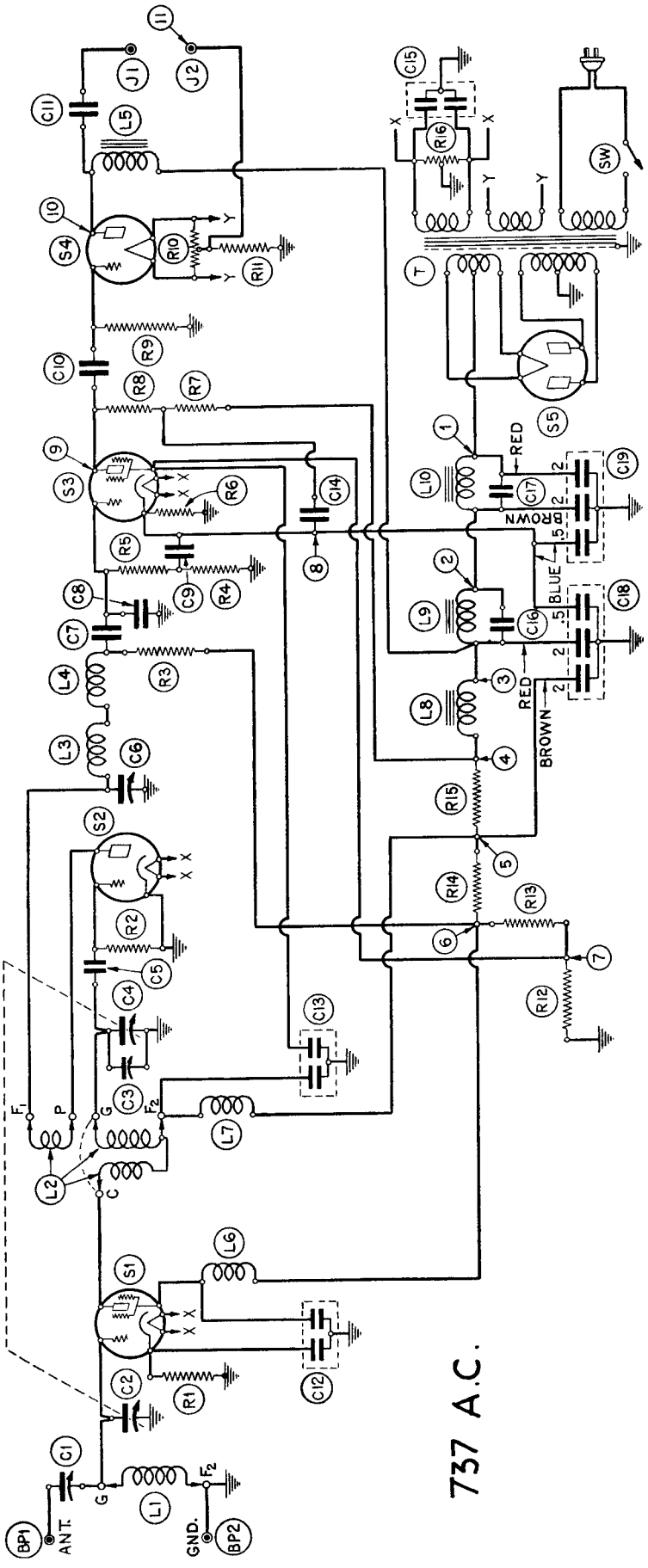


738
CONVERTER

Designation	Qnty.	Description
	1	—S-M 738 Chassis & Shield Assembly
C3, C4	1	—S-M 344 Dual Trimmer Condenser
C2	1	—S-M 314 .00015 Variable Condenser
C1	1	—S-M 317 Variable Condenser
C8	1	—S-M 672-8 mfd. Condenser Bank
L1, L2	2	—S-M 131L Coils @ 1.25
	2	—S-M 131M Coils @ 1.25
	2	—S-M 131N Coils @ 1.25
	2	—S-M 131O Coils @ 1.25
L3	1	—S-M 338U Choke
T1	1	—S-M 285 Power Transformer
	2	—S-M 512 Sockets @ .60
	1	—National E Dial
C6	1	—Polymet .005 Fixed Condenser
C5	1	—Polymet .0001 Condenser
C7	1	—Sprague .1 Mfd. Condenser
R3, R4	2	—Durham 10,000 Ohm 1-watt Resistors @ .75
R1, R2	2	—Durham 300,000 Ohm 1-watt Resistors @ .50
S1	1	—C-R 224 Tube Socket
S2	1	—C-R 227 Tube Socket
S3	1	—C-R 226 Tube Socket
SW	1	—5174 H & H Rotary On-off Switch
	3	—Eby Binding Posts @ .15
	1	—10′ Cord and Plug
	1	—Set of Hardware



SILVER-MARSHALL INC.



1—S-M 738 Chassis, Partitions and Cabinet.
C2, C3 1—S-M 315 Dual .00014 Condenser.....
2—S-M 638 Shields @ 1.50.....
T 1—S-M 336U Transformer...
S1, S2, L1, L2 4—S-M 512 Sockets @ .60.
C1, C4 2—S-M 342B Condensers
C3 1—S-M 343 Condenser...
L5 1—S-M 251S Choke.....
L10 1—S-M 333S Single Choke.
L4, L6, L7 3—S-M 277 Chokes @
L3 1—S-M 275 Choke...
L8 1—S-M 338U Choke..
L9 1—S-M 339U Choke...
2—S-M 816 Large Knobs
1—S-M 817 Small Knob...
2—S-M 818 Hookup Wire
1—National B Vernier Dial.
C18, C19 2—Potter 4536 Condensers @
C12 C13, C15 3—Potter Dual 1/10 condensers
C17 1—Potter 1 Mfd. Condenser.....
C14, C16 2—Potter 1/4 Mfd. Condenser Cased
S3 1—C-R 224 Socket.....
S4 1—C-R 245 Socket.....
S5 1—C-R 280 Socket.....
R2 1—Durham 2 Megohm Resistor...
R14 1—Durham 10,000 ohm Resistor...
R3, R8 2—Durham .15 Megohm Resistors
R7 1—Durham 60,000 ohm Resistor...
R4, R5, R9 3—Durham 1 Megohm Resistors @
R1 1—Carter RU400 Resistor.....
R10, R16 2—Carter 40 ohm Center Tap Resistor
C5, C8 2—Polymet .00015 Condensers @
C7, C10 2—Polymet .006 Condensers @
C17 1—Sprague .1 Mfd. Condenser..
C9 1—Sprague 1/4 Mfd. Condenser.
SW 1—H & H Toggle Switch #991.
BP1 1—Eby Antenna Binding Post.
BP2 1—Eby Ground Binding Post..
R11 1—Ohmite 1500 ohm Resistor.
R15 1—Ohmite 3500 ohm Resistor.
R6, R12, R13 3—Yaxley 3500 ohm Resistors

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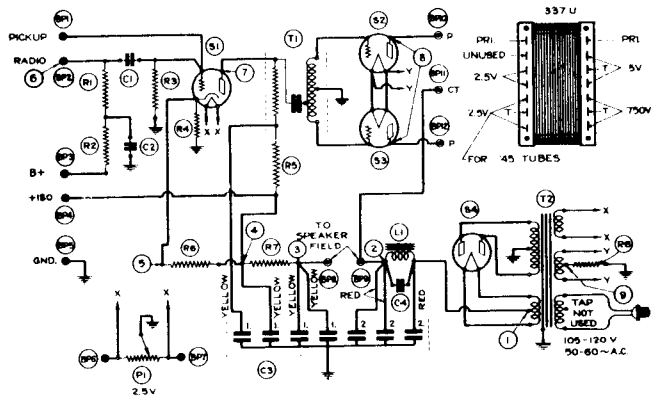
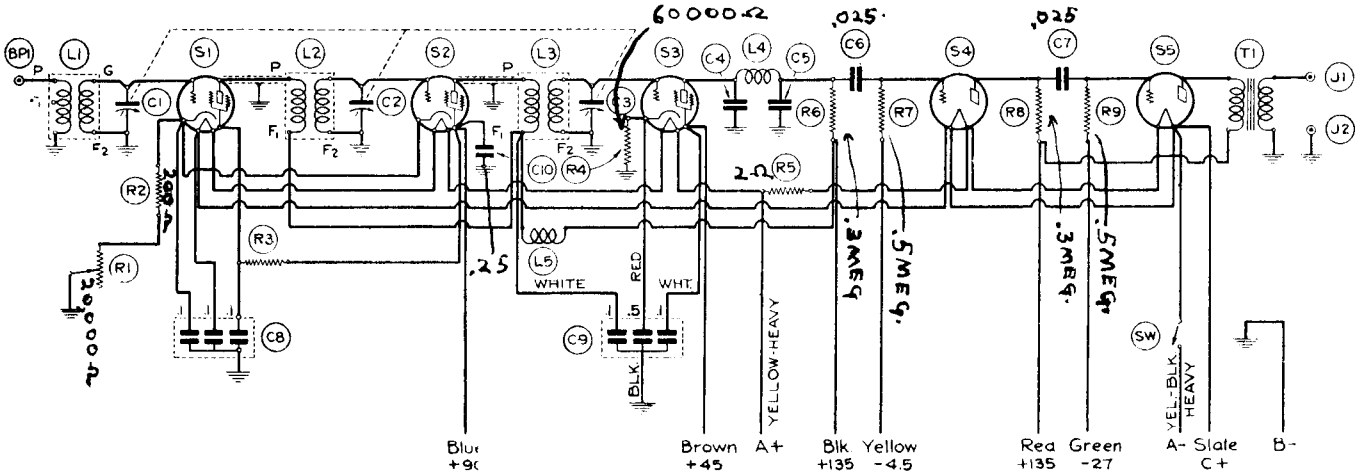
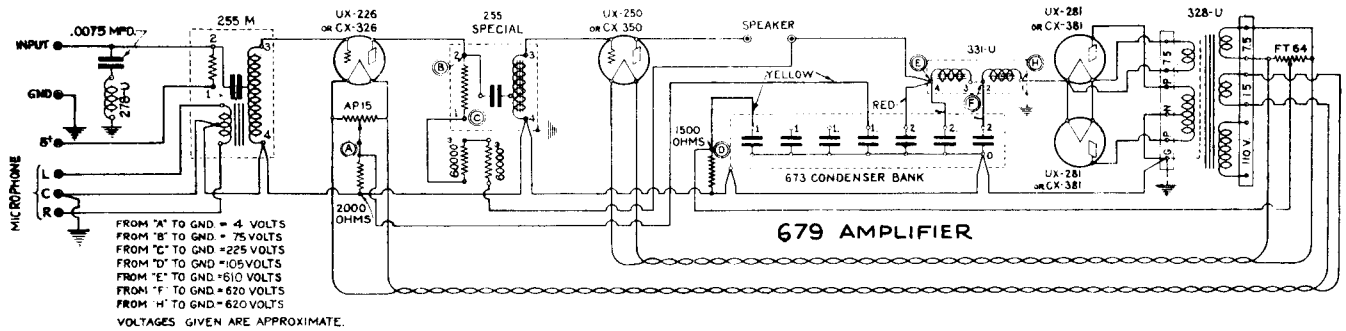
COMPONENT PARTS FOR
677B AMPLIFIER

Designation	
C1	.1 mfd. Sprague Condenser
C2 & C4	.25 " " "
C3	#673 Condenser Bank
R1 & R2	60,000-ohm Durham Resistor
R3	2-megohm Durham Resistor
R4	400-ohm Carter Resistor
R5 & R6	10,000-ohm Durham Resistor
R7 & R8	1500-800-ohmite Resistor
L1	#339 Choke
P1	Carter AP-15 Hum Balance
S1	C-R 227 tube socket
S2 & S3	C-R 245 " "
S4	C-R 280 " "
T1	#257 Audio transformer
T2	#337 Power "
	1 636 tube shield
	1 677 Panel, chassis and case



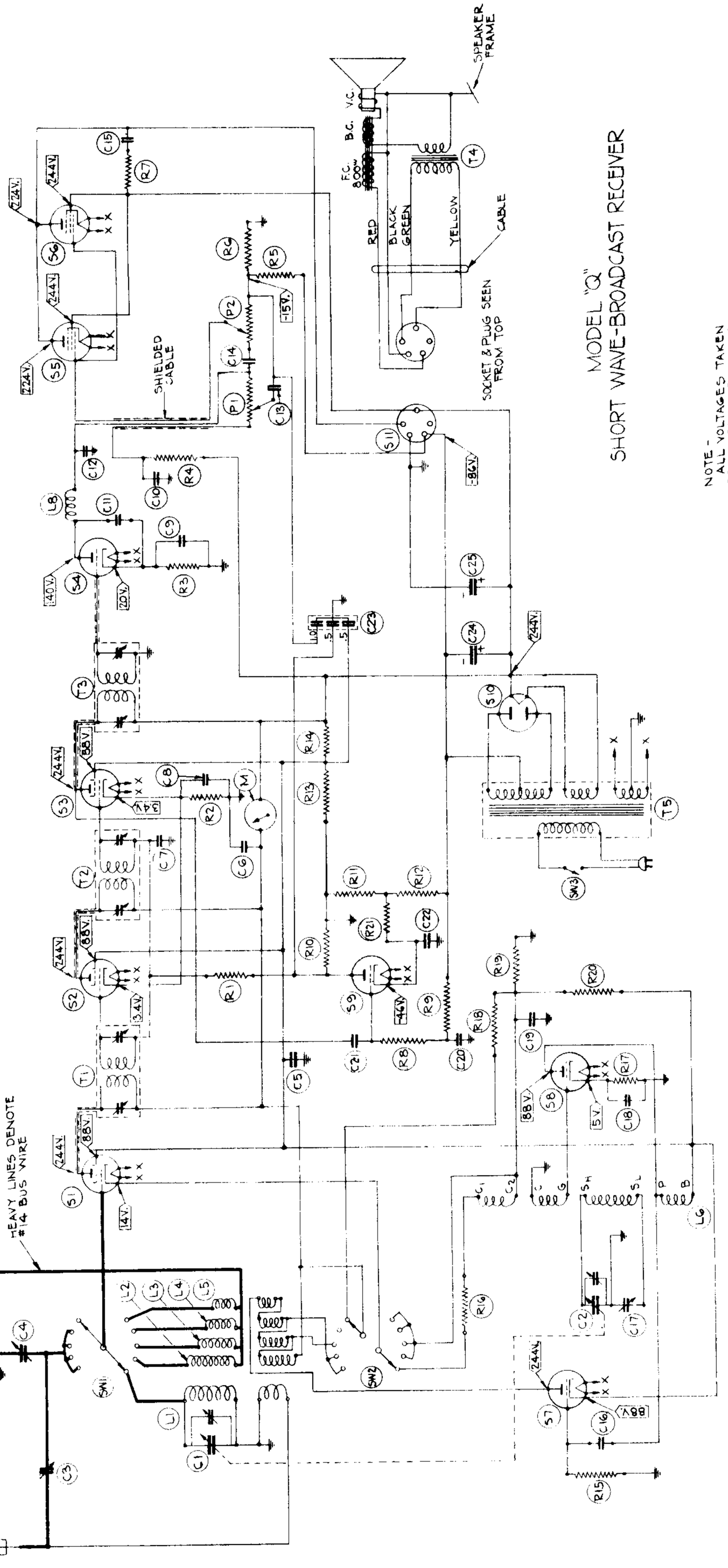
677 B



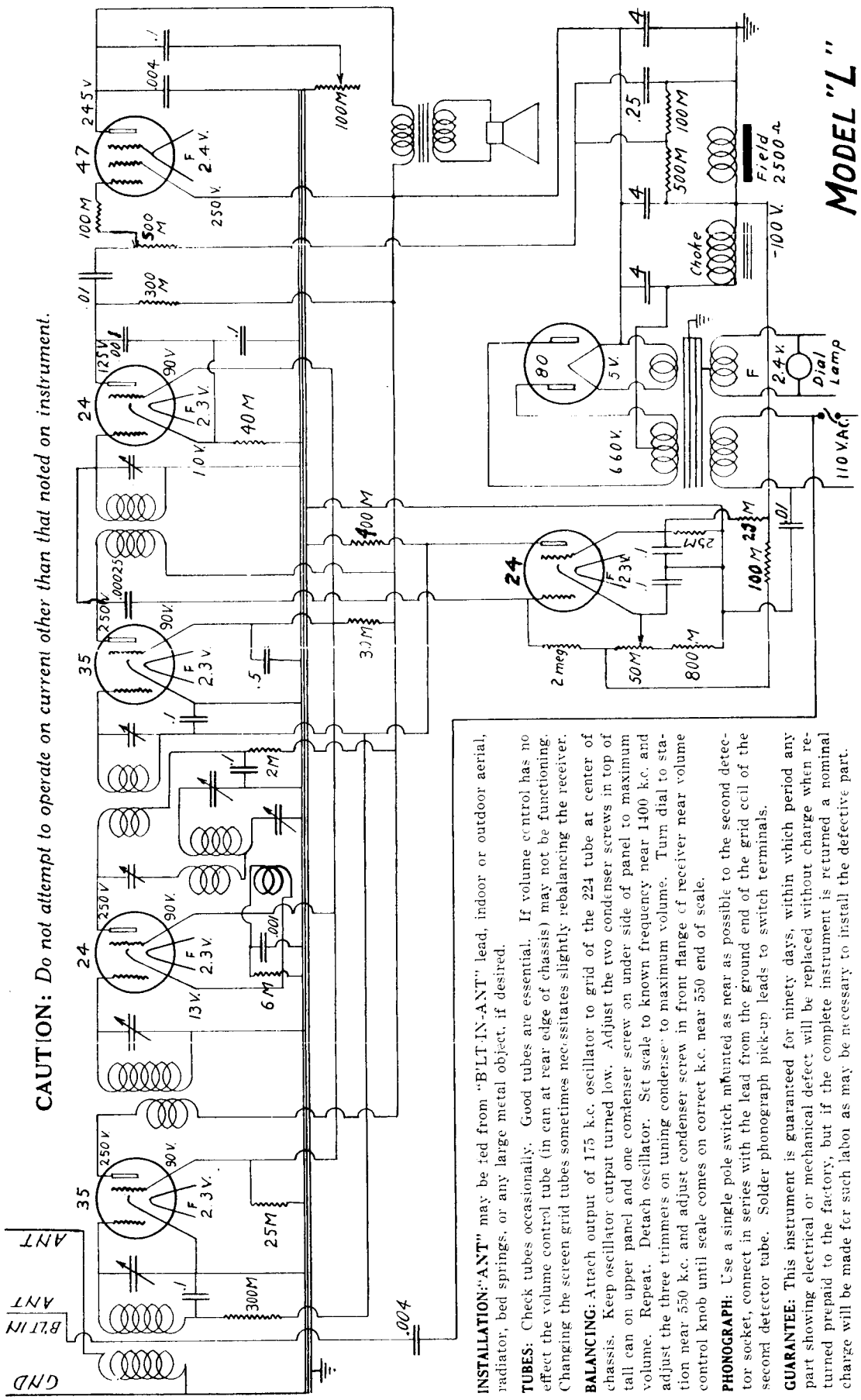


679 AMPLIFIER

SILVER-MARSHALL, Inc.



SIMPLEX RADIO COMPANY



INSTALLATION: "ANT" may be led from "B'LT IN-ANT" lead, indoor or outdoor aerial, radiator, bed springs, or any large metal object, if desired.

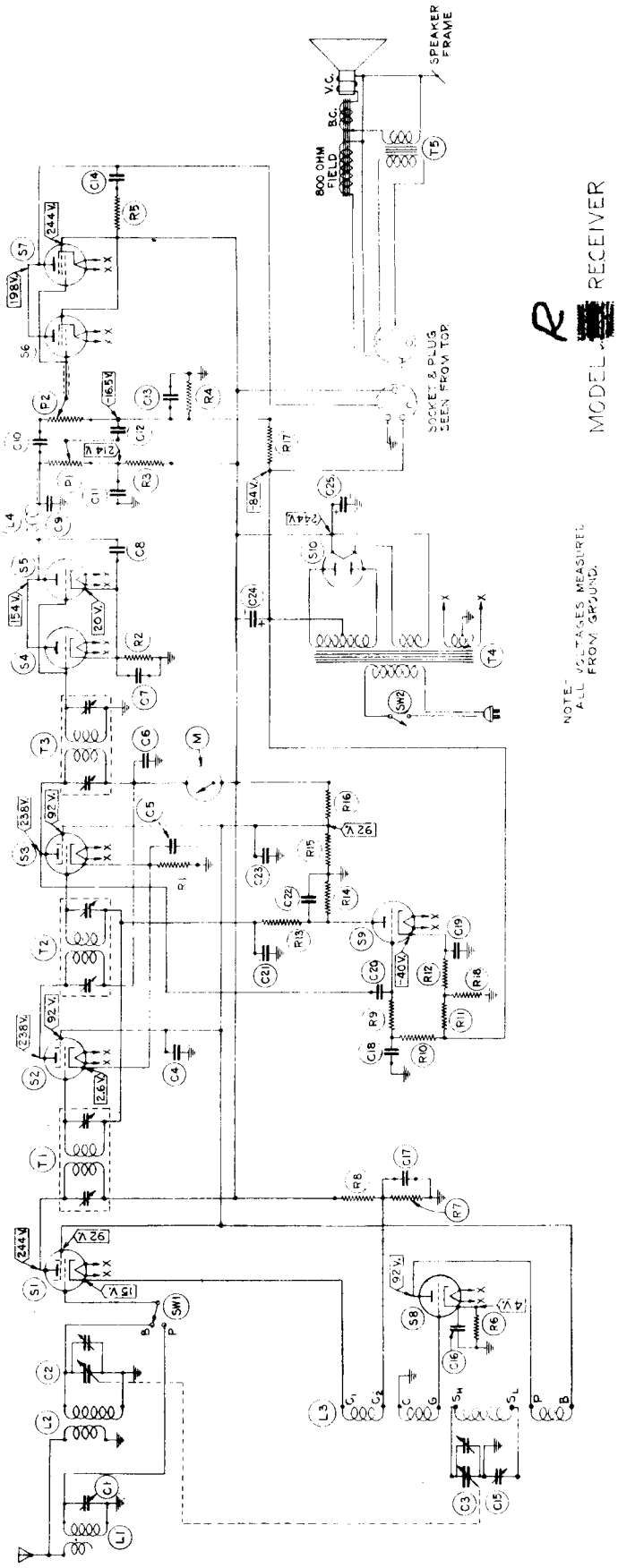
TUBES: Check tubes occasionally. Good tubes are essential. If volume control has no effect the volume control tube (in can at rear edge of chassis) may not be functioning. Changing the screen grid tubes sometimes necessitates slightly rebalancing the receiver.

BALANCING: Attach output of 175 k.c. oscillator to grid of the 224 tube at center of chassis. Keep oscillator output turned low. Adjust the two condenser screws in top of tall can on upper panel and one condenser screw on under side of panel to maximum volume. Repeat. Detach oscillator. Set scale to known frequency near 1400 k.c. and adjust the three trimmers on tuning condenser to maximum volume. Turn dial to station near 550 k.c. and adjust condenser screw in front flange of receiver near volume control knob until scale comes on correct k.c. near 550 end of scale.

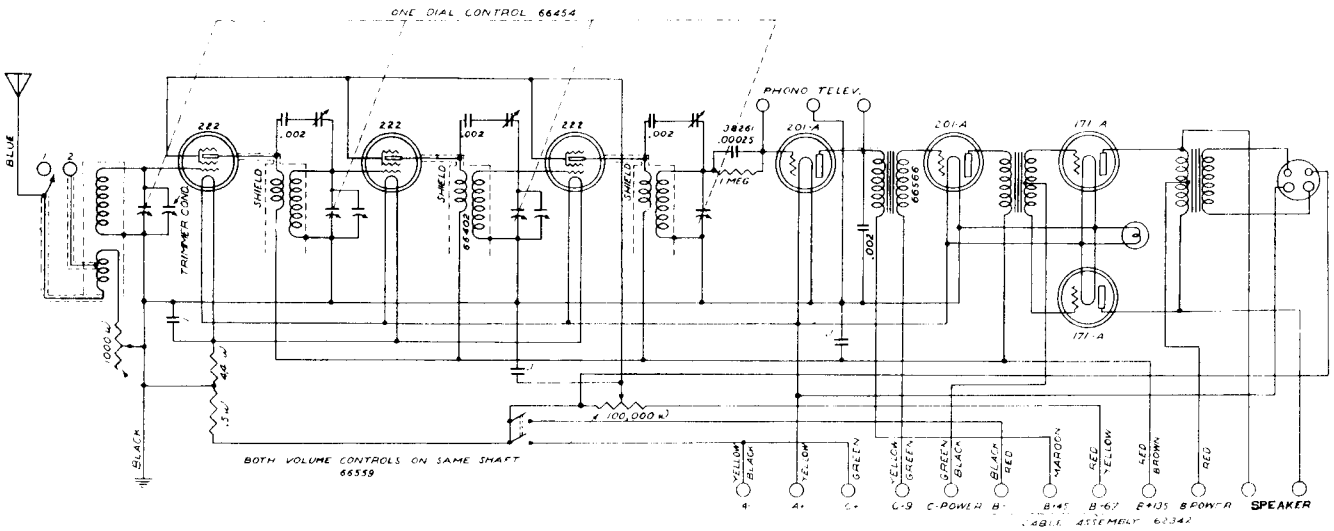
PHONOGRAPH: Use a single pole switch mounted as near as possible to the second detector socket, connect in series with the lead from the ground end of the grid coil of the second detector tube. Solder phonograph pick-up leads to switch terminals.

GUARANTEE: This instrument is guaranteed for ninety days, within which period any part showing electrical or mechanical defect will be replaced without charge when returned prepaid to the factory, but if the complete instrument is returned a nominal charge will be made for such labor as may be necessary to install the defective part.

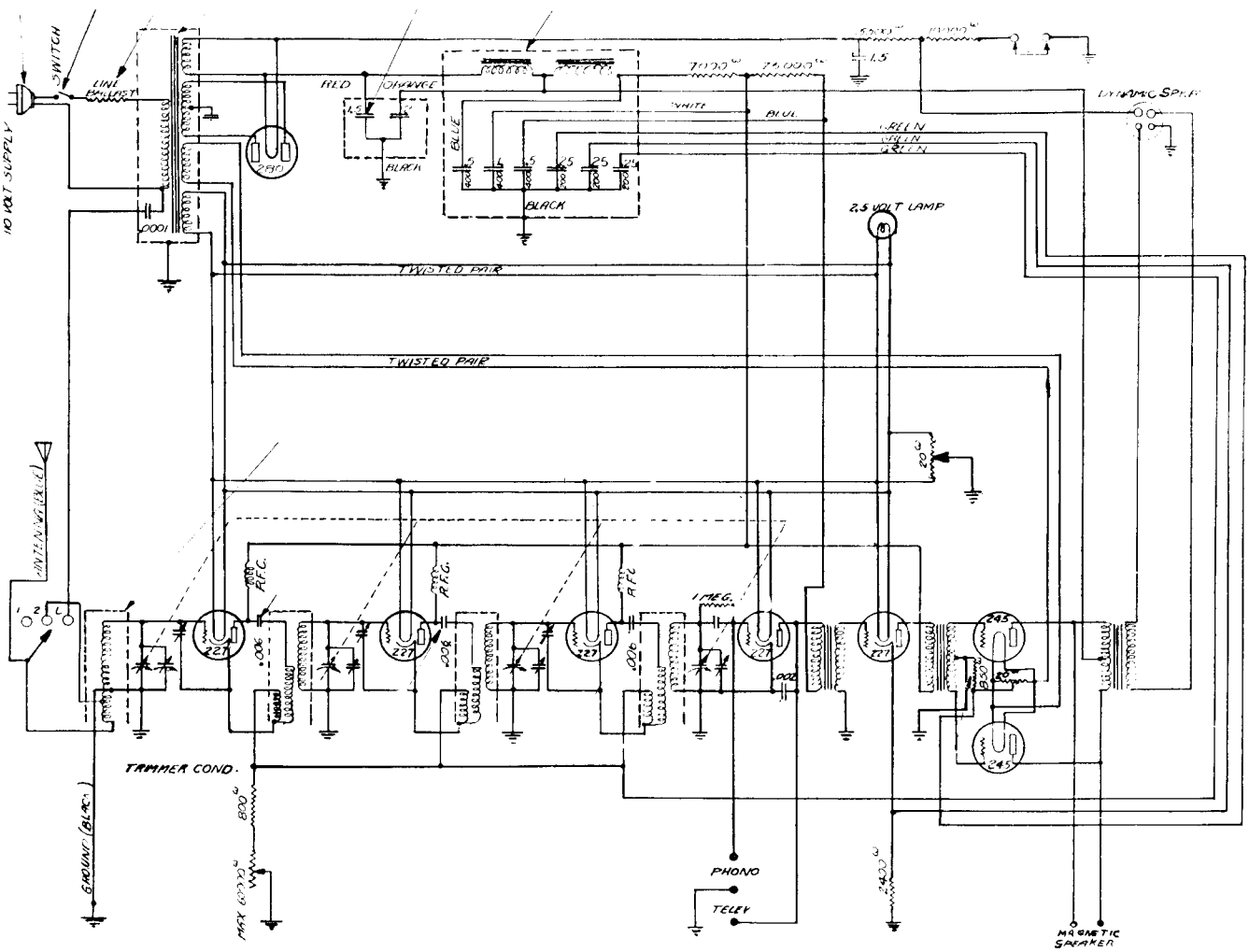
SILVER-MARSHALL, Inc.



STEWART-WARNER CORP.

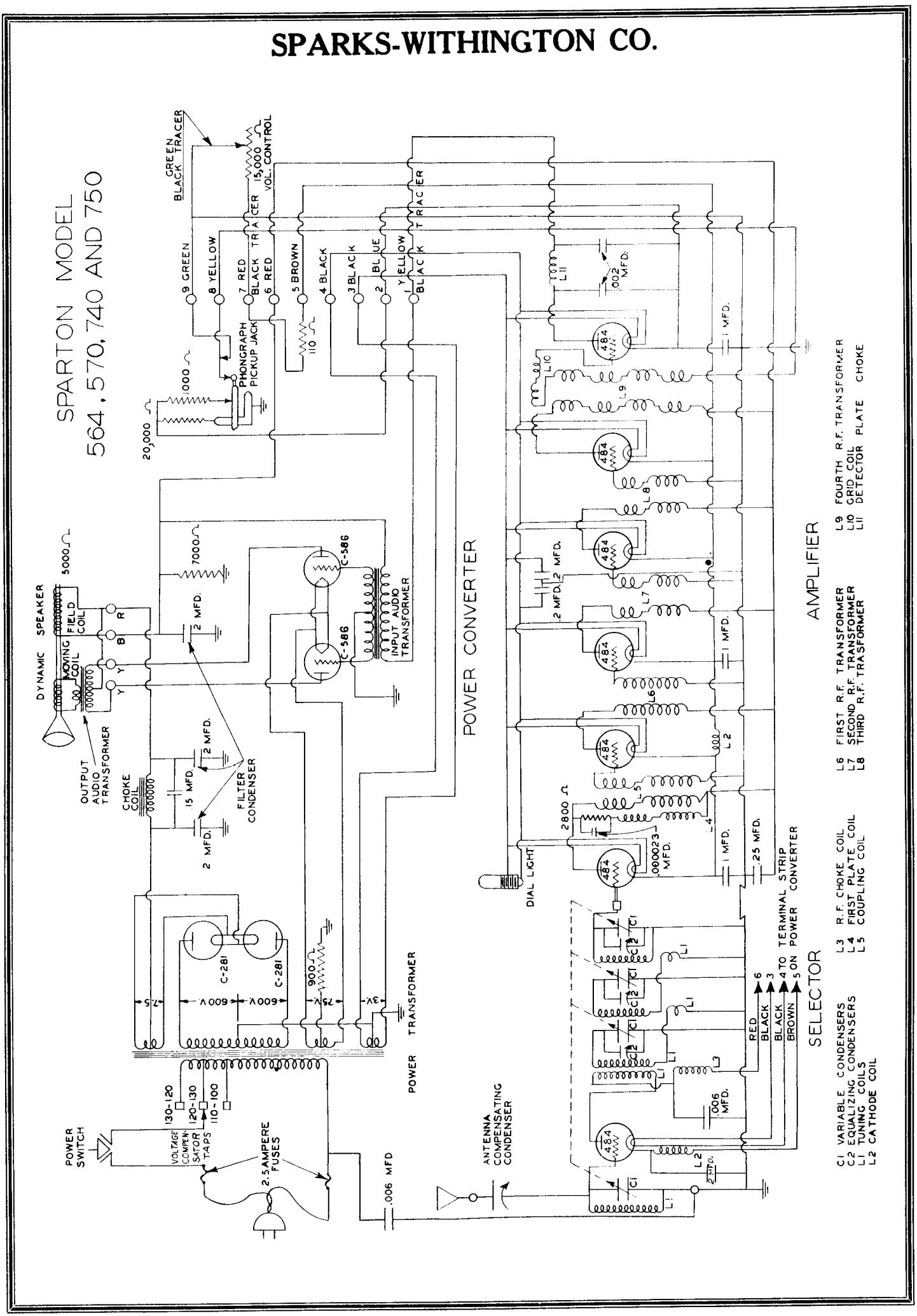


CIRCUIT DIAGRAM OF 950 SERIES BATTERY SCREEN-GRID RECEIVER



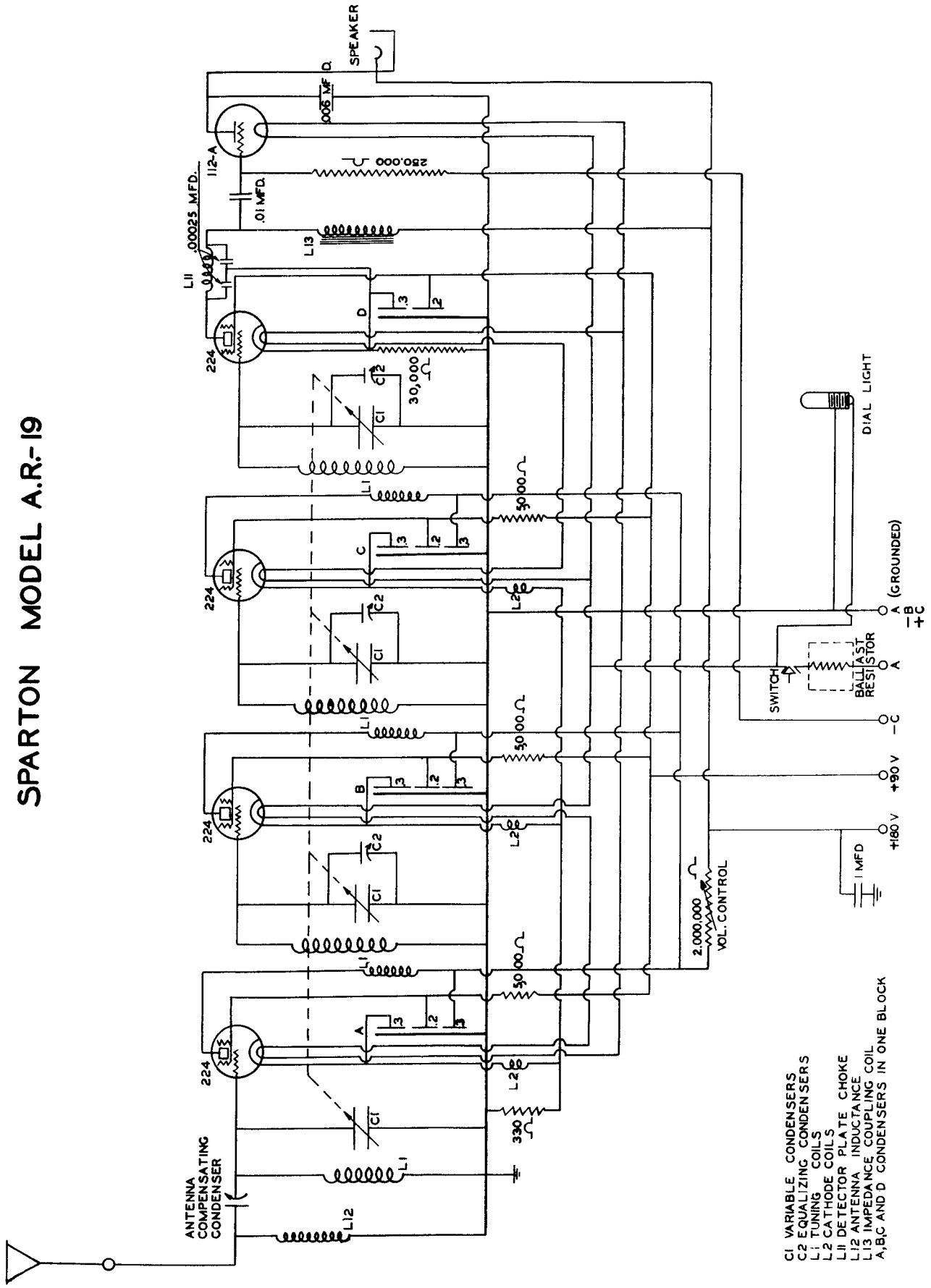
CIRCUIT DIAGRAM OF 900 SERIES A. C. BALANCED BRIDGE RECEIVERS

SPARKS-WITHINGTON CO.



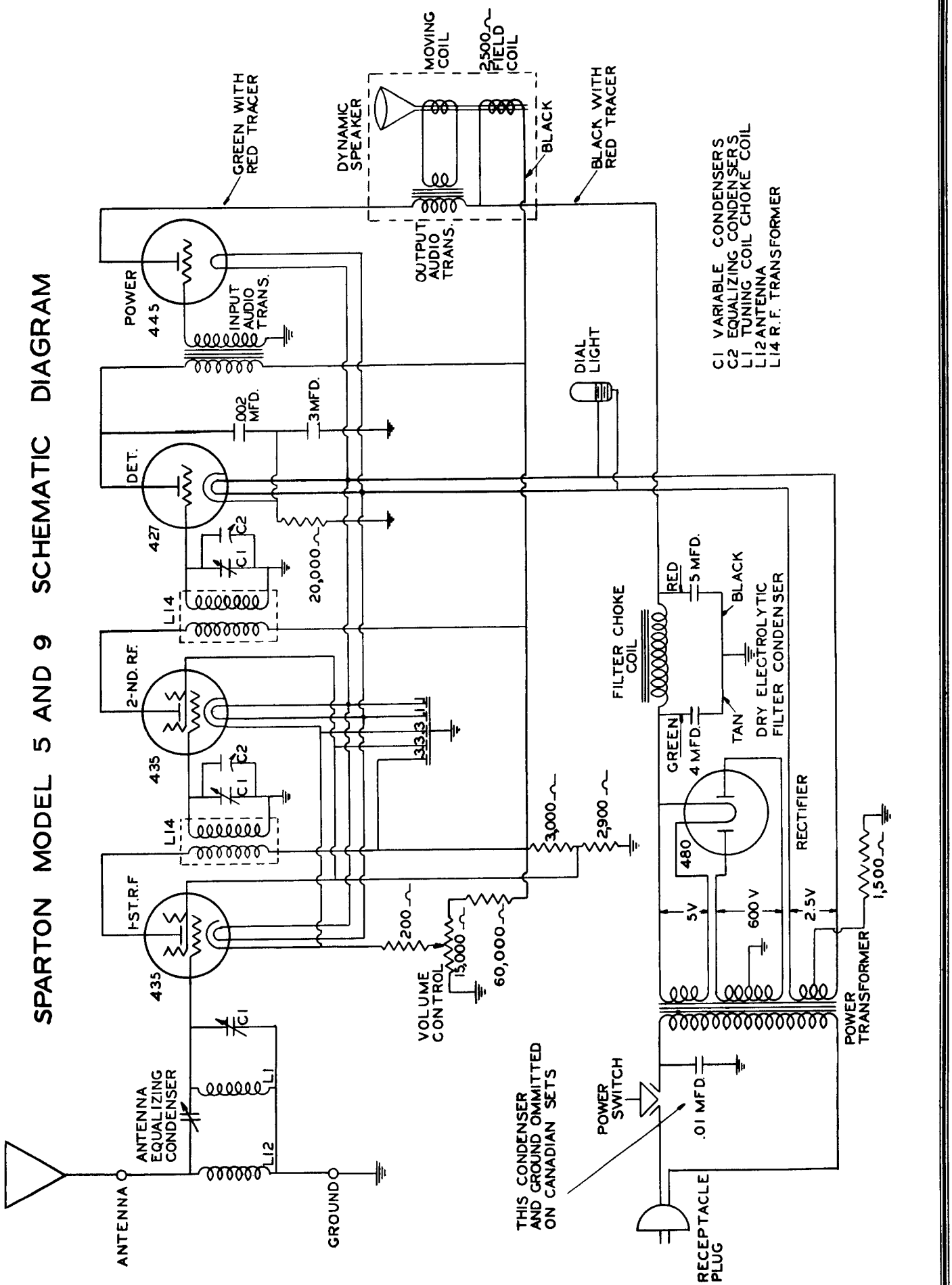
SPARKS-WITHINGTON CO.

SPARTON MODEL A.R.-19

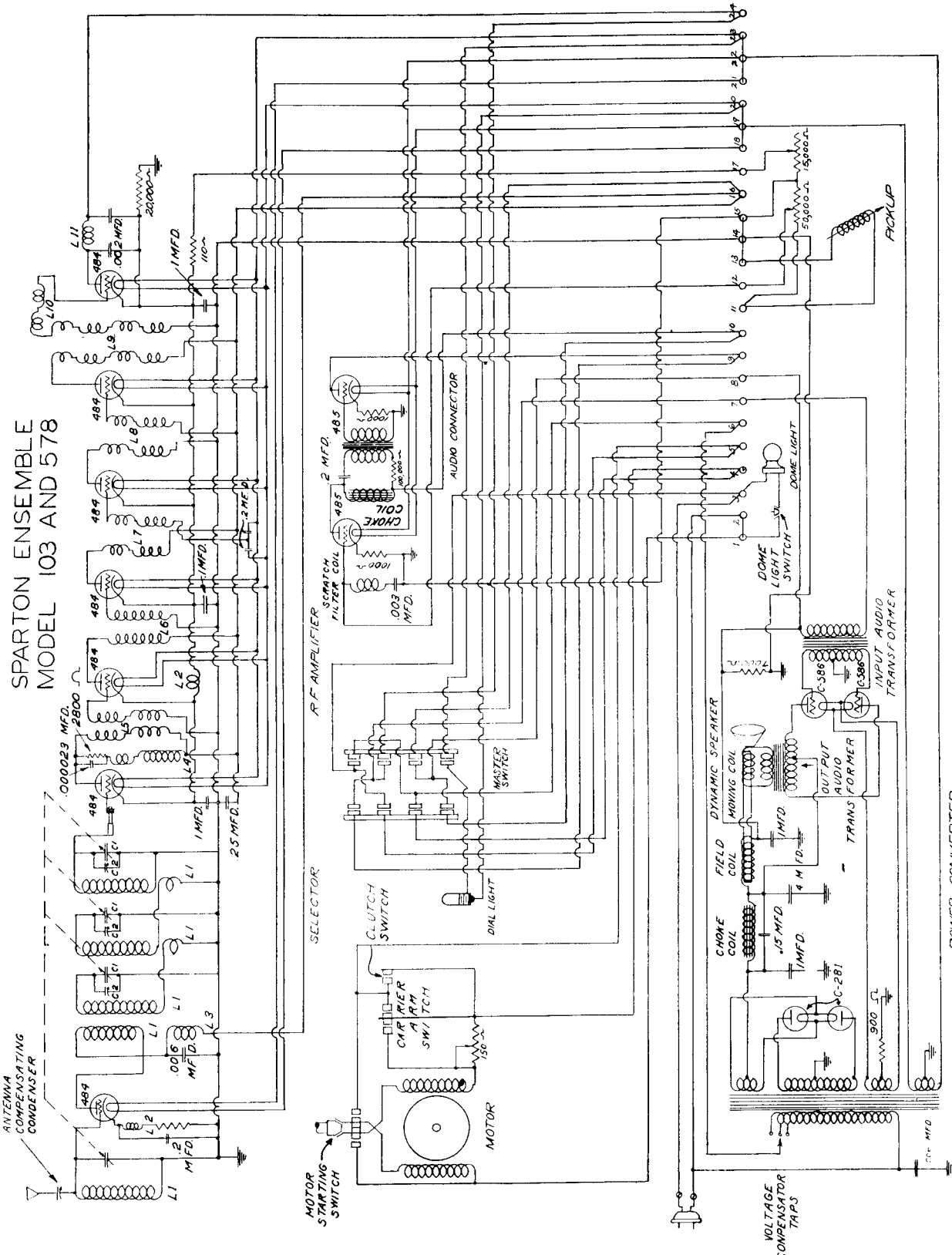


SPARKS-WITHINGTON CO.

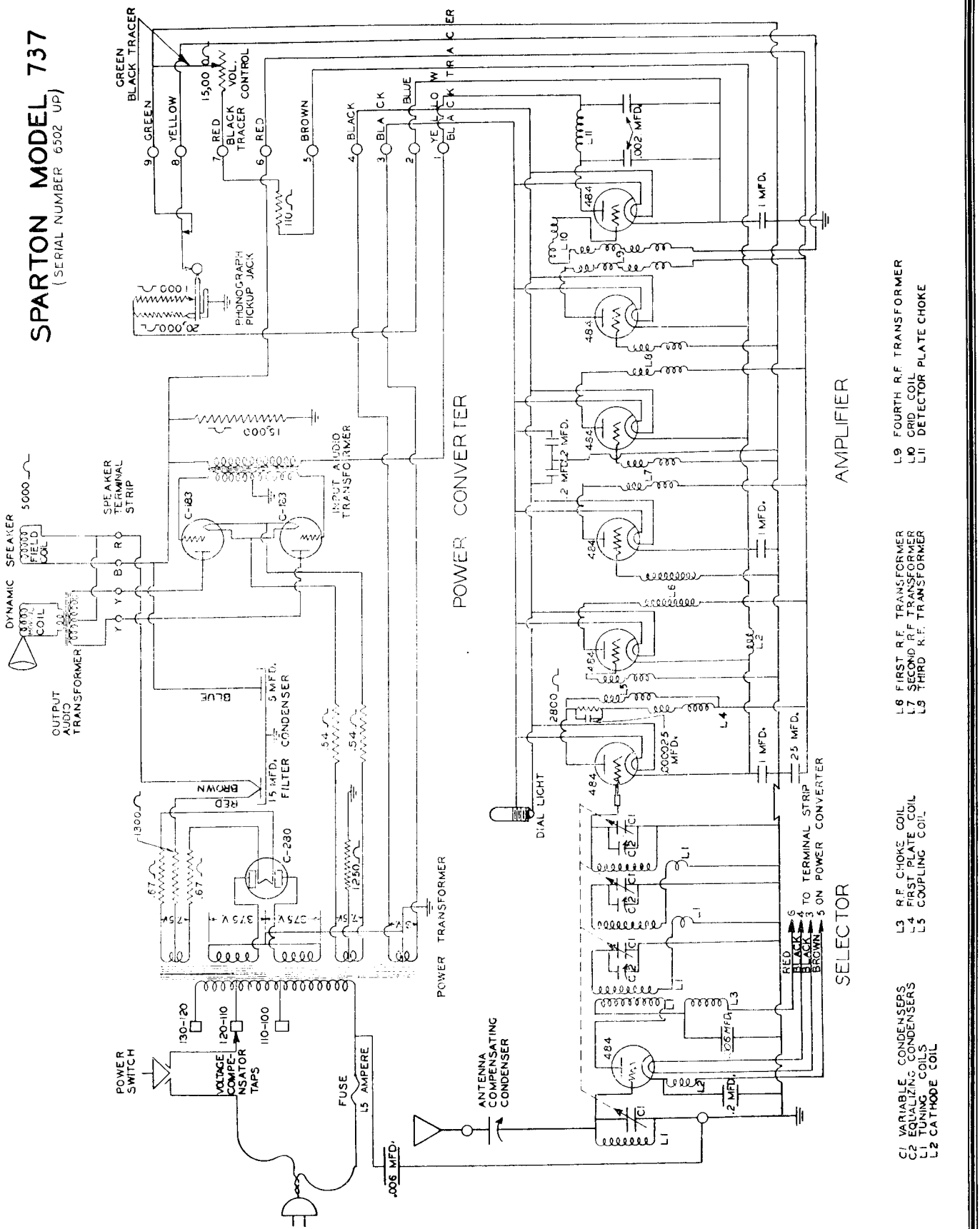
SPARTON MODEL 5 AND 9 SCHEMATIC DIAGRAM



SPARKS-WITHINGTON CO.

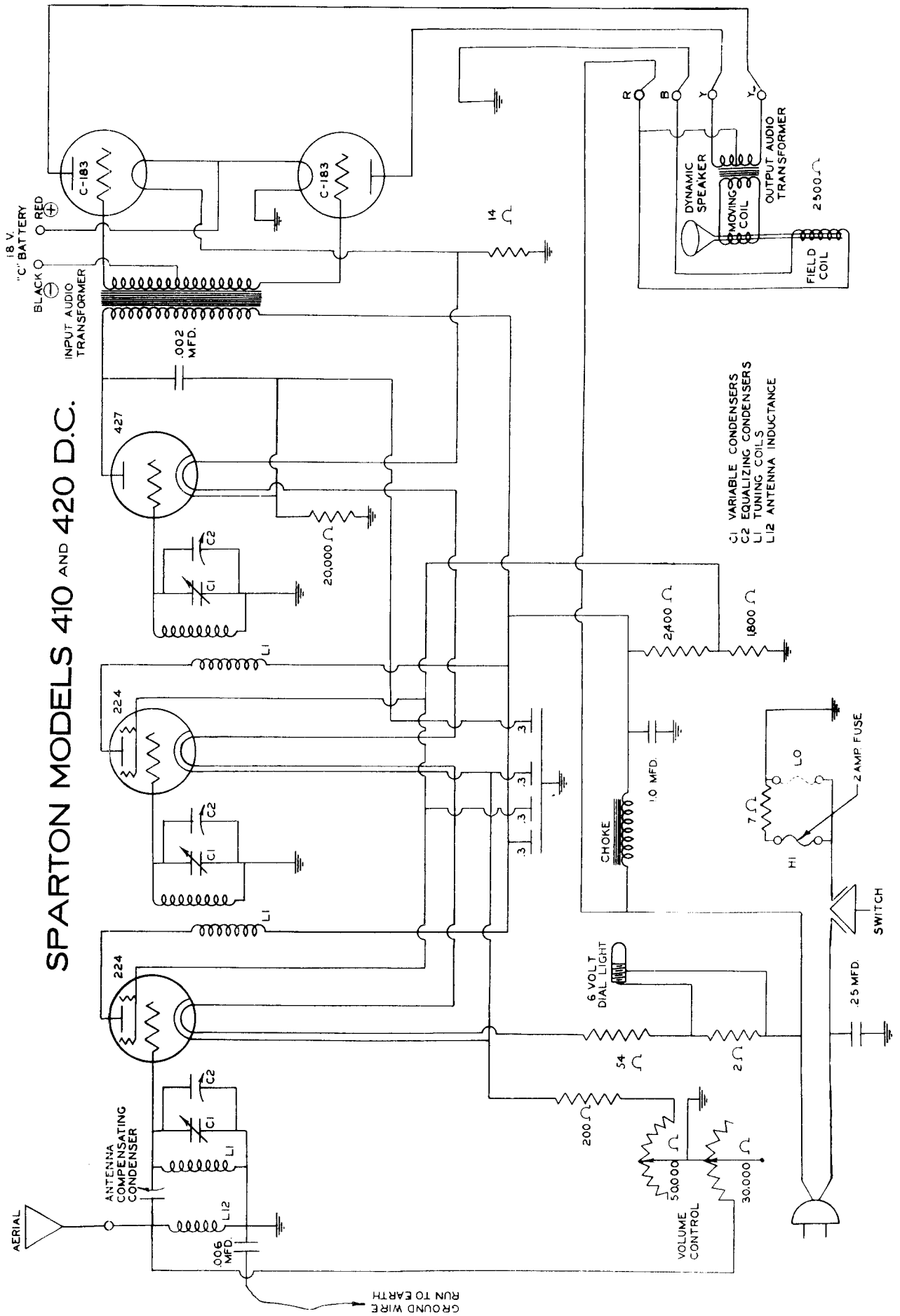


SPARKS-WITHINGTON CO.



SPARKS-WITHINGTON CO.

SPARTON MODELS 410 AND 420 D.C.



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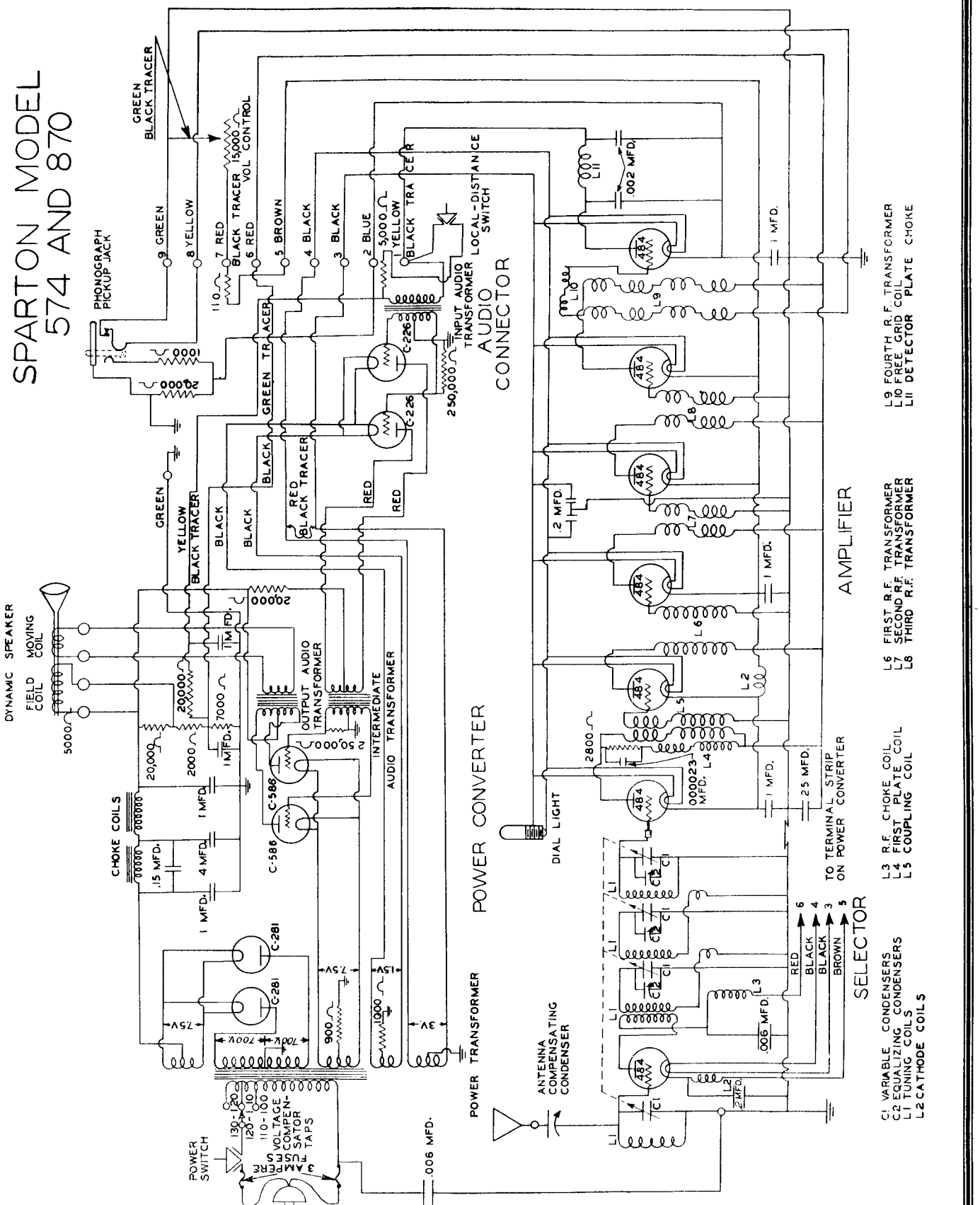
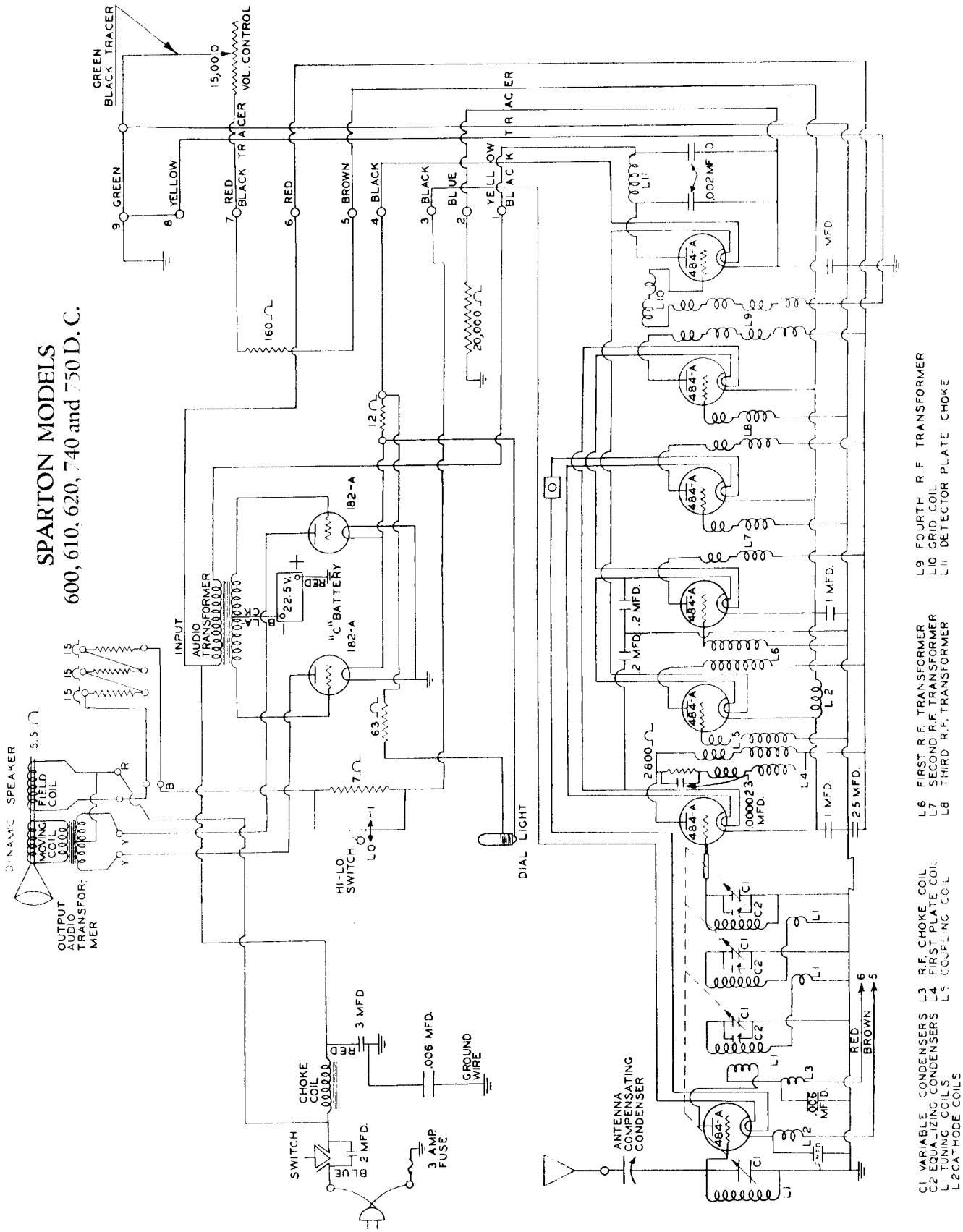


SPARKS-WITHINGTON CO.

SPARTON MODELS
600, 610, 620, 740 and 750 D. C.



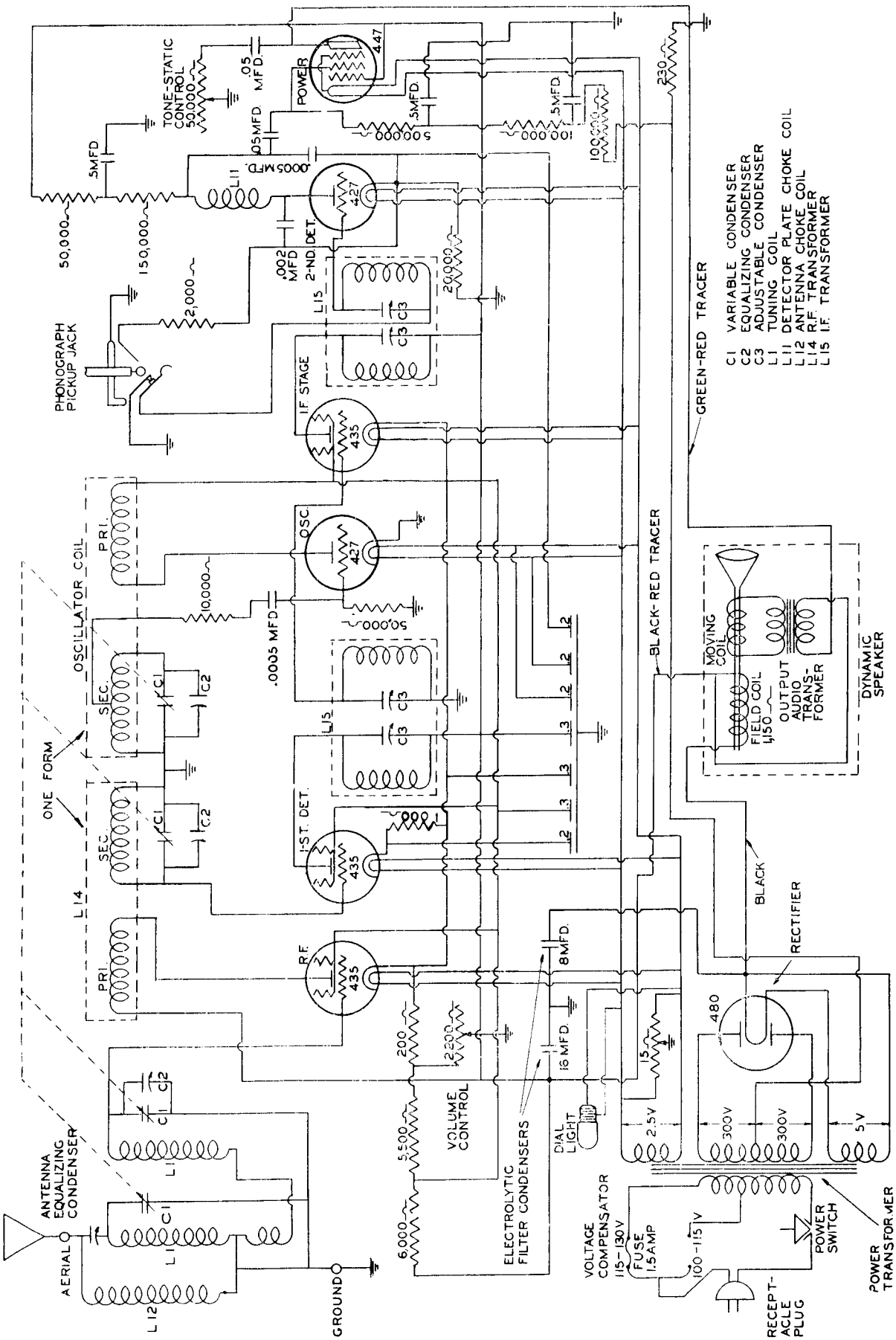
C1 VARIABLE CONDENSERS L3 R.F. CHOKE COIL
C2 EQUALIZING CONDENSERS L4 FIRST PLATE COIL
L1 TUNING COILS L5 COUPLING COIL
L2 CATHODE COILS

L6 FIRST R.F. TRANSFORMER
L7 SECOND R.F. TRANSFORMER
L8 THIRD R.F. TRANSFORMER

L9 FOURTH R.F. TRANSFORMER
L10 GRID COIL
L11 DETECTOR PLATE CHOKE

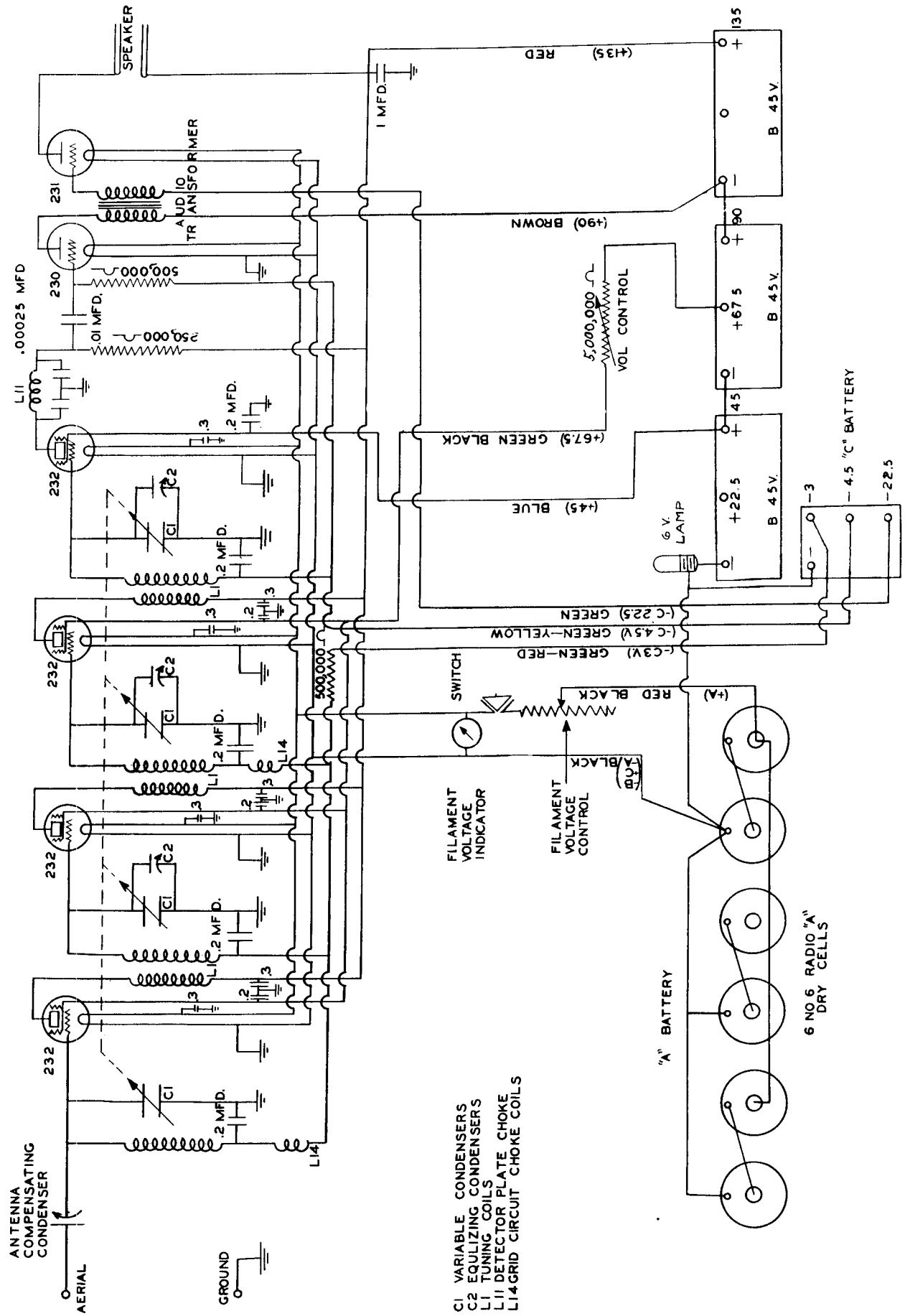
SPARKS-WITHINGTON CO.

Sparton Model 10—Schematic Diagram



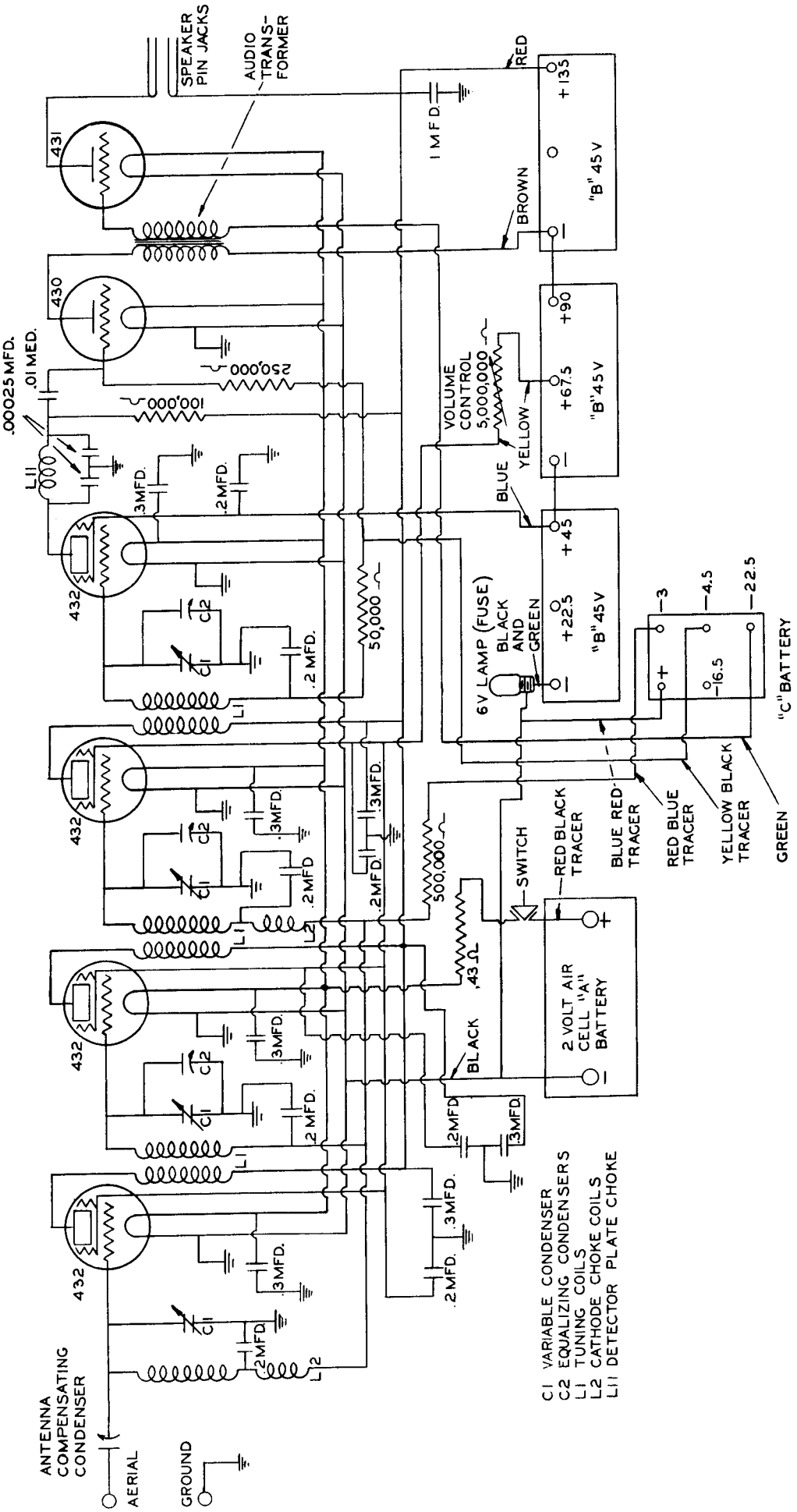
SPARKS-WITHINGTON CO.

SPARTON MODEL 31



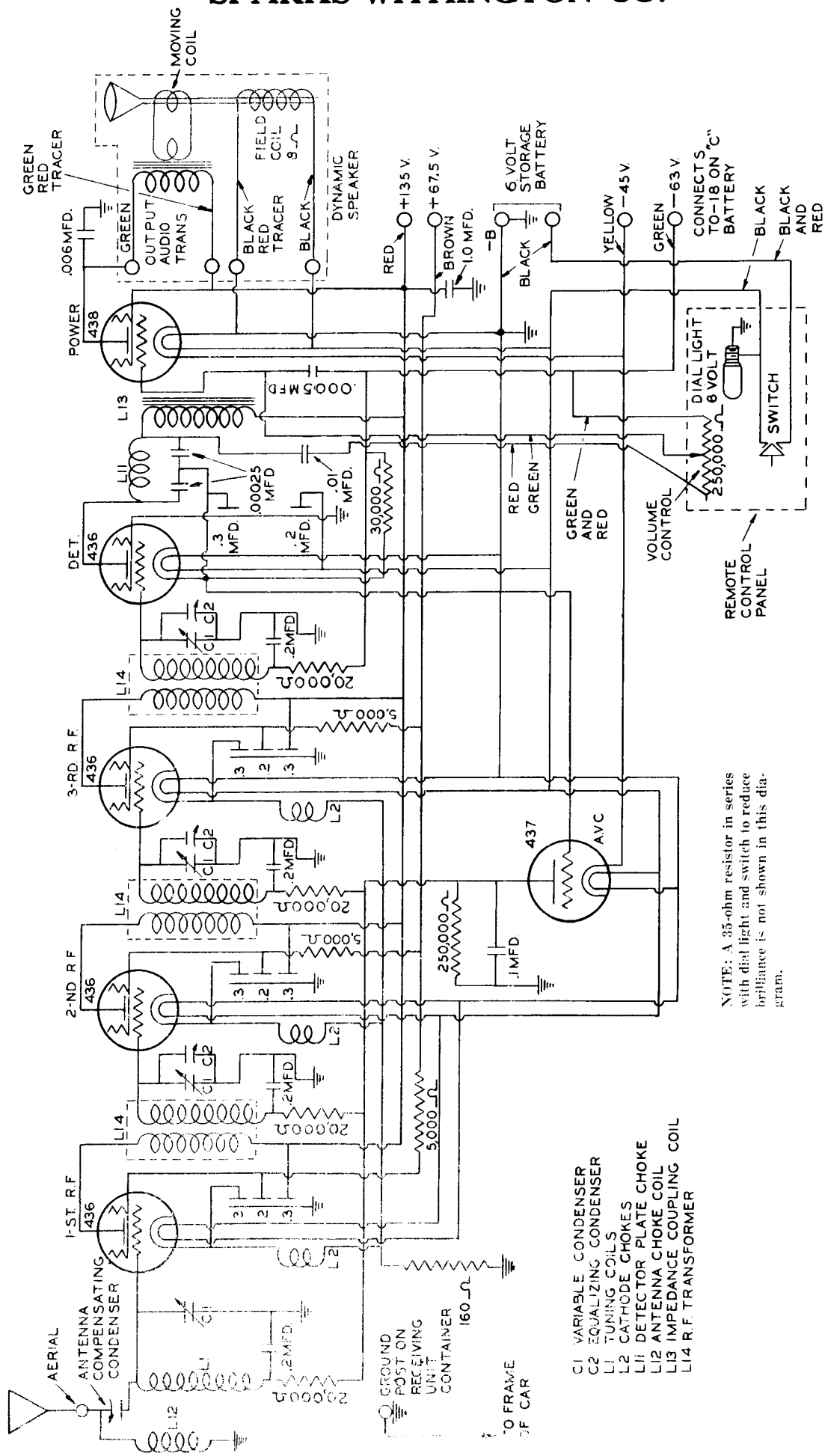
SPARKS-WITHINGTON CO.

Sparton Model 51 and 52 Schematic Diagram



SPARKS-WITHINGTON CO.

SPARTON MODEL 40 SCHEMATIC DIAGRAM

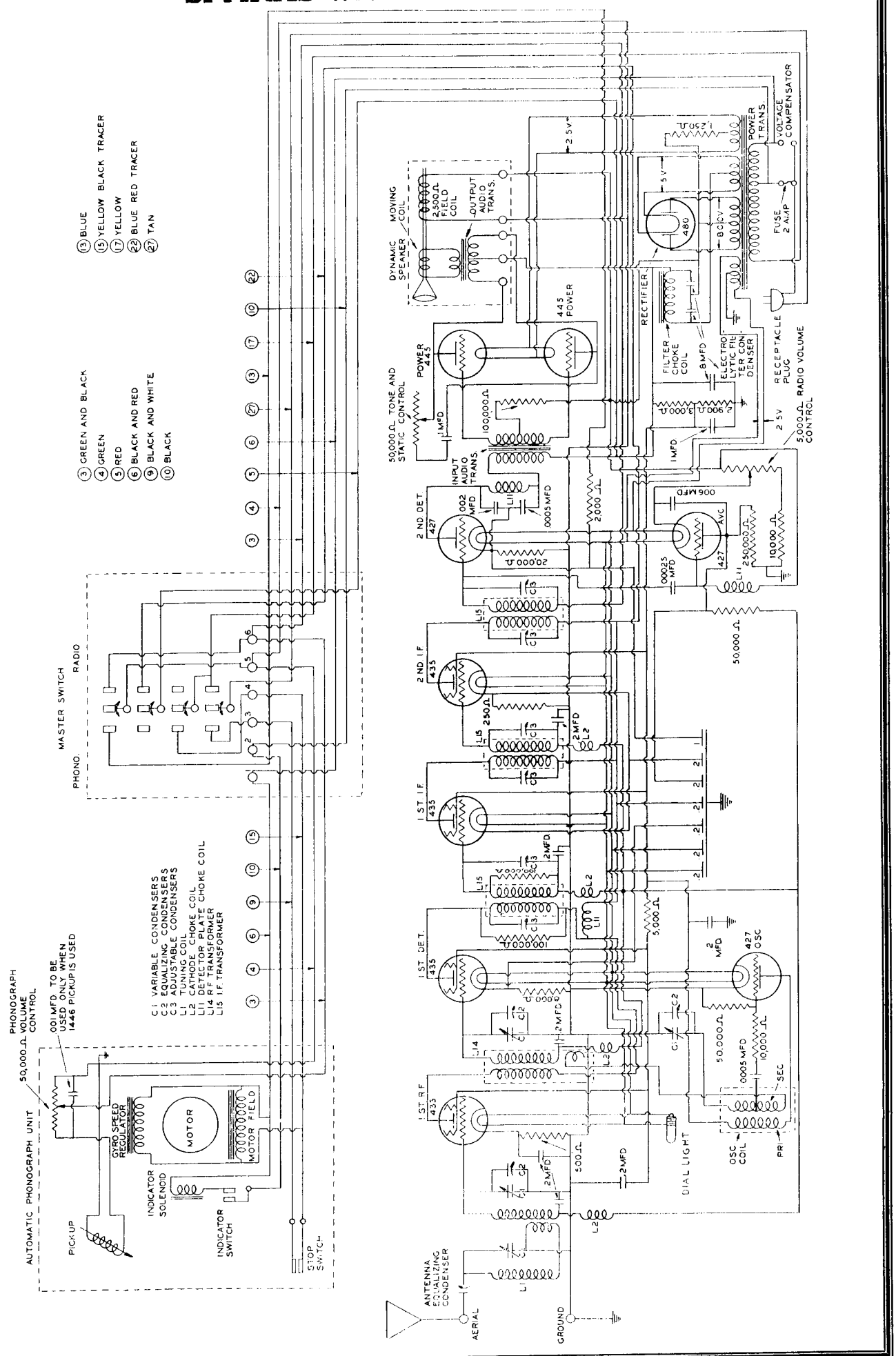


NOTE: A 35-ohm resistor in series with dial light and switch to reduce brilliance is not shown in this diagram.

C1 VARIABLE CONDENSER
C2 EQUALIZING CONDENSER
L1 TUNING COILS
L2 CATHODE CHOKES
L11 DETECTOR PLATE CHOKE
L12 ANTENNA CHOKE COIL
L13 IMPEDANCE COUPLING COIL
L14 R.F. TRANSFORMER

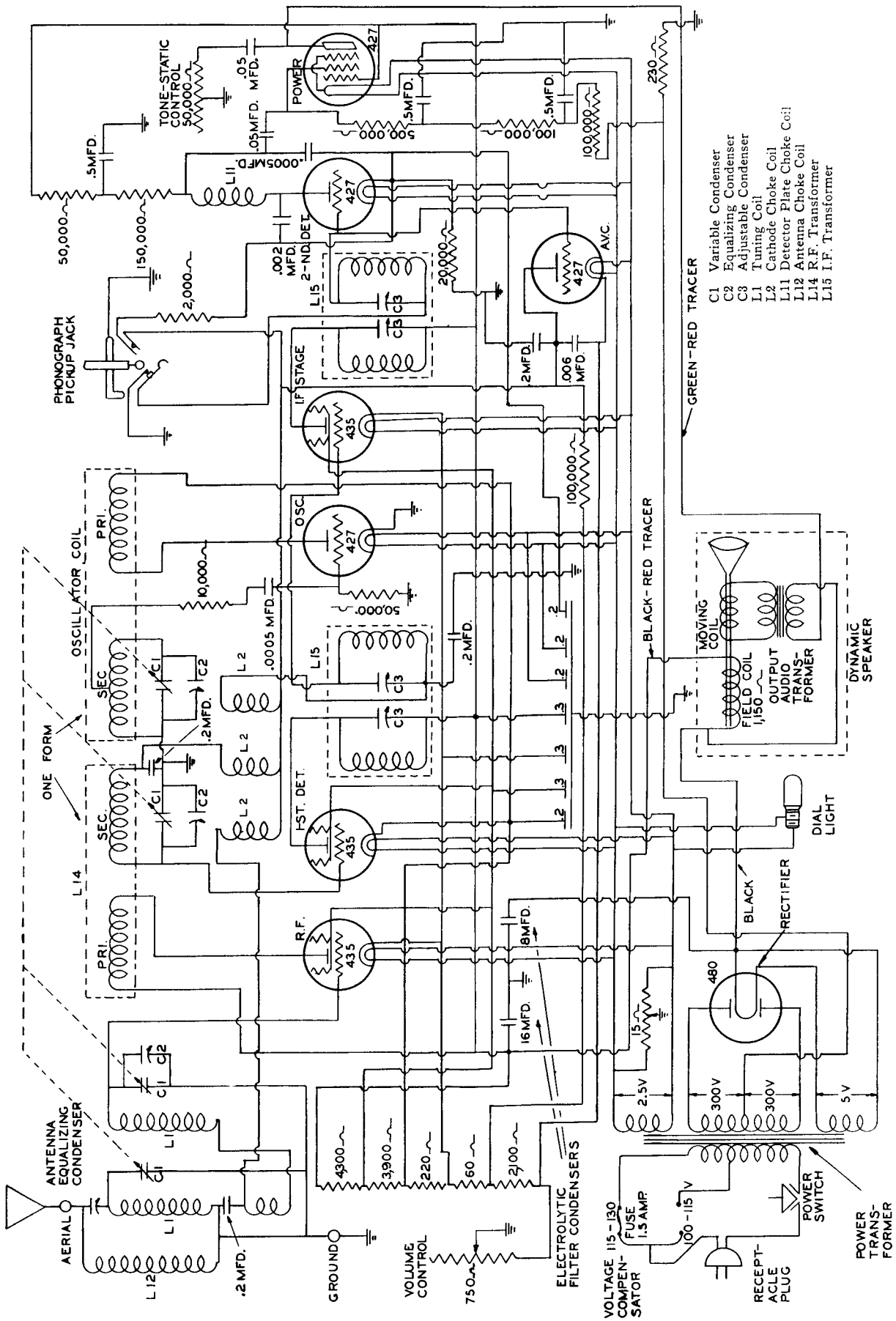
SPARKS-WITHINGTON CO.

SPARTON MODEL 30 SCHEMATIC DIAGRAM



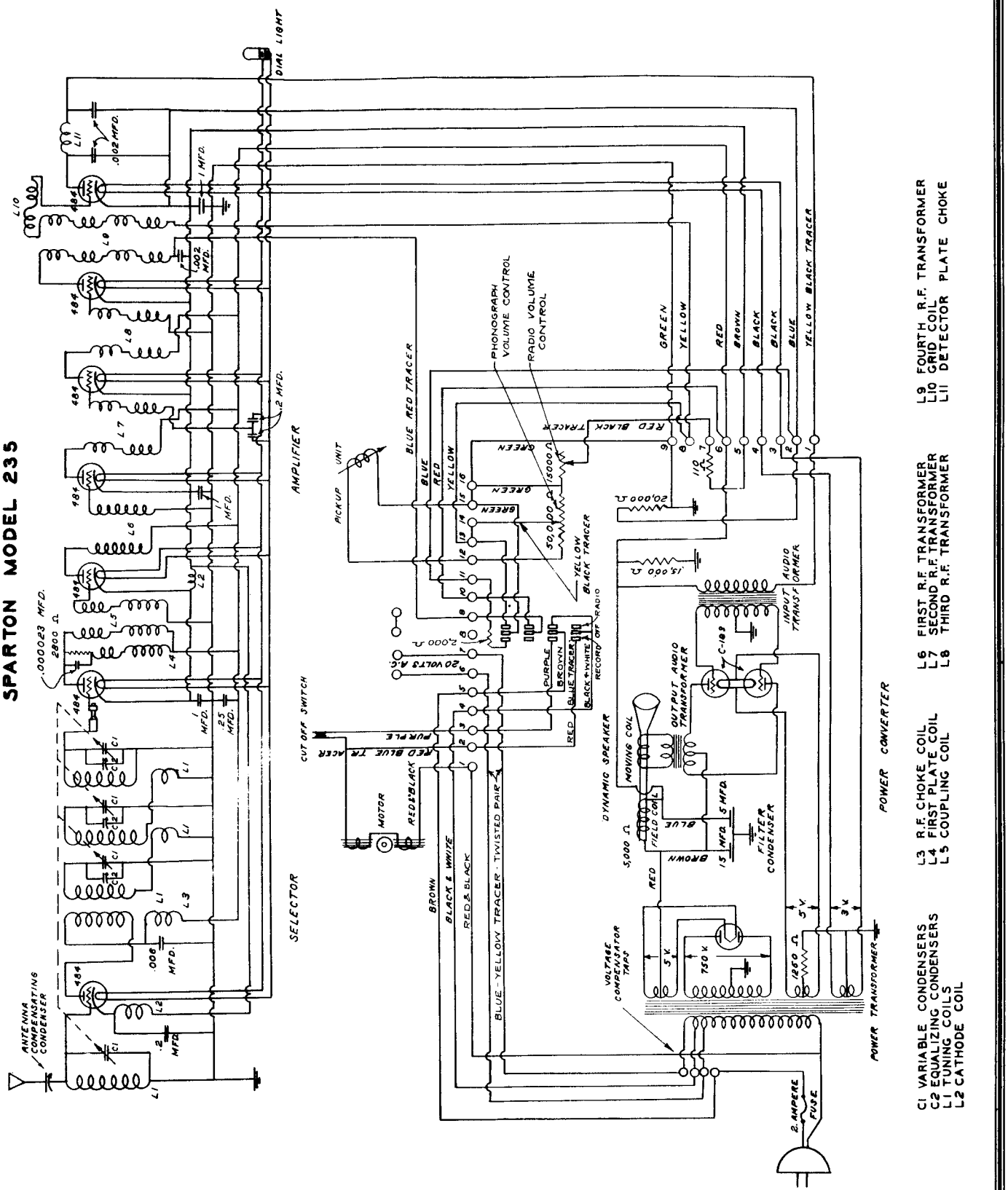
SPARKS-WITHINGTON CO.

Sparton Model 15 Schematic Diagram



SPARKS-WITHINGTON CO.

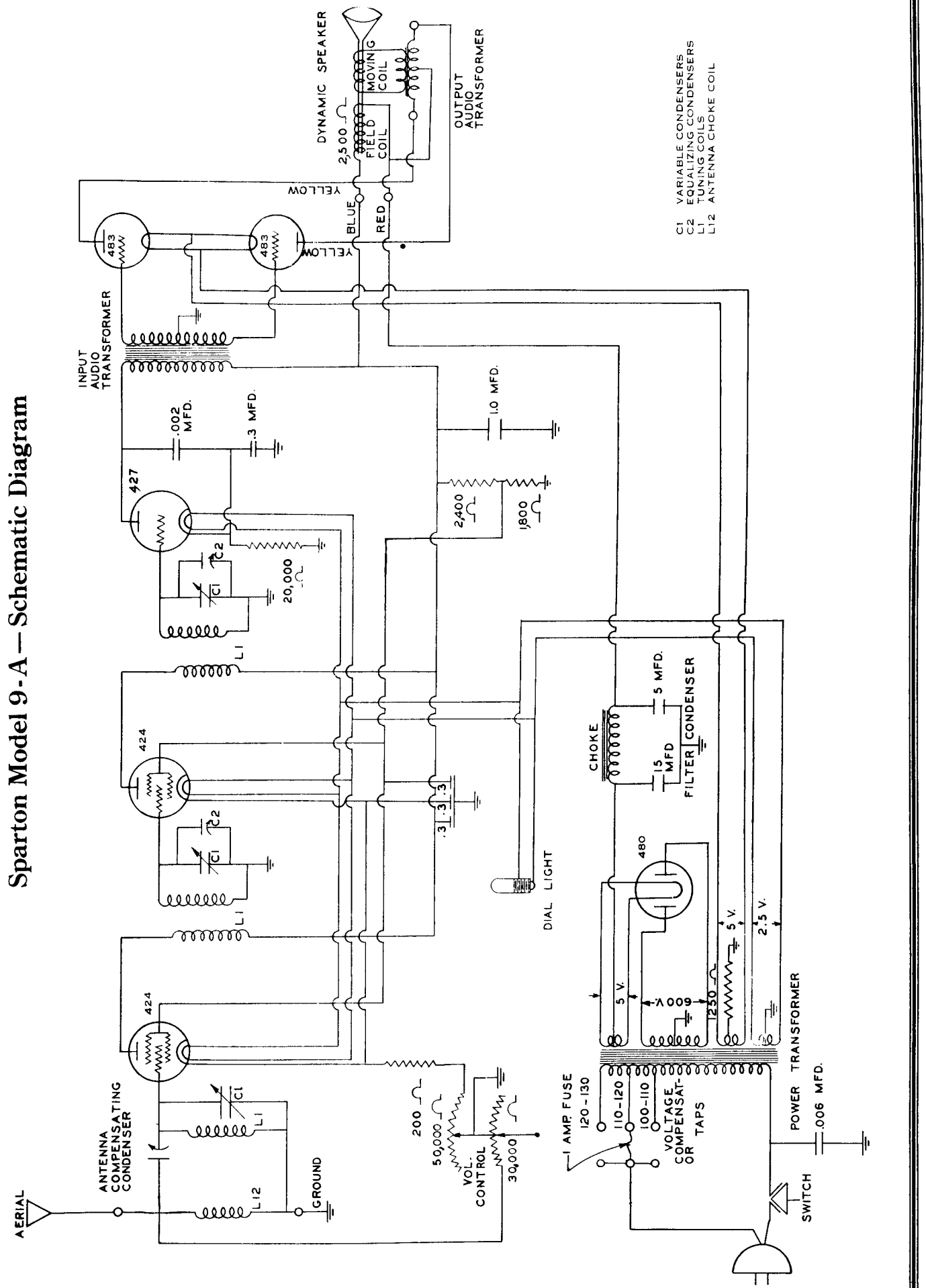
SPARTON MODEL 235



C1 VARIABLE CONDENSERS
C2 EQUALIZING CONDENSERS
L1 TUNING COILS
L2 CATHODE COIL
L3 R.F. CHOKE COIL
L4 FIRST PLATE COIL
L5 COUPLING COIL
L6 FIRST R.F. TRANSFORMER
L7 SECOND R.F. TRANSFORMER
L8 THIRD R.F. TRANSFORMER
L9 FOURTH R.F. TRANSFORMER
L10 GRID COIL
L11 DETECTOR PLATE CHOKE

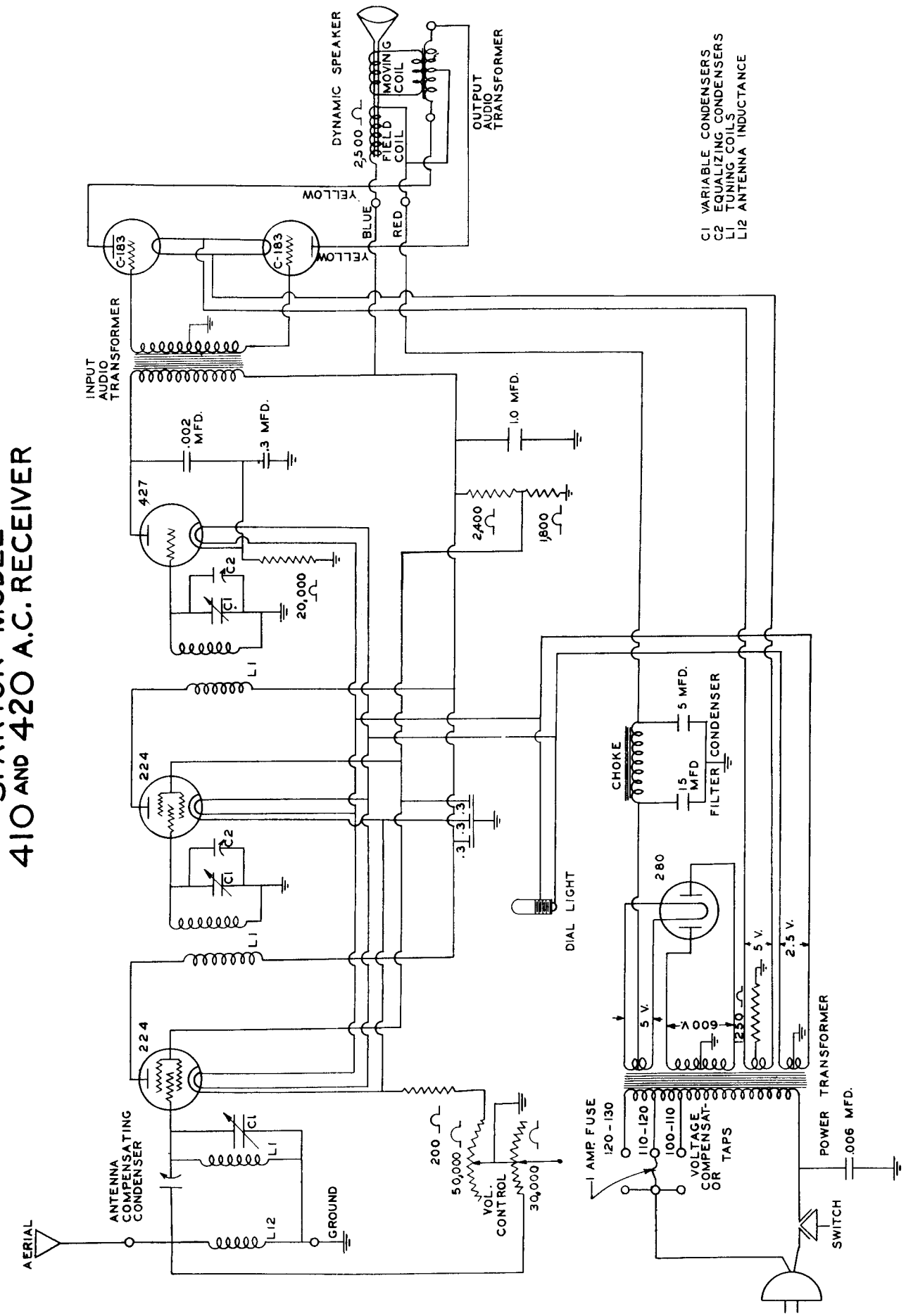
SPARKS-WITHINGTON CO.

Sparton Model 9-A — Schematic Diagram

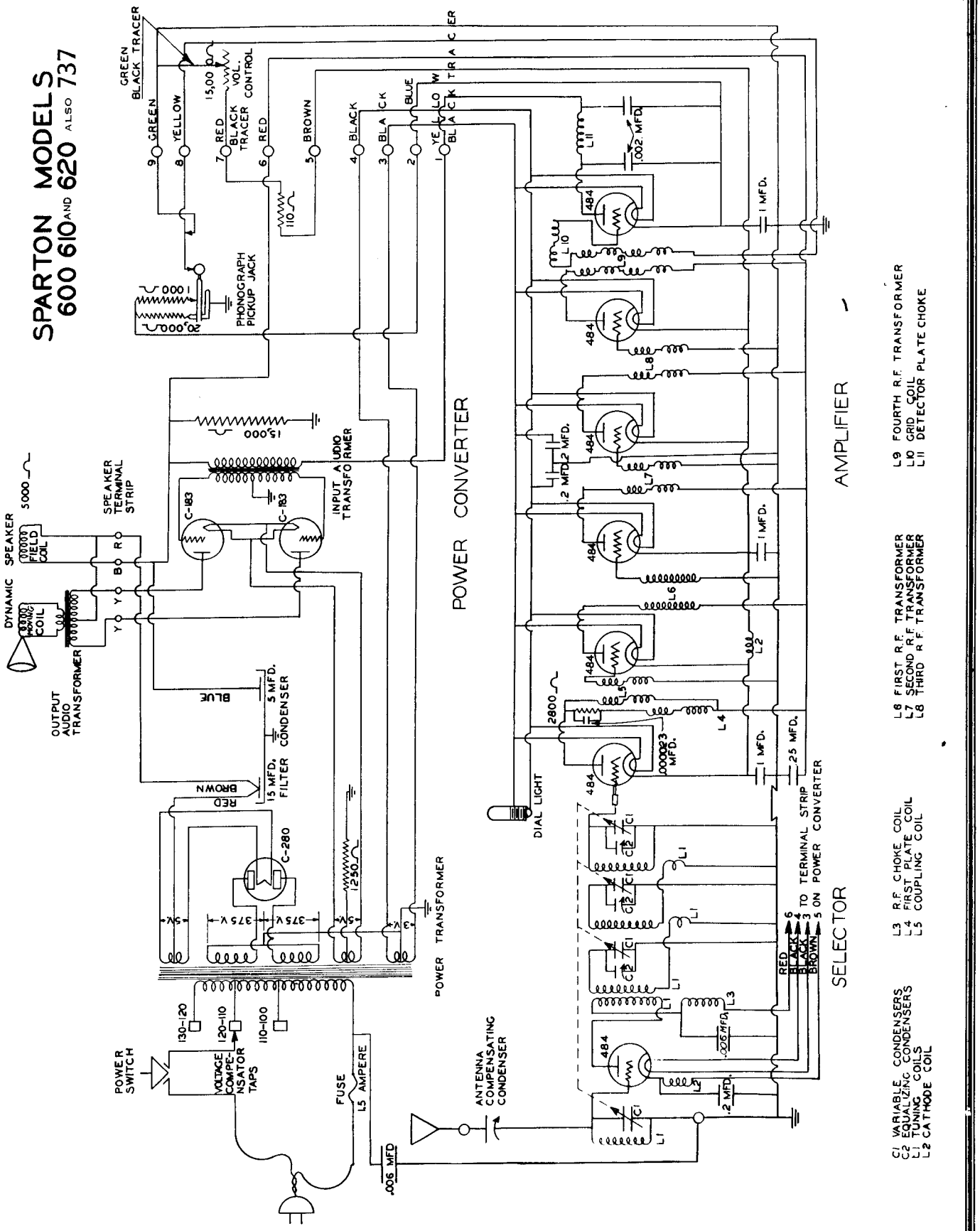


SPARKS-WITHINGTON CO.

SPARTON MODEL 410 AND 420 A.C. RECEIVER

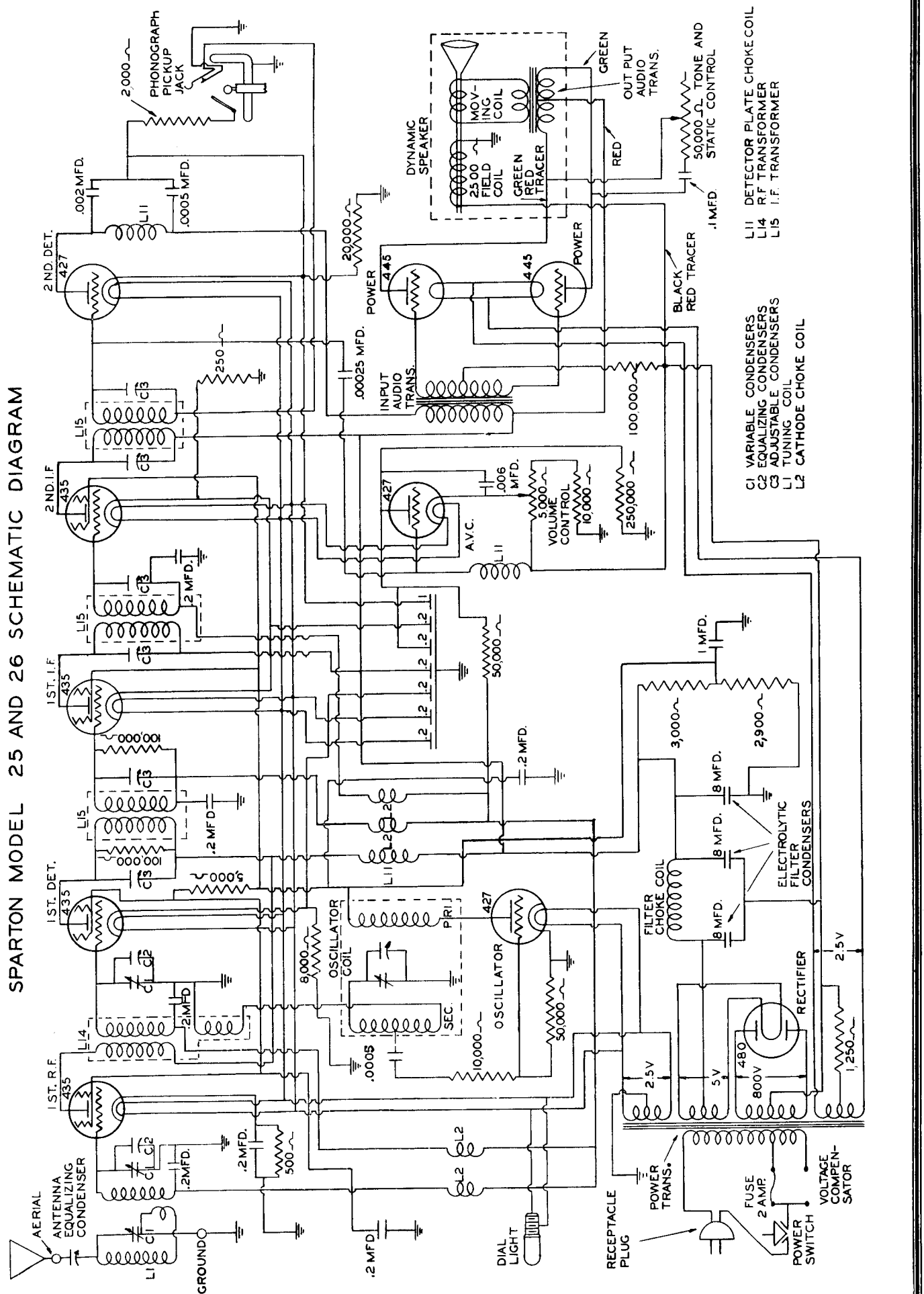


SPARKS-WITHINGTON CO.



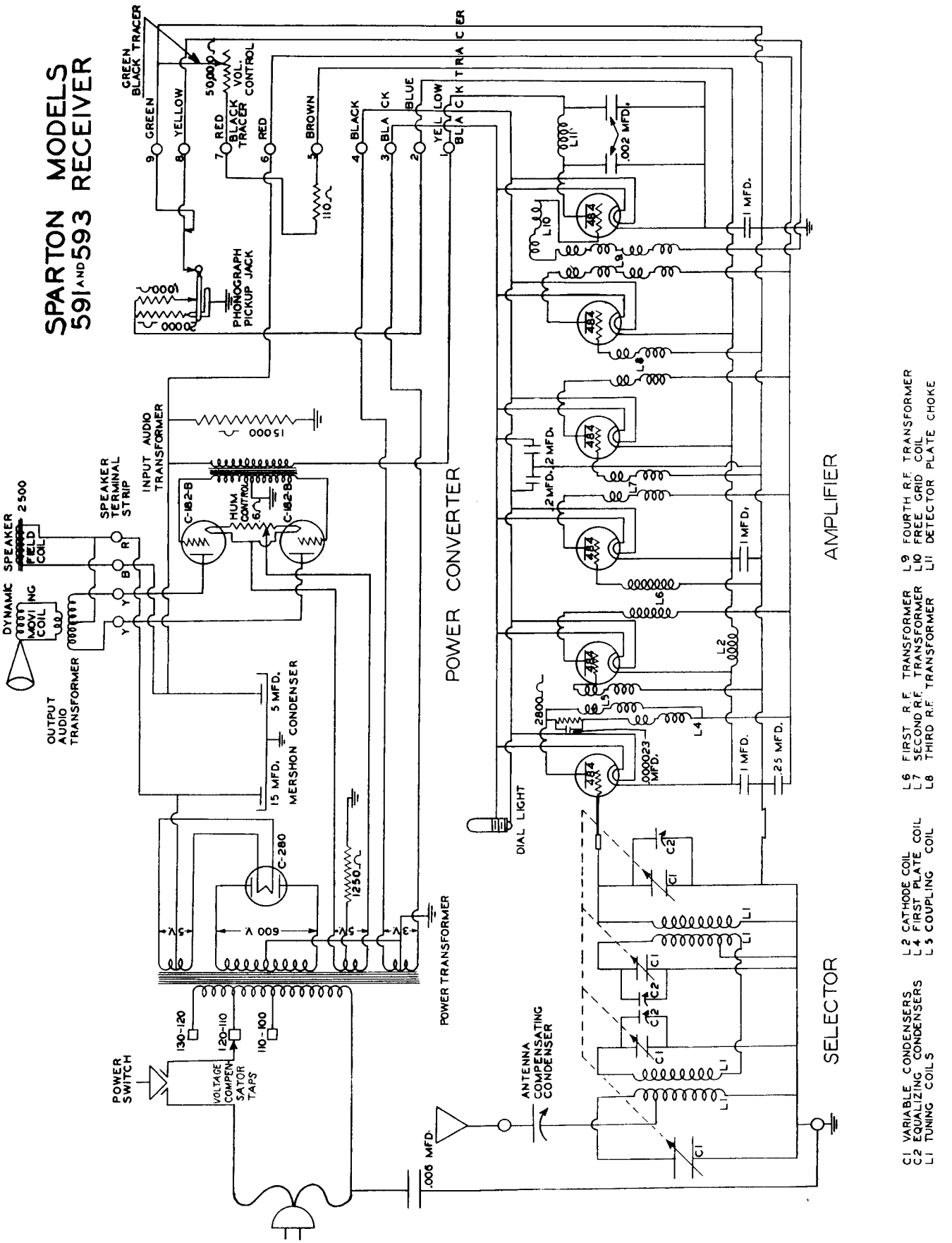
SPARKS-WITHINGTON CO.

SPARTON MODEL 25 AND 26 SCHEMATIC DIAGRAM

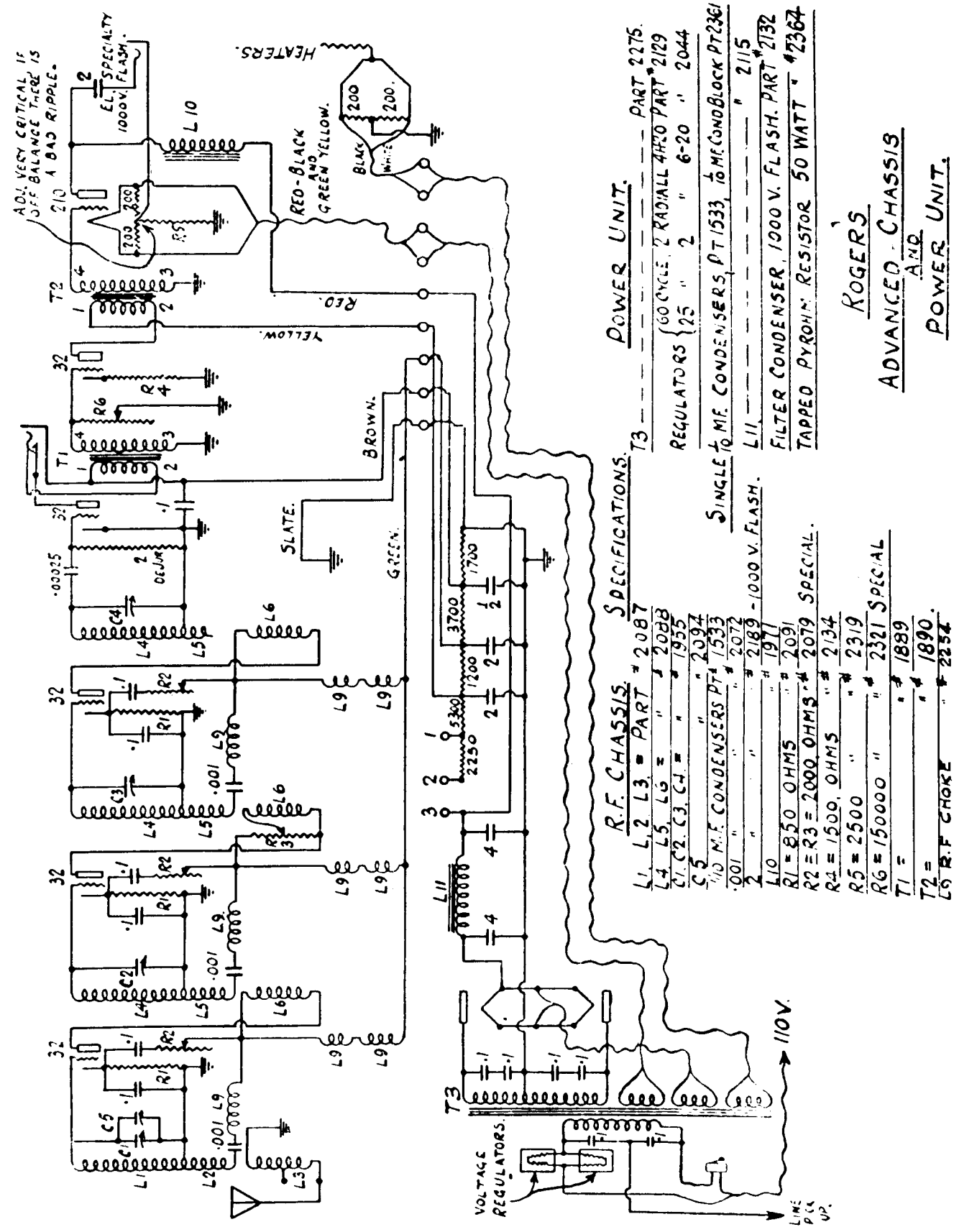


SPARKS-WITHINGTON CO.

SPARTON MODELS 591 AND 593 RECEIVER

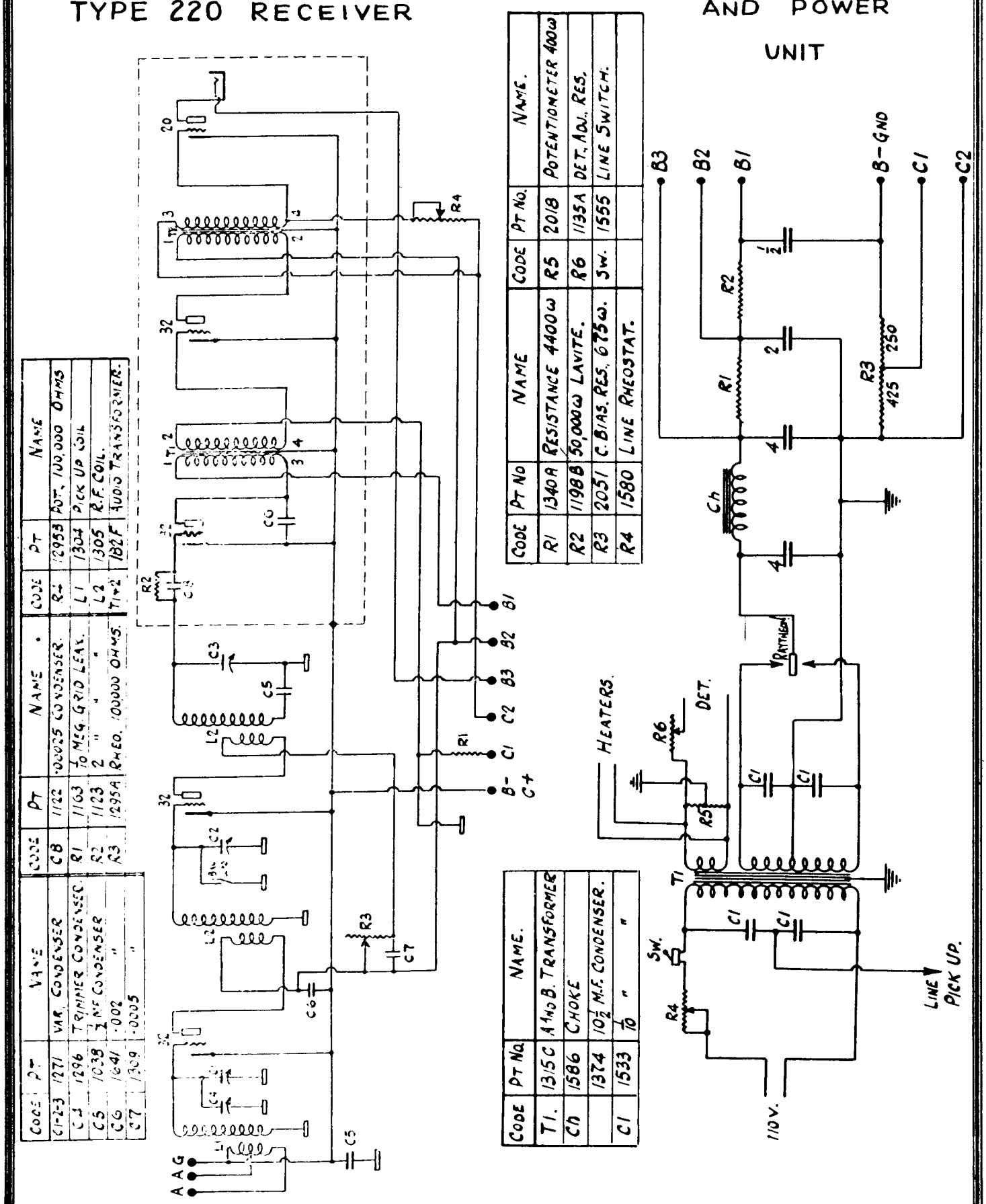


STANDARD RADIO MFG. CORP., LTD.
(ROGERS)



STANDARD RADIO MFG. CORP., LTD.
(ROGERS)

TYPE 220 RECEIVER AND POWER UNIT



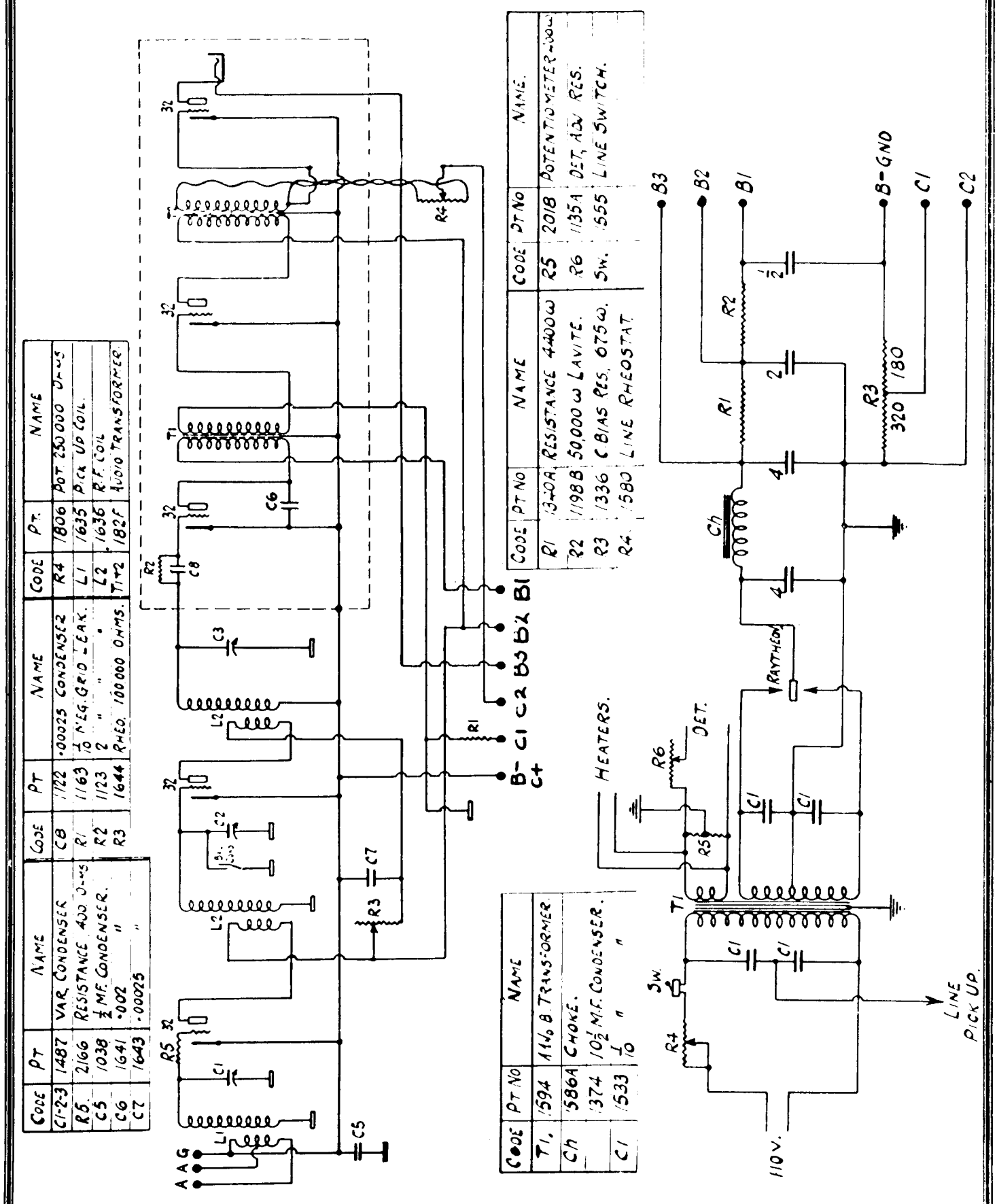
CODE	PT	NAME	CODE	PT	NAME
C1-2-3	1271	VAR. CONDENSER	C8	1122	.0005 CONDENSER.
C4	1296	TRIMMER CONDENSER	R1	1163	1/10 MEG GRID LEAK.
C5	1038	.1 MF CONDENSER	R2	1123	2 " " "
C6	1641	.002 "	R3	1295A	RHEO. 10000 OHMS
C7	1309	.0005 "			

CODE	PT	NAME	CODE	PT	NAME
R2	2953	POT., 100,000 OHMS	T1	1315C	A.F. & B. TRANSFORMER
L1	1304	PICK UP COIL	Ch	1586	CHOKE
L2	1305	R.F. COIL.		1374	10½ M.F. CONDENSER.
T1-2	182F	AUDIO TRANSFORMER.	C1	1533	1/10 " "

CODE	PT NO	NAME	CODE	PT NO.	NAME.
R1	1340A	RESISTANCE 4400Ω	R5	2018	POTENTIOMETER 400Ω
R2	1198B	50,000Ω LAVITE.	R6	1135A	DET. ADJ. RES.
R3	2051	C. BIAS. RES. 675Ω.	Sw.	1555	LINE SWITCH.
R4	1580	LINE RHEOSTAT.			

STANDARD RADIO MFG. CORP., LTD.
(ROGERS)

TYPE 250 RECEIVER AND POWER UNIT



Code	Pt	Name
C1-2-3	1487	VAR. CONDENSER
R5	2166	RESISTANCE 400 OHMS
C5	1038	½ MF. CONDENSER.
C6	1641	.002 "
C7	1643	.00025 "

Code	Pt	Name
C8	1122	.00025 CONDENSER
R1	1163	½ MEG. GRID LEAK.
R2	1123	2 " " "
R3	1644	RHEO. 100 000 OHMS.

Code	Pt.	Name
R4	1806	POT 250 000 OHMS
L1	1635	PICK UP COIL
L2	1636	R.F. COIL
T1-2	182F	AUDIO TRANSFORMER

Code	Pt No	Name
R1	1340A	RESISTANCE 4400Ω
R2	1198B	50,000 Ω LAVITE.
R3	1336	C BIAS RES. 675Ω.
R4	1580	LINE RHEOSTAT

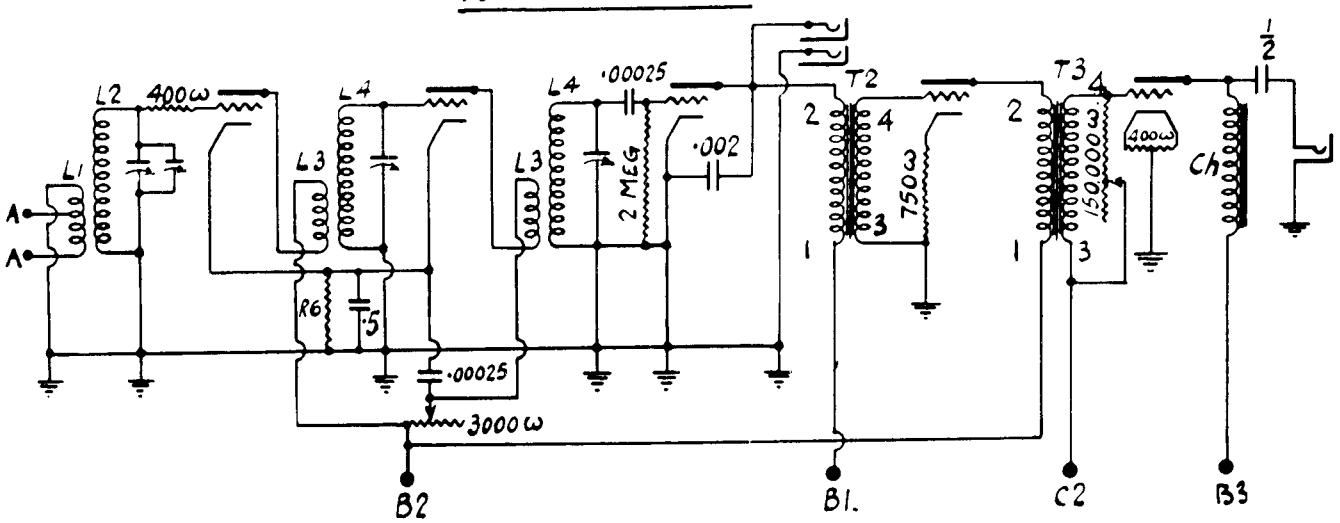
Code	Pt No	Name
R5	2018	POTENTIOMETER-400Ω
R6	1135A	DET. ADJ. RES.
Sw.	555	LINE SWITCH.

Code	Pt No	Name
T1,	1594	11½ B TRANSFORMER.
Ch	1586A	CHOKE.
	1374	10½ M.F. CONDENSER.
C1	1533	½ " "

STANDARD RADIO MFG. CORP., LTD. (ROGERS)

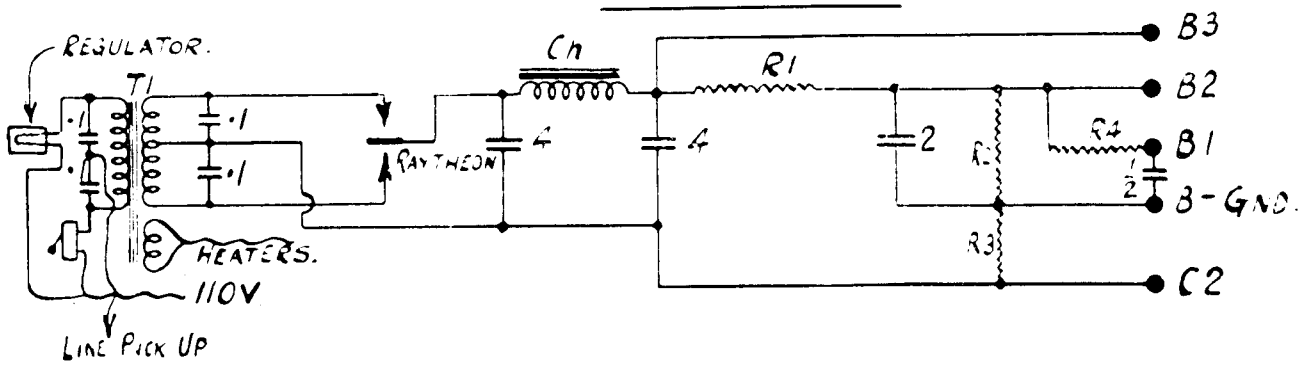
400 SERIES RECEIVER AND POWER UNIT.

R. F. CHASSIS.



L1-L2 PT No 2034 L3 - L4 PT No 2035 Ch PT No 1946
3000 OHM REGENERATION CONTROL PT No 2017
150000 " VOLUME CONTROL " " 2016
T2 AND T3 :- " " 182F.
R6 = 400 OHMS :- " " 2166.

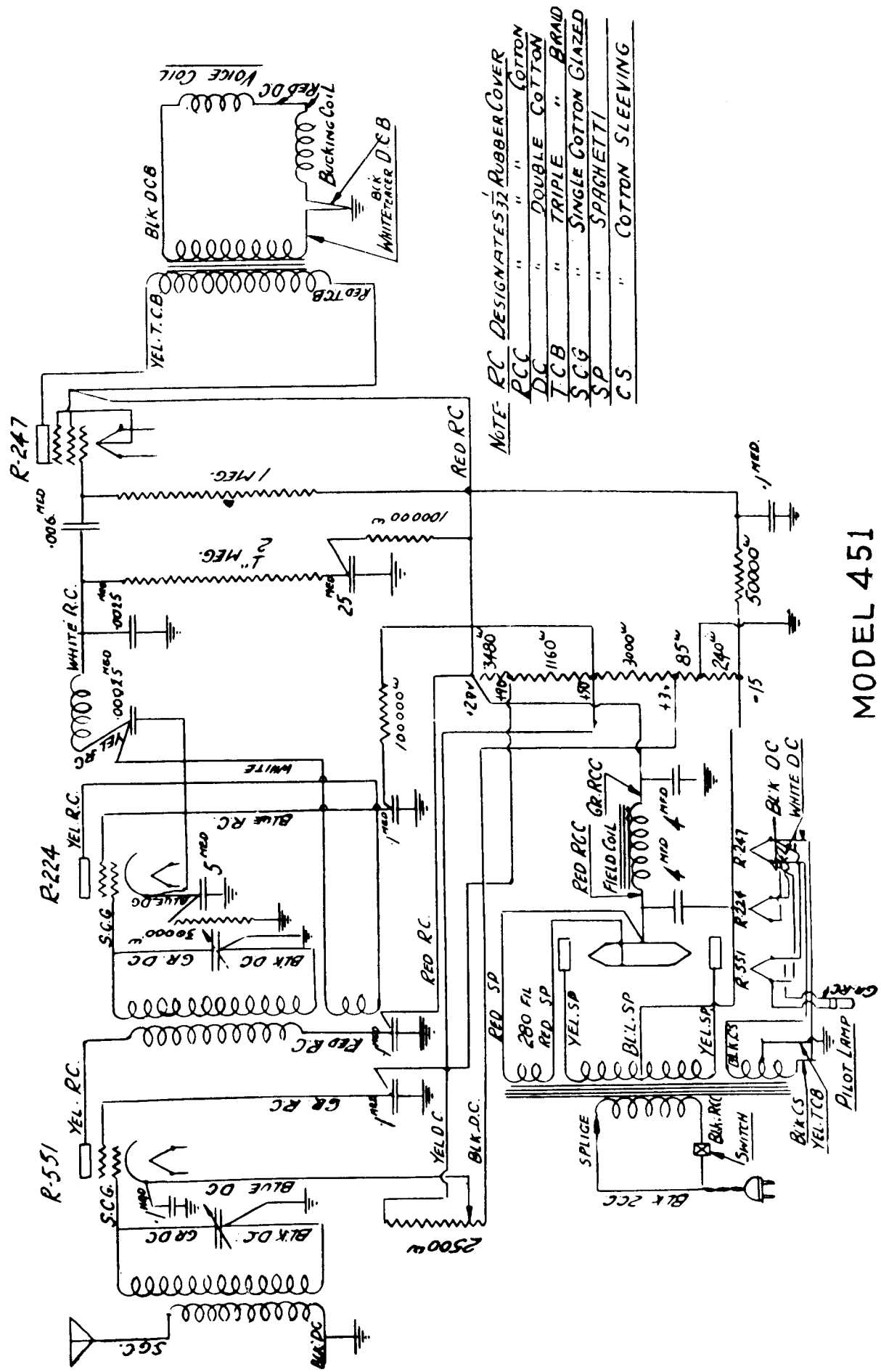
POWER UNIT.



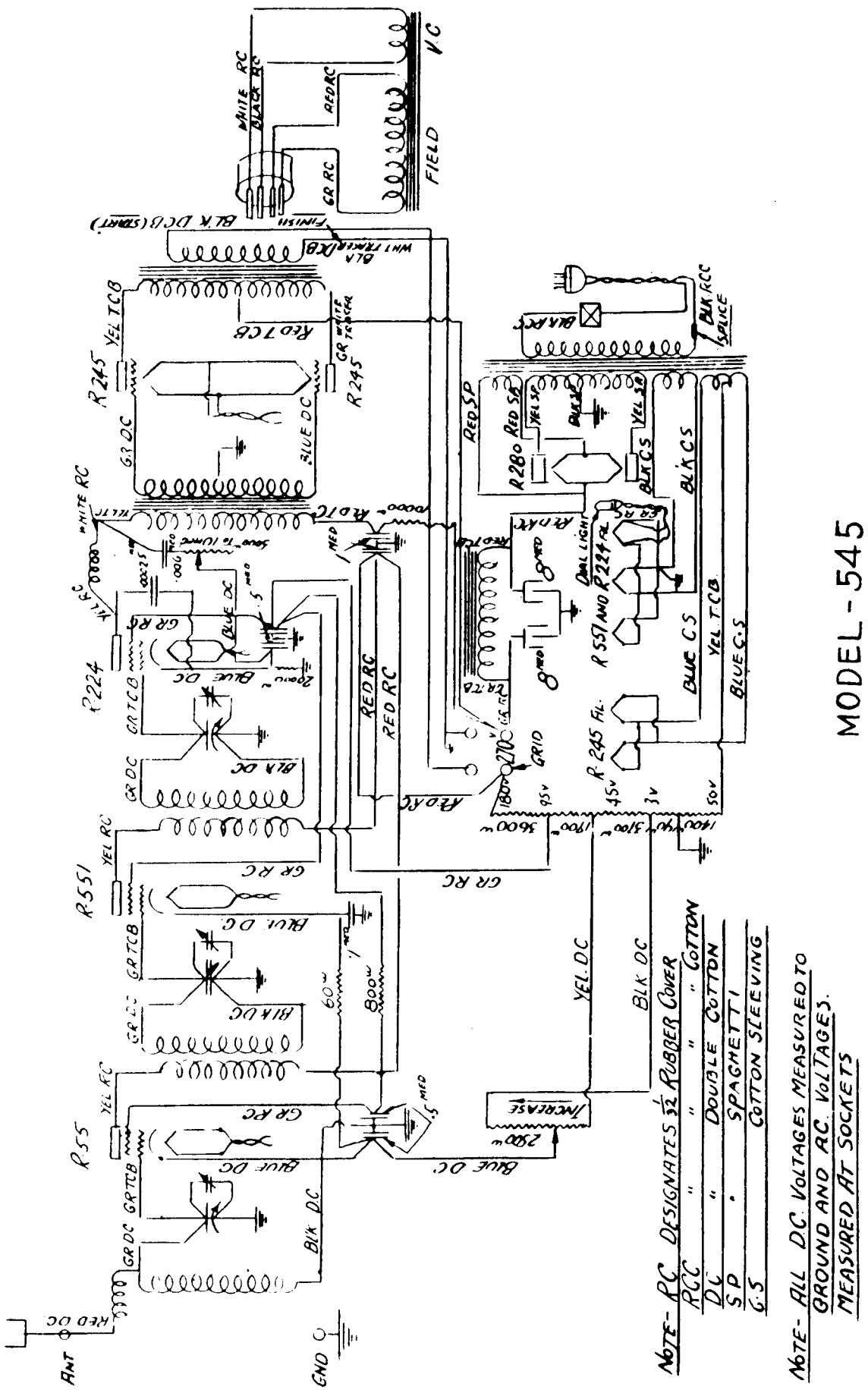
SPECIFICATIONS.

POWER UNIT FOR TYPE 15 POWER TUBE.
T1 :- UNIVERSAL (25 AND 60 CYCLE) PART 2260
Ch PART 2271.
REGULATORS. { 25 CYC TYPE 6-20 REGULATOR. / 60 " " 4H-20 " }
R1 = 7000ω R2 = 20000ω R3 = 1390ω R4 = 50000ω LAVITE
B3 = 250V. B2 = 110V. B1 = 30V. C2 = 50V. 10½ M.F. COND.
1/10 COND - 800V. FLASH TEST PT 2285.

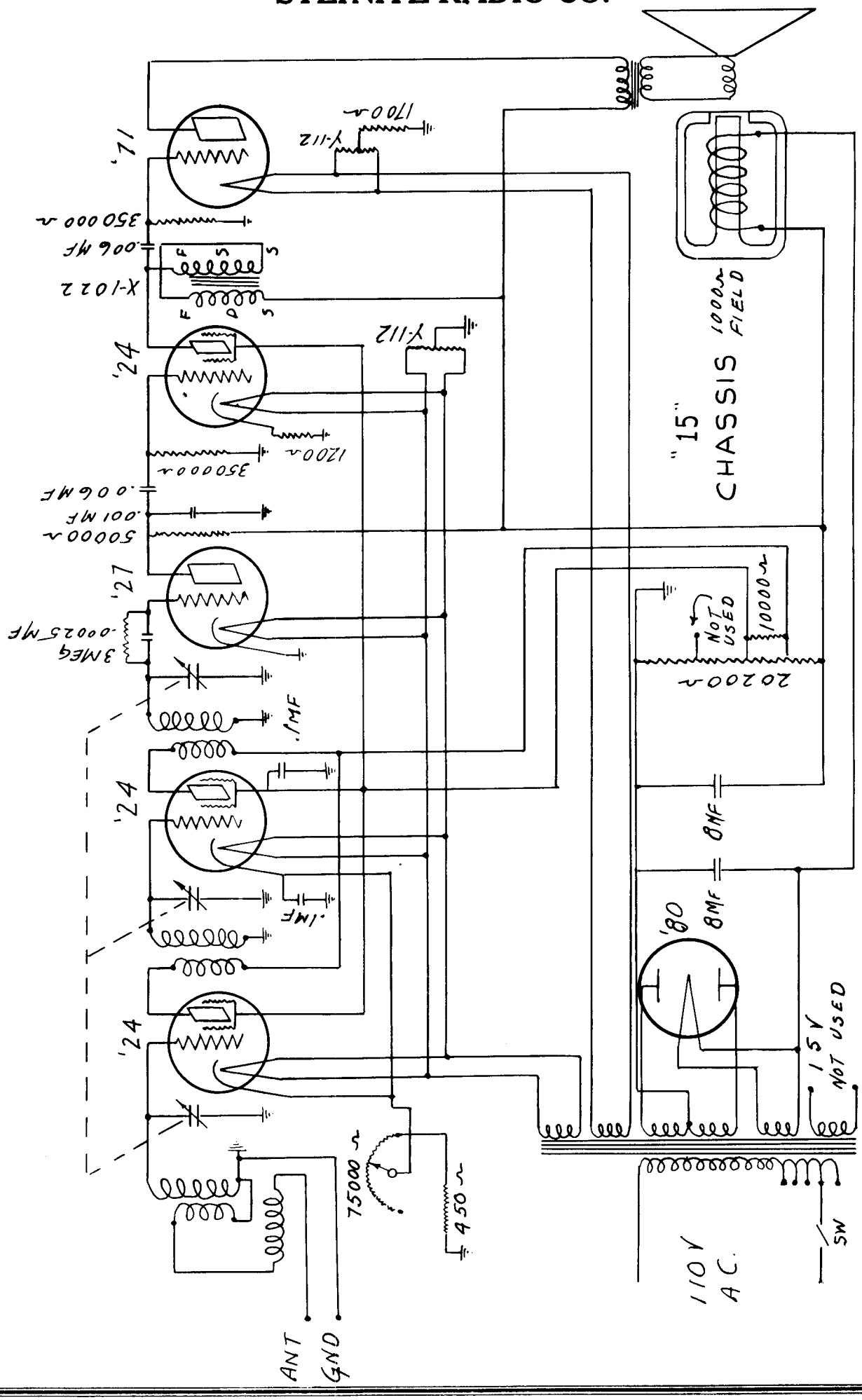
STANDARD RADIO MFG. CORP., LTD.
(ROGERS)



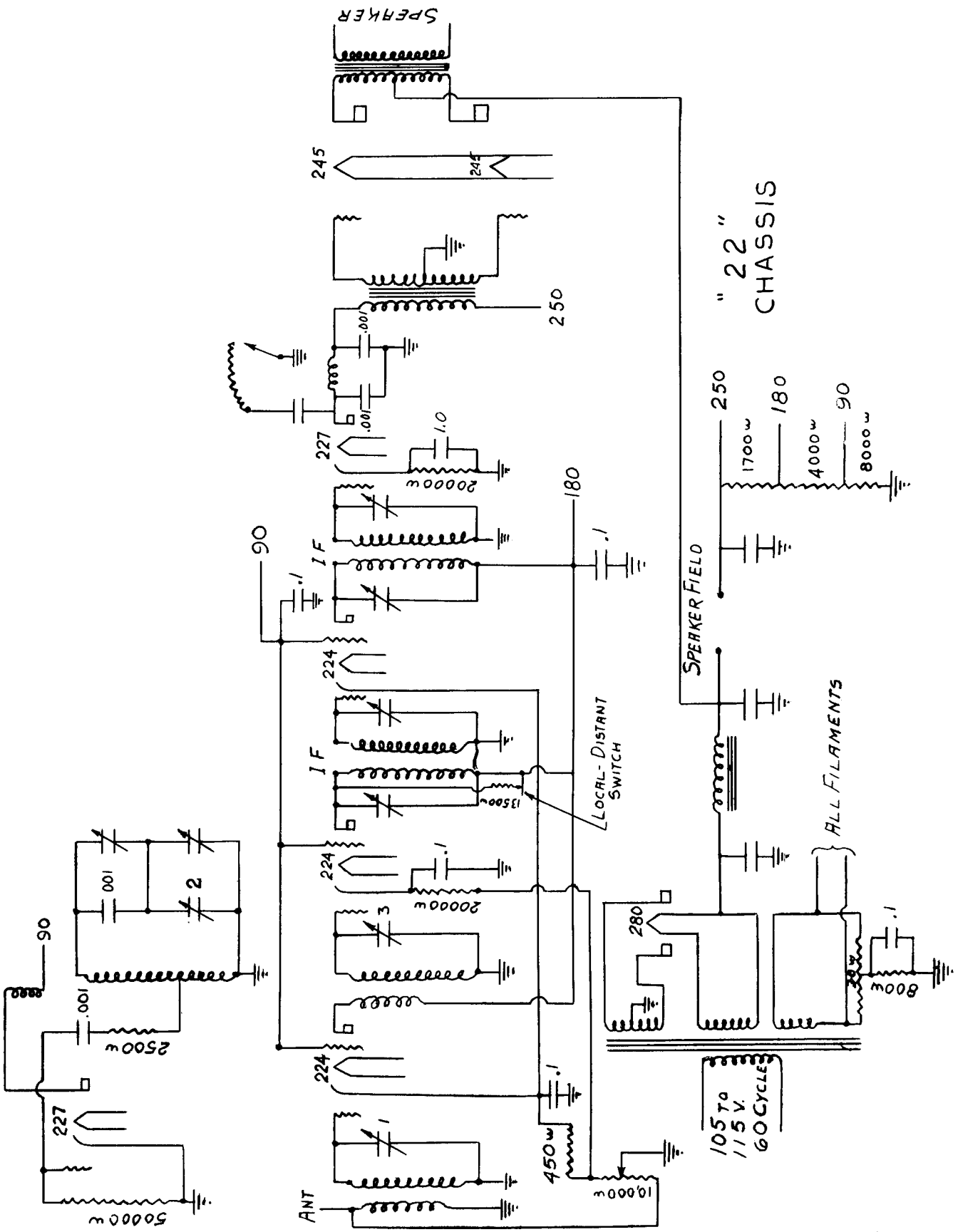
STANDARD RADIO MFG. CORP., LTD.
(ROGERS)



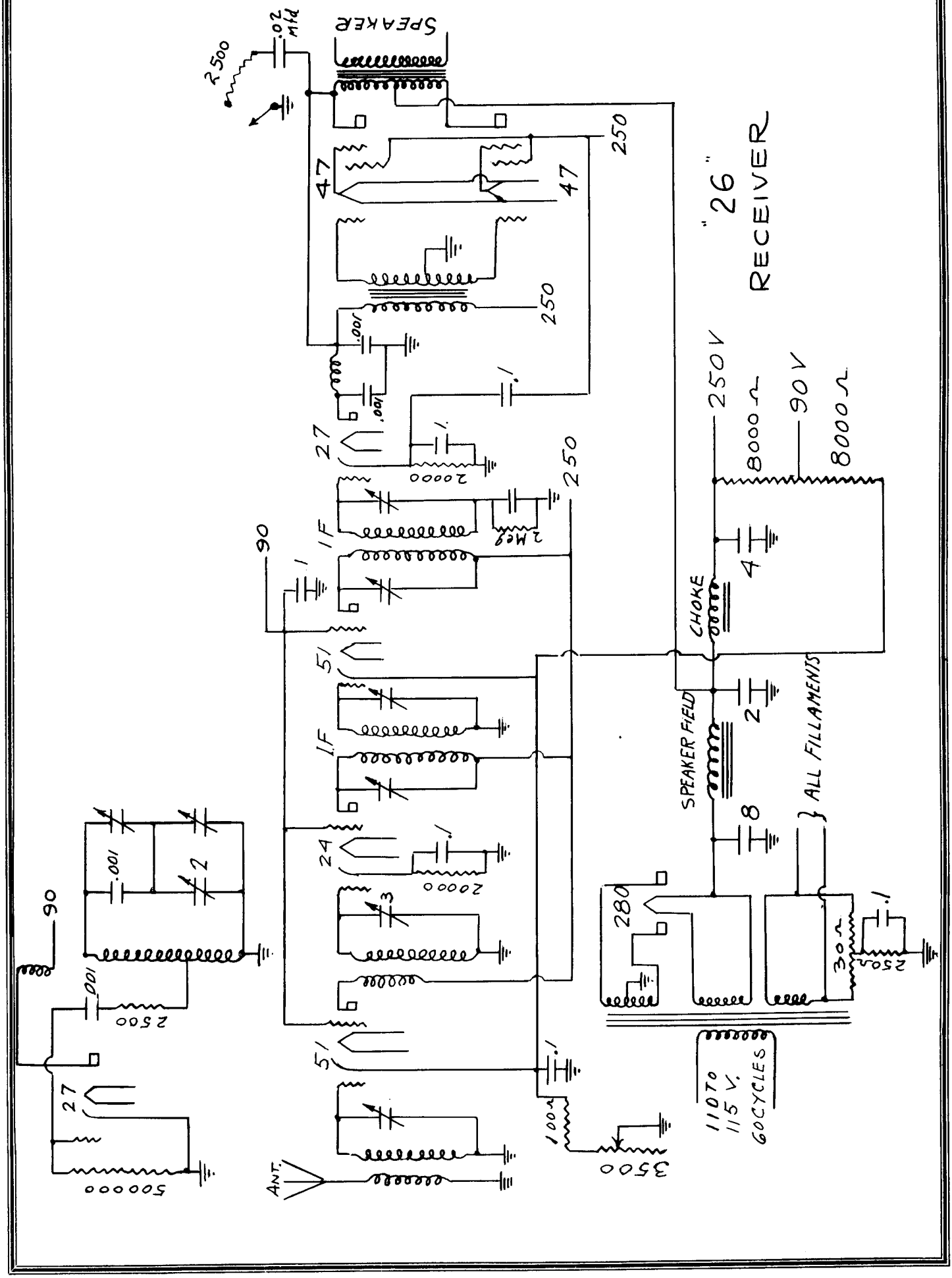
STEINITE RADIO CO.



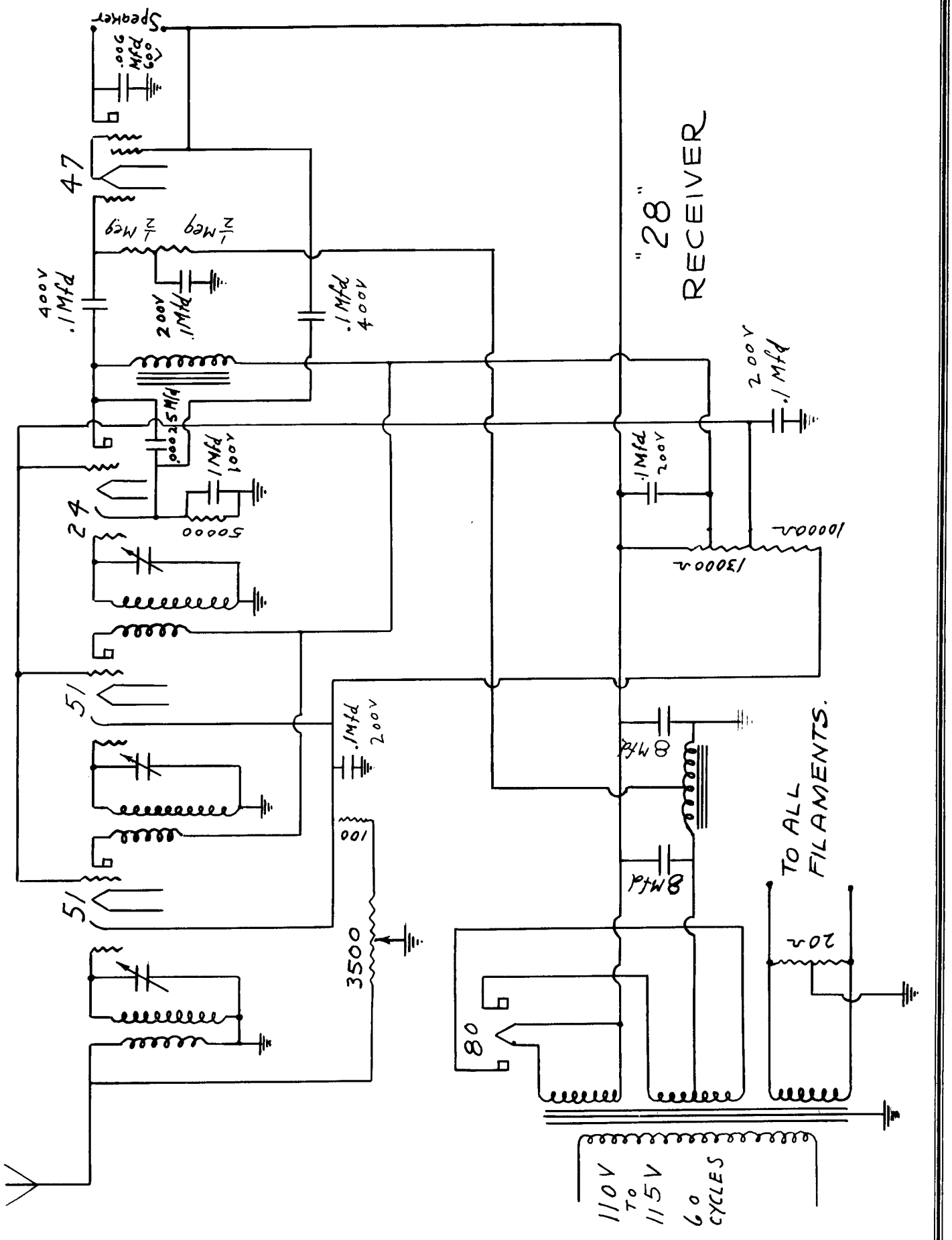
STEINITE RADIO CO.



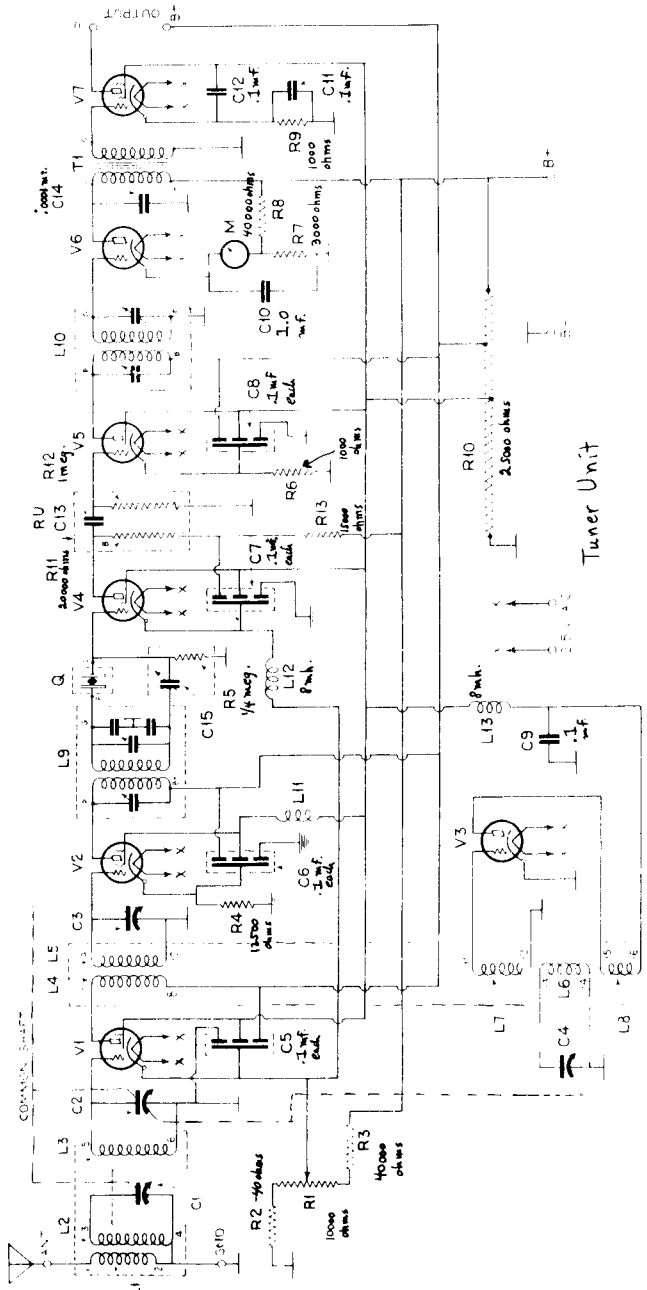
STEINITE RADIO CO.

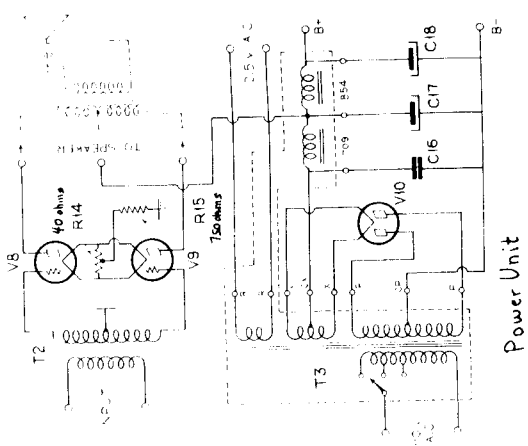


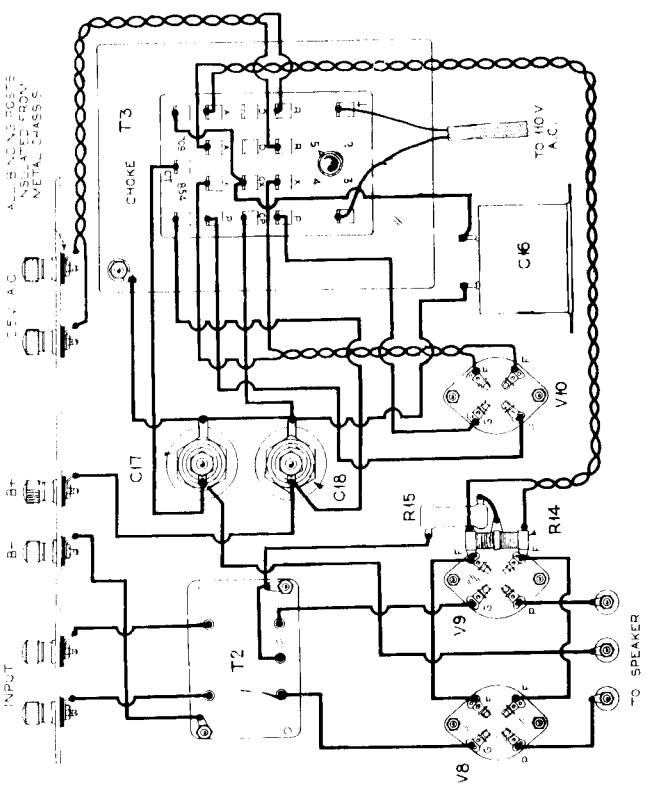
STEINITE RADIO CO.



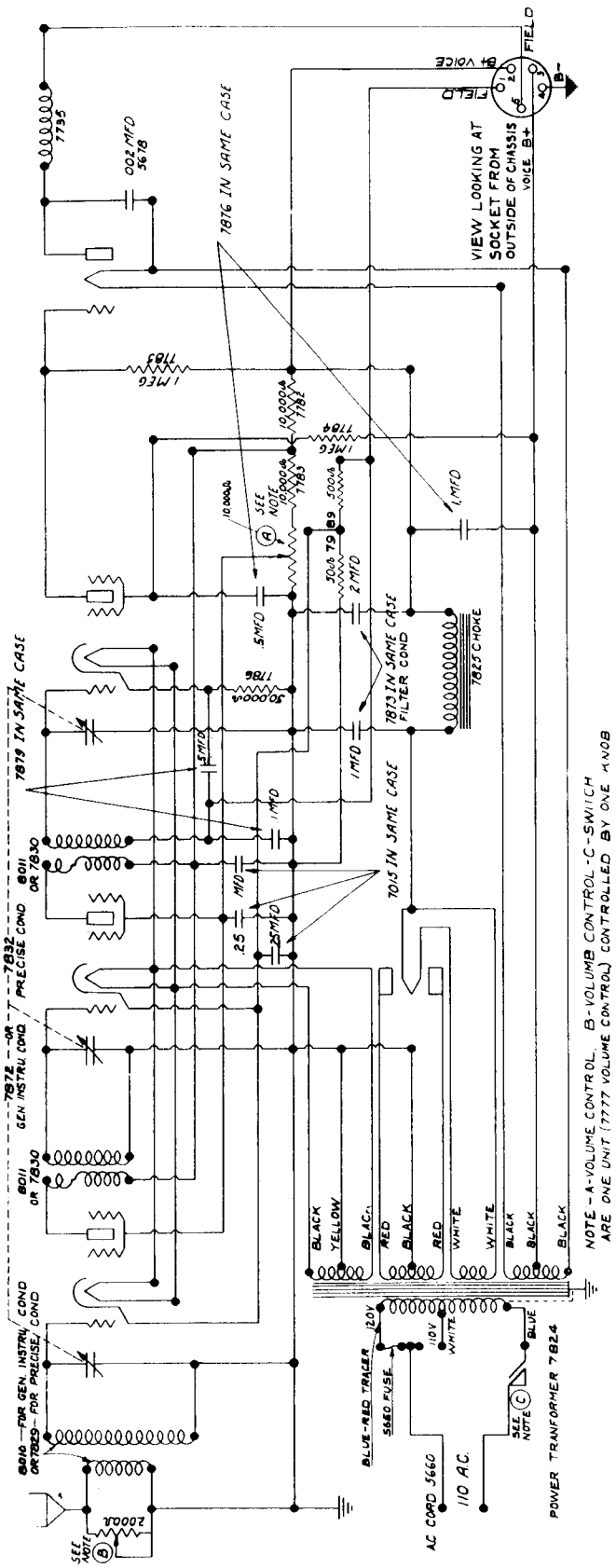
STENODE CORP. OF AMERICA.





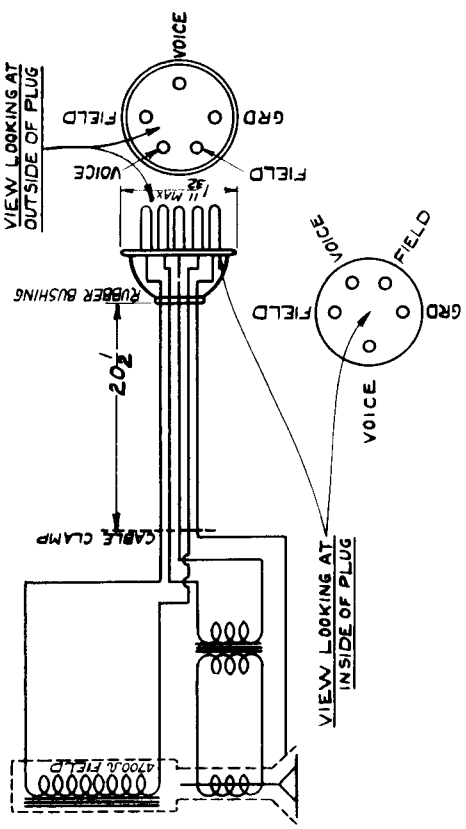


STERLING MFG. CO.



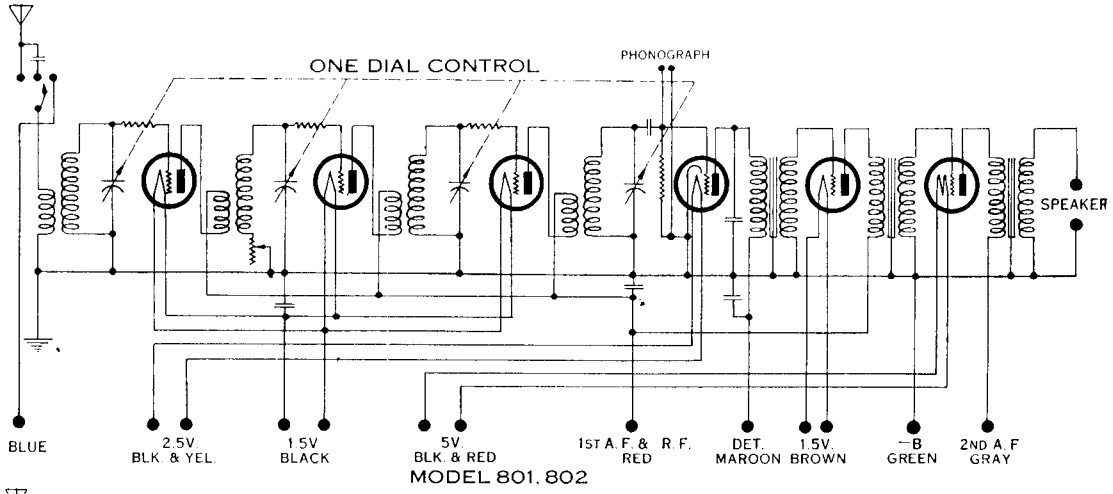
RECEIVER CIRCUIT DIAGRAM

Miniature Receiver

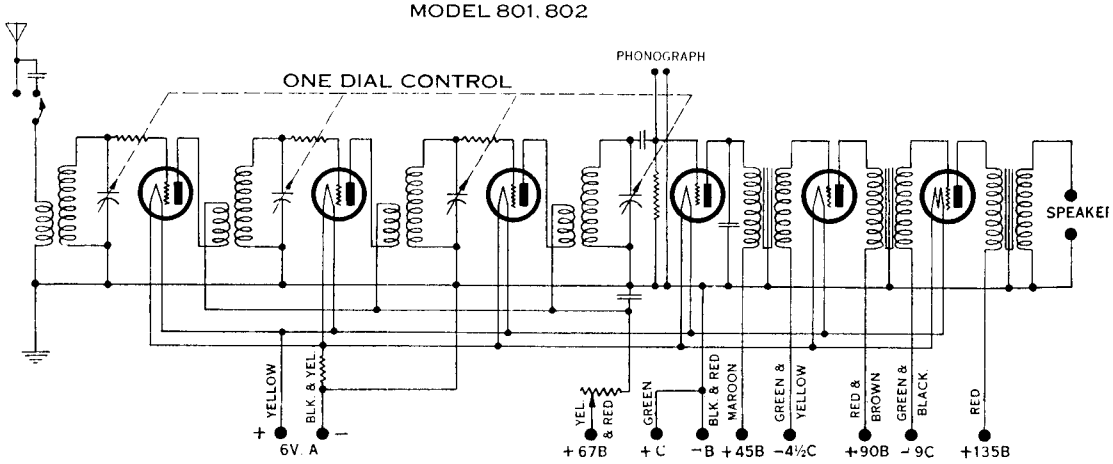


DYNAMIC SPEAKER CIRCUIT DIAGRAM

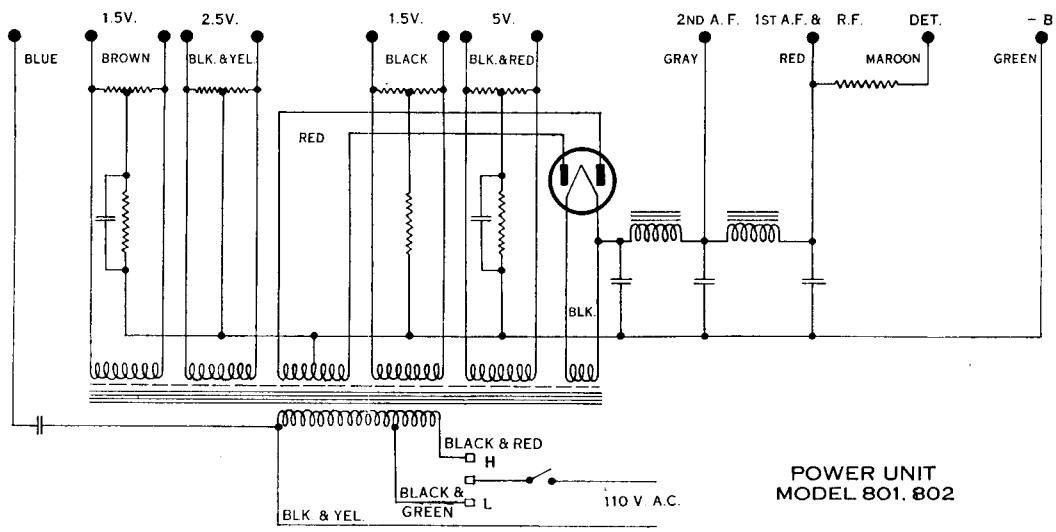
STEWART-WARNER CORP.



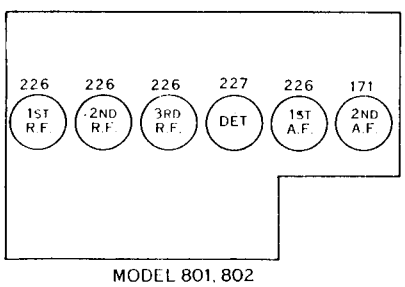
MODEL 801, 802



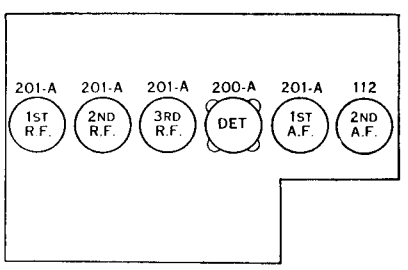
MODEL 806



POWER UNIT
MODEL 801, 802



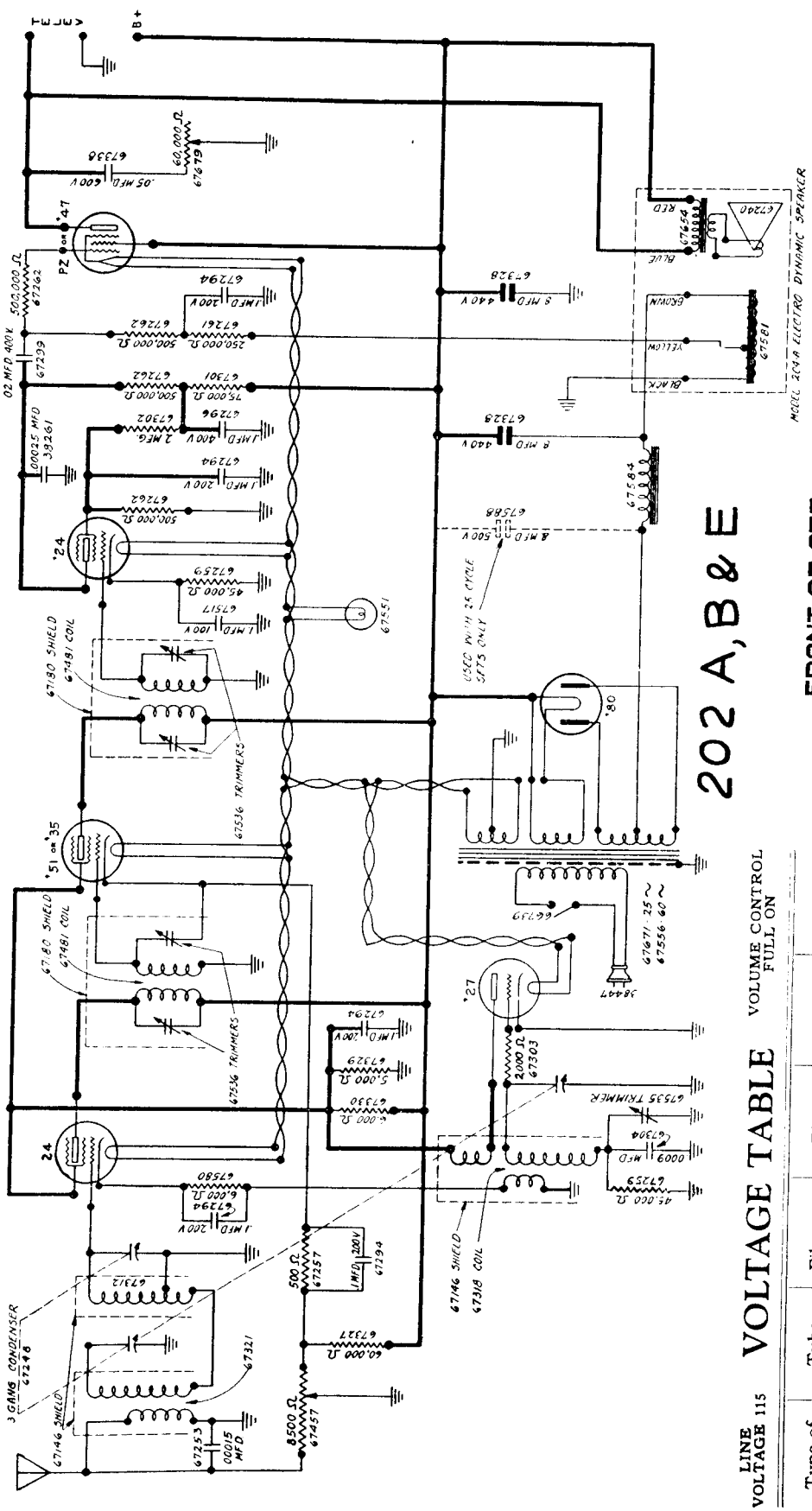
MODEL 801, 802



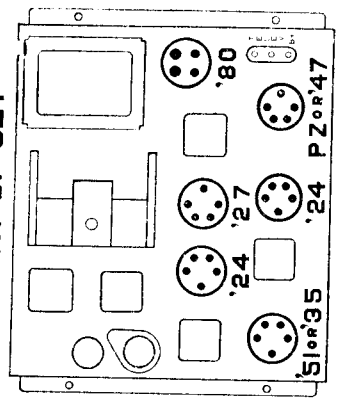
MODEL 806

LOCATION OF VARIOUS TUBES

STEWART-WARNER CORP.



INTERMEDIATE FREQUENCY TRANSFORMERS TUNED TO 177.5 K. C.



TUBE LOCATIONS

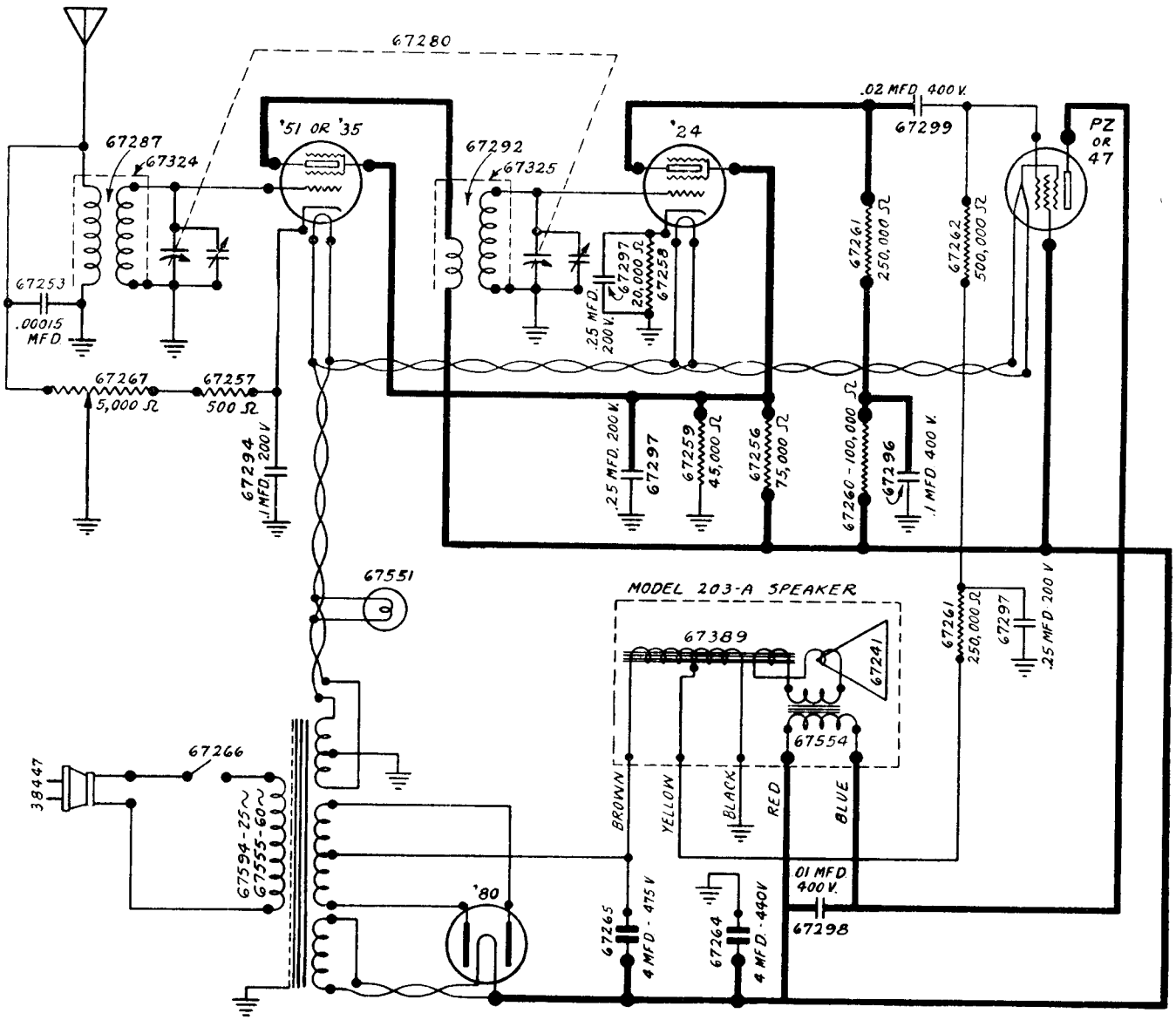
VOLTAGE TABLE

LINE VOLTAGE 115 — VOLUME CONTROL FULL ON

Type of Tube	Tube Circuit	Filament Voltage	Plate Voltage	Screen Grid Voltage	Bias Voltage
'24	1st Det.	2.4	245	90	6.7
'27	Osc.	2.4	90		0
'51	I. F.	2.4	245	90	3
'24	2nd Det.	2.4	100	20	3
P. Z. or '47	Output	2.4	220	245	15*
'80	Rect.	4.8			

* This reading obtained between ground and yellow speaker lead. Direct reading from grid to ground or reading taken with a set tester will show low voltage because of high resistance in grid circuit.

STEWART-WARNER CORP.



Circuit Diagram R-101 A & B

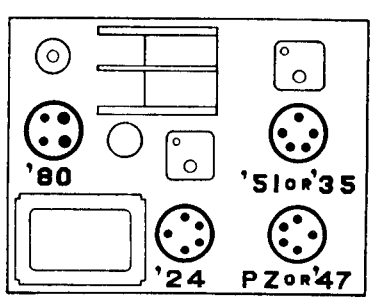
VOLTAGE TABLE

Type of Tube	Tube Circuit	Filament Voltage	Plate Voltage	Screen Grid Voltage	Bias Voltage
'51	R.F.	2.4	243	68	2.75
'24	Det.	2.4	80	68	6
PZ or '47	Output	2.4	228	243	16 *
'80	Rect.	4.8			

* This reading obtained between ground and yellow speaker lead. Direct reading from grid to ground or reading taken with a set tester will show low voltage because of high resistance in grid circuit.

All D.C. voltages are taken between socket terminals and ground with high resistance voltmeters having resistances of 1000 ohms per volt.
Line Voltage—115.
Volume Control full on.

FRONT OF SET



TUBE LOCATIONS

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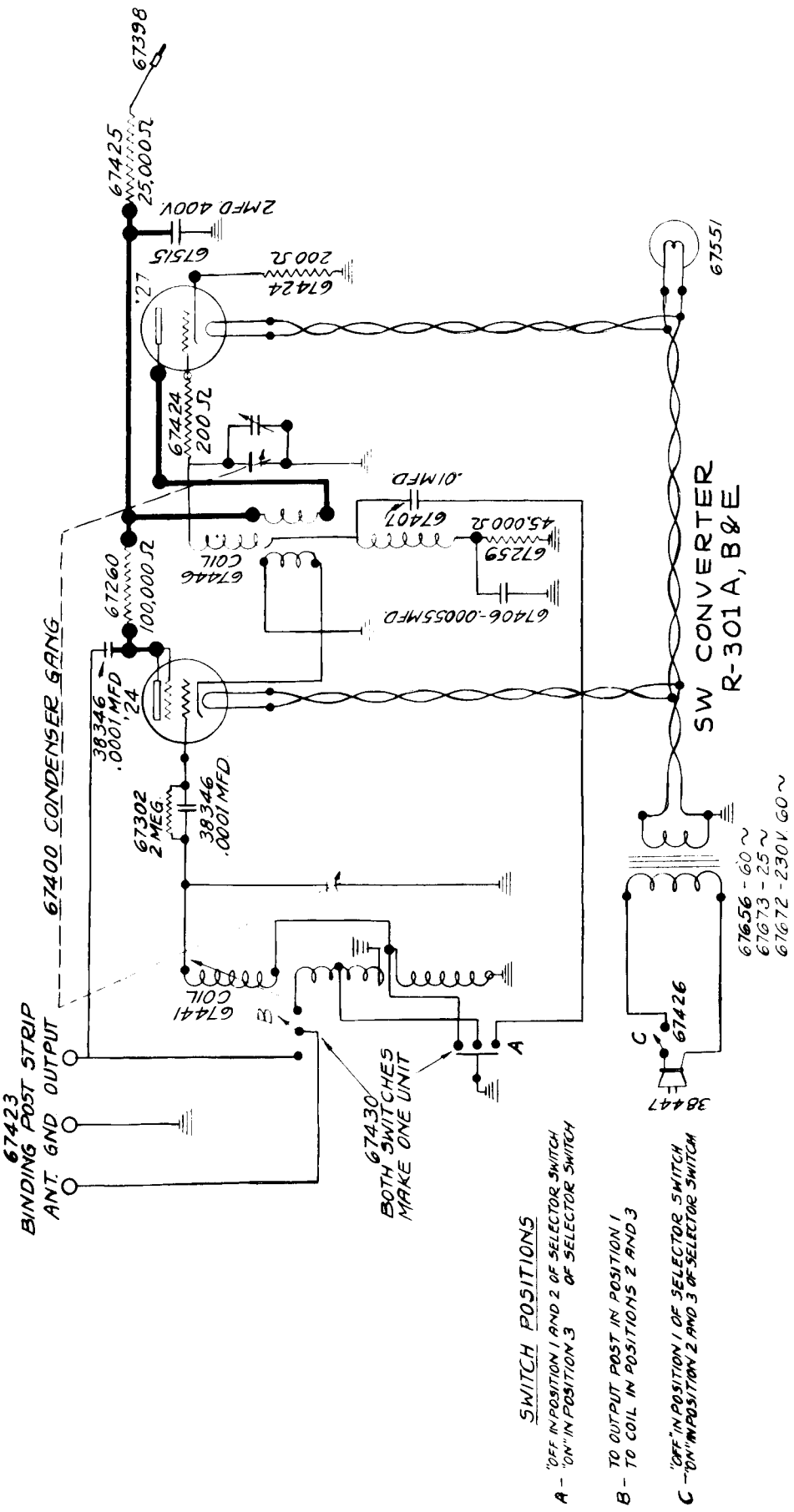

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SERVICING STEWART-WARNER SERIES 950 SCREEN-GRID RADIO RECEIVERS

Since the first essential in servicing radio receivers is to have suitable test equipment, it will be taken for granted in the following discussion that the service man is so equipped. Although, wherever possible, we will indicate simple continuity tests that may be made with a high resistance voltmeter and C battery, a complete check of all circuits cannot be made without great inconvenience unless a more elaborate set tester is available. There are a good many portable outfits on the market for this purpose, ranging in price from about fifty to one hundred and fifty dollars. The service man would do well to equip himself with one that is put out by some reputable manufacturer. The Hickock, Jewell, Supreme and Weston instruments are examples.

Installation Instructions

Before treating the actual servicing of the 950 series A. C. radio receivers a brief discussion of the installation and operation instructions is in order.

Antenna

A standard outside aerial of from forty to one-hundred feet, including lead-in, may be used. The shorter aerial is recommended in congested radio sections, and the longer aerial for rural installations where broadcast stations are widely scattered. Always bear in mind that **longer aerials provide more volume but less sensitivity, while shorter aerials provide better selectivity but less volume.** Antenna length, therefore, is governed entirely by local conditions. If desired, an indoor aerial may be used, or else the antenna selector wire (Fig. 1) may be inserted in position L, thus making use of the built-in light-socket aerial, and doing away with all external aerials. This latter method is not recommended, except for demonstrations or for local reception only. When using the light socket aerial it is always advisable to reverse the electric plug of the set in its socket to determine which position gives best results.

The normal position of the antenna selector wire is in tap 1, but if greater selectivity is required, with, of course, a sacrifice of volume, tap 2 should be used.

Note that the set will work just as well with the antenna selector wire unconnected as when inserted in position 1. This is normal, as a glance at the circuit diagram (Fig. 7) will show.

Ground

A good ground is of particular importance with the 950 series A. C. radio receivers. If the ground is open or poor the set may oscillate. If a condition of this sort arises, the ground should be tested. This is done by connecting a hundred watt globe in series with the ground and each side of the 110-volt line in succession. The globe should light to full brilliancy at one of these tests. If the globe does not light at all, or lights but dimly, the ground is unsatisfactory. If the globe lights brightly, its brilliancy when connected to ground should be compared quickly to the brilliancy when it is connected across the 110-volt line. If there is any noticeable difference, the ground may be unsatisfactory.

Water pipes, as a rule, are the best grounds. Steam and gas pipes, or electric conduit work are often unsatisfactory. If a ground rod is used, it should be made of copper, brass, or galvanized iron, and buried deeply enough to insure contact with moist earth.

Where no good ground is obtainable, a satisfactory substitute is secured by connecting a .006 mfd. or larger condenser between one side of the 110-volt line and ground. This connection must be made inside the set at the terminal strip to which the 110-volt cord is soldered. It will have no effect if connected outside the set.

Connecting the Set

Note that instead of the usual aerial and ground binding posts, two long wires are provided. Connect the blue wire to the aerial and the black to the ground. Then insert tubes, as shown in Fig. 1, and plug the set into the light socket. **Watch the voltage regulator carefully** until the tubes have warmed up to their operating temperature. If the wire in the voltage regulator begins to heat up to a visible red heat, the plug should be pulled from the socket immediately and the set tested, as described later. Do not mistake a slight smoking or odor that ceases in a minute or so, with overheating of the voltage control. This is caused by the burning of the paint or grease on the resistance wire of the voltage regulator, and is usually noticeable with regulators that have not been used previously for more than a minute or two.

If no trouble is experienced at this point turn off the set, place the detector shield and, on table models, the heat deflector in position and insert the speaker. If the Stewart-Warner dynamic speaker is used it should be inserted in the four-prong socket in the rear of the set **and the speaker link in back of the set opened.** Fig. 2 shows this link in the closed position. Failure to open the link will result in overloading the rectifier tube, thus shortening its life and lowering all plate voltages. If a speaker other than the Stewart-Warner dynamic is used it should be connected to the two speaker receptacles in the back of the set in the usual way **and the connecting link closed.** If the connecting link is kept open, voltages throughout the set

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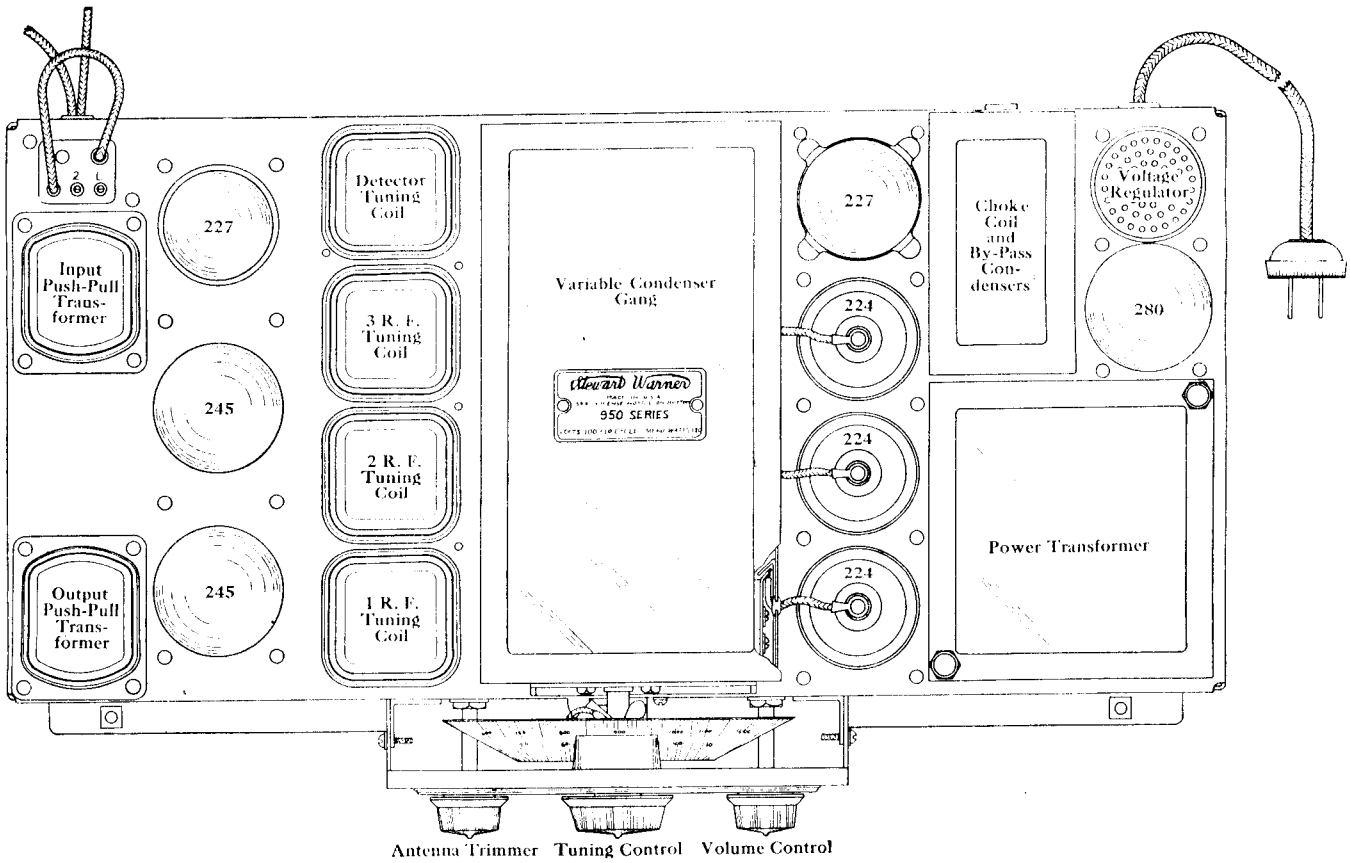

Fig. 1—Top View of Mechanism

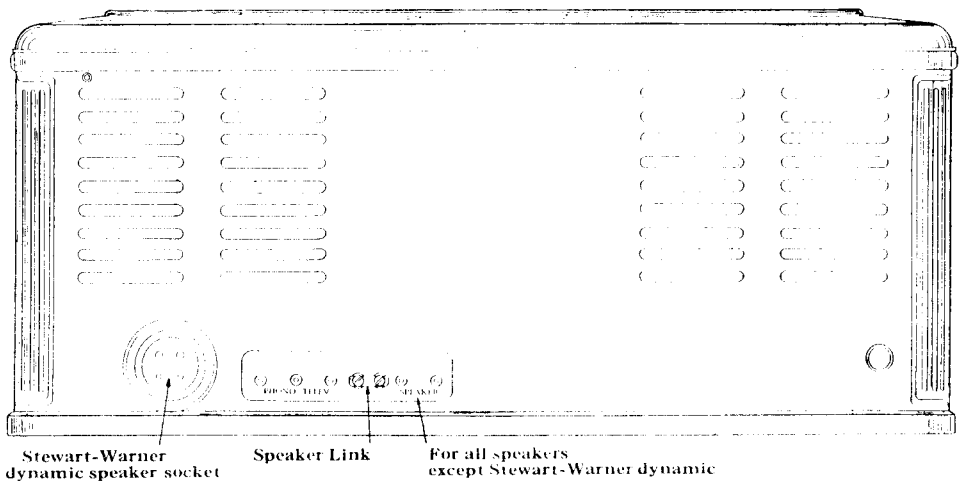

Fig. 2—Rear View, Showing Terminal Layout

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will rise above normal, overloading tubes and endangering condensers. The set should never be turned on without having either the dynamic speaker plugged in or the connecting link closed, as the initial voltage surge may puncture the filter condenser.

Tuning Instructions

Turn on the set and allow sufficient time for the tubes to heat up. If only local stations are desired, turn the volume control half to two-thirds on and rotate the tuning dial until the desired station comes in. Reduce volume to proper level by means of the volume control, after main tuning control and antenna trimmer have been adjusted to give maximum volume.

To tune in distant stations, the procedure should be varied somewhat. Turn volume control full on. Adjust antenna trimmer to produce maximum rushing noise in the speaker. Now slowly rotate main tuning control until a station is heard, operating both this control and antenna trimmer to bring the program in with maximum volume, although the latter should require very little attention if it has been properly set to begin with. Now adjust signal intensity to desired level with the volume control only.

Proper operation of the antenna trimmer as directed above is essential. If instructions are not carefully followed, weak stations may be passed over entirely, or signals from local stations may interfere with reception.

Phonograph Pick-up

The phonograph pick-up receptacles connect to the input of the detector tube instead of to its plate circuit, thus taking advantage of the amplification of the tube. With this connection, however, the phonograph pick-up wires **must** be removed from their receptacles when radio reception is desired, unless the special switch of the Stewart-Warner combination phonograph and radio cabinet is used. The usual type of switch has entirely too much capacity and will cause oscillation and reduce volume.

Circuit Description

The circuit used in the 950 Series radio receiver is of the screen grid type, and is unusual in that it uses a combination of inductive and capacitative coupling in the R. F. stages, thus producing a perfectly flat sensitivity curve over the entire broadcast band; the inductive coupling being most effective at the lower frequencies, and the capacitative at the higher frequencies. The coupling capacities are the small adjustable condensers on the right side of the main tuning condensers. They are adjusted to exactly 16 mmfd. at the factory and sealed. They must never be touched by the service man since their capacity is extremely critical, and the slightest variation will affect the performance of the set.

A power detector is used to handle the tremendous output of the radio frequency stages. This detector feeds into a resistance-coupled stage of audio amplification, and this in turn into a push-pull stage using two 245 tubes.

The complete circuit diagrams are shown in Figs. 7, 8 and 9.

Replacement Parts List

Note that the part numbers of all serviceable parts are shown in the circuit diagrams in addition to their resistance and capacity values. **These part numbers must be used in ordering replacements.**

On page 15 you will find an itemized price list of all the principal serviceable parts used in the 950 Series Radio Receivers.

Set Layout

The mechanical layout of the set, showing all parts and the principal connections, is shown in Fig. 3. Note that many of the soldering lugs are labeled. These will be referred to later.

Servicing the Receiver

In order to save much time and eliminate unnecessary work, we call to the attention of the service man the necessity of replacing **all** tubes before concluding that the set itself is defective. Especially today, with the complicated structure of modern tubes, inter-element short circuits are apt to occur.

Preliminary Receiver Test

The following procedure is recommended for most effectively and quickly checking a suspected set:

1. Put in all tubes, using a known good set of tubes for every test. Connect dynamic speaker; disconnect speaker link. Connect aerial and ground. Be certain that the ground connection **is** a ground. Plug cord into wall receptacle; turn on switch, watching the pilot light for normal brilliancy. A dim light indicates an overload or short in which case the set should be turned off promptly and proceed to (3). If light is O. K. proceed to (2).

2. Pluck each 245 from socket, listening for cluck in speaker; do likewise with first AF 227 and detector which should also be tapped for microphonic response. This indicates that the audio is alive if a set is otherwise dead. In such case proceed to (3). If set is alive: operate, noting response to controls, volume, sensitivity, tendency to oscillate, hum, and tone quality.

3. Holding the set by the sides turn it on its back with the dial away from you. Set is still "on" unless shorted. Remove bottom plate.

4. Give the wiring a close visual inspection, paying particular attention to possibilities of shorts and grounds. Stray ends from the shielded wires shorting on the terminal lugs of the A coil and antenna taps should be particularly examined. Also examine the leads inside the R. F. coils for possible shorts or breaks. Keep all wires away from socket prongs.

5. Using a wood or fibre stick (not metal), prod the connections, not too roughly, for noisy or loose connections while the set is operating at maximum volume. Give the tubular condensers (fire crackers) particular attention. Pry at them firmly to note if they open. An open by-pass condenser (66017, 66019, 66018) will cause decided oscillation. An open first AF coupling condenser (66020) will cause

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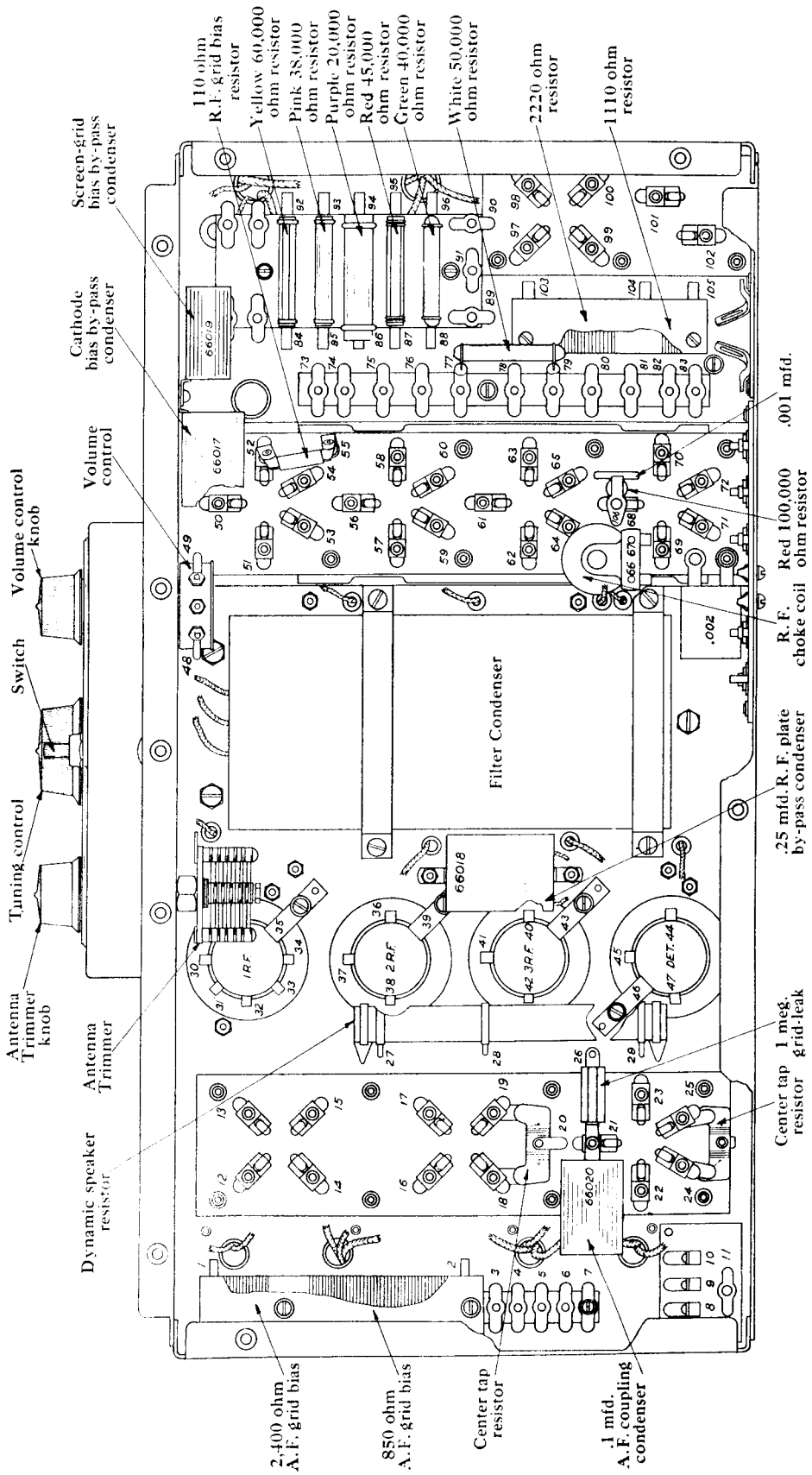

Fig. 3—Bottom View of Set

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RECEIVER CONTINUITY TESTS

Remove Tubes, Disconnect Set, and Use High Resistance Voltmeter

Circuit	*Terminals*	*Correct Effect*	*No Reading Caused By*
1 R. F. Plate	51 to 38	Full reading	Open primary of 2nd R. F. transformer
	51 to 103	About ¾ reading	Open No. 66030 plate resistor
Note: Full reading at this point indicates a ground in R. F. or Choke system. See page 10 on location of grounds.			
	51 to 74	About ⅔ reading	Open filter chokes
Screen-Grid	50 to 79	About ⅓ reading	Open white resistor
Note: Above test must be made with volume control full on. Volume control is tested at this point by turning it back slowly while watching reading. Voltmeter should go to full reading slowly as control is rotated.			
	50 to 94	About ⅓ reading	Open purple resistor
Control-Grid	Grid wire to ground	Full reading	Open secondary 1st R. F. transformer
Cathode	52 to ground	Almost full reading	Open 110 ohm cathode bias resistor.
2 R. F. Plate	57 to 42	Full reading	Open primary of 3rd R. F. transformer
Screen-grid	56 to 79	About ⅓ reading	Open white resistor
Control-grid	Grid wire to ground	Full reading	Open secondary 2nd R. F. transformer
Cathode	58 to ground	Almost full reading	Open 110 ohm cathode bias resistor
3 R. F. Plate	62 to 47	Full reading	Open primary of 4th R. F. transformer
Screen-grid	61 to 79	About ⅓ reading	Open white resistor
Control-grid	Grid wire to ground	Full reading	Open secondary 3rd R. F. transformer
Cathode	63 to ground	Almost full reading	Open 110 ohm cathode bias resistor
Det. Plate	69 to 67	Almost full reading	Open R. F. choke
	69 to 93	About 1/5 full reading	Open pink resistor
	69 to 84	Still lower reading	Open yellow resistor
	69 to 74	Slightly lower reading	Open filter choke
Grid	68 to 106	Very low reading	Open short red resistor
	68 to ground	Very low reading	Open secondary 4th R. F. transformer
Cathode	70 to ground	About ⅛ reading	Open green resistor
1 A. F. Plate	22 to 6	Slightly less than full reading	Open primary input push-pull transformer
Grid	21 to ground	Barely perceptible reading	Open grid leak
Cathode	23 to ground	About 4/5 reading	Open 2400 ohm bias resistor
2 A. F. Plate	16 to 27	Almost full reading	Open primary of output transformer
	12 to 27	Almost full reading	
Grid	13 to ground	About ⅔ full reading	Open secondary of input push-pull transformer
	17 to ground	About ⅔ full reading	

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VOLTAGE TABLES

Set in normal operation. High resistance voltmeter used.

Circuit Tested	*Terminals*	*Voltage Obtained*
1 R. F.		
Plate	51 to ground	160 to 180 volts
Screen-Grid	50 to ground	72 to 85 volts
Cathode	52 to ground	1.4 to 2 volts
Filament	52 to ground	2.1 to 2.5 volts A. C.
2 R. F.		
Plate	57 to ground	160 to 180 volts
Screen-Grid	56 to ground	72 to 85 volts
Cathode	58 to ground	1.4 to 2 volts
Filament	59 to 60	2.1 to 2.5 volts A. C.
3 R. F.		
Plate	62 to ground	160 to 180 volts
Screen-Grid	61 to ground	72 to 85 volts
Cathode	63 to ground	1.4 to 2 volts
Filament	64 to 65	2.1 to 2.5 volts A. C.
Detector		
Plate	69 to ground	120 to 160 volts depending on voltmeter
Cathode	70 to ground	18 to 22 volts
Filament	71 to 72	2.1 to 2.5 volts A. C.
1 A. F.		
Plate	22 to ground	170 to 190 volts
Cathode	23 to ground	12 to 15 volts
Filament	24 to 25	2.1 to 2.5 volts A. C.
2 A. F.		
Plate	{16 to ground / 12 to ground}	275 to 300 volts
Grid Bias	{18 to ground / 14 to ground}	42 to 50 volts
Filament	{18 to 19 / 14 to 15}	2.2 to 2.5 volts A. C.
House Lighting Circuit	89 to 91	100 to 130 A. C.
Power Transformer	101 to 90	80 to 95 volts A. C.

TUBE NO. IN ORDER	TYPE OF TUBE	POSITION OF TUBE 1ST R. F. DET., ETC.	READINGS, PLUG IN SOCKET OF SET — TUBE IN TESTER							
			A VOLTS	B VOLTS	C VOLTS CONTROL GRID	CATHODE HEATER VOLTS	NORMAL PLATE M. A.	PLATE M. A. GRID TEST	PLATE CHANGE M. A.	SCREEN GRID VOLTS
1	2	3	6	7	8	9	10	11	12	13
1	224	1 R. F.	2.3	166	1.5	1.3	3.9	7.2	3.3	78
2	224	2 R. F.	2.3	168	2	2	5.9	9.6	3.7	75
3	224	3 R. F.	2.3	167	2	2	6.2	9.8	3.6	75
4	227	DET.	2.3	180	18.5	20	.6	.65	.05	
5	227	1 A. F.	2.3	182	2.5	13.5	5.8	6.8	1.0	
6	245	2 A. F.	2.35	260	46		24	28	4	
7	245	2 A. F.	2.35	260	46		27	31	4	
8	280	RECT.	4.6							

LINE VOLTAGE 115 VOLUME CONTROL POSITION ON

Fig. 4—Voltage Readings Obtained with Standard Set Tester

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dead or very weak audio. If an open condenser is suspected, shunt or parallel the suspected condenser with a good one, to note if oscillation stops or is decidedly reduced, or if dead set operates.

6. Test all voltages at the socket terminals according to the chart on page 8. The volume control must be on full for all voltage tests. Use a 250 or 300 volt **high resistance** voltmeter. (Imperative—low resistance voltmeter will **not** do.) Pay particular attention to the screen-grid voltage. This should not exceed 85 nor be lower than 72. Low screen-grid voltage will cause set to be weak while high voltage will make it oscillate. The screen-grid voltage with volume control at maximum is governed by the purple resistor (66324) and indirectly by the white resistor (66022) and volume control.

Bear in mind that all voltages are interdependent; that is: if the voltage at one point, say the 245 plate, is open or zero, all other voltages will be high, or if the 245 bias is grounded out or zero, its plate voltage and all other plate voltages will be low, and so on for numerous combinations of causes and effects. Therefore; because the voltage at one particular point is not correct, do not assume that the trouble lies at that point. It may or may not. The point-to-point continuity test given on page 7 is the best way of determining this.

7. After locating and repairing trouble if any is found, the set should be given a final air test, care being taken to see that the bottom is on and firmly fastened to the set.

Using Set Tester

A more direct method of approach, which is more readily usable by the service man with a standard set tester is to run through the routine tests as given in the instruction book supplied with the tester used. It has the advantage of enabling the service man to locate the approximate source of trouble without dismantling the set, but the disadvantage of being unable to locate intermittent shorts and opens, for which the previous procedure is recommended.

The voltage readings obtained in this manner are the surest guide to the trouble, since they locate the exact circuit that is defective. In Fig. 4 we give an average set of voltage readings obtained with a standard set tester.

It is to be noted that these tables give average voltage readings. A certain amount of variation is to be expected, particularly in tube readings. Experience with the particular set tester used, coupled with a knowledge of the circuit of the set, should tell whether the variation found is normal or not.

Voltmeter Tests

Where a set tester is not available, a high resistance voltmeter may be used with equally satisfactory results. However, it is necessary to remove the bottom plate of the set in order to take the various readings, which are given on page 8.

The standard test with a suitable radio set tester will indicate more or less closely in what circuit the defect may be found. It then becomes necessary to make a series of further voltage readings and continuity tests to locate **exactly** the source of the trouble.

Making Continuity Tests

Note that a continuity test may be made with only a voltmeter and a C battery. It is therefore not absolutely necessary to use the more elaborate set testers for this purpose. To make up a continuity tester, connect one terminal of the C battery to the corresponding terminal of the voltmeter, and the two test leads to the remaining terminals of the voltmeter and battery. To test a circuit, simply touch the two test leads to the ends of the circuit. A full reading indicates a closed circuit, a partial deflection indicates a high resistance in the circuit and no readings indicates an open circuit.

To aid in tracing the wiring of the set, refer to the circuit diagram (Fig. 7) and the bottom view of the set (Fig. 3.).

Miscellaneous Continuity Tests

1. Transformers

1 R. F.—primary		34 to 33
		34 to 31
secondary		30 to ground
2 R. F.—primary		37 to 38
secondary		36 to 39
3 R. F.—primary		41 to 42
secondary		40 to 43
Detector—primary		45 to 47
secondary		44 to 46
Input	primary	22 to 6
	secondary	13 to ground
		15 to ground
Output	primary	12 to 5
		16 to 5
	secondary	3 to 4

2. Fixed Condensers

To test fixed condensers of from 0.1 mfd. to 6 mfd. capacity, a suitable A. C. voltmeter and a pair of test leads are required. Connect one of the test leads to the meter and the other to one side of the 110-volt circuit. Connect the other lead from the 110-volt system to the remaining terminal of the meter. Touching the two test leads to a fixed condenser of more than 0.1 mfd. gives an appreciable deflection.

The exact deflection per microfarad obtained depends entirely upon the meter used and the voltage of the house lighting circuit. The table given below shows values obtained by using a voltage of 111 and the 160-volt scale of the A. C. meter in a standard radio set analyzer.

This table is given only as an illustration, since it may differ by several hundred per cent if another meter is used.

Capacity	Voltage Reading
5 mfd.	109
3 mfd.	106
2 mfd.	100
1.5 mfd.	94
1 mfd.	83
.75 mfd.	67
.5 mfd.	52
.25 mfd.	29

In checking filter and by-pass condensers of this capacity they must be disconnected from the set, otherwise the readings obtained will be incorrect.

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3. **Dynamic Speaker Socket**

Plate prong to F—prong gives full reading, indicating that the secondary of the output transformer is O. K.
F to frame—full reading
G to No. 69—full reading

Locating Shorts and Grounds

Short Circuits in Power Supply

The location of short circuits in the power pack is easily determined by the following procedure: Remove the dynamic speaker plug, open the speaker connecting link in back of set, and unsolder the connection to lug No. 103 (see Fig. 3). If a continuity test from lug 76 to ground indicates a complete or partial circuit, a ground is indicated either in the push-pull system, filter chokes, or filter condenser. Remove the stiff red wire connecting to lug 75, thus disconnecting the push-pull system. Repeat above test and if short circuit still is indicated, the ground must be in the filter choke or filter condenser. If no reading is obtained, the ground must exist in the audio output system.

Disconnect the filter condenser by unsoldering the flexible red lead from lug 74 and flexible orange lead from lug 75 and test from lug 76 to ground as before. No circuit indicates broken down filter condenser, which can be confirmed by testing the filter condenser itself. Short circuit indicates grounded filter choke unit. This entire unit must then be replaced.

Grounds in R. F. Plate Supply

Grounds in the R. F. plate supply can be located as follows: Unsolder the two yellow and red wires from resistor lug No. 105, using continuity test between the ends of these wires one at a time to ground. The one that connects to the red resistor No. 66326 should give a slight reading, the other wire should indicate open circuit. If any reading is obtained a short circuit exists. By successively unsoldering the leads from lugs 38, 42 and 47, repeating tests between the yellow and red wires and ground each time, until open circuit is indicated, the grounded circuit is easily found. Once this is done the circuit can be broken down further until the exact location of the ground is discovered.

Grounds in Screen-Grid Circuit

Grounds in screen-grid circuit, as indicated by very low voltage in this portion of the circuit only, can be located by unsoldering the black lead from lug 77. Test between the black wire and ground. Normally no circuit should be indicated. If partial circuit is made, successively unsolder leads from lugs Nos. 50 and 56, testing to original black lead each time until grounded circuit is found.

Open By-Pass Condensers

Open by-pass condensers are most easily found by connecting a good condenser about .25 mfd. capacity across the terminals to which the by-pass condenser is connected. If the audio frequency or radio frequency oscillation ceases, it is positive indication that the unit under test is open.

Shorted or Grounded Condensers

Shorted or grounded condensers can be found by the tests previously outlined for the various grounds.

Oscillation

When operating under normal conditions the 950 series screen-grid radio receiver will not oscillate. A set of this type, however, may oscillate due to any one of the two following general conditions: first, a defect in the set itself; and, second, improper environment for the set.

Oscillation Due to Set Defects

1. Poor Contact At Clips Between Sections Of Variable Condensers: You will note that with the screen grid-models each section of the variable condenser gang is individually grounded by means of a special clip that makes contact at the rotor shaft. Should this contact be poor, due to the clip being bent out of position, or dirt getting between the sliding surfaces, the set may oscillate. Special auxiliary springs, our part number 66680, should be slipped behind these clips to increase the contact pressure. Their use will eliminate many cases of persistent oscillation at low frequencies.

2. Excessive Screen-Grid Voltage: Should the voltage applied to the screen-grids of the R. F. tubes rise above 90 volts, the set may oscillate. It is then necessary to determine why the voltage at this point is excessive and reduce it in a suitable manner. The most likely point to look for is low resistance in the 20,000 ohm resistor part No. 66324. This is the center of the five colored carbon rod type resistors mounted on one strip.

3. Open Screen-Grid By-Pass Condenser: This is evidenced by violent oscillation over the entire wave length band. The condenser in question is of the "fire cracker" type and is the smaller of the two condensers fastened to the front side of the chassis frame. In earlier models it was riveted directly to the screen-rid prong of the second R. F. socket. Check by substituting another condenser of .1 mfd. or greater.

4. Open R. F. By-Pass Condenser: This is evidenced by oscillation that is more pronounced on the high wave lengths. The condenser in question is the large round fixed condenser fastened to the base next to the R. F. coils. Check by substituting another fixed condenser of .25 mfd. or greater.

5. Open Radio Frequency Grid Bias Condenser. An open in this condenser is evidenced by oscillation throughout the tuning range and a very blurry tone.

Oscillation Due to Other Causes

1. Feed-back. Oscillation in an otherwise perfect set is usually caused by the use of a poor ground or feed-back in the external wiring to the set. This feed-back may be introduced by having the aerial close to the terminal strip in back of the set, or crossing either the speaker or 110-volt cord. If the set is being tested in the distributor's or dealer's test room or in the sales room, the use of a change-over switch necessitating the mounting of speaker, aerial and power supply terminals close together will bring about oscillation. It is therefore essential that all wires lead direct to the set, and are kept clear from each other.

2. Poor Ground. An imperfect ground is almost certain to cause oscillation. In this connection, the usual tests for grounds are insufficient. When in doubt, try another ground. A very simple, yet infallible test that will definitely establish whether or not the ground is poor or feed-back is

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occurring, is to connect a fixed condenser of from .006 to .1 mfd. capacity inside the set from the frame to one of the 110-volt wires at the soldering lug on the resistor terminal strip to which the 110-volt cord is connected. If, after reassembling the set carefully all traces of oscillation are gone, the original cause was unquestionably either feed-back or poor ground.

The first step then is to make certain that no feed-back occurs by seeing that all wires go direct to the set, and keeping the aerial well away from the terminal strip in back of the set and both the speaker and 110-volt cords. **Then change the ground.**

3. Unusual Liveliness of Set. There still remains one cause of oscillation—unusual liveliness in the set itself. Oscillation of this type is only apparent on the lower frequencies, usually only when the set is being tuned very carefully and the volume is turned on fully. **The condenser between the line and ground will not eliminate oscillation of this type.**

To cure oscillation of this type first remove the bottom metal plate of the set if this has not already been done, and note the three leads running under the large filter condenser from the R. F. coils to the plate of the screen-grid tubes. If these leads are encased in metal braiding, the braiding should be pulled out more so that the wire is more completely shielded. If these leads are encased in brass channel strips, the filter condenser should be removed, and by means of a pair of heavy pliers, the brass clinched firmly about the wires.

When replacing the filter condenser, omit the cardboard strips between the shielded leads to make certain that pressure on the leads is sufficient to insure a perfect ground. For the same reason, if the condenser is the large black type, it should be reversed so that the paper back, rather than the wax front, presses against the shields.

A word of caution. After making any change in the set, the metal bottom **must be screwed down tightly** when re-testing. The steel bottom of the set plays a very important part in the shielding of the circuits. Unless it is thoroughly grounded, the set may oscillate. For this reason, it is imperative that the bolts holding the bottom in place be drawn up as tightly as possible so that the lock washers may dig through the coating of insulating lacquer and into the steel to insure good contact.

Phasing and Calibrating

1. The process hereinafter called "phasing," might also be termed aligning, trimming or balancing. Phasing is the adjustment of the compensating or trimming plates (found on the left side of the gang tuning condenser in the 950 series and on the right side in the 900 series) which brings each radio frequency stage into step or phase; that is, the stages will tune to the same wave length or frequency at the same time.

2. Bear in mind that very seldom does a receiver that has not been tampered with after it has left the factory require readjustment of the trimming plates. Every 900 and 950 receiver leaving the factory is carefully phased by experienced operators with the aid of extremely accurate test equipment that removes, as much as is possible, the human element responsible for error. After the receiver has been phased and doubly checked, the adjusting screws are cemented to obviate any possible variance from setting.

3. Phasing adjustment on a receiver whose circuits tune as sharply as the 950 series is necessarily critical. If in repair work or inspection, the relative position of the wiring of the tuned circuits is varied, or a coil other than the antenna coil, is replaced, or condenser plates are bent due to careless handling, the receiver may be thrown out of phase. Only in this case, or when the cement on the adjusting screws may be loosened as a result of tampering or injury, will it be necessary to rephase the set.

4. We will assume that you have an adequate modulated oscillator (Fig. 5) for without this, it is impossible to line up a set properly. The practice of phasing a set on a weak or distant station is most strongly discouraged, since it can only result in approximate settings. The signal must be a steady note as well as constant in intensity; likewise it must be sharper than broadcast. A phasing wrench (our tool No. T-59926, price $1.00) and a phasing plunger (tool No. T-62411, price $0.25) as described below are the only tools required.

This plunger consists of a stiff piece of metal about five inches long and one-half inch wide. A section of a hack-saw blade is about right. A number of rubber bands are stretched lengthwise around the metal to insulate it from the sides of the condenser plates when it is used.

5. Operate and check over the receiver to be phased, to be sure that it is otherwise O. K. **Leaving the ground connected,** disconnect the aerial lead and couple it loosely to the oscillator.

6. Turn on the oscillator, adjust its output control or coupling to receiver to maximum, set receiver dial at 1000 K.C. and tune oscillator carefully until its signal is picked up by the set. Adjust antenna trimmer knob very carefully. Leave volume control on full; **this is imperative.** Reduce the signal intensity until it is moderately audible by backing up on the oscillator output control or loosening the coupling between the antenna lead and the oscillator by moving them apart.

7. In phasing the D section or detector stage is used as the reference section. With the receiver tuned to maximum response, take the phasing plunger in the left hand. (This may seem awkward but is done to avoid bringing the hand close to the brown control grid wires.) Thrust the plunger between the stator plates on the left side of the D section, taking care that the plunger is insulated from the stator plates but **is making contact** with the upper left rim of the condenser frame.

8. This action adds a very small capacity to the section under test, and is done at this point to determine whether the D section has enough capacity with respect to the others. Ordinarily on inserting the phasing plunger into the D section, the signal will decrease, indicating that it is either O. K. or high. The same procedure is followed on the C (third RF) and B (second RF) sections. If in all cases the signal decreases approximately the same amount, the next operation is in order. If, however, the volume increases or remains seemingly constant as the plunger is inserted, this indicates

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that capacity should be added to that section which is done by turning in the screw of the trimmer plates a small fraction of a turn at a time, until, when using the plunger in that section, the decrease in volume is approximately the same as in the other sections. If it is necessary to turn the trimmer screw a considerable amount, the set should be retuned before further comparison is made. It is unnecessary to phase the first RF or A stage, as the antenna trimmer control takes care of all variations.

9. Regarding the above as operation one, operation two is now in order. The tuning condenser is turned **out** about two points on the dial, thus reducing the total capacity of each section. This will considerably reduce but not lose the signal as all sections are brought below resonance.

10. Operation one is again repeated, the plunger being inserted between the stator plates of each section. If the set is correctly or nearly phased, the signal will become slightly louder as the plunger is inserted into each section. Careful attention must be paid to the signal intensity as the change in volume is not very great. The speaker must be quite close to the phaser. If on inserting the plunger the signal remains seemingly constant or decreases, this is an indication that the capacity of that section is high and should be reduced by turning out the adjusting screw. Adjust and check the C and B stages until the increase in volume on inserting the plunger is the same in the B, C and D stages.

11. When properly performed, Operation One will indicate a lack of capacity in any tested sections or tuned stages. Operation Two will indicate an excess of capacity in any of the tuned stages. Both operations should be followed exactly, keeping in mind the following precautions: first, the receiver must be properly grounded; second, the volume control must be on full; third, the oscillator signal must be absolutely steady, it must not be too broad nor too loud; fourth, speaker should be placed close to the ear.

12. Care should be taken that the trimmer plates are not turned too far in, since this will necessitate a trimmer on the D section which normally is not necessary; and, further, it will throw the dial off calibration, particularly at the high frequencies. Normally only one combination of trimmer settings will bring a set into phase, while with a trimmer on the D section, various combinations of settings may be obtained to phase the set. Care should be taken in this connection that the trimmers are not turned more than two-thirds in, in which approximate position, the set should be in calibration.

13. **Never** should the adjusting screws of the condenser plates found on the right hand-side of the 950 series gang condenser be touched. These are not trimming, balancing or neutralizing condensers, but are coupling condensers, very accurately set at the factory to 16 micro-microfarads to insure uniform amplifications of all frequencies.

Dial Calibration

If a receiver is found to be off calibration, it can be recalibrated by loosening the escutcheon plate and shifting it slightly; or by turning the dial to 100, loosening the right-hand set screw on the dial collar, tuning in a signal of known frequency, in the middle of the dial, loosening the left-hand set screw, carefully setting the dial to the received frequency, and retightening both set screws.

General Troubles

It will be found that the majority of service complaints that are not directly attributable to defective material or faulty construction of the set may be classed in the following groups:

Weak Reception From Distant Stations

A. Poor Antenna: The antenna should be put up according to the specifications given in the instruction book. It should be kept clear of all surrounding objects, and must not be run too closely to metal roofs, steel framing, or the foliage of large trees.

B. Open Circuit Aerial: An antenna that has a break in it, particularly in the lead-in, will act as an extremely short aerial, giving poor volume on distant stations. A careful check should be made for loose and corroded connections and for breaks in the lead-in. A break at this point may not be noticeable, due to its being hidden by the insulation of the wire.

C. Grounded Aerial: A grounded aerial may be caused by a defective lightning arrestor or lead-in strip, use of bare wire, or broken down wire insulation. Check by using continuity test.

D. Poor Ground: Check the ground wire for broken or corroded connections. If possible, try another ground. An open ground may cause the set to oscillate (see Page 10).

E. Defective Tube: Check for performance by means of a suitable tube tester or try substituting other tubes.

F. Low Line Voltage: Although the 950 series A. C. radio receiver will operate well on exceptionally low input voltages, occasionally one finds locations in which the line voltage may drop to below ninety-five volts at certain times of the day.

G. Location: The shielding effect of large buildings that use a good deal of steel in their construction is very pronounced. In a situation of this sort, it is necessary to use a good aerial and lead-in, and to make certain that both are kept as far from the building as circumstances will permit.

Poor Selectivity

A. Incorrect Antenna: An aerial that is too long, or one that is erected too close to metal roofs, large trees, or electric wires may cause broad tuning.

B. Long Ground: This is quite common if the radio receiver is located several floors above the floor level, or a steam system that is not grounded is used for a ground.

C. Poor Tube: A defective tube in one of the tuned circuits may throw it out of phase and cause broad tuning. Check by substituting other tubes.

D. Local Broadcast Station: A powerful local station may occasionally "blanket" a large portion of the broadcast band. The space covered by the station in question depends on its power, its distance from the set, and the broadness of its wave. This explains why some locals cause much more interference than others.

E. Incorrect Tuning: If the volume control is turned too far to the right, or if the resonator control is not carefully adjusted after the station

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desired is tuned in, interference may result. (See Page 5 for tuning instructions).

Poor Tone Quality

A. Defective Tube: This is more noticeable when volume is increased.

B. Incorrect "C" Bias: Check all grid bias resistors to make certain their resistances are correct and that they are not short-circuiting anywhere. Check grid voltage.

C. Defective Speaker: Check by using other speaker.

Noisy Operation

Noisy operation is usually due to outside disturbances picked up by the aerial system. To determine its source, disconnect both aerial and ground. If the noise continues it is evidently in the set. It may be necessary to turn back the volume control of the receiver and set the dial to an intermediate wave length to prevent oscillation without the ground.

A. Loose Connection: A loose connection anywhere in the entire receiving system may cause noise. It is necessary to check **all** possible points. Jarring or shaking the items under suspicion will frequently indicate the source of the noise.

B. Defective Tube: A defective tube, particularly when used in the detector socket, may cause noisy reception. An interrupted buzzing that continues when the aerial and ground are disconnected is almost certainly caused by the detector tube.

C. Electrical Interference: Crashing, crackling and frying noises may be produced by some electrical apparatus, such as motors, vacuum cleaners, refrigerators, or oil burners. Trolley systems are common causes of this interference.

D. Hum: All A. C. receivers have a slight characteristic hum which should not be audible through the signal. Excessive hum may be caused by a defect in the receiver, the tubes, or the power circuit.

Some 227 tubes hum much more than others. It is advisable to try several in the detector socket and choose the quietest.

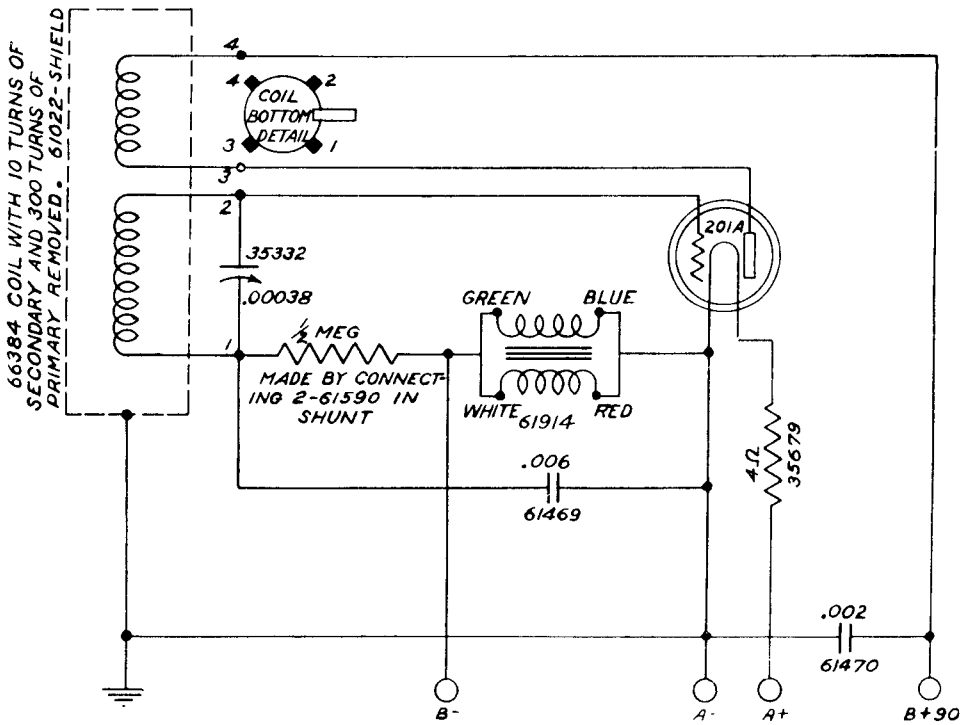

Fig. 5. Circuit Diagram of Modulated Oscillator Using Stewart-Warner Parts

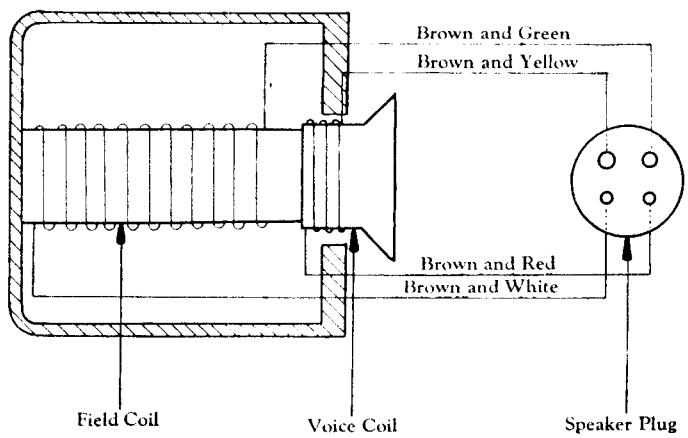

Fig. 6. Circuit of Dynamic Reproducer

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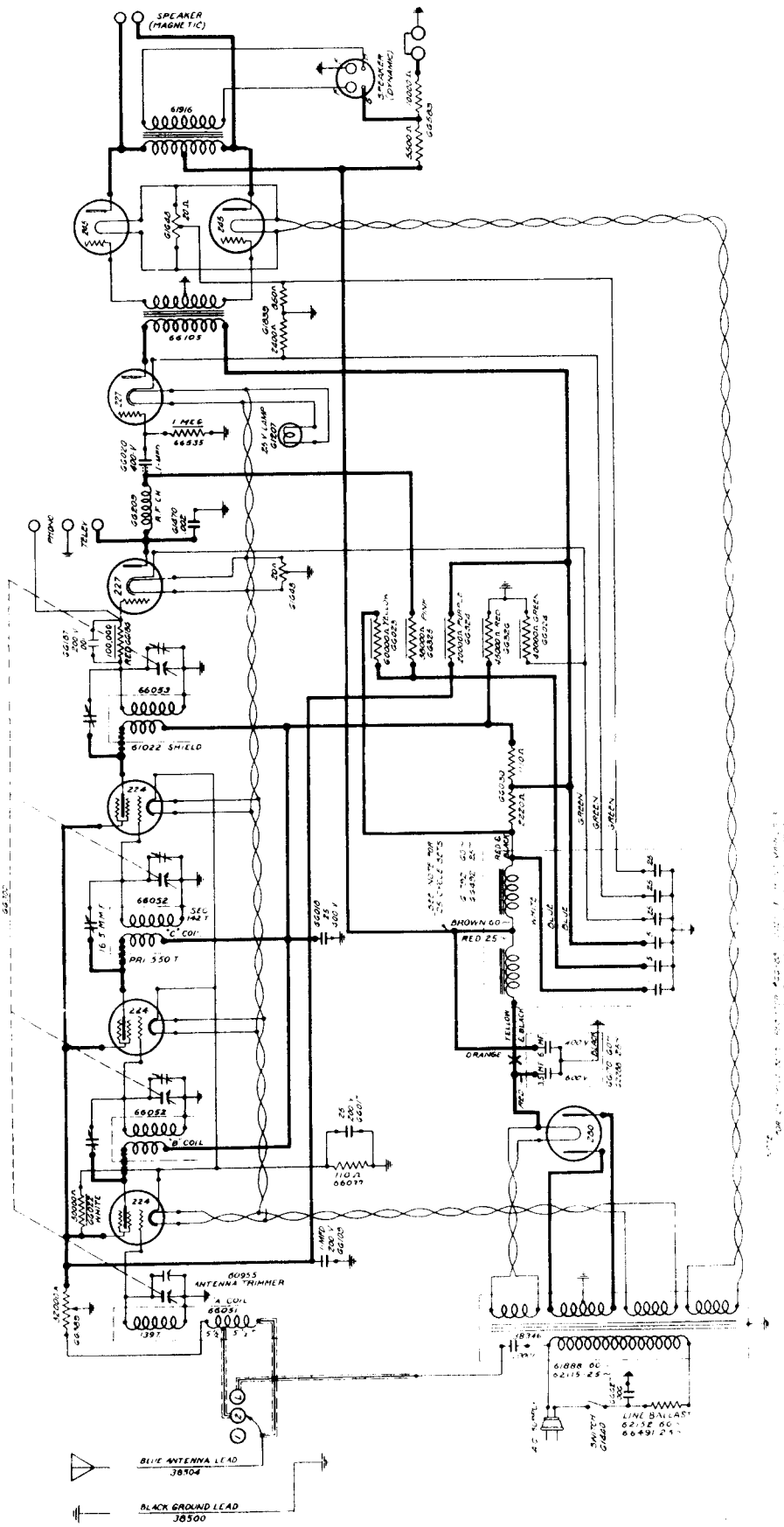

Fig. 7—Circuit Diagram for Stewart-Warner 950 Series A. C. Receivers

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PARTS LIST

950 SERIES 25 AND 60 CYCLE A. C. RECEIVER

Part No.	Description	Price
60955	Antenna Trimmer Condenser	$0.75
61055	Variable Condenser Gang	14.50
61207	2.5 Volt Pilot Light	.30
61440	Switch	.50
61470	.002 By-Pass Condenser	.35
61590	Grid Leak	.35
61648	Center Tap Resistor	.30
61665	Dynamic Speaker Resistor	1.35
61792	Filter Choke Cell (60 cycle)	10.00
61839	A. F. Grid Bias Resistors	.50
61888	Power Transformer (60 cycle)	11.50
61916	Output Transformer	5.00
62115	Power Transformer (25 cycle)	13.50
62152	Voltage Regulator (60 cycle)	1.60
62288	Filter Condenser (25 cycle)	10.00
66017	.25 mfd. R. F. Grid Bias By-Pass Condenser	.65
66018	.25 mfd. R. F. By-Pass Condenser	.75
66019	.1 mfd. Screen-Grid Bias By-Pass Condenser	.50
66020	.1 mfd. A. F. Coupling Condenser	.60
66022	White 50,000 ohm. Resistor	.50
66023	Yellow 60,000 ohm Detector Plate Resistor	.50
66024	Green 40,000 ohm Detector Grid Bias Resistor	$0.50
66030	Plate Series Resistor	.50
66037	110 ohm R. F. Grid Bias Resistor	.35
66051	First R. F. Transformer ("A" coil)	.75
66052	Second and Third R. F. Transformers ("B" and "C" Coils)	1.50
66053	Detector R. F. Transformer ("D" coil)	1.50
66105	In-Put Push-Pull Transformer	5.00
66170	Filter Condenser (60 cycle)	8.00
66186	Red 100,000 ohm Phonograph coupling Resistor	.50
66187	.001 Phonograph Coupling By-Pass Condenser	.35
66209	R. F. Choke Coil	.75
66324	Purple 20,000 ohm Screen-Grid Resistor	.50
66325	Pink 38,000 ohm Detector Plate Resistor	.50
66326	Red 45,000 ohm Resistor	.50
66389	Volume Control	1.60
66491	Voltage Regulator (25 cycle)	1.60
66492	Filter Choke Cell (25 cycle)	12.00

PARTS LIST

950 SERIES D. C. RECEIVER

Part No.	Description	Price
35839	Pilot Light	$0.30
38261	.00025 mfd. Grid Condenser	.35
38346	.0001 mfd. Antenna Series Condenser	.35
60955	Antenna Trimmer Condenser	.75
61303	Filter Condenser	5.50
61440	Switch	.50
61469	.006 mfd. Antenna Series Condenser	.65
61470	.002 mfd. Condenser	.35
61590	1 meg. Grid Leak	.35
61914	1 A. F. Transformer	5.00
61916	Output Transformer	5.00
62163	2 A. F. Filament Resistor	1.75
62164	2 A. F. Grid Bias Resistor	.90
62165	Voltage Control Resistor	2.25
62197	Filter Choke	12.50
62199	32 ohm Pilot Light Filament Resistor	1.85
62204	Filter Choke Cell	7.50
62397	Input Push-Pull Transformer	$5.00
66019	.1 mfd. Condenser	.50
66209	R. F. Choke Coil	.75
66331	.25 mfd. By-Pass Condenser	.80
66369	29 ohm Center-Tap Filament Resistor	.30
66370	29 ohm Filament Resistor	.30
66372	2,500 ohm Plate Series Resistor	.30
66375	1 A. F. Filament Resistor	.30
66381	First R. F. Transformer ("A" Coil)	.75
66384	Second and Third R. F. Transformers ("B" and "C" Coils)	1.50
66385	Detector Stage R. F. Transformer ("D" Coil)	1.50
66421	Variable Condenser Gang Only	16.00
66426	Variable Condenser Gang and Tuning Drive	18.00
66559	Volume Control	3.00

RCA-VICTOR, INC.

RCA VICTOR MODEL R-78 BI-ACOUSTIC 12-TUBE SUPERHETERODYNE

(Also, General Electric "Convention" Model J-125 Chassis.)

This is the first commercial receiver to incorporate the new "super-phonic" line of tubes which have recently made their appearance on the market. The tubes of this series incorporated in the R-78 (and J-125) chassis are the 58 R.F. pentode, 56 general-purpose, 46 Class B and 82 mercury-vapor rectifier. (The type 58 tubes are of 6-prong-base design.)

A feature of the receiver is the tone control, which is designed to maintain even reproduction of the low and high frequencies, regardless of the volume setting. Thus, bass reproduction at low volumes is not attenuated as when non-compensating circuits are used.

The resistance and capacity values of the respective units are indicated by figures within parentheses.

The following operating voltage and current readings are for a 120-volt line, the volume control set at "minimum," and no signal being received.

Filament potential, all tubes, 2.5 volts. Plate potential (to cathode or filament), V1, V2, V4, V6, V7, V10, 210 volts; V3, 70 volts; V5, 200 volts; V8, V9, 400 volts; V11, zero. Plate current, V1, V10, 3 ma.; V2, 1.5 ma.; V3, V6, V7, 5 ma.; V4, 2.5 ma.; V5, 1. ma.; V8, V9, 6 ma.; V11, zero. Control-grid potential (to cathode or filament), V1, V2, V3, V4, V8, V9, V10, V11, zero; V5, 12 volts; V6, V7, 8 volts. Screen-grid (to cathode or filament), V1, 100 volts; V2, V4, V10, 95 volts. Cathode (to heater) potential, V1, V3, V10, 7 volts; V2, 10 volts; V4, 8 volts; V5, 12 volts; V6, V7, 11 volts; V11, 15 volts.

The input signal potential for the I.F. amplifier is applied also to the A.V.C. amplifier tube due to the grids of both being coupled together by means of C32. The output of the I.F. amplifier V4 is applied to second-detector V5 through a sharply-tuned transformer I.F.T.2; however, the output of A.V.C. amplifier V10 is coupled to A.V.C. tube V11 through a broadly tuned unit

Although too much selectivity ahead of V11 is undesirable, since it introduces excessive distortion and overload as a station signal is tuned in, still, a certain amount is essential; otherwise, the A.V.C. will be caused to function by a local station when it is desired to tune in a weaker station on an adjacent channel.

The voltage developed across resistors R4, R21, R22, furnish control-grid bias for V1; the drop across R4, R22, is the control-grid bias for V2; and the drop across R4, control-grid bias for V4.

As the drop in these resistors is due to the signal potential applied to the A.V.C. tube and this voltage is in turn dependent upon the bias of the R.F., first detector, and I.F. amplifier, an automatic action is obtained; greater voltage is applied to the R.F. and first-detector than to the I.F. to prevent overloading of these tubes due to a strong, undesired adjacent carrier.

The undistorted power output of the R-78 is rated at 10 to 20 watts, depending upon the percentage of modulation of the incoming signal; consequently, to compensate for variations in sound intensity over the audio frequency band as the output is varied within these limits the volume control circuit is arranged to produce substantially flat response between the range of 35 and 5,000 cycles.

The trap circuit A.F.C.1, C11 tunes to approximately the middle of the A.F. response range and as the volume is reduced to one point, it causes greater attenuation of the middle register than at either end. From this point to the minimum position the volume control acts as a potentiometer across the trap circuit and reduces the volume without changing the frequency response to any greater degree.

This completes the description of the first half of the volume control; the second, which functions only over the last 20 degrees of the angular movement of the volume control, is resistor R1 connected between the R.F. and first-detector cathodes and varies the overall sensitivity

Push-pull voltage amplifier V6-V7 is the driver stage for push-push amplifier V8-V9.

Cabinet resonance has been nullified by means of two side chambers; the baffle area is large.

To prevent excessive hum and noise, it is essential that a good ground be connected to the yellow lead of the chassis; considerable hum also may be caused by insufficient twist in the volume control leads, due to pickup by A.F.C. 1.

In localities remote from strong stations it may be desirable to increase the A.V.C. action to obtain better than 100 mv. sensitivity. This is accomplished by shorting out R1, as indicated by the dotted line, "short."

To realign the chassis, an output meter will be necessary. (This may be a current-squared galvanometer connected to the secondary of T3 in place of the reproducer voice coil; an 0-5 ma. meter in the plate supply lead to V2; or a low-range A.C. voltmeter across the reproducer voice coil.)

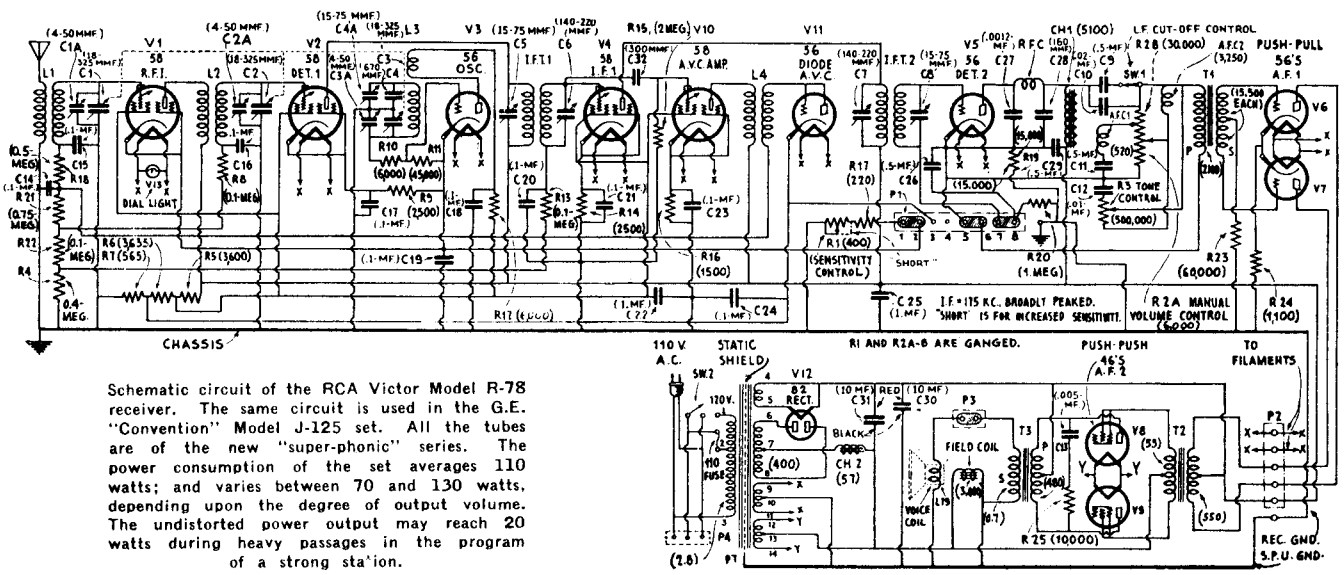
A "dummy" 56-type tube having an open heater circuit is required to replace V11; make certain that the dial pointer reads exactly at the short line on the scale when the gang condenser plates are fully meshed. Then, align the circuits at 1,400 kc., with the volume control in the "maximum" position.

Follow this with the alignment procedure at 600 kc., then repeat the procedure at 1,400 kc. Condenser C4A, the 600 kc. trimmer, is reached through a hole in the top of the chassis, and about half-way along a line drawn from the tuning dial to the socket of the first-detector.

To adjust the I.F. circuits, set the service oscillator at 175 kc., replace the regular type 56 tube with the dummy 56, as previously described, couple the oscillator to the control-grid of the first-detector, and set the volume control at "maximum"; adjust first I.F.T.2, then I.F.T.1. Repeat the procedure. Looking at the rear skirt of the chassis, and reading from left to right, the trimmers of the I.F. transformers are arranged in the following order: C8, C7, C6, C5. Terminal panel P1 is below these adjustments. At the left of P1 is the "fidelity" switch, SW.1.

It is a good plan after making the I.F. realignment adjustments to repeat the oscillator and R.F. adjustments.

Following is the color code of the power transformer: 1, black, red tracer; 2, black-red; 3, red; 4, 5, yellow; 6, 8, brown; 7, brown-black; 9, 11, blue; 10, blue-yellow; 12, 14, green; 13, green-yellow.



Schematic circuit of the RCA Victor Model R-78 receiver. The same circuit is used in the G.E. "Convention" Model J-125 set. All the tubes are of the new "super-phonic" series. The power consumption of the set averages 110 watts; and varies between 70 and 130 watts, depending upon the degree of output volume. The undistorted power output may reach 20 watts during heavy passages in the program of a strong sta'ion.

STEWART-WARNER CORPORATION

STEWART-WARNER, MODELS 50, 51 AND 58, "MAGIC DIAL" SERIES 105 CHASSIS 11-TUBE ALL-WAVE SUPERHETERODYNE

(Incorporates short- and broadcast-wavelength reception; local-distance switch; 33 and 78 r. p. m. phono.; dual reproducers; automatic volume control; tone control; push-pull pentodes; two-speed tuning.)

Latest in the Stewart-Warner line is the "Magic Dial" superheterodyne Series 105 receiver. The "Master All-Wave" console incorporates a single dynamic reproducer; model 50-A, 60 cycles and model 50-B, 25 cycles. The "DeLuxe All-Wave" console incorporates two reproducers; model 51-A, 60 cycles and model 51-B, 25 cycles. The "Radio-Phonograph" console incorporates phono., and dual reproducers.

The following values of the components are used in this receiver. Resistor R1, manual volume-control, 60,000 ohms; R2, tone control, 0.1-meg.; R3, R19, R20, 10,000 ohms; R4, 6,000 ohms; R5, 0.75-meg.; R6, 150 ohms; R7, R11, R14, R17, R25, 40,000 ohms; R8, R24, 4,000 ohms; R9, R22, 2,000 ohms; R10, 2 megs.; R12, 20,000 ohms; R13, 0.1-meg.; R15, 220 ohms, R16, 20 ohms; R18, 100 ohms; R21, R23, 45,000 ohms; R26, 1. meg.; R27, 540 ohms; R28, 1,760 ohms; R29, 4,600 ohms; R30, 2,700 ohms.

Condensers C1 to C5, tuning condensers; C1A, C2A, S.W. trimmers; C3A, C4A, C5A, R.F. trimmers; C6, trimmer; C7, C38, trimmers (one unit); C8, C16, C21, 500 mmf.; C8A, trimmer, C9, C15, 100 mmf.; C9A, trimmer; C10 to C13, I.F. trimmers; C14, trimmer; C17, C19, C27, C28, C37, .001-mf.; C18, .002-mf.; C20, C29, C40, .02-mf.; C22, C24, C30, C33, C42, 0.1-mf.; C23, C34, C41, .25-mf.; C25, 250 mmf.; C26, 1 mf.; C31, 0.5-mf.; C32, .003-mf.; C35, 8 mf. (25 cycles, 10 mf.); C36, 8 mf. (electrolytic); C39, 8 mf. (electrolytic).

In the phonograph models the circuit is open at X2, the dotted connections are made and the following values are used: RA, 0.1-meg.; RB, 2,000 ohms; CA, 0.1-mf.; CB, .25-mf. To use dual reproducers the circuit is broken at X3 and the extra reproducer socket is wired in as shown dotted.

Tube voltage readings must be taken with the set tuned to one of the short-wave ranges, and the local-distance switch Sw. 2 pulled out.

Filament potential, V1 to V5, V8, V9, 2.4 V.; V6, V7, 2.42 V.; V10, 2.44; V11, 4.9 V. Plate potential, V1, 21 V.; V2, 81 V.; V3, V4, V6, 188 V.; V5, 102 V.; V7, 70 V.; V8, V9, 177; V10, zero. Screen-grid potential, V1, 2 V.; V3, V4, V6, 102 V.; V8, V9, 188 V.; V10, zero. Cathode potential, V1, 1.9 V.; V2, 5.2 V.; V3, 2.4 V.; V4, 9 V.; V5 zero; V6, —89 V.; V7, —92 V.; V8, V9, —97 V. (to grid, 16.5 V). Line, 115V.

During broadcast reception interference from short-wave stations is prevented by applying a very high negative bias on V2, preventing it from functioning.

The range switch consists of 8 independent switch sections, each being provided with 5 contacts. Ordinarily, only 7 sections are used, and only 4 of the 5-per-switch; the remainder are wired into circuit only in the radio-phono. models.

1. The antenna is switched to the tuned input circuit of the short-wave detector; 2, the bias on the short-wave oscillator tube is reduced so that it can function; 3, the tuning condenser sections in the R.F., first-detector, and broadcast oscillator stages are cut out of the circuit and replaced by fixed trimmer condensers which are adjusted to tune these circuits to pass a 1,525 kc. signal. This frequency is used to prevent pick-up of broadcast-band stations during short-wave reception. The received short-wave signal passes through the short-wave detector where it is converted to 1,525 kc. by the action of the S.W. oscillator and it is then amplified at this frequency in the broadcast portion of the receiver.

The range switch operates in five positions as follows: 1, phonograph (this position cannot be reached in non-phono. models); 2, broadcast range (position 1 in non-phono. models); 3, 180 to 80 meters; 4, 80 to 33 meters; 5, 33 to 14 meters.

Reproducer part No. R-208-A has a field coil resistance of 460 ohms; No. RL-209-A (the L.F. unit in dual-reproducer sets), 230 ohms; No. RH-209-A, (the companion H.F. unit), 230 ohms.

In the model 105 receiver there are five circuits to be aligned, as follows: Broadcast R.F. amplifier 540 to 1,550 kc.; B.C., I.F. amplifier, 177.5 kc.; first S.W. circuit, 180 to 80 meters; second S.W. circuit, 80 to 33 meters; S.W. I.F. amplifier, 1,525 kc. The third S.W. circuit will be aligned correctly if the first two are correctly aligned. A sensitive output meter must be used to obtain sufficient indication at the low service-oscillator output level required to prevent the A.V.C. circuit functioning. Turn R1 full-on, pull Sw. 2 out and turn R2 right.

Looking at the front of the chassis, the trimmer controls are located as follows: R.F. trimmers, from front to back, top of ganged condensers; I.F. trimmers, along rear of chassis, top of I.F. transformers; S.W. trimmers, left-center of chassis (rear-right of 5-gang tuning condenser). In the factory manual these units are given the following reference numbers: R.F. trimmers, front to back, 5 to 9; I.F. trimmers, left to right, 1 to 4; S.W. trimmers, 10 to 12.

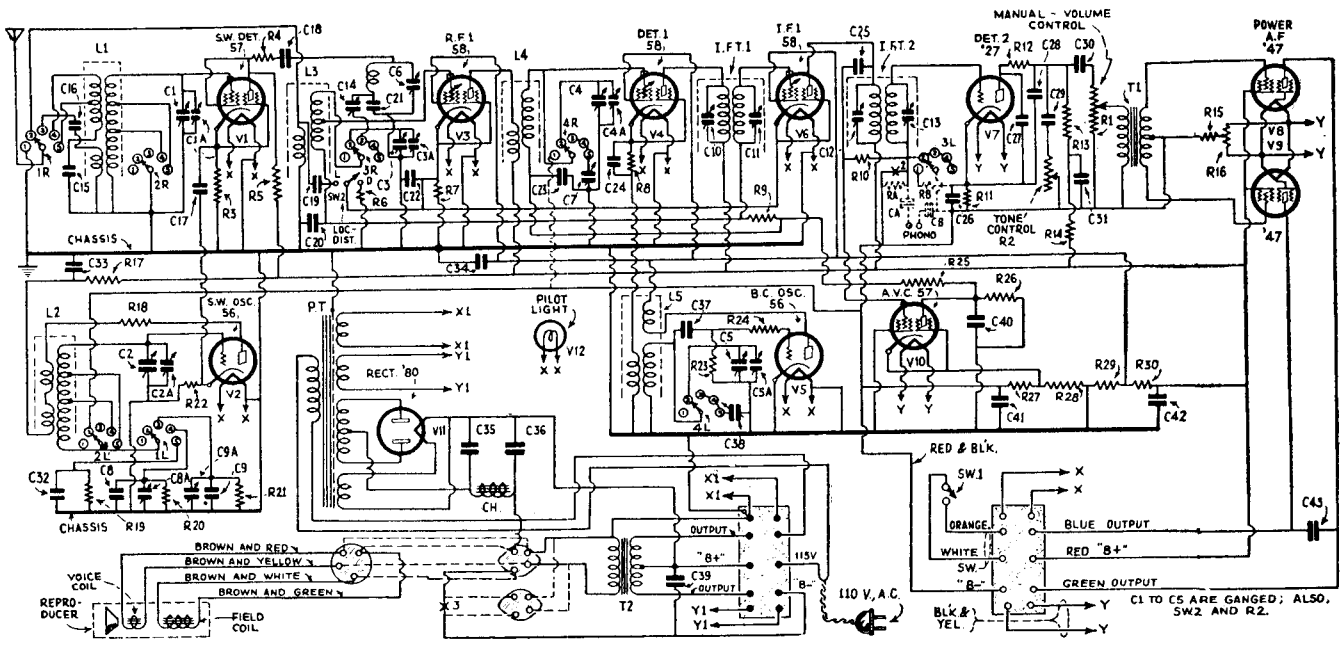
To align the S.W., I.F. circuits, tune broadcast receiver to 1,525 kc. then switch to the 80-to-33 meter range and align 10, 11 and 12. In rare instances it may be necessary to align the remaining sections of the short-wave unit; however, this should be done *only as a last resort*, as follows:

Aligning 180 to 80 meter band. Tune the broadcast receiver to 800 kc.; switch to 180 to 80 meter band and tune to 1,600 kc.; adjust No. 14 for maximum output. Next, tune service oscillator to 975 kc., turn range switch to 80 to 33 meters, tune to extreme right position (4th harmonic) and adjust No. 5 for maximum output. If it is necessary to appreciably vary No. 5, repeat the procedure in adjusting No. 14.

Aligning 80 to 33 meter band. Tune the service oscillator to 925 kc., shift range switch to 80 to 33 meters, turn pointer to extreme left (4th harmonic) and adjust trimmer No. 13 for maximum output.

Next, set the service oscillator at 1,500 kc., tune to about 50 meters (4th harmonic) and adjust Nos. 6 and 15; the latter control setting is not critical.

It is very important that the aligning frequencies given in these directions be exact, otherwise, calibration and sensitivity, particularly at the third short-wave band, will be considerably below par.



STEWART-WARNER CORPORATION

Servicing the Model 801 Stewart-Warner Radio Receiver Using the Jewell Pattern 199 AC—DC Radio Set Analyzer

In the Model 801 and 811 Stewart-Warner radio receiver, as in practically all radio sets on the market, failure of the set to operate satisfactorily can be traced in most cases to some easily located defect in the filament, plate, or grid circuit of one of the stages of amplification. In servicing the set, therefore, the first step would be to make a thorough check of these circuits.

For this purpose the Jewell Pattern 199 AC—DC Radio Set Analyzer is exceptionally convenient. Before starting work, an examination of the wiring diagram is advisable.

PRELIMINARY STEPS

Read the Jewell instruction book carefully. It gives a complete test routine for any radio receiver which must be followed for best results. The material given in this leaflet is intended as a supplement applying particularly to the Stewart-Warner Receiver. It is not complete in itself.

Go through the usual preliminary tests as indicated in the Jewell booklet (pages 2 and 3) before connecting up the set.

MANIPULATION

Connect the set so that it is ready for operation. Take the A, B, and C voltage readings for the first radio frequency stages as indicated on pages 4 to 9 of the Jewell booklet. Values obtained should agree approximately with those given in the table headed "Typical Radio Set Analysis."

You will note that this tests all circuits in the first R. F. stage. If the readings obtained are correct, the trouble must be elsewhere. A departure from normal test values will give a very good indication where the defect lies, in accordance with the following analysis.

Zero A Voltage Reading:

(1) Poor socket contact.
(2) Open circuit. Use continuity test, as given in section headed "Continuity Tests" of Jewell booklet.
(3) Short circuit. Use continuity test to locate.
(4) Burnt out fuse. This will cause *all* readings to be zero.

Low A Voltage Reading:

(1) Defective power transformer. Check by taking filament voltage readings of 2nd and 3rd R. F. tubes.
(2) High resistance in filament leads. Use Continuity test to locate.
(3) Low line voltage.
(4) Short circuit in some other part of the test. This will show up in some later test.

High A Voltage:

(1) High line voltage.
(2) Fuse inserted in wrong clips.
(3) Defective power transformer. Check by taking filament readings of 2nd and 3rd R. F. tubes.
(4) Second or third R. F. tube filaments open.

Zero B Voltage:

(1) Defective rectifier tube.
(2) Open circuit. Use continuity test to locate.
(3) Short circuit. Use continuity test to locate.

Low B Voltage:

(1) Low line voltage.
(2) Fuse in wrong clips.
(3) Short circuit in one of the filament or high voltage circuits. This will show up in some later test.
(4) Defective rectifier tube.
(5) Open grid circuit. Use continuity test.
(6) Low grid biasing resistor. This will show up in C voltage test.

High B Voltage:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Some other plate circuit open. This will show up in some later test.
(4) Defective tubes.

Zero C Voltage:

(1) Grounded grid.
(2) Open grid circuit.
(3) Shorted by-pass condenser.

Low C Voltage:

(1) Low line voltage.
(2) Fuse in wrong clips.
(3) Defective tube in any R. F. socket.
(4) Defective grid bias resistor.

High C Voltage:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Defective grid bias resistor.

Zero Plate Current:

(1) Defective tube.
(2) Open plate circuit.

Low Plate Current:

(1) Defective tube.
(2) Low line voltage.
(3) High grid voltage.

High Plate Current:

(1) High line voltage.
(2) Fuse in wrong clips.
(3) Some other plate circuit open.
(4) Defective tube.
(5) Low grid bias.

STEWART-WARNER CORPORATION

It is obvious that the above test will show up practically any defect in the first radio circuit, or at least give a very good indication of what to expect. Running the same test for the remaining stages of amplification will clear up any doubts.

In testing detector circuits, it is of the utmost importance to allow sufficient time for the tube to warm up fully.

After all tube circuits have been checked in this way, and a fairly accurate idea of the trouble obtained the set may be taken apart for making the necessary continuity tests and repairs.

There remain a few defects that are not readily shown up by the standard circuit test. These are enumerated below.

POSSIBLE SOURCES OF TROUBLE NOT INDICATED BY JEWELL ANALYZER

Hum:

(1) Low emission 280 tube.
(2) Unbalanced 280 tube.
(3) Defective detector tube.
(4) Open center tap filament resistor.
(5) Open by-pass condenser.
(6) Defective power unit.
(7) Tubes not making good contact in sockets.
(8) A. C. line in close proximity to aerial, ground, or set.
(9) Unbalanced 112-A tubes.

No Signal:

(1) Aerial grounded.
(2) Lead-in strip broken or corroded.
(3) Aerial disconnected.
(4) Speaker leads not inserted properly.
(5) Speaker defective.
(6) Output transformer defective.
(7) Tubes not making contact in socket.
(8) Variable condenser shorted.
(9) By-pass condenser shorted.

Distortion:

(1) Oscillating set.
(2) Defective speaker.
(3) Defective transformer.
(4) Speaker out of adjustment.
(5) Defective grid leak.
(6) Defective power unit.
(7) Open by-pass condenser.
(8) Defective power tube.

Excessive Oscillation:

(1) Defective grid resistors.
(2) Short circuited grid resistors.
(3) Open aerial or ground circuit.
(4) Open by-pass condensers.
(5) Exceptionally lively R. F. tubes.
(6) Poor ground.

Schematic Diagram of Circuit for Stewart-Warner A. C. Radio Receiver with Power Unit; and Battery Radio Receiver given on back page

TYPICAL RADIO SET ANALYSIS

NAME OF SET **STEWART-WARNER MODEL 801 — SERIES B**

INPUT VOLTAGE **115**

TUBE NO. IN ORDER	TYPE OF TUBE	POSITION OF TUBE 1 ST. R.F., DET., ETC.	READINGS, PLUG IN SOCKET OF SET						
			TUBE OUT OF TESTER		TUBE IN TESTER				
			A VOLTS	B VOLTS	A VOLTS	B VOLTS	C VOLTS	NORMAL PLATE M. A.	PLATE M.A. GRID TEST
1	UX226	1 R.F.	1.46	157	1.33	155	14.8	2.9	9.7
2	UX226	2 R.F.	1.46	158	1.33	156	14.8	2.3	9.2
3	UX226	3 R.F.	1.48	158	1.32	156	14.8	1.9	9.5
4	UY227	DET.	2.40	132	1.98	25	0	1.4	1.45
5	UX226	1 A.F.	1.62	175	1.42	146	12.5	3.3	4.1
6	UX112-A	2 A.F. Push-	5.1	175	4.93	158	12.0	9.9	14.9
7	UX112-A	2 A.F. Pull	5.1	175	4.95	158	12.0	9.3	14.2
8	UX280	Rectifier	5.7		4.78				

Note: Readings in the column headed "Normal Plate M. A." may vary as much as 50 to 100 per cent from those given, particularly for the UX-226 tubes. Readings in the last column may vary as much as 25 per cent. Such variations are caused by differences in line voltage, non-uniformity of tubes, etc. In general, however, the difference in milliamperes between the last two columns for any tube will approximate the value given in the table.

SPARKS WITHINGTON CO.

SPARTON "TRIOLIAN" 13-TUBE MODEL 28 3-SPEAKER SUPERHETERODYNE

(Inter-station noise suppressor, parallel push-pull pentodes, duo-diode detector with twin 56's, line-noise filter, tone control, hum control, Lafoy delayed A. V. C., parallel '80's, R. F. and I. F. band-selectors.)

Service Men will find after studying the schematic diagram of the new Sparton "Triolian" 3-speaker superheterodyne that although at first glance the circuit arrangement is apparently quite simple, there is incorporated in the ensemble a multiplicity of operations which make it essential for each component to have exactly its rated value, consequently, no tolerance from the specified values should be permitted when making replacements.

The Lafoy system of delayed A. V. C. discussed in RADIO-CRAFT Data Sheet No. 70, July 1932, page 37, in connection with the Sparton model 40 receiver, is incorporated in the Sparton model 28 superheterodyne. The sensitivity of the set is 4 microvolts absolute, across the broadcast band, with an undistorted power output of 20 watts. The combination first-detector and oscillator, V2, in addition to performing these functions also has a gain figure of 40 to 1.

Following are the values of the components: Resistor R1, manual volume control, 10,000 ohms; R2, tone control, 0.1-meg.; R3, inter-station noise control, 9 megs.; R4, 3,000 ohms; R5, 8,000 ohms; R6, R7, 15 ohms; R8, R10, 0.25-meg.; R9, R14, 0.5-meg.; R11, 0.75-meg.; R12, R13, 0.1-meg. Chokes RFC2 and RFC3 are 16 mhy.

Condensers C1 to C4, tuning units; C1A, antenna compensator and R. F. trimmer; C2A, C3A, C4A, R. F. trimmers; C5, .002-mf.; C6, to C9, I. F. trimmers; C10, 50 mmf.; C11, C12, C13, C27, C28, C30, 0.2-mf.; C14, C16, C17, 250 mmf.; C15, C26, .01-mf.; C18, .002-mf.; C19, .05-mf.; C20, C21, .006-mf.; C22, 4 mf.; C23, C24, C25, 5mf.; C29, 0.5-mf.

Transformer T1 has a step-down ratio of .7 to 1. for improved quality.

The three reproducers are pitched to reproduce low notes without accentuation. A 9 in. dynamic reproducer, resonant at 80 cycles, is used in the front grille, and a 7 in. dynamic reproducer, resonant at 130 cycles, in either side grille. It has been found that by positioning these two reproducers at an angle, a "three dimension" sound effect is obtained; that is, one experiences a sensation of depth when listening to the reproduction. Choke Ch. 1, 3,700 (left) and 2,400 ohms; Ch. 2, 250 (left) and 140 ohms; Ch. 3, 3,150 ohms, center-tapped; Ch. 4, 75 ohms.

The station selector of the model 28 set is directly below the illuminated dial; below this knob is another which operates the inter-station noise suppressor, R3. At the right of the latter control is another which adjusts the tone control, R2; and at the left, the combination power switch Sw. and manual volume control R1.

Resistor R3, which controls the inter-station sensitivity of the receiver, is operated as follows: Turn R1 full on; then, tune between the station wanted and an adjacent station, and bring in the undesired between-station noise; next, rotate the R3 control knob counter-clockwise until this noise is reduced to a satisfactory level, or until it disappears entirely; now, tune in the desired program and operate R1 to raise or lower the volume as required. When tuning for distant stations, or if use of R3 is not desired, rotate the control knob of R3 clockwise as far as it will go. However, for reception of local stations this control may be used as a manual volume control, and when operated in this manner the control knob of R1 should be turned to the full position; this eliminates the A.V.C. feature and permits the received signals to fade out and in if atmospheric conditions permit.

To adjust antenna equalizer C1A, tune in a weak station between 1,400 and 1,500 kc., and turn the volume control on full; then, adjust C1A (by means of a hex-socket wrench) for maximum output. Adjust C1A only when the aerial circuit is changed. The recommended antenna length is 50 to 100 ft., and height, 25 to 50 ft.

It is preferable to use as a replacement for V2 a tube of similar characteristics, so that the dial kc. readings for stations above 1,200 kc. are not altered. If the tuning dial goes off-scale, adjust trimmer C4A before any others, at 1,400, 900 and 600 kc., as required.

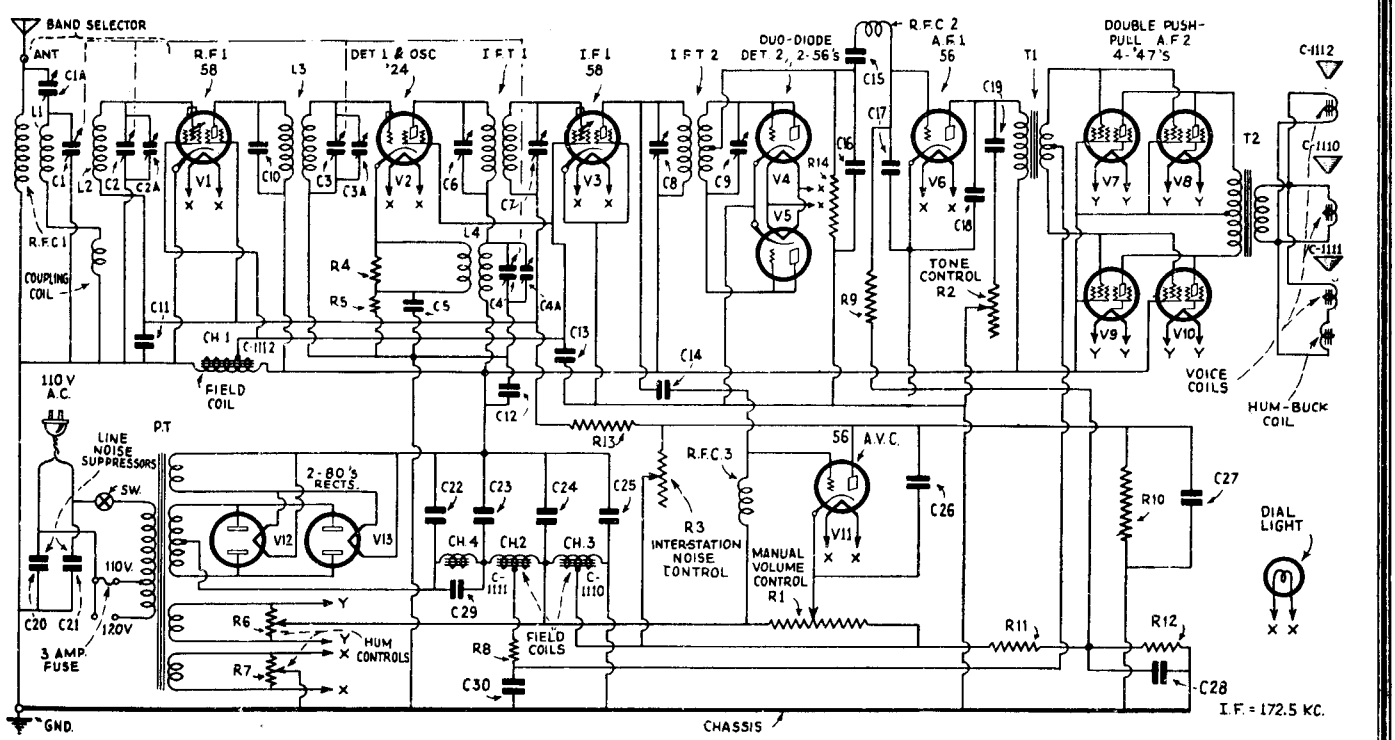
Before adjusting the oscillator, R.F. or I.F. circuits, set R1 full on, R2 full left (natural tone), and R3 full clockwise. It is preferable to use a crystal-controlled, A.F. modulated 172.5 kc. oscillator; its broadcast harmonics will be: 690, 862.5, 1,035, 1,207.5, 1,380, and 1,552.5 kc.

Two peaks will be noted within a one-half or three-quarter turn adjustment of trimmer C3A; the correct peak is obtained with the down adjustment (capacity increase). Unless the latter setting is obtained, tuning dead spots will occur at 1,300 and 1,450 kc., together with poor sensitivity at 900 and 600 kc.

To maintain the A.V.C. inactive, (that is, to prevent the action of the A.V.C. from keeping the signal at one level), in order to obtain accurate condenser adjustments, set R1 to full on and R3 counter-clockwise.

Symptoms and remedies: Dial calibration incorrect; align oscillator. Weak reception, multiple peaks within a 40 kc. band from a loud local station, or hiss; align preselector circuits. When replacing an I.F. condenser or transformer, or when these circuits are out of alignment; align I.F. circuits.

Following are the Sparton model 28 tube average operating characteristics, with a line potential of 115 V. and R1 full on: Filament potential, V1 to V11, 2.4 V.; V12, V13, 4.4 V. Control-grid potential, V1, V3, 2.4 V.; V2, 7 V.; V4, V5, (*); V6, 9 V.; V7 to V10, 25 V.; V11, 65 V. Screen-grid potential, V1 to V3, 94 V.; V7 to V10, 295 V. Plate potential, V1, to V3, 173 V.; V4, V5, (*); V6, 9 V.; V7 to V10, 285 V.; V11, 40 V.; V12, V13, 348 V. Plate current, V1, V3, 6.5 ma.; V2, 1.1 ma.; V4, V5, (*); V6, 5.5 ma.; V7 to V10, 26 ma.; V11, zero; V12, V13, 39 ma. (per plate). (*) A potential is present only when a signal is applied.



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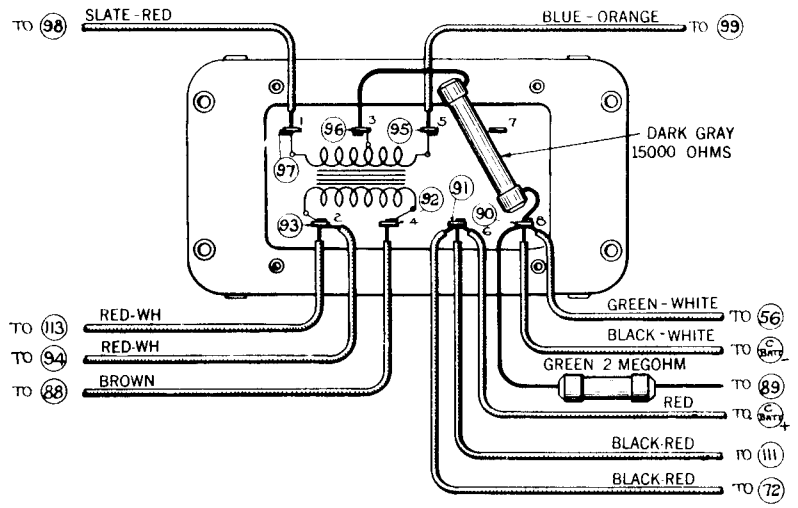
Model 645

"Art Console"



Detail of P-19203 Input Transformer Assembly.

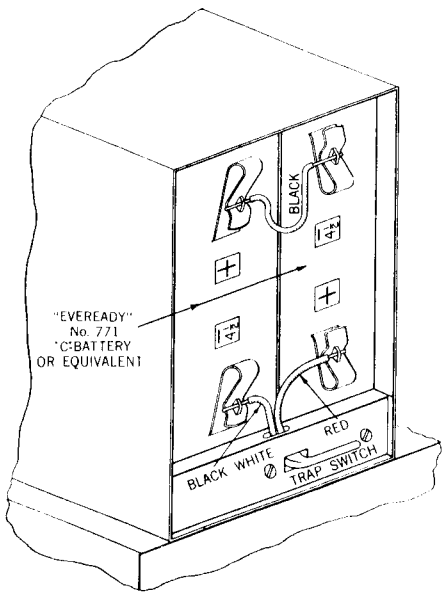
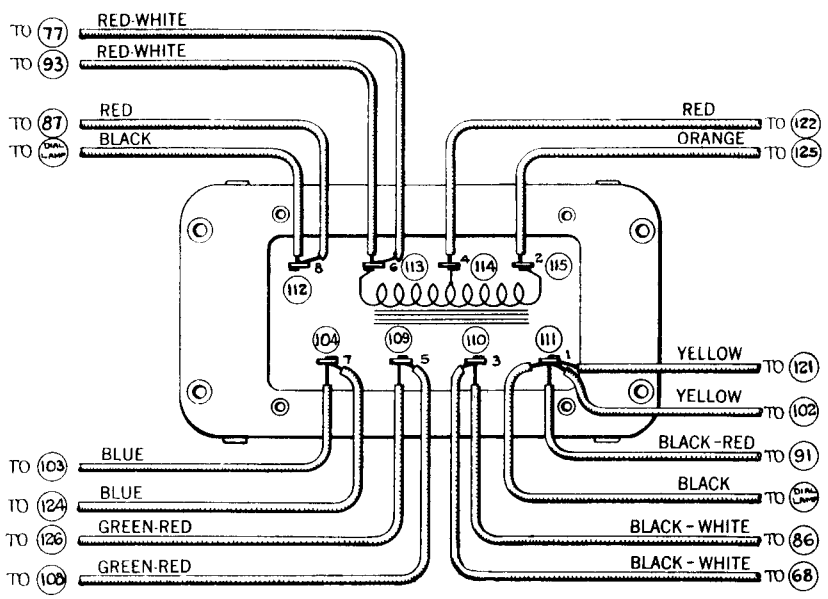
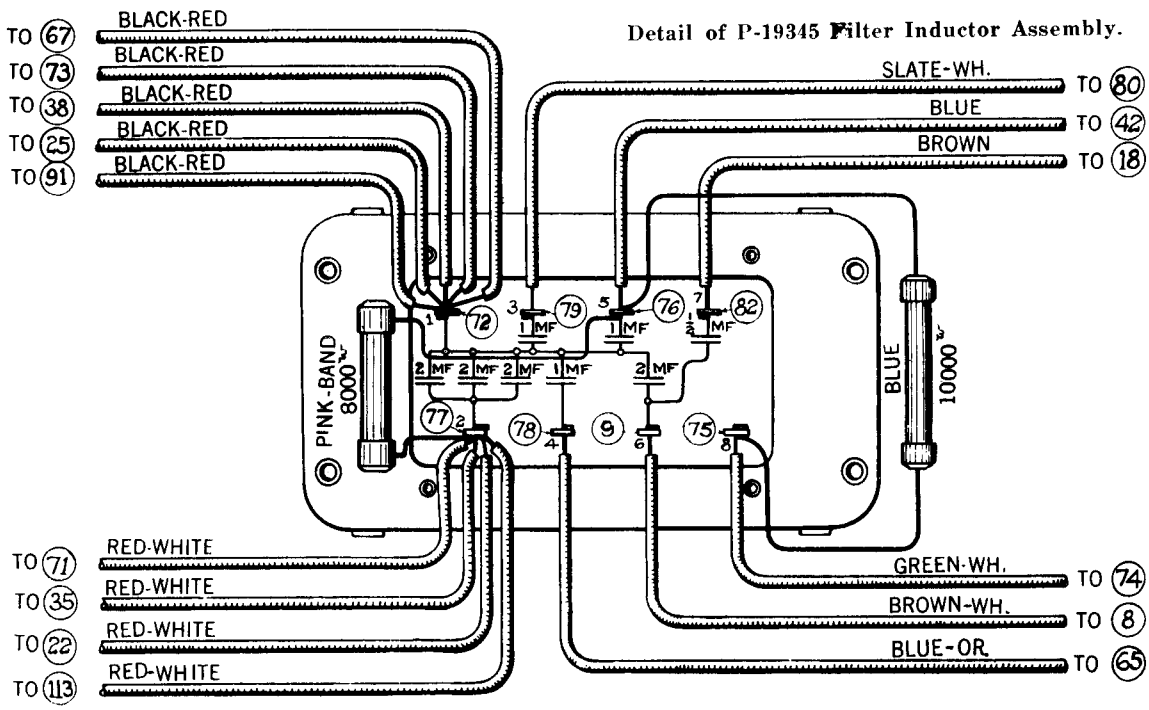


Diagram of "C" Battery Container with Cover Removed Showing Connections.



Detail of P-19345 Filter Inductor Assembly.



Detail of P-19252 Capacitor Assembly.

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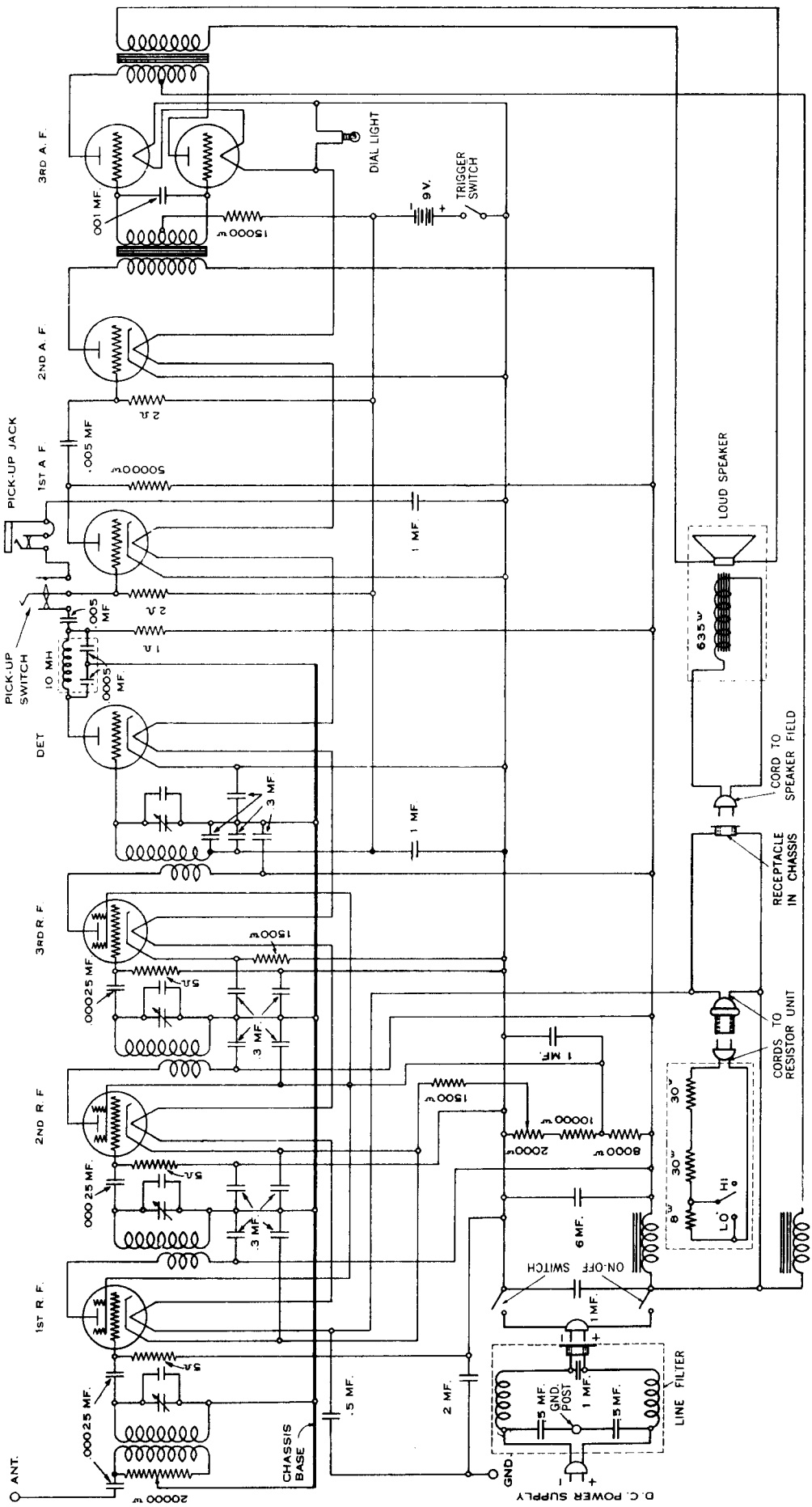

Complete Schematic Circuit of Chassis of No. 645 Art Console.

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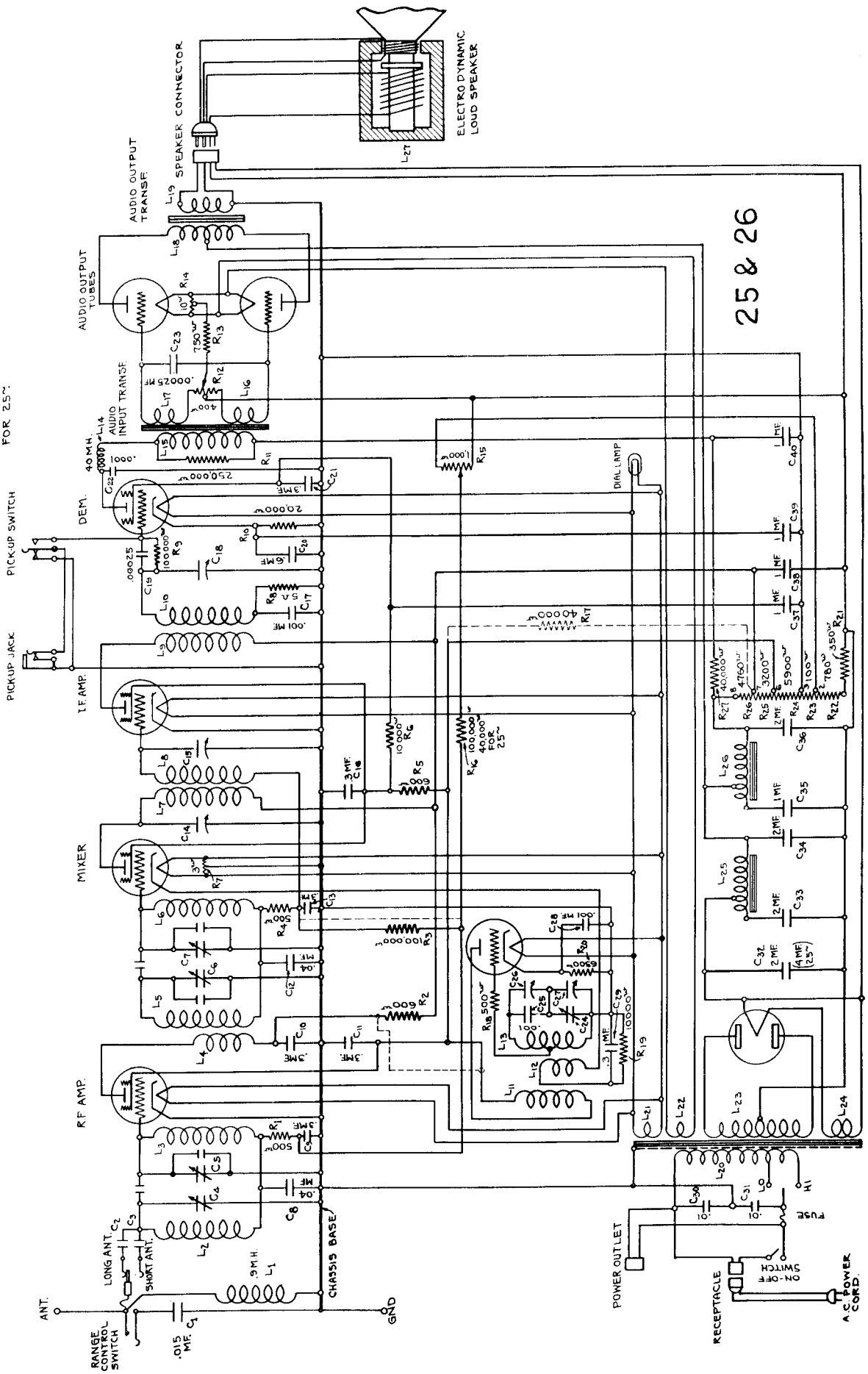

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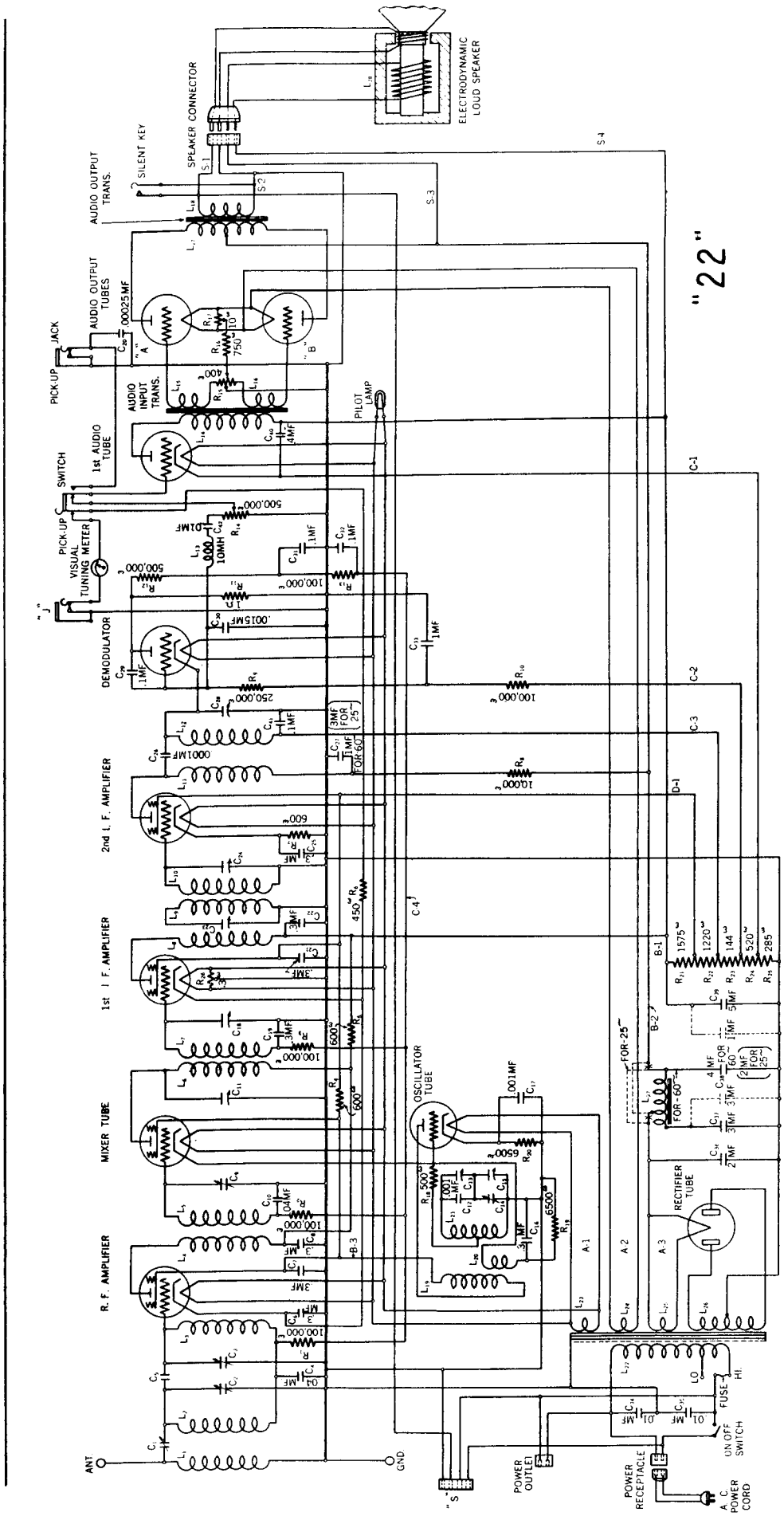

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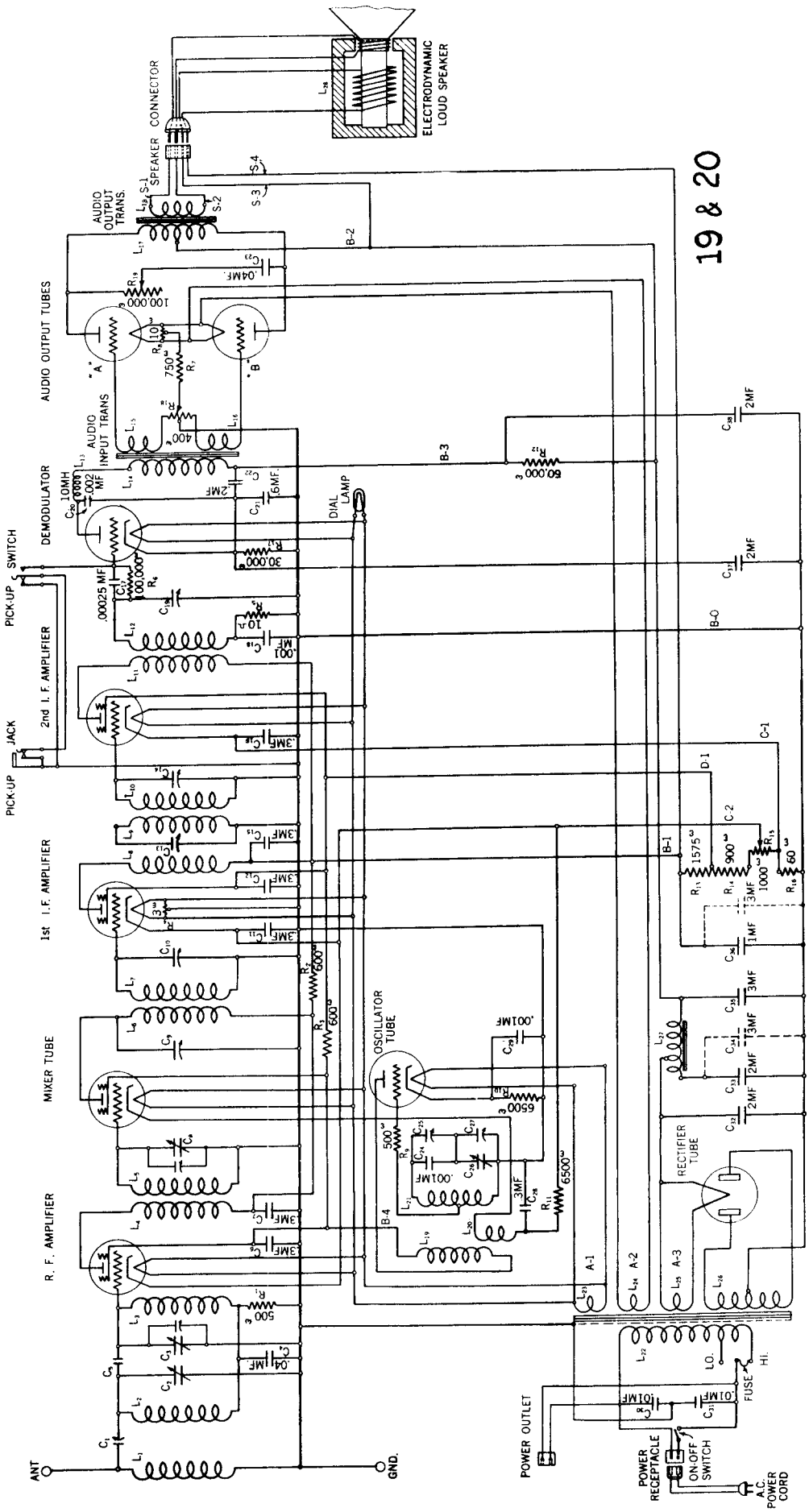

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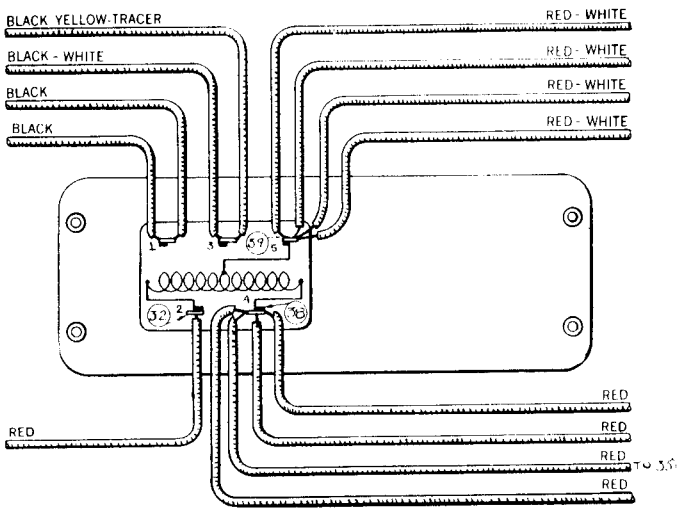
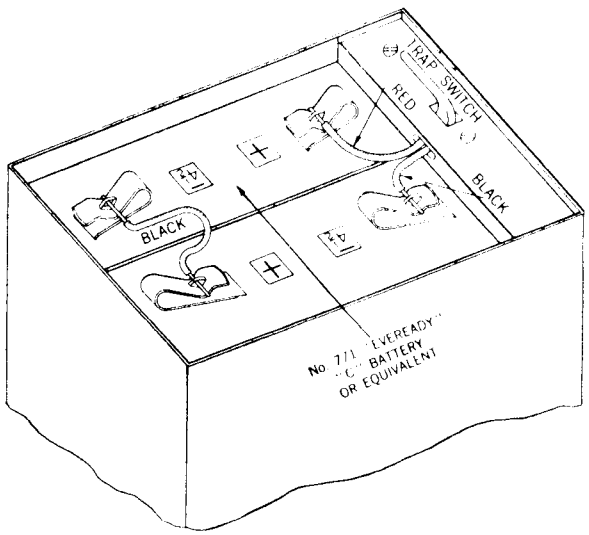
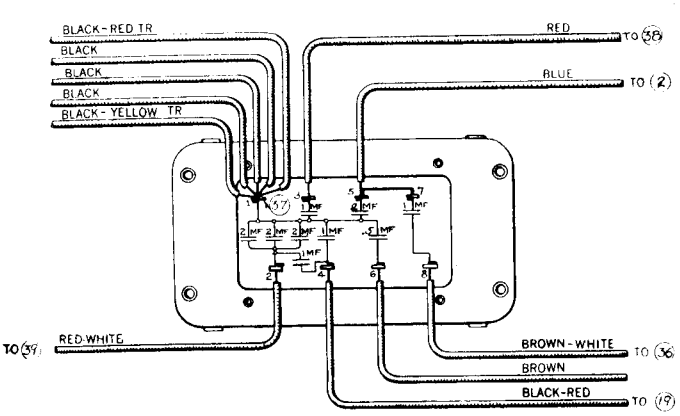


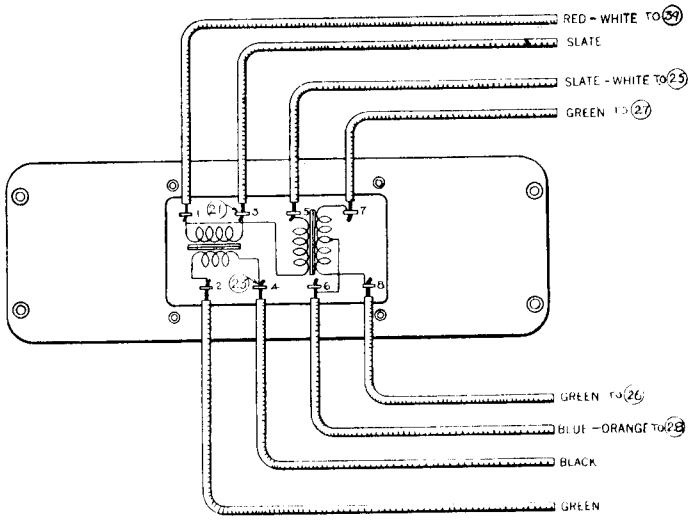
Connection Detail of P-21054 Filter Inductor Assembly showing colors of wires and correct connection to Terminals.



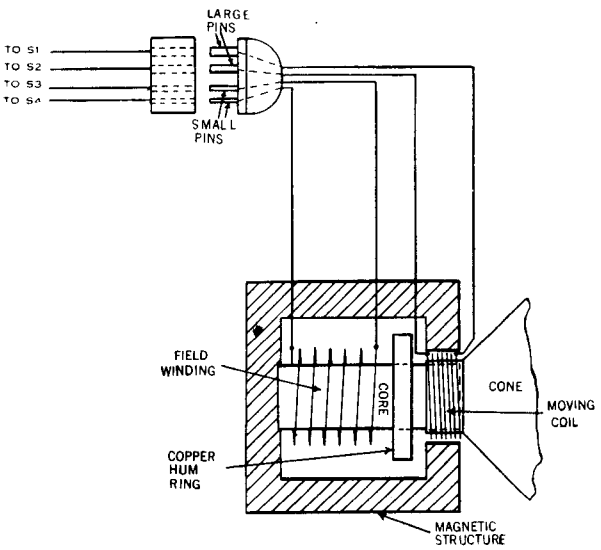
"C" Batteries Mounted in Container on Chassis. Note Trap Switch and Wiring.



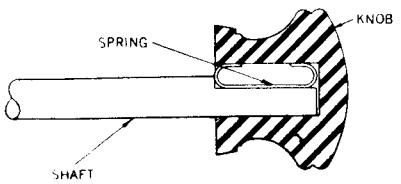
Connection Detail of P-19775 Capacitor Assembly.



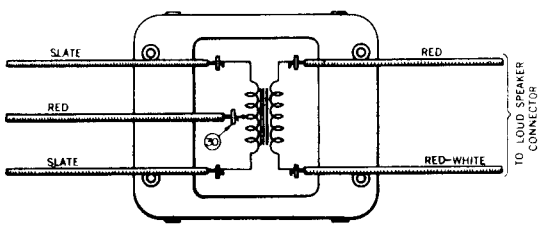
all for Model 16 Receiver



Schematic Circuit of Electro-dynamic Loud Speaker and Connector



Cross Section of Control Knob and Shaft showing arrangement of spring holding Knob in place. If this spring becomes bent so that the Knob is loose it should be reformed by bending in middle, or replaced with a new spring.



Connection Detail of P-19505 Audio Output Transformer.

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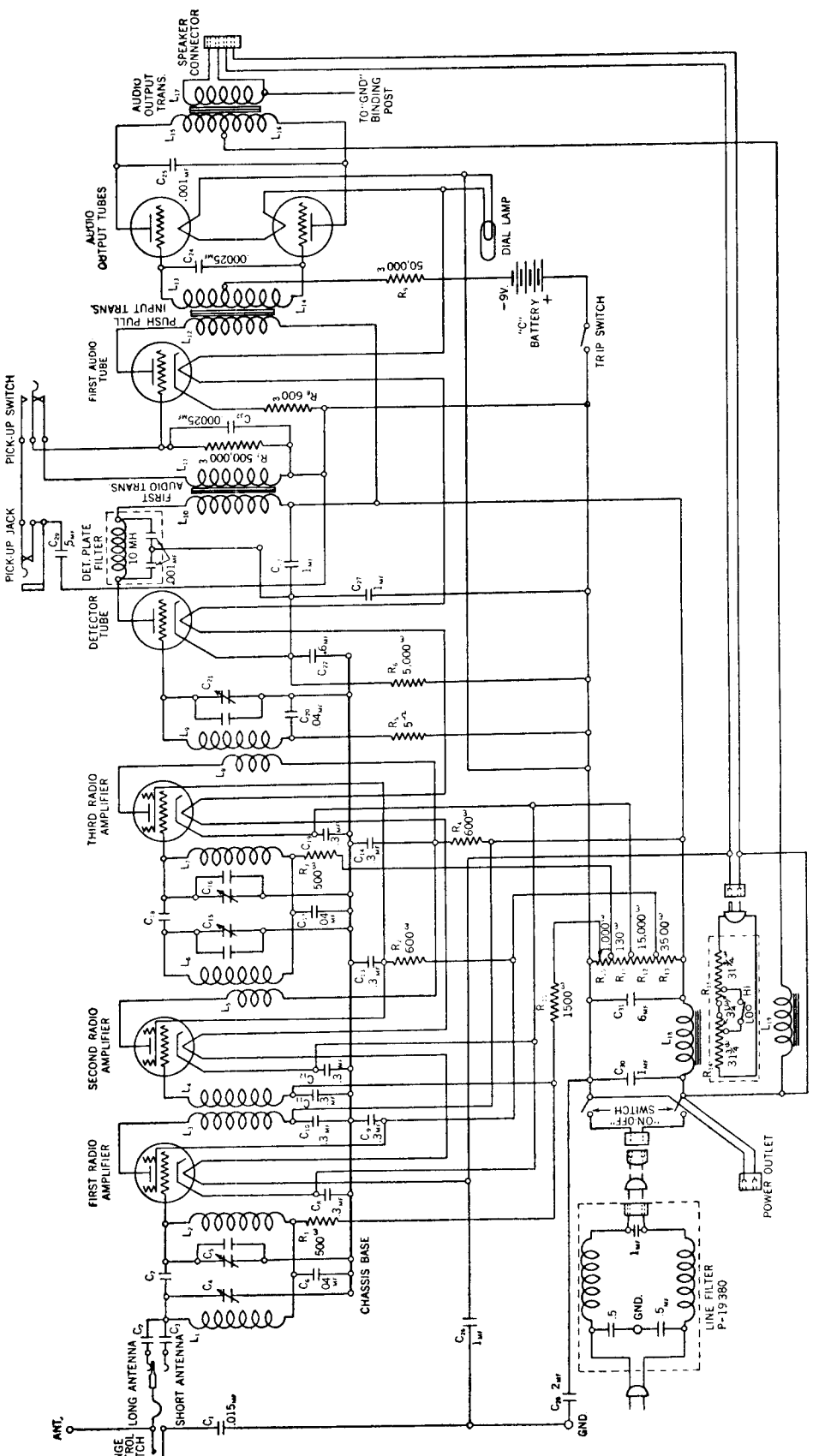
Schematic Circuit of Chassis for No. 16 Receiver



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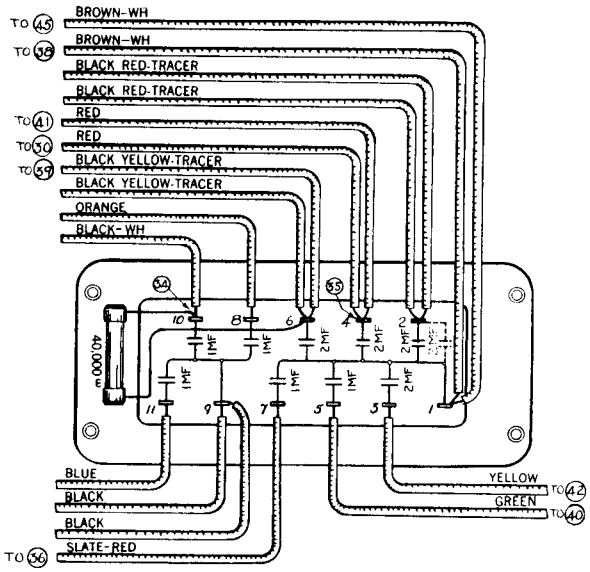
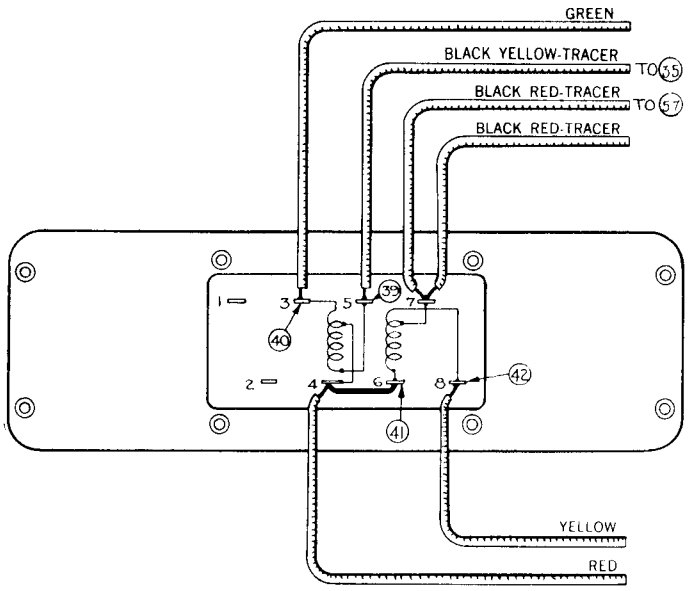
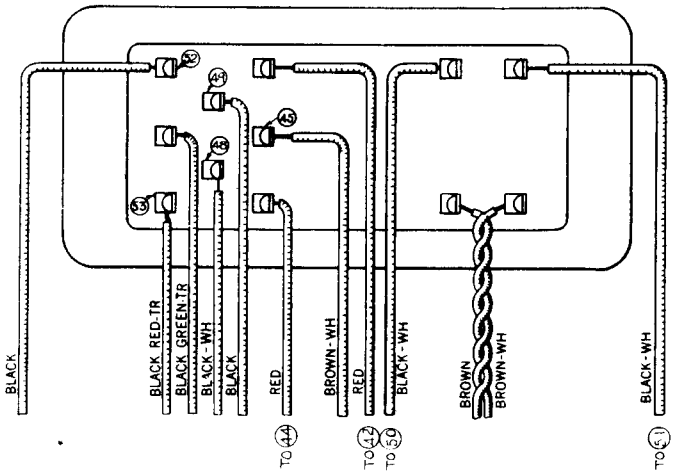
Models 10 and 11



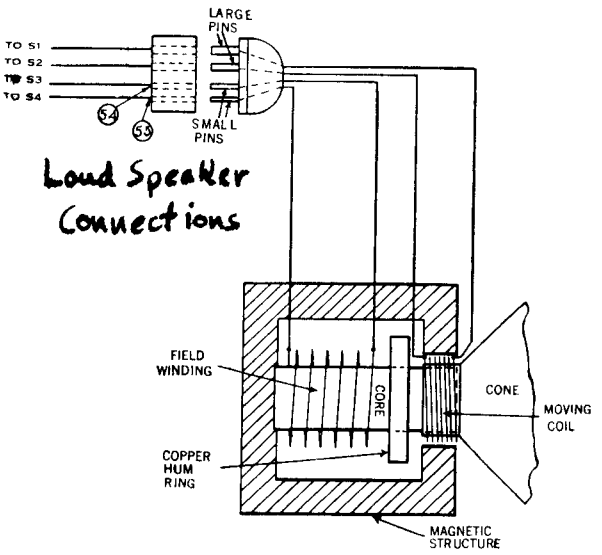
Connection Detail of P-19604 or P-19618 Capacitor Assembly. P-19618 Assembly has 4 Microfarads between Terminals Nos. 1 and 2 and is used in the Chassis of the Nos. 10-B, 10-C, 11-B and 11-C Receivers.

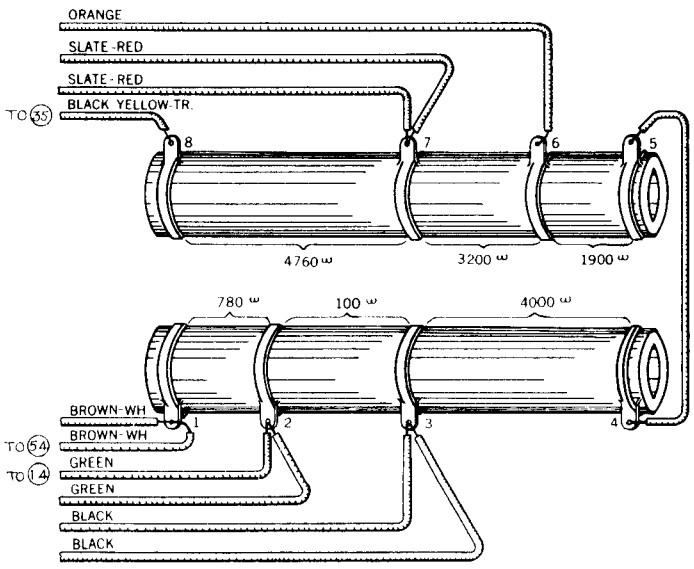


Connection Detail of P-18200 Filter Inductor Assembly

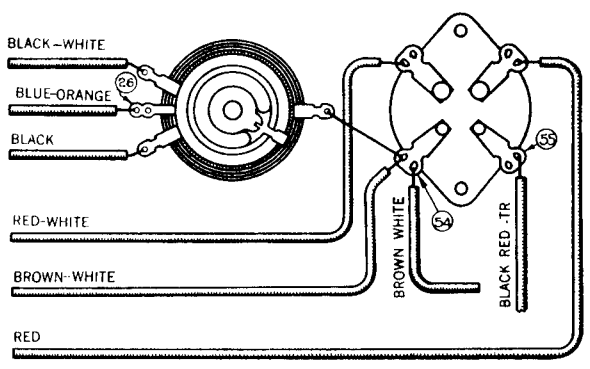


Connection Detail of Power Transformer.





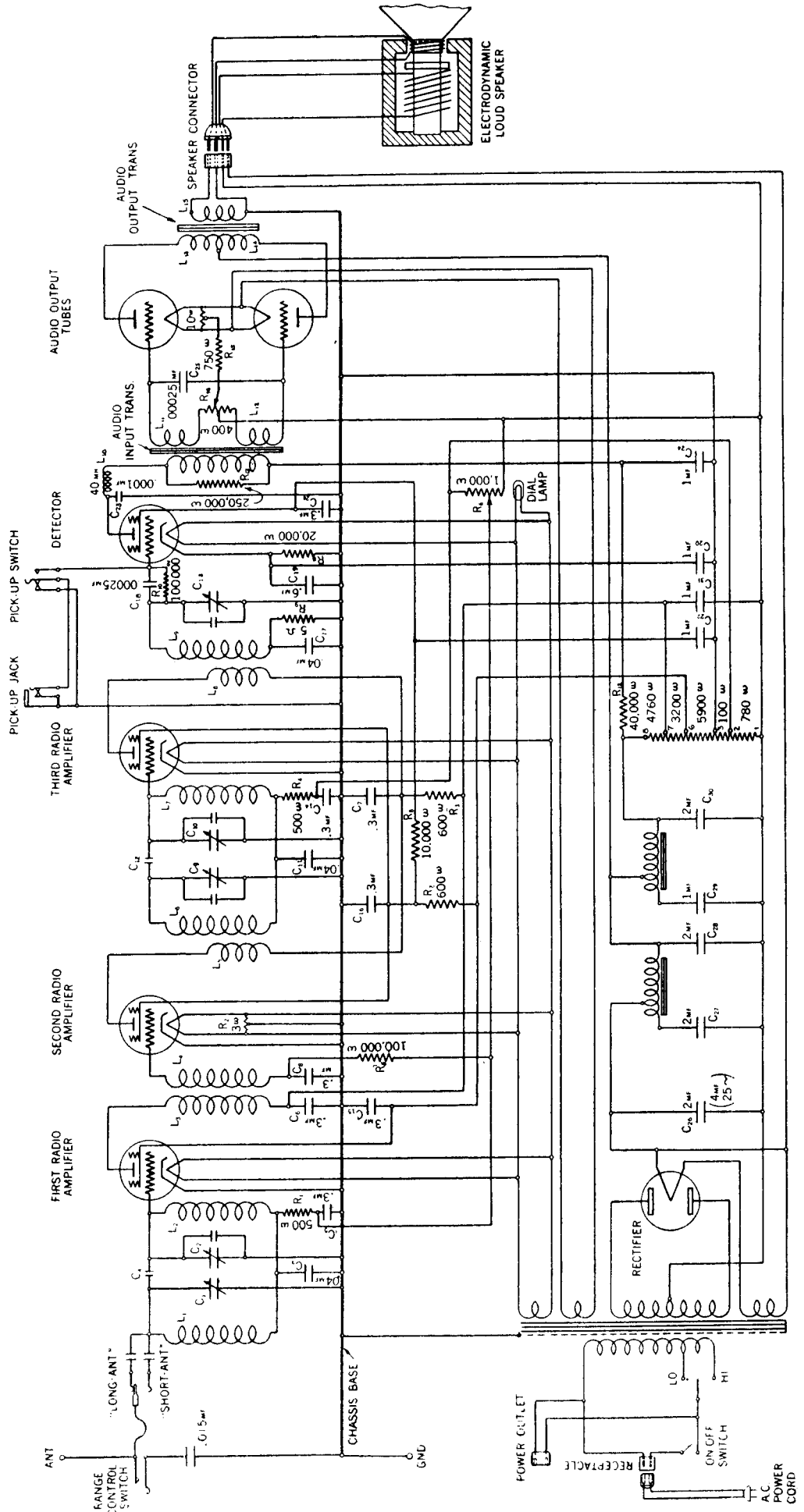
Connection Detail of Voltage Divider Resistors. The upper one is P-19557 and the lower one is P-19559.



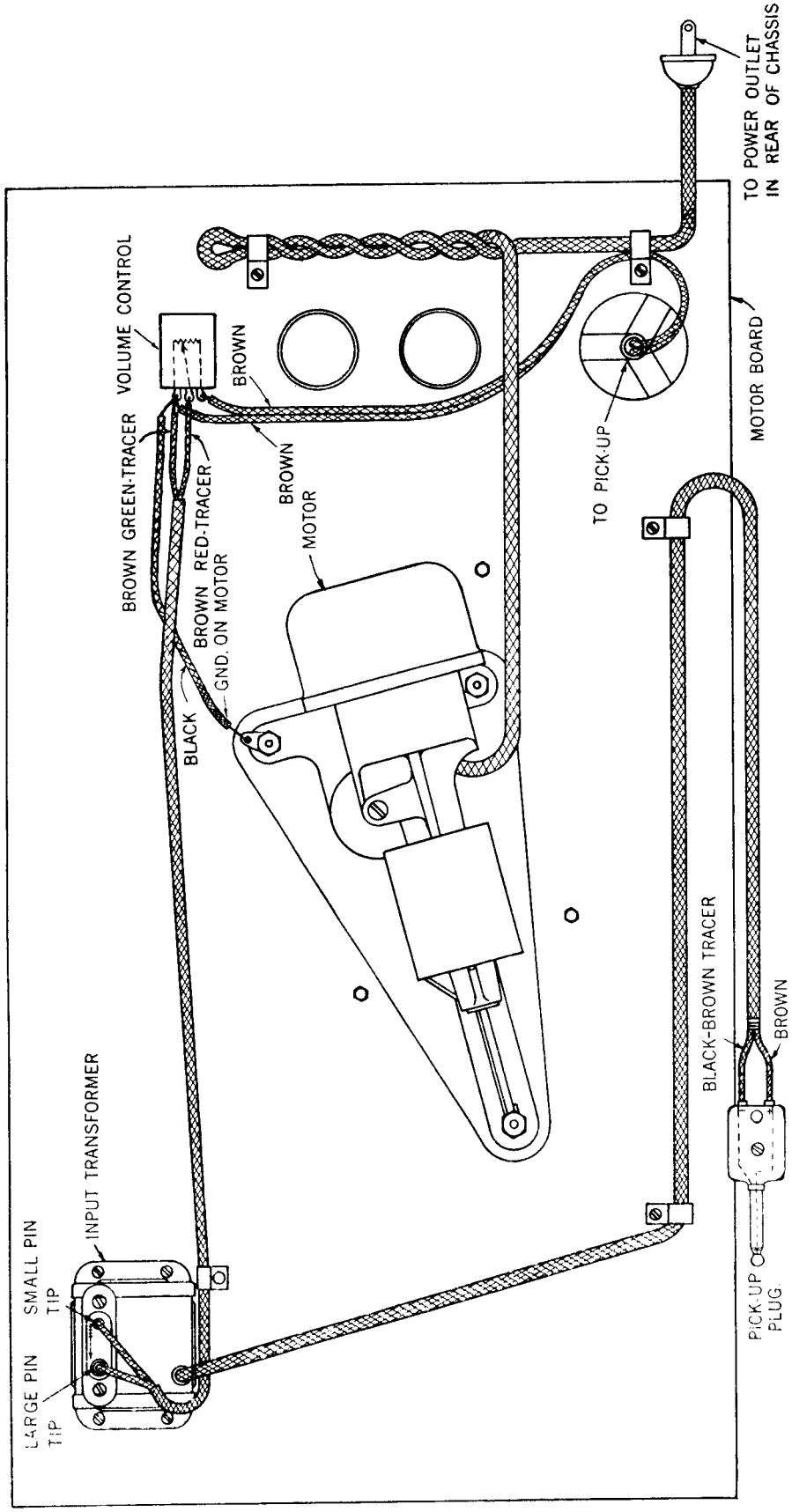
Connection Detail of Hum Balancer and Speaker Connector Socket.

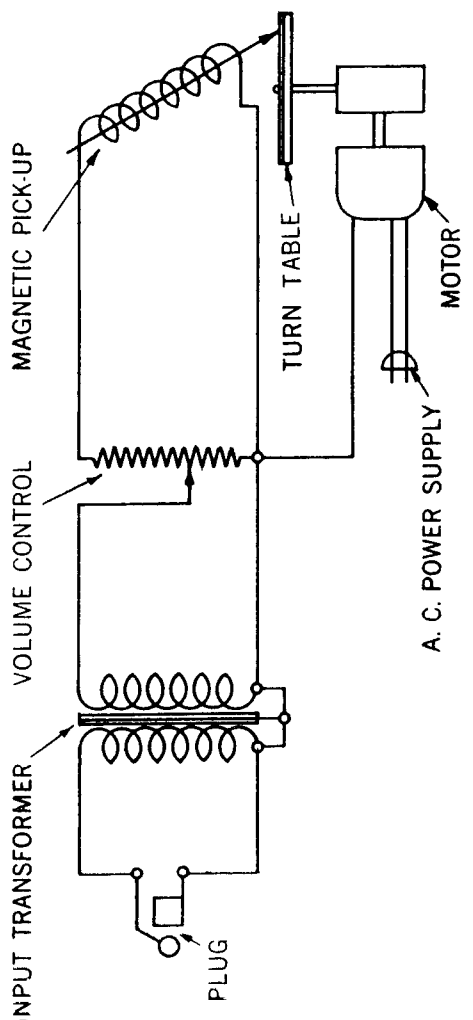
STROMBERG-CARLSON MFG. CO.

Schematic Circuit of Chassis for Nos. 10 and 11 Receivers



STROMBERG-CARLSON MFG. CO.

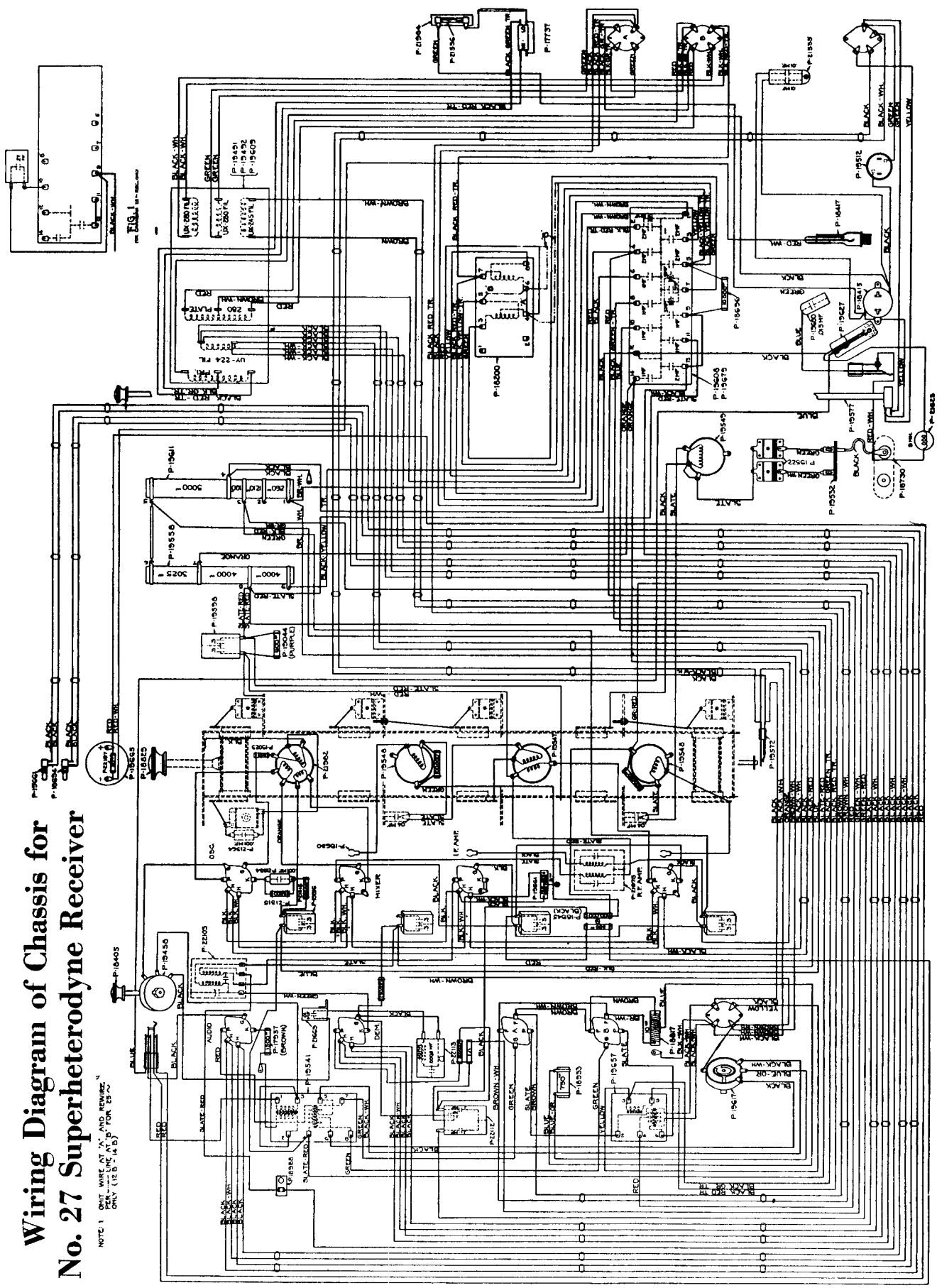




LEFT—Schematic Circuit of No. 1 Phonograph Panel Assembly

BELOW—Wiring Diagram of No. 1 Phonograph Panel Assembly (used in model 11 Receiver)

STROMBERG-CARLSON TELEPHONE MFG. CO.

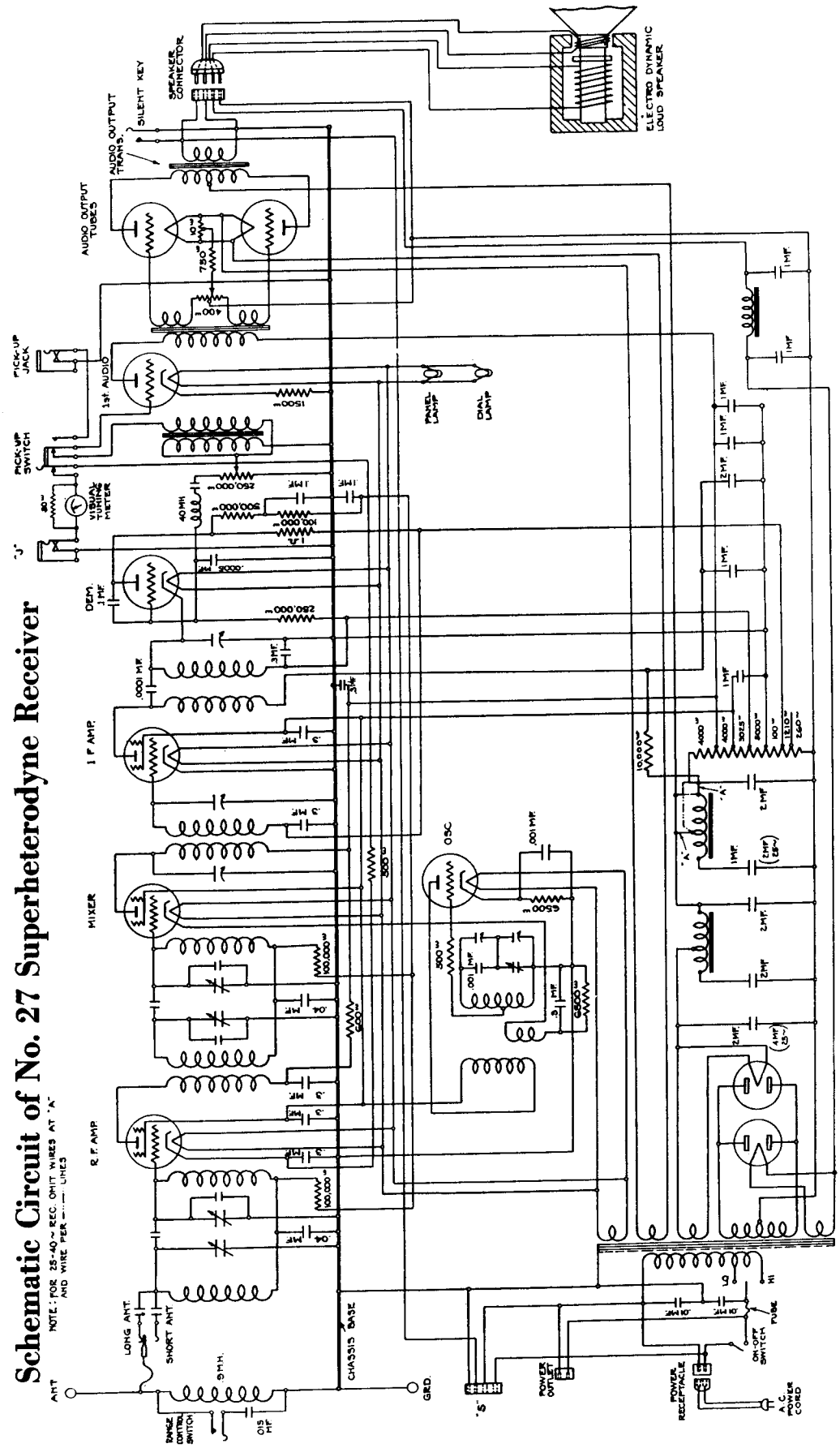


Wiring Diagram of Chassis for No. 27 Superheterodyne Receiver

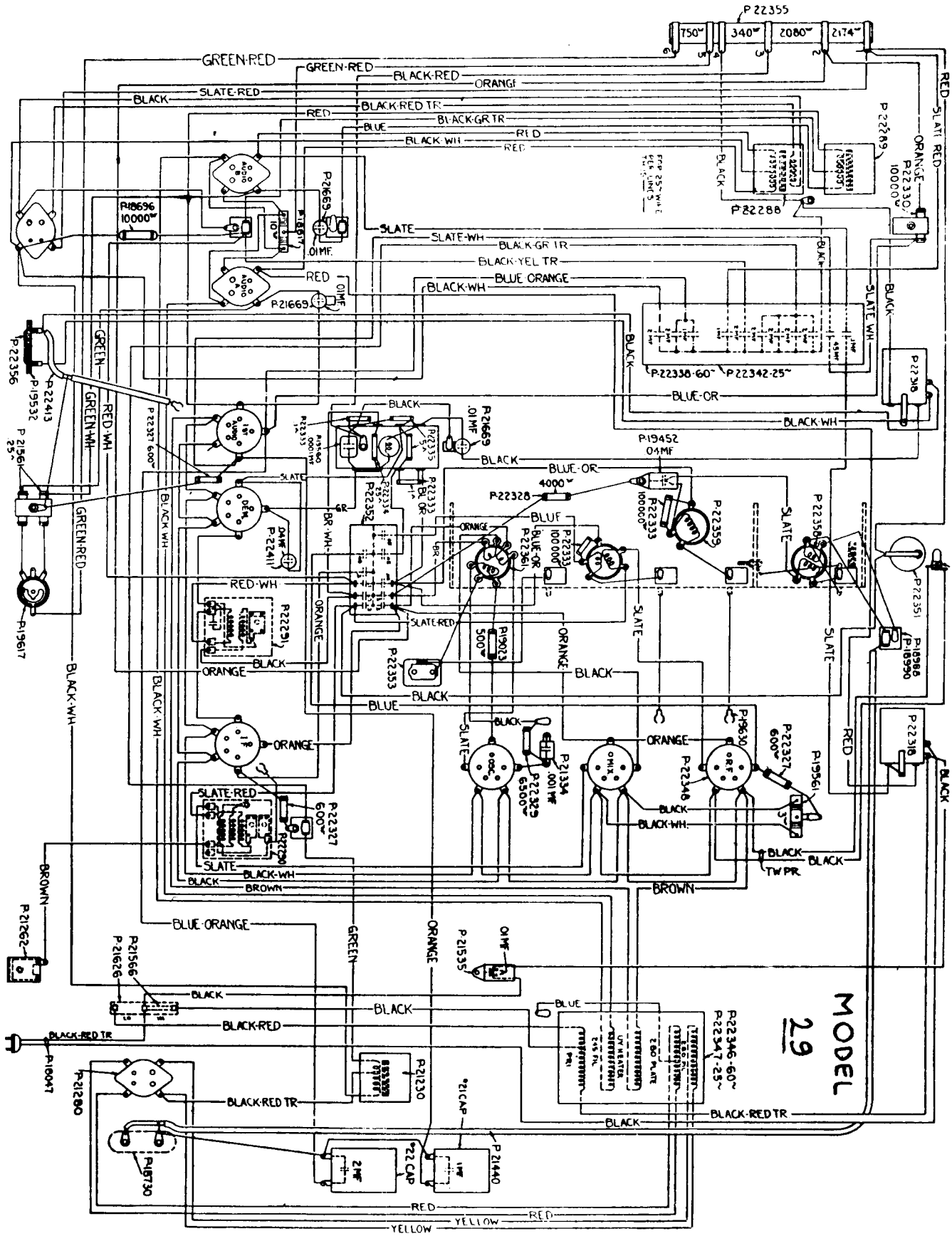
NOTE: OMIT WIRE AT 'A' AND REWIRE AS PER LINE AT 'B' FOR 25~ ONLY (12 B - 14 B)

STROMBERG-CARLSON TELEPHONE MFG. CO.

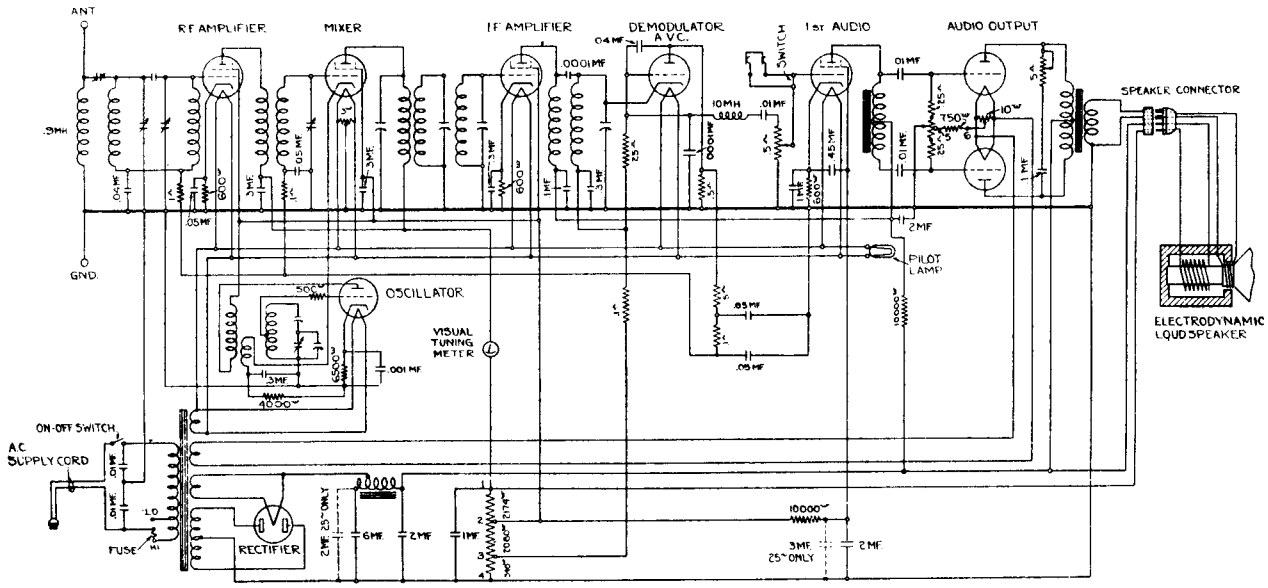
Schematic Circuit of No. 27 Superheterodyne Receiver



STROMBERG-CARLSON TELEPHONE MFG. CO.



STROMBERG-CARLSON TELEPHONE MFG. CO.



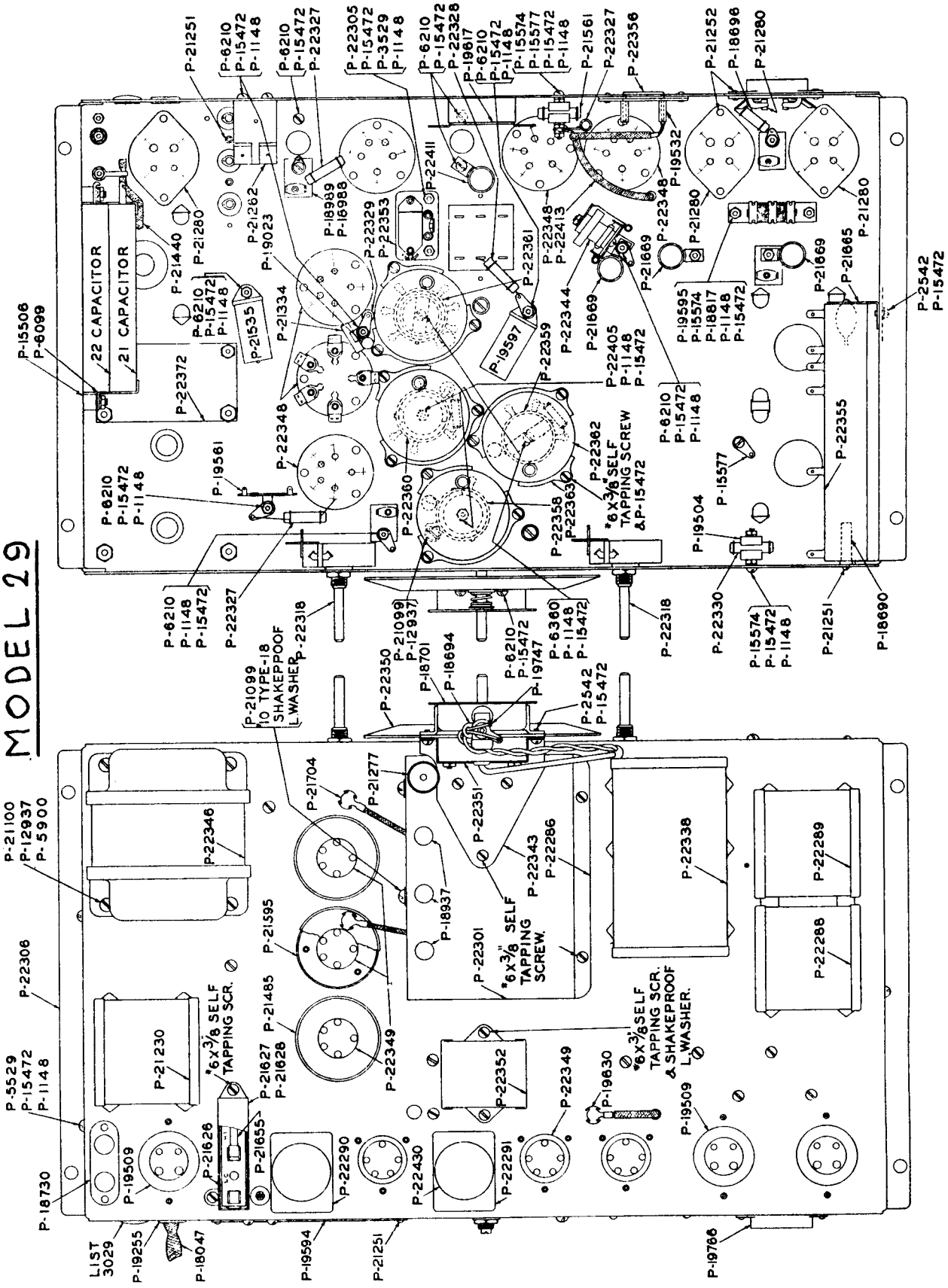
Schematic Circuit of No. 29 Receiver.

NORMAL VOLTAGE READINGS

These voltage readings correspond to a line voltage at 120 volts with the fuse in the "HI" position or 110 volts in the "LO" position. The fuse should be set in the proper position for the line voltage obtained before making measurements. **When voltages are measured proper allowance should be made for a difference in line voltage above or below 110 or 120 volts.** Be sure to make these readings with the Meter and Scale indicated, otherwise the results will not agree with those tabulated. Alternating voltages are indicated by italics.

Voltage	Meter	Scale	Where Measured	Approx. Value in Volts
Heater Voltages No. 227 and No. 235 Tubes	A. C.	0–4	Across Heater Terminals of Sockets	*2.48*
Filament Voltage No. 245 Tubes	A. C.	0–4	Across Filament of Audio Output Socket	*2.48*
Plate Voltage Radio Amplifiers	D. C.	0–250	Between Plate Terminal of R. F. Amplifier Socket (+) and Chassis Base	170
Plate Voltage Mixer Tube	D. C.	0–250	Between Plate Terminal of Mixer Socket (+) and Chassis Base (—)	170
Plate Voltage Oscillator Tube	D. C.	0–250	Between Plate Terminal of Oscillator Tube Socket (+) and Chassis Base (—)	87
Plate Voltage I. F. Tube	D. C.	0–250	Between Plate Terminal of First I. F. Socket (+) and Chassis Base (—)	220
Plate Voltage First Audio Tube	D. C.	0–250	Between Plate Terminal of First Audio Socket (+) and Chassis Base (—)	192
Plate Voltage Audio Output Tubes	D. C.	0–750	Between Plate Terminals of Audio Output Sockets (+) and Midtap 10-Ohm Resistor Midtap (—)	250
"C" Voltage R. F. Amplifier	D. C.	0–10	Between Cathode Terminal of R. F. Amplifier Socket (+) and Chassis Base (—)	3
"C" Voltage Mixer Tube	D. C.	0–10	Between Cathode Terminal of Mixer Socket (+) and Chassis Base (—)	8
"C" Voltage I. F. Amplifier	D. C.	0–10	Between Cathode Terminal I. F. Socket (+) and Chassis Base (—)	3
Grid Voltage Oscillator Tube	D. C.	0–250	Between Cathode Terminal of Oscillator Socket (+) and Chassis Base (—)	14–18
Plate Voltage Demodulator Tube	D. C.	0–250	Between Voltage Divider Terminal No. 3 (+) and Chassis Base (—)	12.5
Screen Voltages of R. F. Amplifier, Mixer, and I. F. Amplifier	D. C.	0–250	Between Screen Terminals on Sockets (+) and Chassis Base (—)	87
"B" Voltage R. F. Amplifier	D. C.	0–250	Between High Side Voltage Divider (+) and Chassis Base (—)	175
"B" Voltage I. F. Amplifier and First Audio Tube	D. C.	0–250	Between Midtap First Audio Transformer (+) and Chassis Base (—)	225
"B" Voltage Output Tubes	D. C.	0–750	Between Midtap on Output Transformer (+) and Chassis Base (—)	305
"C" Voltage First A. F. Tube	D. C.	0–10	Between Cathode of First A. F. Tube (+) and Chassis Base (—)	3
"C" Voltages Output Tubes	D. C.	0–250	Across 750-Ohm Biasing Resistor	50
Speaker Field Voltage	D. C.	0–250	Across Small Pins on Speaker Connector Socket	127.5
Plate Voltage A. C. Per Anode No. 280 Rectifier Tube	A. C.		Between Plate Terminals of No. 280 Rectifier Socket and Chassis Base	*340*
Filament Voltage No. 280 Rectifier Tube	A. C.	0–8	Between Filament Terminals of No. 280 Rectifier Socket	*4.9*

STROMBERG-CARLSON TELEPHONE MFG. CO.



U. S. RADIO AND TELEVISION CORP.

U. S. RADIO AND TELEVISION MODELS 99 AND 99X

Pentode (5-tube) Superheterodyne Receivers

Perhaps the most simplified commercial superheterodyne receiver as yet developed is the No. 99 chassis, a circuit of which is shown below.

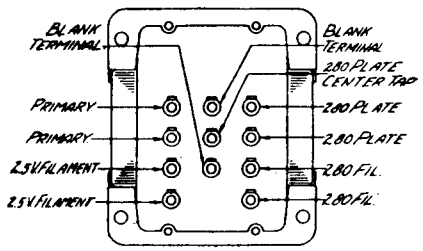
The design includes a combination oscillator and first-detector V1, using a type '24 screen-grid tube; an I.F. amplifier V2, using a type '35 variable-mu tube; a second-detector V3, using a type '24 screen-grid tube; a pentode power output tube V4; and the usual '80 rectifier V5. Note the absence of a separate oscillator tube. The intermediate frequency is 262 kc. A band-selector precedes the detector-oscillator.

A surge of energy fed into the secondary of the oscillator inductively causes this circuit to begin to oscillate at its resonant frequency, 262 kc. above the signal frequency. This oscillator frequency is fed back through the tap in the secondary coil into the grid circuit of the first-detector. There, the oscillating signal is amplified and fed inductively through the primary system in the plate circuit of the tube back into the secondary, thus sustaining the oscillations at the frequency to which the oscillator secondary circuit is tuned.

Operating voltages for this receiver are as follows: Filament potential, V1, V2, V3, V4, 2.25 volts; V5, 4.9 volts. Plate potential, V1, V2, 165 volts; V3, 128 volts; V4, 205 volts. Screen-grid potential, V1, V2, 65 volts; V3, 60 volts; V4, 225 volts. Plate current, V1, 1.3 ma.; V2, 6.4 ma.; V3, 0.22-ma; V4, 29 ma.; V5, 27 ma. per plate. Control-grid potential, V1, 4.5 to 5.25 volts; V2, 2.5 volts; V3, 6.5 volts; V4, 16 volts. Screen-grid current, V1, 0.4-ma.; V2, 1.5 ma.; V3, 0.05-ma.; V4, 8 ma. Cathode potential, V1, 4.5 to 5.25 volts; V2, 2.5 volts; V3, 6.5 volts.

Connections to the power transformer assembly are given in the illustration of this portion of the receiver.

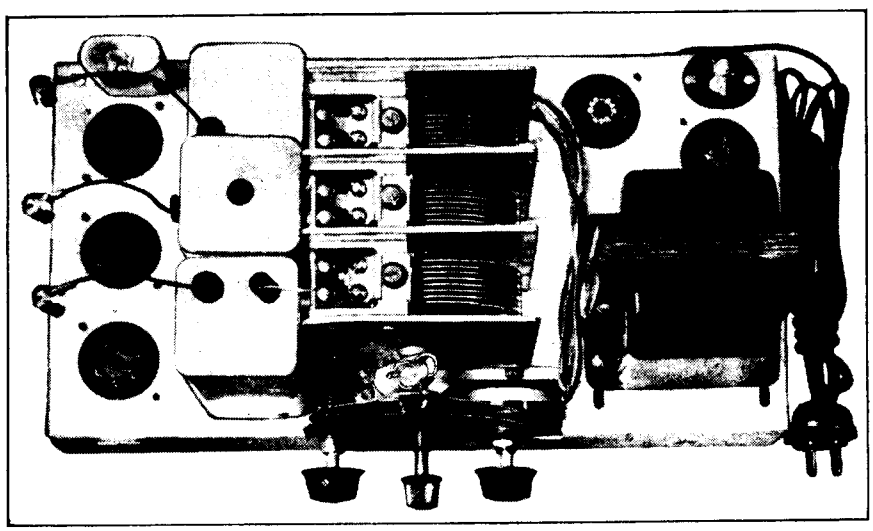
The bias voltage on the first-detector will vary, depending on the frequency to which the receiver is tuned. The voltage is the highest at the center of the dial and drops off at both ends. The reason for this change in bias voltage is due to the change in the oscillatory current with change of frequency setting.



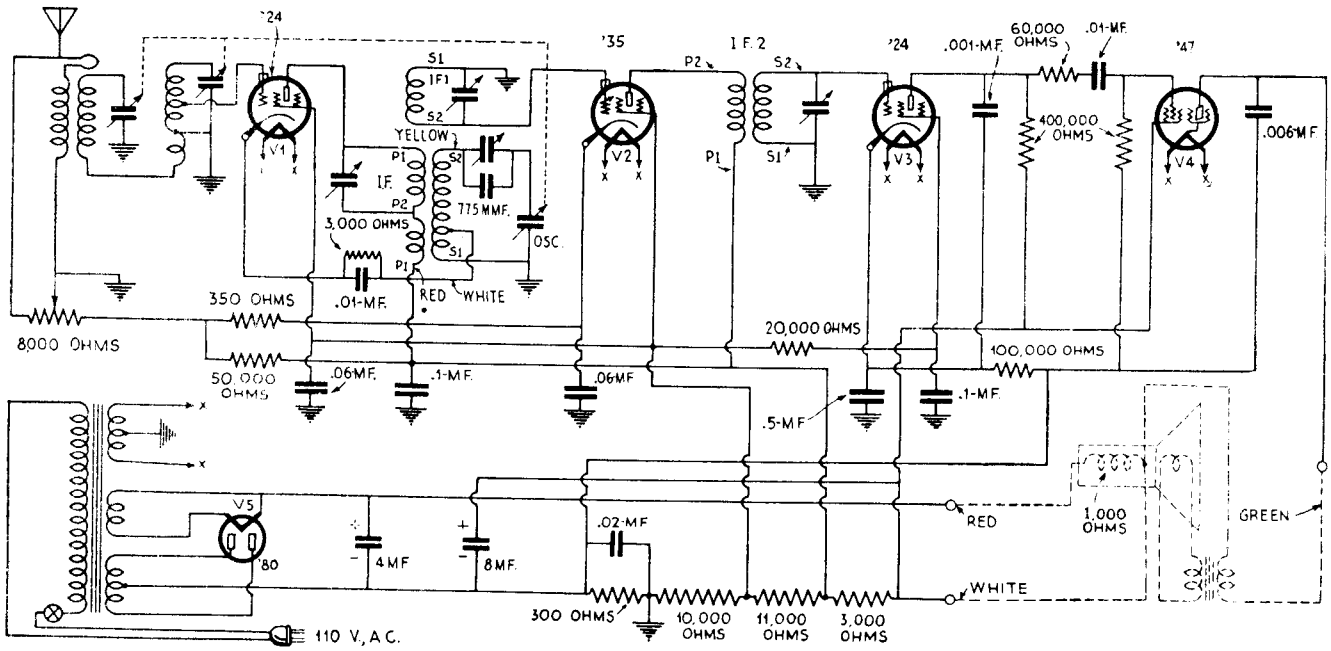
Power transformer terminal connections of the Model 99 Chassis.

All plate readings are measured with a 600,000 ohm meter. The second-detector screen-grid potential must also be read with a high-resistance meter owing to the resistance in this circuit. The pentode grid voltage cannot satisfactorily be read at the socket between the grid and filament owing to the high resistance in the grid circuit. This potential must be read across the 300-ohm section of the voltage divider resistor at which section the bias voltage for this tube is developed.

Should the circuit oscillate on being connected up, it may be due to type '35 or '24 tubes whose characteristics vary considerably from the standard. Also, check the ground connection; and note also the line potential.



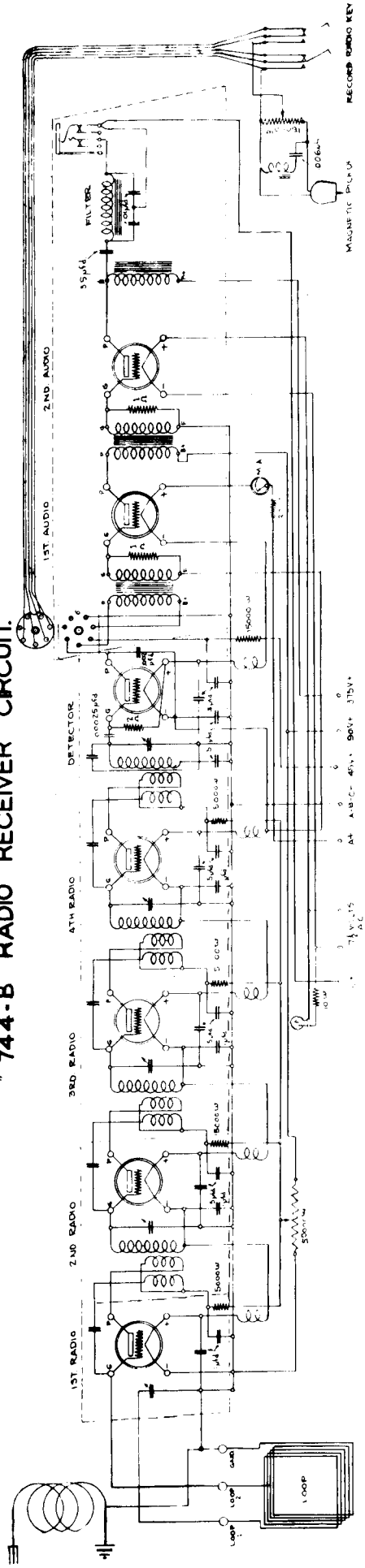
Parts arrangement on top of the Model 99 receiver chassis. To prevent circuit oscillation it is essential to keep all leads short and in correct location. For good operation, an important item is good tubes.

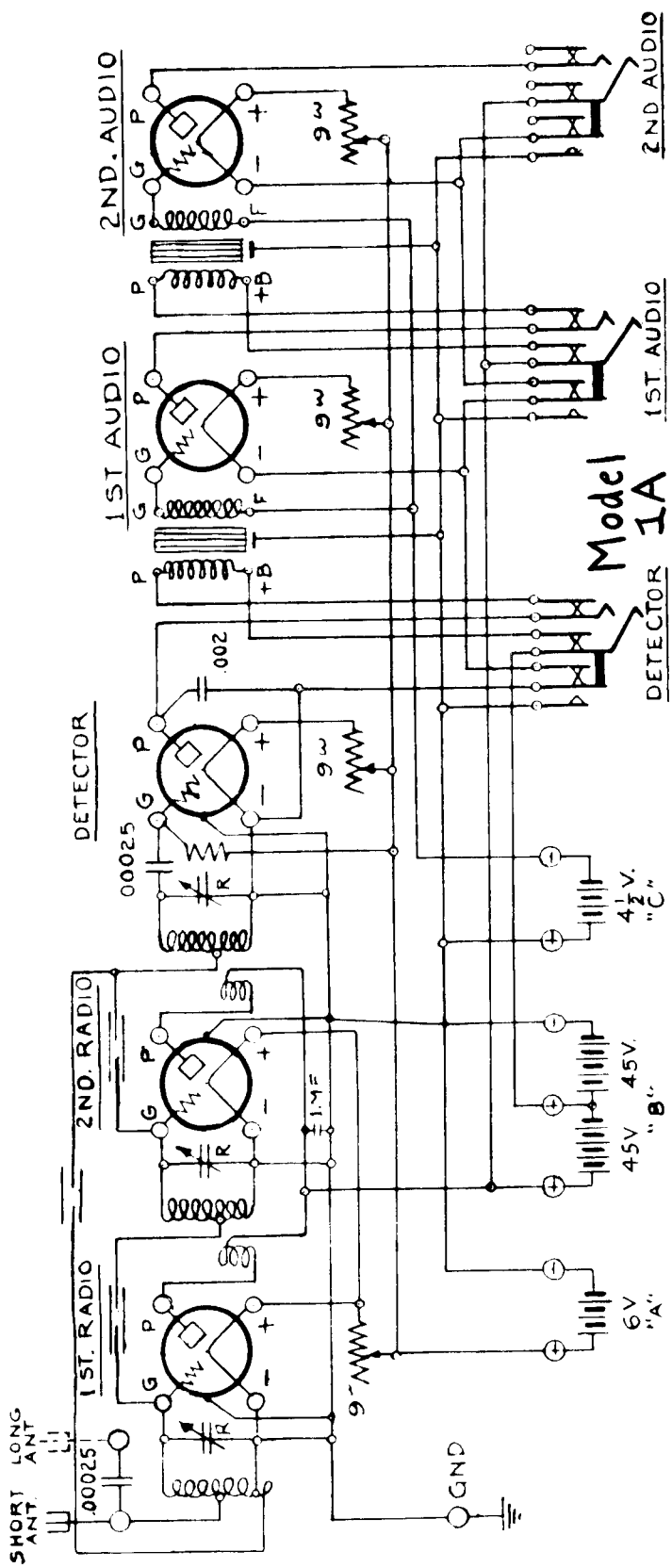


Schematic circuit of the Models 99 60-cycle, and 99X 25-cycle superheterodyne receivers. A band-selector precedes the first-detector-oscillator, V1. The signal frequency settings of the service oscillator must be accurately known, as the dial is calibrated to read directly in broadcast band frequencies.

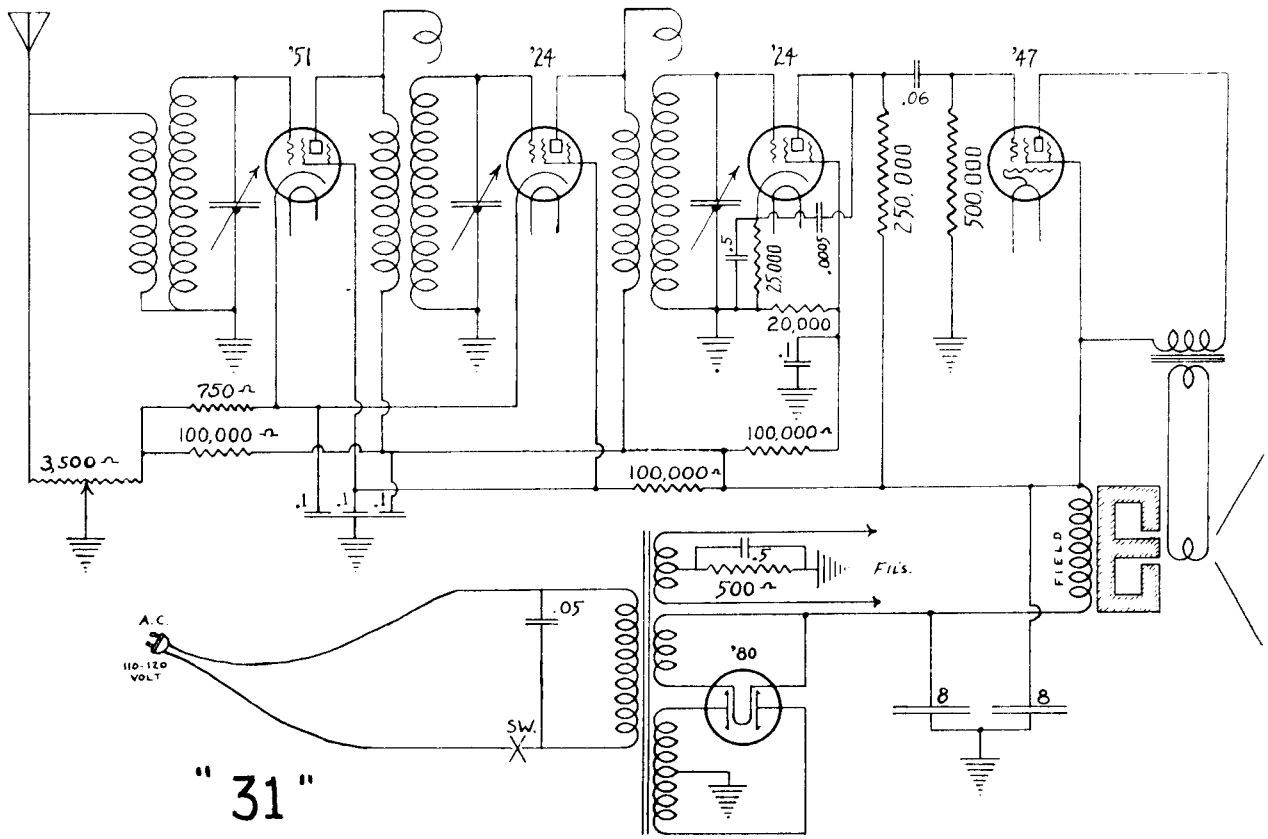
STROMBERG-CARLSON MFG. CO.

#744-B RADIO RECEIVER CIRCUIT.





STUDEBAKER LABORATORIES



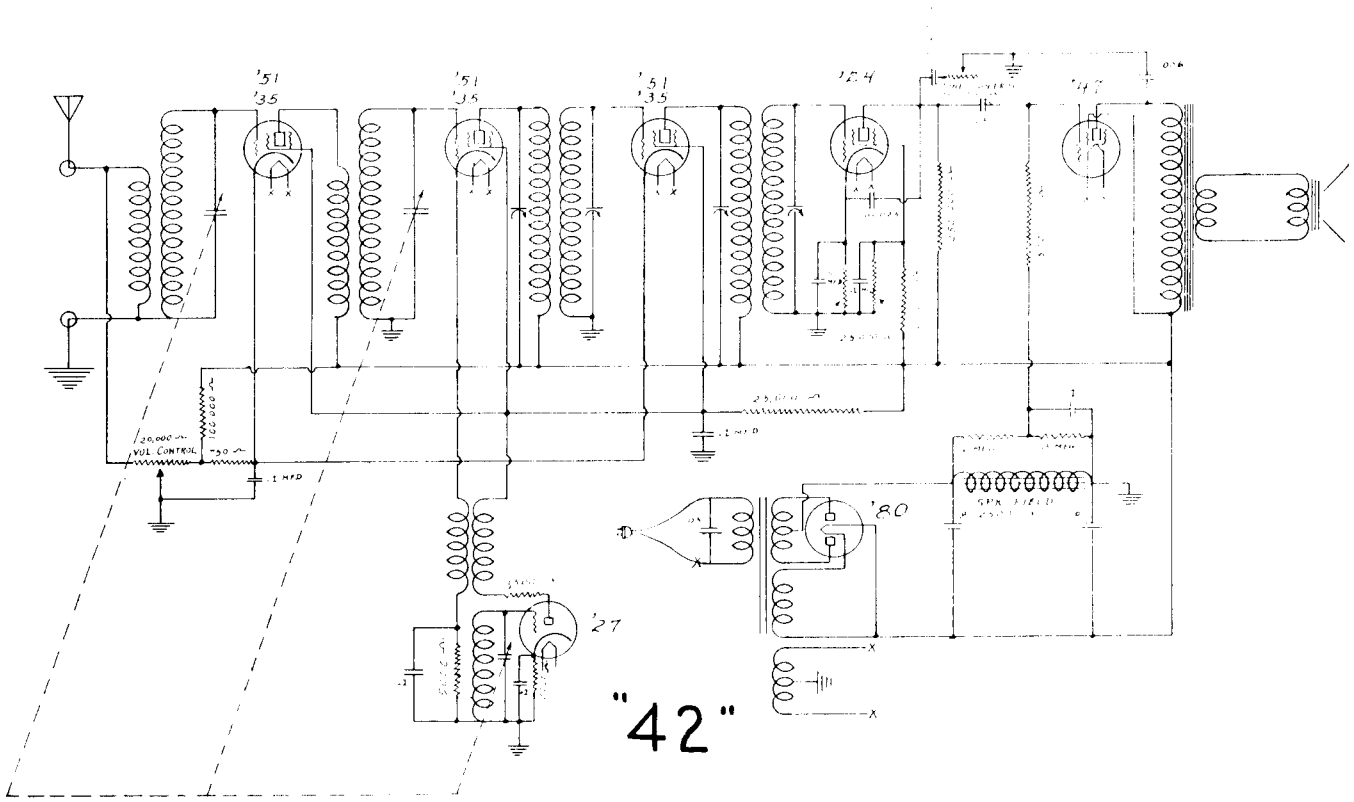
Tube	Fil.	Plate	Screen	Bias "On"	Bias "Off"
1st. R. F.	2.5	185	88	5	16
2nd R. F.	2.5	176	89	5	16
Det.	2.5	120*	32	4*	4
Pentode	2.5	192	208	16	16
Rect.	5.0	.....	.....	....	....

*Voltages not easily measured with Customary test kit.

Parts List

No	Name
P100	Coils (Set 3 matched)
P101	Condenser (3 gang, tuning)
P102	" (By Pass bank)
P103	" (.06 Coupling)
P104	" (.0005 By Pass)
P105	" (.05 Line)
P106	" (8 Mfd. Filter)
P107	Dial Plate
P108	Knobs
P109	Pilot Lamp
P110	Posts (Ant. and Grd.)
P111	Resistor (100,000 & 50,000)
P112	Resistor (20,000 & 500,000)
P113	" (100,000 & 250,000)
P114	" (25,000 & 500)
P115	" (100,000)
P116	" (750)
P117	Socket (551)
P118	" (224)
P119	" (247 Pent)
P120	" (280)
P121	Speaker
P122	Transformer (Power)
P123	Volume Control and Switch

STUDEBAKER LABORATORIES



Tube	Type	Fil. Ac.	Plate	Screen	Bias.
Radio frequency	551	2.45	235	75	6 to 45
1st Detector	551	2.50	235	75	10
Int. Frequency	551	2.45	235	75	6 to 45
2nd Detector	224	2.45	75	40	4
Power Output	247	2.40	225	235	16*
Oscillator	227	2.5	75	....	10

*Effective voltage.

Parts List

S400 Coils—Set matched with Shields

S401 Condenser—Tuning.
S402 " 1 Mfd. 200 volt.
S403 " 1 Mfd. 400 volt.
S404 " .5 Mfd.
S405 " .05 Mfd.
S406 " .006 Mfd.
S407 " .00025 Mfd.
S408 " 8.0 Mfd. filter.
S409 " Insulating washers for 8.0 Mfd.

S410 Cord—A. C. Cord and Plug.

S411 Dial—Dial assembly with scale.

S412 Pilot Lamp—Lamp only.

S413 Resistors—Variable, tone control 500,000.
S414 " Variable, volume control 20,000
S415 " 6 Meg. graphite
S416 Resistors—1.5 Meg. graphite
S417 " 500,000 Ohm. "
S418 " 250,000 " "
S419 " 100,000 " "
S420 " 25,000 " " (1½ watt)
S421 " 5,000 " "
S422 " 2,000 " "
S423 " 1,500 " "

S424 Shields—Tube shield tops
S425 " Tube shield complete

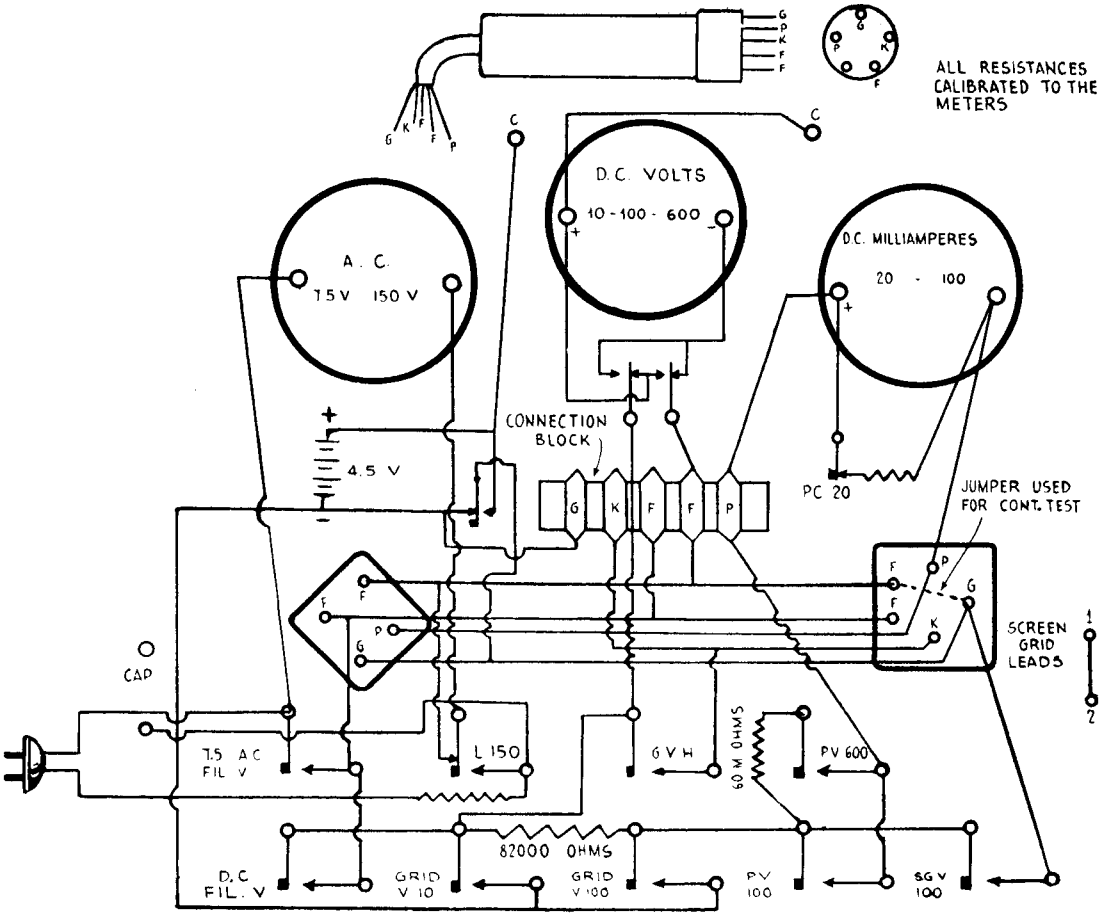
S426 Sockets—Type 551
S427 " Type 224
S428 " Type 247
S429 " Type 227
S430 " Type 280

S431 Speaker—Pentode speaker

S432 Transformers—Power transformer
S433 " Intermediate frequency transformer

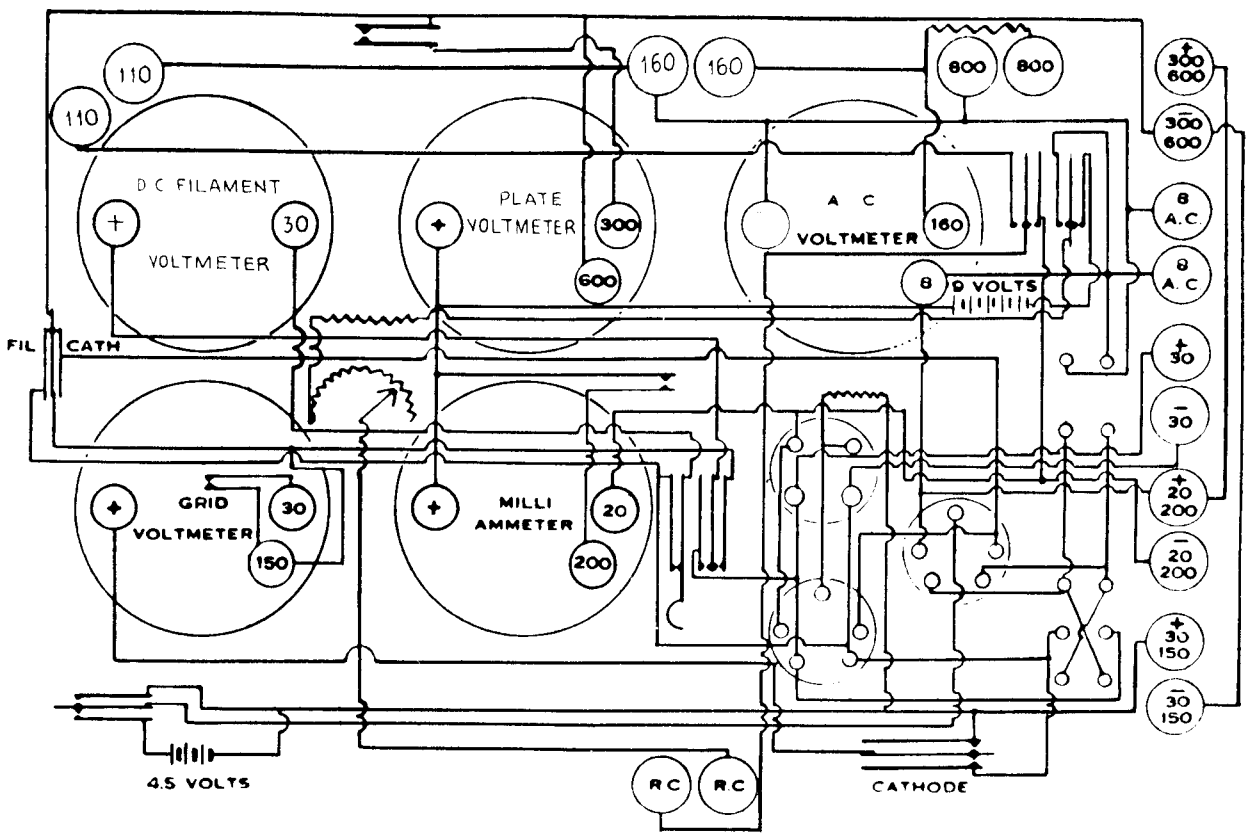
TEST EQUIPMENT SECTION

BEEDE ELECTRICAL INSTRUMENT CO.



Beede "Preston" 1931 Model

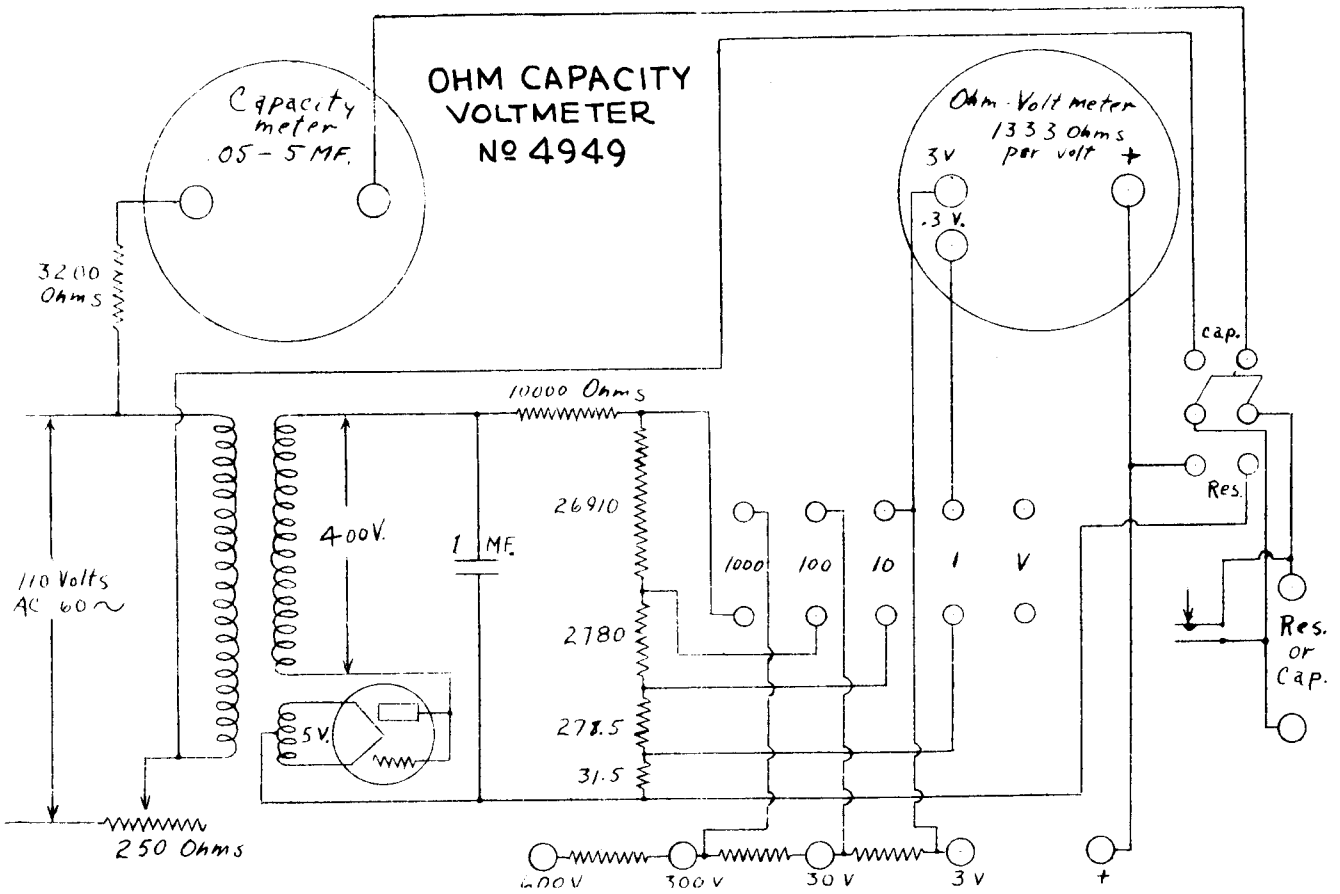
HICKOK ELECTRICAL INSTRUMENT CO.



Hickok "Model SG-4700"

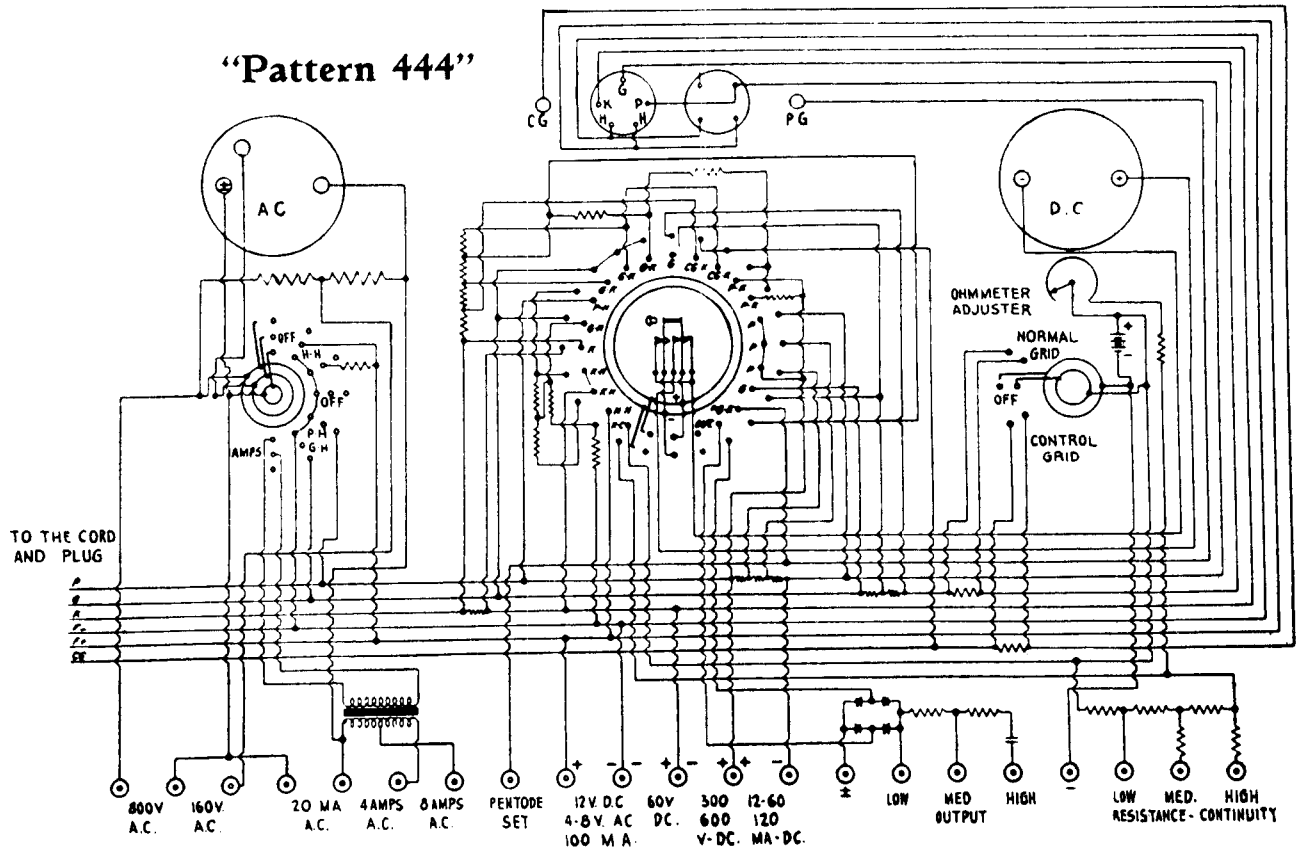
TEST EQUIPMENT SECTION

HICKOK ELECTRICAL INSTRUMENT CO.



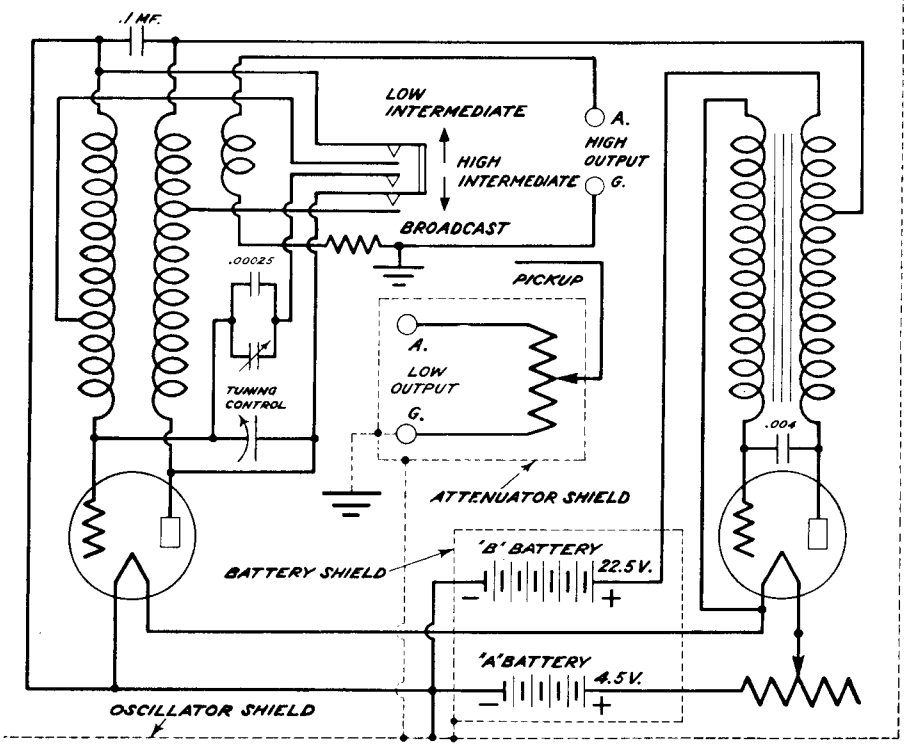
JEWELL ELECTRICAL INSTRUMENT CO.

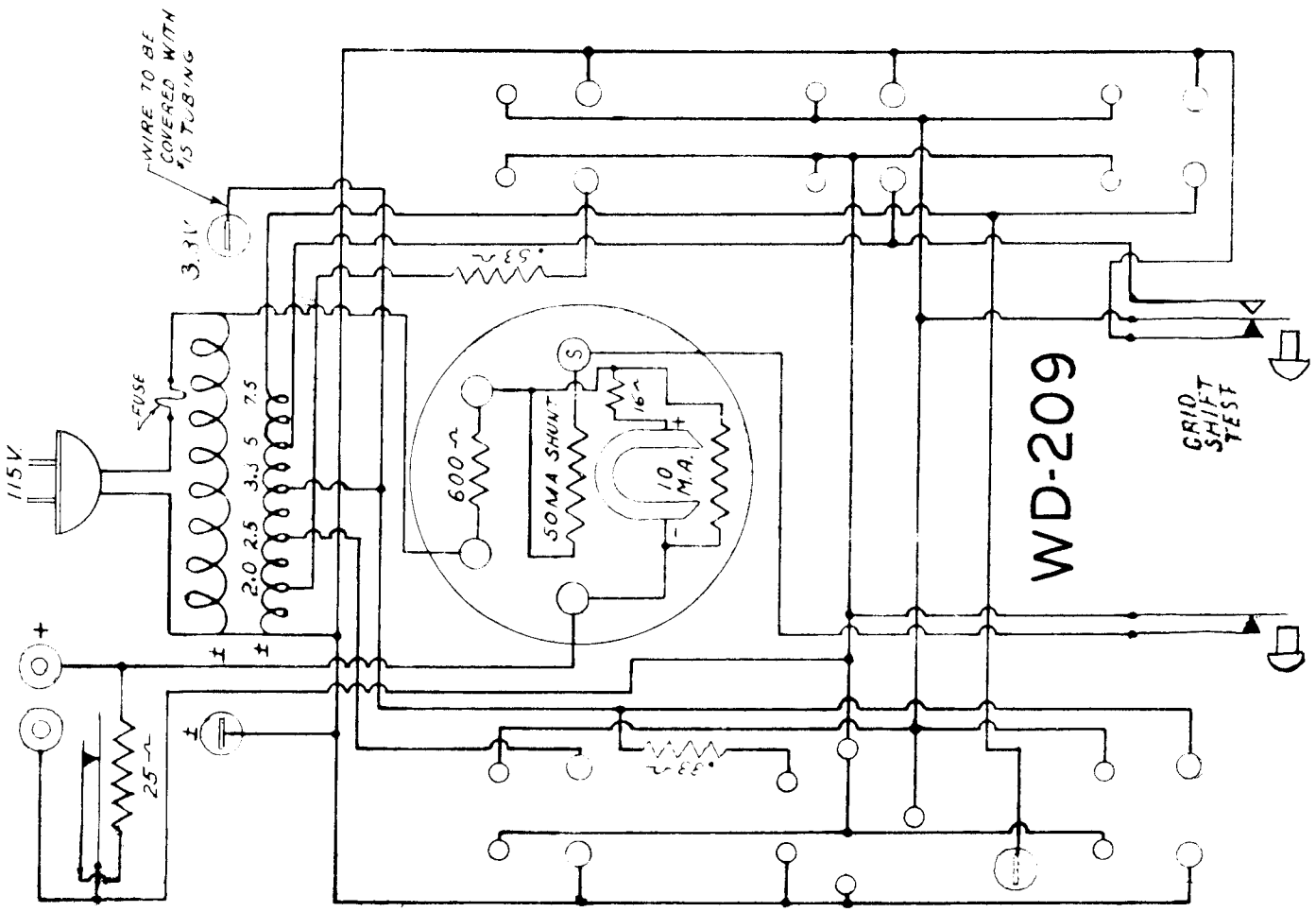
"Pattern 444"



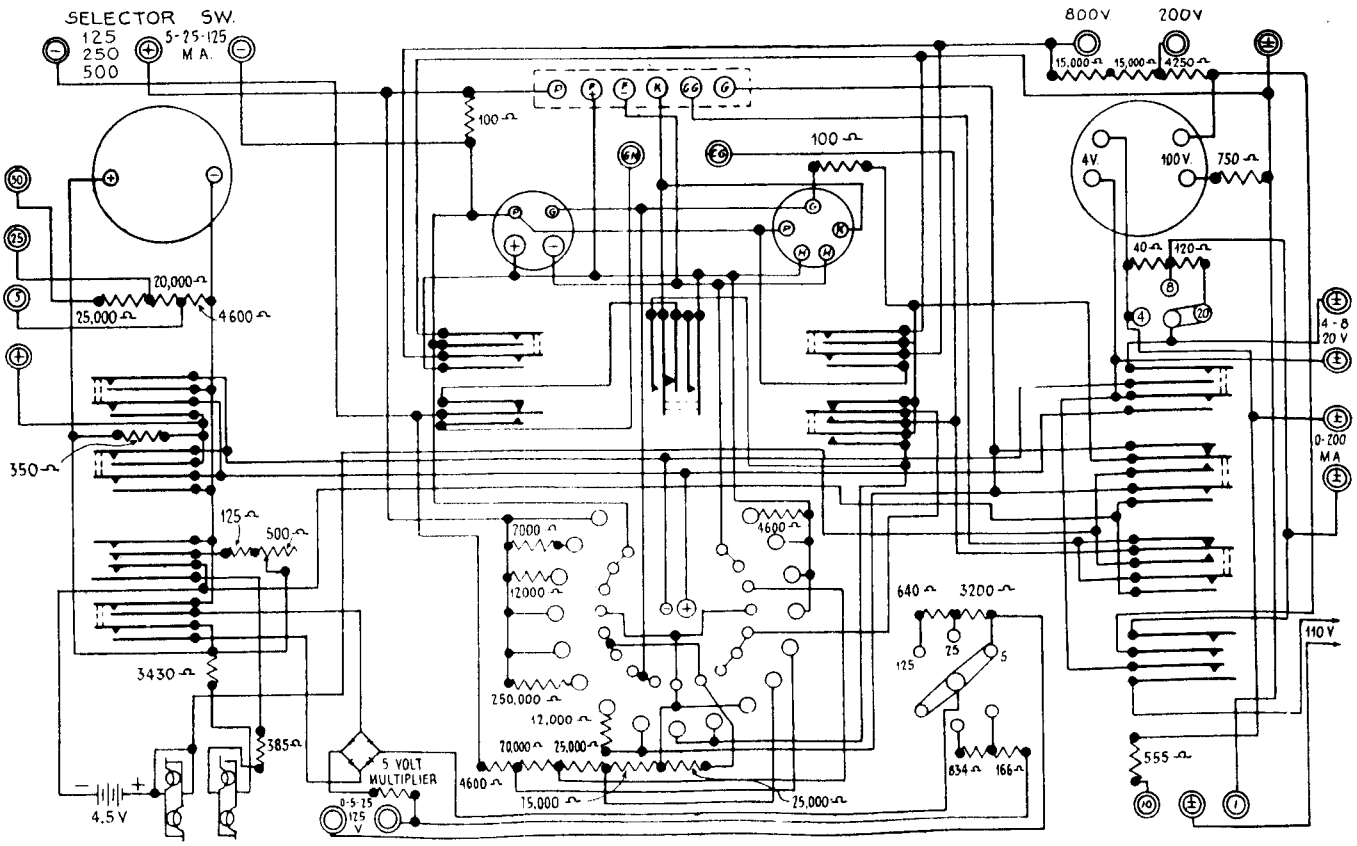
TEST EQUIPMENT SECTION
JEWELL ELECTRICAL INSTRUMENT CO.

PATTERN 560 OSCILLATOR—SCHEMATIC WIRING DIAGRAM.

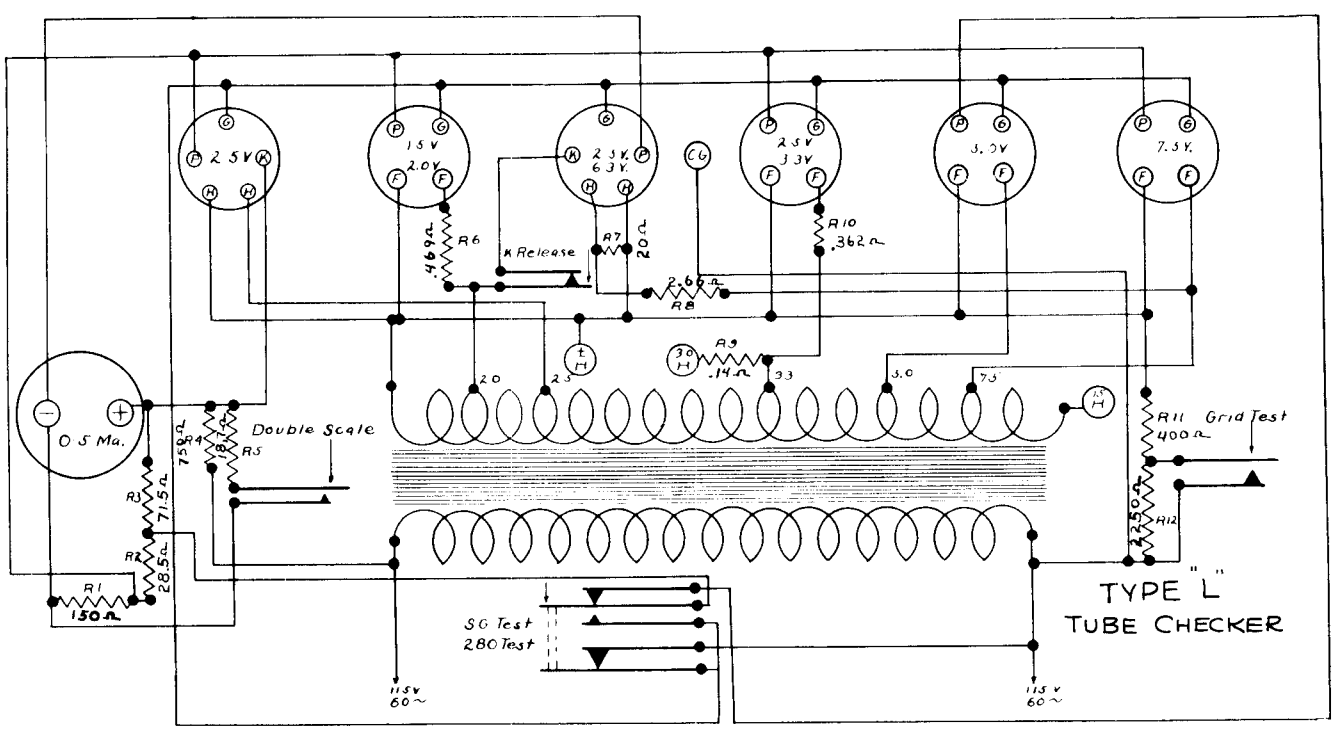




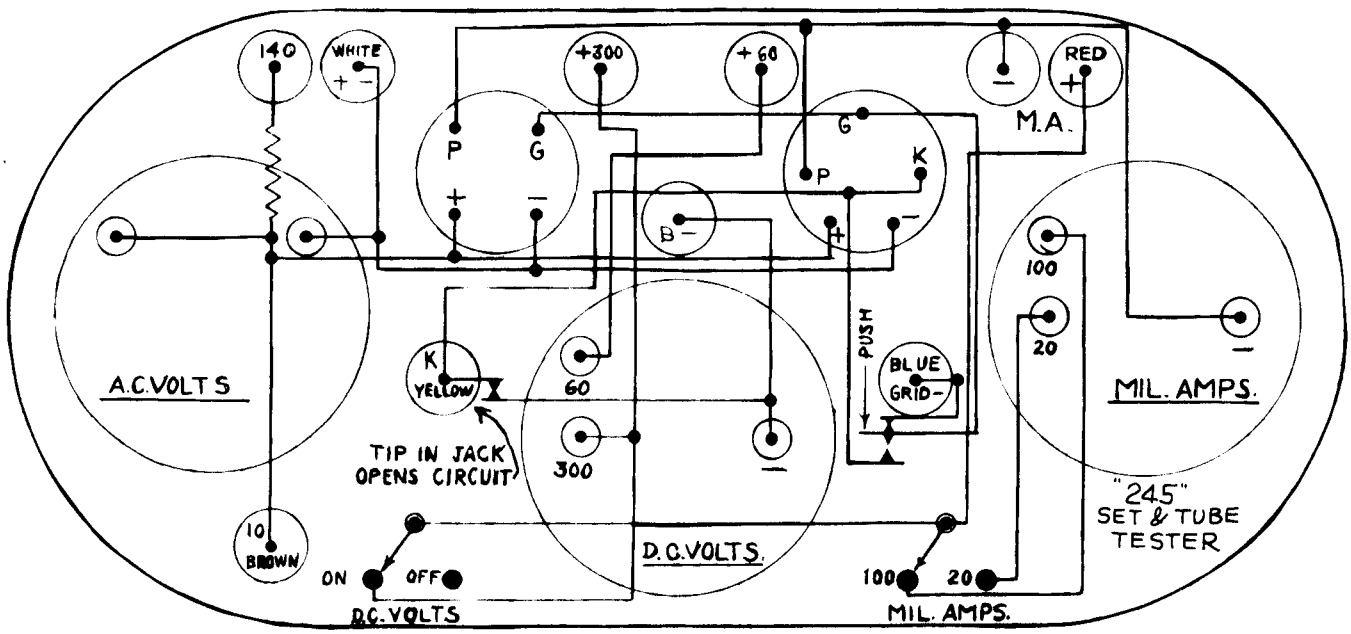
TEST EQUIPMENT SECTION
RADIO PRODUCTS CO., INC.

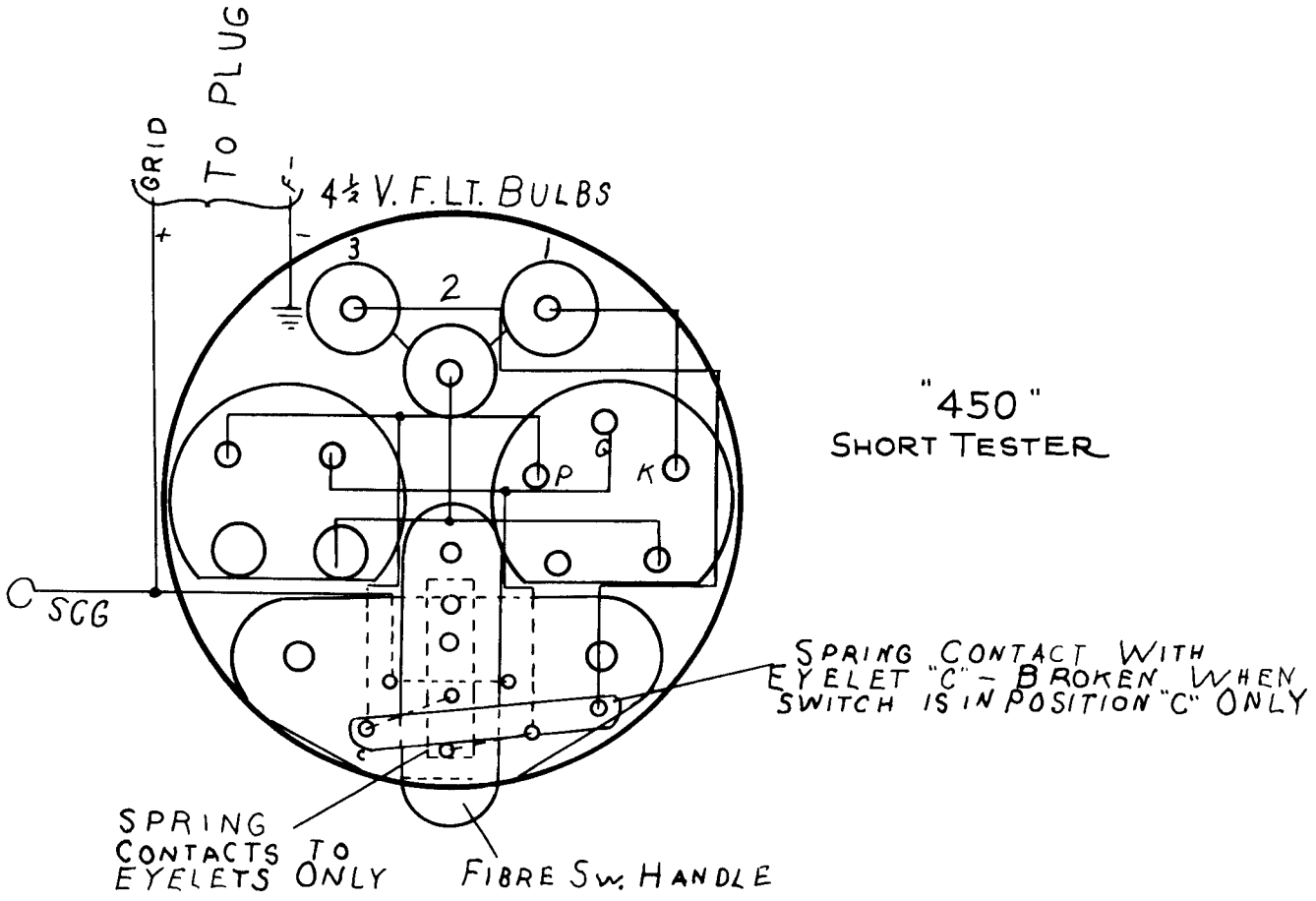


"TYPE 880"



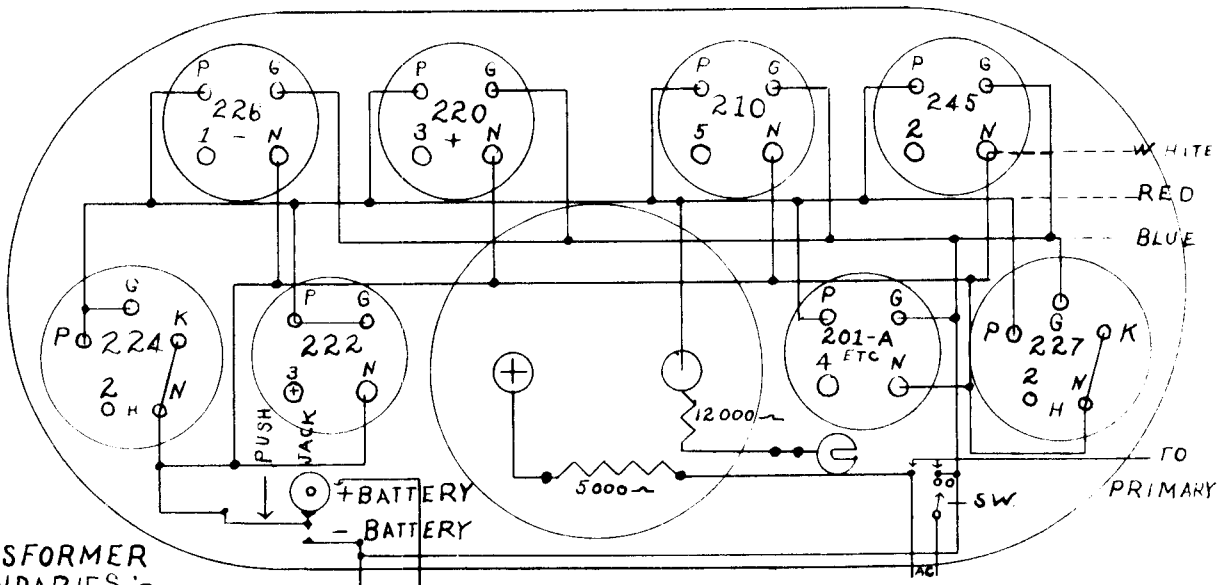
TEST EQUIPMENT SECTION
READRITE METER WORKS





"450"
SHORT TESTER

TEST EQUIPMENT SECTION
READRITE METER WORKS

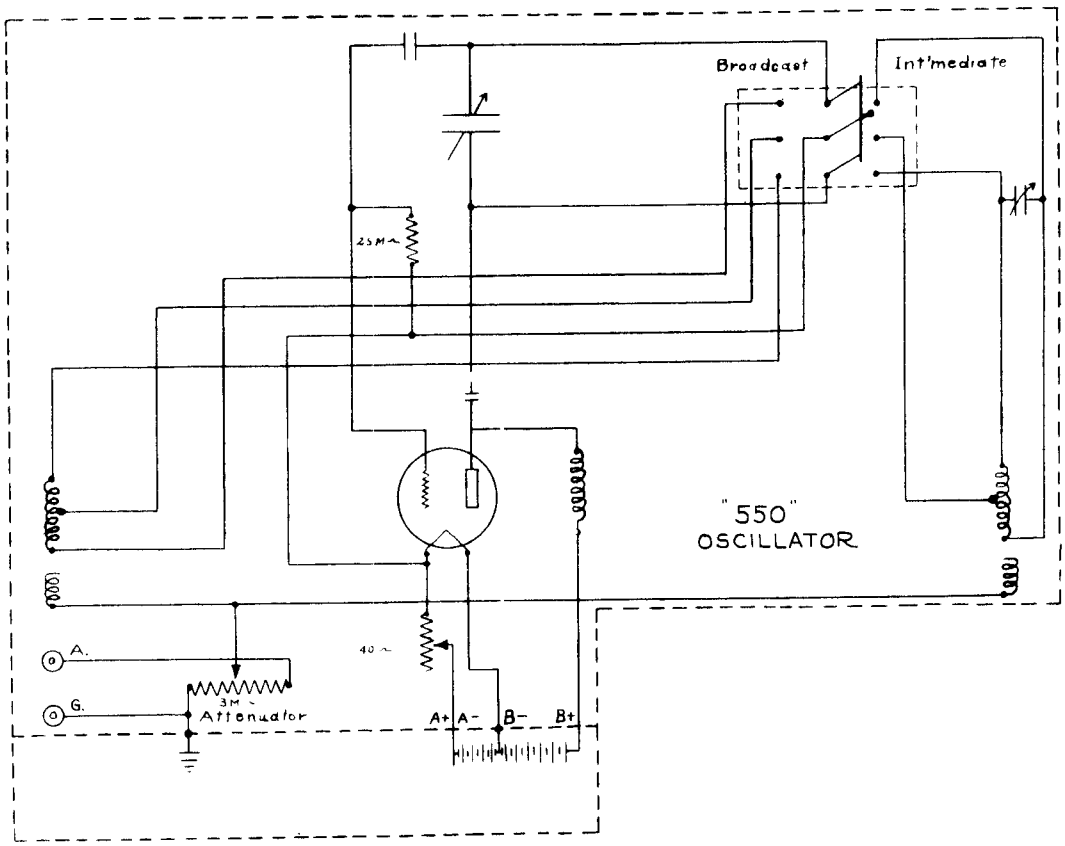


TRANSFORMER SECONDARIES:-
N = NEUTRAL
1 = FIRST FROM NEUTRAL -1.5 -V.
2 = SECOND " " -2.5 -V.
3 = THIRD " " -3.3 -V.
4 = FOURTH " " -5 -V.
5 = FIFTH " " -7.5 -V.

TO TEST BATTERY:-
CONNECT {S-G WIRE TO CENTER 226 SOCKET
NEG(-) FIL. TO CENTER 220 SOCKET

LEADS TO BATTERY

"400" TUBE TESTER



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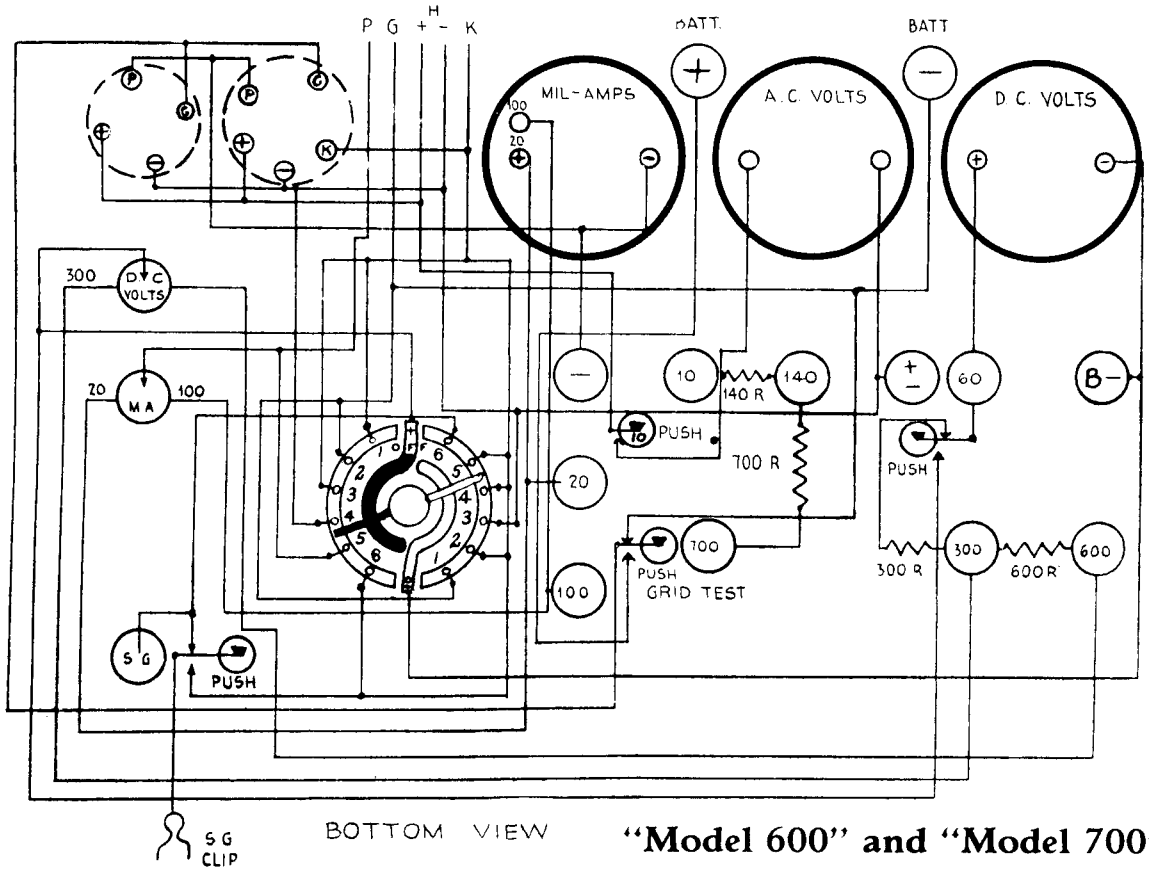
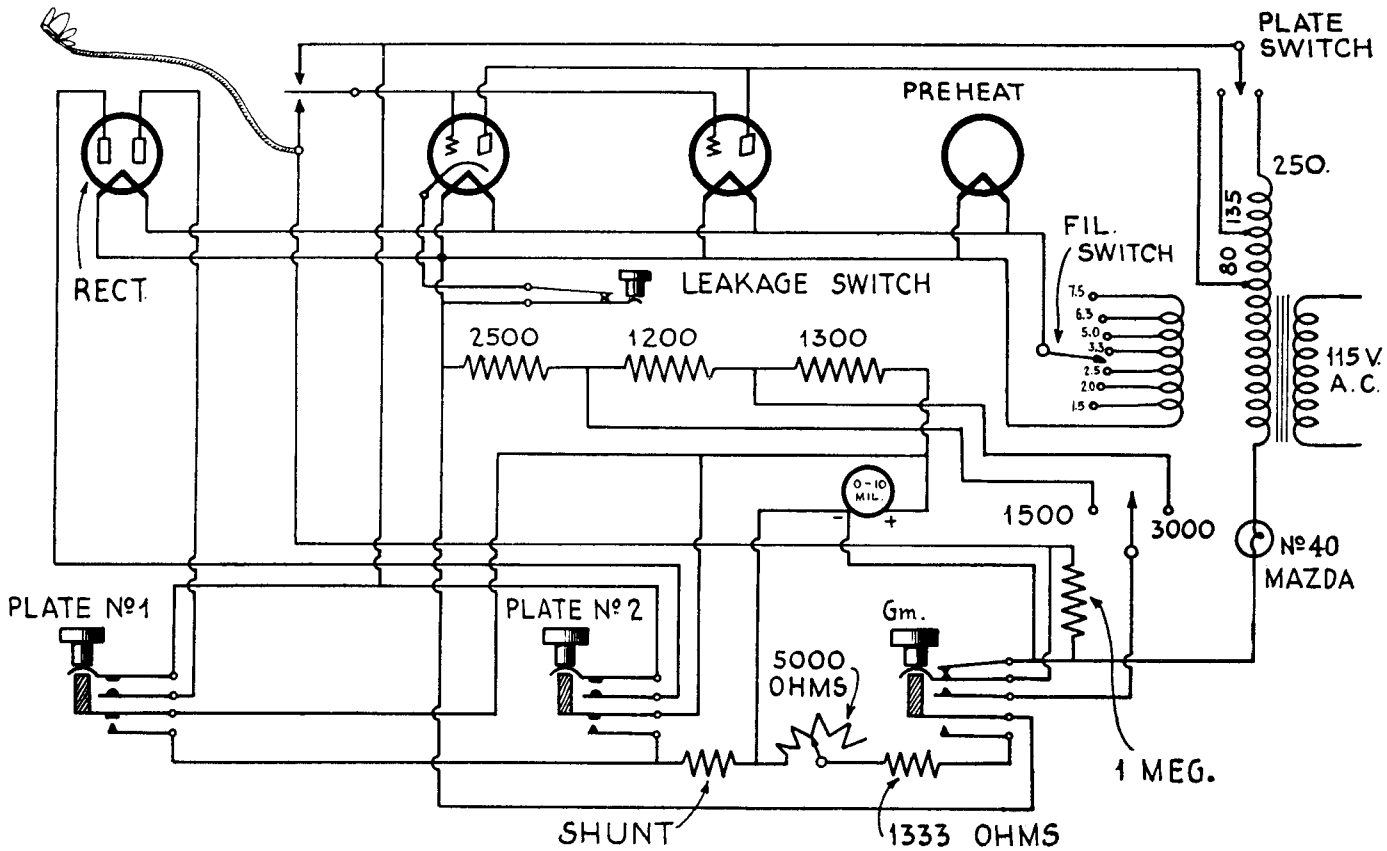
READRITE METER WORKS



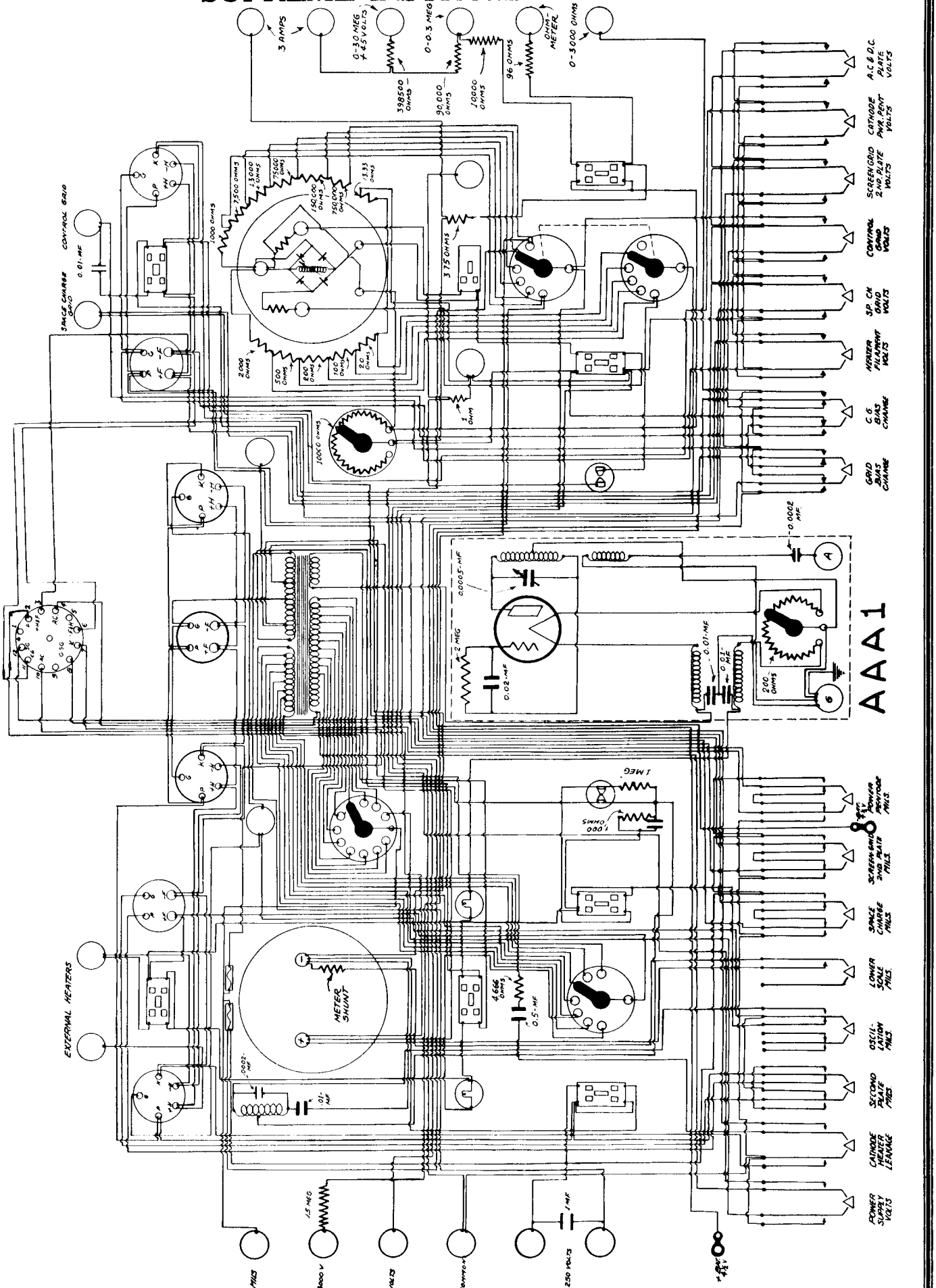
"Model 600" and "Model 700"

STERLING MFG. CO.

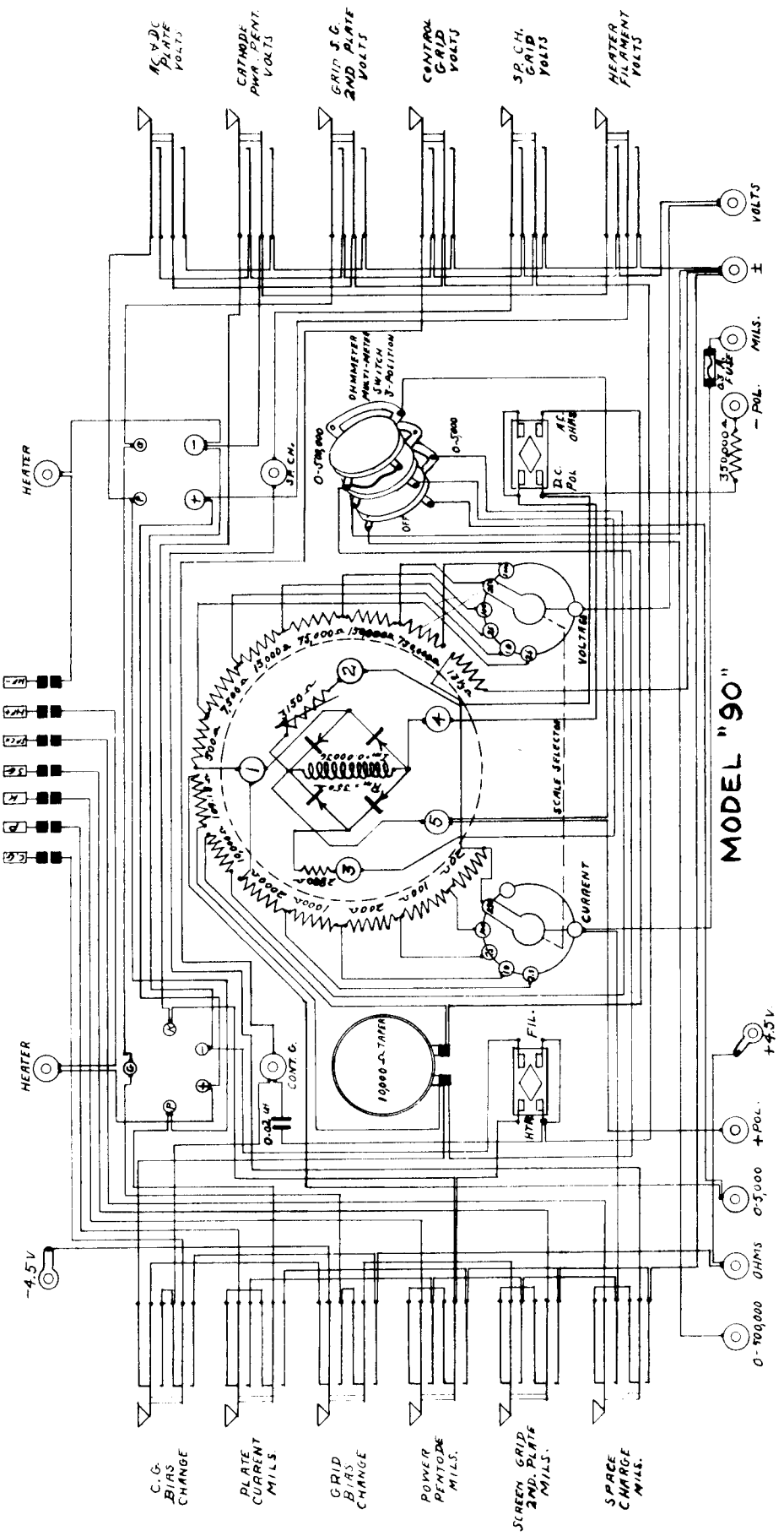


"R-517" Mutual Conductance Meter

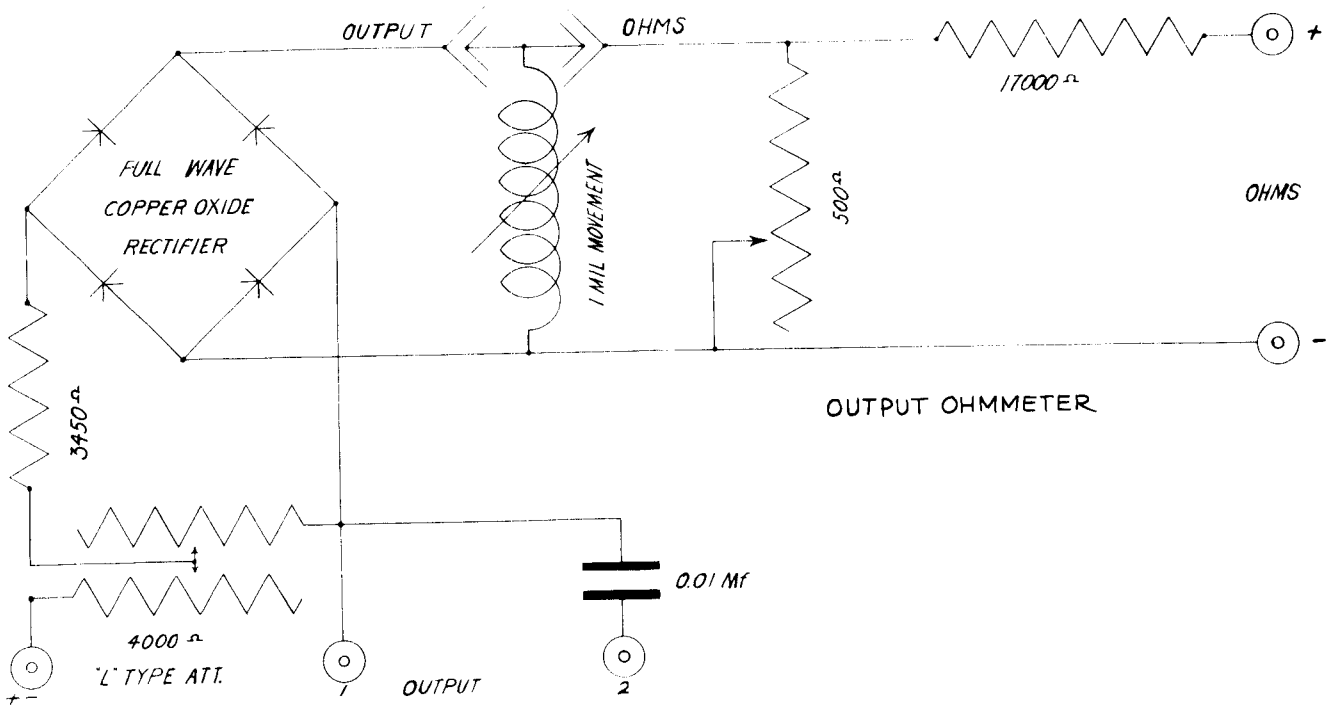
TEST EQUIPMENT SECTION
SUPREME INSTRUMENT CORP.

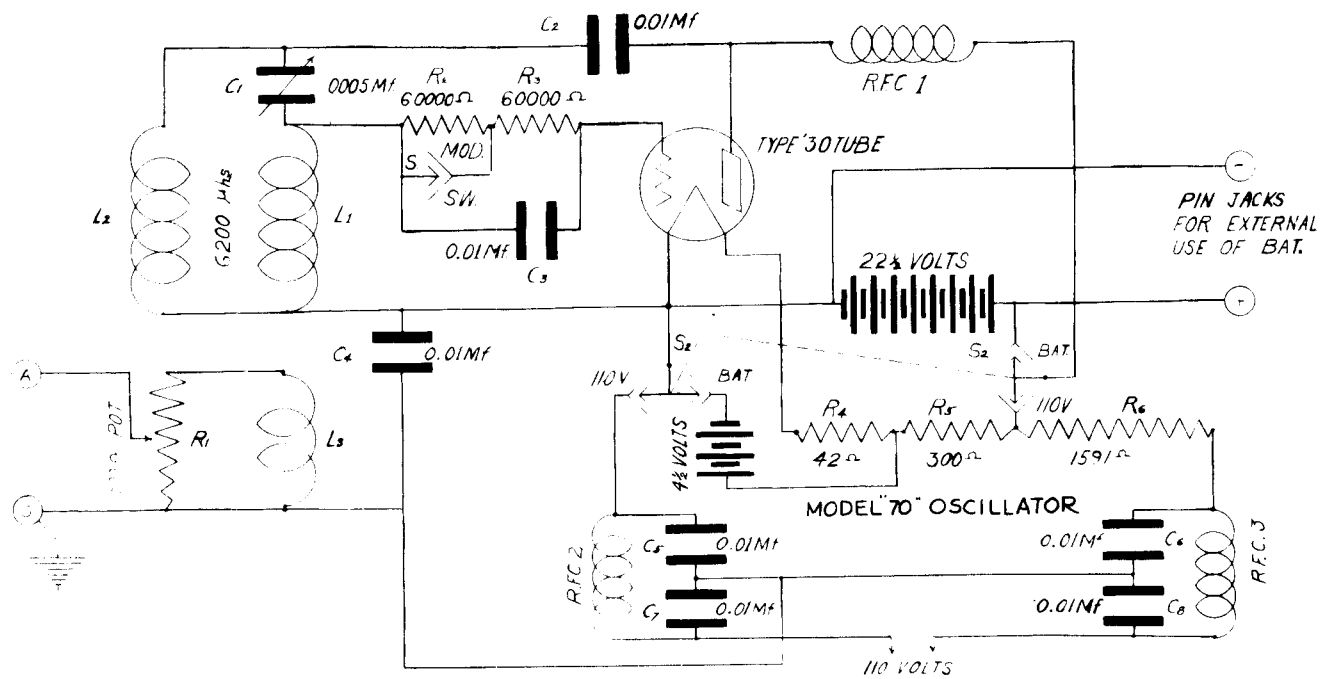


TEST EQUIPMENT SECTION
SUPREME INSTRUMENT CORP.

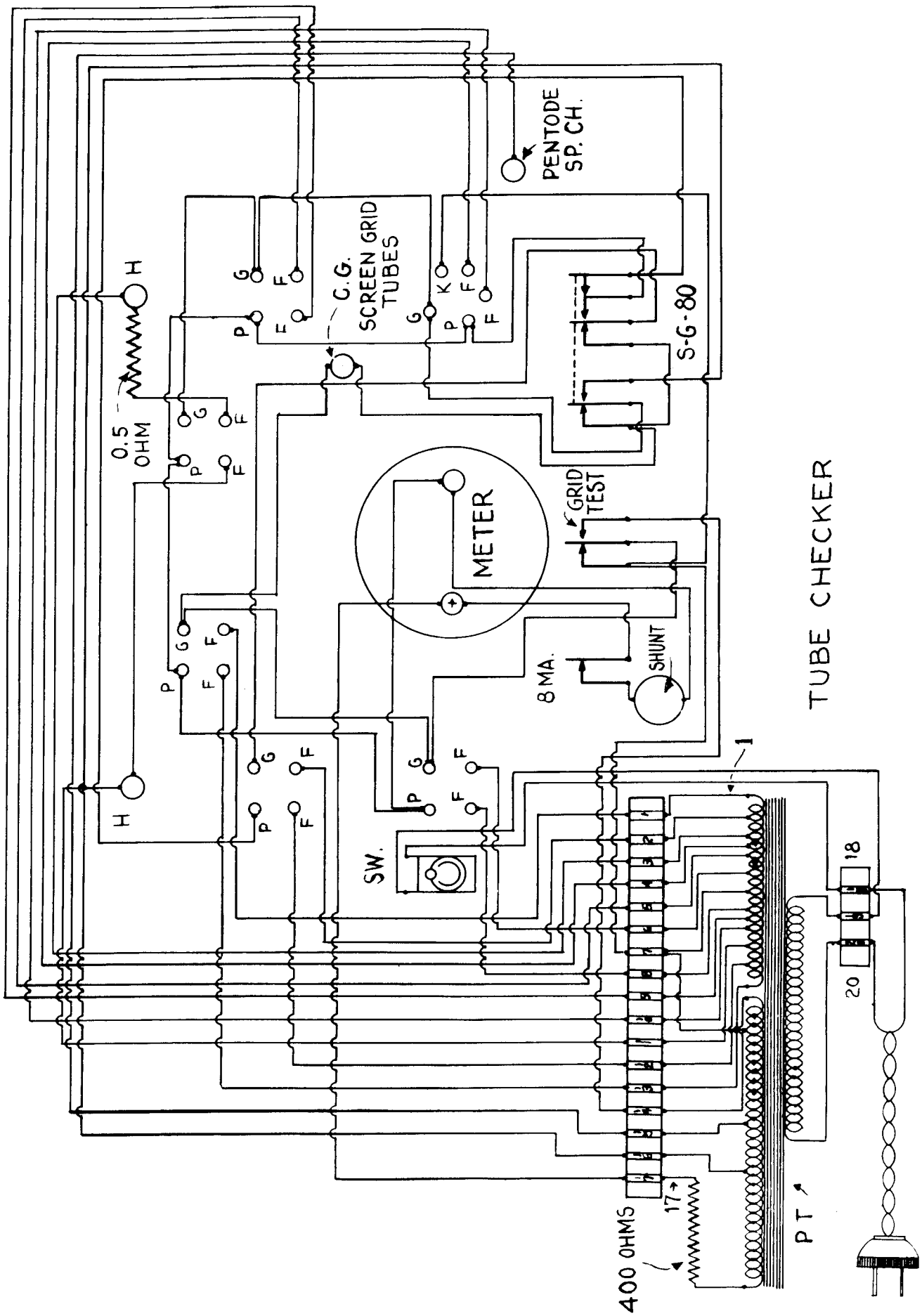


TEST EQUIPMENT SECTION
SUPREME INSTRUMENT CORP.



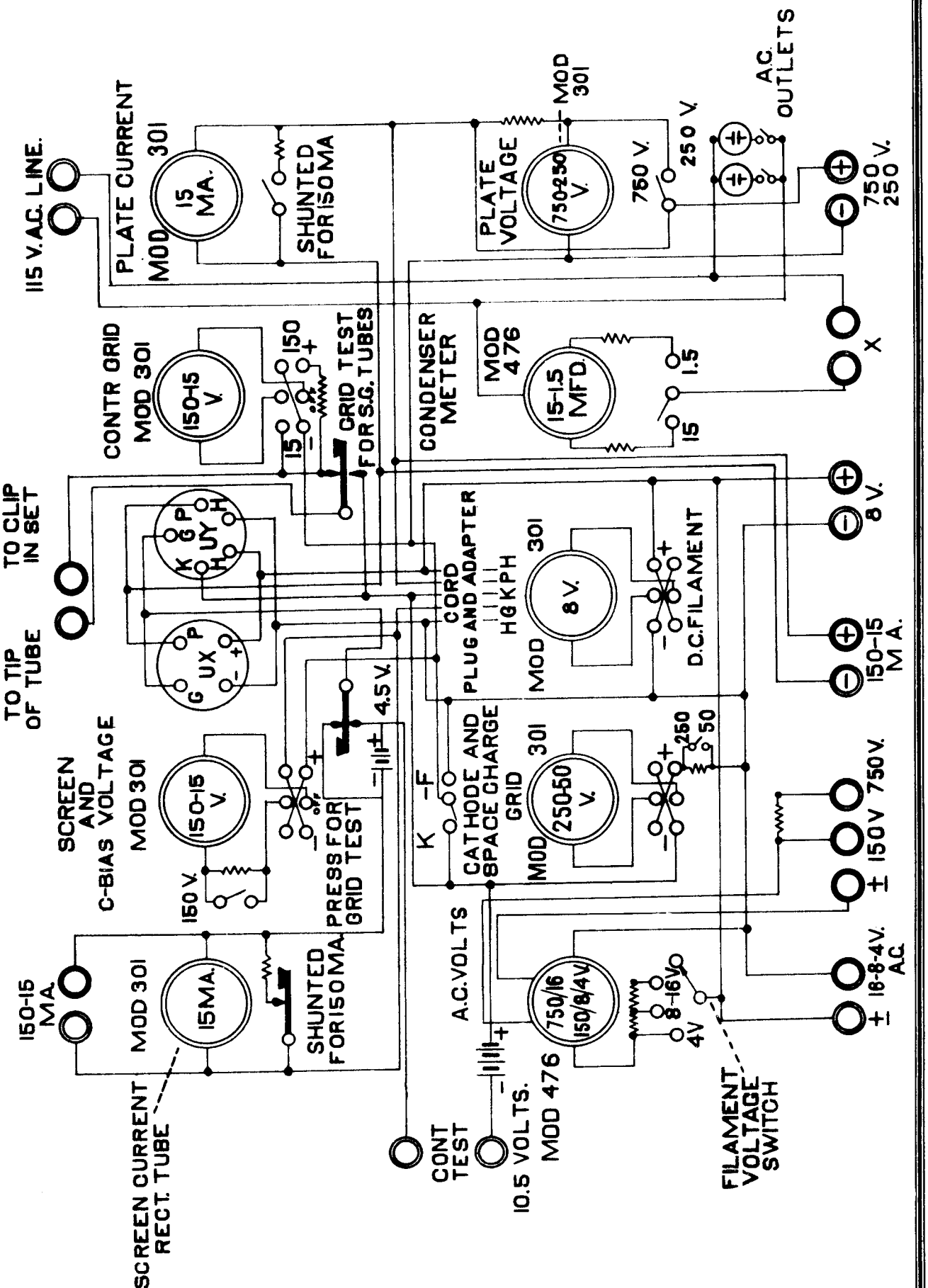


TEST EQUIPMENT SECTION
SUPREME INSTRUMENT CORP.

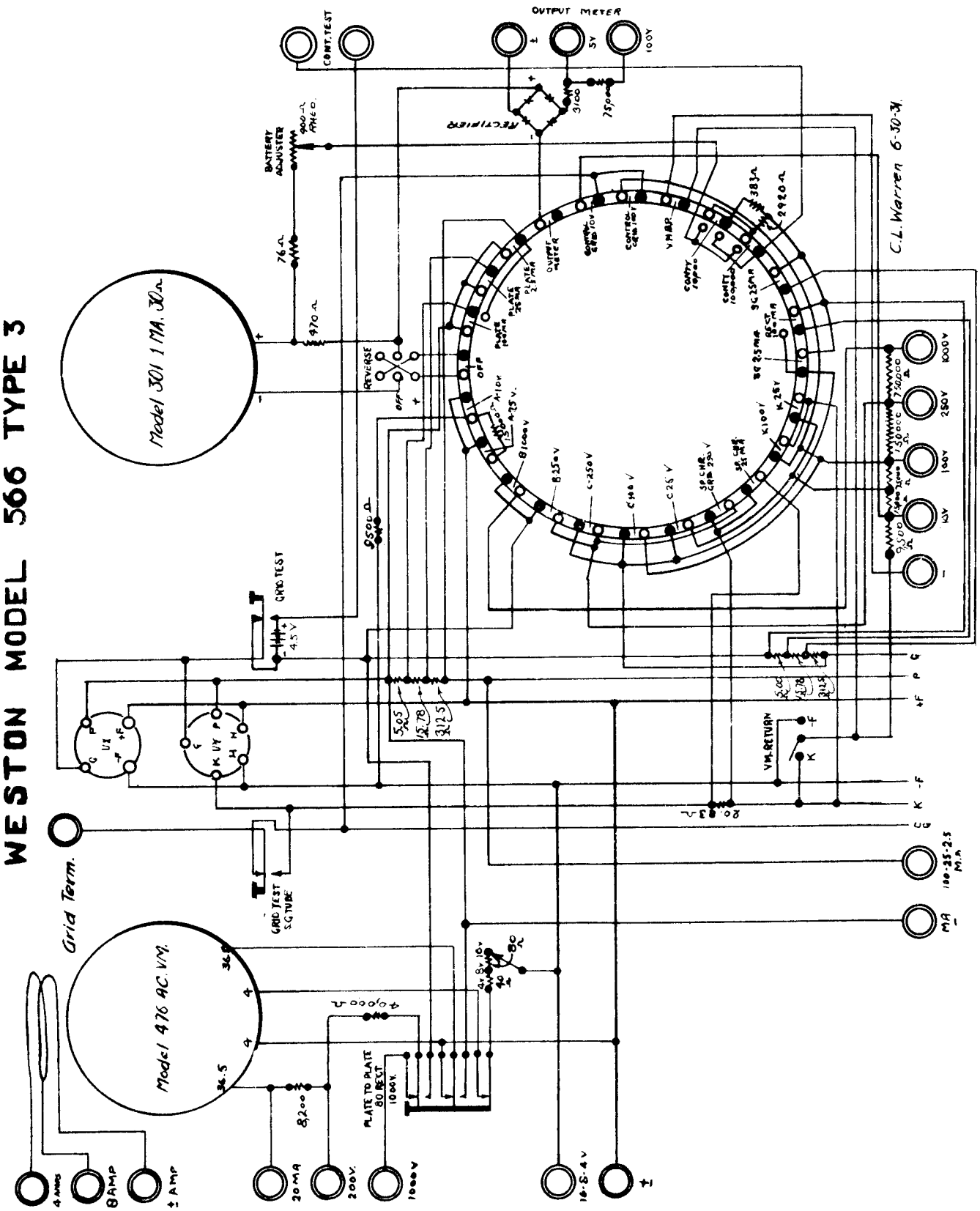


TEST EQUIPMENT SECTION
WESTON ELECTRICAL INSTRUMENT CORP.

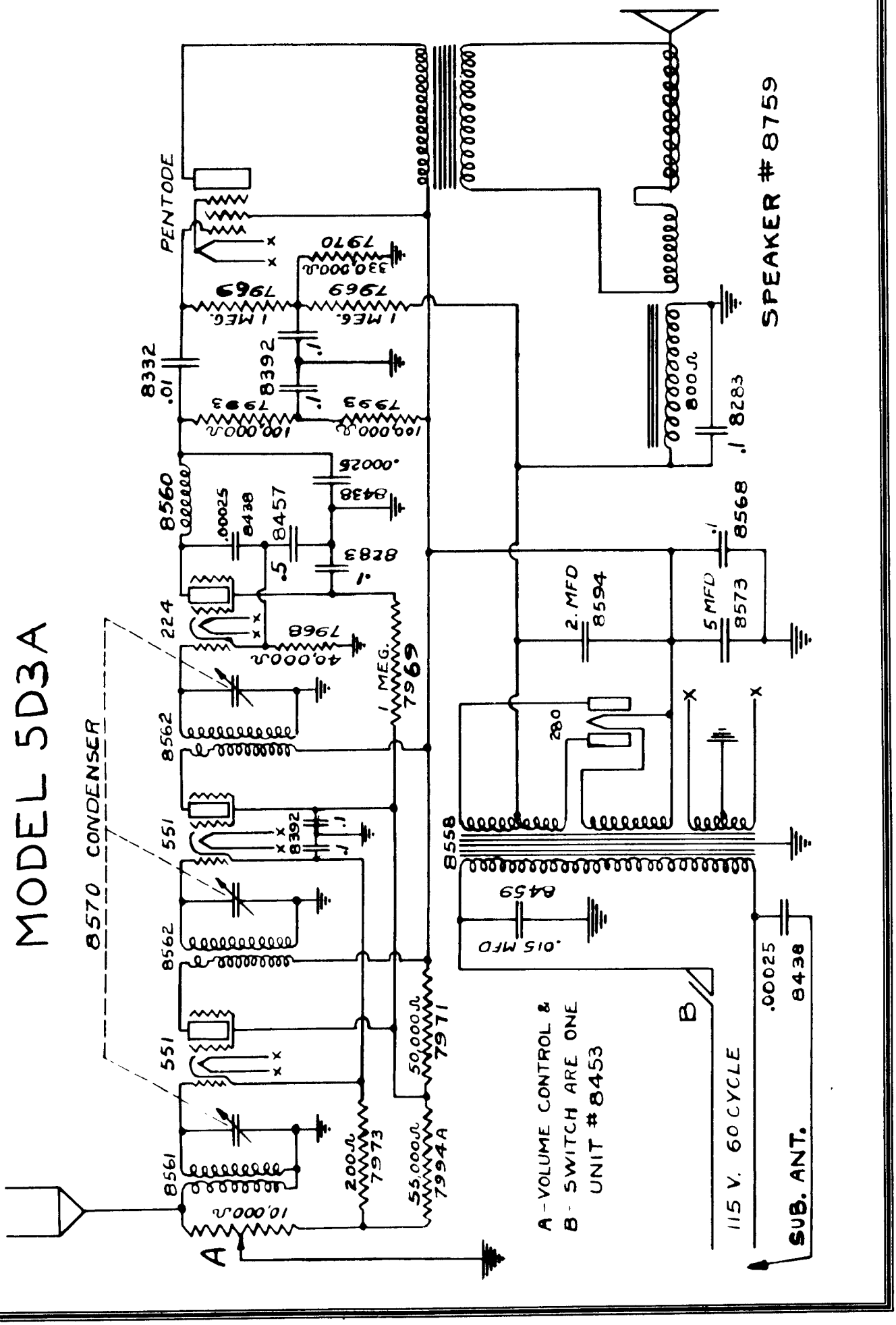
WIRING DIAGRAM OF RADIO TEST PANEL



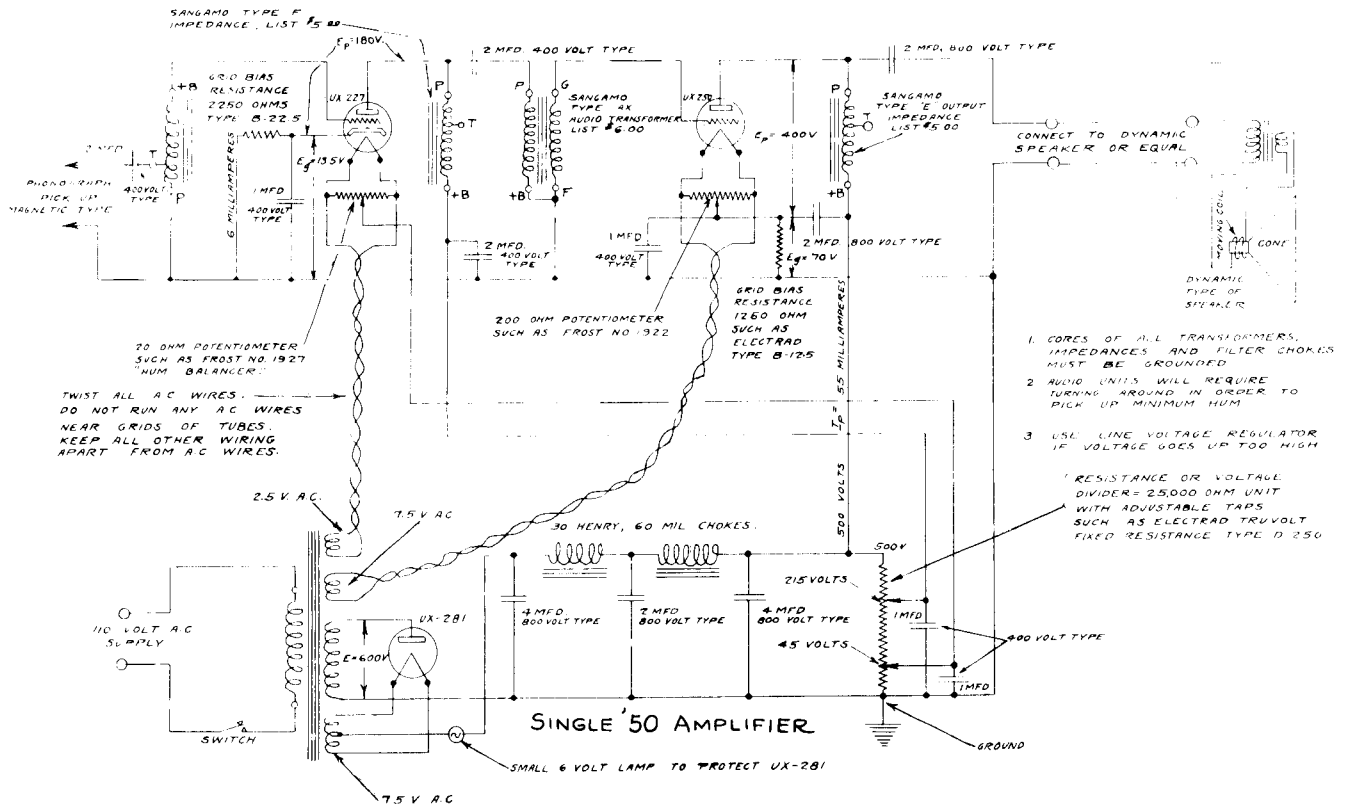
TEST EQUIPMENT SECTION
WESTON ELECTRICAL INSTRUMENT CORP.

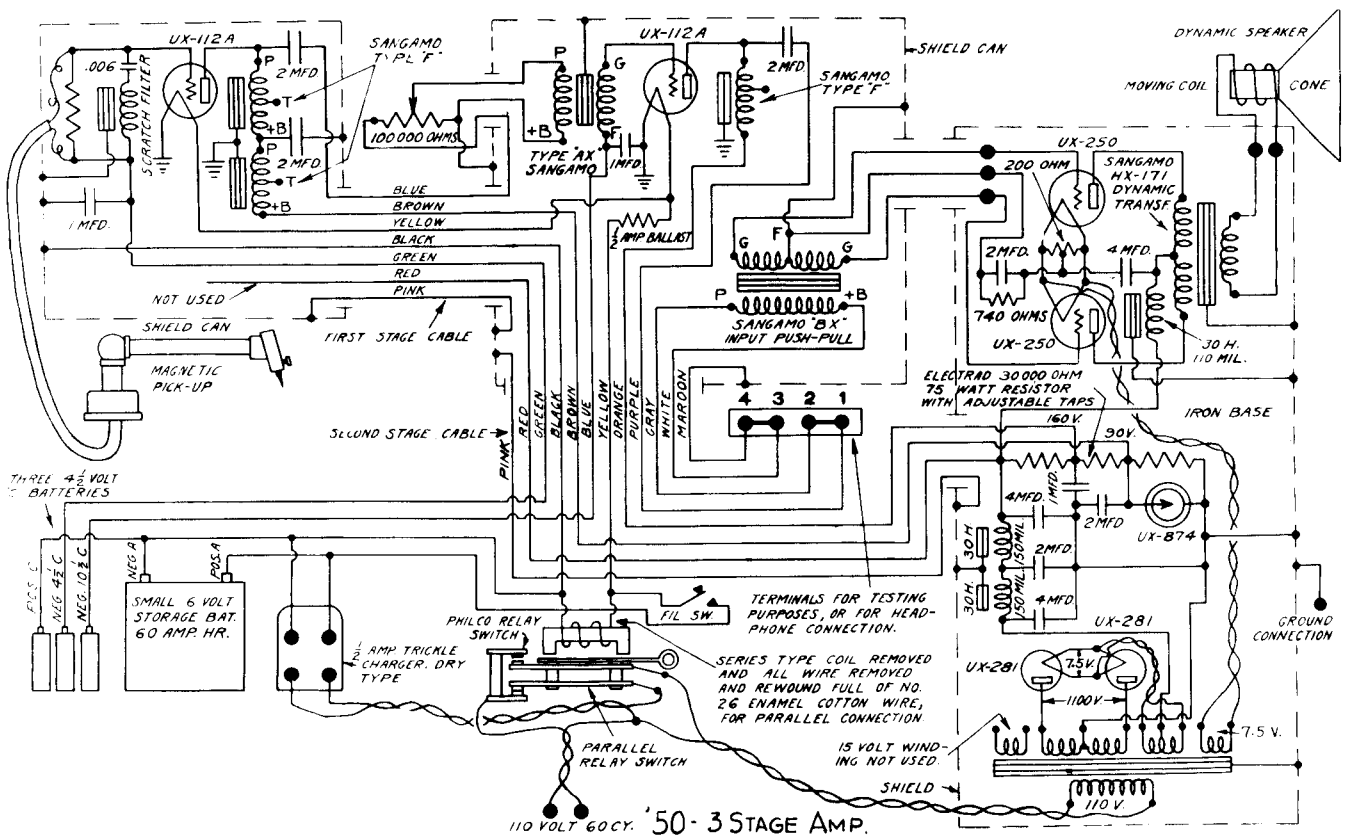


STERLING MFG. CO.

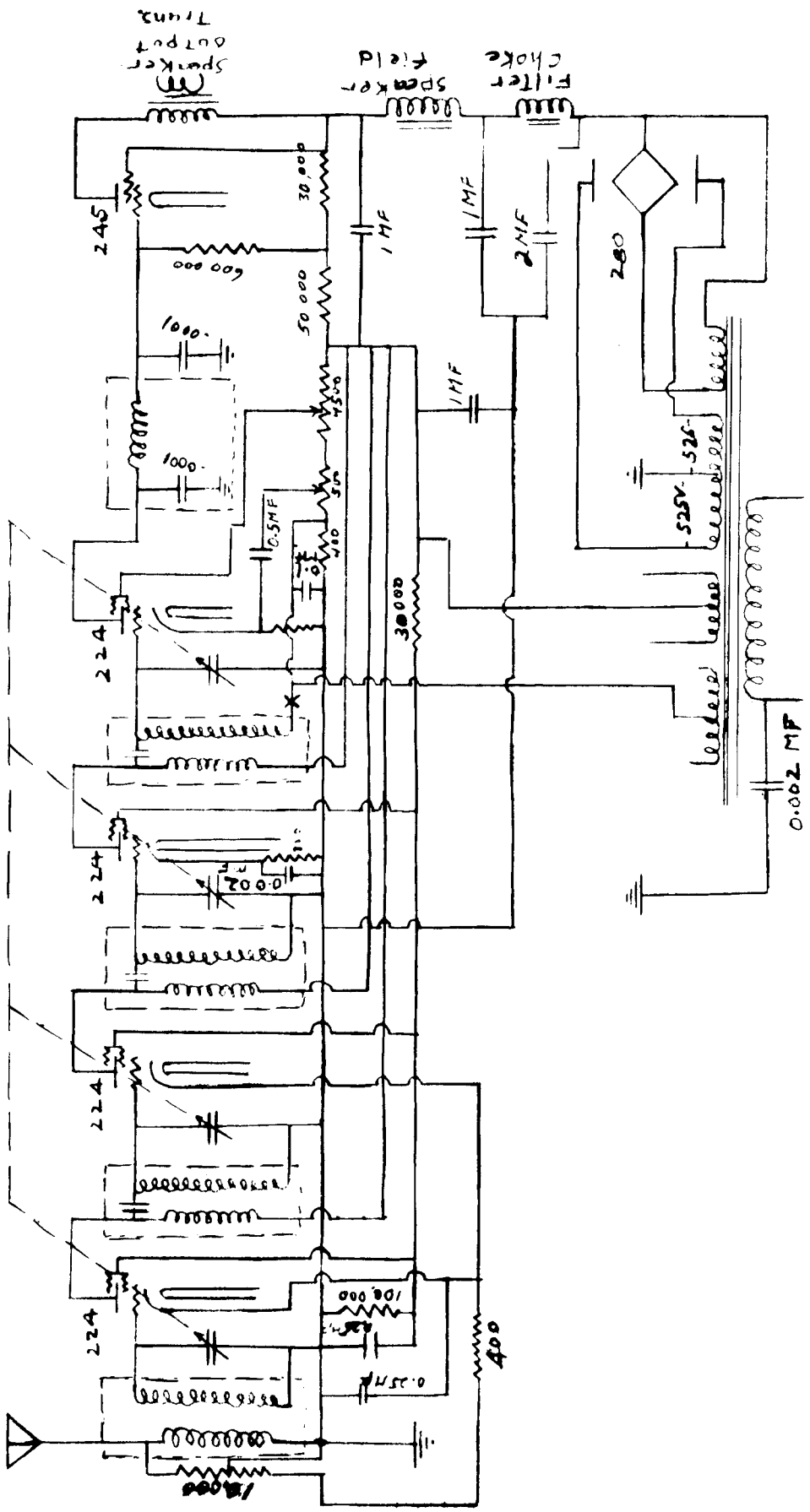


SANGAMO ELECTRIC CO.





TRAV-LER MFG. CO.



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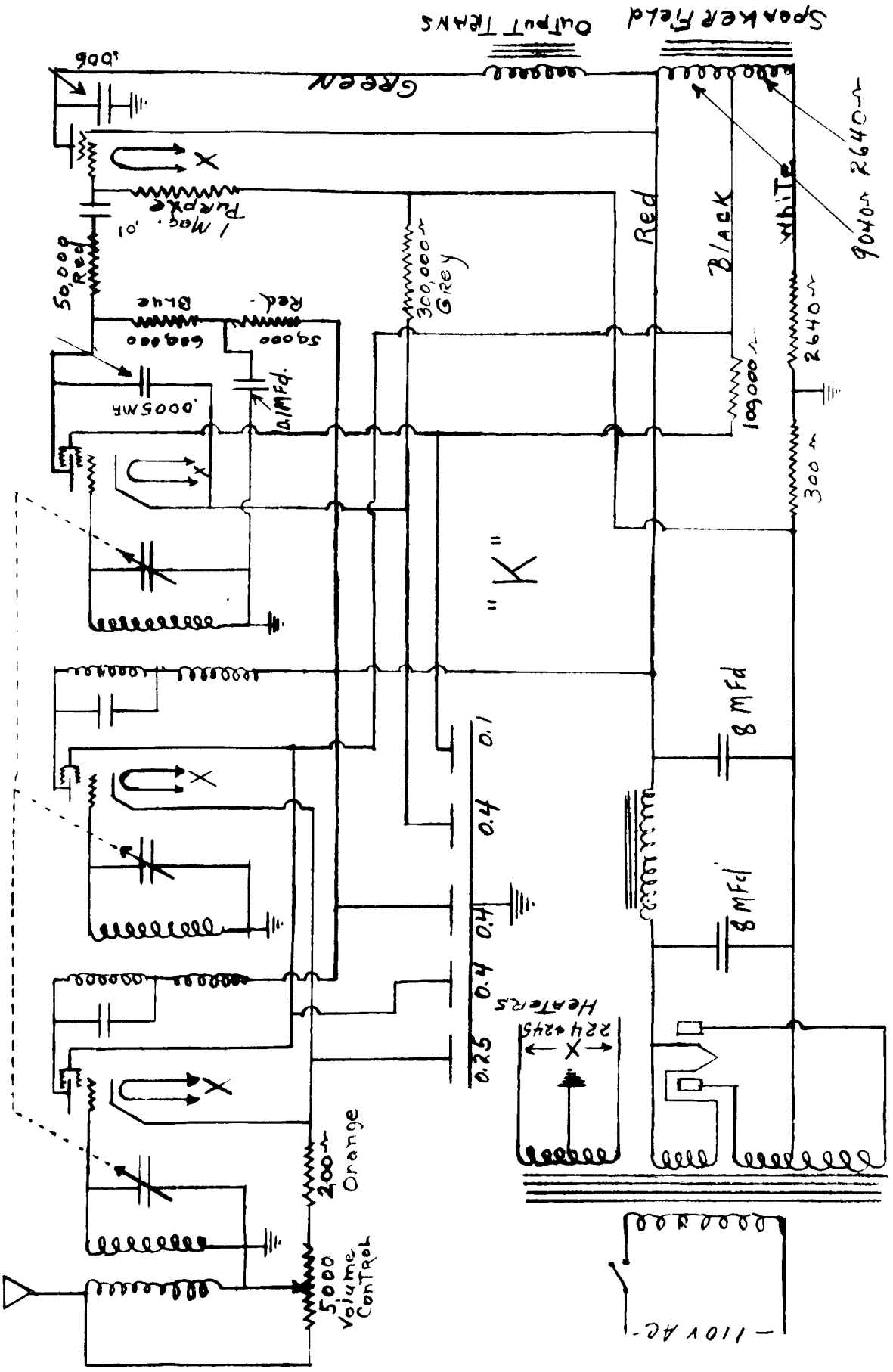
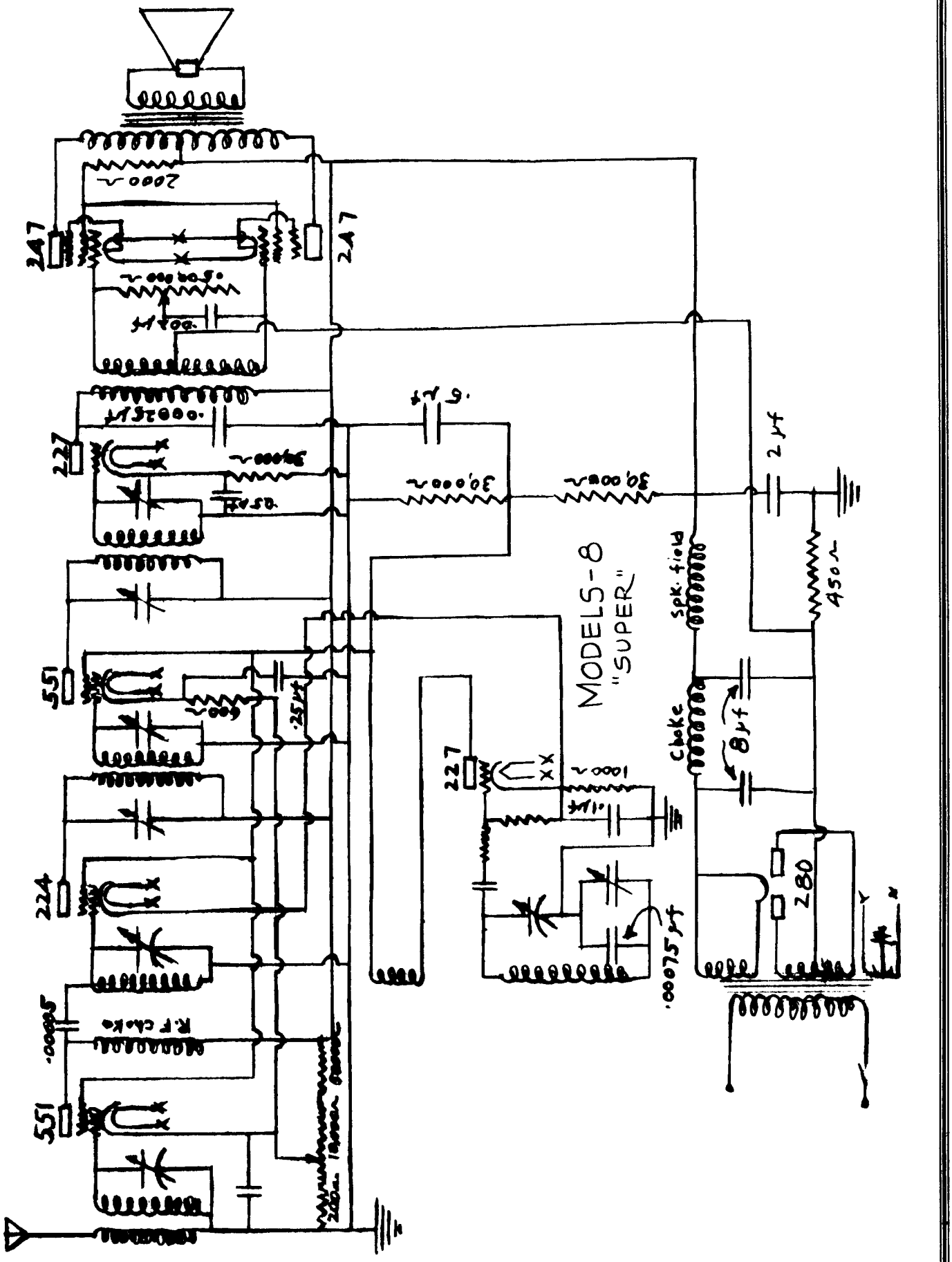
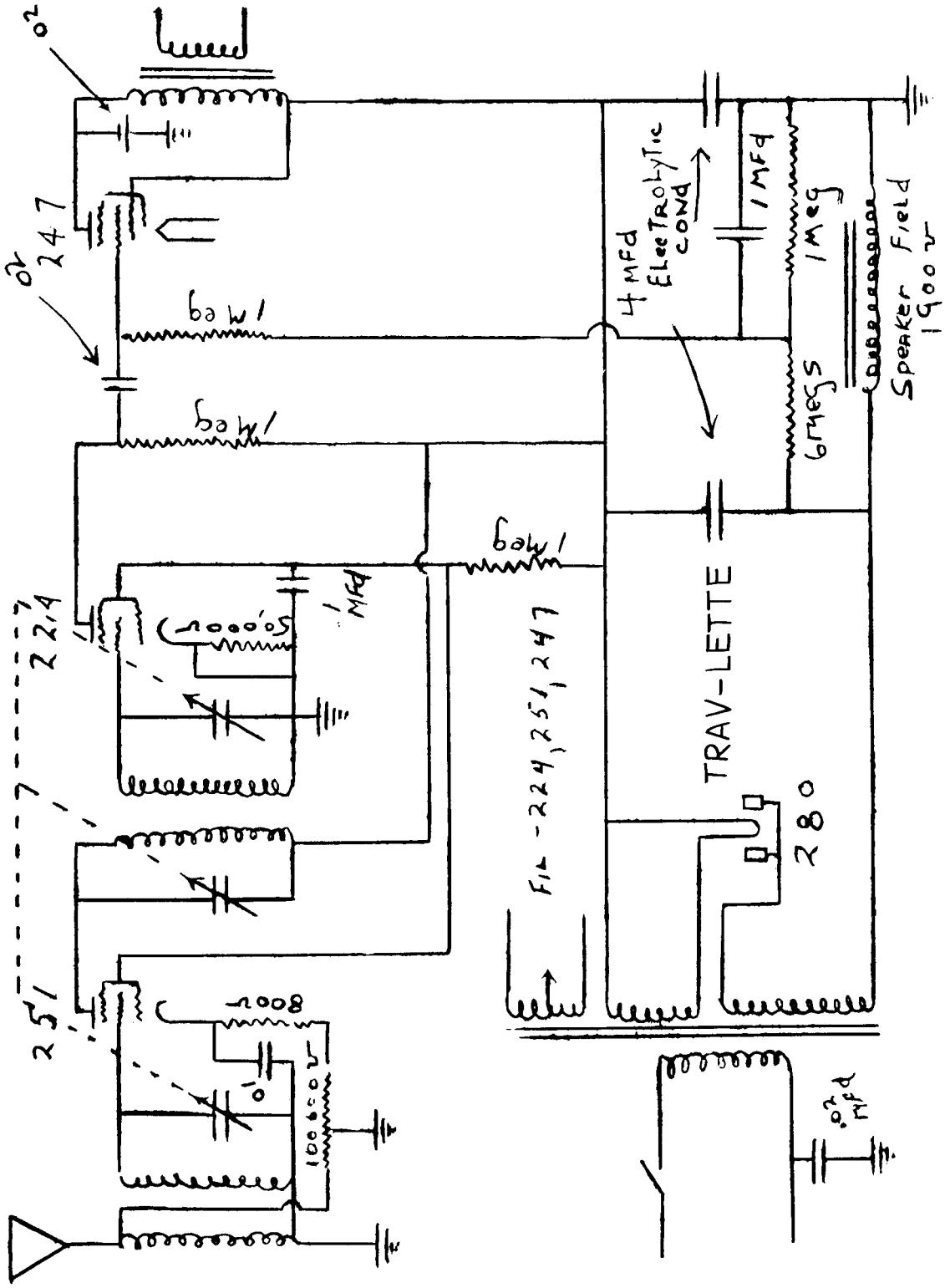


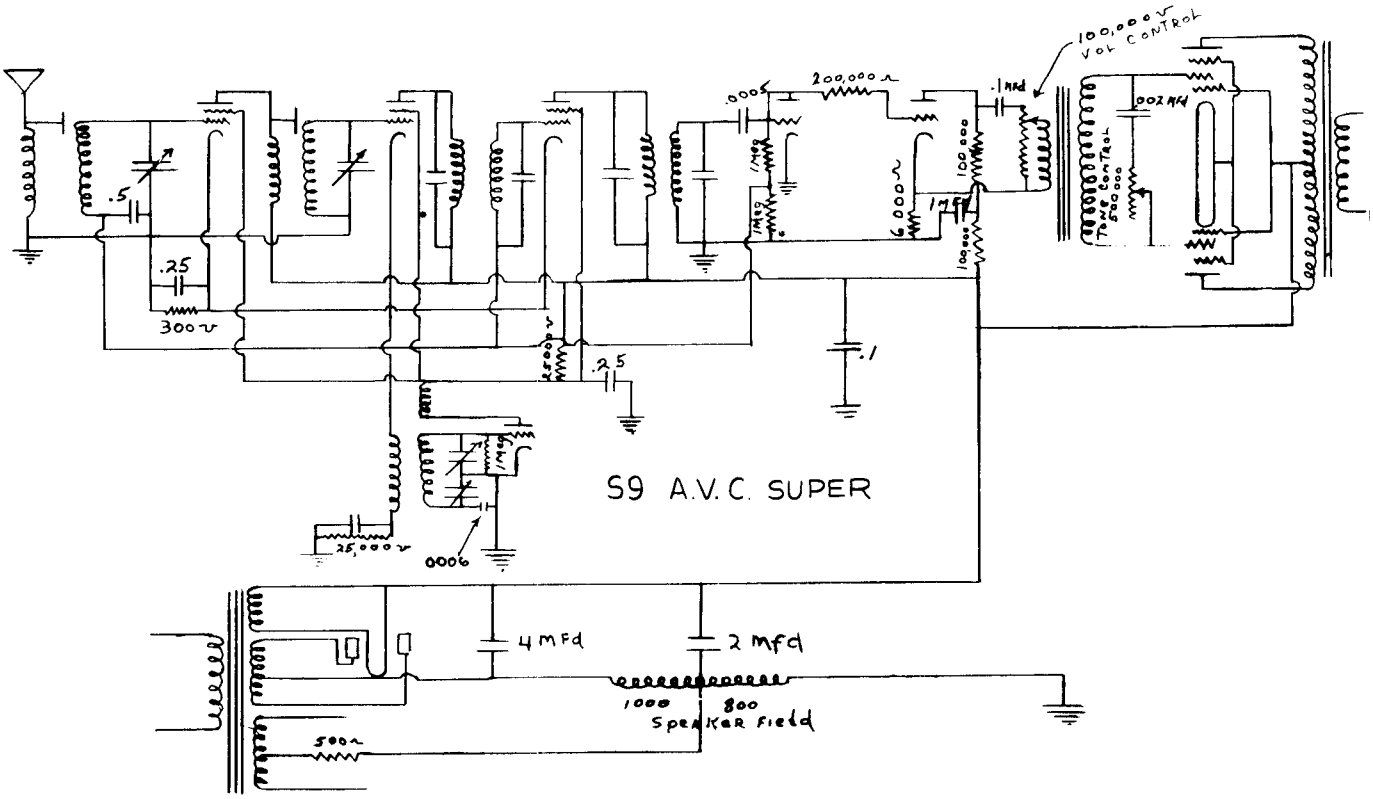
TRAV-LER MFG. CO.

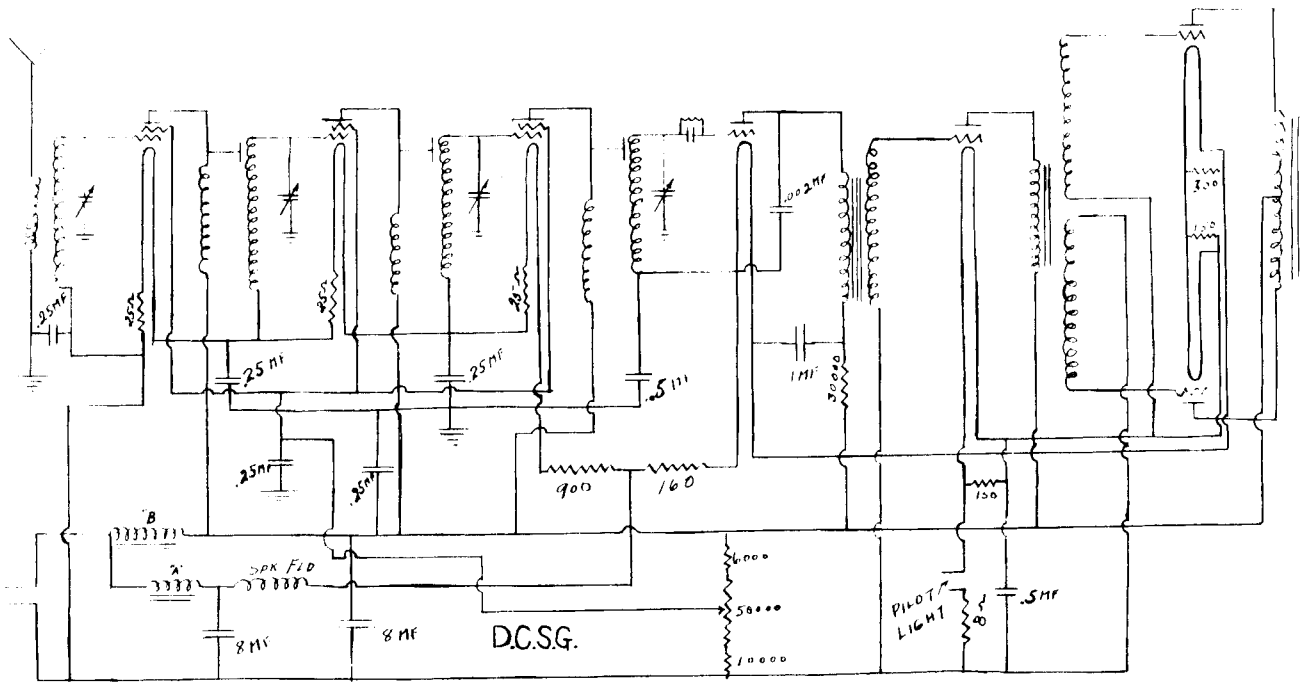


TRAV-LER MFG. CO.



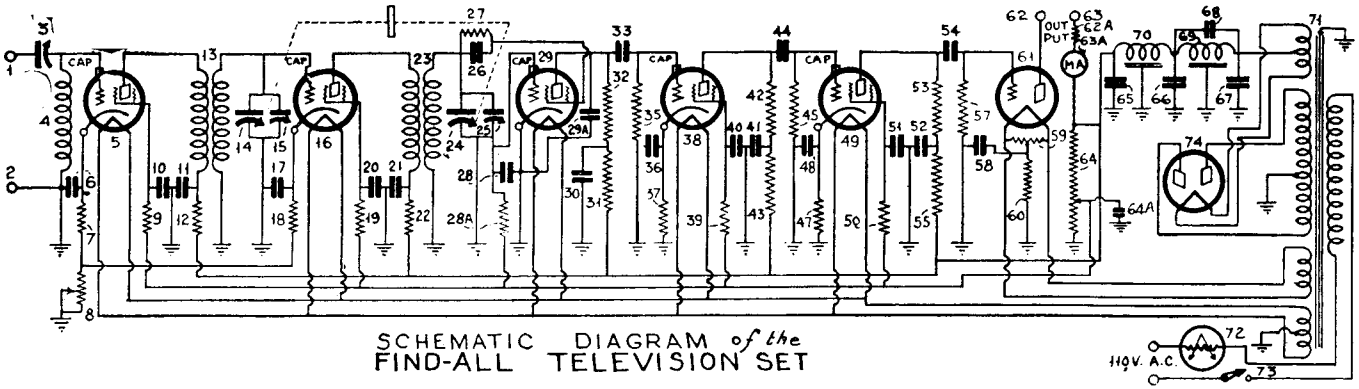
TRAV-LER MFG. CO.





TELVISION RECEIVER SECTION

ALLIED ENGINEERING INSTITUTE



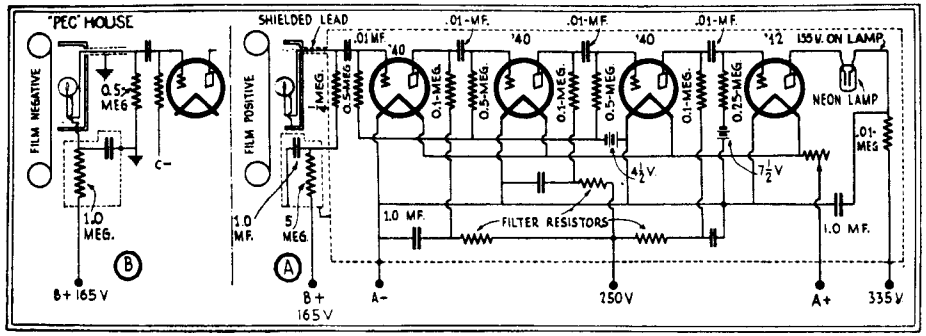
SCHEMATIC DIAGRAM of the FIND-ALL TELEVISION SET

Complete List of Parts Required for the Find-All Television Receiver

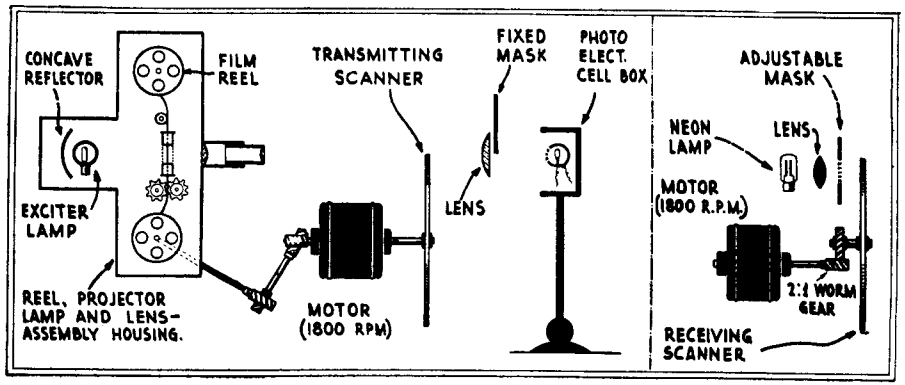
1—.000365-mfd. Cardwell "Midway" Variable Condenser, type 407-C (3).
1—.0002-mfd. (each section) Dual Cardwell "Midway" Variable Condenser, type "C", (14, 24).
2—De-Jur-Amsco Single Varitors, 140-mf. maximum, type X-71 (15, 25).
1—Electrad Volume Control, type RI-202 (8).
1—Electrad Truvolt Fixed Resistor, type B-15 (60).
1—Electrad Truvolt Fixed Resistor, type B-30 (62A).
4—1,000 ohm Electrad Truvolt Flexible Wire Grid Resistors, type 2G-1000 (7, 18, 37, 47).
1—Electrad Truvolt Fixed Resistor Voltage Divider, type C-200, with extra tap (64).
1—Electrad Truvolt Type V-20 Center Tap Resistor (Optional) (59).
1—Power Switch (73).
1—.0001-mf. Aerovox Fixed Mica Condenser, type 1460 (26).
1—0.1-mf. Aerovox Fixed Condenser, type 207 (68).
1—.001-mf. Aerovox Fixed Mica Condenser, type 1460 (optional) (29A).
3—0.25-mf. Aerovox Fixed Condensers, type 207 (33, 44, 54).
1—1-mf. Aerovox Fixed Condenser, type 261 (28).
6—2-mf. Aerovox Fixed Condensers, type 207 (36, 40, 48, 51, 52, 58).
2—0.1-mf. (each section) Triple Section, Metal Case Aerovox Condensers, type 461-31 (6, 10, 11) and (17, 20, 21).
2—8-mf. Aerovox Hi-Farad Dry Electrolytic Condensers, type G5-8 (66, 67).
1—16-mf. Aerovox Hi-Farad Dry Electrolytic Condensers, type G5-88 (65).
2—4-mf. Aerovox Fixed By-Pass Condensers, type 207 (30, 41).
8—50,000-ohm Durham Metallized Resistor Powerohms, with Pigtail Connectors, type MF-4 (9, 19, 28A) (32, 39, 42, 50, 53).
(NOTE: Resistors (34, 46, 56) are omitted in revised diagram; these are not needed.)
1—4-mf. Aerovox Fixed By-Pass Condenser, type 207 or G5-4 (64A).
3—25,000-ohm Durham Metallized Resistor Powerohms, with Pigtail Connectors, type MF-4 (31, 43, 55).
1—50,000-ohm Durham Metallized Resistor Grid Leak, with Pigtail Connector (27).
2—75,000-ohm Durham Metallized Resistor Powerohms, with Pigtail Connectors (12, 22), type MF-4.
3—250,000-ohm Durham Metallized Resistor Powerohms, type MF-4 (33, 45, 57).
1—Find-All Shielded Television Antenna R.F. Inductance Coil (4).
2—Find-All Shielded Television R.F. Transformers (13, 23).
1—Acratest 45-type Power Transformer (Television Model) (71).
1—Acratest Double Filter Choke (two 30 Henry—80 mil. Chokes in Single Case) (69, 70).
1—Roll Corwico Braidite Hook-up Wire, Solid Core.
5—Five-Prong Wafer-type Sockets (5, 16, 29, 38, 49).
3—Four-Prong Wafer-type Sockets (61, 72, 74).
1—Amperite Self-Adjusting Line Voltage Regulator, type 8A-5 (72).
4—Binding Posts (1, 2) and (62, 63).
3—Tube Shields.
5—124 Arcturus Screen-Grid Tubes (5, 16, 29,.38, 49).
1—145 Arcturus Power Output Tube (61).
1—180 Arcturus Rectifier Tube (74).
1—Weston Milliammeter, 0-50 ma. type 301 (63A).
1—Aluminum Chassis, 12 gauge, 12" x 15" x 3½" high.
2—Vernier Dials.
(NOTE—Numbers in Parentheses refer to Corresponding Numbers Used to Mark Parts on Diagrams.)

Radiovisor Parts Required

1—Jenkins Radiovisor Kit Assembly, type RK.
1—Low Internal Capacity Neon Lamp, type 601.
1—Lens Assembly, type RK-11.
1—Jenkins Self-Synchronizing Motor, type 502, with necessary amplifier Kit, type SK-30 (optional).

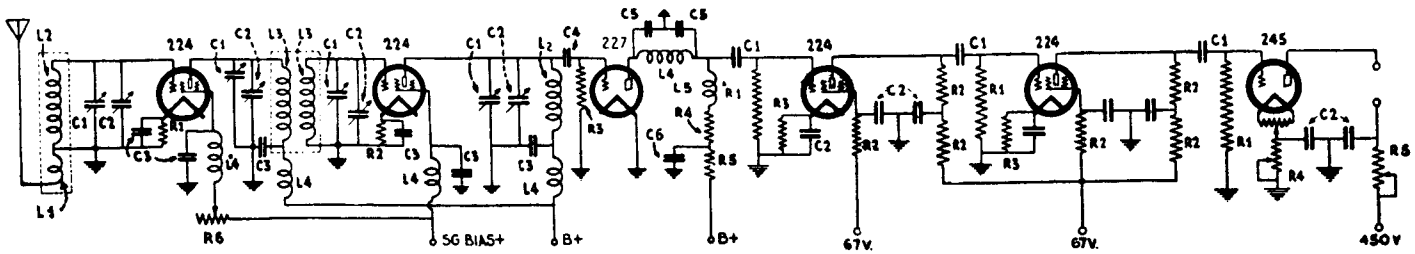


The electrical circuit of the home television projector and receiver described here; the phase-shifter is connected as shown at the left (B) for use with negative films; as at the right (A) with positives. It is the resistor and condenser shown in the grounded shield (dotted lines).



Arrangement of "movie" television projector at left; receiver at right.

INSULINE CORPORATION OF AMERICA



Radiovision receiver with band-pass filter, and 15 to 30,000 cycle radiovision amplifier—L1, 24 turns No. 32 DCC, 1 in. diameter; L2, 48 turns No. 32 DCC, 1 in. diameter; L3, 48 turns No. 32 DCC, 1 in. diameter (ends together); L4, R. F. choke; L5, 20-100 mh. choke; C1, .00015-mf. gang condenser (shielded); C2, trimmer condensers; C3, .01 mf. radio frequency by pass condenser; C4, .0001 mf. grid condenser; C5, .001-mf. by pass condenser; C6, 1 mf.; R1, 500 ohms.; R2, 500 ohms.; R3, 2 meg.; R4, 30,000 ohms.; R5, 20,000 ohms.; R6, 0-200,000 variable resistor; C1, .2 mf.; C2, 1 mf.; R1, .25 meg.; R2, .05 meg.; R3, 1000 ohms.; R4, 2000 ohms variable; R5, 2500 ohms variable. The neon tube connects in a '45 tube plate circuit.

NATIONAL RADIO INSTITUTE

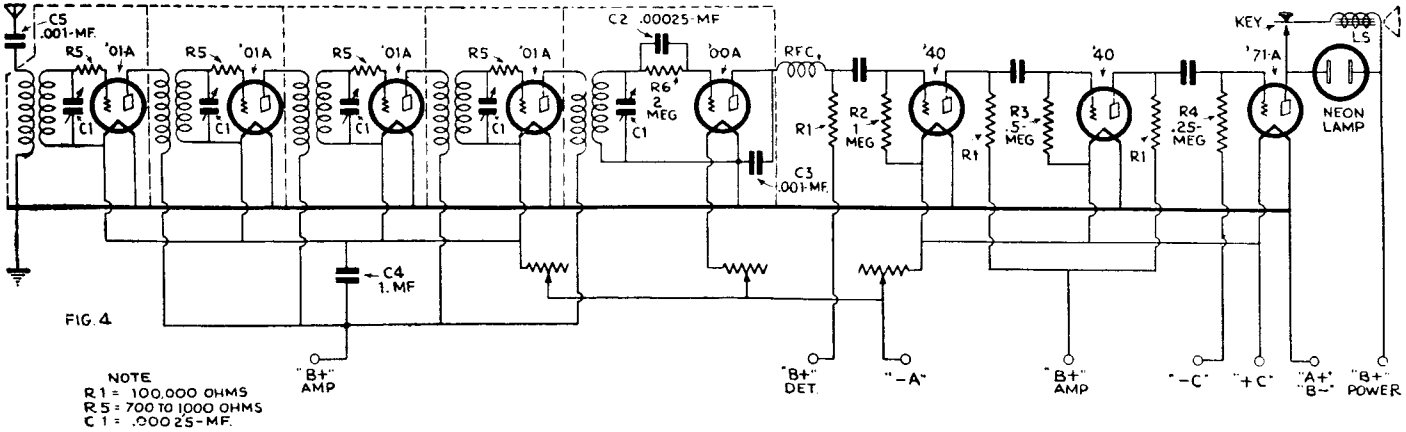
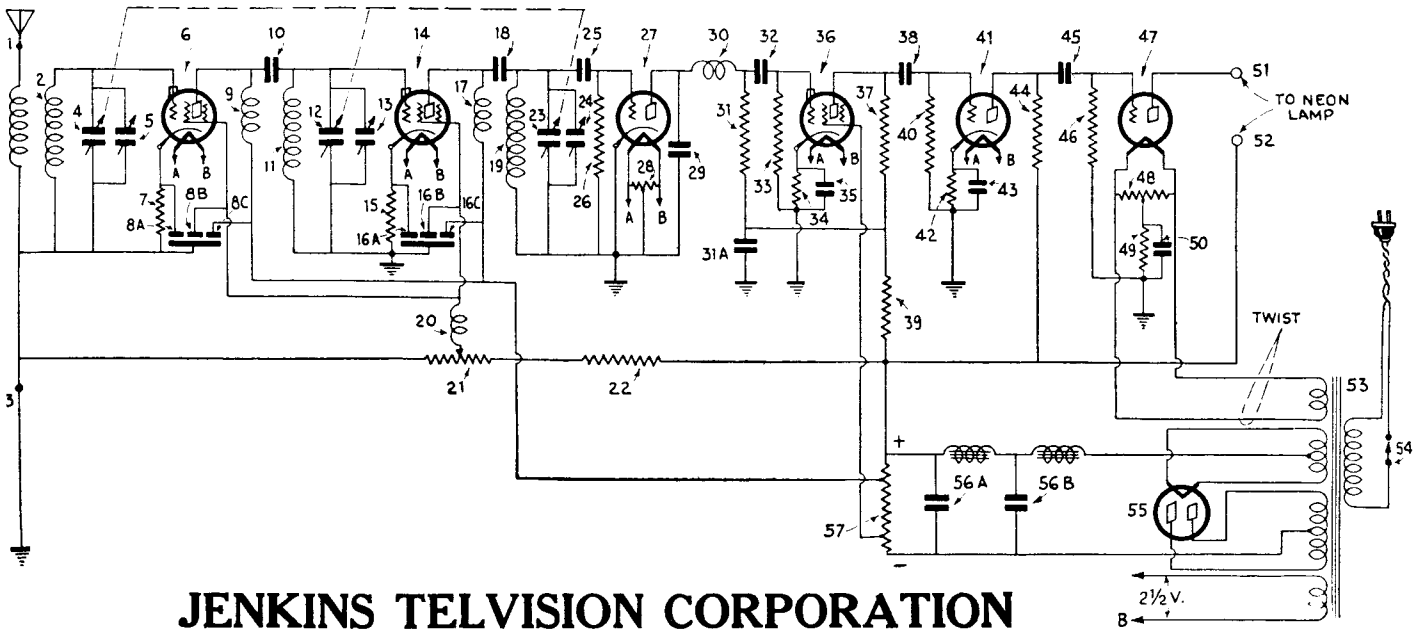


FIG. 4

Shows wiring diagrams of the Stair-Winters television tuner and amplifier, the latter utilizing three stages of resistance coupling. A key or switch cuts the loudspeaker out of circuit and the neon tube in circuit.

STAIRS - WINTERS CO.



JENKINS TELVISION CORPORATION

Complete wiring diagram of new Jenkins television receiver. The numbers correspond to those on the photo of the set shown on opposite page. List of parts appears at end of article. This receiver was designed and tested in the Jenkins television laboratory under actual "image reception" conditions of all kinds. No regeneration is used in this receiver.

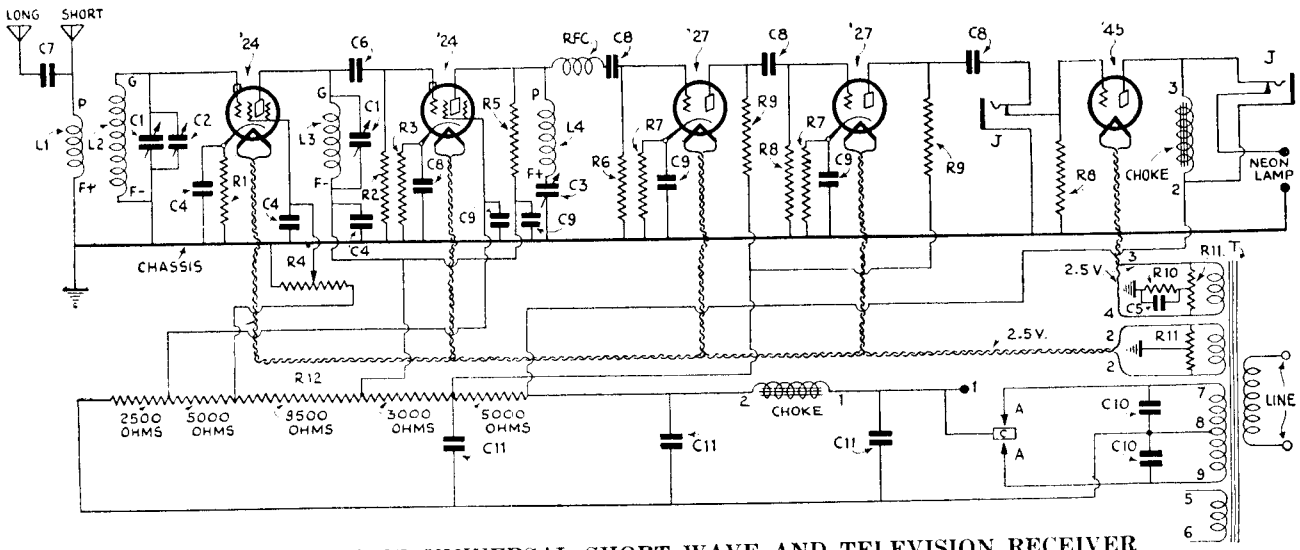
List of Jenkins Parts Required

(These Parts, without tubes, are available in Kit Form)

1—Three-gang Variable Condenser, .00025-mf. each section, sections shielded (4, 12, 23);
3—.00002-mf. Trimmer Condensers (5, 13, 24);
1—Special Shielded Jenkins Television Antenna Coupler (2);
2—Special Shielded Jenkins Television R.F. Coils (11, 19);
4—Special 300-Turn R.F. Chokes (9, 17, 20, 30);
2—By-Pass Condenser Blocks, each containing 3 -0.1-mf., 400-volt units (8A, B, C), (16A, B, C);
4—.0001-mf. Fixed Mica Condensers (10, 18, 25, 29);
1—1-mf. 600-volt By-Pass Condenser (31A);
3—¼-mf., 600-volt Blocking Condensers (32, 38, 45);
3—2-mf., 200-volt, By-Pass Condensers (35, 43, 50);
1—Filter Condenser Block containing one-4-mf., 600-volt unit (56A) and one- 2-mf., 600-volt unit (56B);
1—Power Compact (also containing two-30 henry chokes) for supplying all plate and filament voltages (53);
3—500-ohm, 1-watt Metallized Resistors (7, 15, 34);
3—100,000-ohm, 2-watt Metallized Resistors (22, 26, 31);
2—50-ohm, Center-Tapped Wire-Wound Resistors (28, 48);
3—¼-megohm, 1-watt Metallized Resistors (33, 40, 46);
1—25,000-ohm Potentiometer Volume Control (21) with Power Switch (54);
1—2000-ohm, 1-watt Resistor (42);
1—2000-ohm, 5-watt Resistor (49);
2—50,000-ohm, 2-watt Metallized Resistors (37, 44);
1—25,000-ohm, 2-watt Metallized Resistor (39);
1—41,000-ohm, 10-watt Enameled Resistor Voltage Divider (57);
5—UY-type Five-Prong Sockets (6, 14, 27, 36, 41);
2—UX-type Four-Prong Sockets (47, 55);
4—Binding Posts (1, 3, 51, 52);
3—Screen-Grid Tubes, type 424, (6, 14, 36);
2—427-Type Tubes (27, 41);
1—480-Type Full Wave Rectifier Tube (55);
1—445-Type Power Tube (47);
1—Aluminum Panel, 6¾"x12⅞"x⅛";
1—Chromium-Plated Steel Chassis (mounting holes drilled), 12⅞"x18½"x1⅝" high;
1—Dial;
Wire, etc.

(NOTE: Numbers in parentheses after each part, refer to corresponding numbers used to designate parts on diagrams.)

TELVISION RECEIVER SECTION
SHORT WAVE AND TELEVISION LABORATORY



WIRING DIAGRAM No. 3—BAIRD UNIVERSAL SHORT WAVE AND TELEVISION RECEIVER

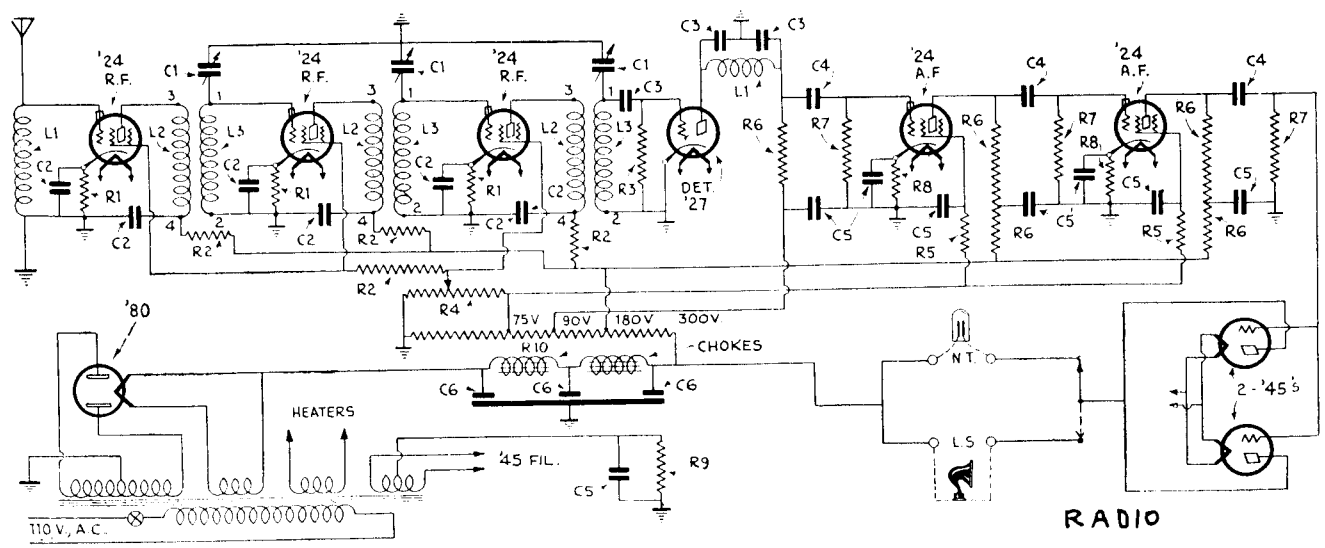
L1-L2—Octocoil, No. 7 Socket, connect as shown.
L3-L4—Octocoil, No. 8 Socket, connect as shown.
C1—MLW No. 150 Hammarlund Variable Condenser.
C2—J-13 Midget Variable Condenser.
C3—J-23 Midget Variable Condenser.
C4—No. 1450 .02 mfd. Aerovox Bakelite Moulded Condenser.
C5—No. 261 2 mfd. Aerovox Non-Inductive By-Pass Condenser.
C6—No. 1450 .00015 mfd. Aerovox Bakelite Moulded Condenser.
C7—No. 1450 .00005 mfd. Aerovox Bakelite Moulded Condenser.
C8—No. 260 .25 mfd. Aerovox Condenser.
C9—No. 261XX 1 mfd. Aerovox Condenser.
C10—No. 1070 .02 mfd. Aerovox 1,000v. DC Buffer Condenser.
C11—3 Section Aerovox No. E5-888 Electrolytic Condenser.
R1—No. 992 400 ohms Pyrohm Aerovox Resistor.
R2—5 megohms 1-watt Resistor.
R3—50,000 ohms 1-watt Resistor.
R4—50,000 ohms Royalty Electrad Potentiometer.
R5—100,000 ohms 1-watt Resistor.
R6—.5 megohms 1-watt Resistor.
R7—4,000 ohms Electrad Wire Grid Resistor.
R8—.25 megohms 1-watt Resistor.
R9—50,000 ohms 1-watt Resistor.
R10—1,500 ohms International 2-watt Resistor.
R11—No. 354 Center Tapped Resistors, 20 ohms.
R12—Aerovox No. 996SW Special Voltage Divider, 25,000 ohms.
J—Frost 3-contact Jack.
R.F.C.—No. 100 Baird Television Choke.
Choke—No. 431 Double Choke.
T—No. 411 Power Transformer.
C—Cathode of B.H. Raytheon.
A—Anode of B.H. Raytheon.

Connect Anodes to Filament Prongs on No. 1 Socket. Connect Cathode to Plate of this Socket.

R3 is replaced with a 201A Fixed Rheostat which acts as a short circuit when regeneration is used.

Windings 5 and 6 light power tube in synchronizing amplifier.

RADIO TECHNIC LABORATORY



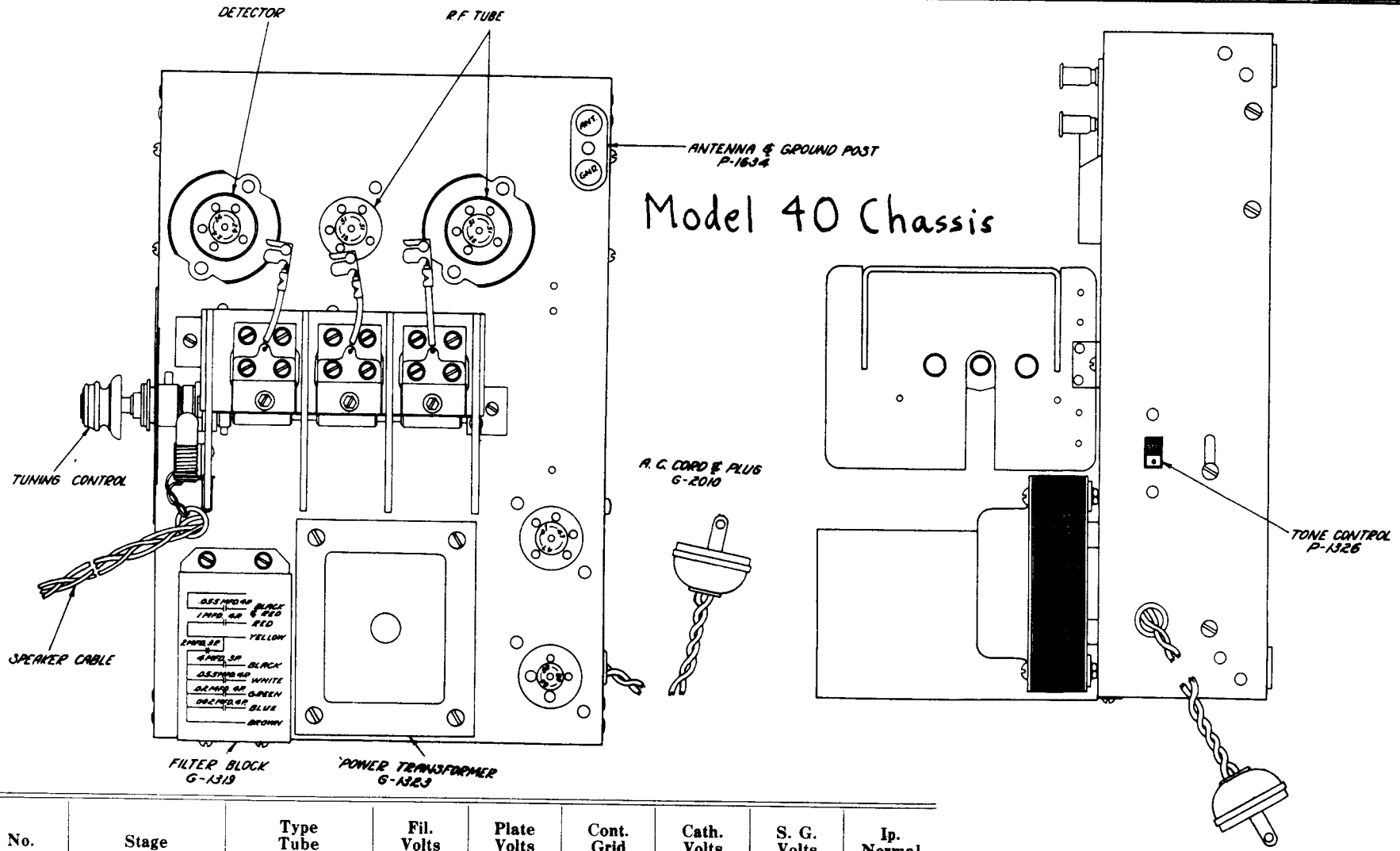
List of Parts

R1	500 *ohms*	*R7*	250,000 *ohms*	*C4*	.01 *mf.*
R2	10,000 *ohms*	*R8*	1,000 *ohms*	*C5*	1. *mf.*
R3	2 *Megohms*	*R9*	750 *ohms*	*C6*	8. *mf.*
R4	50,000 *ohm potentiometer*	*R10*	13,500 *ohm voltage divider*	*L1*	*Shortwave R.F. choke (60 millihenries)*
R5	20,000 *ohms*	*C1*	.00014 *mf.*	*L2*	*Primaries of R.F. Trans.*
R6	50,000 *ohms*	*C2*	.1 *mf.*	*L3*	*Secondaries of R.F. Trans.*
		C3	.00015 *mf.*		

RADIO TECHNIC CORP.

TRANSFORMER CORP. OF AMERICA

Model 40 Chassis



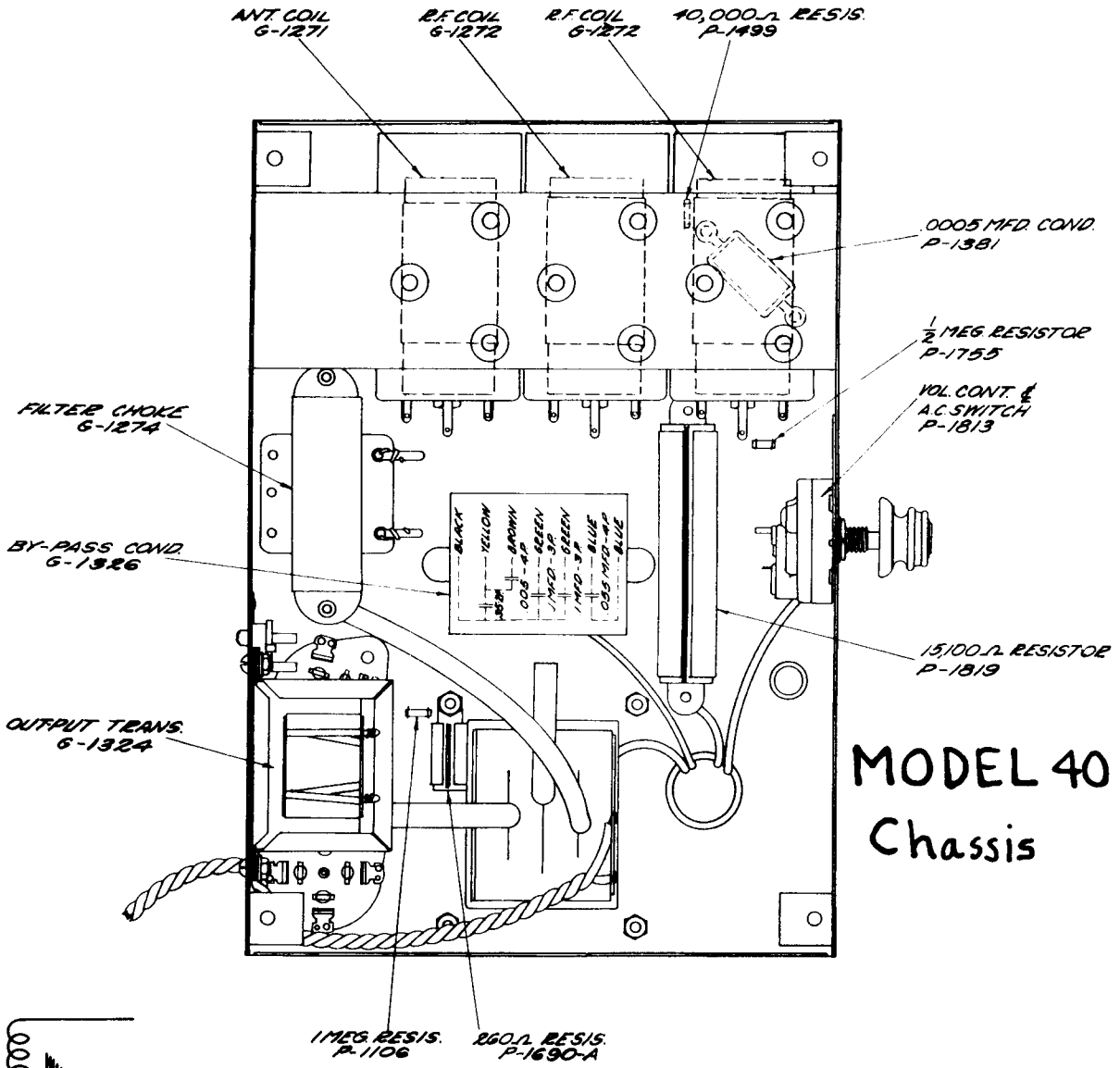
No.	Stage	Type Tube	Fil. Volts	Plate Volts	Cont. Grid Volts	Cath. Volts	S. G. Volts	Ip. Normal
1	1st R. F.	C. L. 51	2.1	225	2.1	2	75	5
2	2nd R. F.	C. L. 51	2.1	230	2.2	2	75	4.5
3	Det.	C. L. 24	2.1	160*	7	5	75	.02
4	Output	C. L. 47	2.1	215	5*	0	225	26.5
5	Rect.	C. L. 80	4.8	280				†30

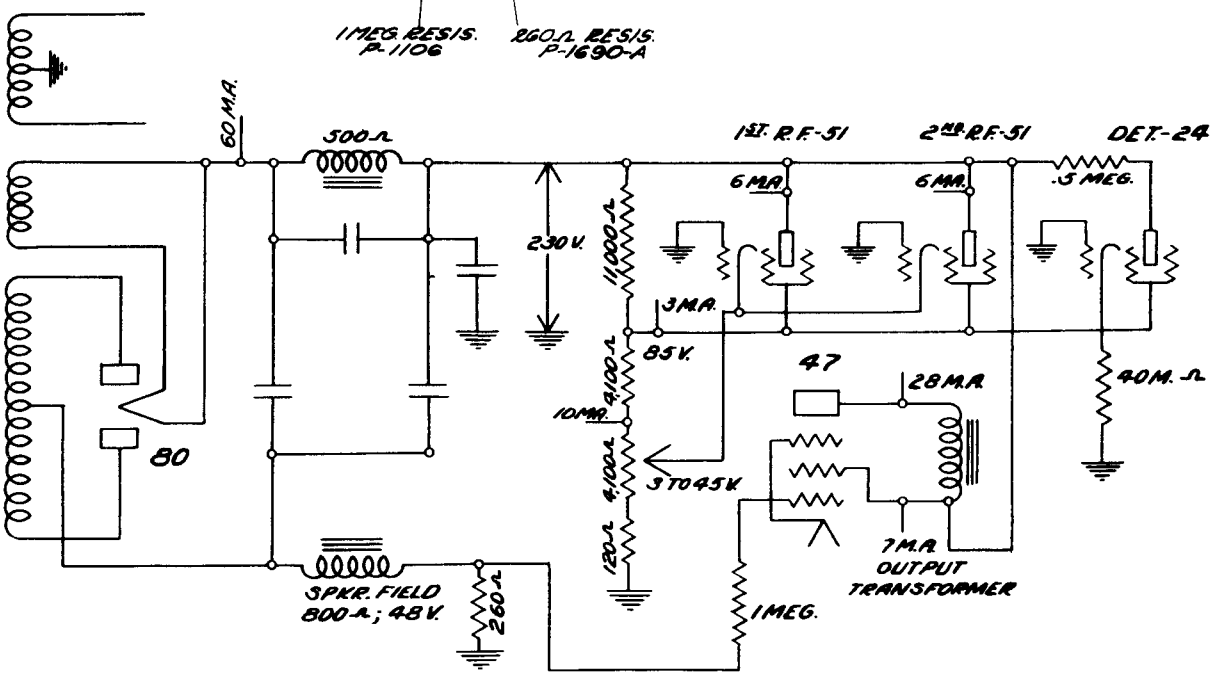
*Reading dependent upon resistance of meter.

†Reading taken for one anode only: 60 milliamperes would be about correct. Volume control position full. Line voltage 115—60 cycle.

READINGS TAKEN WITH WESTON MODEL 565 ANALYZER on Model 40

TRANSFORMER CORP. OF AMERICA

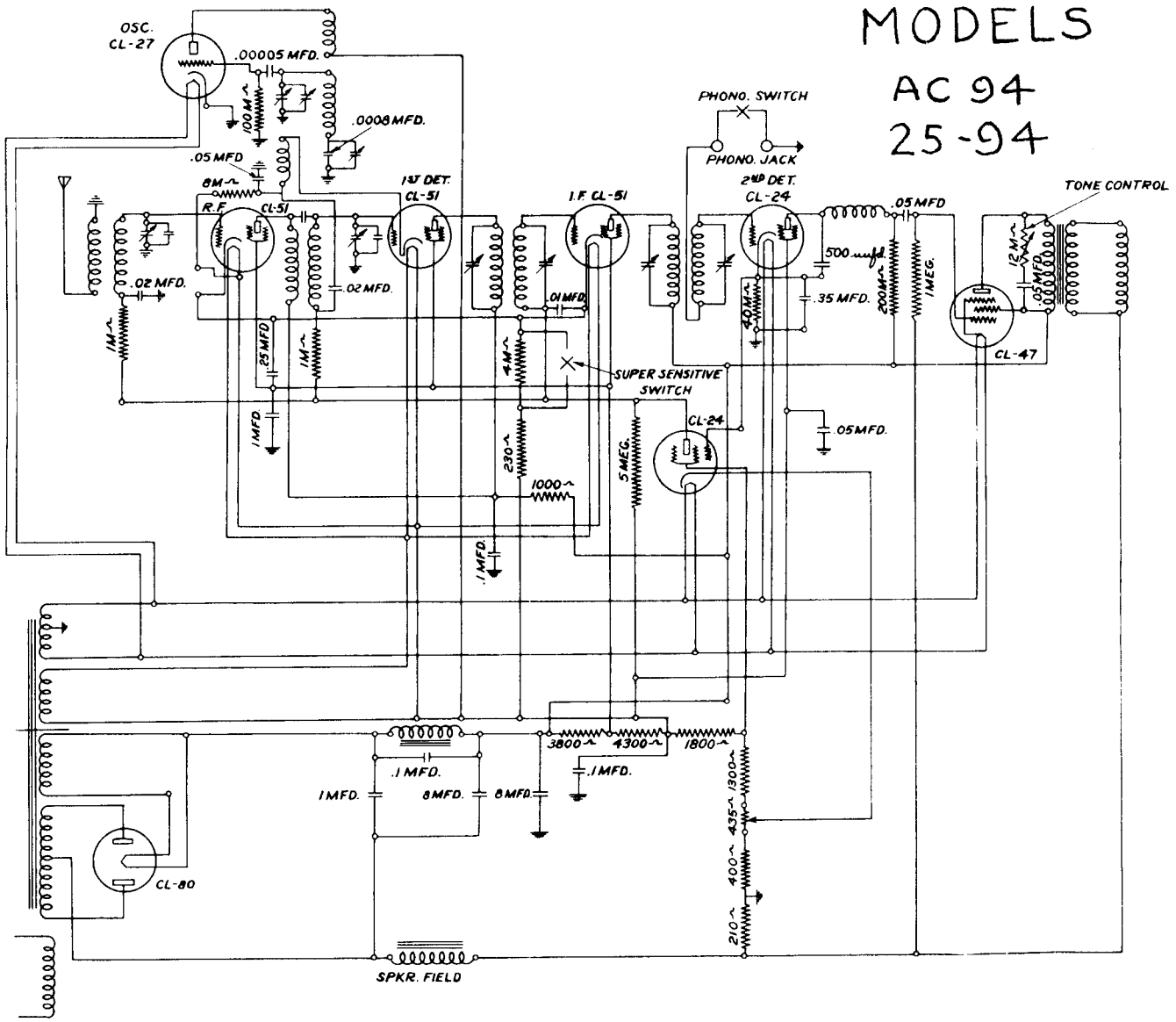




BREAKDOWN ANALYSIS
FOR
MODEL-40

TRANSFORMER CORP. OF AMERICA

MODELS
AC 94
25-94



READINGS TAKEN WITH WESTON MODEL 565 ANALYSER

No.	Stage	Type Tube	A Volts	B Volts	Cont. Grid Volts	Cath. Volts	Ip' Norm.	SG Volts
1	r. f	51	2.1	178	1.5	2.5	4.5	82
2	1st det.	51	2.1	160	9.5	10.	1.2	75.
3	Osc.	27	2.05	120	0	0	10	0
4	I. F.	51	2.05	180	.6	3.	3	82.
5	2nd det.	24	2.05	220	8.	8.	.25	85.
6	A.V.C.	24	2.05	50	12.	20	0	37
7	A.F.	47	2.1	260	16.5		40	275.
8	Rect.	80	4.6	160			40	

Volume control position Full. Line Voltage 115-60 cycle.

NOTE: Filaments and cathodes of R.F., I.F., and first detector are 95 volts positive with respect to ground.
NOTE: Since resistance tolerances in the sets are plus or minus 10%, and tubes may vary over 20%, your readings may disagree with the above by plus or minus30%.

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RESUME OF PROBABLE FAULTS

Poor sensitivity, poor selectivity, poor tone and noisy operation are very often caused by improper voltage and current values through the set or by defective tubes. Therefore, every set to be tested for any of the above complaints must first be closely checked with a set tester or analyzer and the readings compared with those given in the tables in this manual.

POOR SENSITIVITY might be due to a high resistance connection in antenna coil, superautodyne, intermediate or second detector primary or secondary windings, short circuited turns in these windings or grounds due to loose strands of wire or excess solder or poor contact at control grid cap and at tube prongs. If the variable condenser were out of phase, the sensitivity would be low, but THIS SHOULD BE THE LAST CONSIDERATION. Remember, these condensers are accurately set at the factory on precise instruments by skilled operators, and the only reason for them becoming out of adjustment would be from abuse or tampering.

Rough handling in shipment will not ordinarily change their setting. Tests have been conducted at the Factory to determine this. The process of re-phasing should be resorted to only when there is actual knowledge or a strong suspicion that the original settings have been tampered with. Complete instructions for re-phasing will be found in a later paragraph.

POOR SELECTIVITY. This condition may arise from the same causes and appear simultaneously with poor sensitivity. Where tuning is unusually broad and the local broadcasting station is not causing the trouble, it is a good idea to check for high resistance in the R. F. grid circuits.

A high resistance connection in a r. f. circuit need not run to thousands or hundreds of ohms, especially in the oscillatory circuit, *i.e.*, the circuit comprising the variable condenser and r. f. secondary. Therefore, tests with a continuity meter may not give sufficient indication of the poor connection. In a case where the connections are suspected, a practical remedy would be to go over them with a hot soldering iron. An improvement should be immediately apparent.

POOR TONE. It is characteristic of selective superheterodyne receivers that the tone of the received music will be badly distorted unless the set is tuned to EXACT resonance

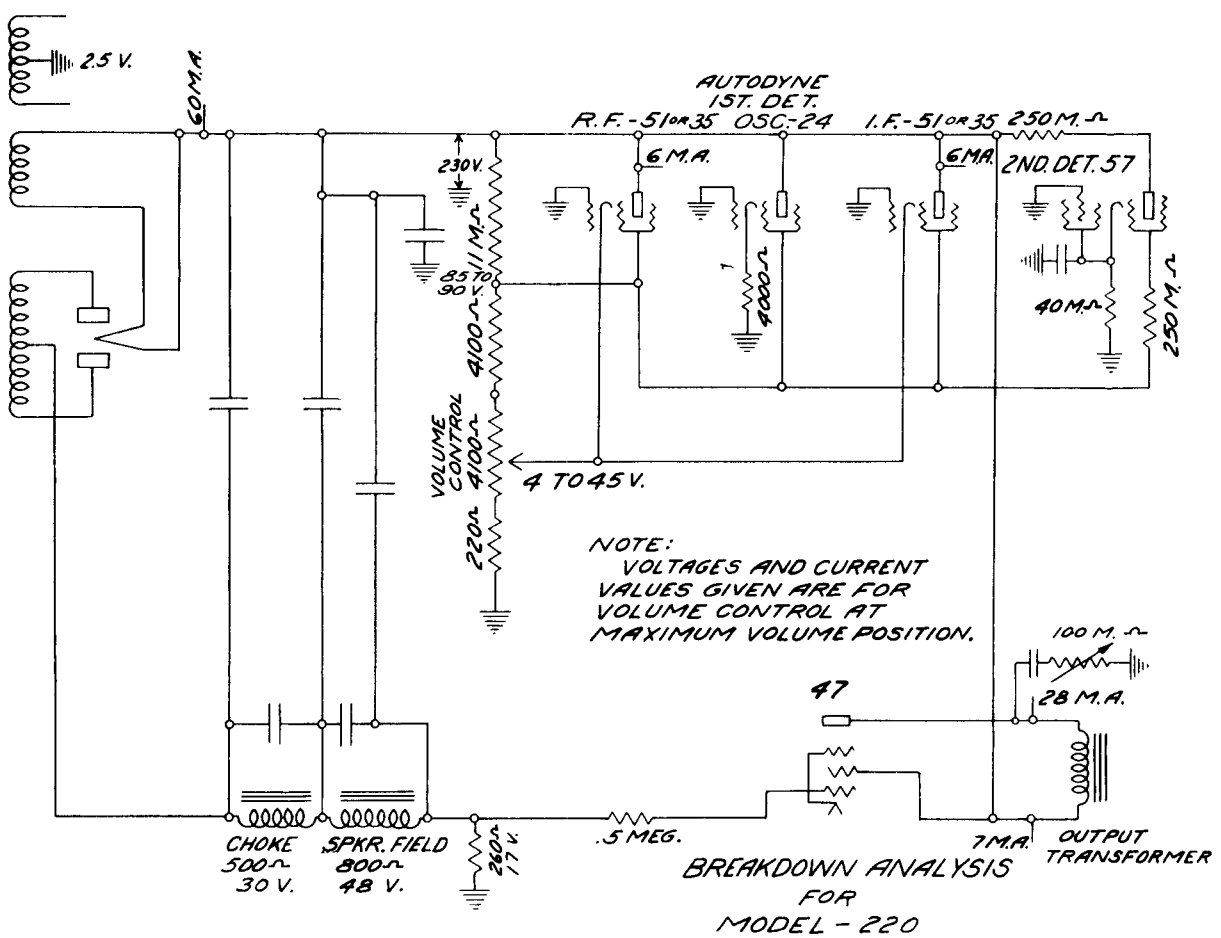
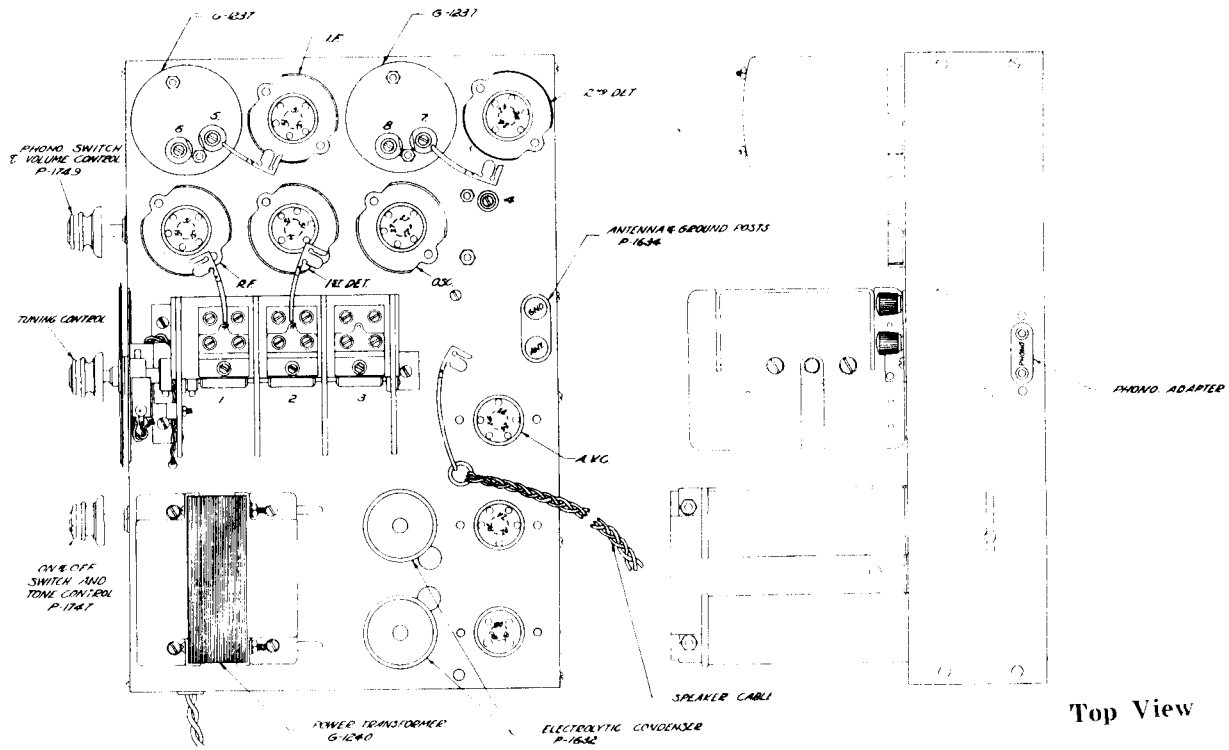
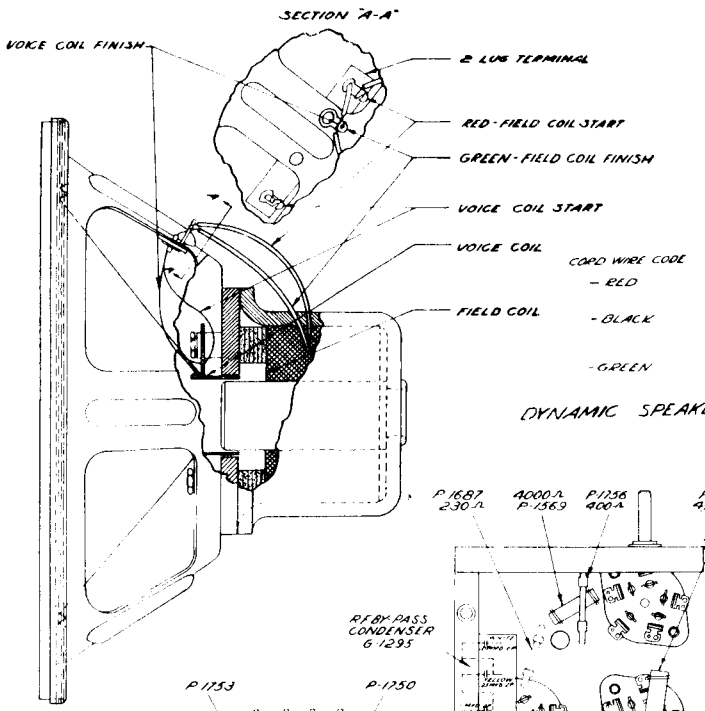


Fig. 5

TRANSFORMER CORP. OF AMERICA

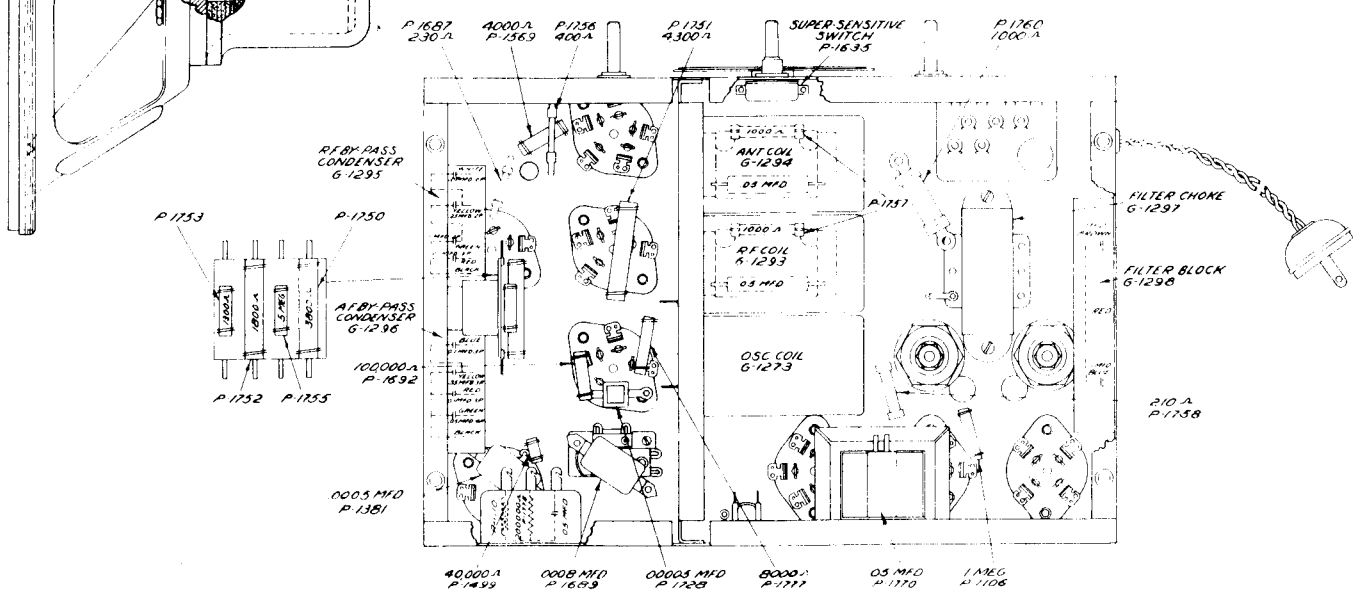


Top View



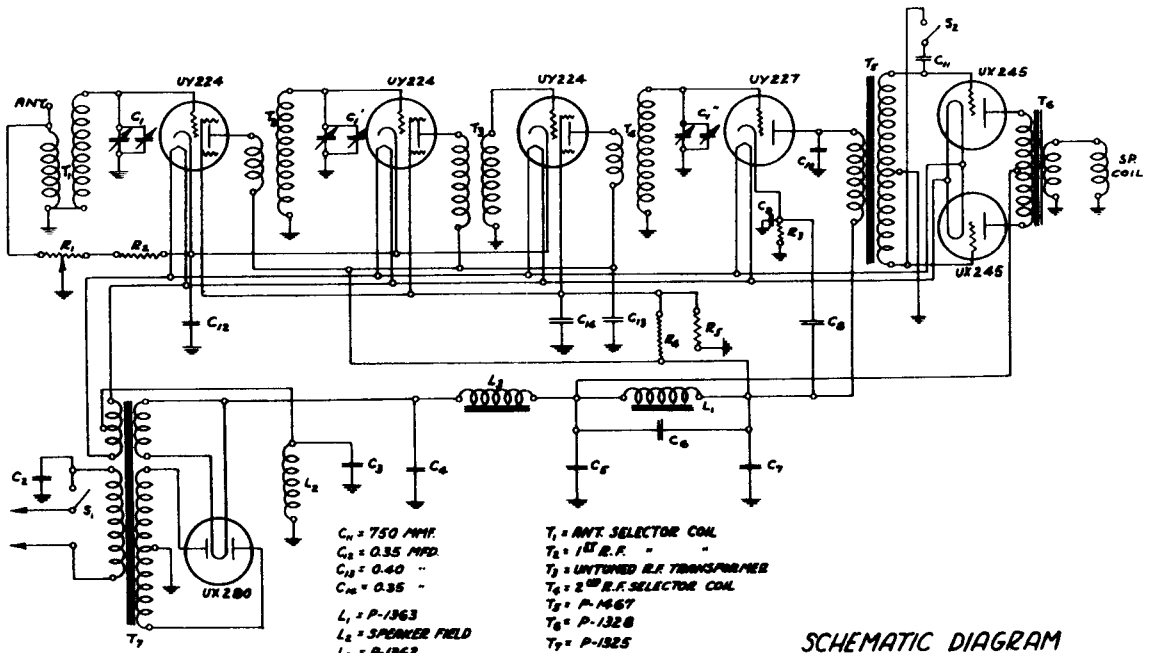
MODELS

AC-94 25-94



Bottom View

TRANSFORMER CORP. OF AMERICA



C_H = 750 MMF.
C_{12} = 0.35 MFD.
C_{13} = 0.40 "
C_{14} = 0.35 "

L_1 = P-1363
L_2 = SPEAKER FIELD
L_3 = P-1362

R_1 = VOL. CONT., 12,000 ~
R_2 = 200 ~
R_3 = 20,000 ~
R_4 = 13,000 ~
R_5 = 10,000 ~

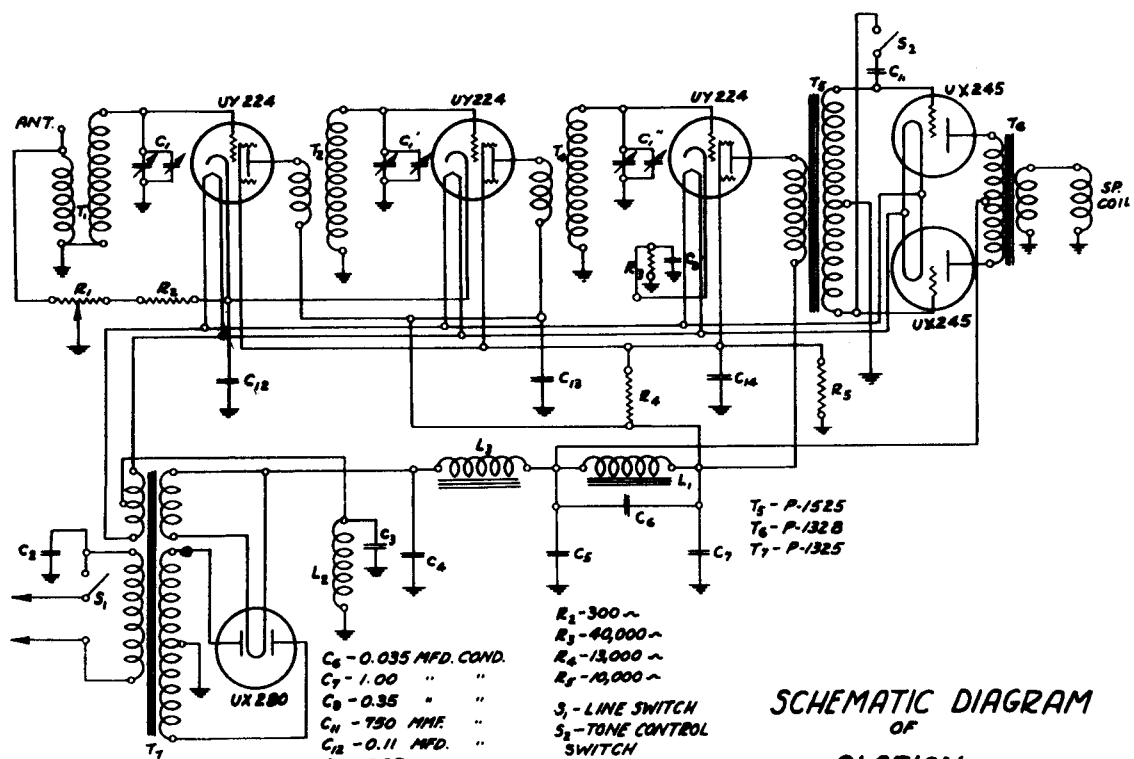
S_1 = LINE SWITCH
S_2 = TONE CONT. SWITCH

T_1 = ANT. SELECTOR COIL
T_2 = 1ST R.F. " "
T_3 = UNTUNED R.F. TRANSFORMER
T_4 = 2ND R.F. SELECTOR COIL
T_5 = P-1467
T_6 = P-1328
T_7 = P-1325

DESIGN DATA:

C_1-C_1'-C_1'' = 410 MFD. 3 GANG VARIABLE CONDENSER.
C_2 = 0.05 MFD.
C_3 = 0.35 "
C_4 = 1.50 "
C_5 = 1.50 "
C_6 = 0.035 MFD.
C_7 = 1.0 "
C_8 = 0.05 "
C_9 = 0.35 "
C_{10} = 750 MMF.

SCHEMATIC DIAGRAM OF CLARION MODEL "70"



C_6 - 0.035 MFD. COND.
C_7 - 1.00 " "
C_8 - 0.35 " "
C_H - 750 MMF. "
C_{12} - 0.11 MFD. "
C_{13} - 0.25 " "
C_{14} - 0.25 " "

L_1 - P-1363
L_2 - SPEAKER FIELD
L_3 - P-1362

R_1 - VOL. CONT. 12,000 ~
R_2 - 300 ~
R_3 - 40,000 ~
R_4 - 13,000 ~
R_5 - 10,000 ~

S_1 - LINE SWITCH
S_2 - TONE CONTROL SWITCH

T_1 - ANT. SELECTOR COIL
T_2 - 1ST R.F. SELECTOR COIL
T_4 - 2ND R.F. " COIL

T_5 - P-1525
T_6 - P-1328
T_7 - P-1325

DESIGN DATA:

C_1, C_1', C_1'' - 410 MMF. 3 GANG VARIABLE CONDENSER.
C_2 - 0.05 MFD. COND.
C_3 - 0.35 " "
C_4 - 1.50 " "
C_5 - 1.50 " "

SCHEMATIC DIAGRAM OF CLARION MODEL - 61

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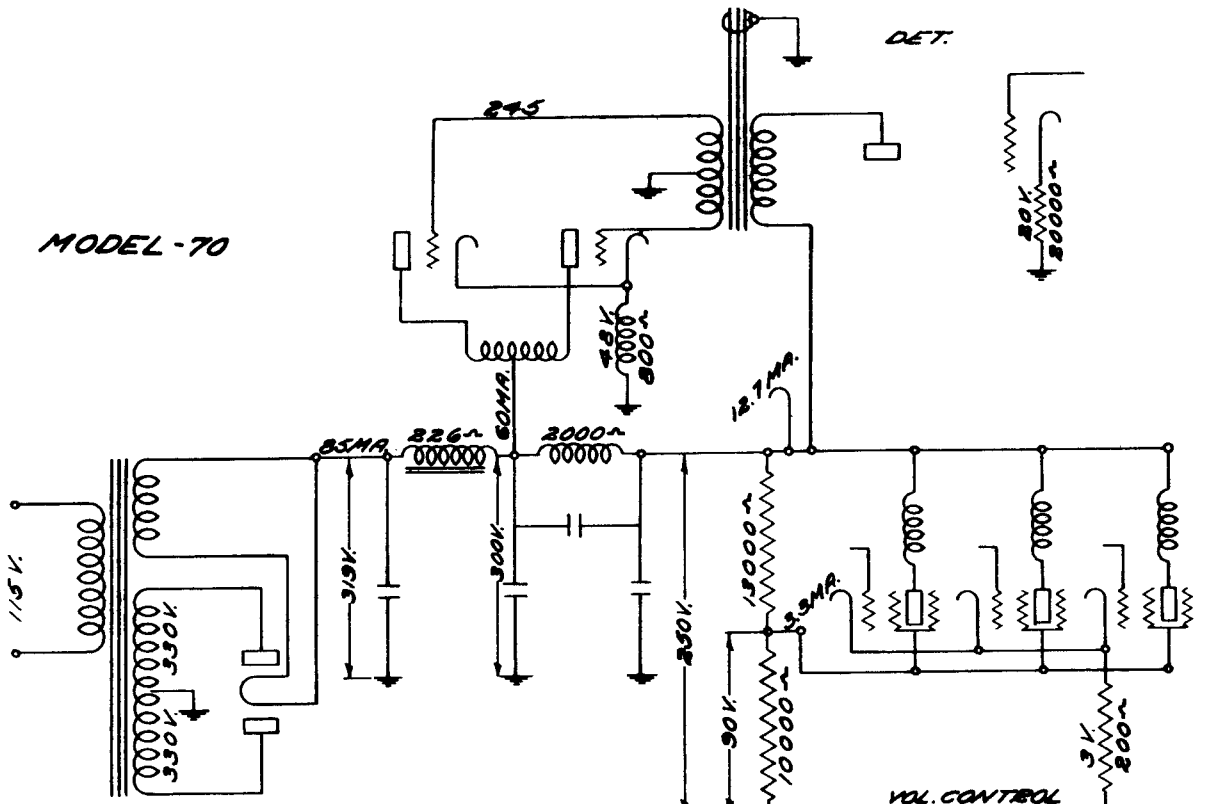
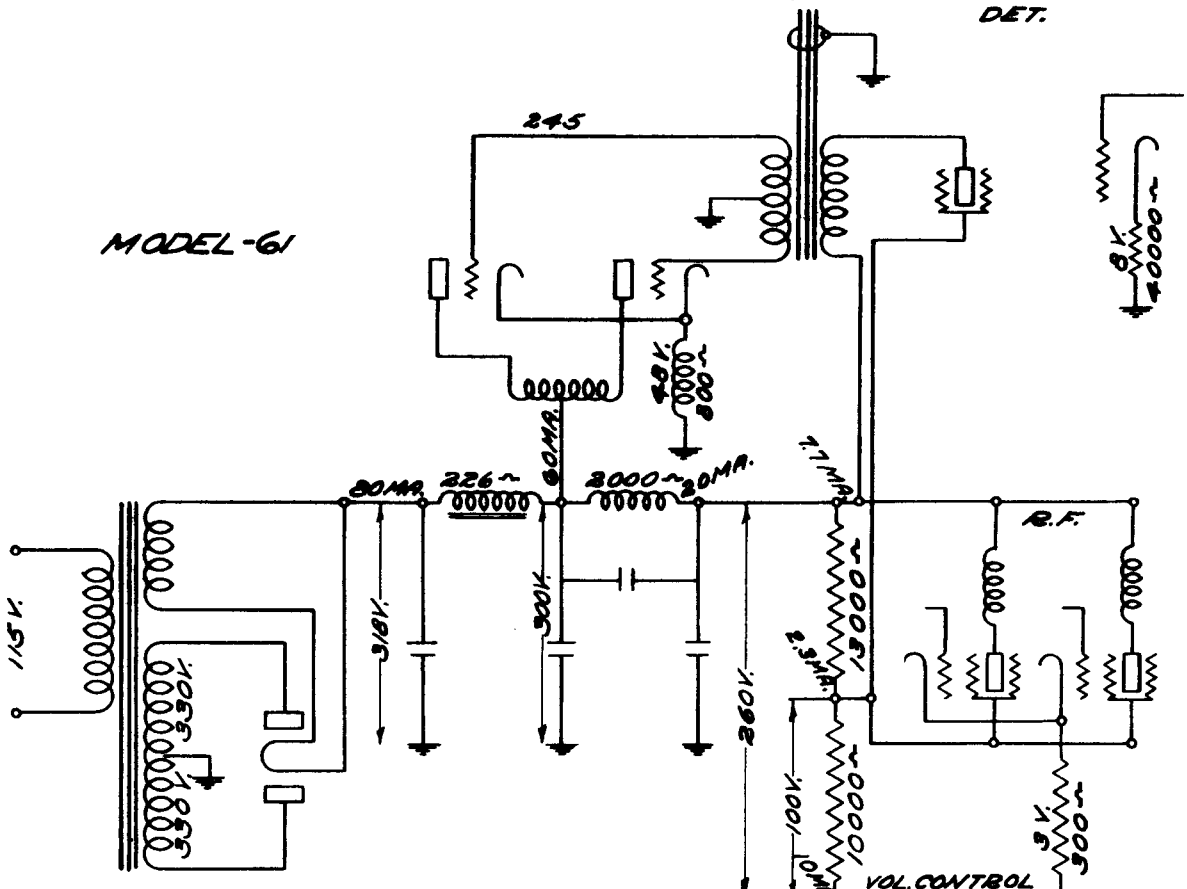
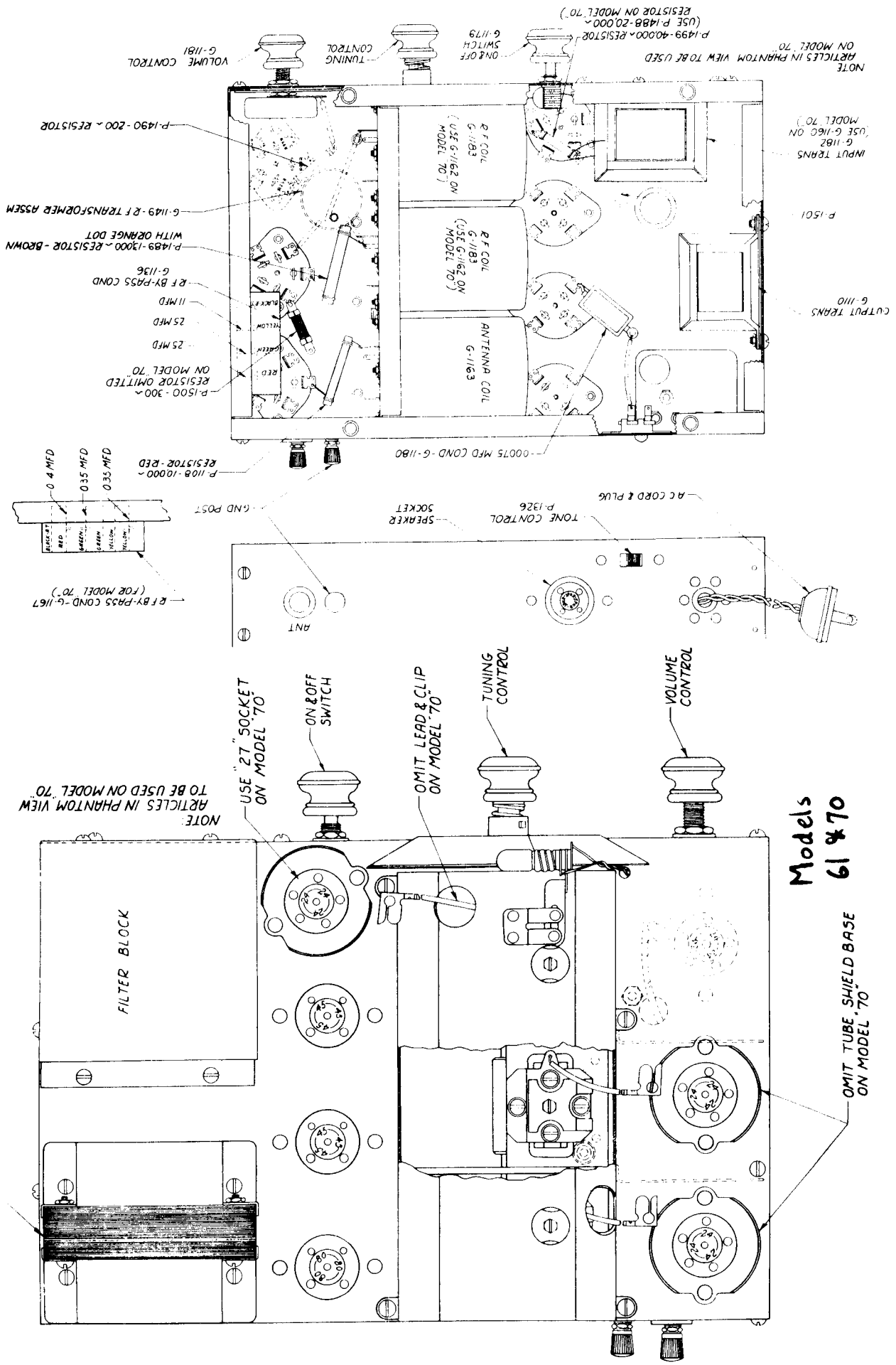


CIRCUIT BREAKDOWN ANALYSIS
MODEL-70



CIRCUIT BREAKDOWN ANALYSIS
MODEL-61

TRANSFORMER CORP. OF AMERICA



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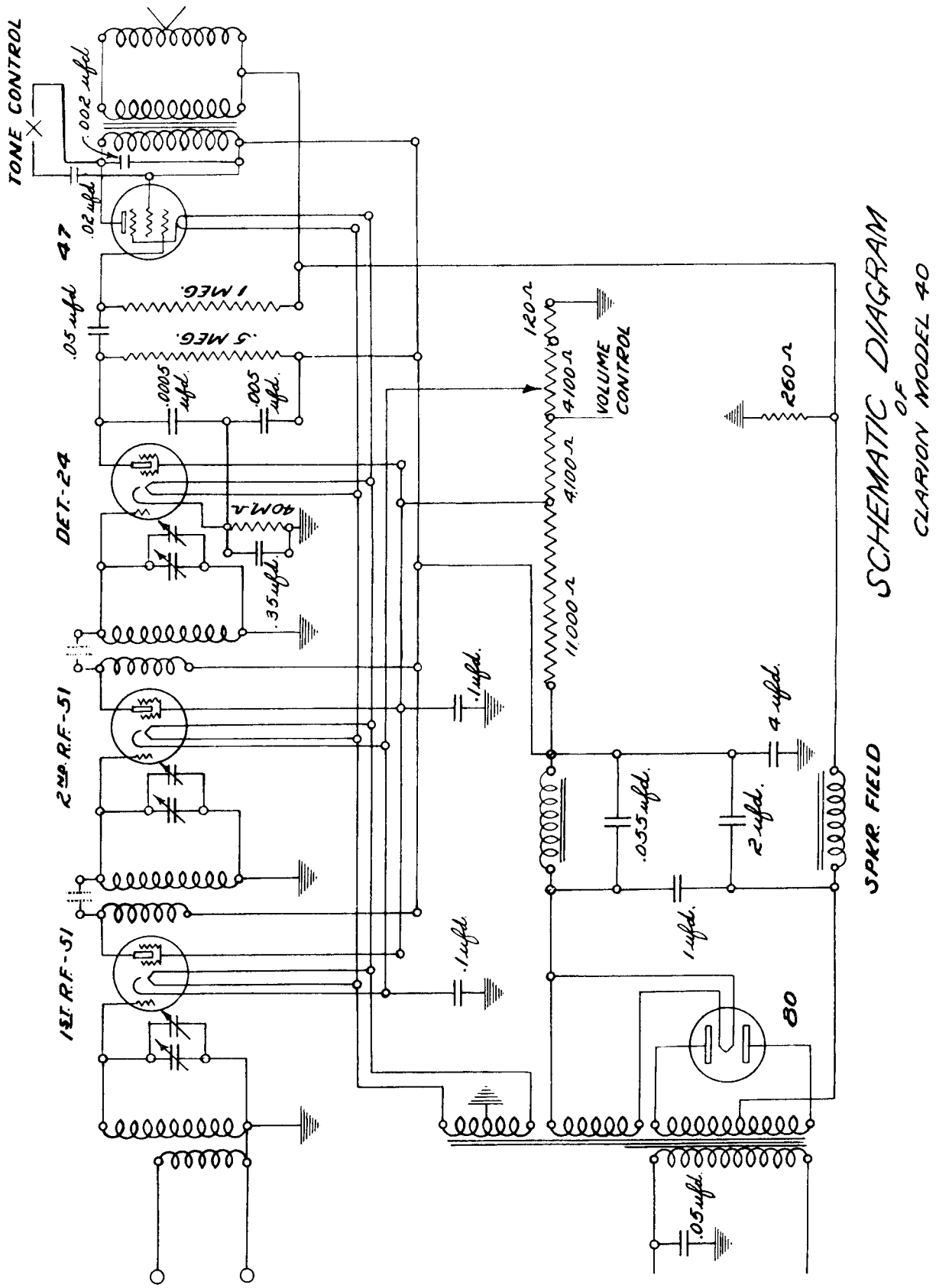
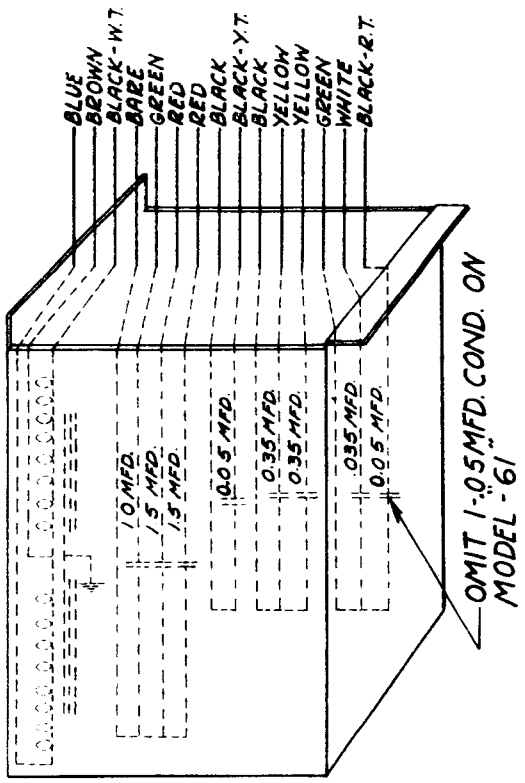
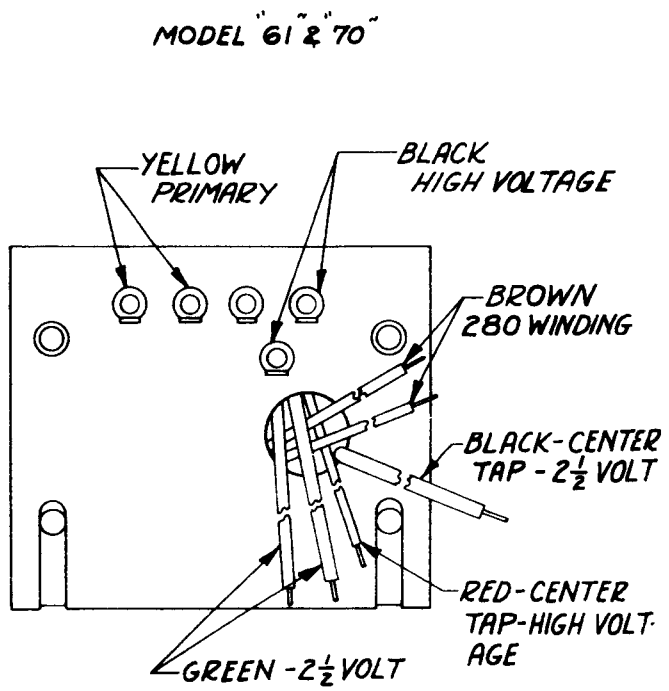


SCHEMATIC DIAGRAM OF CLARION MODEL 40

TRANSFORMER CORP. OF AMERICA

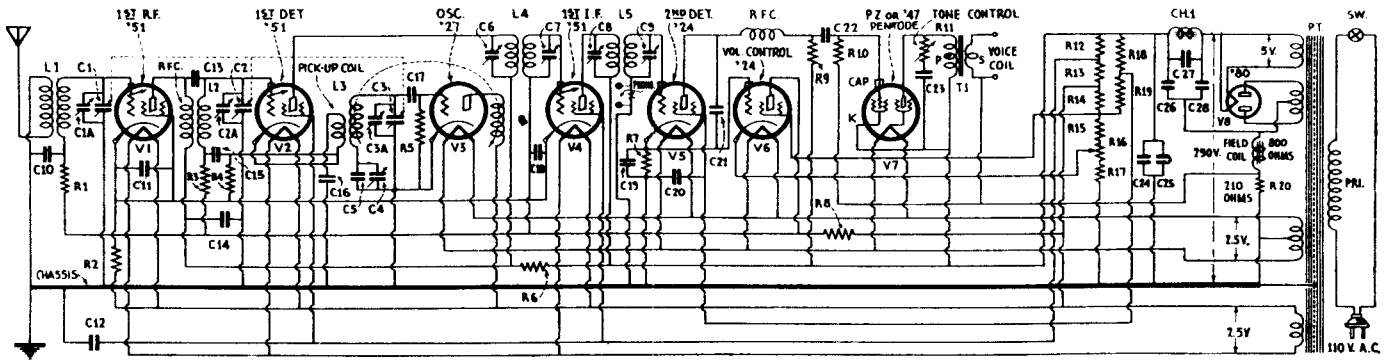


60 CYCLE FILTER BLOCK



60 CYCLE POWER TRANSFORMER

MODEL 90

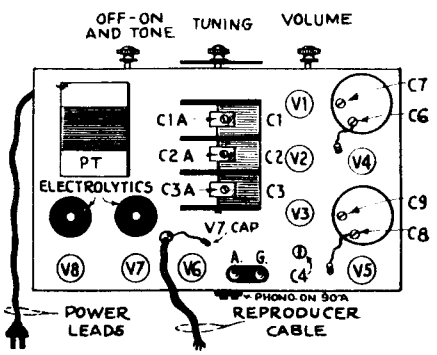


Schematic circuit of the highly-developed midget and console Clarion "Series 90" superheterodyne receivers; these utilize both variable-mu and pentode tubes, with automatic volume control. (Note: in the manufacturer's "breakdown analysis" illustration of this receiver, condensers C24 and C25 return to the juncture of R10 and R20, instead of to the chassis.)

All available constants are as follows: condensers C1, C2, C3, tuning units; C1A, C2A, C3A, shunt trimmers; C5, C21, .0008-mf.; C6, C7, C8, C9, I.F. circuit trimmers; C10, C15, C16, C18, C20, C22, C23, .05-mf.; C11, 0.25-mf.; C12, 1.0-mf.; C14, C24, C27, C28, 0.1-mf.; C17, .00005-mf.; C19, 0.35-mf.; C25, C26, 8 mf. (electrolytic).

Resistors R1, R3, R6, 1,000 ohms; R2, 230 ohms; R4, 2,000 ohms; R5, R9, 100,000 ohms; R7, 40,000 ohms; R8, ½-meg.; R10, 1.0-meg.; R11, 12,000 ohms; R12, 3,800 ohms; R13, 4,300 ohms; R14, 1,800 ohms; R15, 1,300 ohms; R16, 435 ohms; R17, 400 ohms; R18, 65,000 ohms; R19, 20,000 ohms; R20, 210 ohms.

Operating voltages (with volume control in position "full" and line potential 115 volts) are as follows: Filaments V1, V2, V3, V4, V5, V6, V7, 2.2 volts; V8, 4.6 volts. Plate potentials, V1, 160 volts; V2, 168 volts; V3, 125 volts; V4, 163 volts; V5, 178 volts; V6, 25 volts; V7, 260 volts; V8, 350 volts. Control-grid potentials, V1, 0.9-volt; V2, 7.6 volts; V3, none; V4, 0.6-volt; V5, 6.8 volts; V6, 4.6 volts; V7, 16.5 volts. Cathode potentials, V1, V4, 2 volts; V2, 4.9 volts; V3, none; V5, 9 volts; V6, 4.5 volts. Plate currents (normal), V1, 2.8 ma.; V2, V4, 2. ma.; V3, 9.5 ma.; V5, 0.25-ma.; V6, none; V7, 36 ma.; V8, 72 ma. Screen-grid potentials, V1, V2, V4, 77 volts; V5, 90 volts; V6, 40 volts; V7, 260 volts.



Top view of a Clarion superheterodyne

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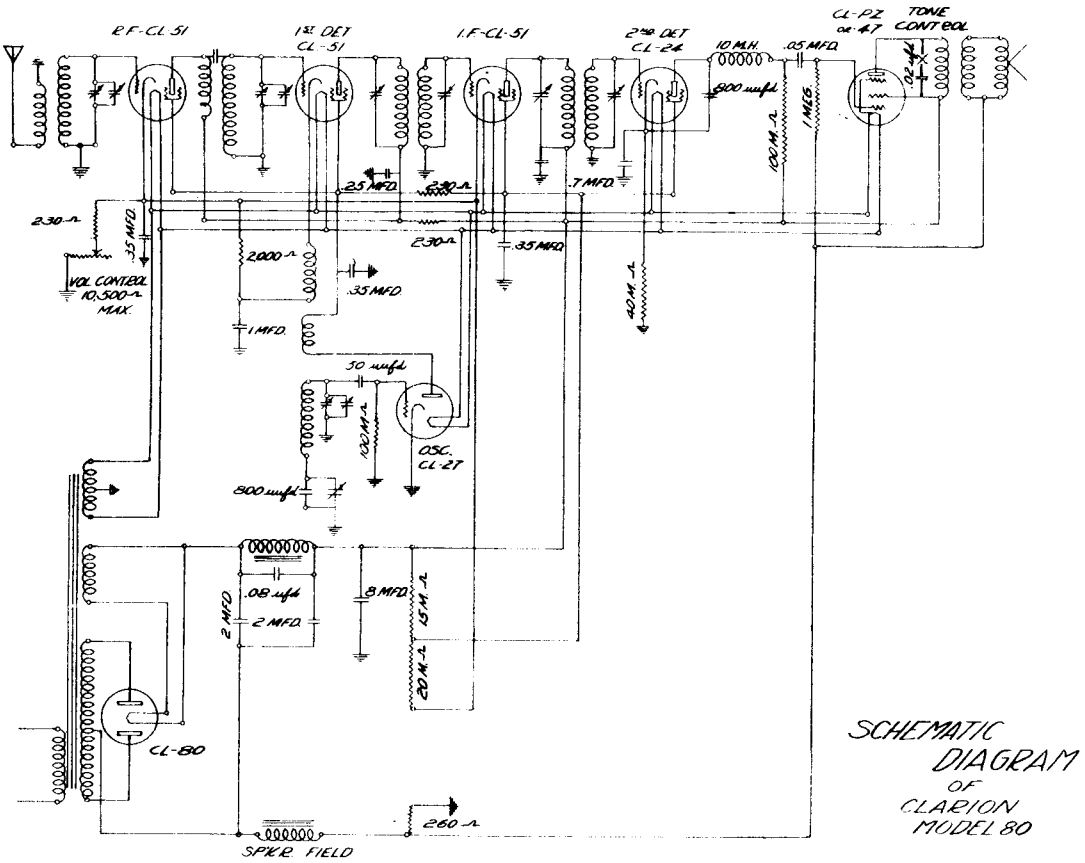
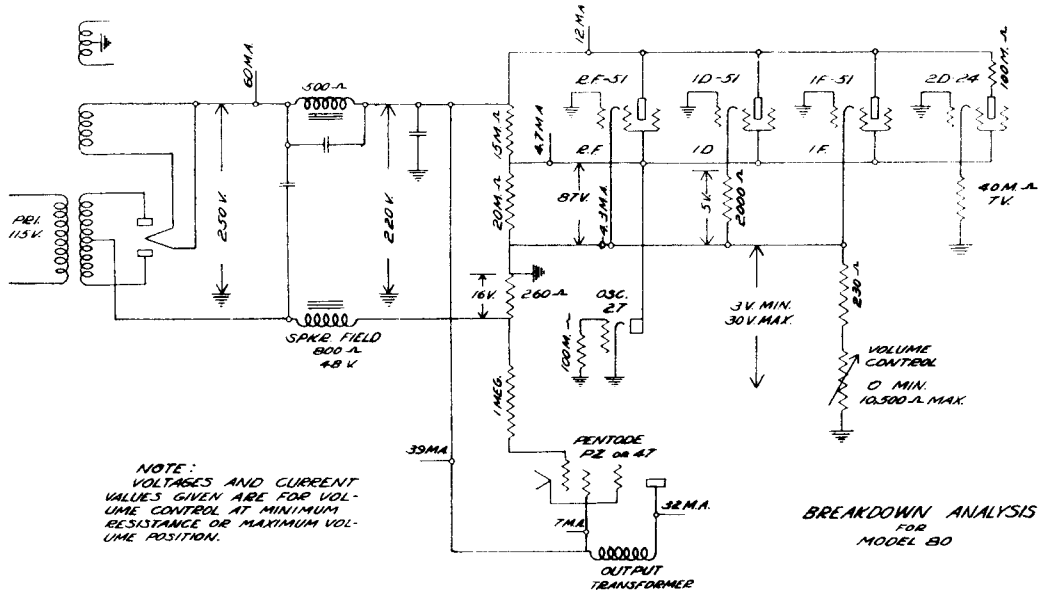


SCHEMATIC DIAGRAM OF CLARION MODEL 80



NOTE: VOLTAGES AND CURRENT VALUES GIVEN ARE FOR VOLUME CONTROL AT MINIMUM RESISTANCE OR MAXIMUM VOLUME POSITION.

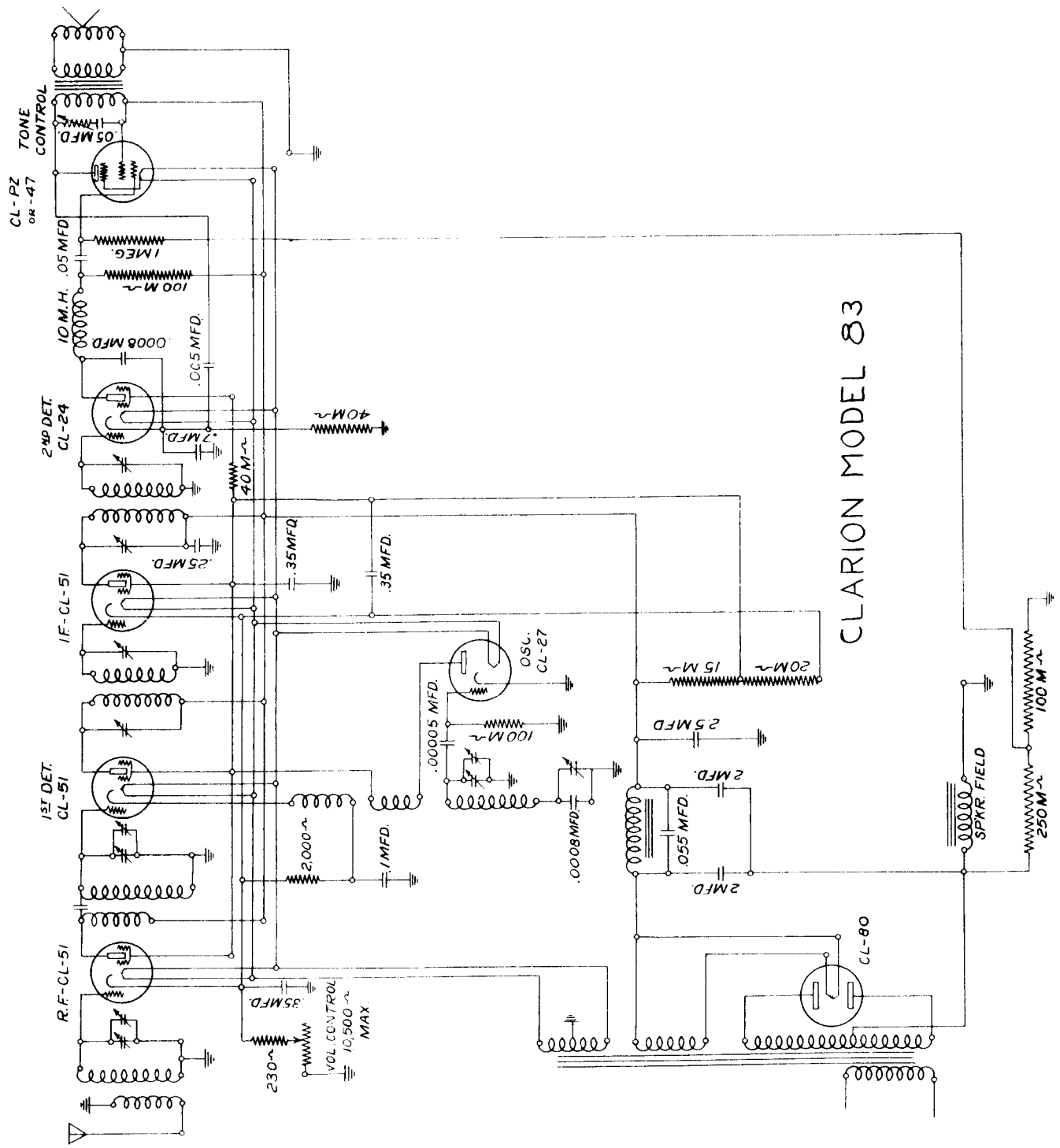
BREAKDOWN ANALYSIS FOR MODEL 80

READINGS TAKEN WITH WESTON MODEL 565 ANALYSER

No.	Stage	Type Tube	A Volts	B Volts	Cont. Grid Volts	Cath. Volts	Ip' Norm.	SG Volts
1	r. f.	CL-51	2.2	233	3.	3.	5.	66
2	1st Det.	CL-51	2.2	233	7.	7.	2.3	73
3	Osc.	CL-27	2.2	80	0	0	4.	0
4	I.F.	CL-51	2.2	233	3	3	5.	77
5	2nd det.	CL-24	2.2	162	6.2	7.2	5	73
6	Output	CL-PZ	2.2	228	15.	0	27.	233
7	Rect.	CL-80	4.8	300	0	0	50.	0

Volume control position **Full** Line Voltage **115**

TRANSFORMER CORP. OF AMERICA



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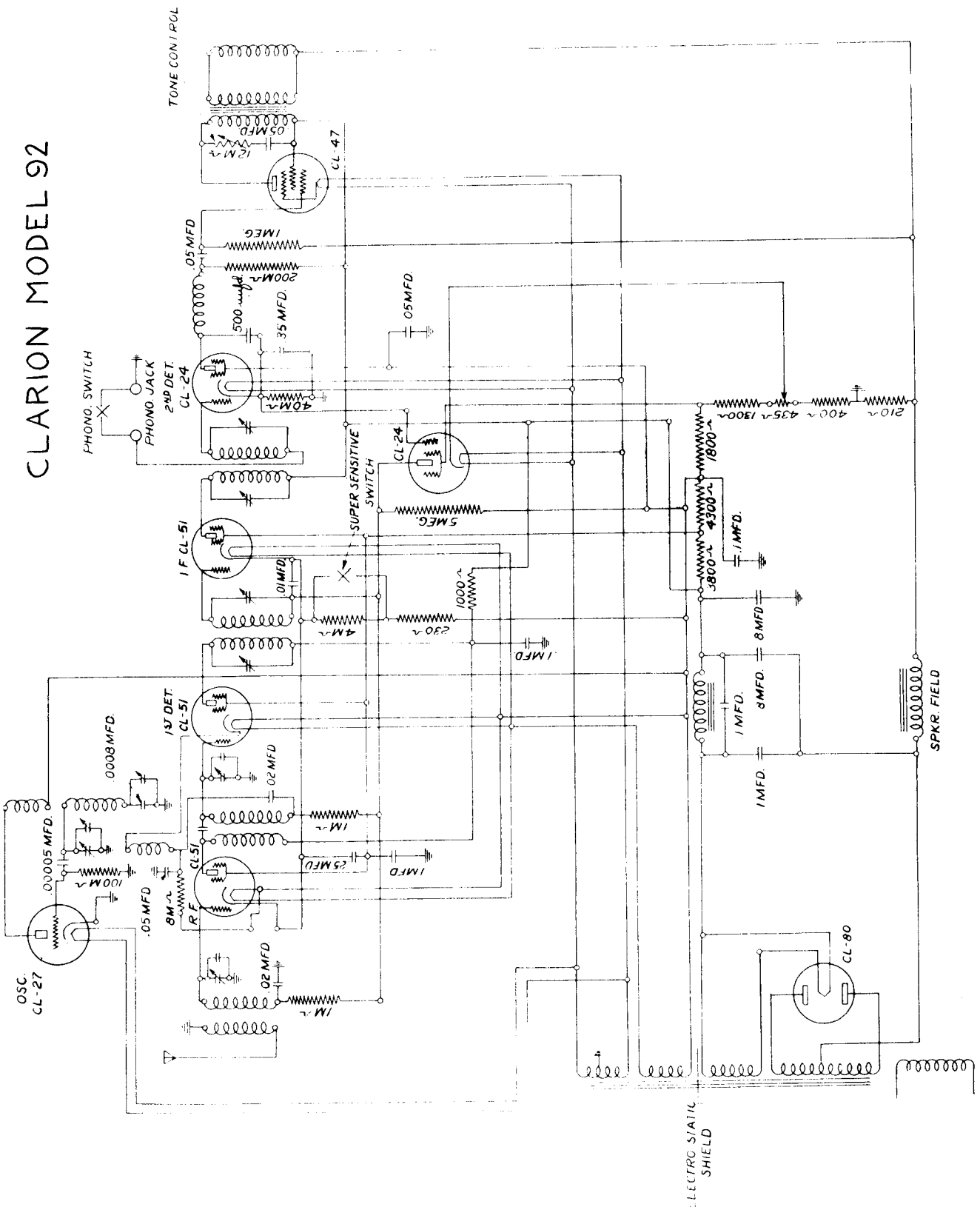
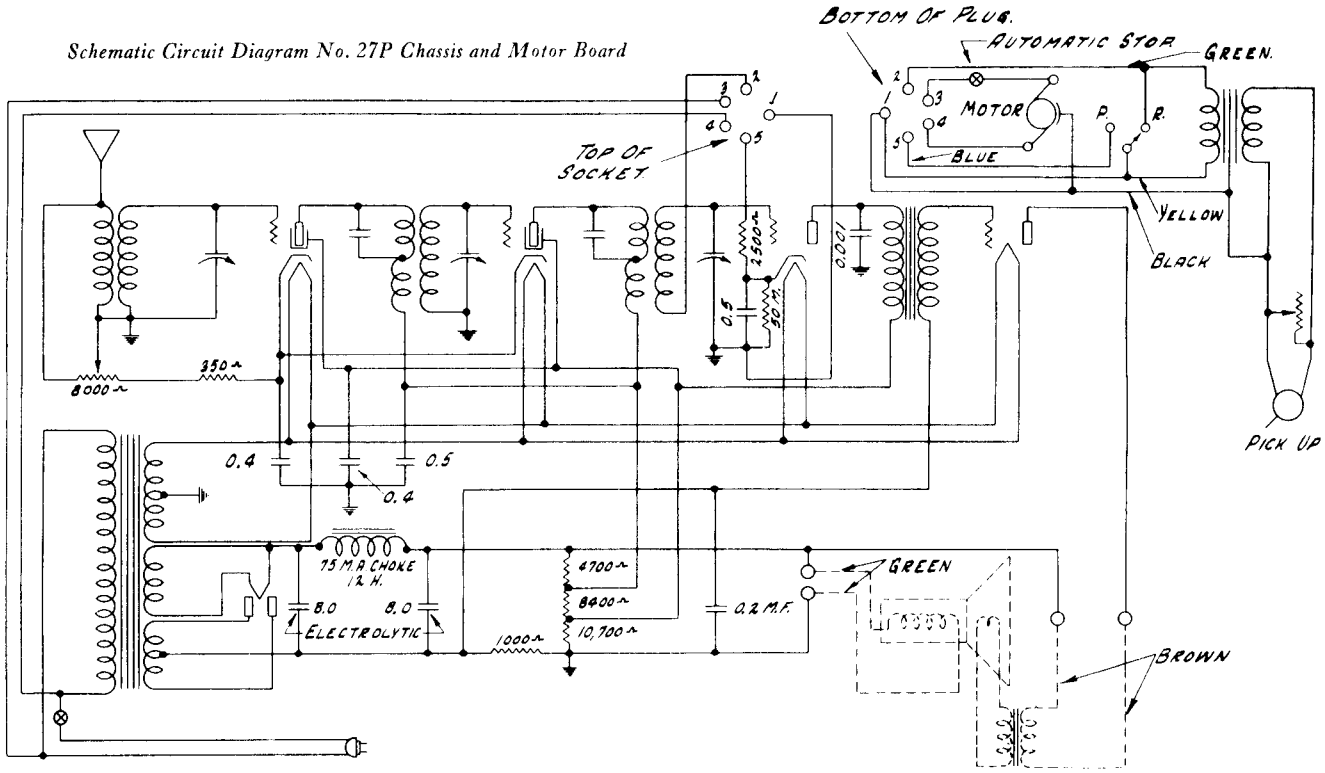
CLARION MODEL 92

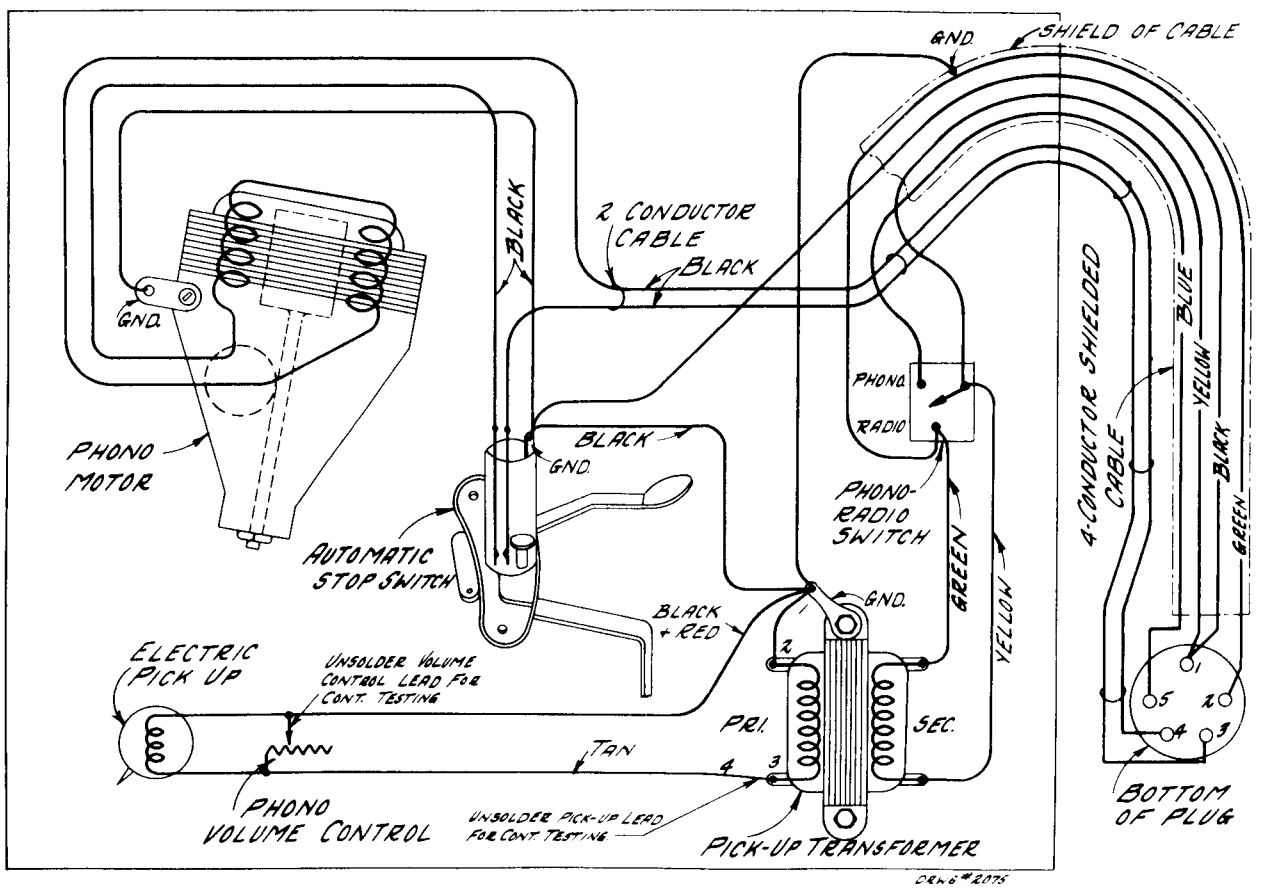


U. S. RADIO AND TELEVISION CORP.

Schematic Circuit Diagram No. 27P Chassis and Motor Board



DOTTED LINES SHOWN ARE IN SPEAKER.



Wiring Diagram, Model 27P Motor Board

TRANSFORMER CORPORATION OF AMERICA

Series 200 Short Wave Clarion Radio

The series 200 Short Wave unit was designed and is intended for use with our series 100 superheterodyne, six tube receiver, and as such comprises our model 140 series broadcast-short wave superheterodyne.

The following service notes, however, concern themselves only with the short wave unit, since our model 100 service manual adequately covers servicing instructions on our series 100 superheterodyne.

ANTENNA

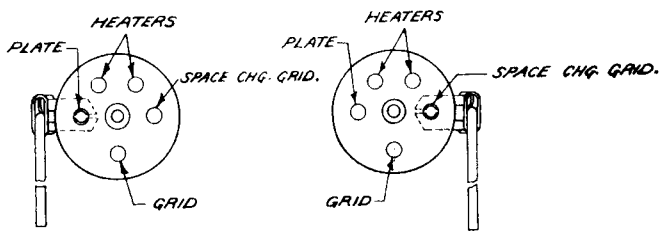
An outdoor antenna up to 150 feet overall, including lead-in should be connected to the post marked ANT on the left hand side of the rear of the chassis. A shorter outside aerial could, of course, be used, but the short wave signals are usually so weak that a long antenna is advisable. An inside aerial also can be used, but this will greatly decrease the distance getting ability of the receiver.

GROUND

It is very important for satisfactory operation that a good ground be connected to the post marked GND on the left hand side of the rear of the chassis.

CONNECTING THE SET

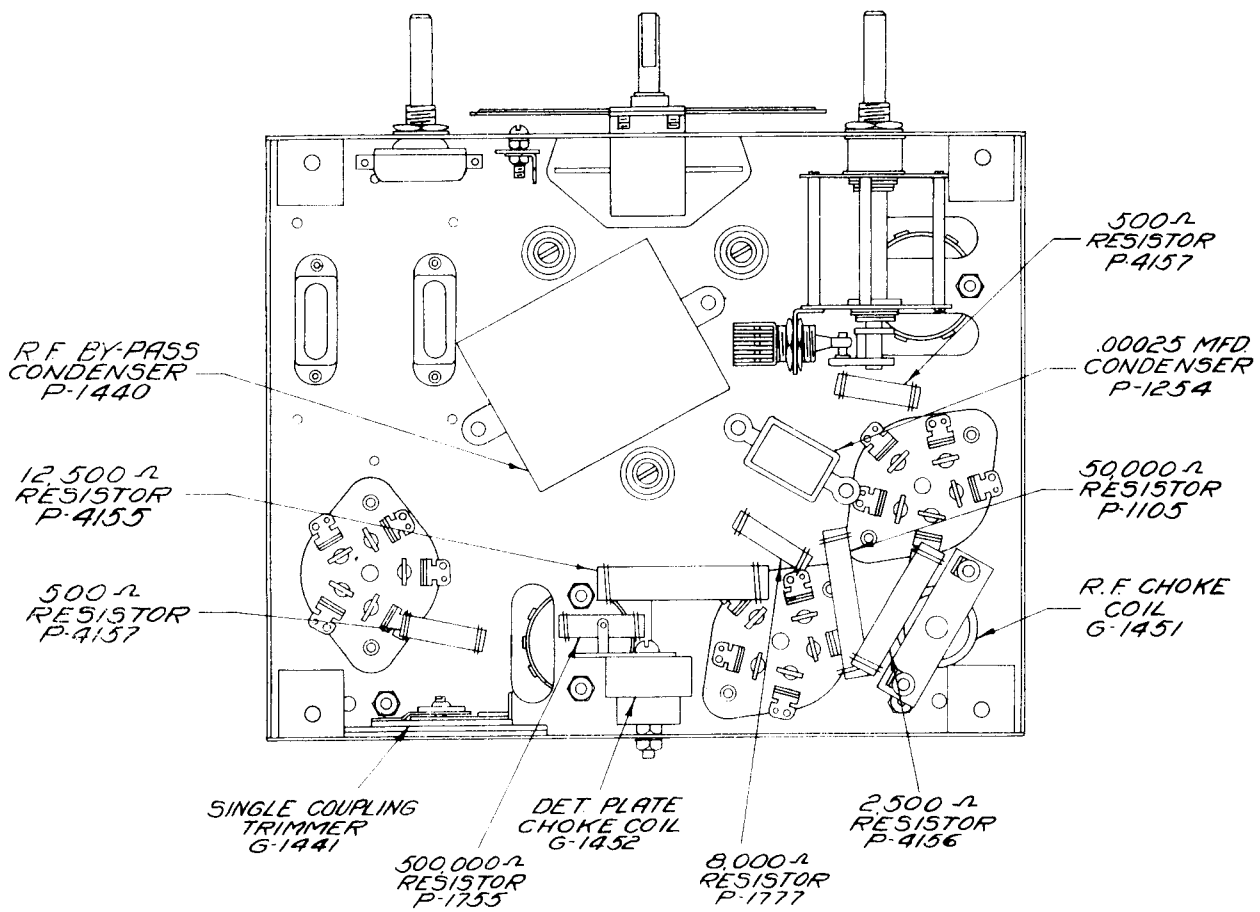
On the right hand rear of the chassis, there are two binding posts marked GND and OUT respectively. A short length of braided, shielded wire is supplied with the unit, and



WRONG
WEAK SIGNALS AND OSCILLATION

CORRECT
STRONGER SIGNALS

THE RIGHT AND WRONG WAY THE LUG CAN BE INSERTED IN THE ADAPTER WAFER



G-200 CHASSIS
BOTTOM VIEW

TRANSFORMER CORPORATION OF AMERICA

this wire should be connected to the "OUT" or output binding post. The outer metal shield has a small piece of wire soldered to it, and this wire should be connected to the "GND" binding post. The other ends of these wires should connect to the antenna and ground binding posts respectively of the broadcast receiver.

The adapter plug at the left hand side of the unit should be inserted into the pentode tube socket of the broadcast receiver, and the pentode tube plugged into the adapter. This supplies "B" power for the unit. The filaments of the tubes in the unit are fed separately through the small transformer located at the front right of the chassis. It should be noted that in the wafer type adapter, ***the lug connection can easily become reversed by mis-handling,*** and an improper connection here, would mean that ***the "B" power for the short wave unit, would be taken from the plate prong of the pentode tube*** rather than from the space charge grid prong ***and the result would be weakness of signals, and oscillation.*** A diagram of the right and wrong connections is, therefore given in this manual.

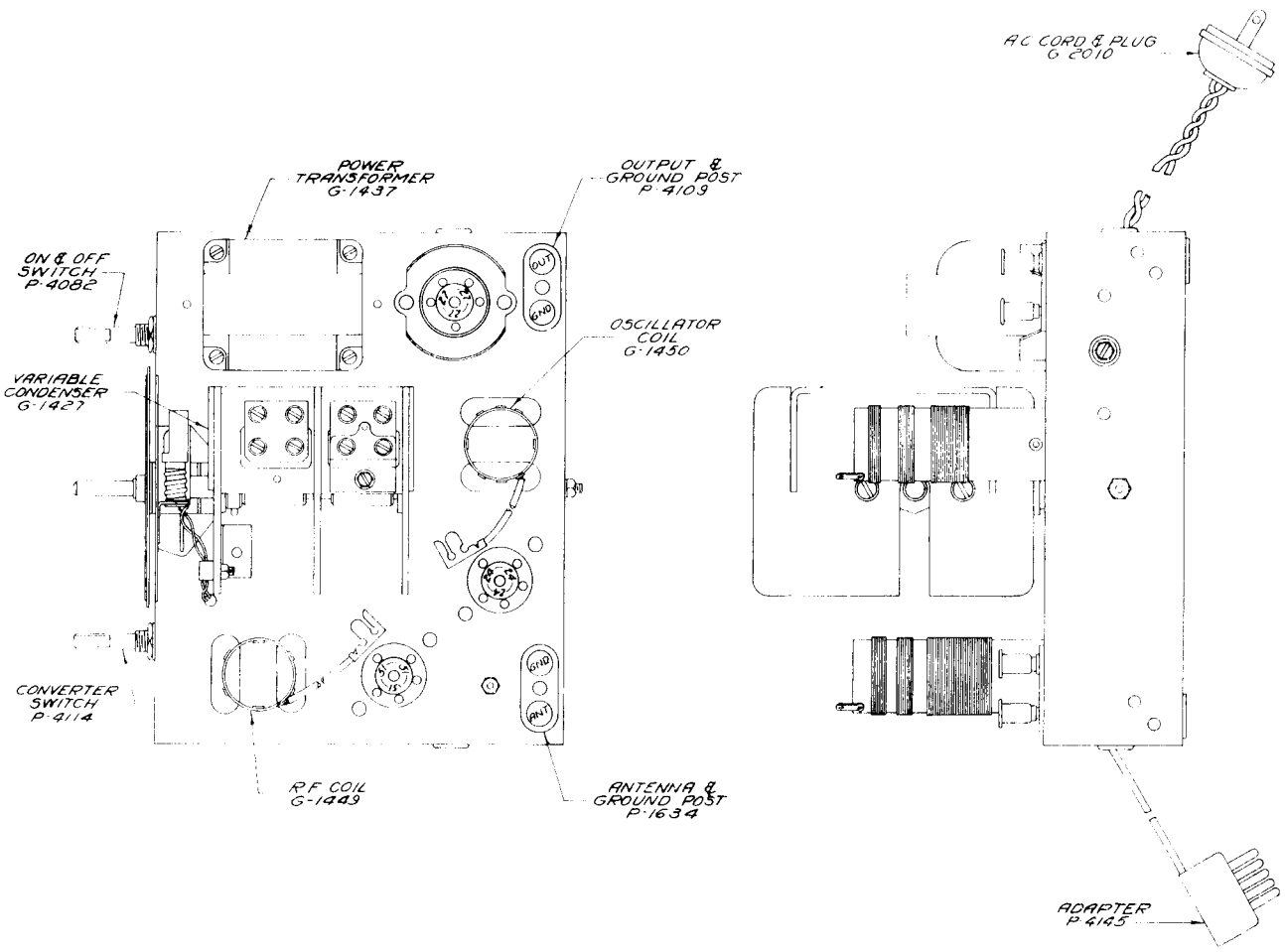
The trimmer adjustment screw on the right rear of the chassis is intended to adjust the output impedance of the unit to the antenna coil of the broadcast receiver into which it operates. This adjusting screw need not be moved if the unit is connected to a model 100 receiver.

TUBES

Three tubes, in all, are employed, one type 27 oscillator, one type 24 detector and one type 51 R. F. tube.

OPERATION

This unit covers a frequency range of from 1500 K. C. to 15000 K. C. For normal broadcast reception, when the unit is working into a standard broadcast receiver, it is only necessary to turn the "Band Switch" [which is controlled by the lower right hand knob and is marked broadcast 550 to 1500 (left)- 1500 to 5500 (center), and 5500 to 15,000 (right)], to the extreme left position and then tune the broadcast receiver. When it is desired to pick up short wave stations between 1500 and 5500 K. C., such as police,



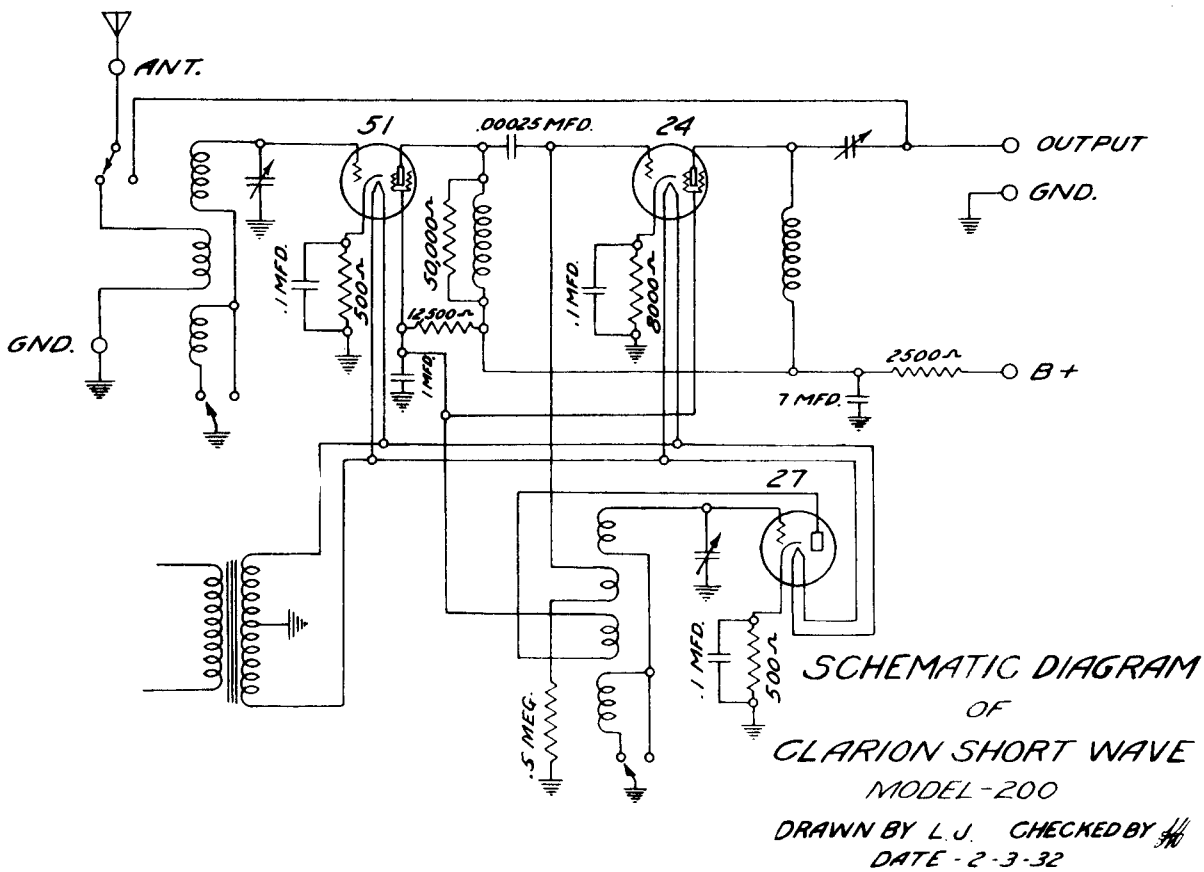
G-200 CHASSIS

TRANSFORMER CORPORATION OF AMERICA

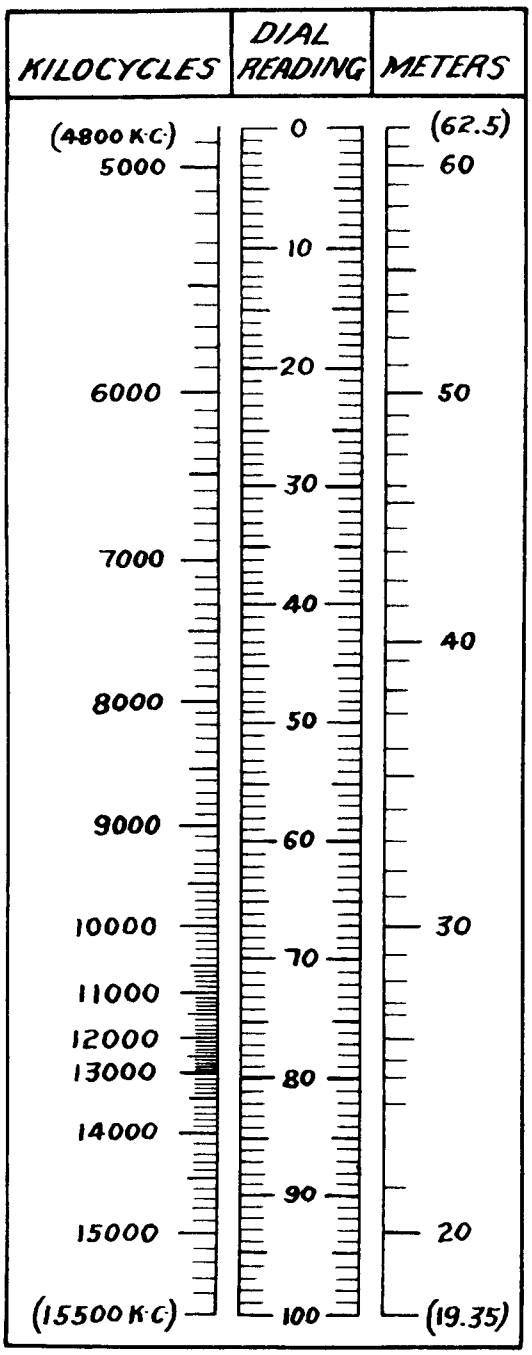
aeroplane, television and amateur phones, the band switch should be turned to the center or "up" position. To receive signals between 5500 and 15,000 K. C., such as foreign stations, the band switch should be thrown all the way over to the right. To assist in tuning we have incorporated diagrams of the 0 to 100 dial scale in this manual with a notation to the left of the scale indicating K. C. calibration and to the right of the scale, indicating calibration in meters, for both bands. This scale should be used in conjunction with a good short wave log book as reference, to facilitate tuning, The double line in the diagram permits logging by pencil spotting at the points where stations are received.

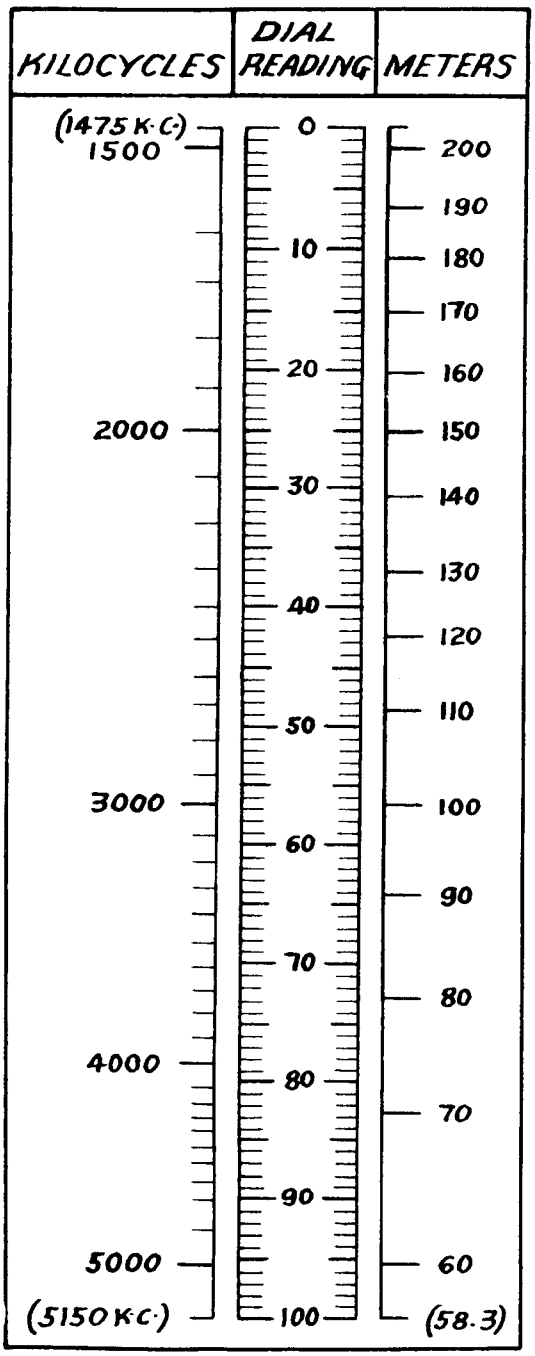
Filament power for the unit is turned on by turning the right hand switch or knob over to the right. The broadcast receiver operating in conjunction with this short wave unit should be adjusted to 600 K. C. to maintain accurate calibration on the short wave unit, as shown by the calibration diagram in this manual. Since the sensitivity of various broadcast receivers will differ over the broadcast range, ***it is advisable to try adjusting the broadcast receiver to 600 K. C., then to 1000 K. C., then to 1500 K. C.,*** and select that setting which gives loudest signals from any short wave station. This will have no effect on the short wave set's operation that will be detrimental, but will merely shift the calibration of your short wave receiver between five and seven points over to the right, or higher frequency. It should be noted that any short wave station can be tuned in at two settings on the short wave dial, the first setting will be found from the log book you are using through comparison with the calibration diagram in the manual, the second signal from the station will be an ***image*** frequency signal and this image signal will come in rather weakly at exactly twice the broadcast dial setting frequency less than the original short wave setting or fundamental frequency of the station. As an example to explain this, let us take station WIXAZ, Springfield, Mass., at 9570 K. C. With your broadcast dial set at 600 K. C. this station will tune in at approximately 63 on your short wave dial. Twice the broadcast setting frequency, which happens in this instance to be 600 K. C., equals 1200 K. C., and 1200 subtracted from 9570 equals 8370. which will bring an image frequency of the same station at approximately 51 on the short wave dial.

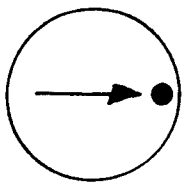
As a technician, you should be able to advise the short wave initiate not to expect unreasonable performance or extremely unusual reception from a high frequency (short wave) receiver. The great amount of advertising and publicity given high frequency reception recently, is very mis-leading, unless one sits down and carefully considers the conditions which must be met



TRANSFORMER CORPORATION OF AMERICA



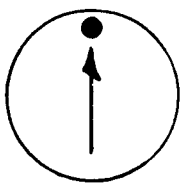




RIGHT

5500 TO 15000 K·C.

5.5 TO 15 MEGACYCLES



UP

1500 TO 5500 K·C.

1.5 TO 5.5 MEGACYCLES

AVERAGE CALIBRATION OF MODEL 200 DIAL SCALE

TRANSFORMER CORPORATION OF AMERICA

in order to receive foreign stations. No one would accept responsibility for foreign reception due to the many conditions surrounding the reception over which the radio has no control. *The model 200 is capable of foreign reception, but cannot be guaranteed.* Foreign reception may be attempted between 11 A. M. and about 6 P. M. for the users in the United States. World time differences account for reception in not being readily available at other hours, providing atmospheric conditions were favorable, which, by the way, they seldom are.

A simplified *time chart* diagram is given in tabulated form in this manual to assist you in determining times at various parts of the world, as compared to your local time, and the sub-notes appended to this diagram should make it self-explanatory.

Before tuning for foreign stations, one should have a ***reliable radio log*** of which there are many on the market, for example the Listner's Official Log, published by the All American Service, 5707 N. Clark St., Chicago, Ill. The customer is apt to be mislead into believing that foreign reception is easily accomplished since on his broadcast receiver he may often hear relayed programs from foreign stations, which relayed, signals may come to him clear and understandable from his local broadcasting station, but it should be pointed out that such relaying of foreign programs is only accomplished under great difficulty and at a great expense. It has been stated elsewhere that the picking up of a foreign program for relay purposes often requires about a dozen receiving sets, sometimes more, situated in towns up and

WORLD CITIES	*YESTERDAY												*TODAY													
FIJI	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	180°
UNALASKA	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	165°
HONULULU	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	150°
JUNEAU	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	135°
LOS ANGELES	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	120°
DENVER	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	105°
CHICAGO	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	90°
NEW YORK	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	75°
BUENOS AIRES	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	60°
RIO DE JANIERO	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	45°
AZORES	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	30°
ICELAND	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	15°
LONDON	XII	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	0°
BERLIN-NAPLES	1	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	15°
CONSTANTINOPLE	2	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	30°
BAGDAD	3	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	45°
MAURITIUS ISL.	4	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	60°
BOMBAY	5	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	75°
CALCUTTA	6	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	90°
BATAVIA	7	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	105°
SHANGHAI	8	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	120°
TOKYO	9	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	135°
MELBOURNE	10	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	150°
NEW CALEDONIA	11	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	165°
FIJI	12	I	II	III	IIII	V	VI	VII	VIII	IX	X	XI	XII	1	2	3	4	5	6	7	8	9	10	11	12	180°
	*TODAY													*TOMORROW												

DEGREES OF LONGITUDE WEST OF GREENWICH. — G.M.T. — DEGREES OF LONGITUDE EAST OF GREENWICH.

NOTE:
ARABIC NUMERALS, 1-2-3 ETC. REPRESENT HOURS A.M.
ROMAN NUMERALS, I-II-III ETC. REPRESENT HOURS P.M.

READ ACROSS TO TIME IN YOUR CITY AND THEN UP OR DOWN STRAIGHT TO TIME IN CITY OR PLACE DESIRED.

*FOR READINGS UP OR DOWN WITHIN A SAWTOOTH SECTION TIME SHOWN IS THE SAME DAY.
FOR READINGS DOWN THRU A SAWTOOTH LINE TIME SHOWN IS FOLLOWING DAY.
FOR READINGS UP THRU A SAWTOOTH LINE TIME SHOWN IS PREVIOUS DAY.

WORLD TIME CHART

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down the Atlantic seaboard. The fading at one receiving station being unnoticed at another receiving station, permits them to feed all received programs to a common point, and relay the average value of all these programs and does provide a stable signal.

In tuning the short wave receiver, it should be remembered that by their nature, these signals are tuned with extreme sharpness, and it is easy to pass over a station without even hearing it. It is for this reason that a high gear ratio is used in the short wave dial drive, but even this avails nothing if the operator tunes quickly or carelessly. It is a good plan to tune as closely as possible to the short wave station, and then ***make a fine adjustment to bring the station in clearly by adjusting the broadcast dial,*** which acts as ***a Vernier control*** on intermediate frequency; this intermediate frequency, we speak of being really the output of the short wave unit or the frequency to which the broadcast receiver is tuned.

TESTS

A continuity test of the circuits of this unit are listed in the manual for your guidance.

Analyzer test readings are also given, but in making an analyzer test of this unit, it should be remembered that the "B" power for the short wave set is drawn through the adapter plug under the pentode tube from the broadcast receiver, and any erroneous current or voltage reading shown by an analyzer test of the short wave unit should always be traced back to determine if the cause is not in the broadcast set itself or the adapter plug.

CONTINUITY TABLES

Taken With Ten Volt Scale of 1000 Ohm Per Volt Meter in Series With 4.5 Volt Battery

Circuit Tested	From	To	Readings	Your Readings
Ant. Primary	Ant. Post	Ground Post	4.5	
R. F. Grid	R.F. Grid Clip	Ground	*4.5	
R. F. Cath	R. F. Cath Prong	Ground	4.2	
R. F. Screen	R. F. Screen Prong	Space Charge Grid Prong on Adapter	1.6	
R. F. Plate	R. F. Plate Prong	Space Charge Grid Prong on Adapter	3.5	
Osc. Grid	Osc. Grid Prong	Ground	*4.5	
Osc. Cath	Osc. Cath Prong	Ground	4.2	
Osc. Plate	Osc. Plate Prong	Space Charge Grid Prong on Adapter	1.6	
Det. Grid	Det. Grid Clip	Ground	.05	
Det. Cath	Det. Cath Prong	Ground	2.5	
Det. Screen	Det. Screen Prong	Space Charge Grid Prong on Adapter	1.6	
Det. Plate	Det. Plate Prong	Space Charge Grid Prong on Adapter	3.5	

*When testing grid circuits, throw switch to each short wave band, in turn, while continuity of grid is established. This checks complete switching arrangement.

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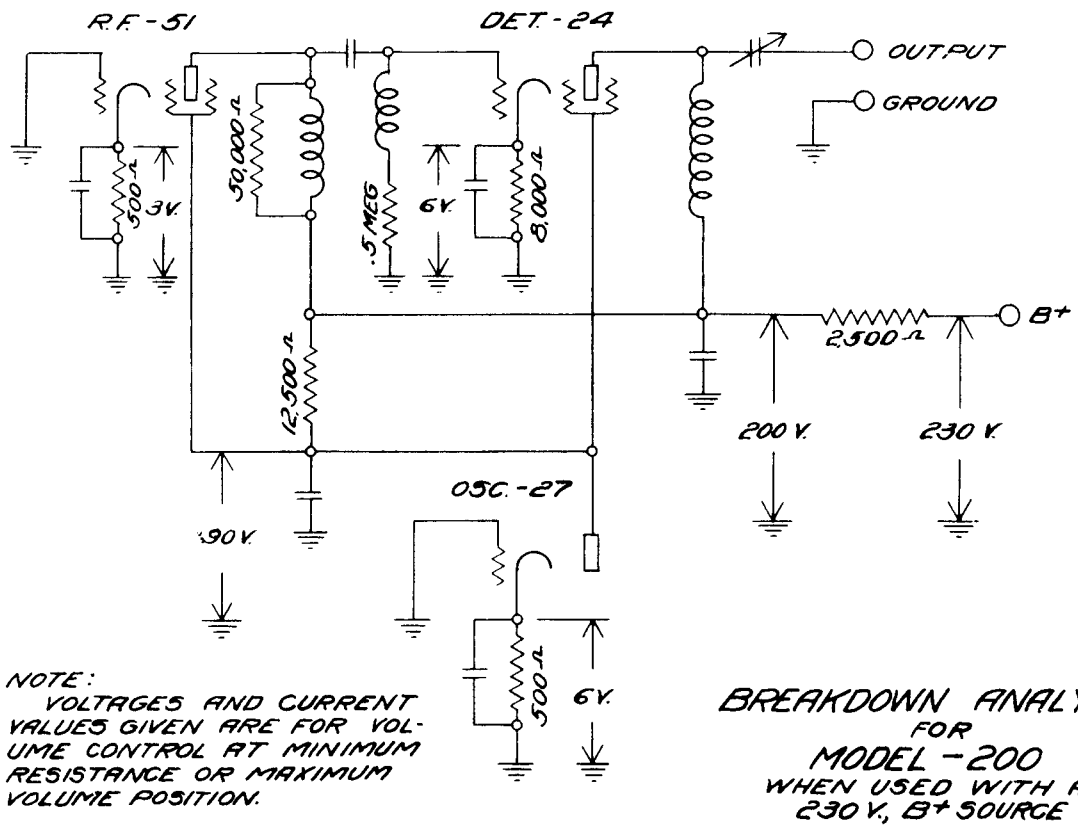
VOLTAGE ANALYSIS

Readings Taken With Western 565 Analyser

No.	Stage	Type Tube	"A" Volts	"B" Volts	Cont. Grind Volt	Cath. Volts	S. G. Volts	Ip. Norm.
1	R. F.	51	2.3	190	1.	1.	50	3.
2	Osc.	27	2.3	155	0	0	0	6.
3	Det.	24	2.3	180	.4	3	50	.4

Line Voltage 115. Switch Position 55,000 K. C. Band.
(Broadcast Volume Control Full On)

Since resistance tolerances in the sets are plus or minus ten per cent and tubes may vary over twenty per cent, your readings may disagree with the above by plus or minus, thirty per cent.



NOTE:
VOLTAGES AND CURRENT VALUES GIVEN ARE FOR VOLUME CONTROL AT MINIMUM RESISTANCE OR MAXIMUM VOLUME POSITION.

BREAKDOWN ANALYSIS FOR MODEL-200 WHEN USED WITH A 230 V., B+ SOURCE

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SERIES 220 SUPERHETERODYNE CLARION RADIO

GENERAL

The shipping weight of the model 220 when packed is thirty-two pounds. The dimensions are, height, sixteen and one-half inches, width, thirteen and three-fourths inches, depth, nine and one-half inches. The tube complement is: two type '51, one type '24, one type '57, one type '47 and one type '80. Power, 69 watts at 115 volts.

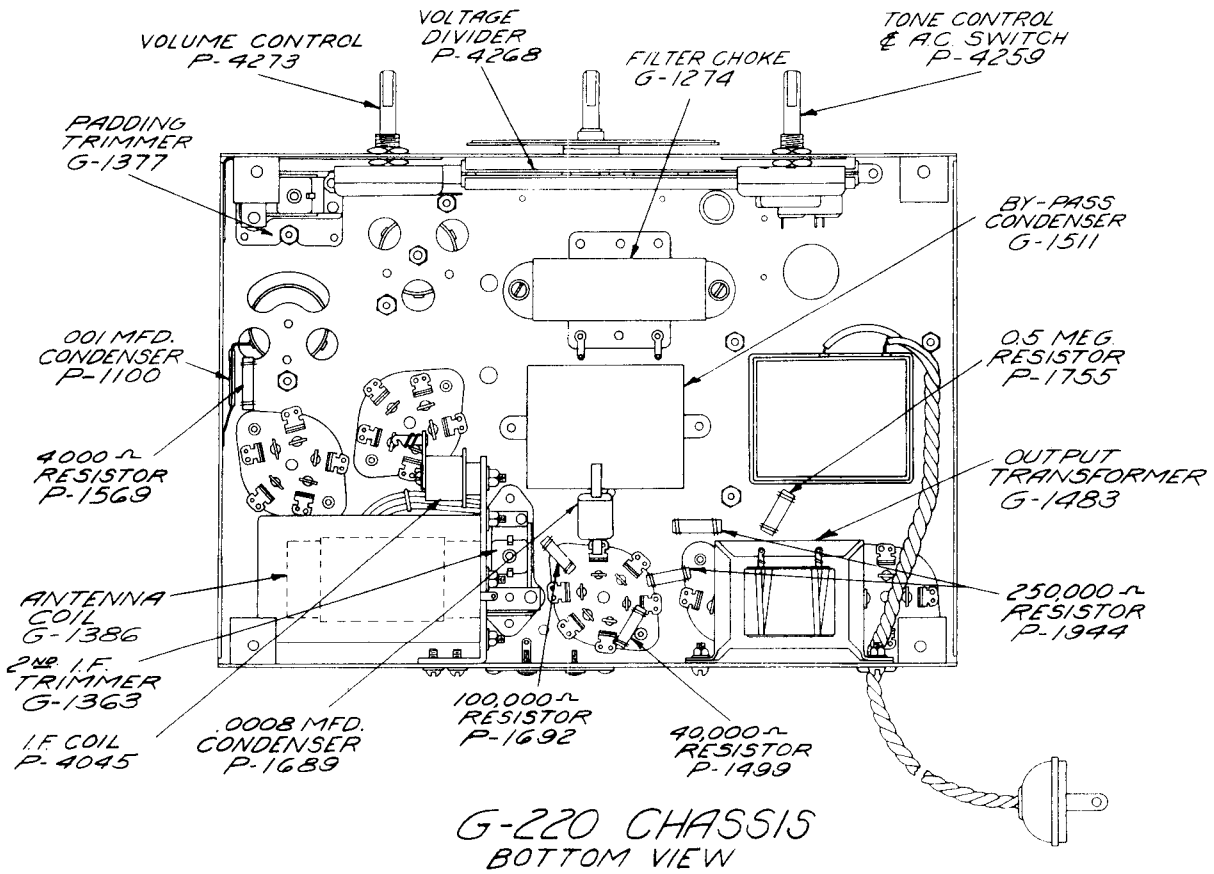
ANTENNA

A standard outside aerial of sixty feet (including lead-in) may be used. The length of the aerial is not critical and increasing the length should not materially reduce selectivity unless high capacity is introduced. The sensitivity may increase with longer antennas, but the noise level will rise proportionately.

Where a strong signal is being received and the long antenna is used, overloading of the tubes can be brought about unless the volume control is turned down. This overload may take the form of a double peak in tuning, reduced volume or distortion of tone, and may often cause a whistle on the station side bands similar to oscillation, when the receiver is being operated at a point considerably beyond comfortable room volume and is attributable entirely to characteristics of the vacuum tube.

No local-distance switch is employed with these models; the volume control is complete in its action, even on very strong signals, and the output of the receiver may be reduced to zero level.

An inside aerial can be used with the receivers if local reception and a moderate distance only is desired, but in modern buildings of steel frame construction, high capacity effects may be present to spoil selectivity and may necessitate a short outside stretch of wire, which in the case of high apartment and office buildings, may be vertical and spaced at least eigtheen inches from the side of the building.



G-220 CHASSIS
BOTTOM VIEW

Fig. 1

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CONNECTING THE SET

Series AC 220 receivers are designed for operation on 110 to 120 volt 50 to 60 cycle alternating current. The series 25-220 are to be operated on 110 to 120 volts 25 to 40 cycles alternating current only.

Do not connect the ground wire to the "ANT" post unless a fixed condenser is connected in series to prevent a burn-out of the antenna coil in the event that a ground occurred in the power transformer. The condenser will act to prevent any heavy current from passing, but will be of low enough reactance to permit temporary demonstration.

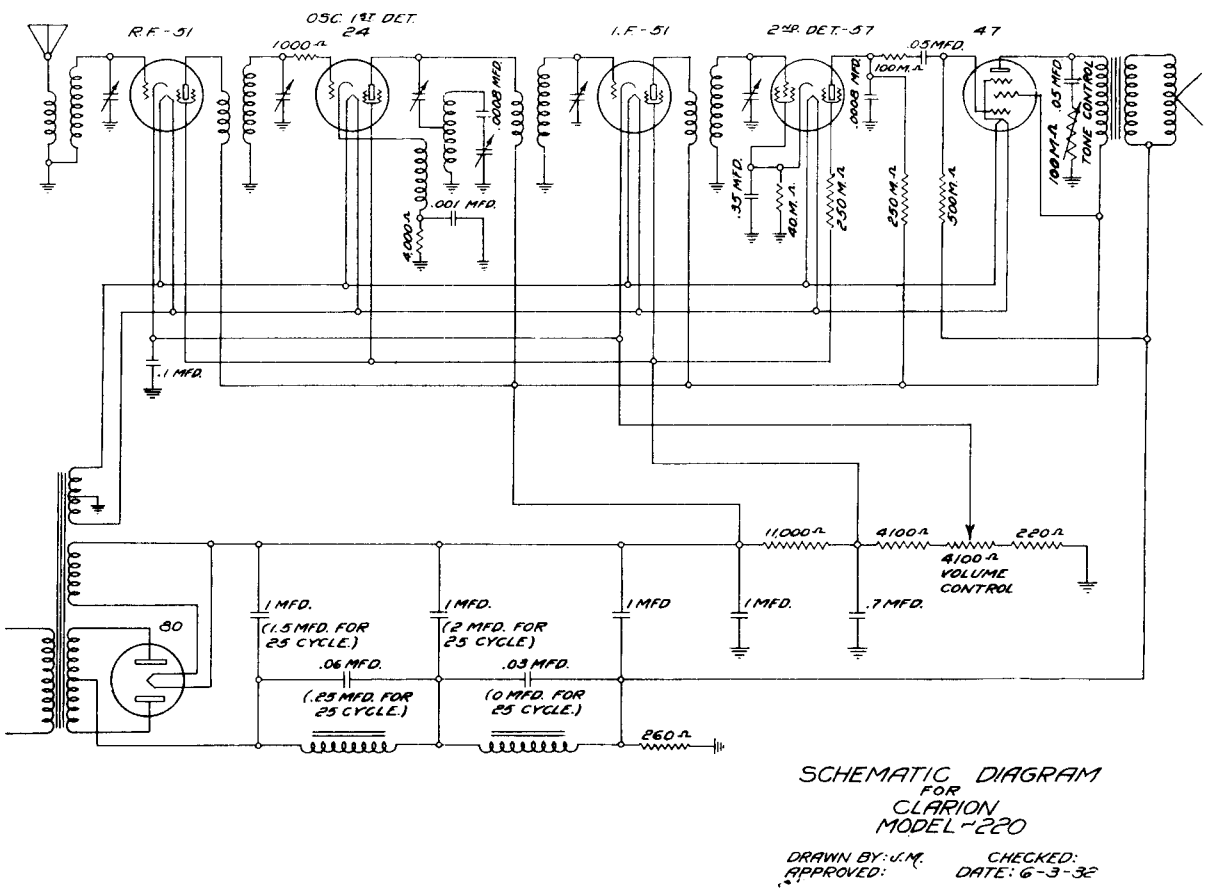
GROUND

A good ground is important to satisfactory operation. Selectivity and stability demand that the installation be COMPLETE. Noisy operation will occur if a poor ground or no ground at all is used, and extraneous noises will be picked up by the receiver, marring reception of distant stations when the ground is connected in series with the condenser and used as an aerial.

To test your ground, connect a hundred watt lamp in series with ground and each side of the 110 volt line in succession. The lamp should light brilliantly from one side of the line to ground. If the lamp does not light at all, it indicates "no ground," and if it lights but dimly, it indicates a high resistance ground which must be corrected. Where the line test indicates that no ground on the power lines is being used, the local power company should be notified, as this condition generally results in hum and back-ground noise in the receiver. A cold water pipe ground is the best, and while grounds to steam pipes and electrical conduit may work in some instances, we do not recommend them at all. A ground rod of brass, copper or galvanized steel might be used. It should be about five feet long and should be driven into moist earth.

If either of these models are connected to direct current an immediate burnout of the transformer primary will occur. It would be advisable to telephone your local light company in any case where doubt exists as to line voltage and frequency.

Connect the antenna to the "ANT" binding post and the ground wire to the "GND" binding post and make sure that the socket into which the 110 volt power cord is plugged



SCHEMATIC DIAGRAM FOR CLARION MODEL 220

DRAWN BY: J.M. CHECKED:
APPROVED: DATE: 6-3-32

Fig. 2

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is alive. This may be tested by connecting a floor lamp or table lamp to the socket, making sure that it lights.

RADIO OPERATION

In the series 220 receivers, power is turned on by turning the right hand knob over to the right — turning this same knob continuously over to the right adjusts the tone control to the "high" position; volume is controlled by the left hand knob, which when turned all the way over to the right, is in the maximum volume position; turning it back over to the left, reduces volume. Tuning is controlled by the upper knob. The indicating scale is calibrated directly in kilocycles to facilitate tuning.

TUBE SHIELDS

Circular tube shields are provided with these receivers and the shields should be firmly in place over the tubes at all times when the set is operating. Removing these shields will cause instability.

CIRCUIT DESCRIPTION

The Superheterodyne circuit is employed in the series 220 receivers. The superhetero-

CONTINUITY TEST TABLES

Taken with 1000 ohm per volt meter and 4.5 volt battery in series

Circuit Tested	From	To	Readings	Your Readings
Antenna Primary	Ant. Post	Ground Post	4.5	
R. F. Grid	Rect. Fil. Prong	R. F. Grid Clip	1.5	
R. F. Screen	Rect. Fil. Prong	R. F. Screen Prong	2.1	
R. F. Cathode	Rect. Fil. Prong	R. F. Cathode Prong	1.5	
R. F. Plate	Rect. Fil. Prong	R. F. Plate Prong	4.5	
Autodyne Grid	Rect. Fil. Prong	Autodyne Grid Clip	1.5	
Autodyne Screen	Rect. Fil. Prong	Autodyne Screen Prg.	2.1	
Autodyne Cathode	Rect. Fil. Prong	Autodyne Cath. Prg.	1.4	
Autodyne Plate	Rect. Fil. Prong	Autodyne Plate Prg.	4.5	
I. F. Grid	Rect. Fil. Prong	I. F. Grid Clip	1.5	
I. F. Screen	Rect. Fil. Prong	I. F. Screen Prong	2.1	
I. F. Cathode	Rect. Fil. Prong	I. F. Cathode Prong	1.5	
I. F. Plate	Rect. Fil. Prong	I. F. Plate Prong	4.5	
2nd Det. Grid	Rect. Fil. Prong	2nd Det. Grid Clip	1.5	
2nd Det. Screen	Rect. Fil. Prong	2nd Det. Screen Prg.	.2	
2nd Det. Cathode	Rect. Fil. Prong	2nd Det. Cath. Prong	.6	
2nd Det. Suppressor Grid	Rect. Fil. Prong	2nd Det Suppressor Grid Prong	.6	
2nd Det. Plate	Rect. Fil. Prong	2nd Det. Plate Prong	.2	
Pent. Cont. Grid	Rect. Fil. Prong	Pent. C. G. Prong	.1	
Pent. S. C. Grid	Rect. Fil. Prong	Pent. Plate Prong	4.4	
Pent. Plate	Rect. Fil. Prong	Pent. S. C. Grid Prg.	4.5	
Autodyne Tuning Ckt.	Green Lead to I. F. Coil	Ground	4.5	
Pwr. Trans. Pri.	Across	A. C. Plug	4.5	
Pwr. Trans. Sec.	Across	Rect. Plate Prongs	4.2	
Spkr. Field	Black Lead Cable	Red Lead Cable	4.2	
Spkr. V. C.	Black Lead Cable	Green Lead Cable	4.5	

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dyne circuit is the most highly efficient circuit of any yet developed. Sensitivity and selectivity, to a degree, hitherto unheard of with tuned radio frequency receivers are possible with the superheterodyne circuit.

The circuit of this set comprises one stage of R. F. amplification, using the type 51 Variable Mu tube. One type 24 is employed as a combination oscillator and first detector in a specially arranged circuit termed the Super-Autodyne.

Feed back is obtained by the close proximity of the cathode pick up coil to the plate tuning coil. Owing to the double use of the type 24 tube in this circuit, it may be found that some tubes are not suitable as oscillators or as detectors. However, by changing the type 24 tube, this difficulty should be eliminated. This fault might have its source in low emission or unusual characteristics, although a test of the tube in a checker may show it to be OK.

One type 51 tube is used in the intermediate frequency stage. A type 57 tube is employed as power detector which is resistance capacity coupled to an output stage, using the type 47 pentode tube.

TESTS

With a superheterodyne receiver, substitution tests are not applicable in view of the fact that three group frequencies are used: R. F., intermediate and audio. To determine roughly the unit which is defective, the chassis and speaker, of course, can be substituted, but a continuity test, we believe, would have more application.

CONTINUITY TESTS

(Applicable to Completely and Partially Inoperative Sets and Circuits)

Service men have indicated to us that profuse reading matter in service manuals is not especially desired, more can be learned from circuit diagrams, sketches and tables than from the printed word. Therefore, we recommend that the circuit diagram be carefully studied, as only sufficient reading matter to clarify unusual points will be used. The following continuity tests were taken with a 4½ volt battery and 10 volt range voltmeter, having an internal resistance of 1000 ohms per volt. A blank column has been left for your convenience in noting the readings across the various circuits listed when using your meter and battery, in view of the fact that your voltmeter may be of lower resistance and give, therefore, lower readings.

To determine which section of the receiver is defective, the second detector tube might be tapped with the finger, listening for a ringing noise in the speaker—this indicates that the audio end is O. K. *A 175 K. C. test oscillator* should be connected to the grid cap of the Super-autodyne tube so that the modulated signal can be reproduced in the loud speaker. This indicates that the Super-autodyne and intermediate frequency stages are operating. To determine if the super-autodyne is oscillating as it should be, a broadcast test oscillator should be connected to the grid cap of the super-autodyne tube. No signal will come through unless the tube is oscillating, and the stage functioning correctly. The R. F. tube, of course, can be checked, lastly by connecting the broadcast test oscillator to the antenna and ground binding posts of the receiver.

VOLTAGE ANALYSIS TAKEN WITH WESTON TYPE 565 ANALYZER.

No.	Stage	Type Tube	"A" Volts	"B" Volts	Cont. Grid	Cath. Volts	Screen Volts	Ip Norm.	Misc.
1	R. F.	51	2.15	245	3.4	3.1	81	5.	
2	Auto-dyne 1st. Det.	24	2.15	240	4.4	5.0	85	1.6	
3	I. F.	51	2.15	245	4.4	3.5	84	7.	
4	2nd. Det.	57	2.25	106	1.8	3.	43	.1	Suppressor Grid 3.
5	Output	47	2.25	245	15.	0	0	31.	Pent-space Charge-Grid 250
6	Rect.	80	4.8	300	0.	0.	0	68.	

Line Voltage — 115 Volts.

NOTE: Since resistance tolerances in the sets are plus or minus 10%, and tubes may vary over 20%, your readings may disagree with the above by plus or minus 30%.

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ANALYZER TESTS

(Applicable to Operative Sets and Circuits Performing Below Normal)

While most breakdowns are of a simple nature and can be readily found with some experience of the receiver circuit and a continuity test of that circuit suspected, there comes to every service man, an occasional set which appears O. K. to all simple tests, but may be just sufficiently noisy, weak or discordant to occasion complaint. It is in this type of complaint that the really high caliber service man is conspicuous, while the less capable may blame the design, the broadcast station, the weather or something else. To approach such a problem, we must assume, first that the set design is right, and all external components, such as tubes, antenna, ground, line voltage and broadcast station or oscillator are known to be free from fault. These conditions being satisfactory, the performance of the receiver will depend on the voltage and current values throughout the receiver. Any discrepancy in these values from a standard set of readings should indicate the cause.

As a rule, the slighter the complaint, the greater the difficulty in determining the fault. For this reason, it would be well to determine if the complaint has a sound basis or is merely a whim of the customer. Occasionally a set may be returned by a customer with no *definite* complaint. Insist that the reason for the return be given with a specific cause for the dissatisfaction.

A set tester or analyzer should be used to determine faults of this nature and the readings should be taken as accurately as possible, then compared with the tables shown here, giving values obtained at the Factory with a line voltage of 115 volts. A marked deviation from the standard value of any circuit immediately places that circuit under suspicion and one should proceed to test that individual circuit for high resistance, open circuit or short circuit, as the case may be.

The manufacturers of analyzers and other test equipment advise us that special adapters have been designed to facilitate testing on the Pentode tube. This tube will require testing with external meter connections (if an old style analyzer is used), to obtain plate voltage reading, control grid voltage and space charge grid voltage. In the test table of voltage and current values, herewith given, the above mentioned values were taken as follows:

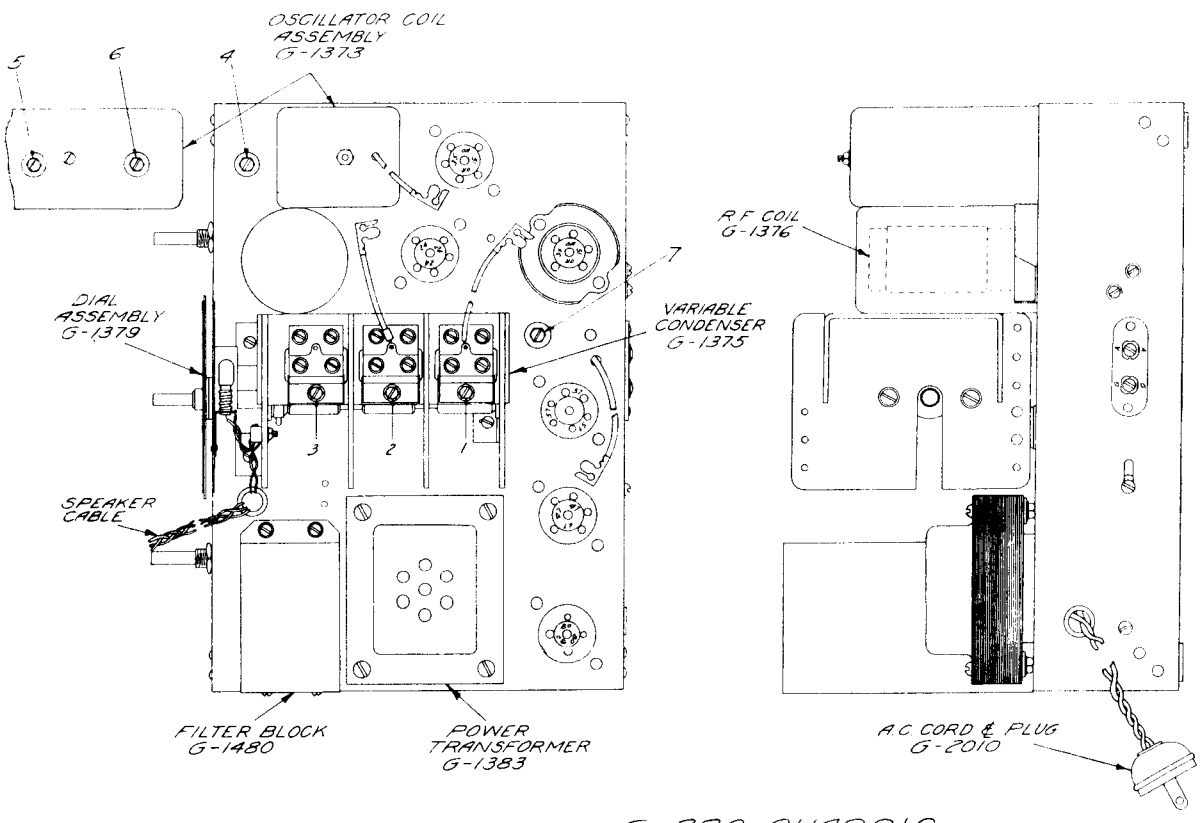

Fig. 3

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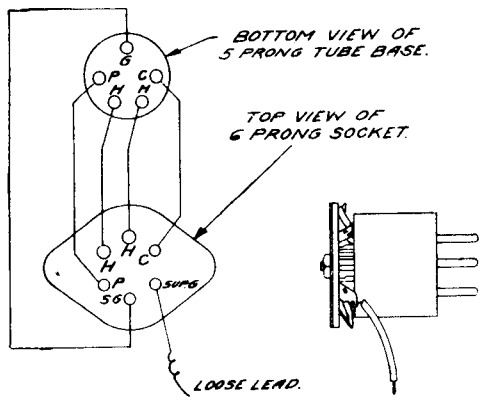
For the plate voltage reading, using the 250 volt scale meter, connect betwen plate and filament prongs. For the control grid voltage, check between the black common lead on the loud speaker voice coil circuit and the ground.

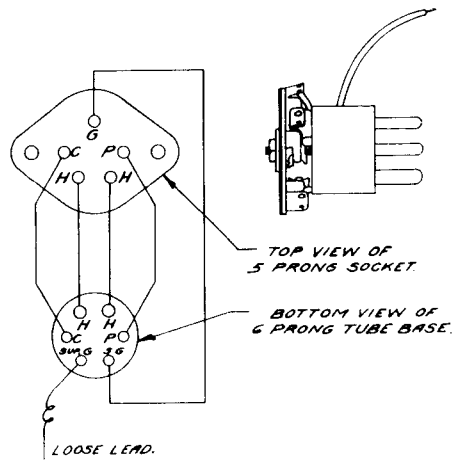
For space charge grid voltage, test between the space charge grid prong and the filament. (It should be noted that the Pentode tube base resembles the type '27 tube base, the prongs having the same connection with the exception of the space charge grid prong on the '47 tube, which will correspond in position to the cathode prong on the type '27 tube.) It might be advisable to have an adapter, either purchased or made up, which would fit into the Pentode socket and into which the '47 Pentode tube would be plugged; the adapter being so arranged that the various terminals are exposed for ready connection during tests.

The type '57 tube employed as second detector, is of the new type with the six pin base. It would be advisable to make up two adapters, if you do not already own them, which will permit an analyzer test of this tube and its circuits. Such adapter plugs can be readily constructed from one defective six prong and one 5 prong tube base, and one five prong and one six prong socket, provided, of course, that your analyzer plug is of the 5 prong variety. The socket and base should be connected together, terminal for terminal, as explained in the accompanying diagram. Two adapter plugs must be made up, since one must plug into the analyzer, to take the six pin tube, and requires a five pin base, and six pin socket; the other is to plug into the set to take the analyzer plug. This adapter requires six pin base and five pin socket.

Leave the connecting wire from the suppressor grid of one six prong base and six terminal socket, respectively, disconnected, and so arranged that the other end of this lead can be readily attached to the cathode, heater, control grid, plate or screen grid terminal in the adapter as the circuit demands. In the case of the model 220, this test should be made with the suppressor grid lead of the special adapter connected to the cathode terminal of the adapter at the set end, and the suppressor lead connected to the cathode terminal of the adapter at the analyzer end. In connecting up these two adapter plugs, especial care should be given to the diagram of connections in the manual, and note that the terminals in the socket and tube base are marked "Heater," "Cathode," "Plate," etc., and that these markings hold good while looking at the bottom of the tube base, and at the top of the socket; turning the socket or tube base around would naturally reverse the position of these terminals.



SKETCH OF CONNECTIONS FOR ADAPTER TO PLUG INTO ANALYZER.



SKETCH OF CONNECTIONS FOR ADAPTER TO PLUG INTO SET.

Fig. 4

"HIGH VOLTAGE" in one circuit will indicate an open circuit in another paralleled circuit having a common supply, or else a short circuit in a component part in series with the circuit having high voltage.

"LOW VOLTAGE" will indicate the reverse condition, *i.e.*, a short circuit in a parallel circuit, or a high resistance connection in series with the circuit having low voltage.

It should at all times be remembered that all voltages are interdependent, *i.e.*, if the voltage at one point is zero (say the '47 tube plate circuit is open), all other voltages will be high, or if the '47 plate is grounded, or the bias resistor is short circuited, occasioning heavy plate current drain, all other plate voltages will be low. Therefore, we cannot assume that because the voltage at one particular point is incorrect, that the trouble lies at this point. This is an effect rather than a cause.

After locating and repairing the trouble, if any is found, the set should be given a final air test to be checked under actual operating conditions for sensitivity, selectivity and tone.

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with the broadcast signal. Tuning should be done by reducing the volume to low audibility and then finding the peak volume.

Inasmuch as the loud speaker reproduces the tone, it should be the next item tested by comparing with another known to be good. Oscillation will also spoil tone quality by cutting out the higher tone frequencies. Broad tuning, on the other hand, may permit another station in an adjacent channel to over-lap. Overloading, another common source of poor tone, arises from improper operation, *i.e.*, tuning a local powerful station with the volume control on full. Only a weak radio would have good tone under such operation.

NOISY OPERATION. Due to its extreme sensitivity, the superheterodyne may appear a trifle noisy on distant reception. However, it will be found that in turning down the volume on any station to equal that of a tuned radio frequency receiver, the superheterodyne will perform as quietly, and possibly more quietly, than the tuned radio frequency set does.

Other than this, loose connections causing intermittent open circuits or short circuits are probably causes. Much of noisy operation arises in location, installation or 110 volt supply. Tubes also are a common source of noisy operation, but we are assuming, in all these tests, that everything external to the chassis and speaker are known to be good.

Where loose connections are suspected, go over all connections with a wood or fiber stick, moving each connection firmly BUT NOT ROUGHLY, listen for clicks or rasping noises from the speaker. Excess vibration on a particular tone occurring repeatedly during the playing of music, generally is due to a loose or vibrating part on the speaker, and roughness or rasping at all tones is usually due to a rubbing voice coil. A rattle may develop if the tube shields are loose.

HUM. All receivers have a characteristic hum which should not be audible through the signal. An excessive hum (where tubes are not causing it) may be due to a breakdown of the filter chokes or filter condensers in the filter pack. Test for an open condenser or a shorted choke coil. Hum may be picked up as local interference and a poor ground would make it worse. A defective 280 tube will give rise to hum. Replacement of the tube is the only remedy.

OSCILLATION. It should be remembered that with an intermediate frequency of 175 k. c. a heterodyne whistle, similar to oscillation, will be picked up at 700 k. c. This is due to the fourth harmonic of the receiver's oscillating frequency beating with the carrier frequency of the broadcasting station to produce an audio note in the loud speaker. However, this condition has been minimized in these receivers and the intermediate frequency of 175 k. c. has been selected by many manufacturers as the one intermediate frequency having most advantages and least disadvantages.

In addition, oscillation may be brought about by a poor ground, or no ground at all being used. High line voltage or omission of tube shields aggravates this condition. "Hot" tubes will seldom cause oscillation in a superheterodyne due to the wide tolerance shown by this circuit.

Also by the following:

An open r. f. cathode by-pass condenser,
An open det. cathode by-pass condenser,
A high resistance connection in series with a by-pass condenser.

Over-loading, as previously mentioned, can cause a whistle, which is similar to oscillation on the broadcast station side bands. Reducing volume on the station should eliminate the whistle.

READJUSTING TRIMMERS

The most important advice we can give you in regard to the adjustment of trimmers would be "don't make 'em." It has been proven conclusively to us that the Factory adjustment of these trimmers will not vary even when the set is severely jarred or dropped. However, if a customer were to tamper with their settings, a readjustment may have to be made. First, let us explain

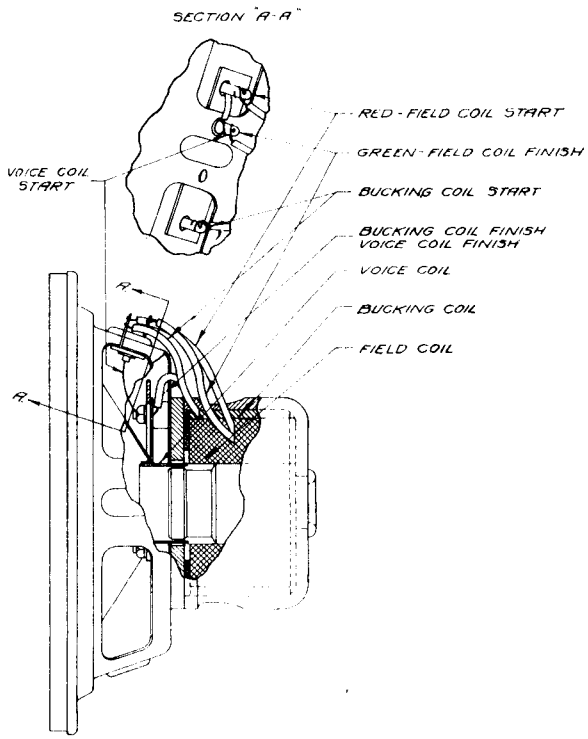

Fig. 6

TRANSFORMER CORPORATION OF AMERICA

the location of the various trimmers. Diagram No. 3, top view of the series 220 chassis, shows each trimmer numbered. You should be acquainted intimately with each adjustment. A customer would not have to change the settings very much to ruin the sensitivity of the receiver. Further, if a readjustment appears to be necessary, it is imperative to know which circuit is being adjusted when a trimmer is being turned.

Number 1 is the antenna trimmer.

Number 2 is the gang condenser trimmer tuning the grid of the Super-autodyne.

Number 3 is the gang condenser trimmer tuning the plate (or oscillator of the super-autodyne).

Number 4 is the oscillator padding trimmer.

Number 5 is the Super-autodyne plate trimmer.

Number 6 is the I. F. grid trimmer.

Number 7 is the second detector grid trimmer.

To readjust the trimmer, it will be necessary that a good design of 175 k. c. oscillator be employed, and that a dependable broadcast test oscillator be on hand so that stages handling intermediate frequency, and those handling radio frequency can be thoroughly checked. It is advisable to use a bakelite screwdriver when making any of these adjustments.

First, connect the 175 k. c. oscillator output leads from the control grid cap of the super-autodyne tube to ground. Do not remove any of the tubes from the sockets, and it is not necessary to disconnect the grid cap clip from the tube. Reset trimmers numbers 5, 6 and 7 for maximum output. While this test oscillator is working into the intermediate frequency stages, no adjustment of the tuning condenser on the receiver will have any effect, inasmuch as the intermediate frequency stage is fixed tuned.

If your test oscillator is properly designed, it will supply exactly 175 k. c., and when trimmers number 5, 6 and 7 are set for maximum output, they will be correctly adjusted and should be sealed.

Next, disconnect the 175 k. c. test oscillator and connect to the antenna binding post of the receiver, the output lead from your broadcast test oscillator, or tune in a broadcast signal around 1400 k. c., then reset trimmers numbers 2 and 1 respectively for maximum output. This adjustment will track the super-autodyne grid circuit of the R. F. stage.

To check the calibration of the receiver, whether it be high or low, trimmer number 3 should be reset until a station of known high frequency is brought in on the correct dial marking with peak volume. If your broadcast test oscillator is accurately calibrated, it might be used in place of the broadcasting station signal. In this adjustment, a broadcast station or test oscillator signal at about 1400 k. c. should be chosen. The setting of the trimmer at 1400 k. c. is more critical than it would be at 600 k. c.; calibration, therefore more accurate.

The next adjustment is important and not easily explained in writing, so pay close attention to the following instruction. We will now balance the oscillator to the r. f. and first detector stages.

Tune the external broadcast test oscillator and the receiver both to 600 k.c., then slowly increase or decrease the capacity of No. 4 (oscillator padding trimmer), at the same time and continuously tuning back and forth across the signal with the receiver tuning condenser gang. The output meter needle will now be swinging up and down in step with the variation in tuning. Watch the peak of this swinging closely and readjust No. 4 trimmer until the swinging needle reaches its highest peak.

Retune the receiver and broadcast test oscillator to 1400 k.c. and re-check trimmer No. 3 to make sure that the adjustment of No. 4 has not thrown the receiver out of calibration. If it has, then readjust No. 3 until the calibration is correct, (as previously explained), and check on trimmers No. 2 and No. 1, to make sure that the adjustment of No. 4 has not reduced the sensitivity.

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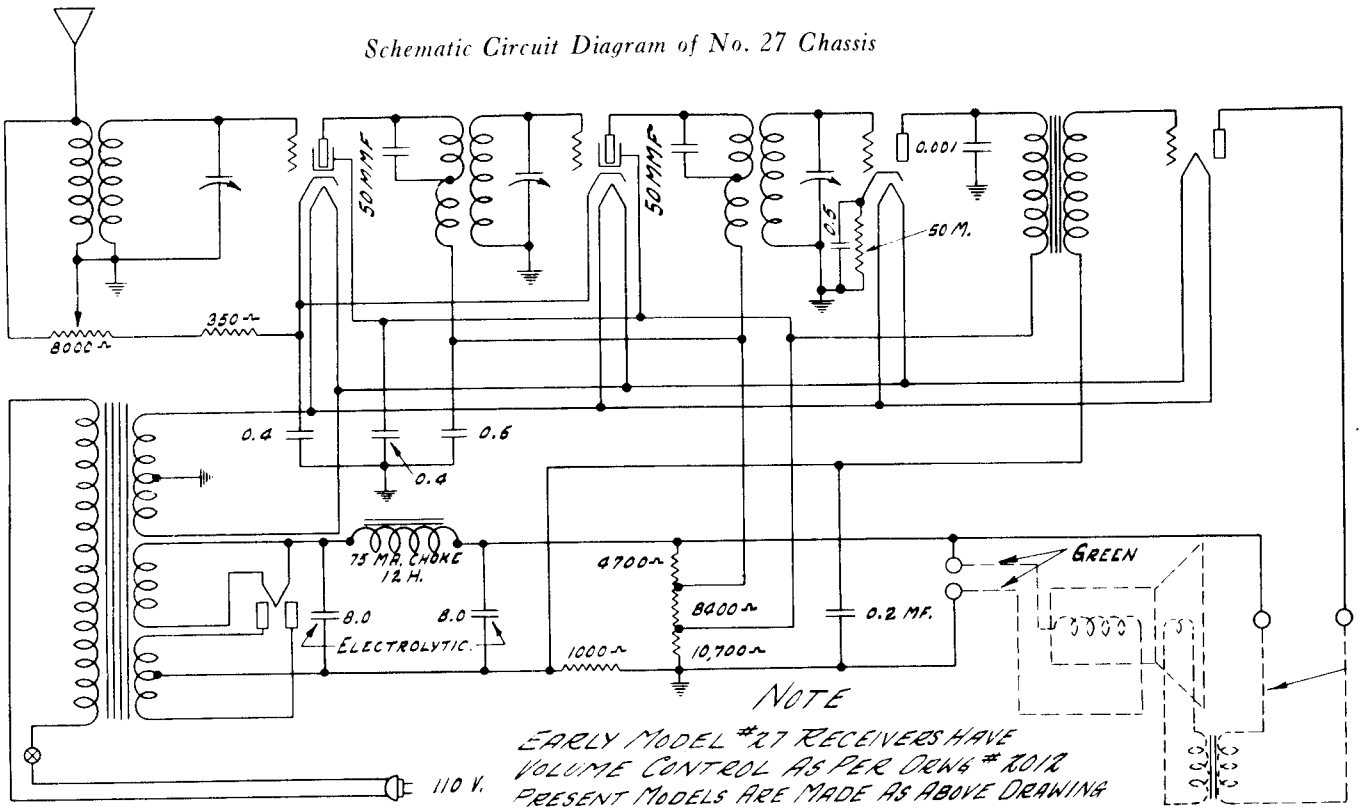
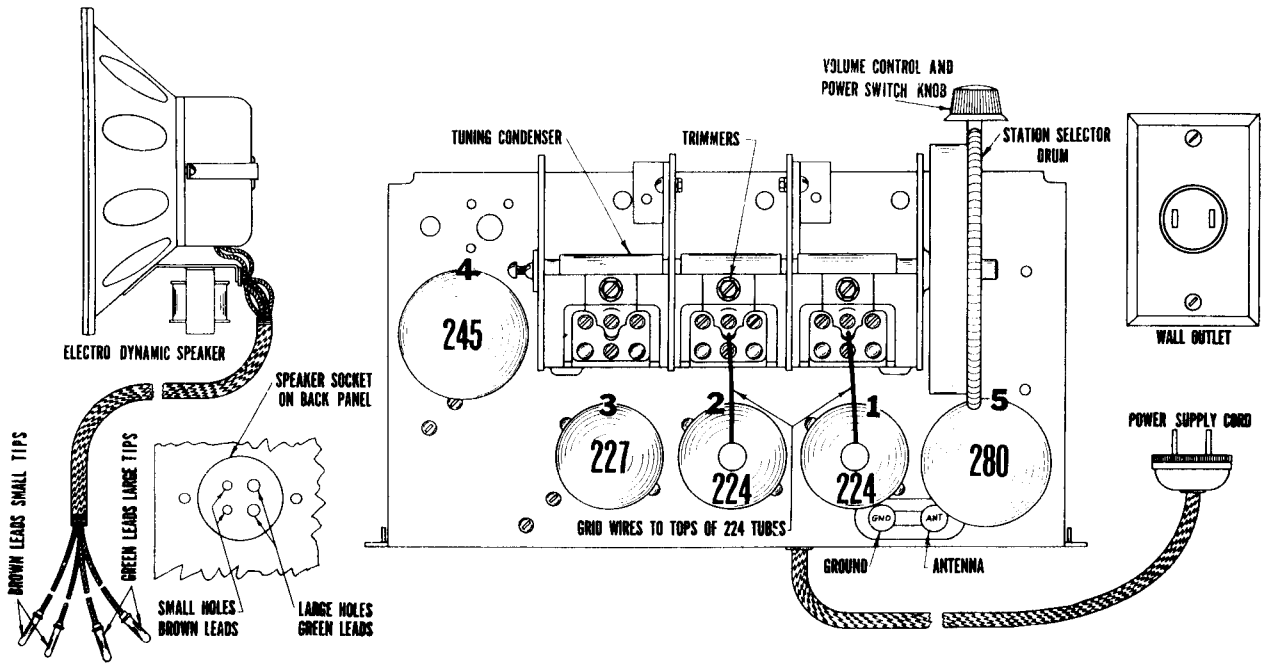
Schematic Circuit Diagram of No. 27 Chassis





Top View of No. 27 Chassis Showing Tube Sequence and Speaker Connections

VOLTAGES AT SOCKETS — VOLUME CONTROL AT MAXIMUM — LINE VOLTAGE, 115 — PLUG IN SOCKET OF RECEIVER — TUBE IN TEST SET

Type of Tube	Position of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current M.A.	Cathode Volts	Plate M.A.	Grid Test M.A.
224	1	1st Radio	2.25	160	2.5	80	6	2.5	3.	5.1
224	2	2nd Radio	2.25	160	2.5	80	6	2.5	3.	5.1
227	3	Detector	2.25	70	8.5			8.5	.1	.2
245	4	Audio	2.35	238	41.				19.	22.
280	5	Rectifier	4.8						26.5 per Plate	

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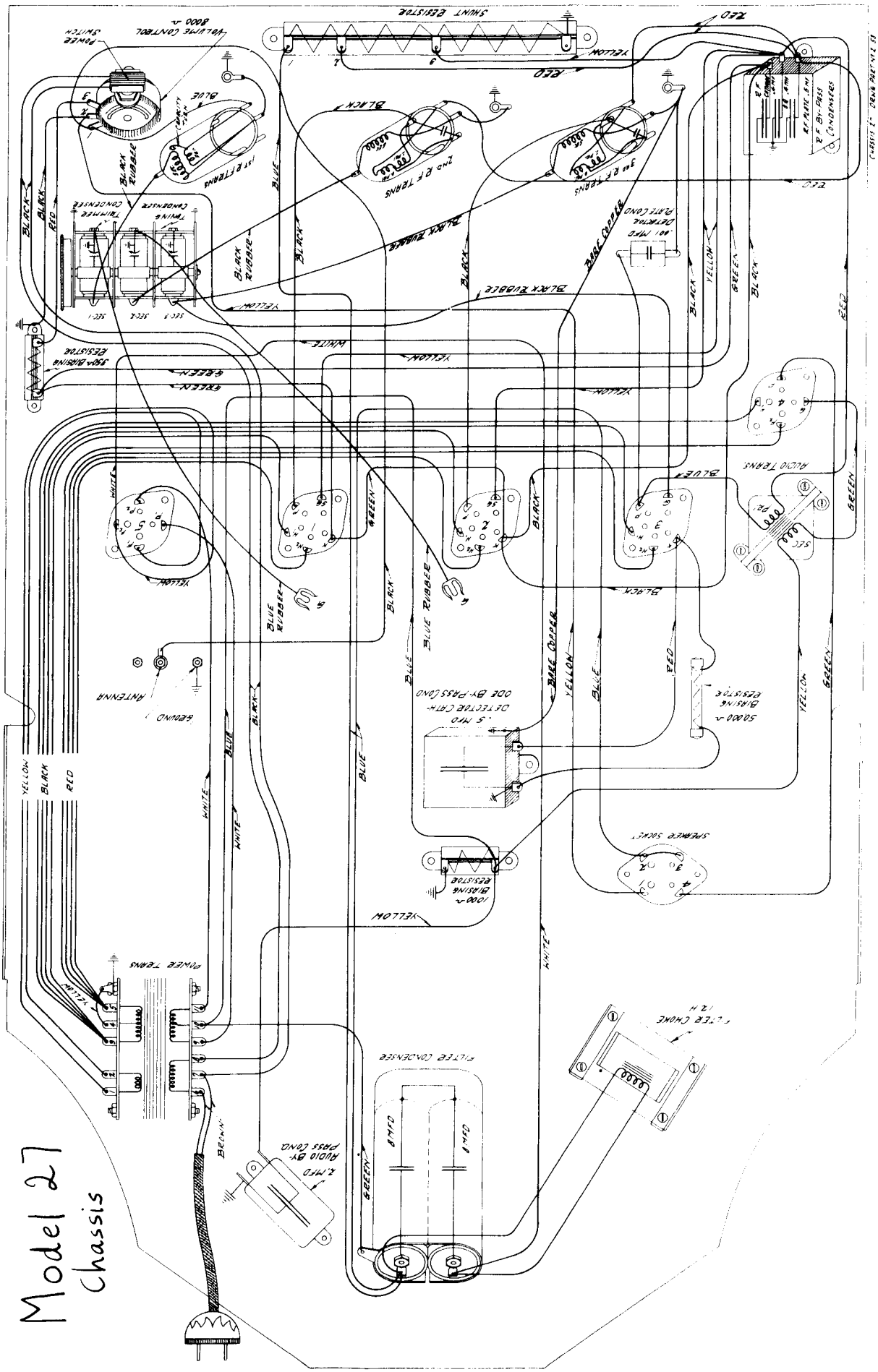
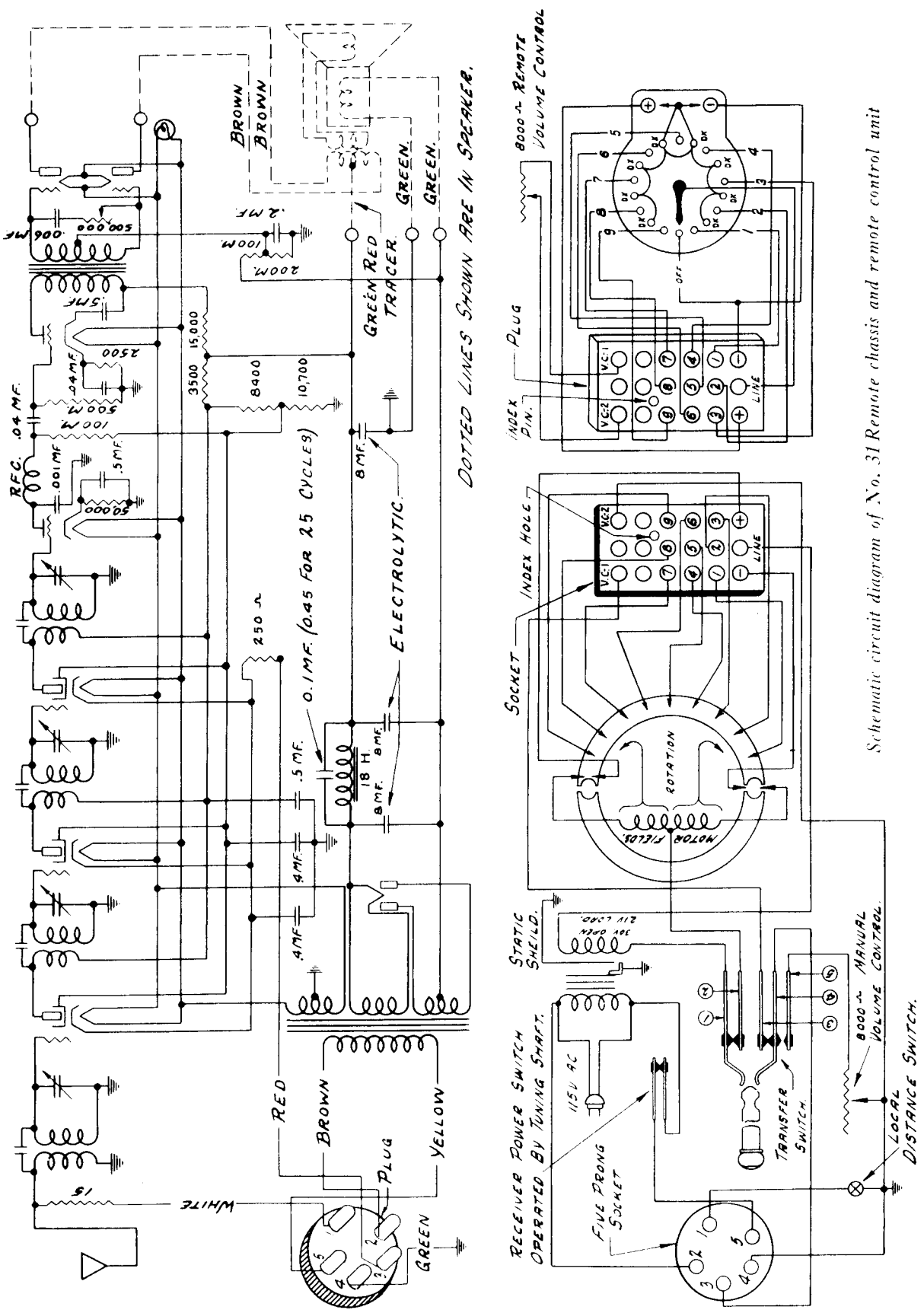
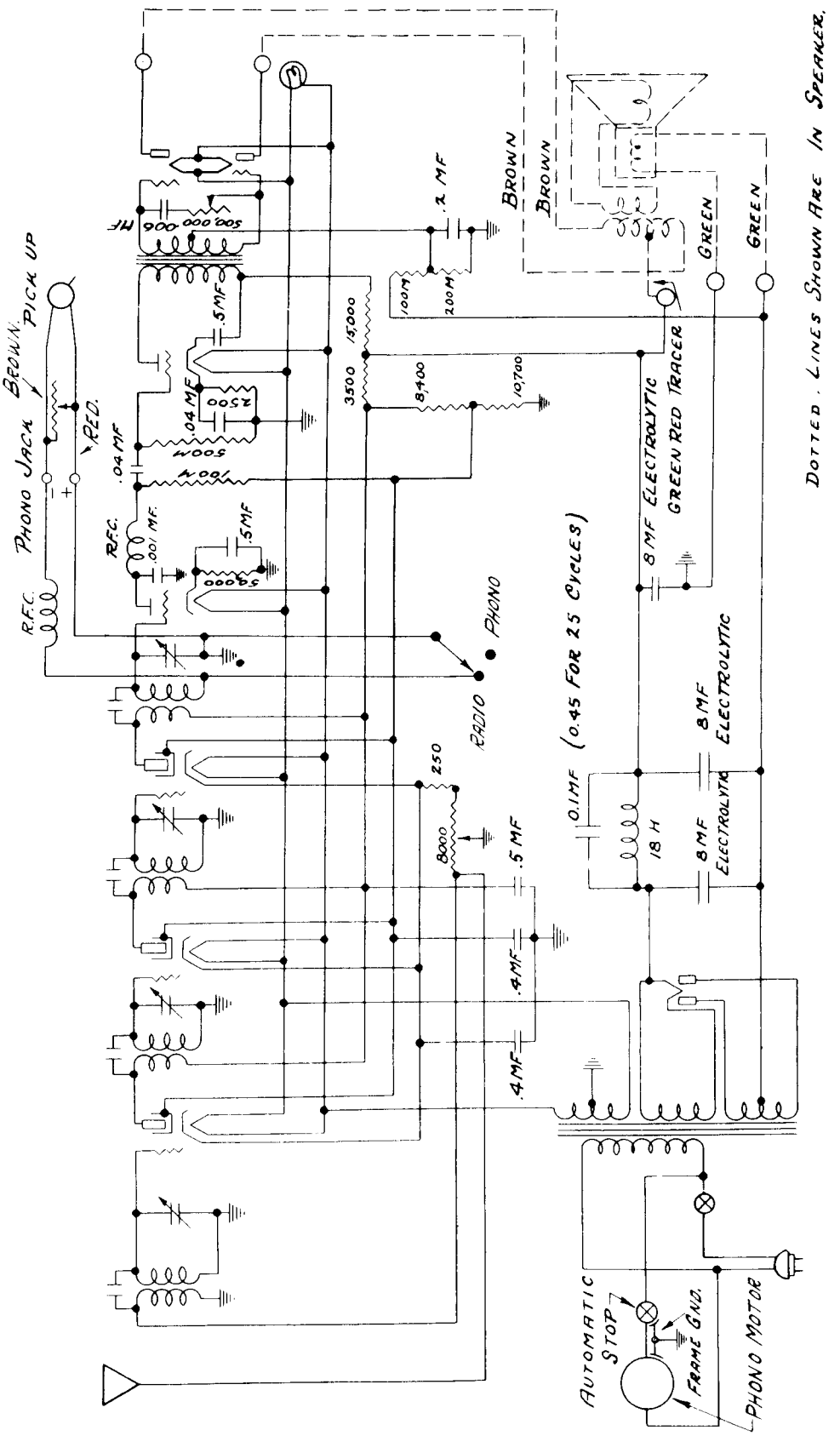


U. S. RADIO AND TELEVISION CORP.



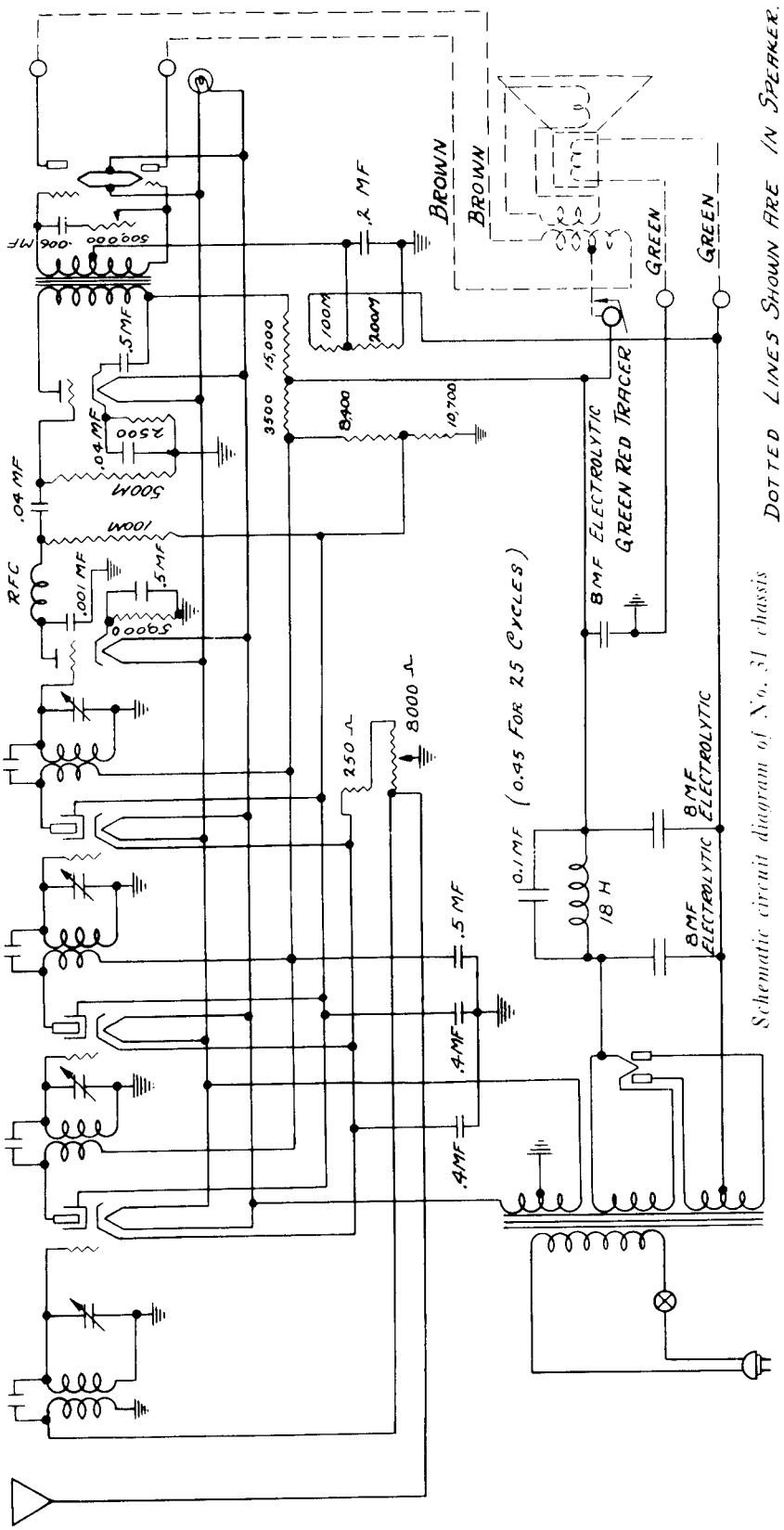
Schematic circuit diagram of No. 31 Remote chassis and remote control unit

U. S. RADIO AND TELEVISION CORP.

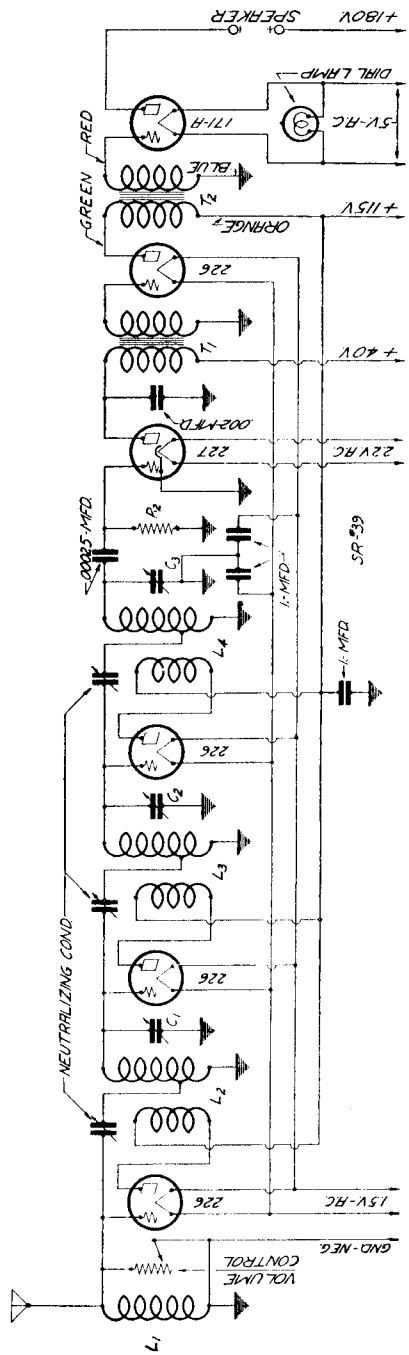


Schematic circuit diagram of No. 31 Phono chassis

U. S. RADIO AND TELEVISION CORP.

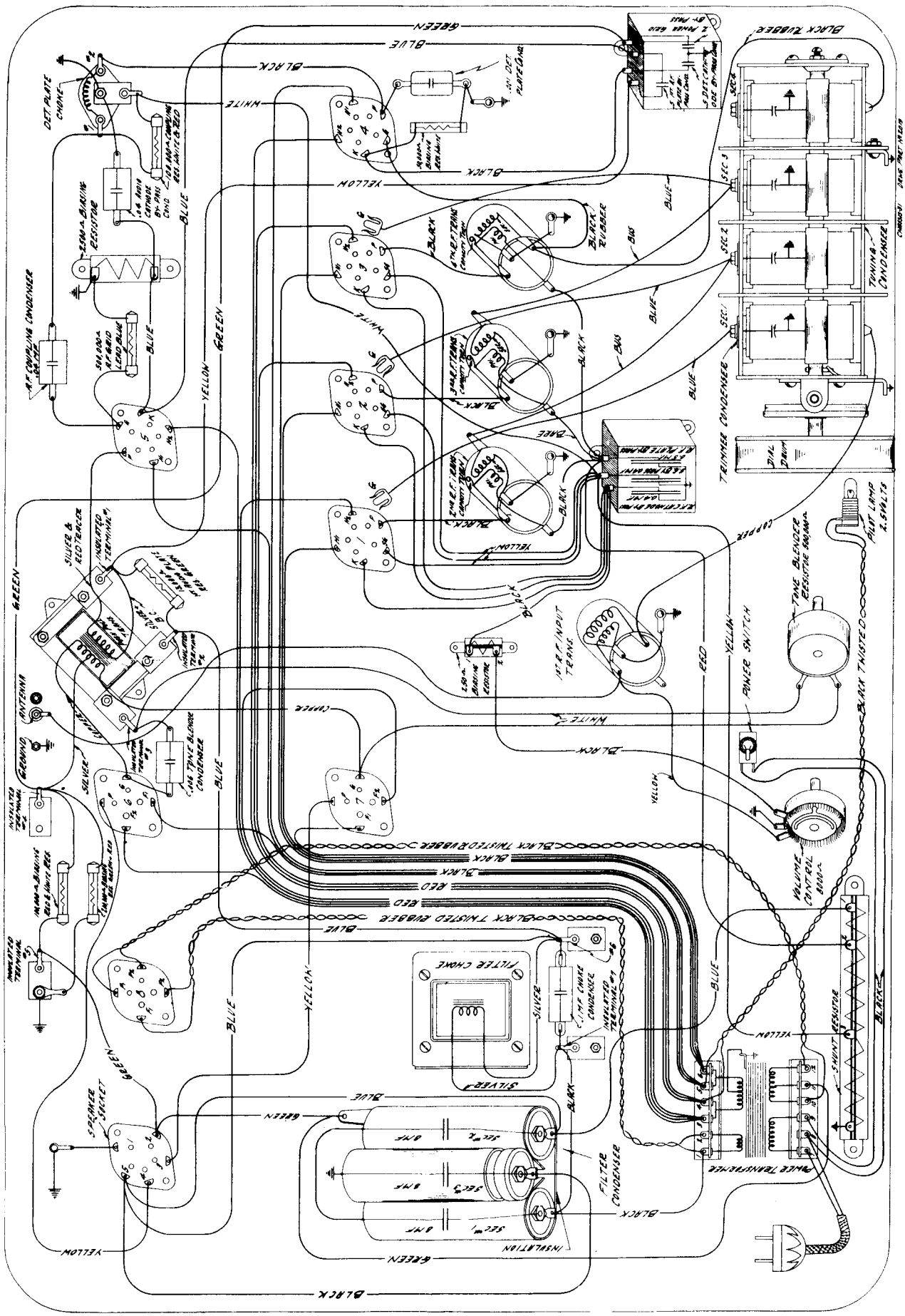


Schematic circuit diagram of No. 31 chassis DOTTED LINES SHOWN ARE IN SPEAKER.



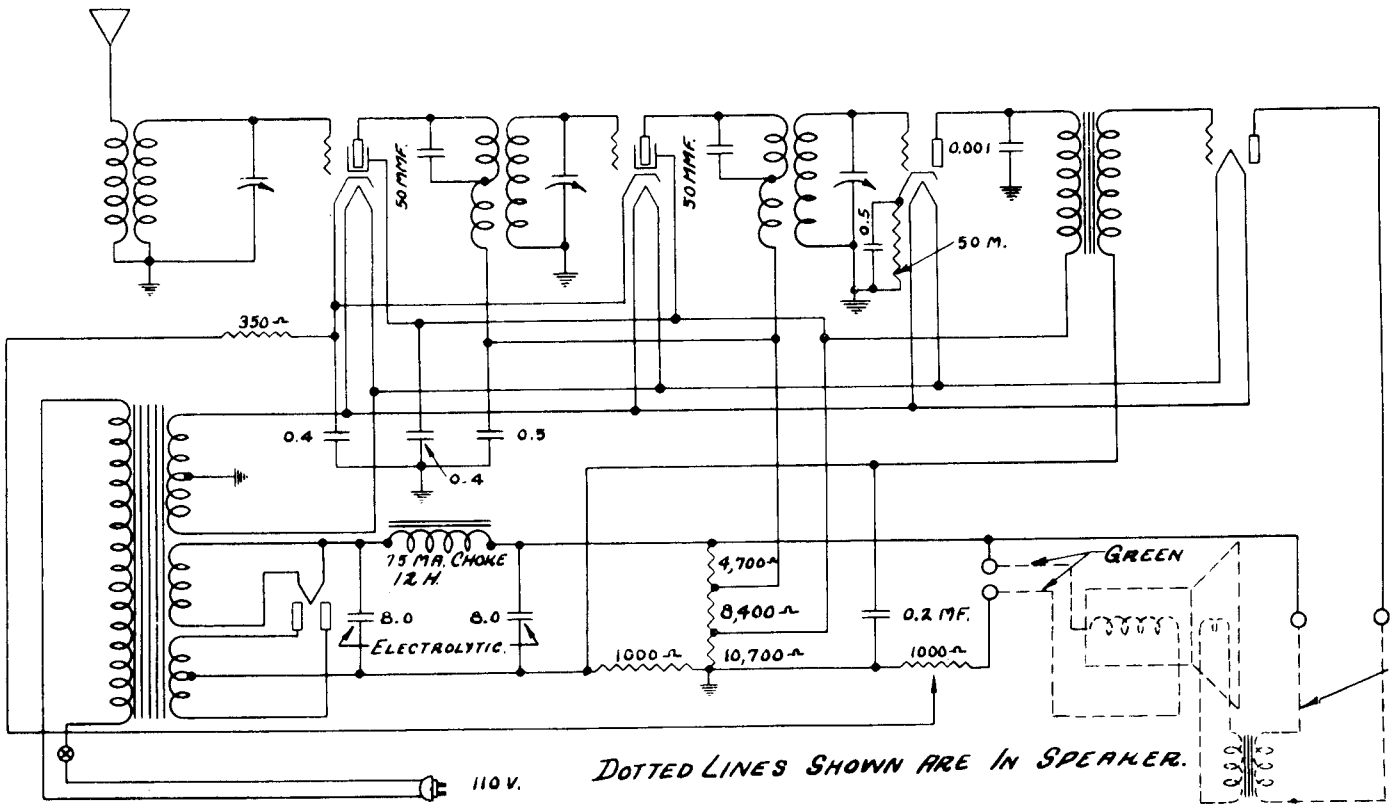
In this illustration may be seen the schematic diagram of the U. S. Radio and Television model 37 chassis

U. S. RADIO AND TELEVISION CORP.



Wiring diagram No. 31 chassis complete assembly

U. S. RADIO AND TELEVISION CORP.



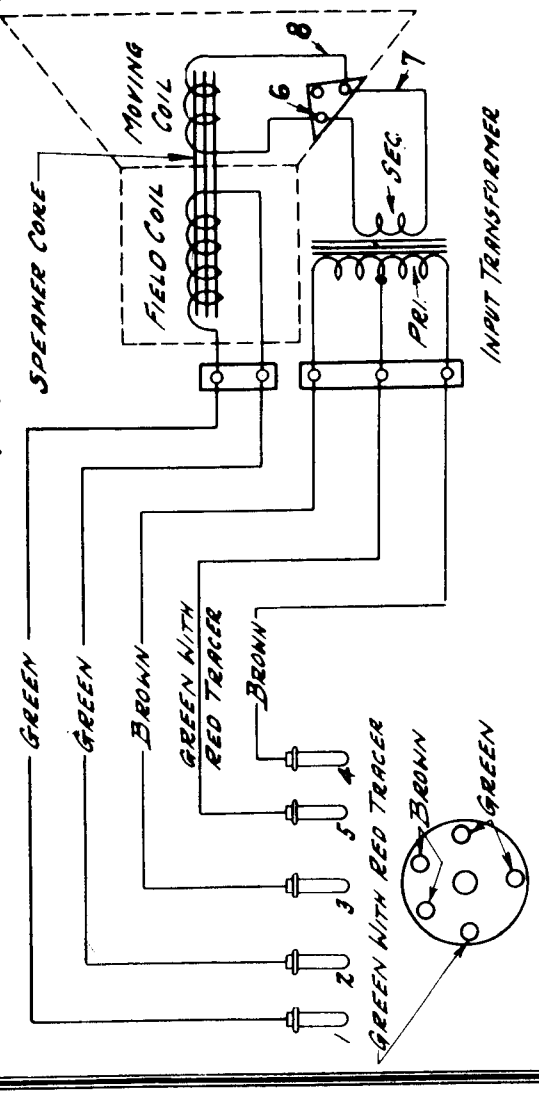
NOTE

EARLY MODEL Nº27 RECEIVERS HAVE VOLUME CONTROL AS PER ABOVE DRAWING. FOR PRESENT MODELS SEE DRWG # 2012A

VOLTAGES AT SOCKETS — VOLUME CONTROL AT MAXIMUM — LINE VOLTAGE, 115 — PLUG IN SOCKET OF RECEIVER — TUBE IN TEST SET **MODEL 31**

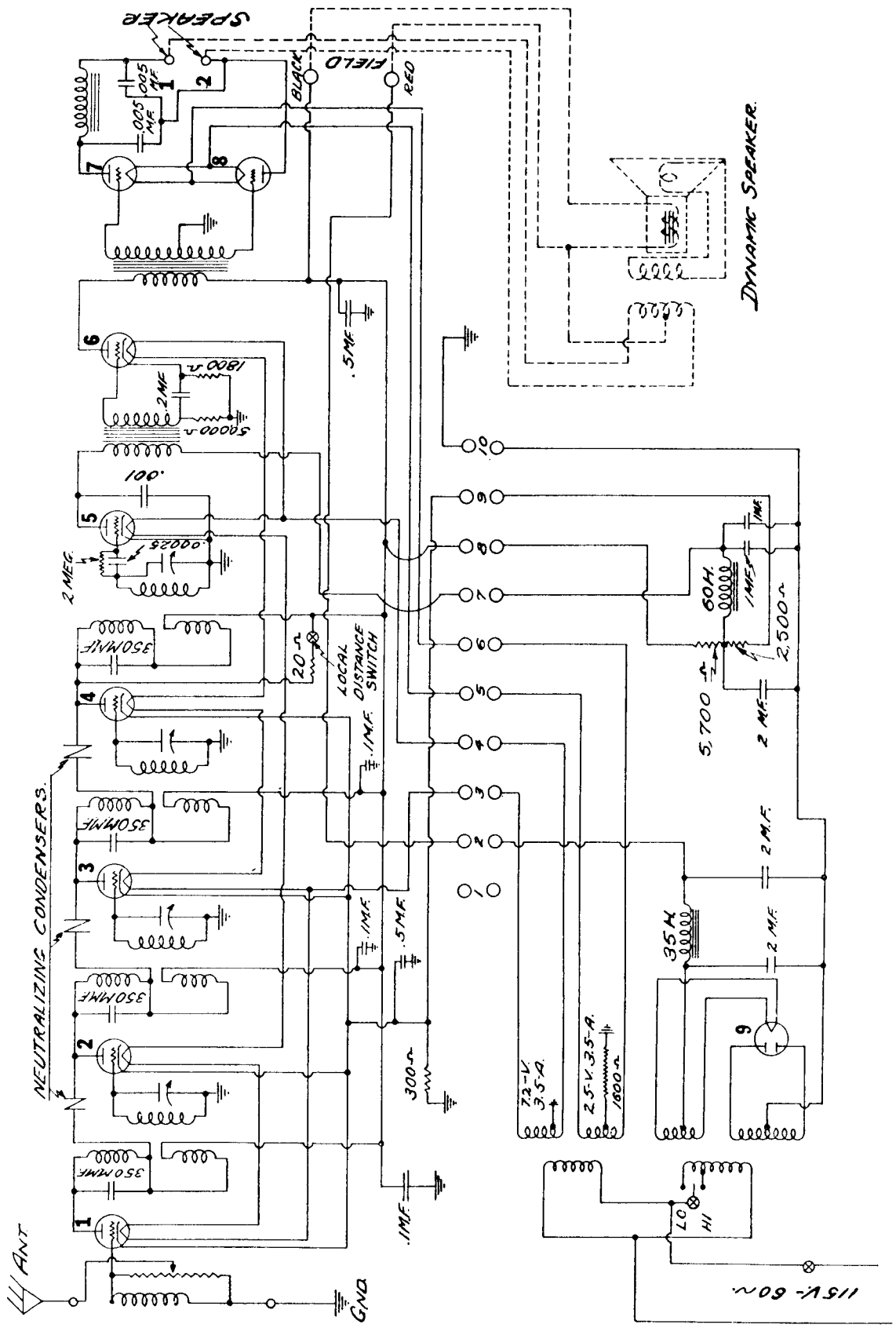
Type of Tube	Position of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current M.A.	Cathode Volts	Plate M.A.	Grid Test M.A.
224	1	1st Radio	2.25	178	3.0	86	.45	3.0	3.4	5.8
224	2	2nd Radio	2.25	178	3.0	86	.45	3.0	3.4	5.8
224	3	3rd Radio	2.25	178	3.0	86	.45	3.0	3.4	5.8
227	4	Detector	2.25	60	9	9		9	.25	.3
227	5	1st Audio	2.25	160	12	12		12	4.5	5.5
245	6	2nd Audio	2.35	246	40	40			25	30
245	7	2nd Audio	2.35	246	40	40			25	30
280	8	Rectifier	4.9						37 Per Plate	

Model 27



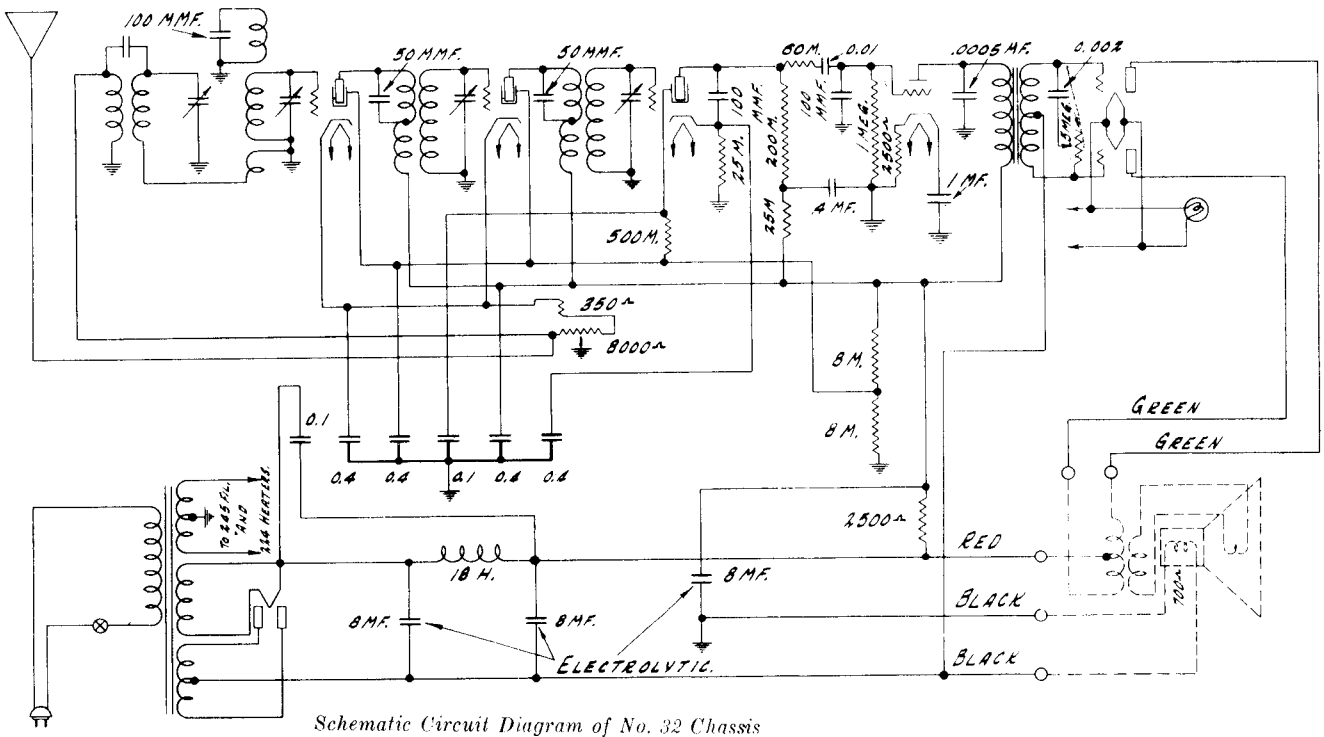
ELECTRODYNAMIC SPEAKER
Model 31

U. S. RADIO AND TELEVISION CORP.



Schematic circuit diagram of No. 90 chassis

U. S. RADIO AND TELEVISION CORP.

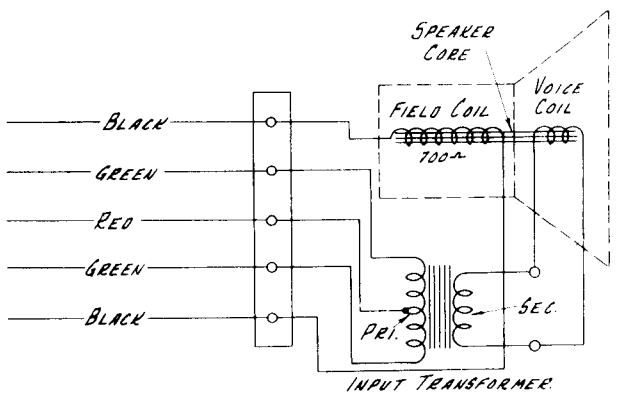


Schematic Circuit Diagram of No. 32 Chassis

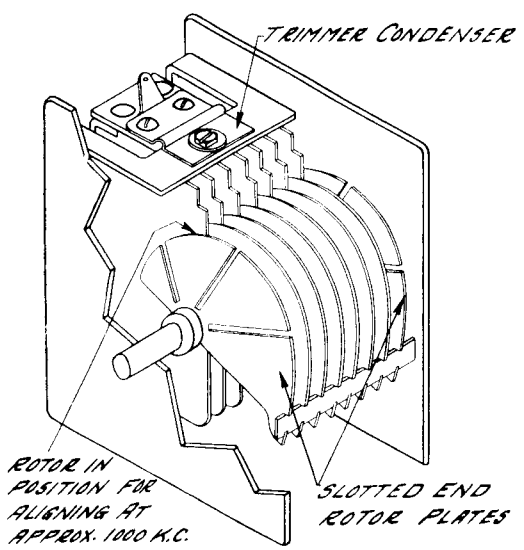
DOTTED LINES SHOWN ARE IN SPEAKER.

No. 32 CHASSIS—VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM LINE VOLTAGE, 115—PLUG IN SOCKET OF RECEIVER—TUBE IN TEXT SET

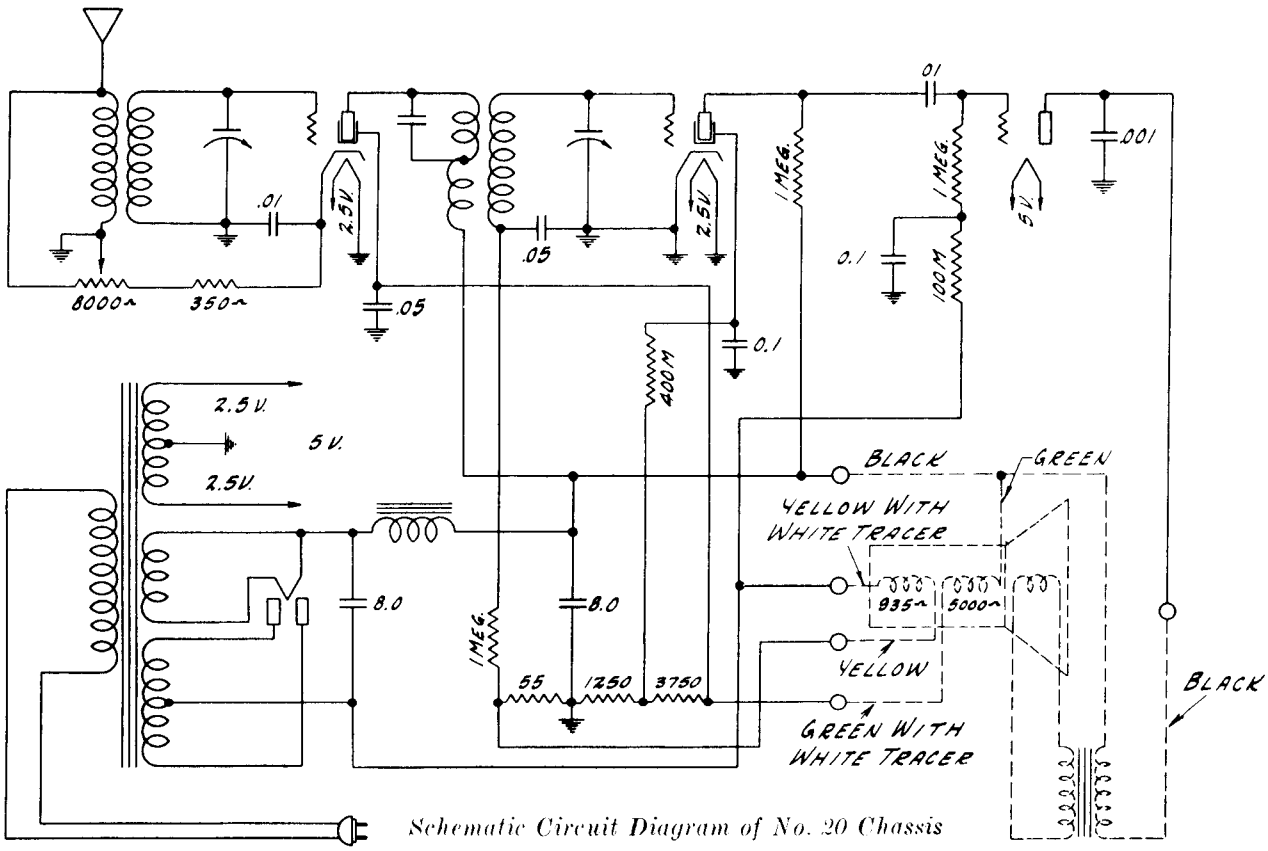
Type of Tube	*Position of Tube*	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
224	1	1st Radio	2.3	198	3.	88	.9	3.	3.5	6.
224	2	2nd Radio	2.3	198	3.	88	.9	3.	3.5	6.
224	3	Detector	2.3	150	6.	45	.1	6.	.25	.4
227	4	1st Audio	2.3	180	12.5			12.5	5.	6.1
245	5	2nd Audio	2.4	255	55.				26.	31.
245	6	2nd Audio	2.4	255	55.				26.	31.
280	7	Rectifier	5.						36. Per Plate	



Electrodynamic Speaker and Connections



U. S. RADIO AND TELEVISION CORP.



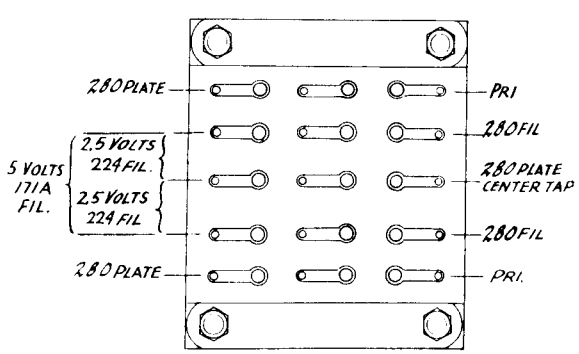
Schematic Circuit Diagram of No. 20 Chassis

DOTTED LINES SHOWN ARE IN SPEAKER.

No. 20 CHASSIS—VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM LINE VOLTAGE, 115—PLUG IN SOCKET OF RECEIVER—TUBE IN TEST SET

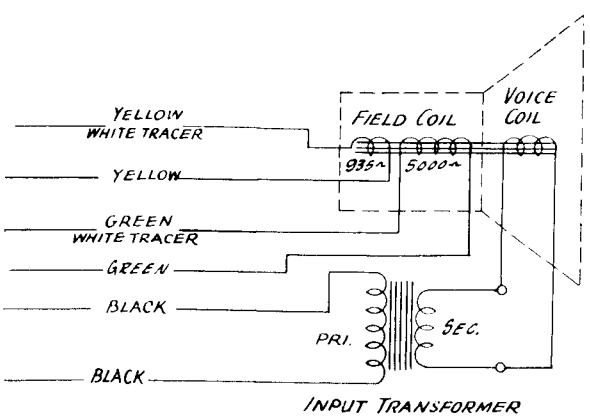
Type of Tube	*Position of Tube*	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
224	1	1st Radio	2.5	196	2.2	85	1.4	2.2	5.	7.1
224	2	Detector	2.5	95(1)	2.3(2)	17(3)	.015		.1	.2
171A	3	1st Audio	5.1	191	43. (4)				18.	20.
280	4	Rectifier	5.1						23. Per Plate	

(1) (3) Computed value. Reading with voltmeter will be lower.
(2) This voltage read across 55 ohm section of shunt resistor.
(4) This voltage read across 935 ohm section of speaker field and 55 ohm section of shunt resistor.



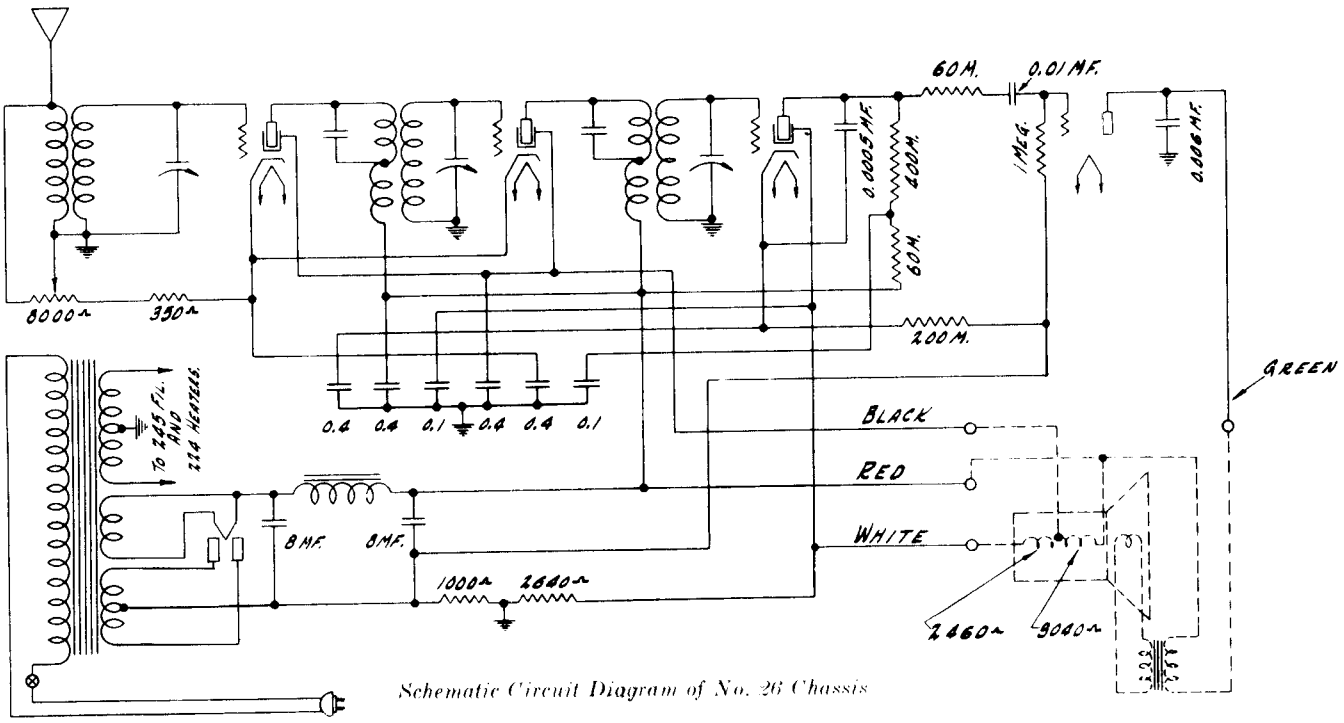
CENTER ROW OF LUGS USED AS WIRING TERMINALS ONLY

Power Transformer Terminals



Electrodynamic Speaker and Connections

U. S. RADIO AND TELEVISION CORP.

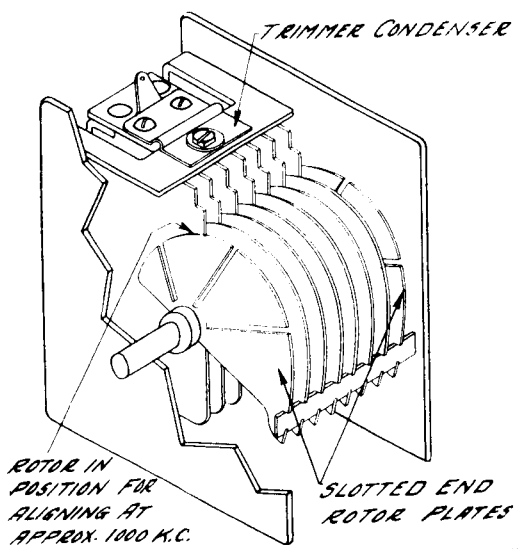


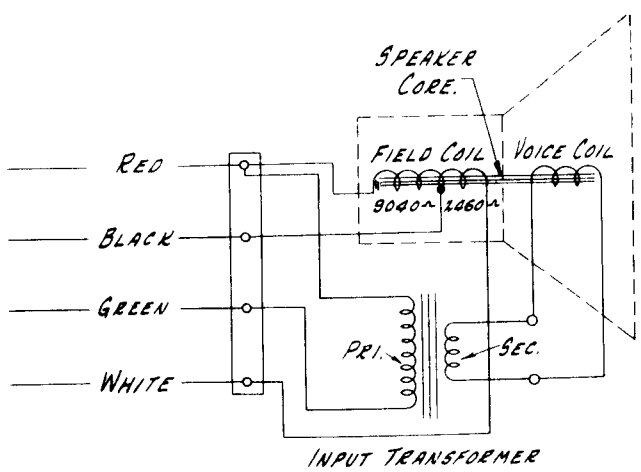
Schematic Circuit Diagram of No. 26 Chassis

DOTTED LINES SHOWN ARE IN SPEAKER

No. 26 CHASSIS—VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM LINE VOLTAGE. 115—PLUG IN SOCKET OF RECEIVER—TUBE IN TEST SET

Type of Tube	*Position of Tube*	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
224	1	1st Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	2	2nd Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	3	Detector	2.2	130	3.	40	.1	3.	.25	.4
245	4	Audio	2.35	245	50.				28.	31.
280	5	Rectifier	4.6						25. Per Plate	

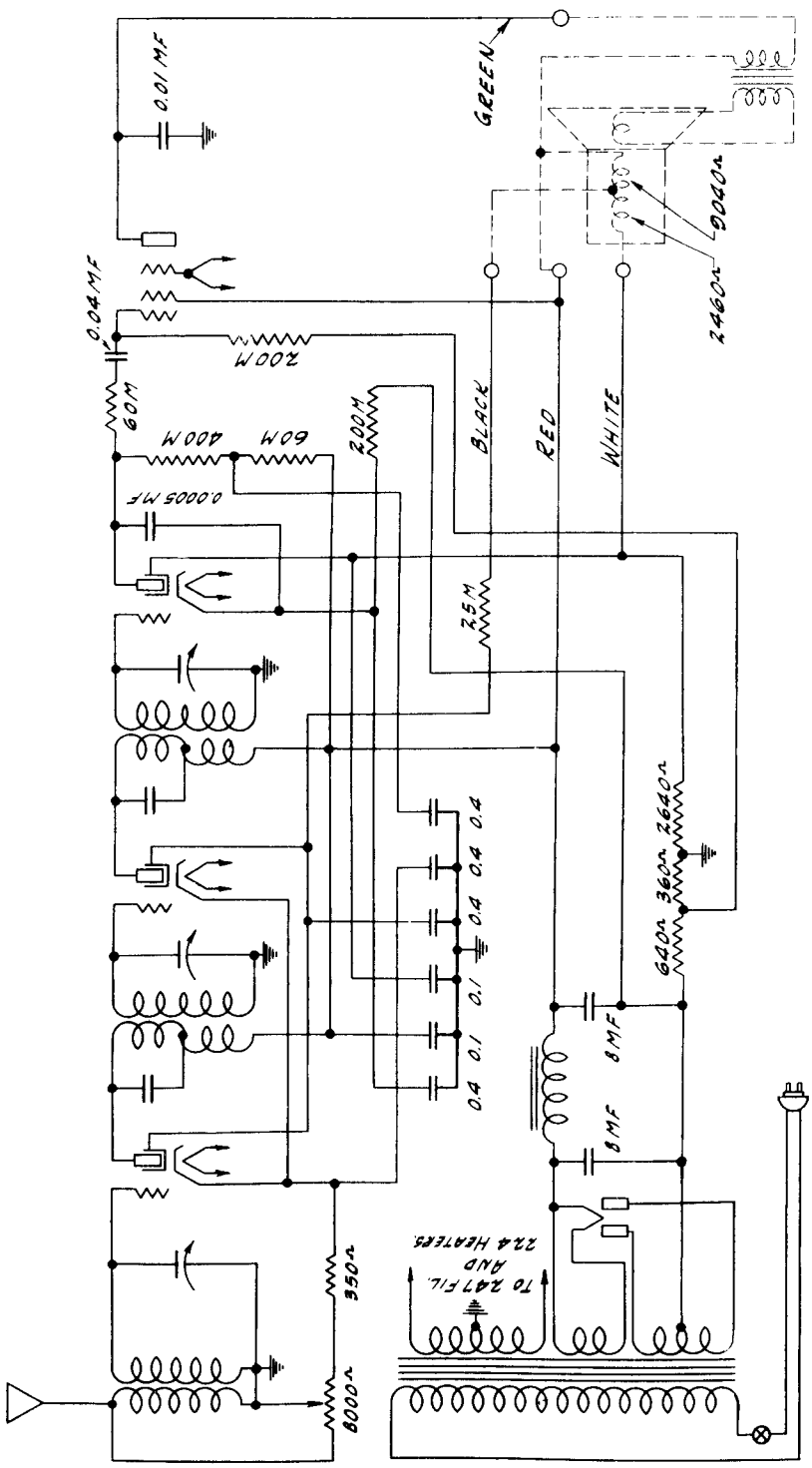




Electrodynamic Speaker and Connections

U. S. RADIO AND TELEVISION CORP.

Model 26P



Making Pentode Current and Voltage Readings

Reading	Terminals	Meter
A Volts	Across filament terminals	0-4 A.C. Voltmeter
B Volts	Plate terminal to subpanel	0-300 D.C. Voltmeter
C Volts	Across 360 ohm resistor	0-50 D.C. Voltmeter
Screen Volts	Screen grid terminal to subpanel	0-300 D.C. Voltmeter
Screen M.A.	Insert milliameter in screen grid line	0-25 D.C. Milliameter
Plate M.A.	Insert milliameter in plate line	0-50 D.C. Milliameter

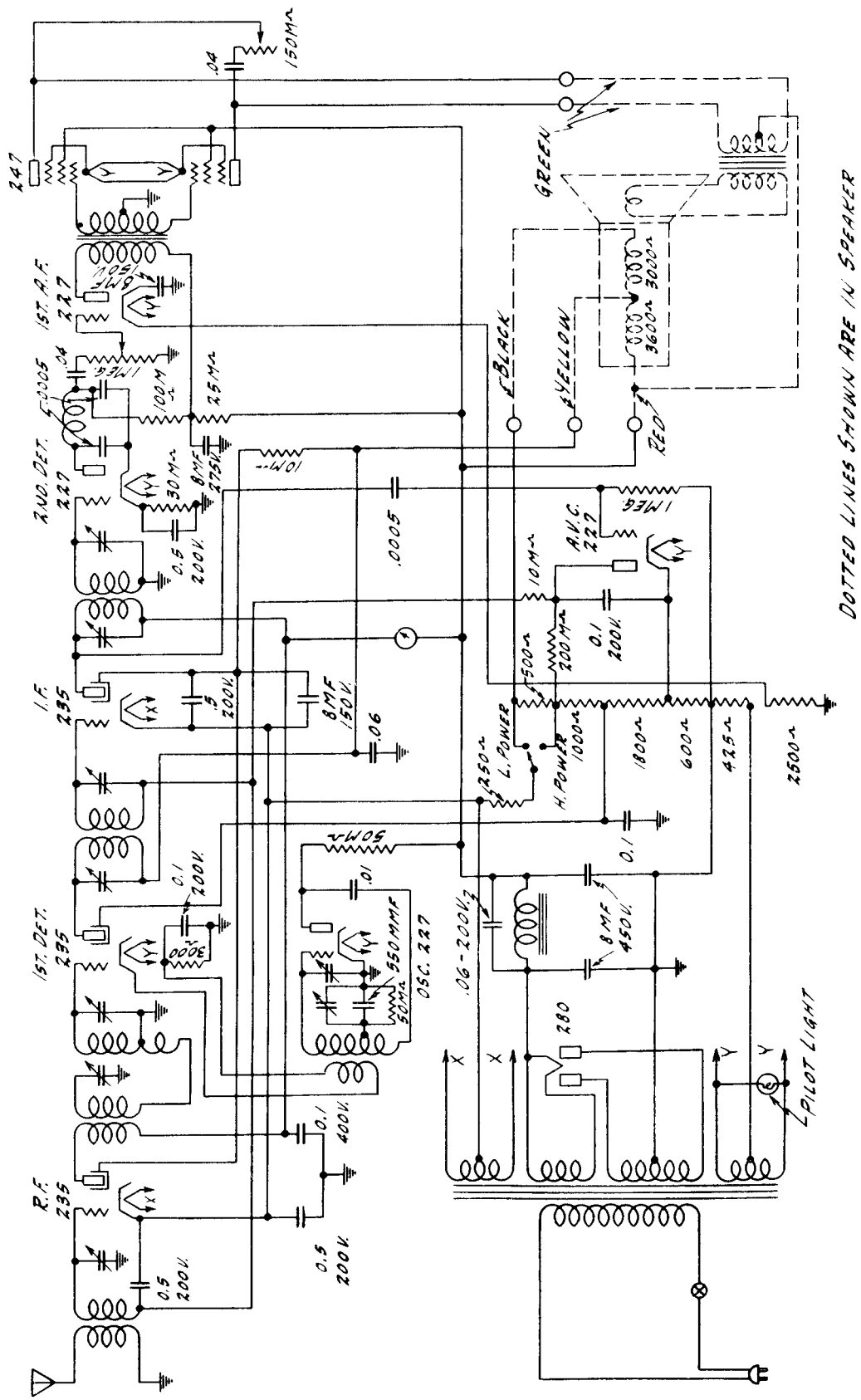
No. 26P CHASSIS—VOLTAGES AT SOCKETS
VOLUME CONTROL AT MAXIMUM—LINE VOLTAGE, 115

Type of Tube	*Position of Tube*	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
224	1	1st Radio	2.2	250	2.	55(1)	.6	2.	2.1	3.5
224	2	2nd Radio	2.2	250	2.	55(1)	.6	2.	2.1	3.5
224	3	Detector	2.2	130	2.8	40(1)	.1	2.8	.25	.4
247	4	Audio	2.3	238	18.(2)	250	5.5		27.	31.
280	5	Rectifier	4.65						28. Per Plate	

(1) Reading with 250,000 ohm meter. Reading will be less with lower resistance meter.

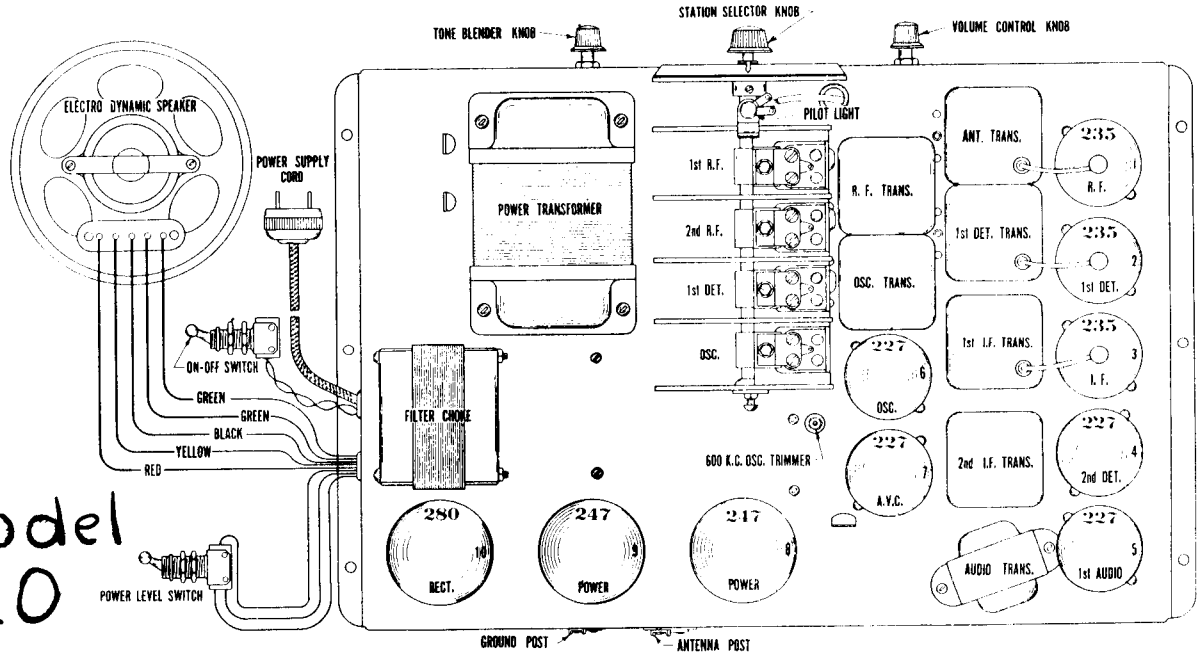
(2) This voltage read across 360 ohm section of shunt resistor.

U. S. RADIO AND TELEVISION CORP.



Schematic Circuit Diagram of No. 10 Super-heterodyne Chassis

U. S. RADIO AND TELEVISION CORP.

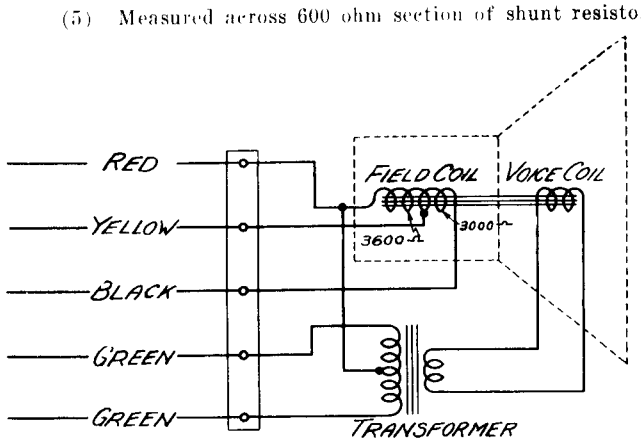


Top View of Chassis Showing Tube Location and Speaker Connections

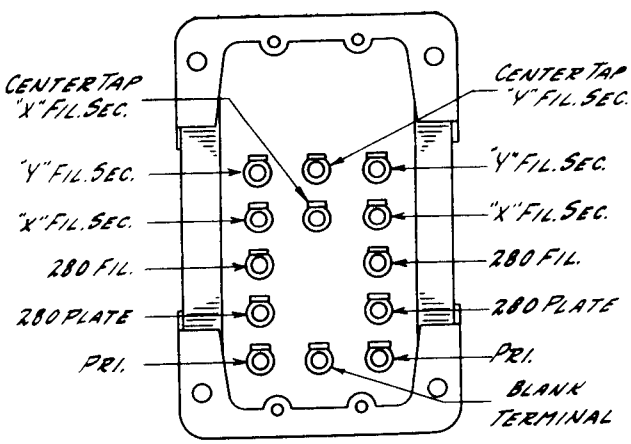
No. 10 CHASSIS—VOLTAGES AT SOCKETS—LINE VOLTAGE 115 VOLUME CONTROL AT MAXIMUM—POWER LEVEL SWITCH HIGH POWER

Type of Tube	*Position of Tube*	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
235	1	R.F.	2.3	175	2.3 (1)	65	.7	0.	4.0	6.0
235	2	1st Det.	2.3	185	7.0	69	.4	14.	2.0	2.6
235	3	I.F.	2.3	175	2.3 (1)	65	.7	0.	4.0	6.0
227	4	2nd Det.	2.3	115	12.			7.5	.4	.5
227	5	1st Audio	2.3	145	11. (2)			10.	4.6	5.4
227	6	Osc.	2.3	83	15-35 (3)			21.	4.2	4.4
227	7	A.V.C.	2.3	89 (4)	20. (5)			1.5	0.	0.
247	8	Power	2.35	255	18.5	265	4.5		21.	28.
247	9	Power	2.35	255	18.5	265	4.5		21.	28.
280	10	Rect.	4.9						45. Per Plate	

(1) Measured across 250 ohm series resistor.
(2) Measured across 2500 ohm series resistor.
(3) Bias voltage varies from 15 to 35 between 1500 and 550 K.C. settings of tuning condenser.
(4) Measured across 1000 and 1800 ohm sections of shunt resistor.
(5) Measured across 600 ohm section of shunt resistor.

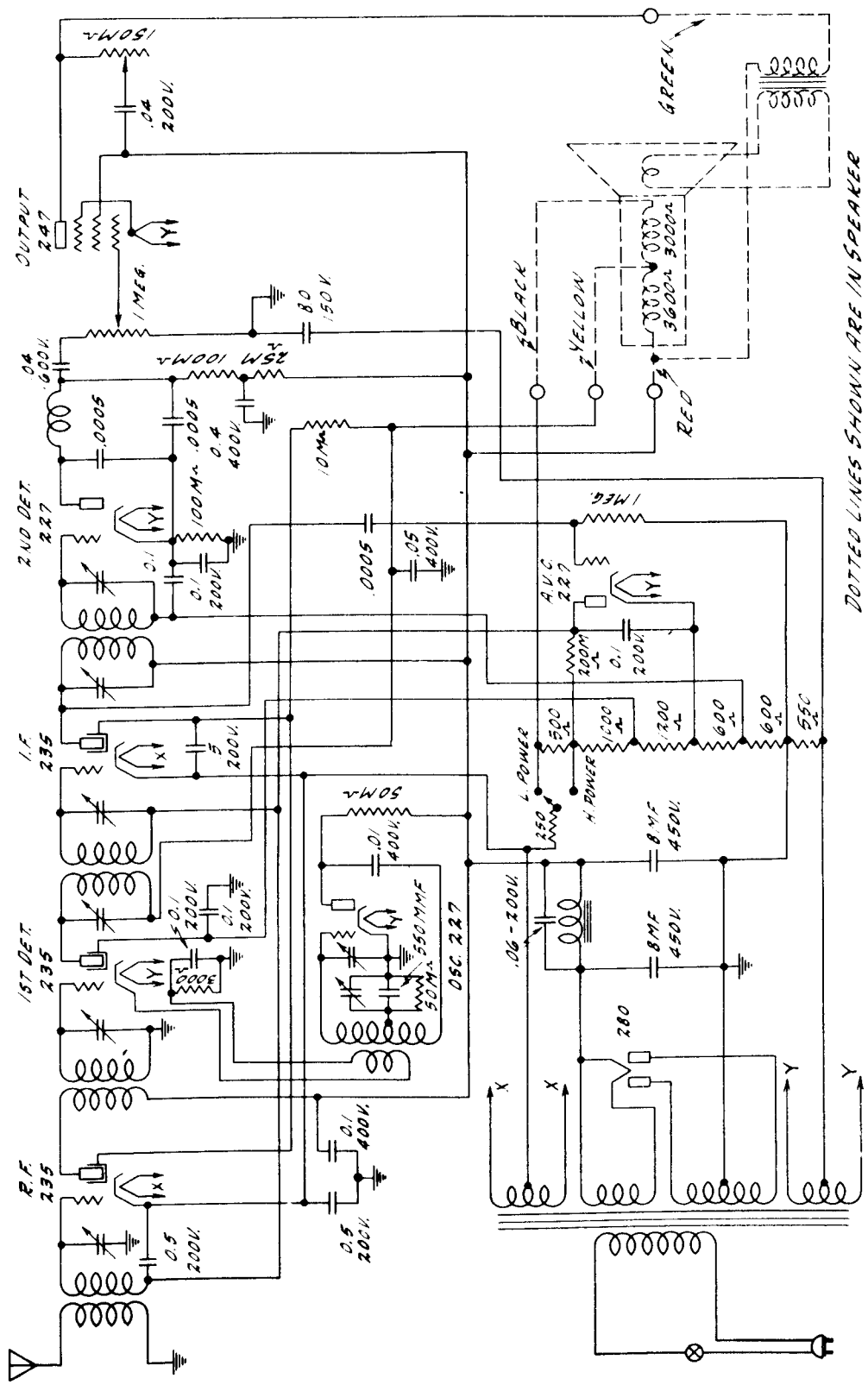


Electrodynamic Speaker and Connections



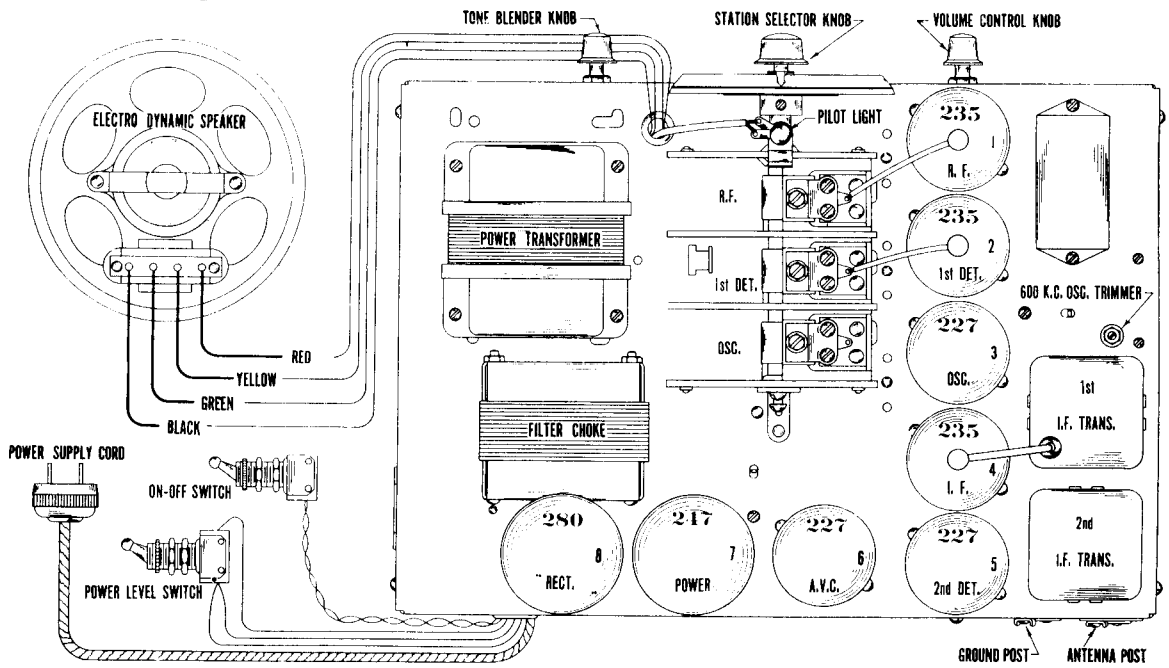
Power Transformer Terminals

U. S. RADIO AND TELEVISION CORP.



Schematic Circuit Diagram of No. 8 Super-heterodyne Chassis

U. S. RADIO AND TELEVISION CORP.

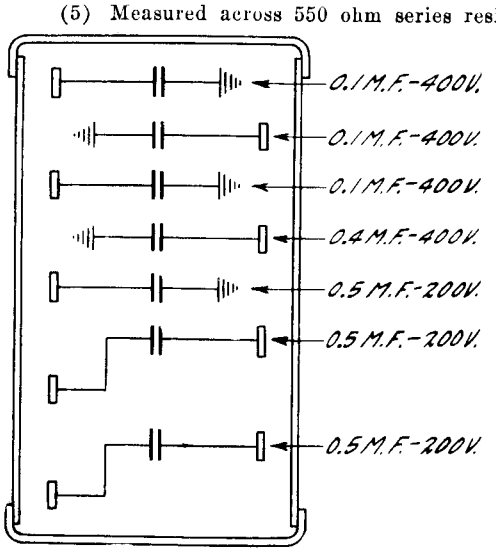


Top View of Chassis Showing Tube Location and Speaker Connections

No. 8 CHASSIS—VOLTAGES AT SOCKETS—LINE VOLTAGE 115
VOLUME CONTROL AT MAXIMUM—POWER LEVEL SWITCH HIGH POWER

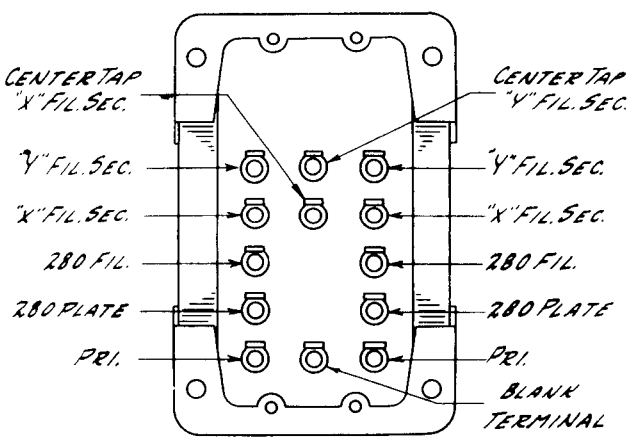
Type of Tube	*Function*	*"A" Volts*	*"B" Volts*	*Control Grid "C" Volts*	*Screen Volts*	*Screen Current MA*	*Cathode Volts*	*Plate MA*	*Grid Test MA*
235	R.F.	2.3	190	2.3(1)	68	1.0	0.	3.8	6.5
235	1st Det.	2.3	190	6.5	70	.35	14.	2.0	4.9
227	Osc.	2.3	80	15–50(2)			20.	4.7	4.8
235	I.F.	2.3	190	2.3(1)	68	.6	0.	3.6	6.0
227	2nd Det.	2.3	150	20.			20.	.4	.4
227	A.V.C.	2.3	65(3)	40. (4)			20.	0.	0.
247	Power	2.35	260	20. (5)	280	7.		32.	36.
280	Rectifier	5.						41. Per Plate	

(1) Measured across 250 ohm series resistor.
(2) Bias voltage varies from 15 to 50 between 1500 and 550 K.C. settings of tuning condenser.
(3) Measured across 1000 and 1200 ohm sections of shunt resistor.
(4) Measured across two 600 ohm sections of shunt resistor.
(5) Measured across 550 ohm series resistor.



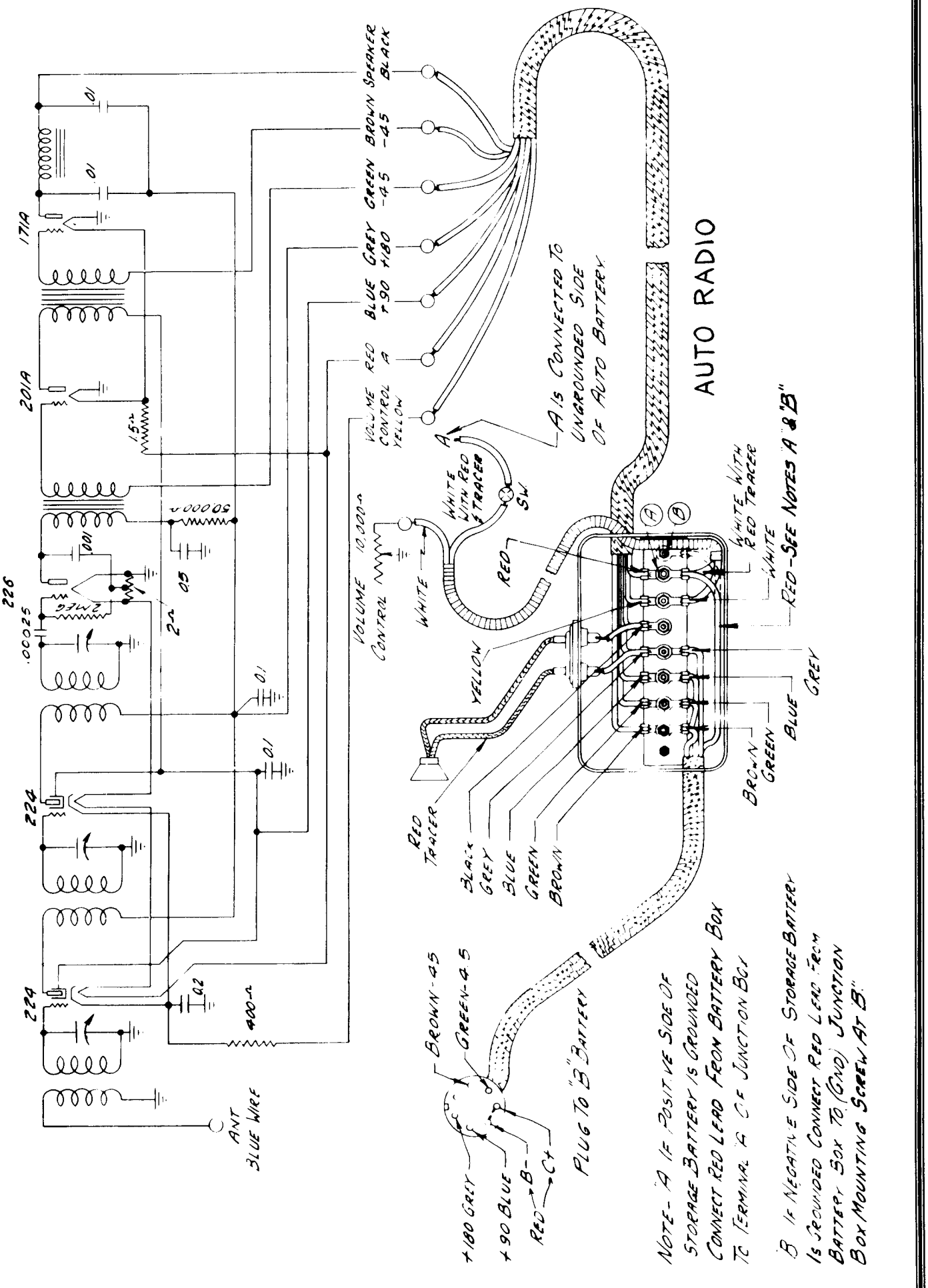
7 Section Condenser Internal Wiring

Model 8

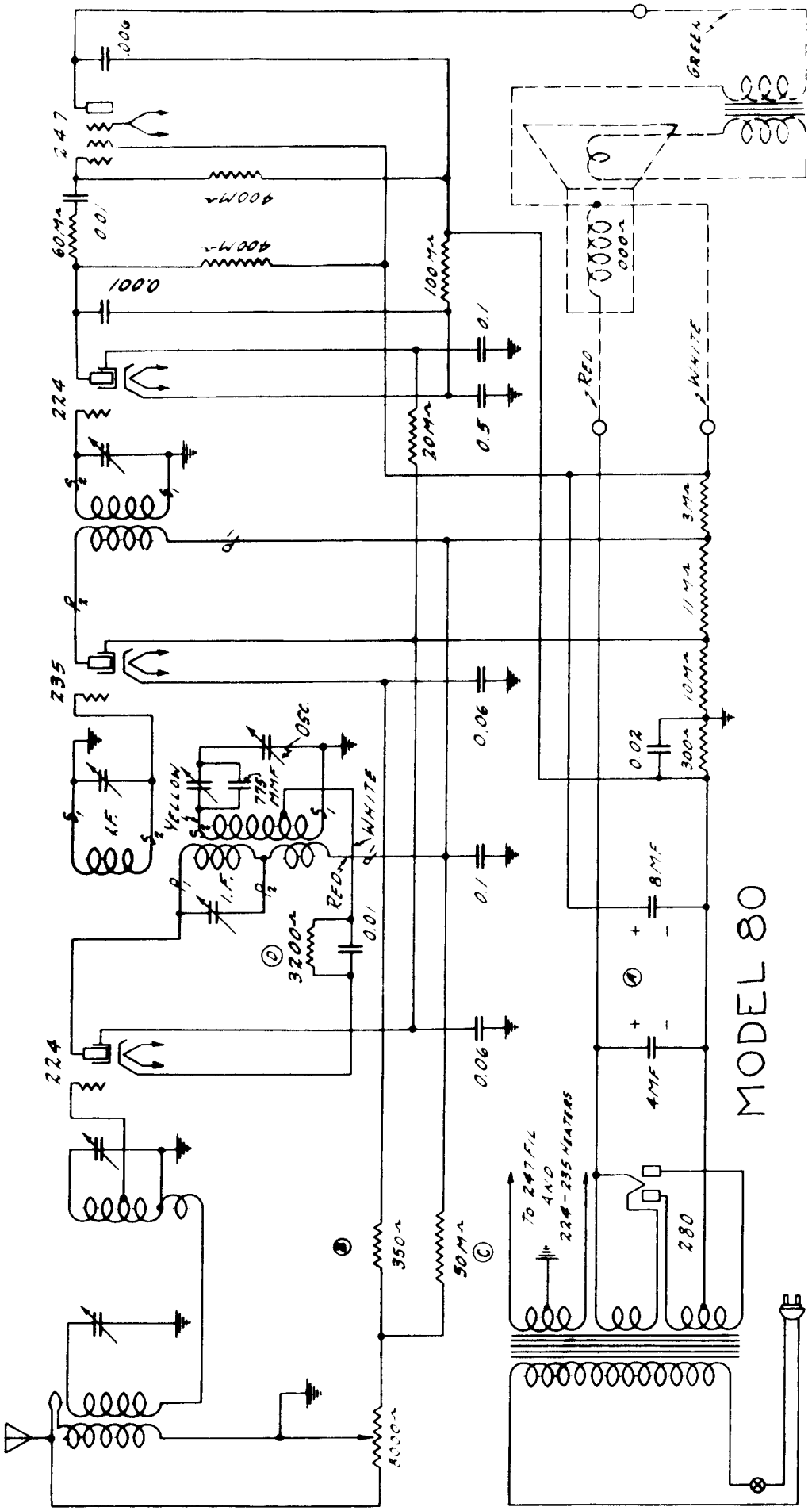


Power Transformer Terminals

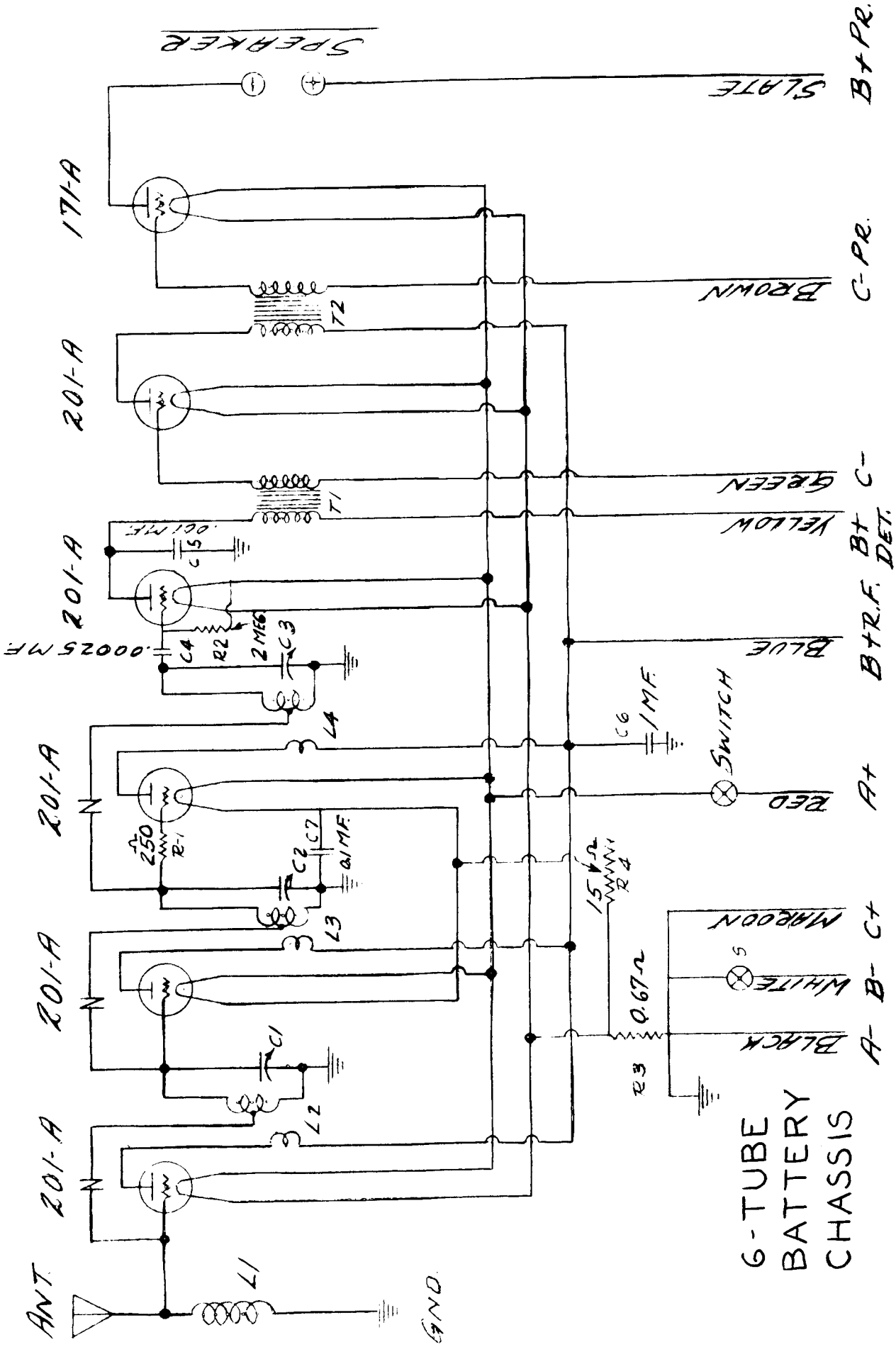
U. S. RADIO AND TELEVISION CORP.



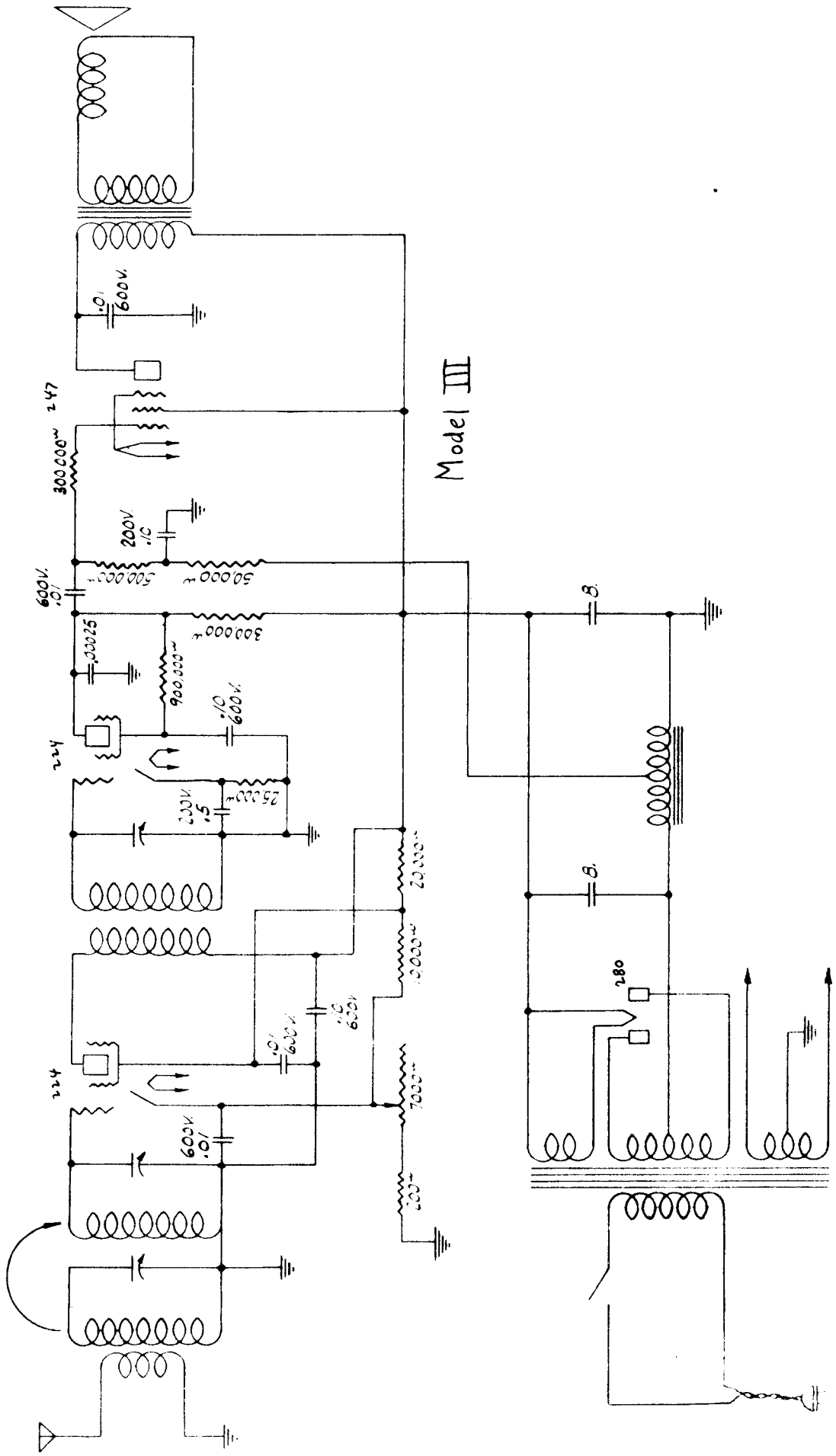
U. S. RADIO AND TELEVISION CORP.



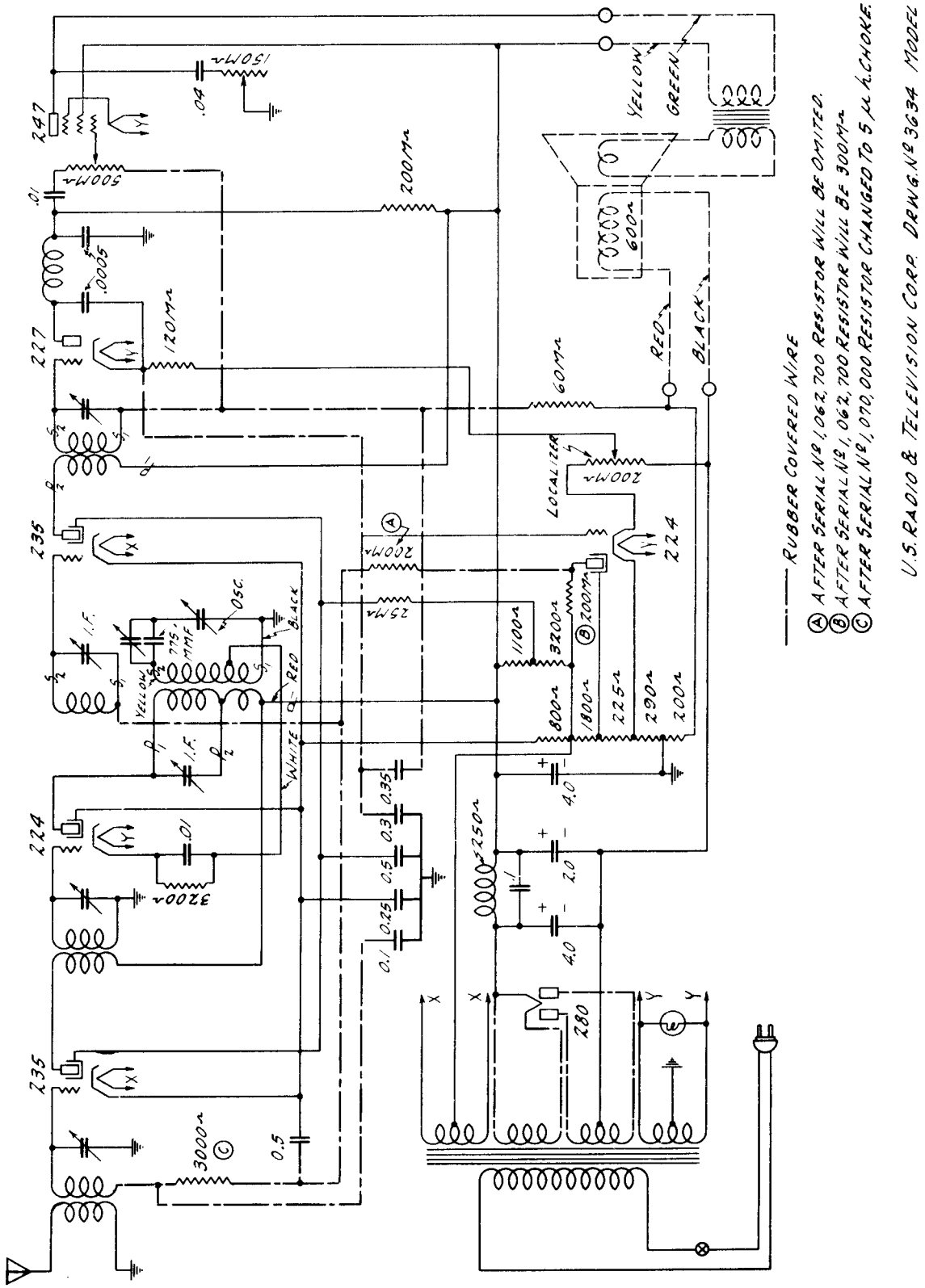
U. S. RADIO AND TELEVISION CORP.



U. S. RADIO AND TELEVISION CORP.



U. S. RADIO & TELEVISION CORP.

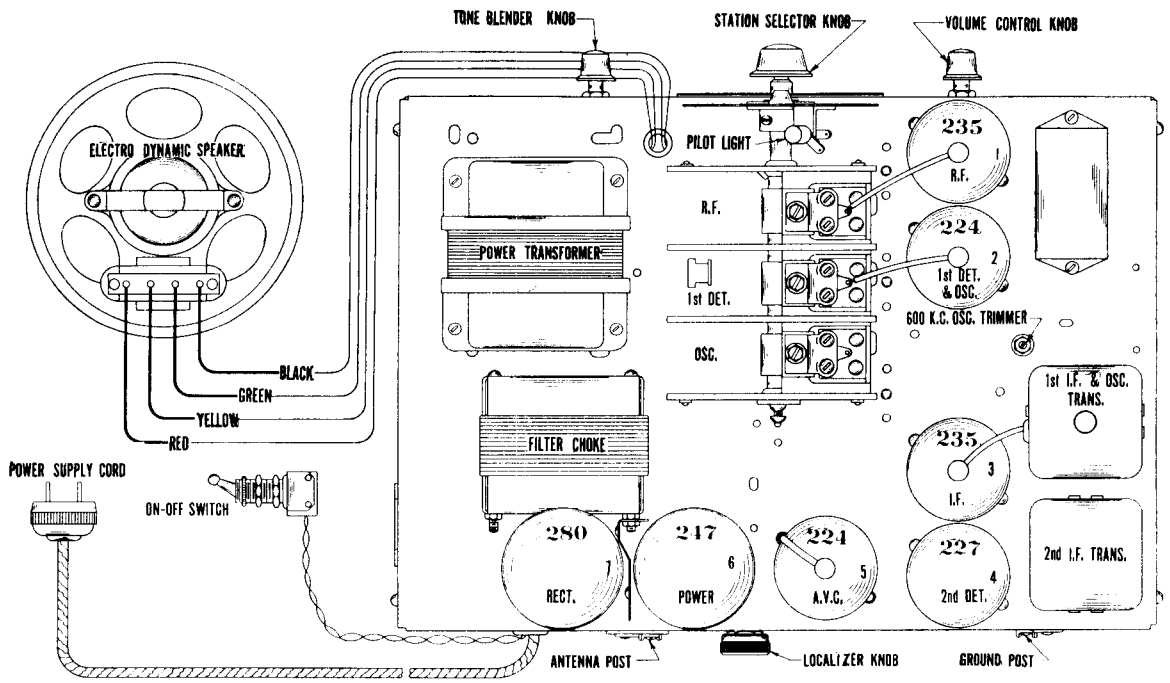


U. S. RADIO & TELEVISION CORP.

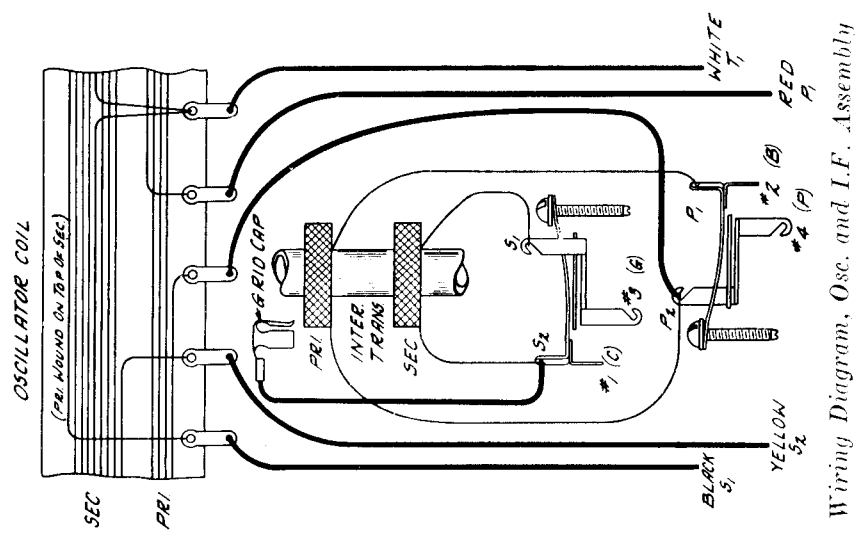
No. 7 CHASSIS—VOLTAGES AT SOCKETS—LINE VOLTAGE 115 VOLUME CONTROL AT MAXIMUM—LOCALIZER AT NORMAL SETTING

Type of Tube	*Position of Tube*	*Function*	*Across Filament or Heater*	*Plate to Cathode*	*Grid to Cathode*	*Screen to Cathode*	*Screen MA*	*Cathode to Heater*	*Plate MA*	*Grid Test MA*
235	1	R.F.	2.35	150	4.5(1)	70(2)	.9	4.5	2.7	4.2
224	2	1st Det. & Osc.	2.35	240	6.4	93	.3	6.4	1.8	2.6
235	3	I.F.	2.35	150	4.5(1)	70(2)	.9	4.5	2.7	4.2
227	4	2nd Det.	2.35	150	12–24(3)			0–10(3)	.2–.5(3)	.21–.51(3)
224	5	A.V.C.	2.35	60	0–15(3)	9	0 (4)	12	0 (4)	0 (4)
247	6	Power	2.35	220	16 (5)	240	6.4		34	40
280	7	Rect.	4.9						39 Per Plate	

(1) This voltage read across 800 ohm resistor.
(2) Voltage as read with 600,000 ohm meter.
(3) Varies with setting of localizer. Voltages read with high resistance meter.
(4) Current zero with no signal and localizer at normal position.
(5) The voltage read across 200 ohm section of voltage divider.

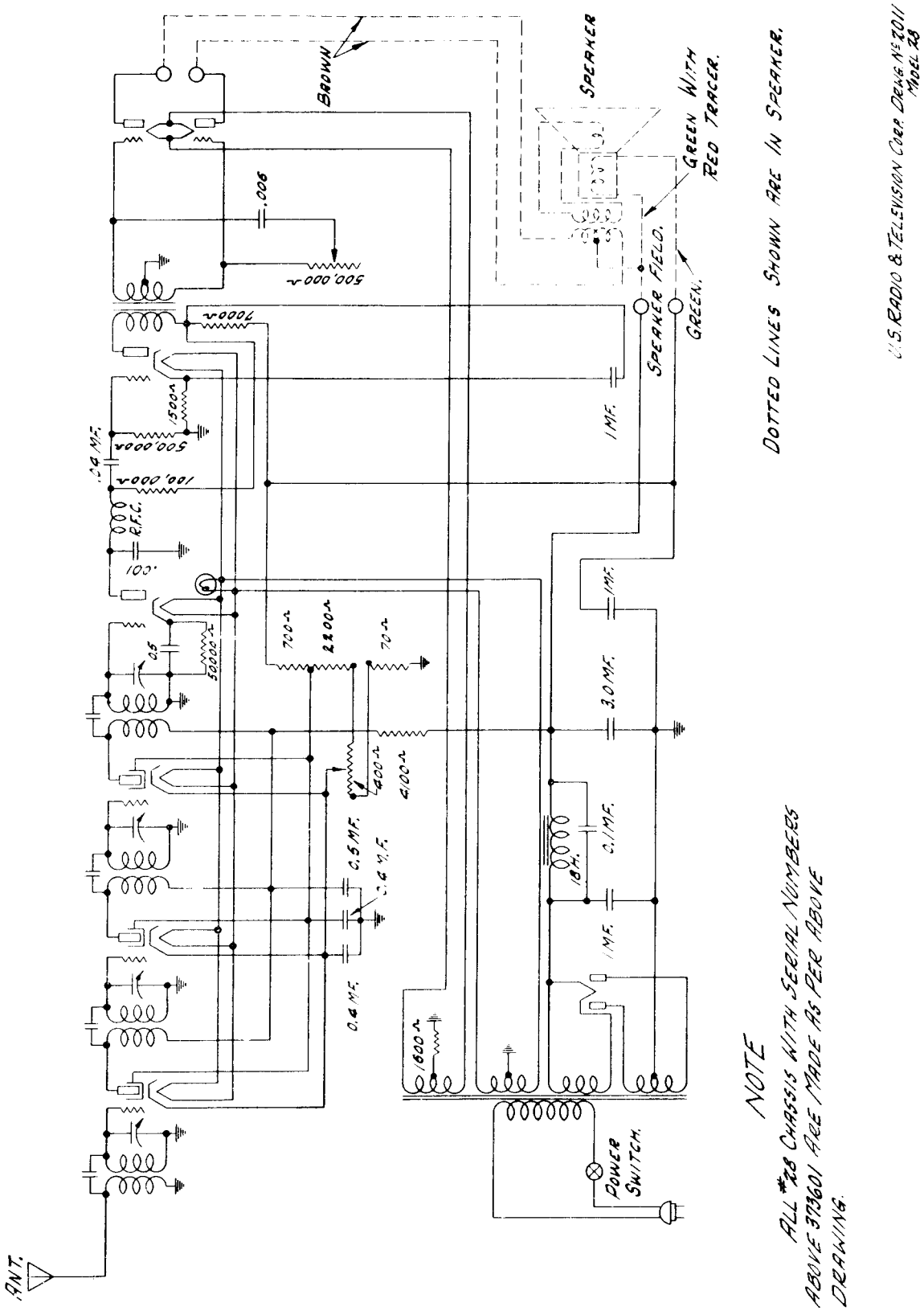


Top View of No. 7 Chassis showing Tube Sequence and Speaker Connections

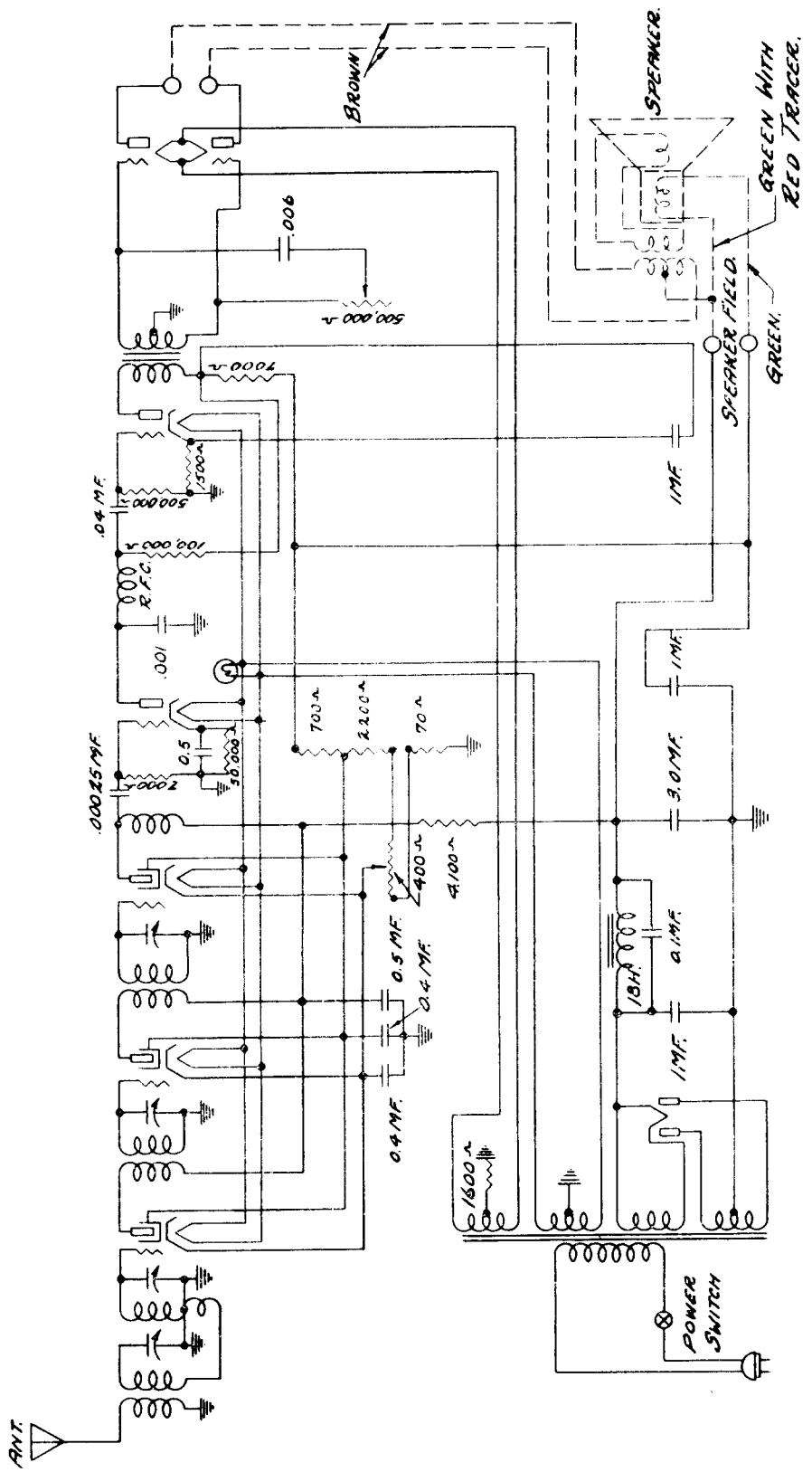


Wiring Diagram, Osc. and I.F. Assembly

U. S. RADIO & TELEVISION CORP.



U. S. RADIO & TELEVISION CORP.



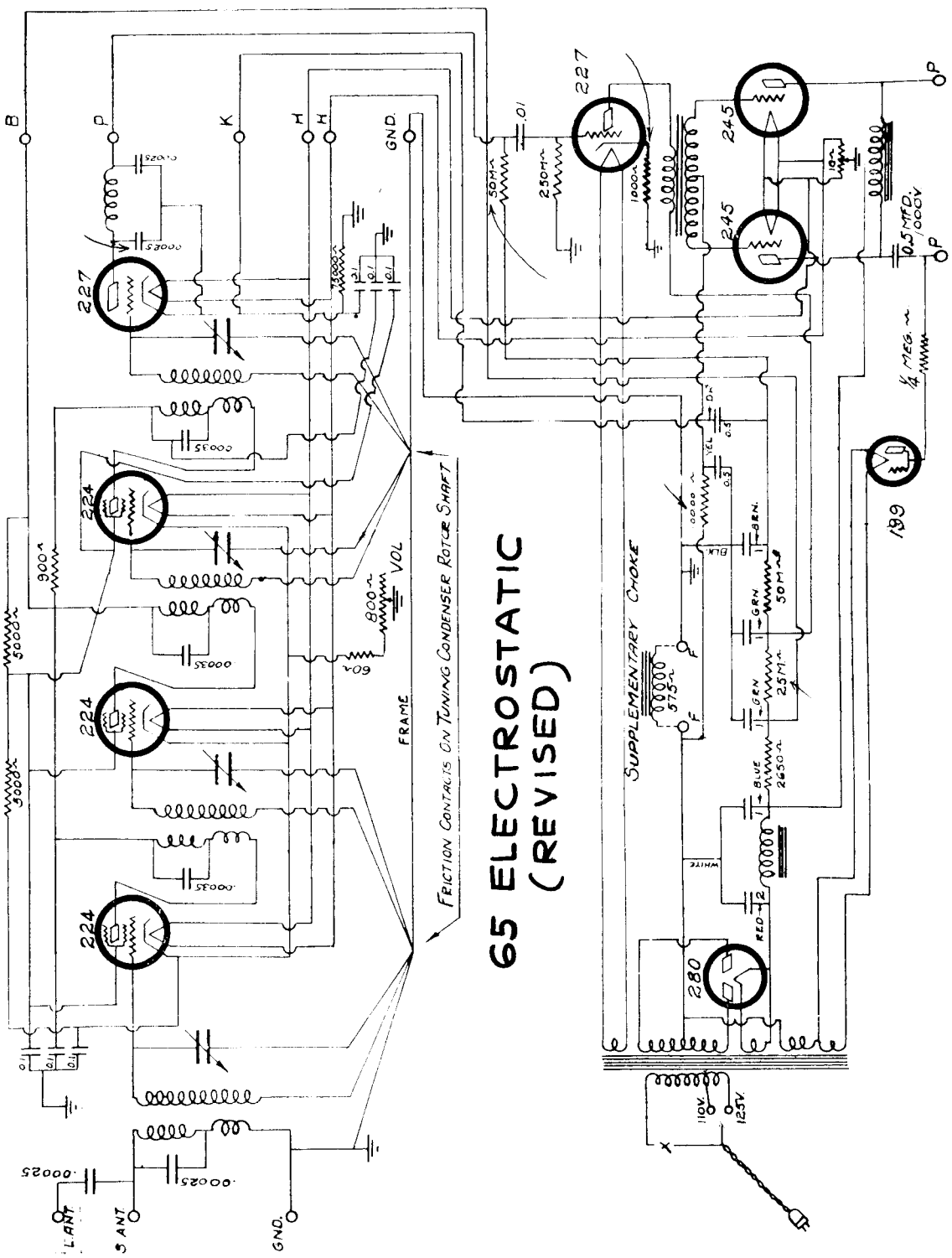
DOTTED LINES SHOWN ARE IN SPEAKER.

U.S. RADIO & TELEVISION CORP. DWG. NO. 2011 MODEL 28

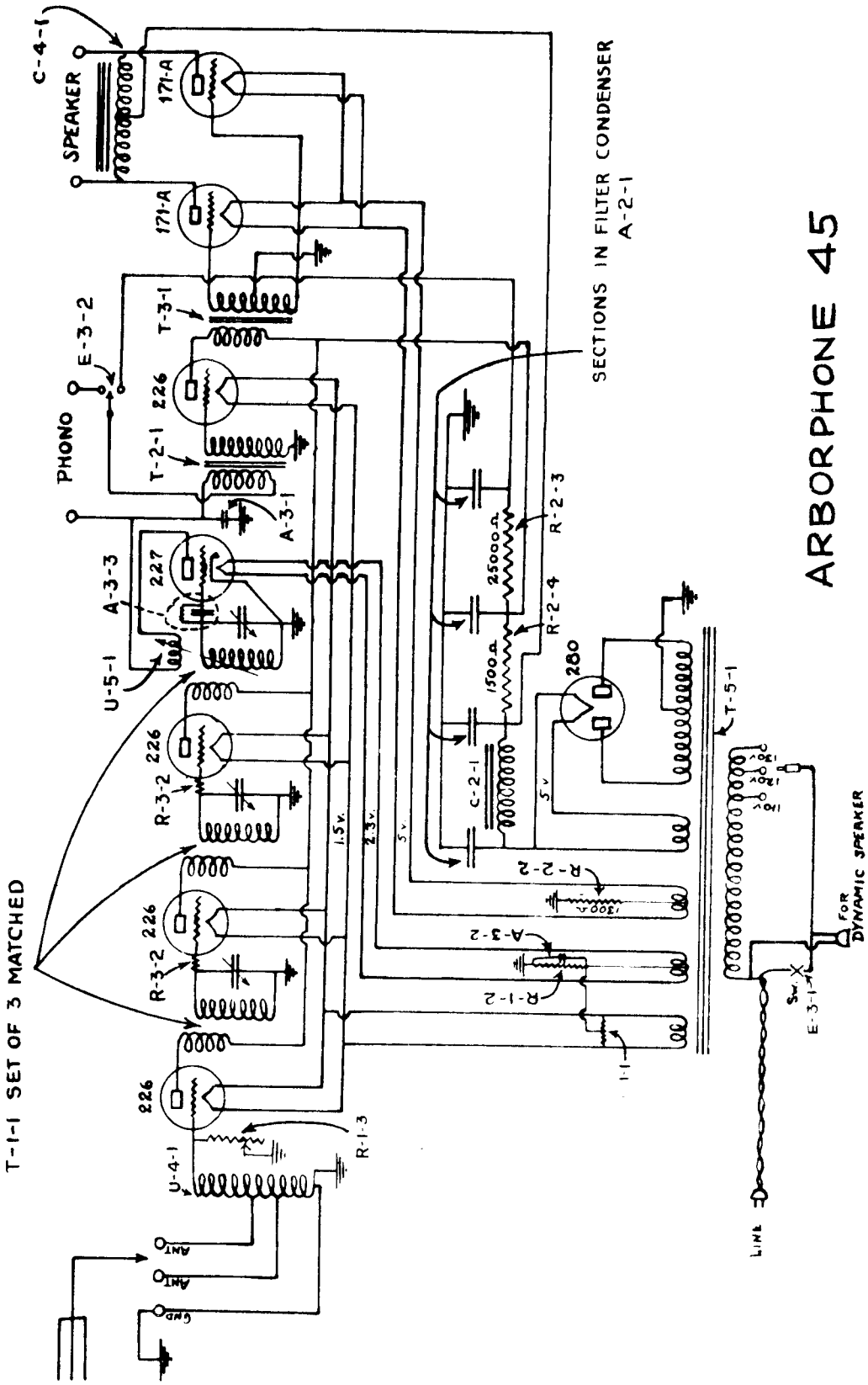
NOTE

ALL #28 CHASSIS WITH SERIAL NUMBERS BELOW 37360 ARE MADE AS PER ABOVE DRAWING

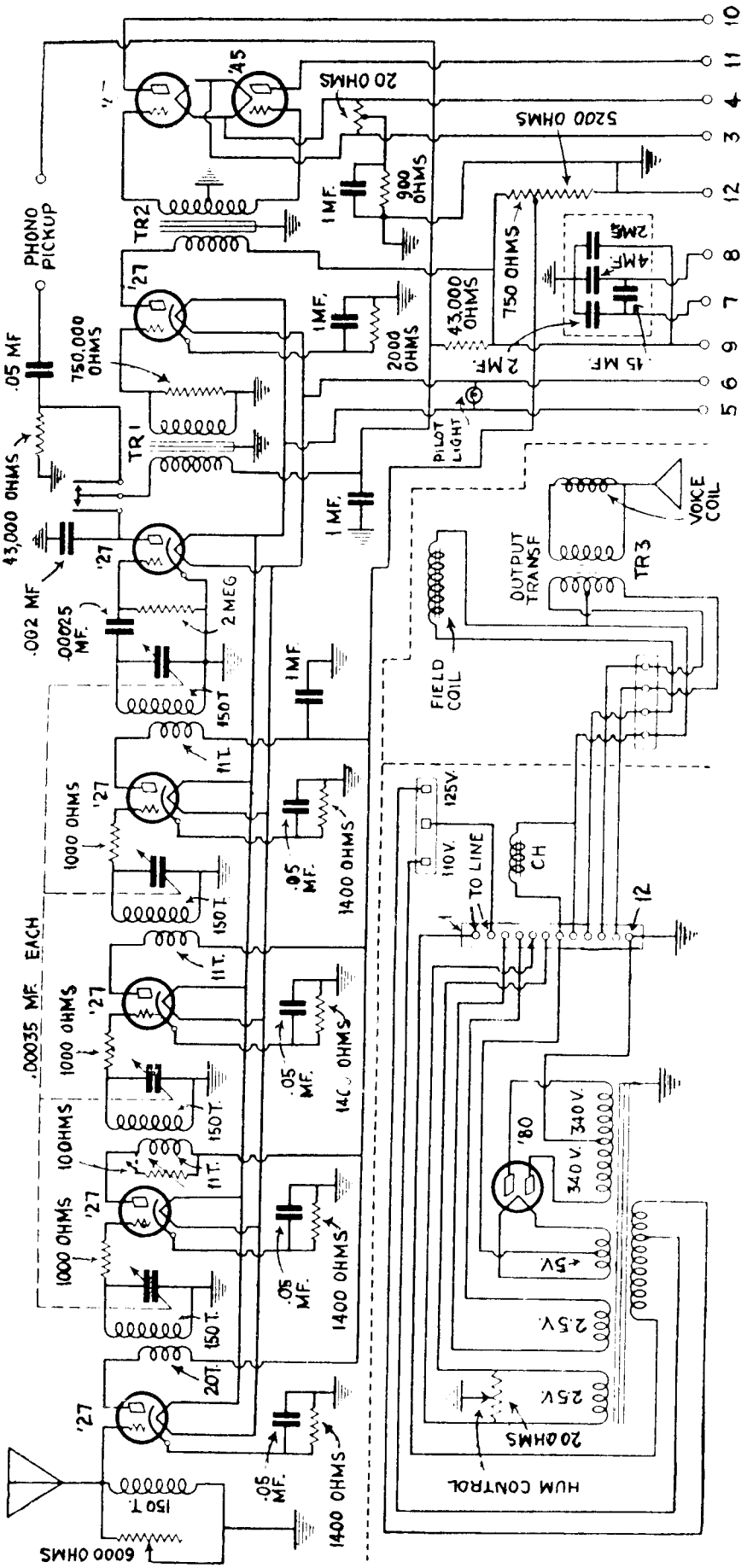
UNITED REPRODUCERS CORP.



UNITED REPRODUCERS CORP.

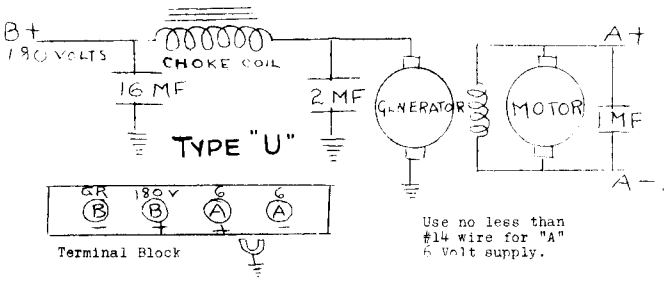


UNITED REPRODUCERS CORP.



TEMPLE MODELS 8-60, 8-80, 8-90 (REVISED.)

U. S. ELECTRIC WORKS



Type "U" is used with the Universal Radio Set and all others using B Negative as a common ground.

Type "U" should not be used on sets where the C Bias current is from B negative to ground.

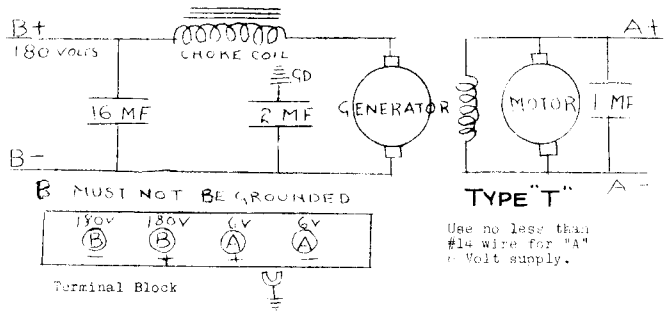
Type "U" is recommended for sets using Automobile Pentode tubes.

Type "U" is rated at 180 Volts at 35 Milliampere drain, at 6 Volt input. On the installation of Genemotor it is absolutely necessary that you have no less than 6 Volt supply at the Genemotor Terminal Block.

The Common ground connection is connected to the A+ when the positive side of the battery is grounded to the car frame or to the A- when the negative side of the battery is grounded to the frame of the car.

Genemotor requires no further lubrication for one year after installation, and then less than one drop in each bearing. String the rubber grommet on the cables before connecting to the terminal block.

The serial number is stamped on the bottom flange of the base. The live "A" line or input comes direct from the set control switch, so that when the set is turned off it automatically cuts the supply to the Genemotor.



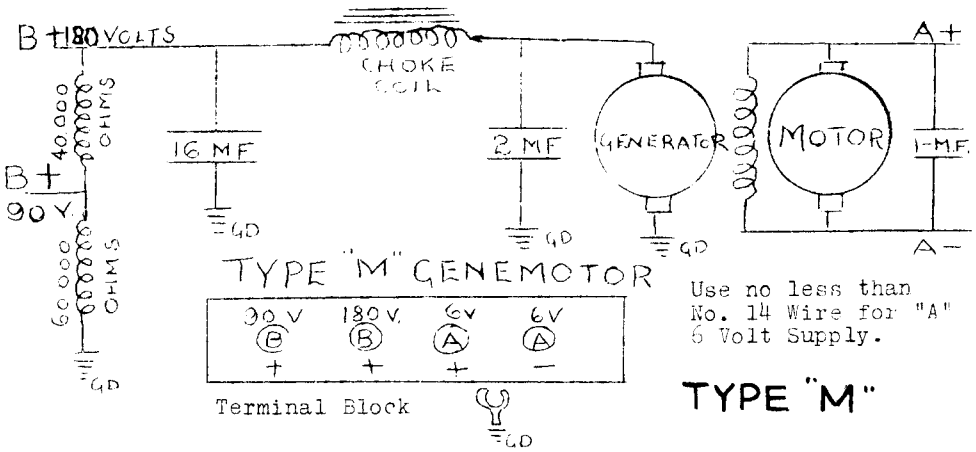
TYPE "T" is used with Philco Transitone and all similar type sets, where the C Bias current is taken from B negative to the ground.

Type "T" is rated at 180 Volts at 35 Milliampere drain, at 6 Volt input. On the installation of Genemotor it is absolutely necessary to have no less than 6 volt supply at the Genemotor terminal Block.

The common ground connection is connected to the A+ when the positive side of the battery is grounded to the car frame, or to the A- when the negative side of the battery is grounded to the frame of the car.

Genemotor requires no further lubrication for one year, after installation, and then less than one drop in each bearing. String the rubber grommet on the cables before connecting to the terminal block.

The serial number is stamped on the under side of flange of the Base. The live "A" line or input comes direct from the set control switch, so that when the set is turned off it automatically cuts the supply from the Genemotor.



The common ground connection is connected to the A+ when the positive side of the battery is grounded to the car frame or to the A- when the negative side of the battery is grounded to the frame of the car.

Type M is used on the Majestic, Bosch and other sets using a 90 Volt tap at about 1/2 millampere drain. The Negative B is a common ground.

Type M is recommended where the Automobile Pentode Tubes are used. String the rubber grommet on the cables before connecting to the terminal block.

Genemotor requires no further lubrication for one year's service and then less than a drop in each bearing.

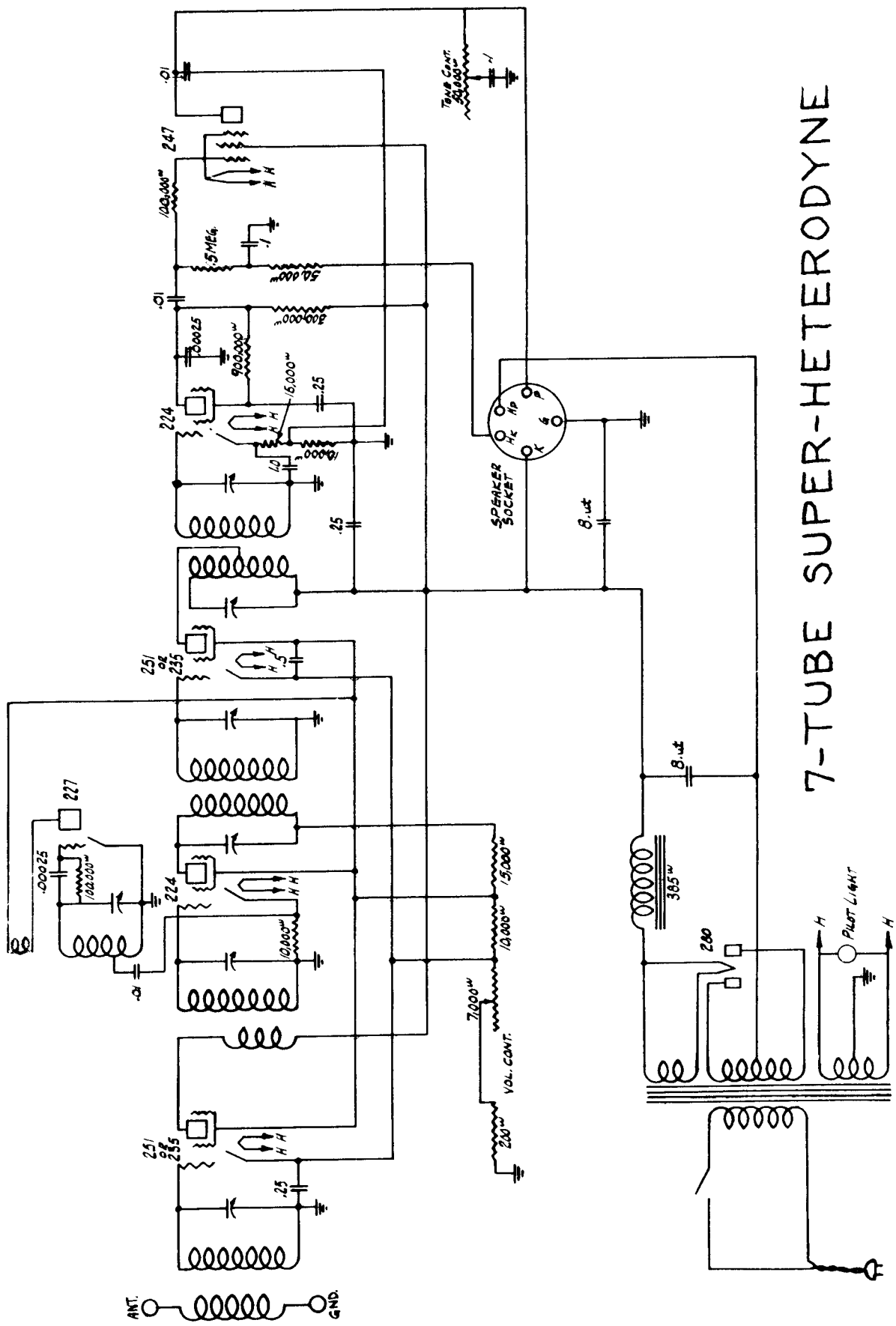
This Genemotor has been thoroughly tested at the factory, and is guaranteed against defective workmanship and material for a period of ninety days from date of installation.

Type M should not be used on sets where the C Bias current is from B negative to ground.

Serial number of the Genemotor is stamped under the bottom flange of the base. The live A line or input comes direct from the set control switch, so that when the set is turned off it automatically cuts the supply to the Genemotor.

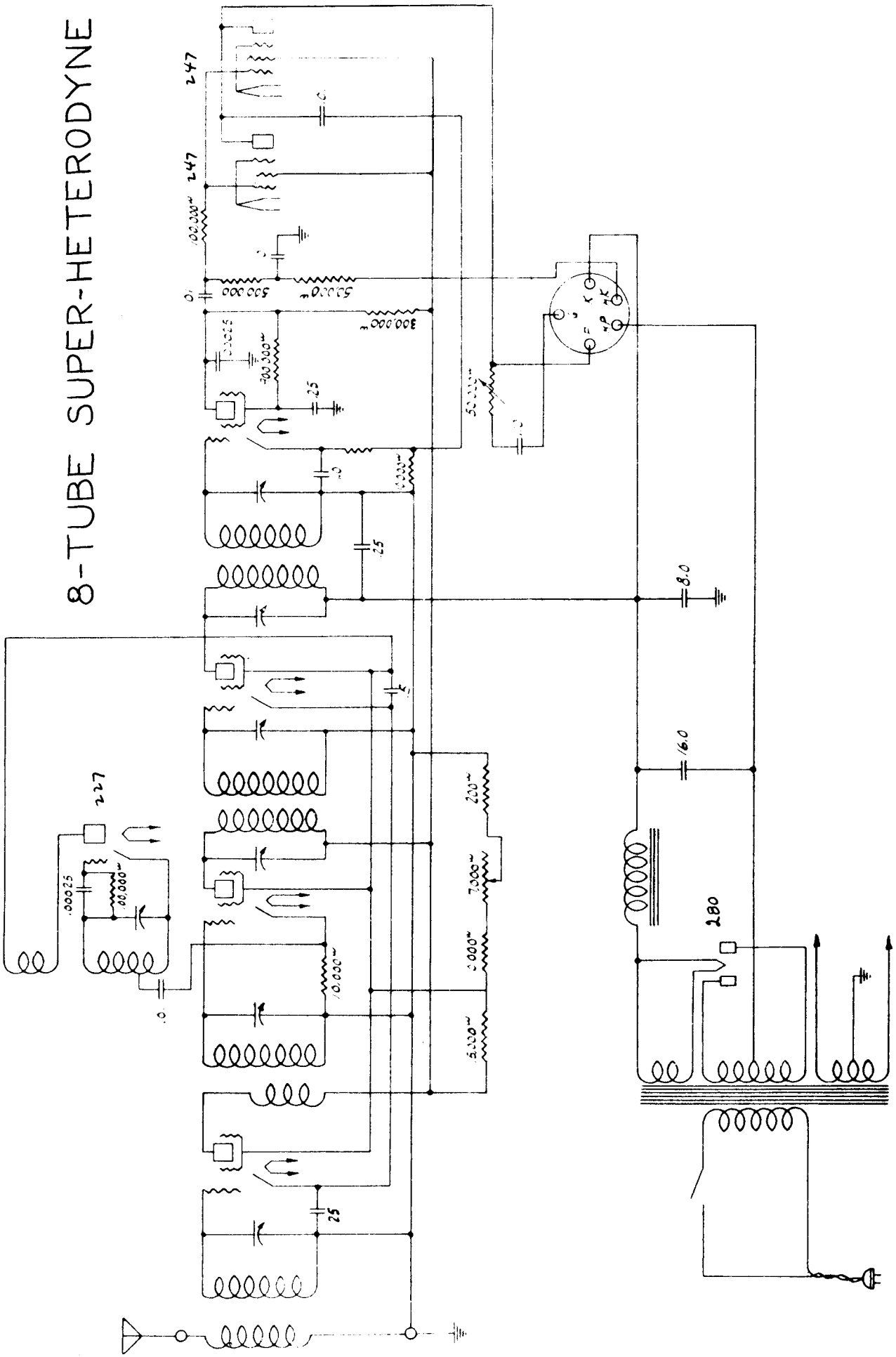
Type M Genemotor is rated at 180 volts at 35 Milliampere drain, at 6 volt input. On the installation of Genemotor it is absolutely necessary that you have no less than 6 Volt supply at the Genemotor terminal block.

UNITED AIR CLEANER CO.



UNITED AIR CLEANER CO.

8-TUBE SUPER-HETERODYNE


247
247
227
280
8.0
16.0
.25
.25
.25
.0005
.00025
.00005
.0001
.00035
.0003
.0002
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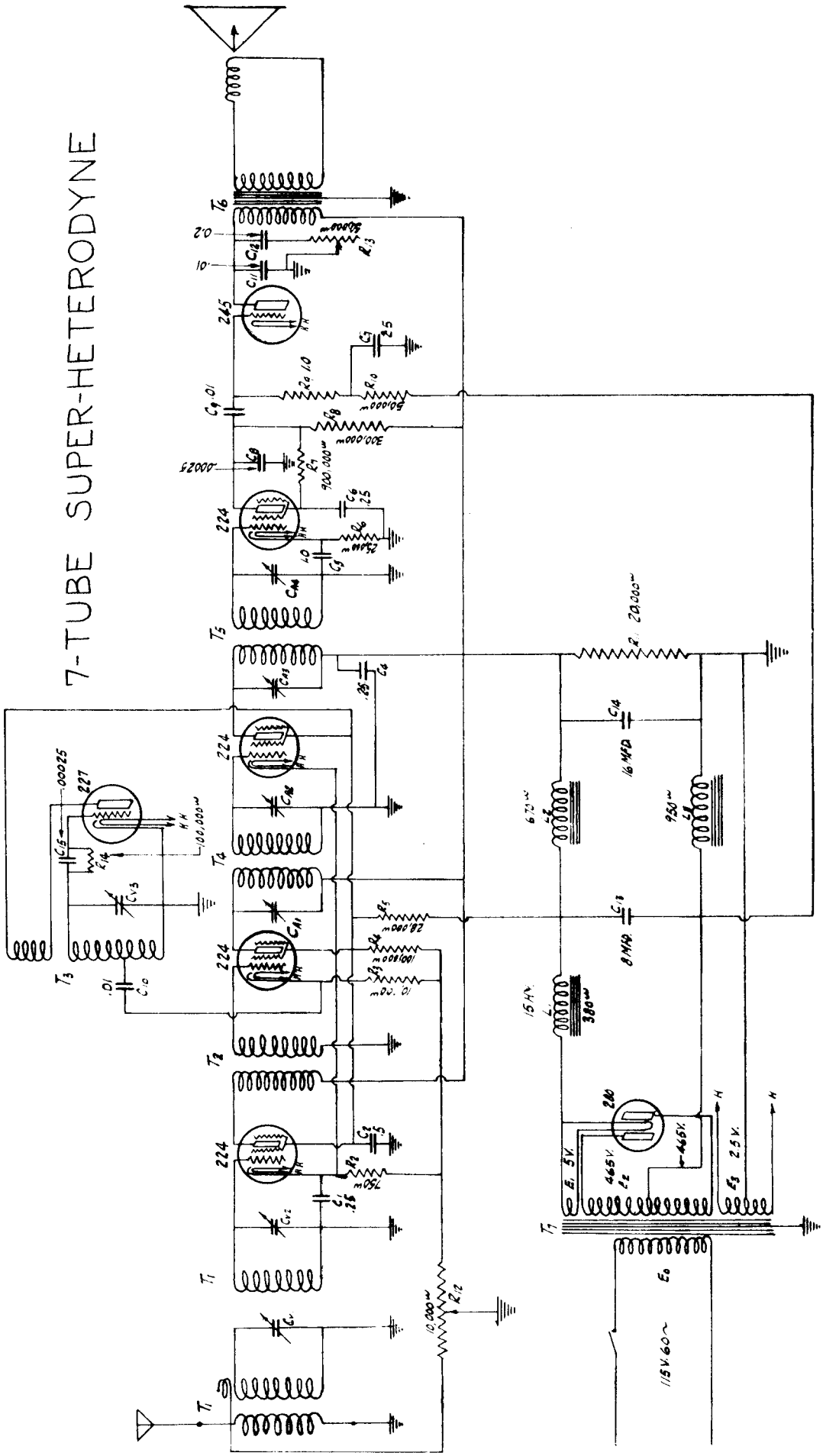
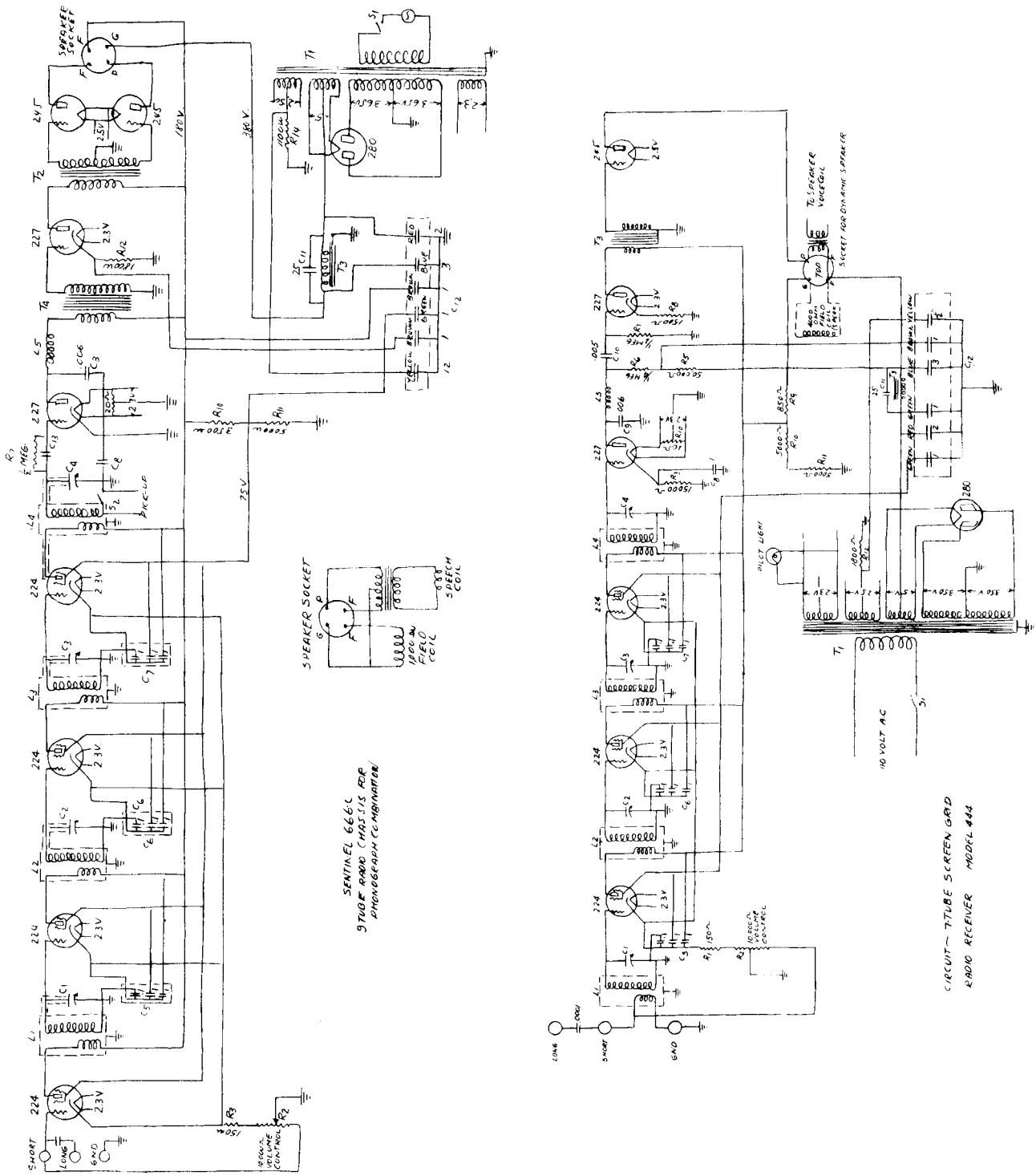
UNITED AIR CLEANER CO.

7-TUBE SUPER-HETERODYNE



UNITED AIR CLEANER CO.



ZANEY - GILL CORPORATION

CAUTION: Before attempting to install or operate, ascertain if this receiver corresponds with the voltage and the cycles of your power supply. The voltage and cycle reading is marked plainly on the license plate. ("Check Same"). Information on the above figures can be ascertained by calling your local power company. In localities where extreme fluctuations of voltages occur, we recommend that a separate voltage compensator be used to maintain a steady power supply.

NOTE: We are not responsible for damage caused by excessive voltages or incorrect installation.

ANTENNA & GROUND

The quality and amount of reception depends on the correct use of both aerial and ground. In congested areas where several broadcasting stations are in operation, it is not necessary to have an outdoor aerial. Set can be operated on from 3 to 15 feet of aerial for all local reception. In outlying territories or where your relativity to a broadcasting station permits, an aerial of from 25 to 150 feet may be used properly insulated and with correct lead-ins.

A very important feature in connecting a radio is to have a good ground as close to the receiving set as possible. A poor ground is a producer of noises, fading and generally poor reception. Both aerial and ground should be inspected every six months for loose connections or broken strands.

Aerial and ground connections are marked on the binding posts at the back of the chassis.

TUBES

The equipment for this radio consists of 3-224, 1-227, 1-280 and 1-245.

CAUTION: Do not insert or remove tubes from sockets while current is turned on.

SWITCH & VOLUME

The switch and volume control are located on the lower right hand knob which, when turned completely to the left, will act as a switch. To increase volume gradually turn to the right until desired output is gained, being careful to see that the tuning indicator is directly on the station signal.

For distance reception it is well to turn the volume control to almost full capacity and weak signals will break through and can be cleared by compensating the sharpness of the dial to the volume required.

The lower left hand knob operates VITATONE and tone control. The principle of VITATONE is supplying the backward notes with vitality and bringing them to the proper required impetus so that all reception carries *breadth* as well as the other registers. A further use of VITATONE is the elimination of line noises and static, which also can be accomplished by turning the knob completely to the right. This latter feature is exceptionally desirable for distance reception.

HINTS NECESSARY FOR BETTER RADIO RECEPTION

Use only standard high grade tubes. Cheap tubes will result in poor reception, poor tone and break downs at inopportune moments.

FUSE

Should there be a short in the wiring or a defective tube installed in the set, the fuse, which is located on the right hand side of the chassis assembly, will be blown. This can be replaced by an ordinary 3 amp. automobile type fuse. There are two positions to install the fuse, the two rear clips being used for 110 volts and the two front clips being used where excessive voltages rises as high as 130 volts.

In case of any unusual disturbances in the set, do not attempt to operate same until advised by an experienced service man.

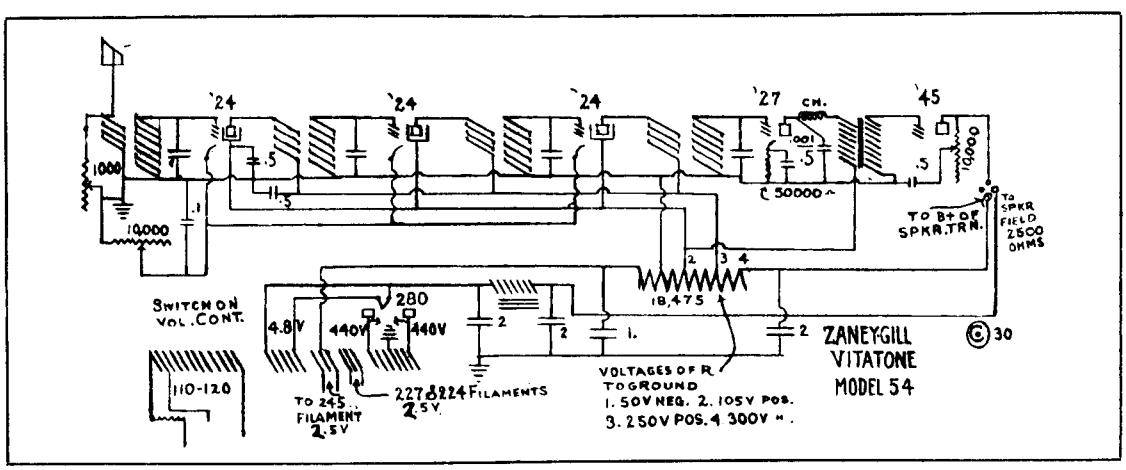
If set does not light, inspect plug connections to wall, also fuse.

If set lights and does not play, inspect speaker terminal and see if it is plugged into the holes marked speaker at the rear of the chassis.

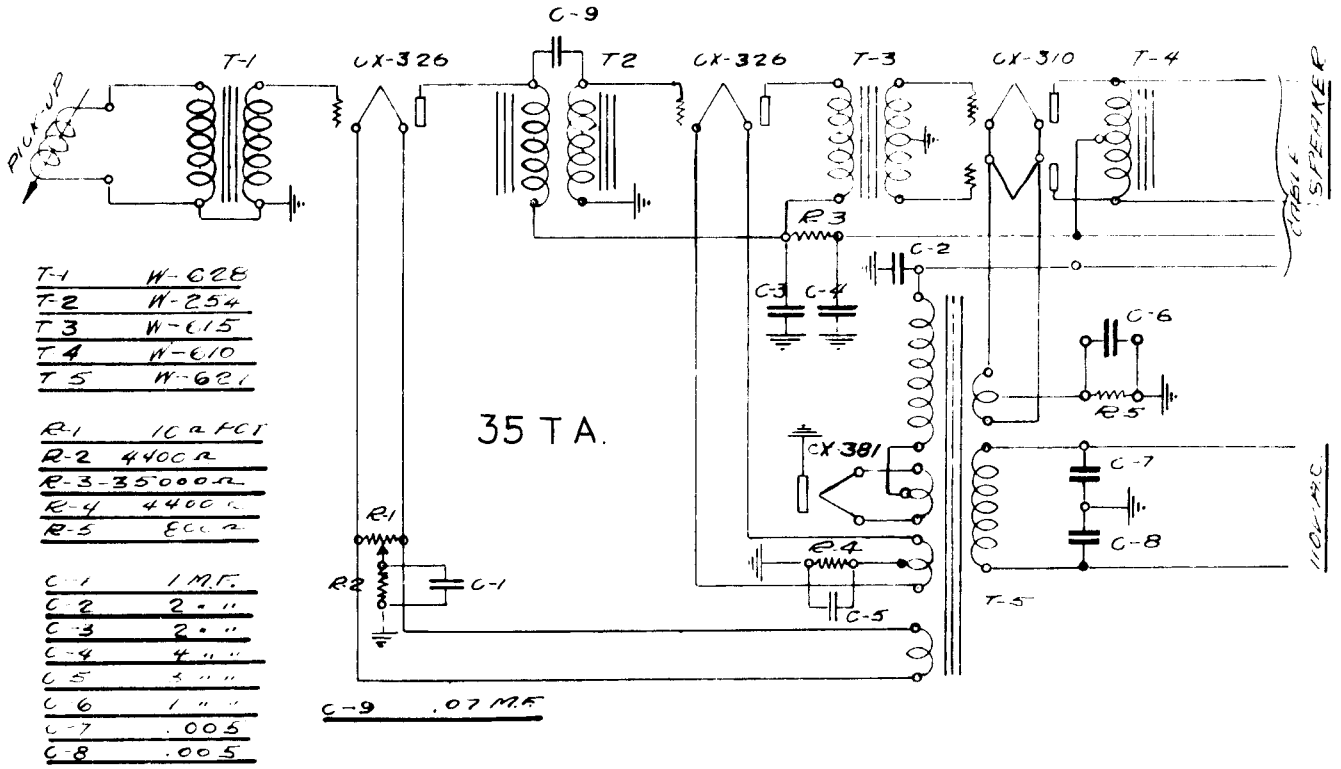
Also, have tubes tested for probable filament shorts.

In all cases, do not attempt to repair the set yourself. Call a competent service man, otherwise your guarantee will be nullified and void.

All parts of this receiver, excepting TUBES are guaranteed by the manufacturer for a period of 90 days against factory defects of workmanship and defective material.



WEBSTER ELECTRICAL CORP.

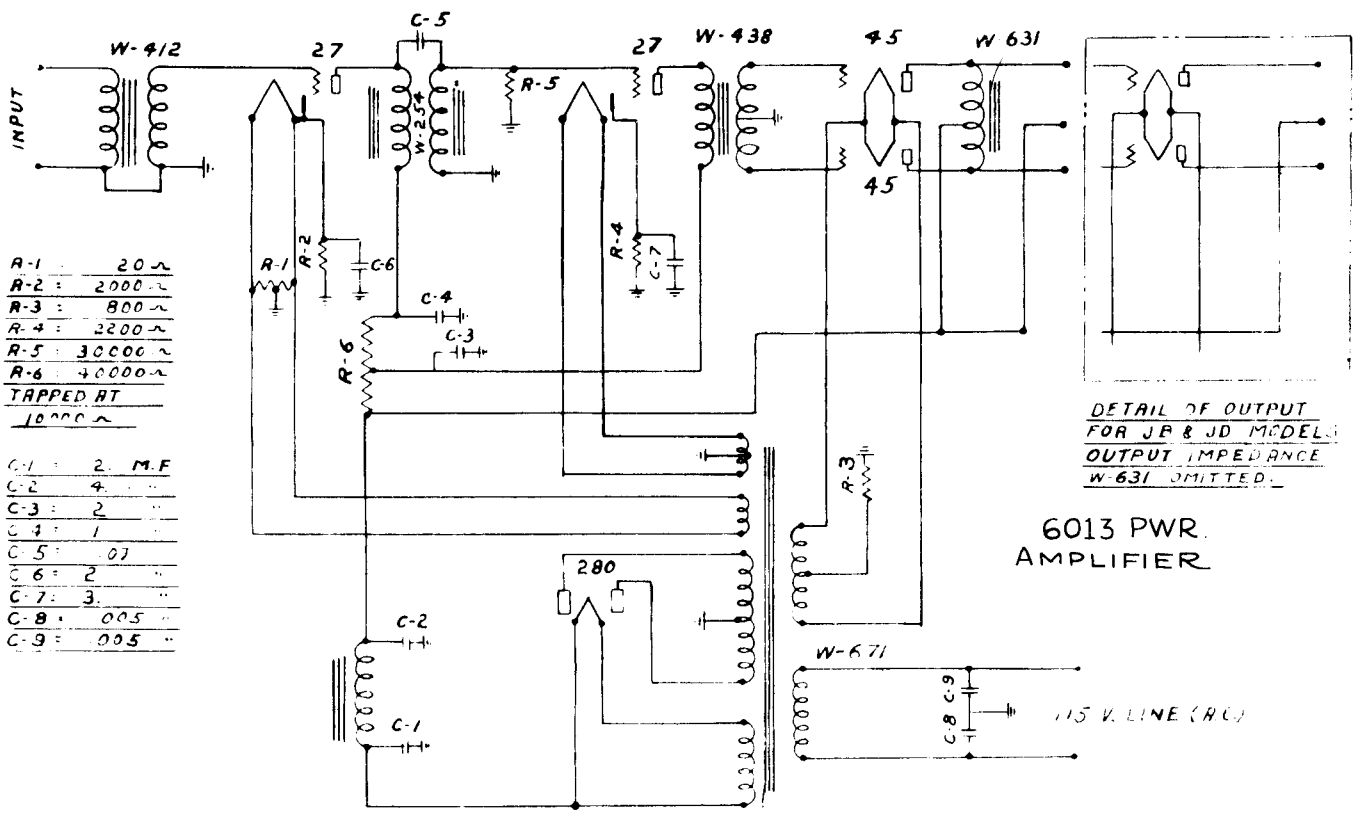


T-1	W-628
T-2	W-254
T 3	W-615
T 4	W-610
T 5	W-621

R-1	10 a HCT
R-2	4400 R
R-3	35000 R
R-4	4400 R
R-5	Ecc R

C-1	1 M.F.
C-2	2 "
C-3	2 "
C-4	4 "
C-5	1 "
C-6	1 "
C-7	.005
C-8	.005

C-9 .07 M.F.



R-1	20 R
R-2	2000 R
R-3	800 R
R-4	2200 R
R-5	30000 R
R-6	40000 R
TAPPED AT	10000 R

C-1	2. M.F
C-2	4. "
C-3	2 "
C-4	1 "
C-5	.01 "
C-6	2 "
C-7	3. "
C-8	.005 "
C-9	.005 "

DETAIL OF OUTPUT FOR JB & JD MODELS OUTPUT IMPEDANCE W-631 OMITTED.

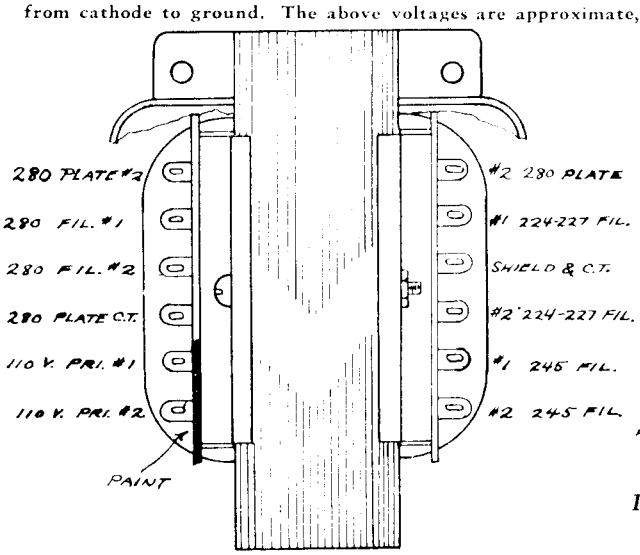
WELLS-GARDNER AND CO.

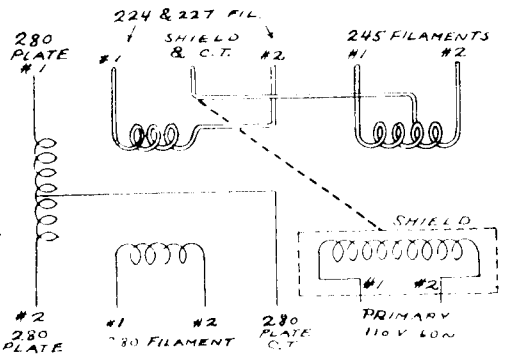
VOLTAGE CHARACTERISTICS

8-TUBE A.C. MODEL

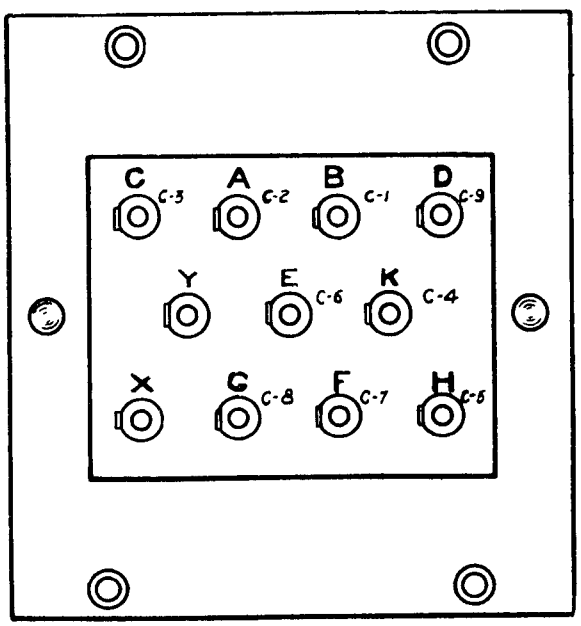
Tube Circuit Under Test		LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
224	Fil.	1.7	1.9	2.1	2.3	2.5
	Plate	151	166	183	199	215
	Screen	72	79	84.7	93	100
	Grid*	−2.2	−2.6	−2.9	−3.2	−3.6
	Cathode	2.2	2.6	2.9	3.2	3.6
227 Det.	Fil.	1.7	1.9	2.1	2.3	2.5
	Plate	87	97	104	112	122
	Grid*	−13.4	−15.0	−16.5	−18.2	−20.0
	Cathode	13.4	15.0	16.5	18.2	20.0
227 1st A.F.	Fil.	1.8	1.9	2.2	2.4	2.6
	Plate	109	120	129	139	150
	Cathode	6.9	7.9	8.9	9.8	11.0
245 2nd A.F.	Fil.	1.8	1.9	2.2	2.4	2.6
	Plate	211	235	258	285	310
	Grid	36	42.4	47	53	59
280 Rect.	Fil.	3.6	4.0	4.5	4.8	5.2

*NOTE: Grid voltages on the 224 and detector tubes are measured from grid to cathode terminals on the tube socket. The grid voltage on the first audio tube cannot be measured from grid to cathode, but is measured from cathode to ground. The above voltages are approximate, and will vary with different tubes.

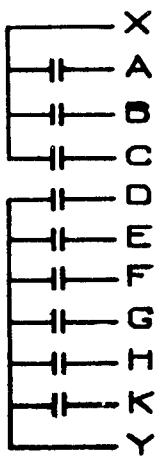




Power Transformer.

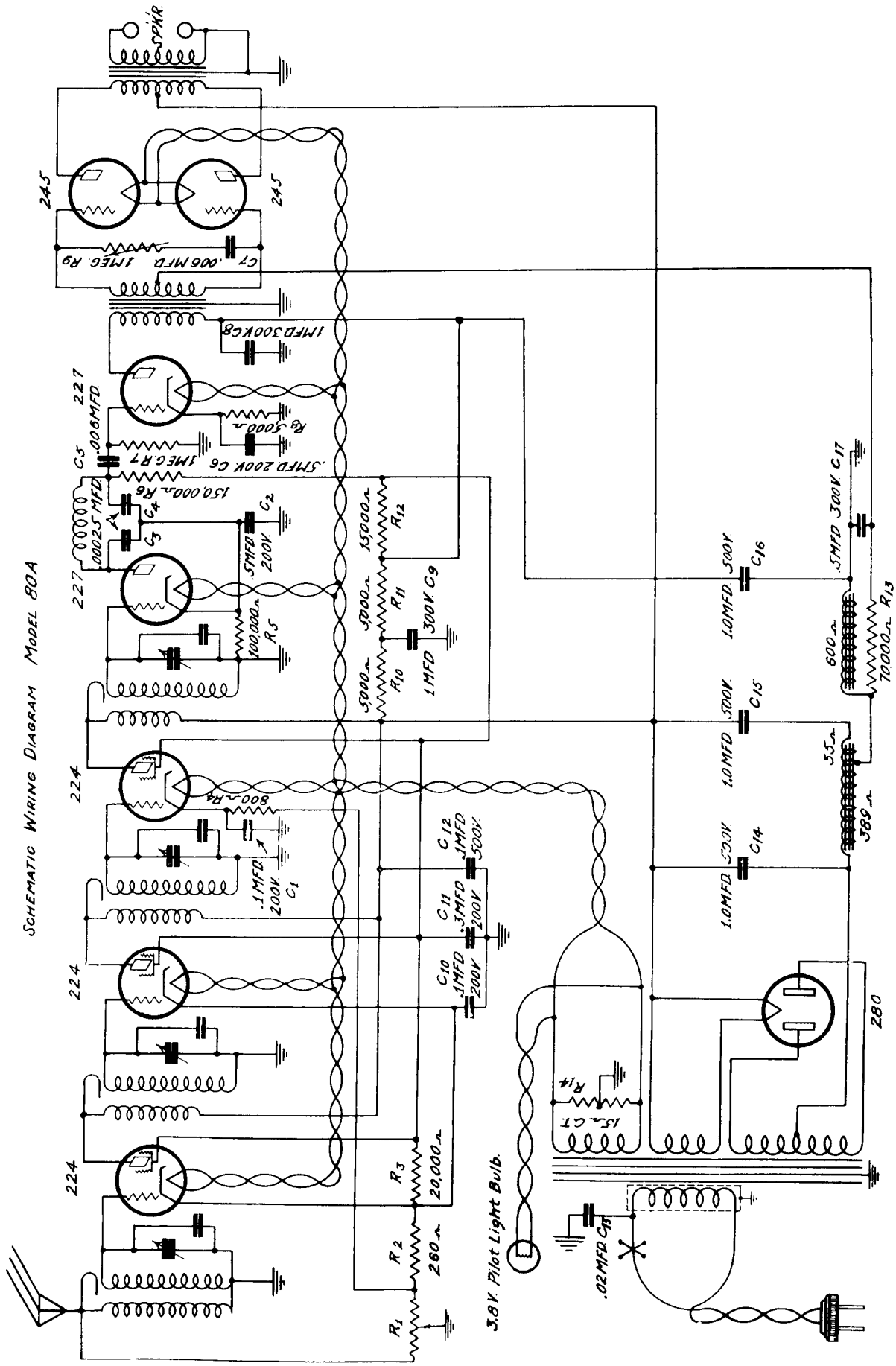


CAPACITY		
CODE	60 CYCLE	25 CYCLE
A	1.0 MF. C-2	
B	1.0 MF. C-1	2.5 MF. C-1
C	1.5 MF. C-3	4. MF. C-3
D	1.0 MF. C-9	1.0 MF. C-9
E	1.0 MF. C-6	1.0 MF. C-6
F	0.5 MF. C-7	0.5 MF. C-7
G	1.0 MF. C-8	1.5 MF. C-8
H	0.5 MF. C-5	0.5 MF. C-5
K	1.5 MF. C-4	2.0 MF. C-4
X	COMMON	COMMON
Y	COMMON	COMMON

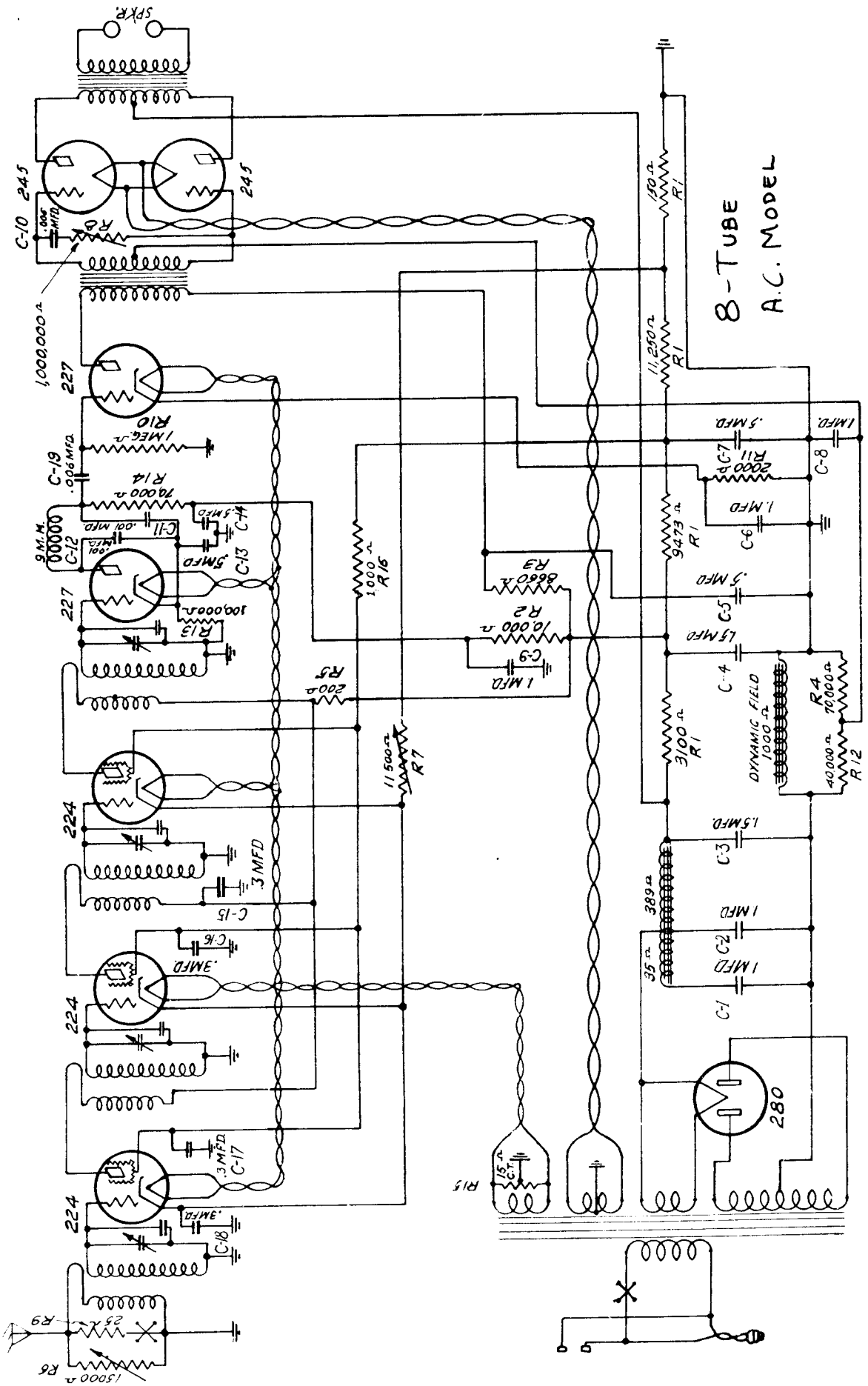


Filter Condenser (60 and 25 cycle receivers).

WELLS-GARDNER AND CO.



WELLS-GARDNER AND CO.



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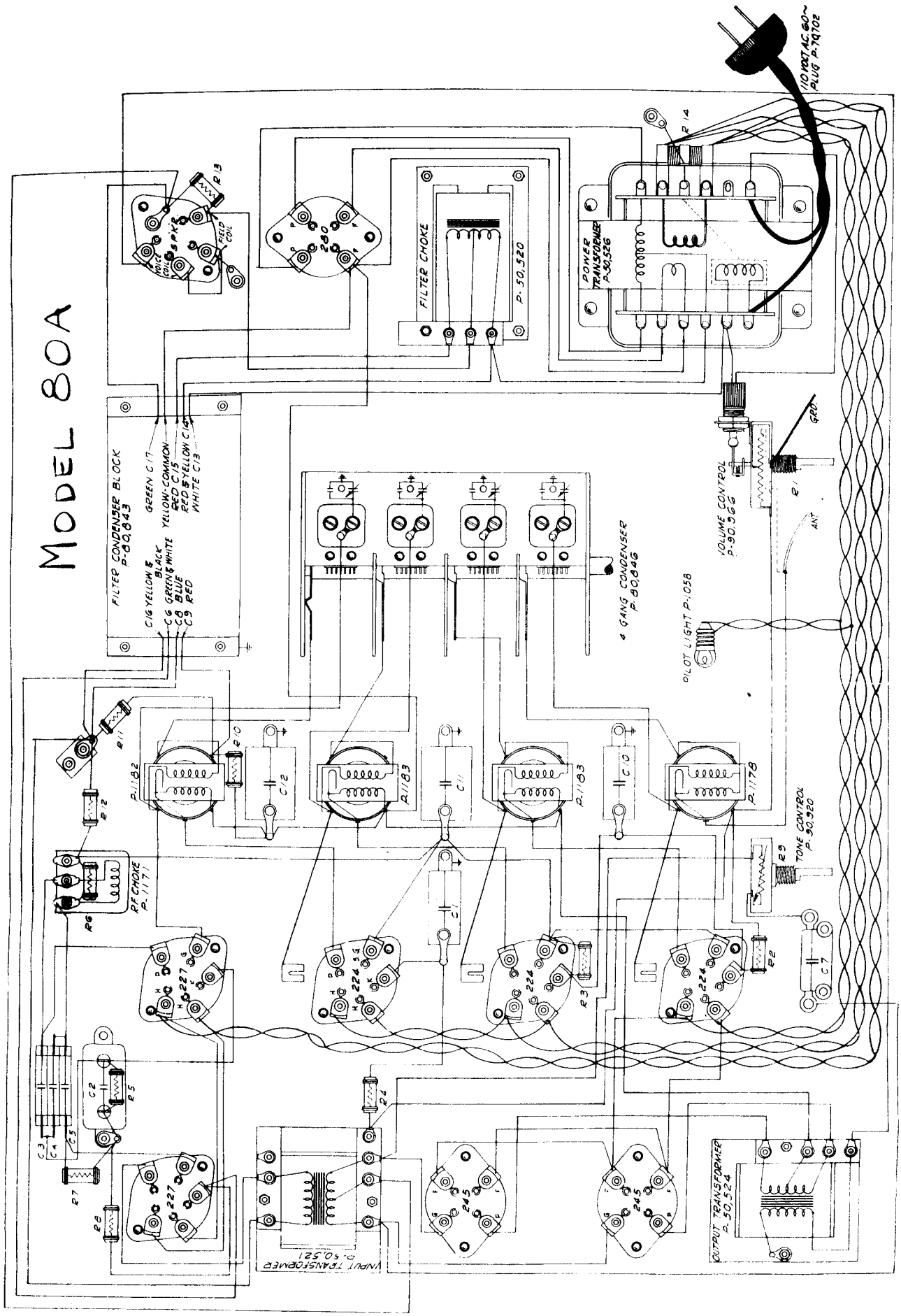
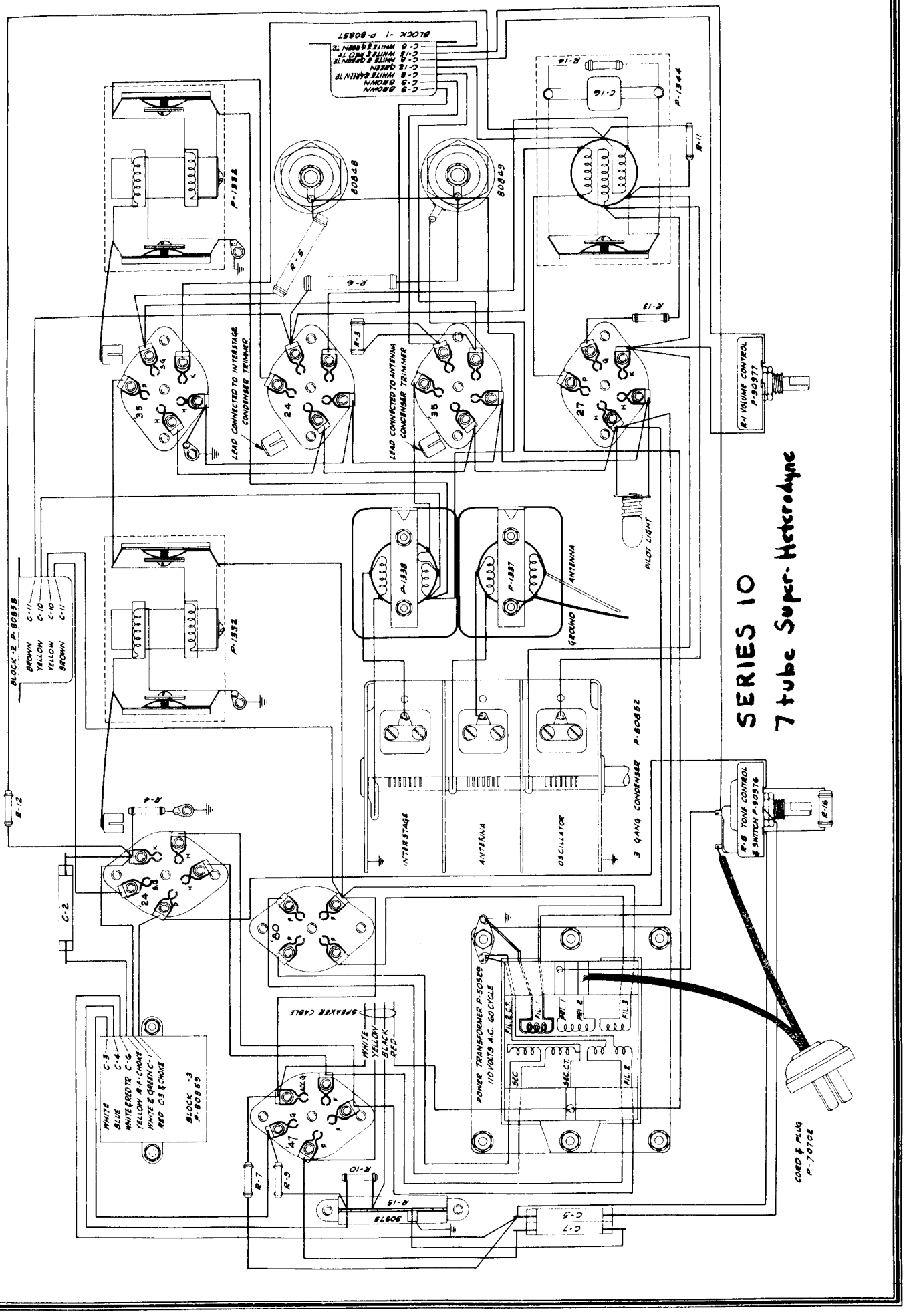
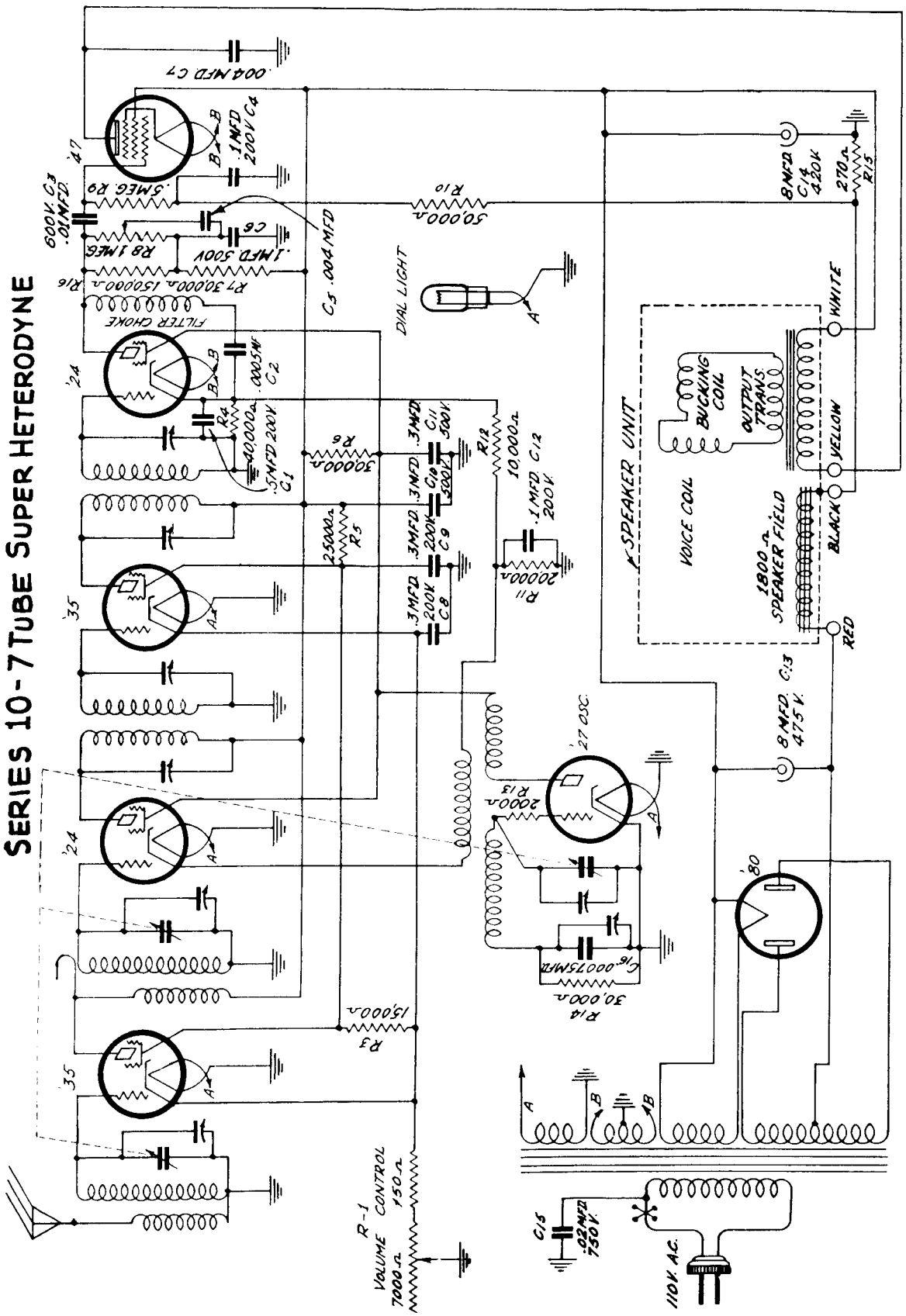


WELLS-GARDNER AND CO.



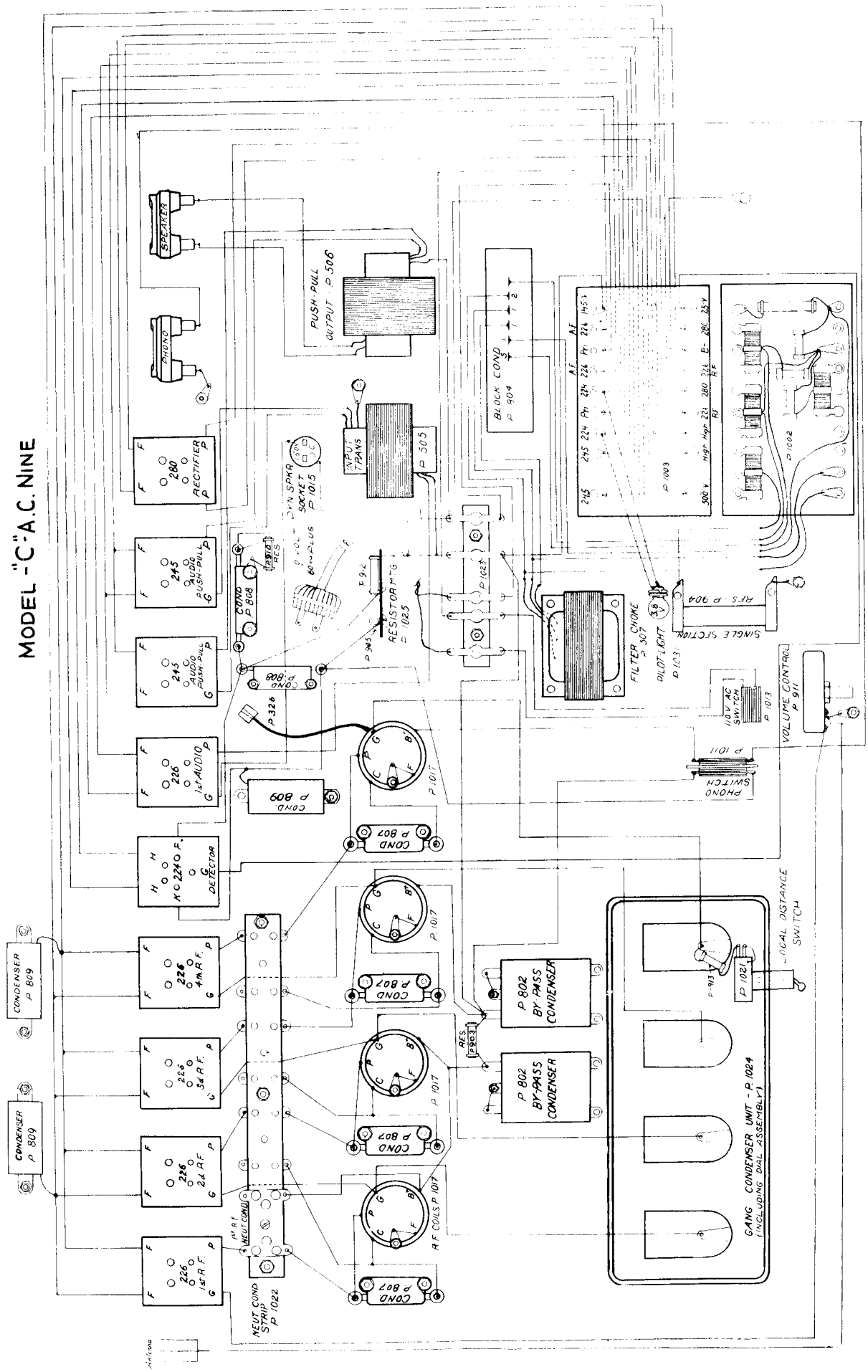
WELLS-GARDNER AND CO.

SERIES 10-7 TUBE SUPER HETERODYNE

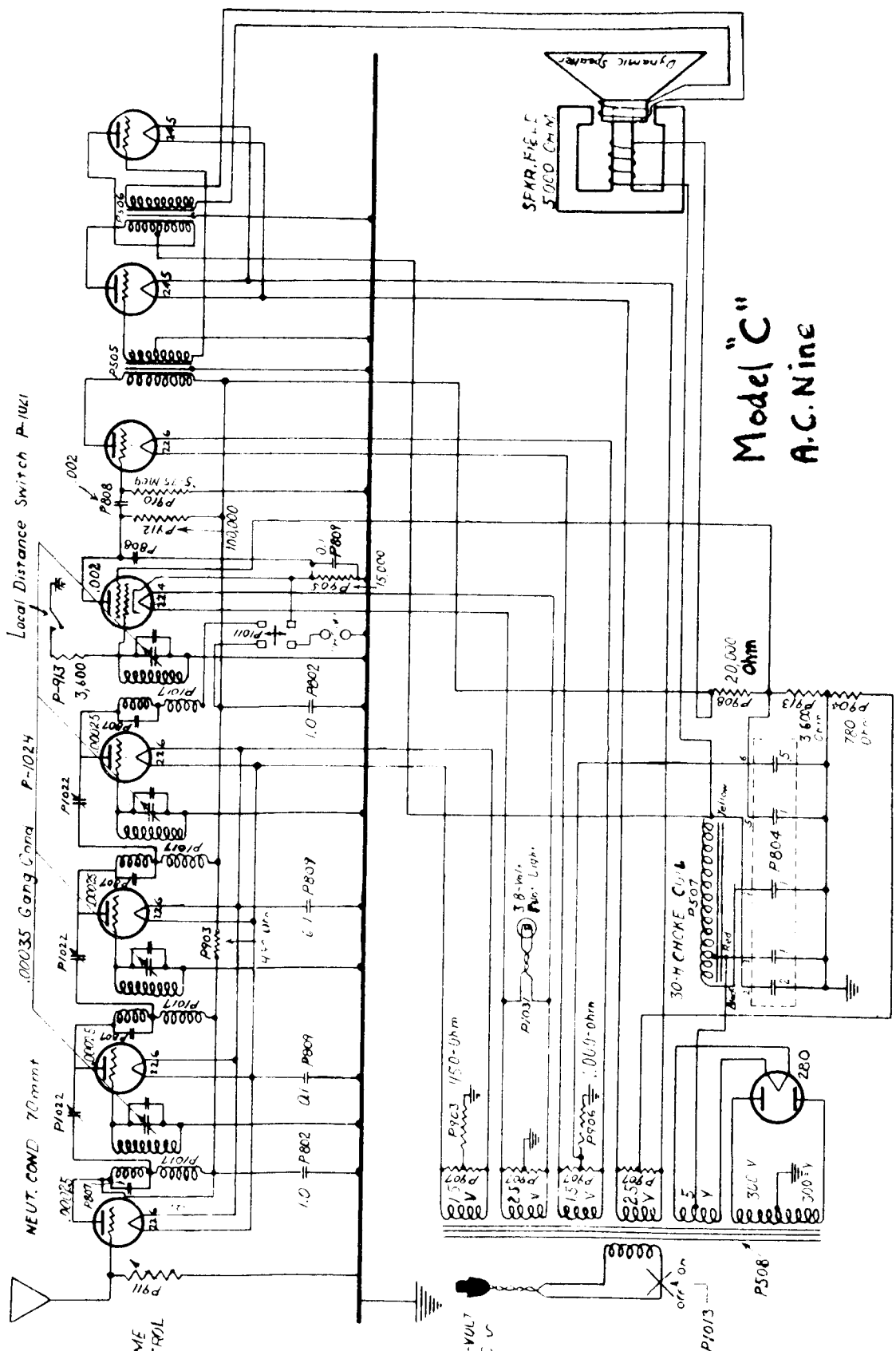


WELLS-GARDNER AND CO.

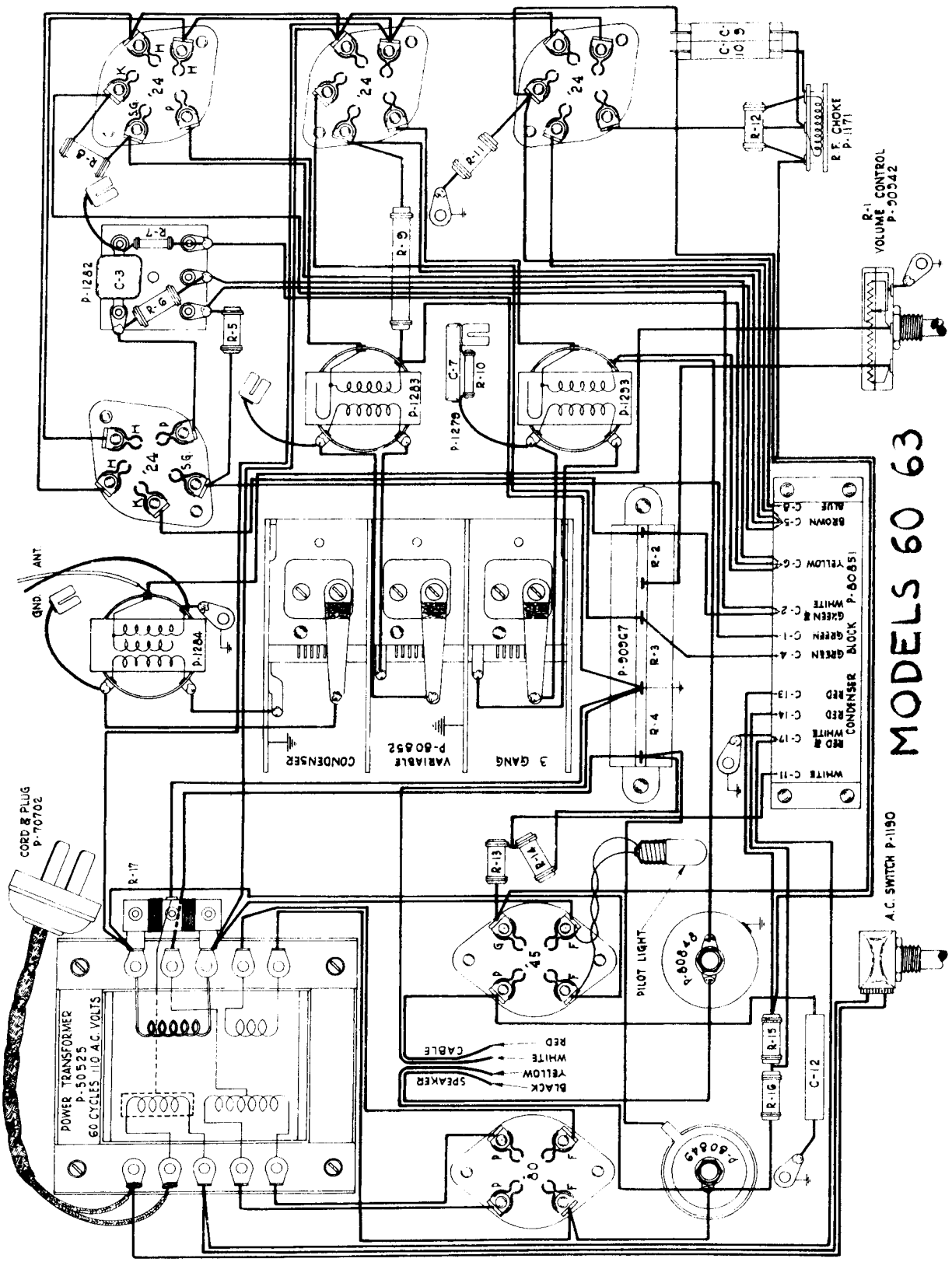
MODEL "C" A.C. NINE



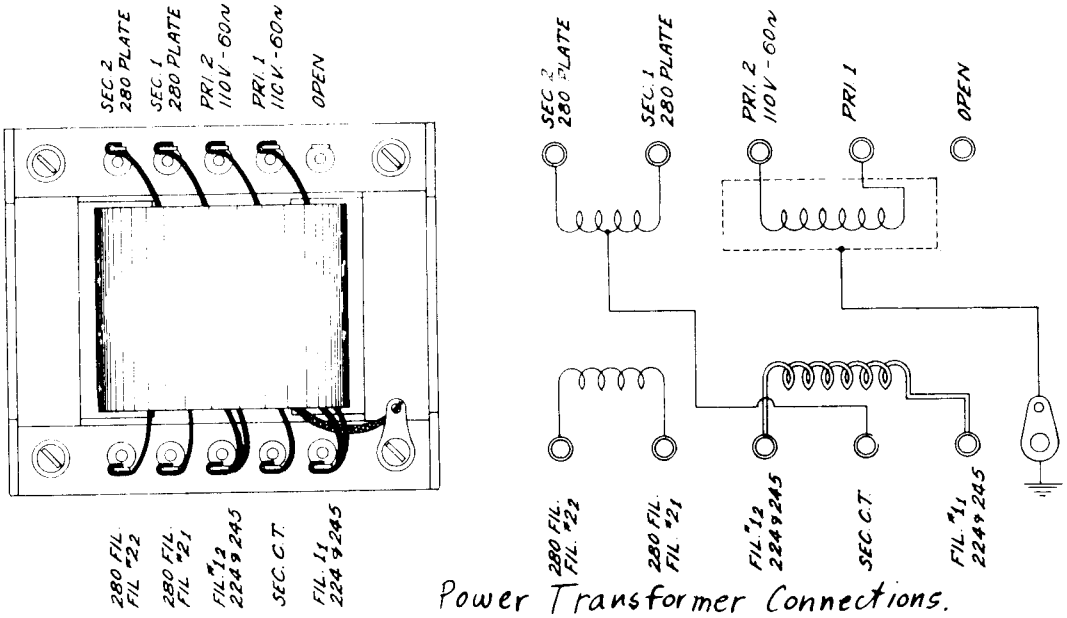
WELLS-GARDNER AND CO.



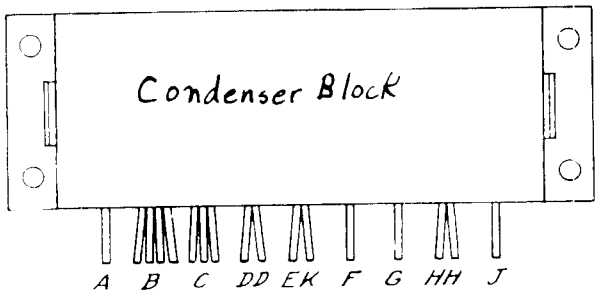
WELLS-GARDNER AND CO.

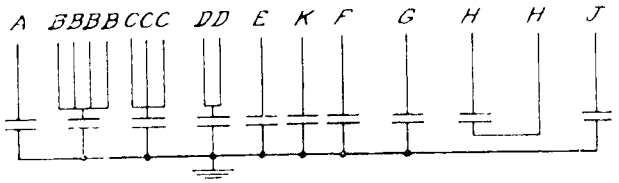


WELLS-GARDNER AND CO.



Power Transformer Connections.





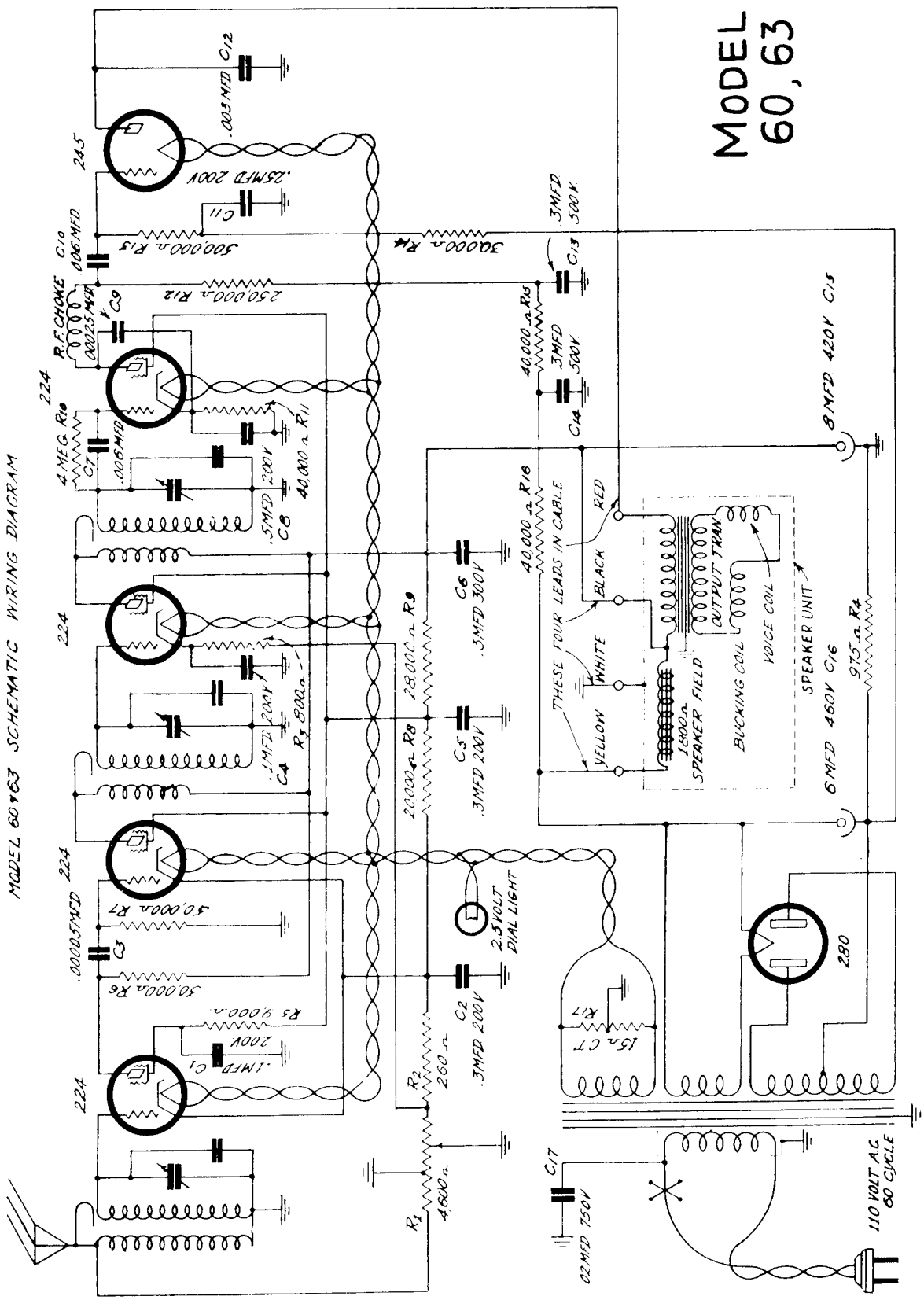
SPECIFICATIONS			
LEAD	CODE	COLOR	CAPACITY
A	C-8	BLUE	0.5 MFD.
B	C-5	BROWN	0.3 MFD.
C	C-6	YELLOW	0.3 MFD.
D	C-2	GREEN & WHITE	0.3 MFD.
E	C-4	GREEN	0.1 MFD.
F	C-14	RED	0.3 MFD.
G	C-13	RED	0.3 MFD.
H	C-17	RED & WHITE	0.02 MFD.
J	C-11	WHITE	0.25 MFD.
K	C-1	GREEN	0.10 MFD.

MODELS
60 63

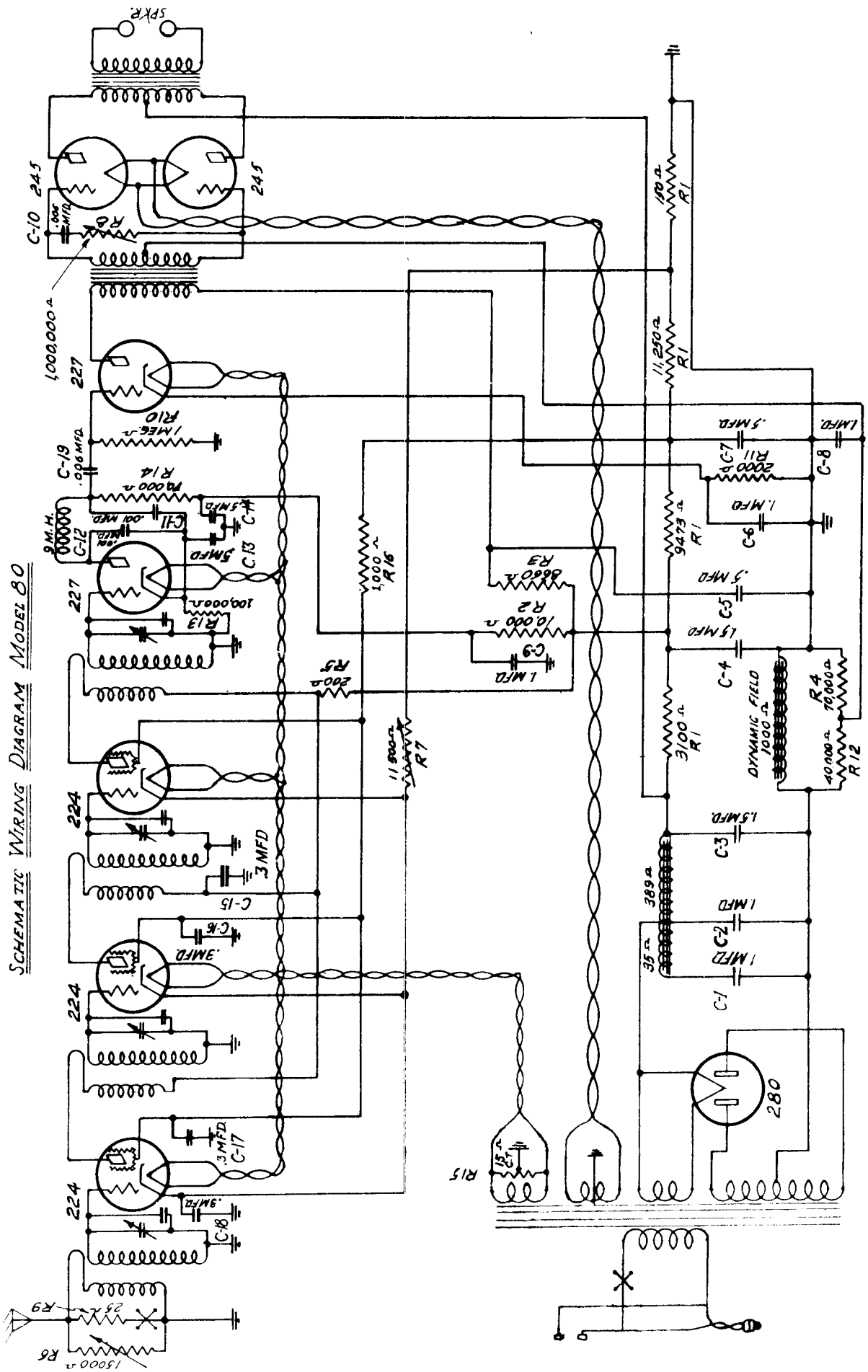
Below:
Analyzer
Readings

Tube	*Circuit*	*Meter Scale*	90 V.	100 V.	110 V.	120 V.	130 V.
1st R.F. 224	Grid	0—10	2	2.3	2.6	3	3.3
	Screen Grid	0—100	52	58	63	68	73
	Plate	0—250	133	142	155	167	178
2nd R.F. 224	Grid	0—10	.4	.5	.6	.7	.8
	Screen Grid	0—100	60	67	72	78	83
	Plate	0—1000	190	210	230	250	278
3rd R.F. 224	Grid	0—10	2	2.3	2.6	3	3.3
	Screen Grid	0—100	60	67	72	78	83
	Plate	0—1000	190	210	230	250	278
Detector 224	Grid	0—10	.08	.09	.1	.11	.12
	Screen Grid	0—100	48	54	59	63	67
	Plate	0—100	58	66	72	78	87
Audio 245	Grid	0—100	23	27	31	35	40
	Plate	0—1000	202	222	242	262	282
280 Rectifier	Plate Current	0—100	40 mils.	45 mils.	50 mils.	56 mils.	64 mils.
280 Rectifier	Filament to Ground	0—1000	265	298	330	358	392

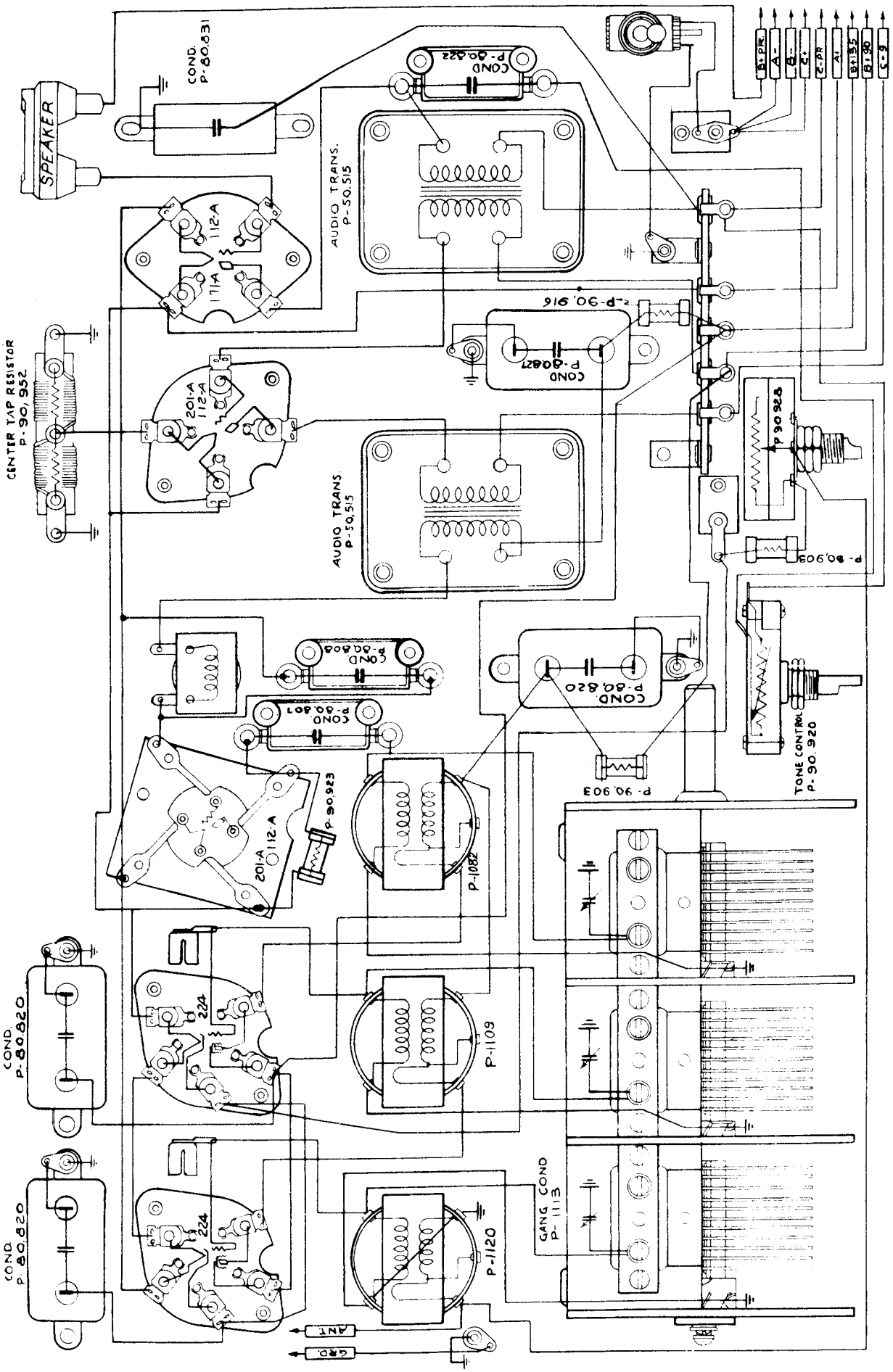
WELLS-GARDNER AND CO.



WELLS-GARDNER AND CO.

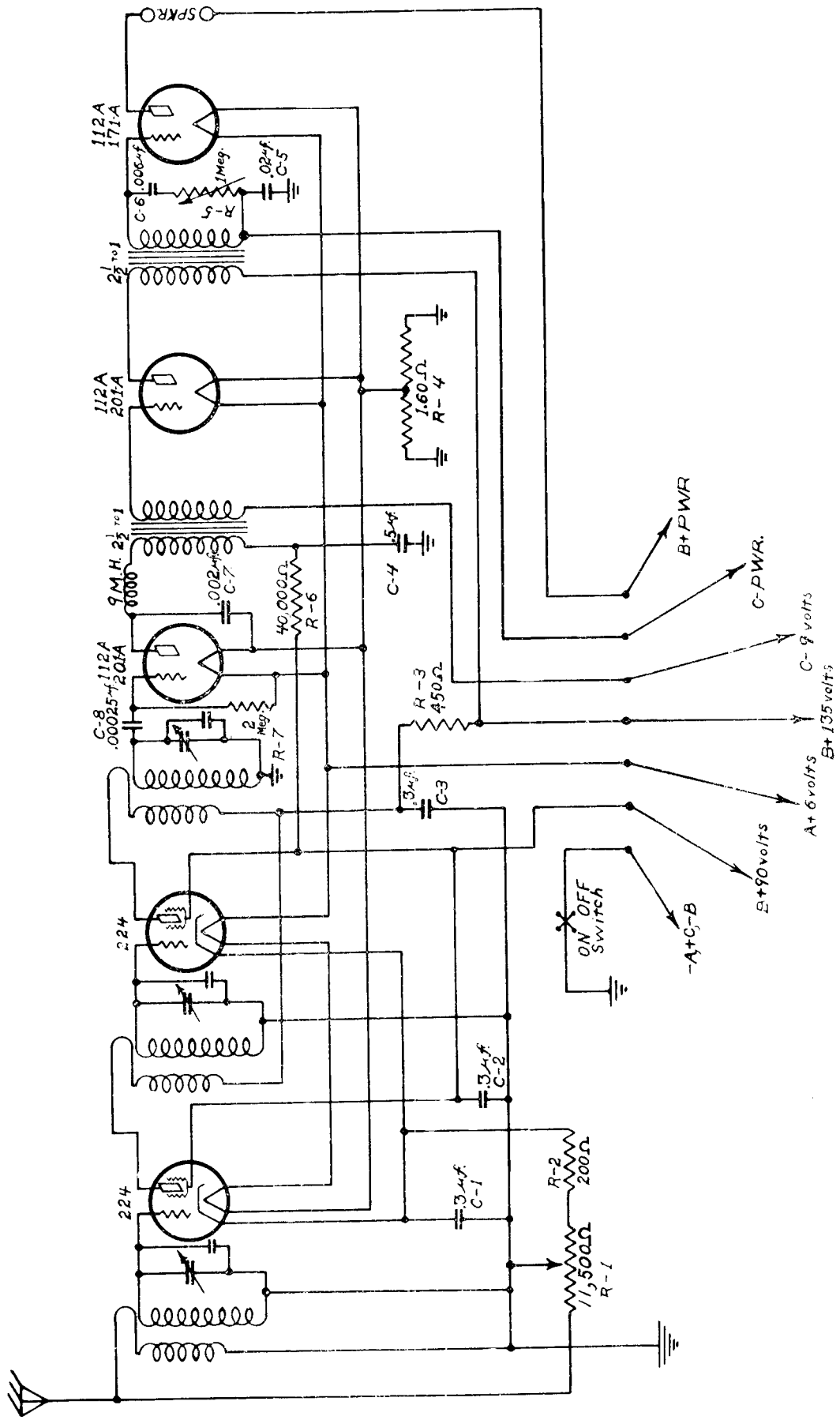


WELLS-GARDNER AND CO.



FIVE-TUBE D.C. MODEL

WELLS-GARDNER AND CO.



FIVE-TUBE D.C. MODEL

WELLS GARDNER & COMPANY

WELLS-GARDNER SERIES 062 AUTOMOTIVE SUPERHETERODYNE

(Incorporating types '36, '37, '38 and '39 tubes; also A.V.C.)

Numerous mail-order houses sponsor this chassis under their particular trade name; consequently, it is better remembered by its circuit connections than by the name of the chassis manufacturer.

In the No. 062 Series automotive receiver the following electrical values are used: Resistor R1, 0.5-meg.; R2, 7,000 ohms; R3, 1 meg.; R4, R13, 0.5-meg.; R5, R12, 0.1-meg.; R6, R7, R8, 2 megs.; R9, 1,000 ohms; R10, 20,000 ohms; R11, 15,000 ohms; R14, 350 ohms; R15, 1,300 ohms.

Condensers C1, C2, C3, equipped with trimmers, constitute the tuning gang; C4 is the oscillator padding condenser; C5, C6, C7, I.F. trimmers; C8, .006-mf.; C9, .02-mf.; C10, C14, 4 mf.; C11, .002-mf.; C12, C18, .05-mf.; C13, C15, C16, 0.1-mf.; C17, .001-mf.

Operating potentials are as follows: Filament potential, all tubes, 6 volts. Plate potential, V1, V3, 177 volts; V2, 173 volts; V4, zero; V5, 54 volts; V6, 159 volts. Screen-grid potential, V1, V3, 80 volts; V2, 76 volts; V4, zero; V5, 77 volts; V6, 165 volts. Control-grid potential, V1, V3, 3 volts; V2, 7 (depending upon dial setting); V4, zero; V5, 6 volts; V6, 15.5 volts. Plate current, normal, V1, V3, 2.6 ma. V2, 0.9-ma. (depending upon dial setting); V4, zero; V5, 1.2 ma.; V6, 10 ma. All bias voltages must be read from cathode to ground.

Do not check the "A" and "B" potentials at the multi-point socket on the cable head, as the pilot light may be burned out when the switch is turned off. (This is due to the high inductance of the speaker field, which will increase the voltage at the break of the circuit.) Also, when the cable head and multi-point socket are taken off, the connections between the chassis and power unit are open so that readings are not made under load conditions.

To read the voltages at the sockets the chassis box, in most cases, will have to be removed from its mounting. In some instances, the cables, which may be attached to the dash or at other points, will have to be removed. The voltages can be read at the sockets with a long plug or with a pair of long, insulated test prods.

All tubes must be inserted and all units connected. A signal will effect the control voltages on V1, V3 and V5. If signals are received, ground the antenna and remove V4 to take the other readings.

The diode current establishes a drop across a resistor network; this potential is used as an additional bias potential on V1, V3 and V5, giving A.V.C. action.

The full control potential is applied to V1, two-thirds to V3 and one-third to V5. As the signal increases in intensity, the applied control potential is increased, thus giving uniform output as set by the manual volume control. The manual volume control varies the diode A.F. potential applied to V5.

The tone control is mounted on the dynamic reproducer, which derives its field supply from the storage battery in the car.

Aerials are preferred in the following order: Roof antenna; tape antenna on roof (this is not very effective where a grounded chicken-wire mesh remains inside the roof); plate antenna (strung underneath the running board); under-car antenna (A wire fastened from the right side of the rear axle to the lowest point under the motor, then back to the left rear axle, forming a V. At the vertex of the V is a spring to take up the slack. The lead-in is brought up from the vertex end.).

Do not turn the set on until all the wiring connections of the installation have been completed—this is extremely important.

To adjust the antenna trimmer, tune in a weak signal at the high frequency end of the dial with the manual volume control about three-quarters on. On one end of the chassis box is a small metal plate. Remove the two screws holding this plate. Directly under the hole in the chassis box is the antenna trimmer condenser screw. Adjust this up or down until maximum output is obtained.

Noise, in some instances, may be due to weak pickup caused by a poor antenna. The action of the automatic volume control, due to the low pickup, causes the set to operate at maximum sensitivity, thereby increasing noisy reception, due both to external pickup and internal conditions.

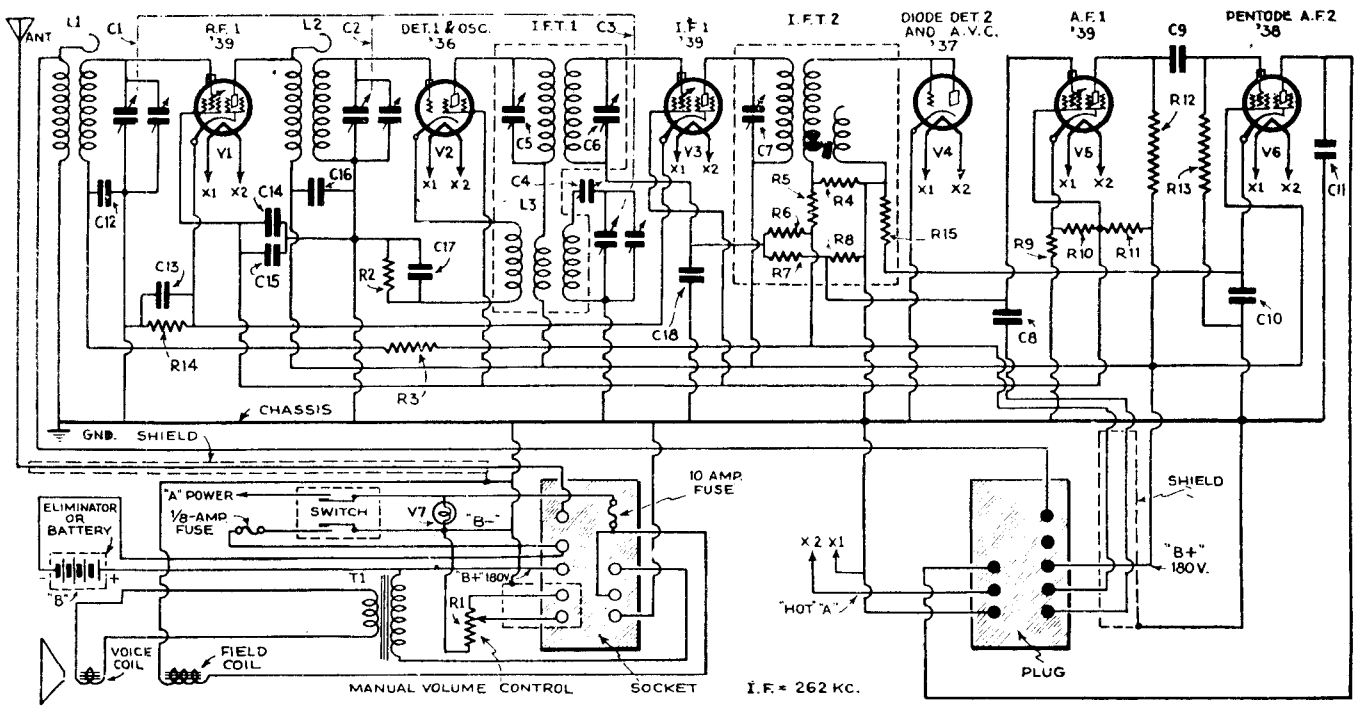
Noisy operation is also caused in some instances by loose parts in the car body or frame. These loose parts rubbing together affect the grounding and cause noises, due to the rubbing or wiping action. Tightening up the frame and body at all points and, in some cases, the use of copper jumpers, will eliminate noise of this nature.

Loose lamps or wiring are also a common cause of noisy operation.

Compensate for the increased battery drain occasioned by the radio set, by increasing the charging rate of the car generator. After a week of car operation, check the condition of the battery and re-adjust the charging rate accordingly.

Two fuses are used on this receiver. The 10 A. "A" fuse is located on the multi-point socket; the 1/8-A. "B" fuse, inside the control unit. The pilot lamp is a standard 6 volt No. 40 unit.

Poor operation may be due to moisture, from car-washings or storms, seeping into undesired places.



RADIO-CRAFT'S LIST OF TRADE NAMES AND MODEL NUMBERS

So much confusion exists in radio regarding trade names and model numbers that RADIO-CRAFT painstakingly collected the data below and presents it to its readers

ALL AMERICAN MOHAWK CORP.
Trade Name: LYRIC

Designation of chassis	*Designation of complete set*	*Alternative designations*
SA-65	Model SA-65 table Model SA-66 console	
SA-91	Model SA-91	
SA-130	Model SA-130	Channel Control
SW-80	Model SW-80	Short Wave
B-7	Model B-7	Battery Model
B-80	Model B-80	Battery Model
S-6	Model S-6 Midget Model S-61 Console Model S-62 Clock Model	
S-7	Model S-7	
S-8	Model S-8	
S-10	Model S-10	
S-63	Model S-63	
S-80	Model S-80 Midget Model S-81 Console	
DC-65	Model DC-65	Direct Current

ATWATER KENT MANUFACTURING CO.

Designation of chassis	*Designation of complete set*	*Alternative designations*
91	91-Auto	
93	93-Converter	
188	188-Lowboy	L Cabinet, 368 speaker
260	260-Semi-Highboy	M Cabinet
469	469-Lowboy	K Cabinet, 380 speaker
469D	469-D (D. C.)	K Cabinet, 469D speaker
469Q	469-Q Compact (Battery)	K Cabinet, 469Q speaker
480	480-Semi-Highboy	M Cabinet, 380 speaker
558	558-Compact	
558D	558-D (D. C.)	
558Q	558-Q Compact	
612	612-Semi-Highboy	M-2 Cabinet 1-324 speaker 1-326 speaker
627	627-Compact	
812	812-Highboy	B Cabinet 1-336 1-338

AUDIOLA RADIO COMPANY

Designation of chassis	*Designation of complete set*
4-T	4 Tube T.R.F. Midget
5-T	5 Tube T.R.F. Midget
5T-SW	5 Tube T.R.F. Midget with short wave attachment
8-T	8 Tube Super Console
8-T	8 Tube Super Midget
10-T	10 Tube Super Console
10-T	10 Tube Super Midget
11-T	11 Tube Super Console

BROWNING-DRAKE RADIO CORP.
Trade Name: BROWNING-DRAKE

Designation of chassis	*Designation of complete set*	*Alternative designations*
40 series	Model 40 (Console)	200-550 meters
	Model 42 (Mantel)	200-550 meters
	Model 44 (Phono Comb.)	200-550 meters
80 series	Model 80 (Console)	200-550 and
	Model 83 (Mantel)	1000-3000 meters
90 series	Model 90 (Console)	15-550 meters
	Model 92 (Mantel)	15-550 meters

CANADIAN MARCONI COMPANY
Trade Name: MARCONI

Designation of chassis	*Designation of complete set*	*Alternative designations*
Model No.	1932 Models	
26 A & B	Mantel	Same chassis used in 26-C
26-C	Console	26 A & B
26-SW	Console Short Wave	
27-SW	Console Short Wave	Similar to 26-A.B.C.
28	Midget	
29 A & B	Mantel	
31	Console	
31-SW		Similar to 31
32	Battery Console 1933 Models	
32-B	Battery Console	
33	Battery Console	
33-AW	All Wave Battery Console	Similar to 33
34	Console	
35	Console	
36	All Wave Console	
37	All Wave Console	Similar to 36

CANADIAN WESTINGHOUSE CO., LTD.
Trade Name: WESTINGHOUSE

Designation of chassis	*Designation of complete set*	*Alternative designations*
	RC	RA, DA
	Model 89	Consolaire 89
	Model 99	Consolaire 99
Model 99	Model 99A	Consolaire 99A
	Model 110	Consolaire 110
Model 110	Model 120	Consolaire 120
	Model 90	Consolaire 90
Model 801	Columaire 8	
Model 101	Columaire 10	
Model 801	Model 802	
Model 122	Consolaire Grand	

COLUMBIA PHONOGRAPH CO.
Trade Name: COLUMBIA

Designation of chassis	*Designation of complete set*	*Alternative designations*
C-80A	C-81	Table Model
	C-83	Console
C-80B	C-84	Console-Twin Speakers
C-800A	C-85	Combination
C-90	C-93	Console
	C-95	Console-Twin Speakers
C-100	C-103	Consolette
C-120	C-123	Battery Console

CROSLEY RADIO CORP.
Trade Name: CROSLEY

Designation of chassis	*Designation of complete set*	*Speaker Number*
127, 7-2	Adventurer	304
129-1	Alderman	318-3, 319-3
132-1	Ambassador	324-4, 325-4
124	Announcer	306
124-1	Announcer	321-5, 320-4
126-1	Announcer	298 or 308
77	Arbiter or 77B	264
125	Bigfella	291
135	Bigfella	312-4
131	Bonniboy	284
124	Caroler	306
133 & 7-2	Caroler	312-4
134	Caroler	312-4
134 & 7-2	Caroler	312-4
124	Cheerio	287
132-1	Chief	325-4, 324-6
128	Chieftain (Battery)	235J or 235M
132-1	Commissioner	324-4, 325-4
130-1	Congressman	320-4, 326-4
146-1	Congressman	327-4, 325-4
26	Crony or 26-J (Battery)	273
76	Director or 76-A (D.C.)	263
77	Director or 77-A (A.C.)	264
125 & 7-2	Discoverer	291
135 & 7-2	Discoverer	312-4
133	Forty-five	312-4
136-1	Governor	320-4, 326-4
127	Happy Hour	304
127-1	Happy Hour	322-6, 320-4
129	Judge	309-4
129	Justice	309-4
146-1	Legislator	327-4, 325-4
125	Litlboy	291
135	Litlboy	312-4
125	Litlfella	291
135	Litlfella	312-4
53	Mate or 53-E (A.C.)	272
130	Mayor	310-4
146	Mayor	315-4
128	Mayor (Battery)	235J or 235M
124	Merrymaker	287 or 306
124-1	Merrymaker	321-5, 320-4
126-1	Merrymaker	298 or 308
134-1	Merrymaker	320-4, 323-5
54	New Buddy or 54-G (A.C.)	274
141	Nomad	313-3
53	Pal or 53-F (A.C.)	272
26	Partner or 26-K (Battery)	273
77	Phono-Automatic or 77-L	264
124	Playboy	287
126-1	Playboy	298
134	Playboy	312-4
134 & 7-2	Playboy	312-4
128	Playboy (Battery)	
124	Playtime	306
124-1	Playtime	321-5, 320-4
126-1	Playtime	298 or 308
134-1	Playtime	320-4, 323-5
125	Playtime, Jr.	291
135	Playtime, Jr.	312-4
137	Pup	284-3
127	Reveler	304
90	Roamio	214
91	Roamio	279
92	Roamio	295
95	Roamio	286
96	Roamio	333
951	Roamio	332
84	Rondeau or 84-C	249
136-1	Secretary	320-4, 326-4
130	Senator	310-4
146	Senator	315-4
27	Showboy	234
28	Showboy	234
9	S. W. Adapter	
84	Sondo or 84-D	249
127	Tenstrike	301
127 & 7-2	Tenstrike S.W.	301
131	Tynamite	284
141	Vagabond	313-3
53	Wood's Desk or 53-M	272

DE FOREST RADIO CORP.
Trade Name: DE FOREST CROSLEY

Designation on chassis	*Designation of complete set*	*Alternative designations*
608A	Windsor Model Console	25 cycle
608B	Windsor Model Console	60 cycle
608C	Berwick Compact Model	25 cycle
608D	Berwick Compact Model	60 cycle
708A	Cavendish Console Model	25 cycle
708B	Cavendish Console Model	60 cycle
851A	York Console Model	25 cycle
851B	York Console Model	60 cycle
851C	Mayfair Compact Model	25 cycle
851D	Mayfair Compact Model	60 cycle

902A	Montrose Console Model	25 cycle
902B	Montrose Console Model	60 cycle
140	Balmoral Console Model	Universal 25 & 60
801	Embassy Console Model	Battery (Air Cell)
802	Embassy Jr. Compact	Battery (Air Cell)

ECHOPHONE RADIO MFG. CO.
Trade Name: ECHOPHONE

Designation of chassis	*Designation of complete set*	*Designation of chassis*	*Designation of complete set*
D	D	16	16
E	E	17	17
S-3	S-3	18	18
4	4	20	20
S-4	S-4	35	35
5	5	40	40
S-5	S-5	50	50, 55
10	10	60	60, 65
12	12	70	70, 75
14	14	80	80
15	15	90	90

FADA RADIO & ELECTRIC CORP.
Trade Name: FADA

Shop Type	*Designation of complete set*	*Type*
A	265-A & RR-65	Battery
AP	265-CA & RP-65CA	A. C.
B	475-A & 45/75-A	Battery
BP	475-CA & 45/75-CA	A. C.
C	480-B & 50/80-B	Battery
D	10, 11, 30 & 31	A. C.
DC	12	D. C.
E	50, 70, 71 & 72	A. C.
Rev. E	75 & 77	A. C.
F	460-A & R-60	Battery
G	16, 17 & RP-17	A. C.
GA	20	A. C.
GB	32	A. C.
GC	18	D. C.
H	480-A, 50/80-A & R-80	Battery
K	35	A. C.
KA	41, 42, 44, 46 & 47	A. C.
KB	81, 82, 84, 86	D. C.
KE	122	Air Cell
KF	43	A. C.
KG	761, 762, 764 & 766	A. C.
KO	51	A. C.
KO-220	251, 253 & 257 (257 comb.)	D. C.
KOC	53 & 57 (57 comb.)	A. C.
KOC-110	171, 173	D. C.
KOC-222	Chassis	
KOF	512, 532, 572 (220 volts)	A. C.
KU	45	A. C.
KW	48 & 49	A. C.
KX	61 & 63	A. C.
KY	66	
Rev. K	35-B	A. C.
M	25, M-180, 15-M, 35-M	A. C.
Rev. M	25, M-250, 35-C, 7-MA	A. C.
O	22	Battery
P	40	A. C.
RA	74, 76, 83, 87, 88, 89, 97	A. C.
RC	78 & 79	A. C.
RE	73 & 85	A. C.
RE-110	Chassis	D. C.
RE-220	Chassis	D. C.
RF	732, 852	A. C.
RG	55	
RX	93 & 95	

Besides the model number of the receivers there are letter designations. These letter designations are the letters which appear after the serial number of the receiver and they help designate the type chassis.

In other words, a receiver bearing serial number 0000-RE will indicate that the chassis could be one from either a model 73 or 85 as attested by the attached sheet.

FRESHMAN RADIO CORP.

CORRESPONDING MODEL NUMBERS
EARL and FREED RECEIVERS

On the corresponding sets, as listed below, the mechanism is identical. There is a slight difference in cabinets.

Earl 21	equivalent to Freed 56
Earl 22	equivalent to Freed 55
Earl 31	equivalent to Freed 78
Earl 31-S	equivalent to Freed 78-S
Earl 32	equivalent to Freed 79
Earl 32-S	equivalent to Freed 79-S
Earl 41	equivalent to Freed 95
Earl 33	equivalent to Freed 90
Earl 33-S	equivalent to Freed 90-S
Earl 24	equivalent to Freed 65
Earl 121	equivalent to Freed 53

GRIGSBY GRUNOW CO., INC.
Trade Name: MAJESTIC

Designation of chassis	*Designation of complete set*	*Alternative designations*
10	11	Short Wave Converter
20	21, 22, 23	
30	31	
50	51, 52	
55	56	Ardmore
55	57	Berkshire
55	58	Viking (Short & Long Wave)
10	58	Viking
60	61, 62	
90-B	90, 91, 92, 93	1930 Models
90	91 & 92	1929 Models
100	101	
100-B	102, 103	
110	110	Auto
120	121	
120-B	123	
130-A	130, 131, 132	
15	151	Havenwood
15	153	Ellswood
15-B	154	Fyfewood
150	155	Castlewood
15	156	Sherwood
160	163	
180	181	
200	201	Sheffield
200	203	Fairfax
200	204	Explorer (Short & Long Wave)
10	204	Explorer (Short & Long Wave)
210	211	Whitehall
210	214	Stratford
210	215	Croydon
220	221	Collingwood, 1932
220	223	Abbeywood, 1932
230-A	233	
25	251	Cheltenwood, Oct. 1931
25-B	251	Cheltenwood, Nov. 1931
25	253	Brentwood, Oct. 1931
25-B	253	Brentwood, Nov. 1931
25	254	Brucewood, Oct. 1931
25-B	254	Brucewood, Nov. 1931
290	291	Madison
290	293	Adams
10	294	Monroe (Short & Long Wave)
290	294	Monroe (Short & Long Wave)
300	303, 304, 307	
310	311, 314	
320	324	
35	351	Collingwood, 1931
35	353	Abbeywood, 1931

GULBRANSEN COMPANY
Trade Name: GULBRANSEN

352	Model 3521
Five tube A. C.	Model 3525
872	Model 8726
Seven tube A. C.	
392, Nine tube Battery	Model 3925
322	Model 3225
Twelve tube A. C.	Model 3226
3622, Six tube Auto	Model 3622
3722, Seven tube Auto	Model 3722

HOWARD RADIO COMPANY
Trade Name: HOWARD

Designation of chassis	*Designation of complete set*
Style K	Model K
Style H	Model H
Style M	Model M
Style PH	Model 500 De Luxe with Short Wave Model 501

KELLOGG SWITCHBOARD & SUPPLY CO.
Trade Name: KELLOGG

Designation of chassis	*Designation of complete set*	*Alternative designations*
504	504-505-506 Wave Master	
507	507-508	Battery Sets
510	510-511	
514	514-516-517	
515	515-518-519-520-521	
523	523-526†	
524	524-527†-528	
533	533-534-535-536	

†25 cycle

KOLSTER RADIO INC.
Trade Name: KOLSTER

All models carry combination letter-number symbols only.

LANG RADIO CORP.
Trade Name: LANG

Designation of chassis	*Designation of complete set*
AA5	Junior AA5 table model
	Senior AA5 table model
AA6	Junior AA6 T. M.
	Senior AA6 T. M.
DC6	Junior DC6 T. M.
	Senior DC6 T. M.
MA8	MA8 T. M.
MD8	MD8 T. M.
SA9	
SD8	

NATIONAL COMPANY, INC.
Trade Name: NATIONAL

Designation of chassis	*Designation of complete set*
SW58AC	5 Tube A. C. Short Wave Receiver
SW34DC	5 Tube D. C. Battery Short Wave Receiver
SW3DC	3 Tube D. C. Battery Short Wave Receiver
SW3AC	3 Tube A. C. Short Wave Receiver
NC5	5 Tube Short Wave Converter
NB32	5 Tube Broadcast R. F. Tuner
H. F. R.	5 Meter Receiver
H. F. C.	M. C. Converter

PIERCE AIRO, INC.
Trade Name: PIERCE AIRO-DEWALD

Designation of chassis	*Designation of complete set*
B.A.C.	B.A.C.-4, B.A.C.-7, B.A.C.-8
K.A.D.	K.A.D.-8, K.A.D.-4, K.A.D.-7
50	50-4, 50-7, 50-8
B.A.H.	B.A.H.-1, B.A.H.-2, B.A.H.-400 B.A.H.-212, B.A.H.-42
K.A.F.	K.A.F.-1, K.A.F.-2, K.A.F.-400 K.A.F.-212, K.A.F.-42
B.A.M.	B.A.M.-6, B.A.M.-212, B.A.M.-42

PILOT RADIO & TUBE CORP.
Trade Name: PILOT

Designation of chassis	*Designation of complete set*	*Alternative designations*
10	1010 Dragon Monarch	
10	8810 Dragon Emperor	
39	7639 Twentieth Century	
39	8239 Golden Arrow	
43	8443 Twin Coupler Brand	Liberty
43	8643 Armada	
51	9251 Twin Coupler Brand	Rainbow
55	9255 Corsair	
55	9855 Twin Coupler Brand	Captain Kidd

READRITE METER WORKS
Trade Name: READRITE

Designation of chassis	*Designation of complete set*
406	60 Cycle Tube Tester
407	60 Cycle Tube & Short Tester
408	25 Cycle Tube Tester
409	25 Cycle Tube & Short Tester
500	0 to 10,000 Ohmmeter
502	0 to 40, 0 to 10,000 Ohmmeter
550	Oscillator
610	Set Tester
710	Set Tester
900	A.C. & D.C. Current Measuring Device
1000	Point to Point Tester

SEARS ROEBUCK & COMPANY
Trade Name: SILVERTONE
1932-1933 line

Designation of chassis	*Designation of complete set* Name	Model	*Alternative designations*
5 tube Battery Super		1620	Midget Cab.
8 tube Bat. Allwave Sup.	Wellington	1520	Midget Cab.
8 tube Bat. Allwave Sup.	Westminster	1574	Console Cab.

6 tube A.C. Super	Sussex	1590	Midget Cab.
7 tube A.C. Allwave sup.	Roland	1584	Midget Cab.
7 tube A.C. Allwave sup.	Warwick	1586	Console Cab.
9 tube A.C. Allwave sup.	Cromwell	1630	Console Cab.
12 tube A.C. Allwave sup.	Alexander	1640	Console Cab.
10 tube A.C. Super		1650	Console Cab.
12 tube A.C. Super		1652	Console Cab.
6 tube A.C. Super	Adrian	1592	Console Cab.

THE SIMPLEX RADIO COMPANY
Trade Name: SIMPLEX

Designation of chassis	*Designation of complete set*
Model P	Super
Model P-DC	Super
Model P-Battery	Super
Model R	T.R.F.
Model R-DC	T.R.F.
Model S	T.R.F. All wave

THE SPARKS-WITHINGTON COMPANY
Trade Name: SPARTON

Designation of chassis	*Designation of complete set*
Model 16-AW	Sparton Multi-Wave Receiver
Model 26-AW	Sparton Multi-Wave Receiver
Model 28	Sparton Triolian
Model 45	Sparton Visionola
Model 60	Short Wave Converter
Model 99	Sparks Ensemble
Model 101	Sparks Ensemble
Model 103	DeLuxe Ensemble
Model 109	DeLuxe Model 109
Model 110	DeLuxe Model 110
Model 410	Sparton Junior
Model 420	Sparton Jewel

STEWART-WARNER CORP.
Trade Name: STEWART-WARNER

Designation of chassis	*Designation of complete set*	*Alternative designations*
104A	40-A	Apartment Model
104A	43-A	Leader Console, without converter
104 & 301 Short Wave chassis	44-A	Leader Console with converter
104A	45-A	Standard Console without converter
104 & 301 Short Wave chassis	46-A	Standard Console with converter
104A	47-A	Portable Console without converter
104A & 301 Short Wave chassis	48-A	Radio-Phonograph Combination
105A	50-A	Master All Wave Console
105A	51-A	DeLuxe All Wave Console
105A	58-A	Radio-Phonograph Combination

TRANS. CORP. OF AMERICA
Trade Name: CLARION

Sets have numbers only. Model is designated by a label or sticker in cabinet, except 160C and 260C replacement chassis for modernizing old sets. 60 cycle sets are marked, for example, "AC-60"; the 25 cycle set would be "25-60".

UNITED AMERICAN BOSCH CORP.
Trade Name: AMERICAN BOSCH

Designation of chassis	*Name*	*Alternative designations*
Model 16	Amborola	
Model 27	Amborada	
Model 35	Cruiser	Imperial Cruiser Royal Cruiser
Model 66, 76	Cruiser	
Model 46, 126	Little Six	
Model 5	Personal	
Model 84	Cruiser	(Marine Receiver)
Model 100	9.20 Motor Car Receiver	
Model 200	Personal Chest	
Models 200, 205, 236, 242, 250, 260, 312	Vibro Power	

Note: Above are only sets having names. All others have model numbers only. When the same chassis is used in different cabinets the model number is never changed but a letter is added as cabinet designation—200A, 200B, etc.

WELLS-GARDNER & COMPANY
Trade Name: Regular trade name is Wells-Gardner but all receivers are supplied under private stencils such as Arcadia, Airline, Truetone, Fearnola, Mayola, Hudson, Gt. Northern, Coronada, Granada, LaFayette

Designation of chassis	*Designation of complete set*
052 5-tube	2522 Mantel
AC Super	2525 Console
	1520 Mantel
572 7-tube	7721 Mantel
AC Super	7725 Console
502 10-tube	9027 Console
AC Super	7025 Console
022 12-tube	2225 Console
AC Super	2227 Console
	2228 Console
92 5-tube	925 Console
Battery Super	926 Console
092 9-tube	2925 Console
Battery Super	
062 6-tube	1622 Auto Radio
Auto Super	Remote Control

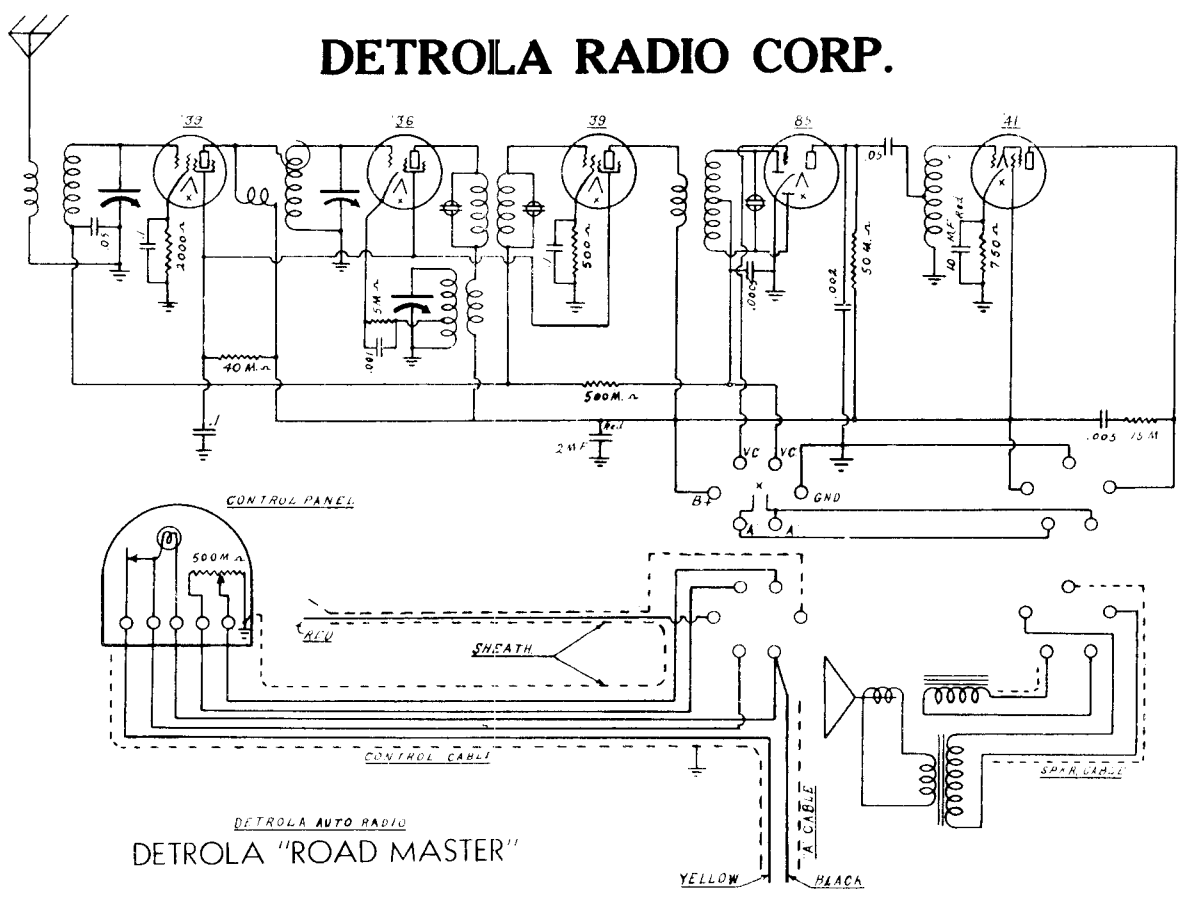
WILCOX-GAY CORPORATION
Trade Name: WILCOX-GAY

Designation of chassis	*Designation of complete set*	*Alternative designation*
2S5	2S5—30	Cameo
2T5	2T5—30	Cameo Hilo
2DB5	2DB5—32	Cantata
2EB5	2EB5—32	Cantata Hilo
2V7	2V7—31	Carillon
2V7	2V7—510	Coronet
2W10	2W10—515	Corona

ZENITH RADIO CORP.
Trade Name: ZENITH-ZENETTE

Designation of chassis	*Designation of complete set*
7 tube 2022A	Models 210-220
8 tube 2036A & B	Models 230-240-245
9 tube 2031 Short & Standard Wave	Models 250-260-272
10 tube 2030 / 0432	Models 410-411-420
12 tube 2033	Models 210-5, 211-5, 270-5

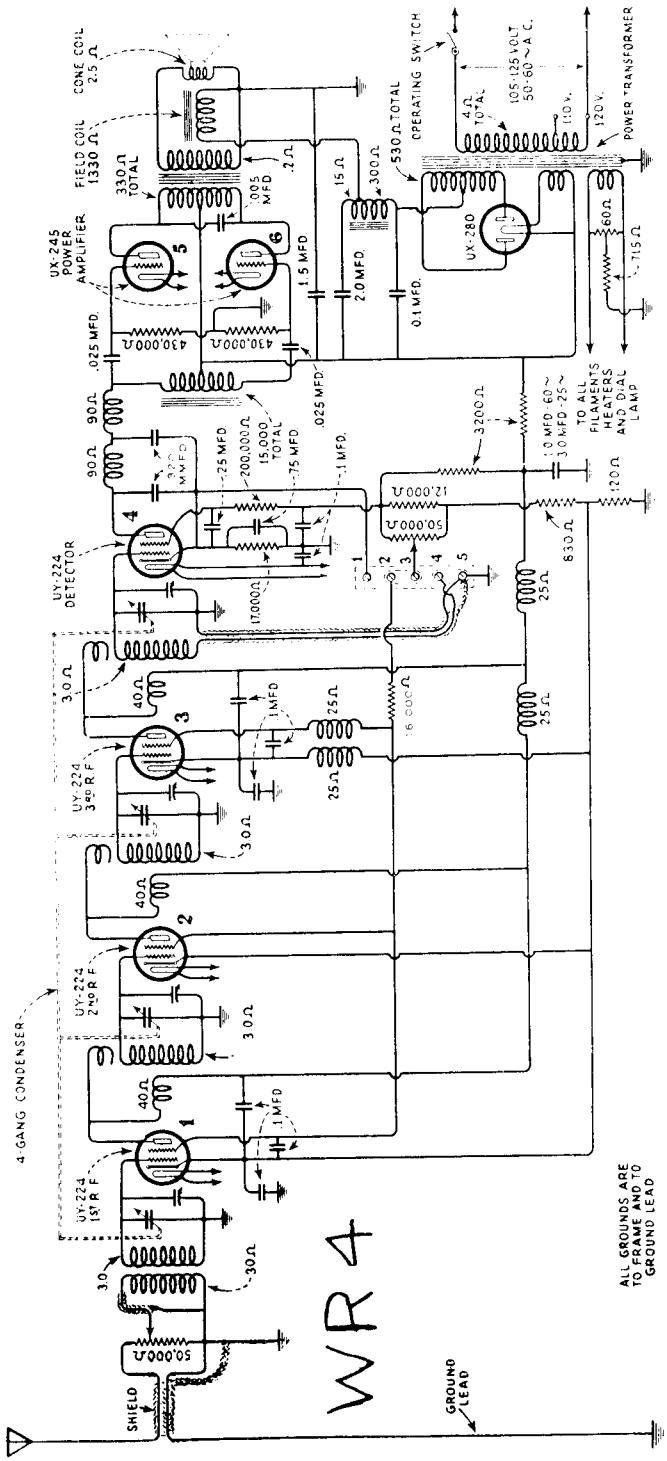
DETROLA RADIO CORP.

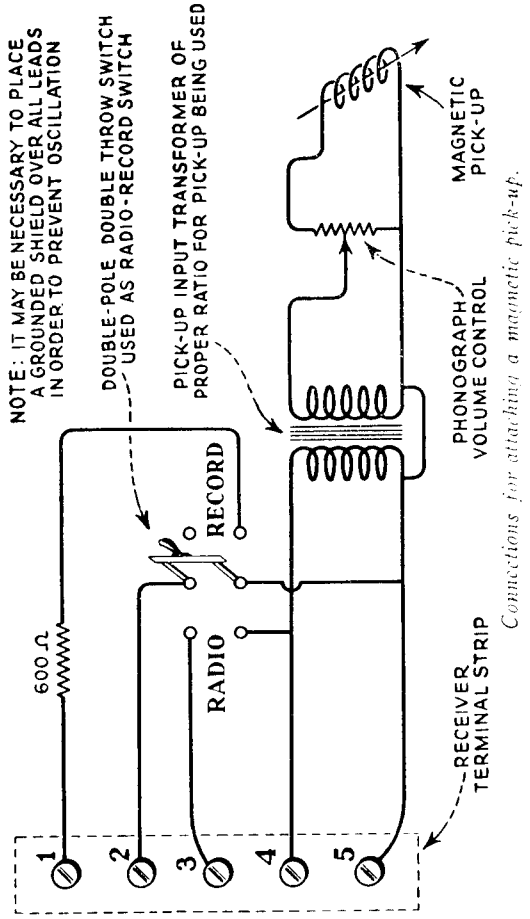


DETROLA AUTO RADIO

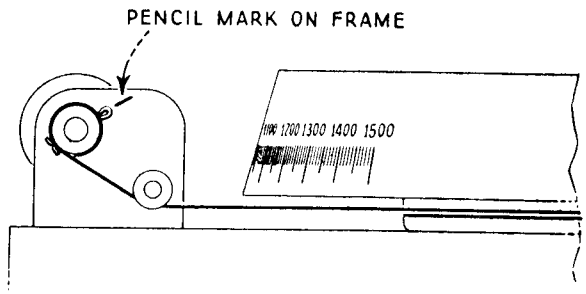
DETROLA "ROAD MASTER"

WESTINGHOUSE ELECTRIC AND MFG. CO.

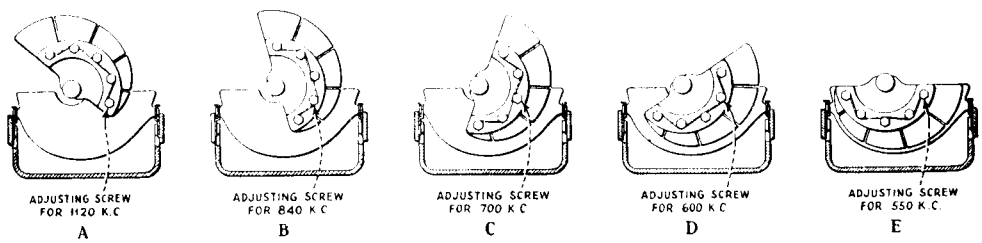




Connections for attaching a magnetic pick-up.



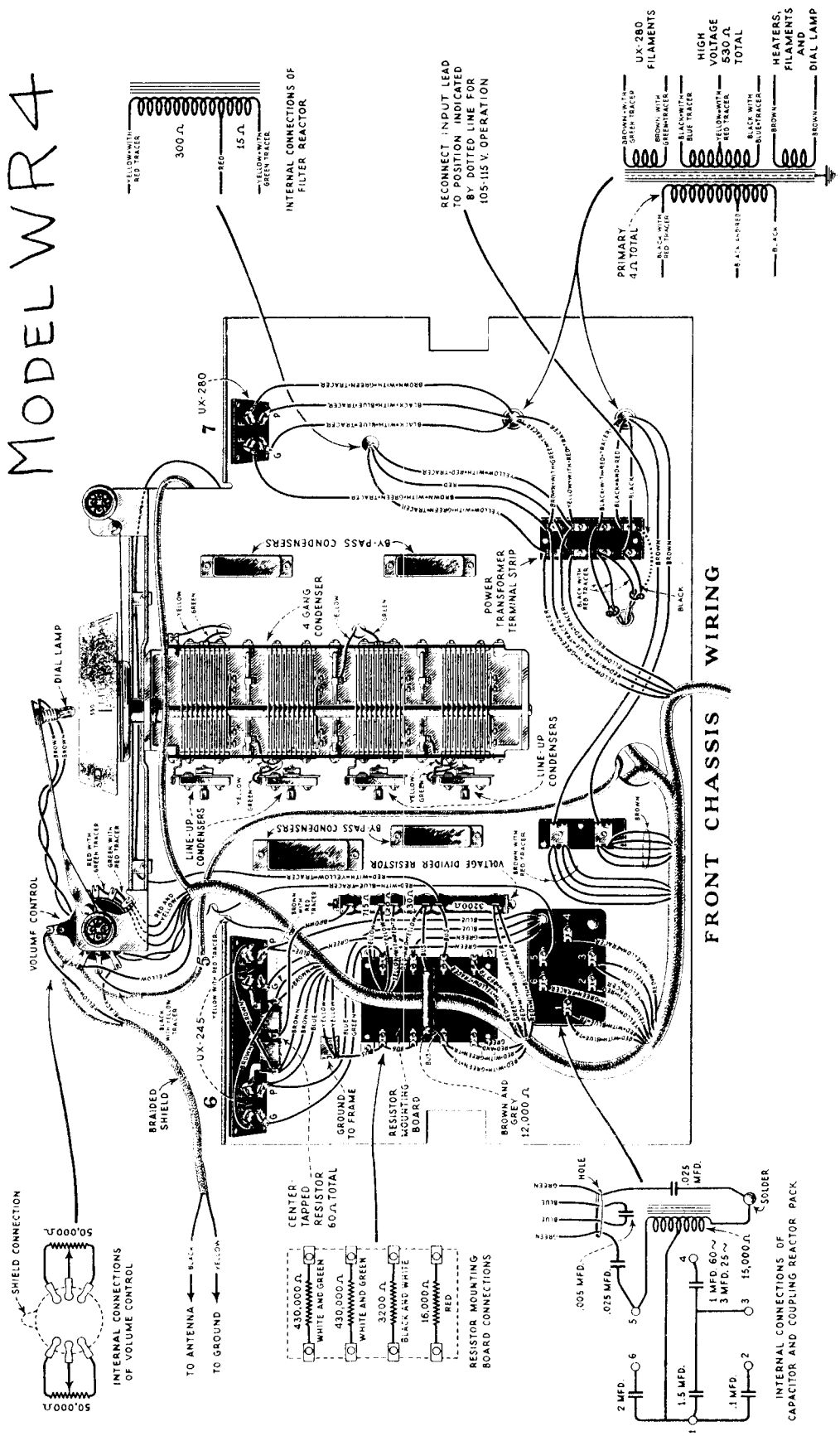
View showing method of checking position of dial.



Gang condenser adjustment positions.

WESTINGHOUSE ELECTRIC AND MFG. CO.

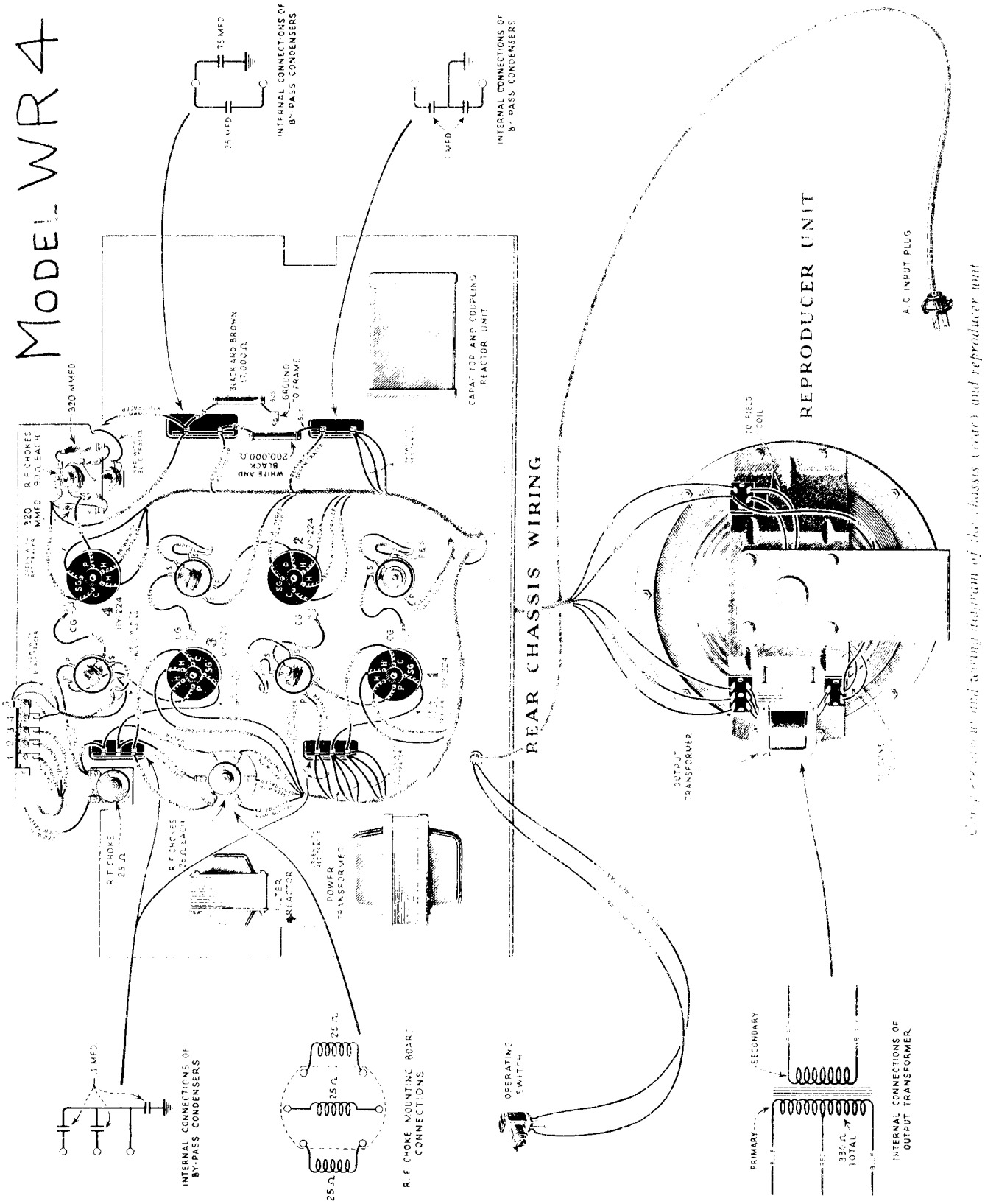
MODEL WR 4



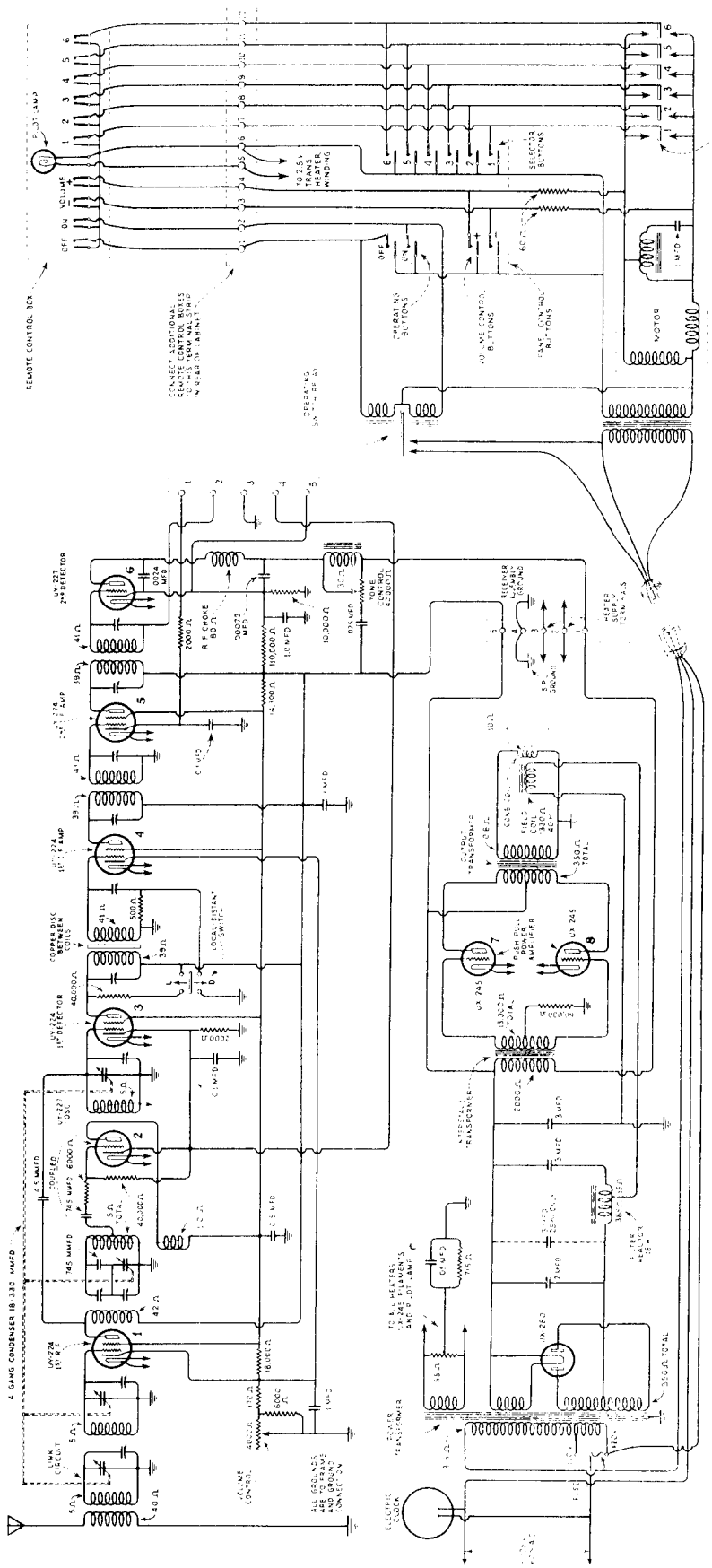
Layout and wiring diagram of the chassis (front)

WESTINGHOUSE ELECTRIC AND MFG. CO.

MODEL WR4

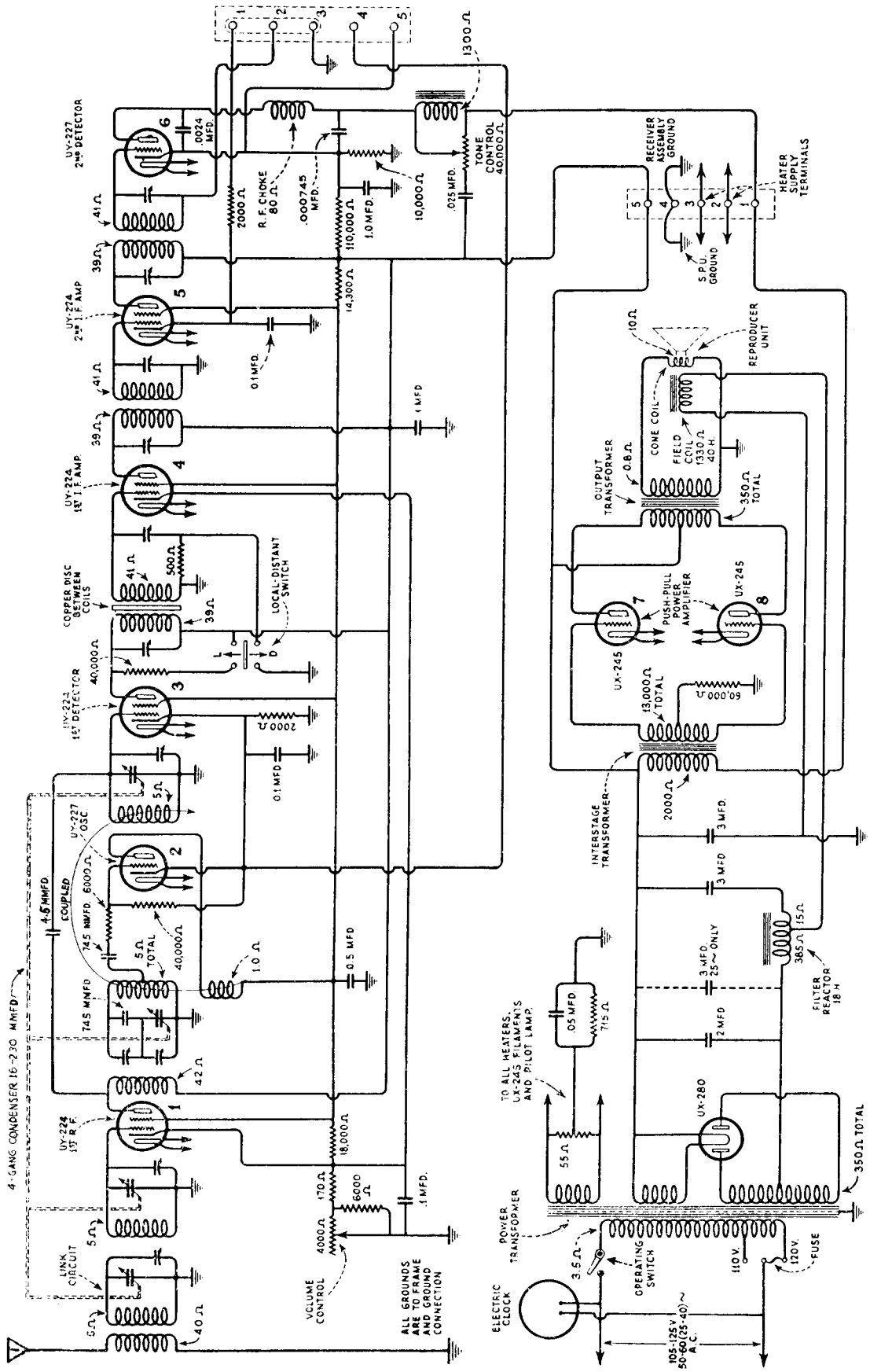


WESTINGHOUSE ELECTRIC AND MFG. CO.

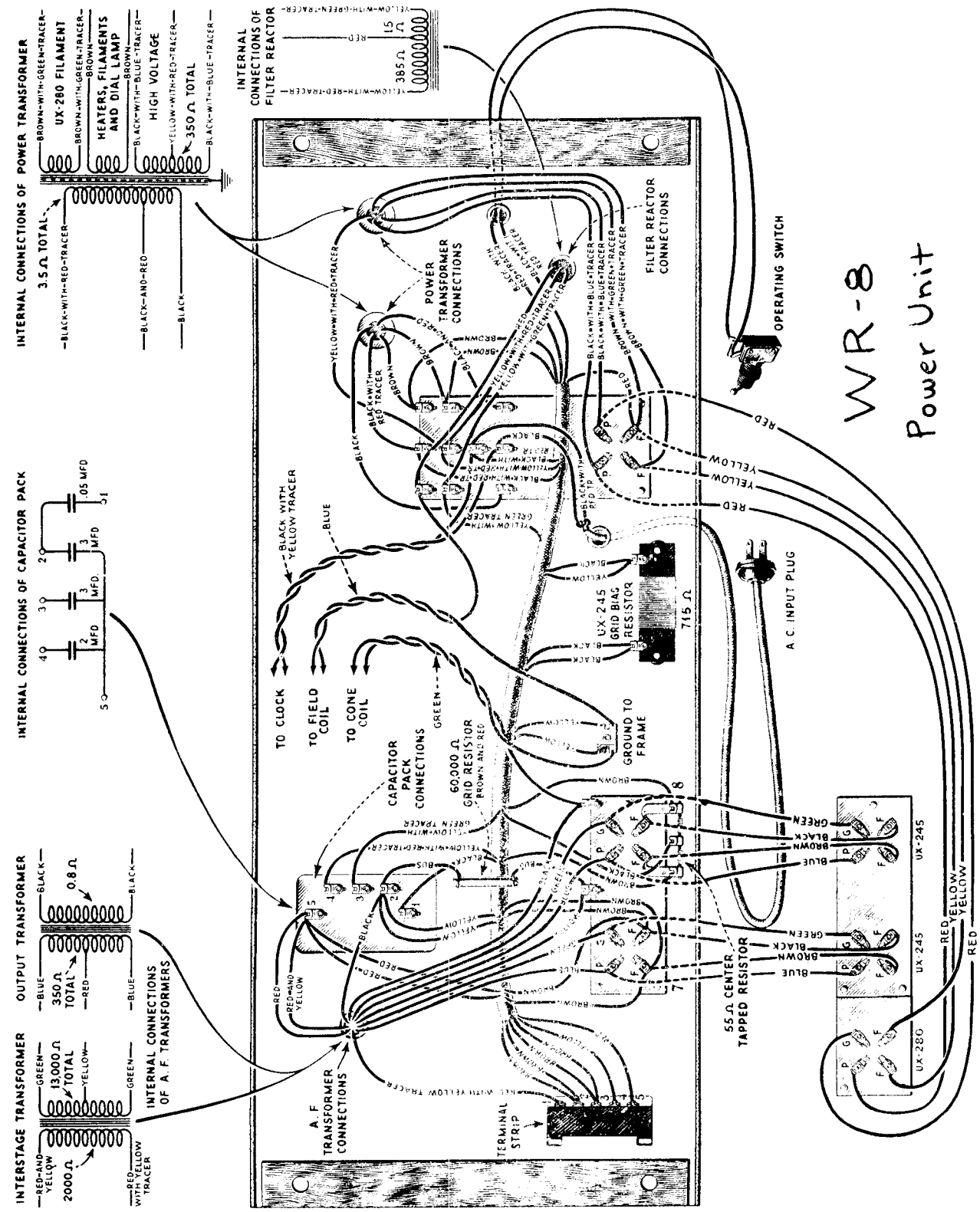


MODEL WR-8-R

WESTINGHOUSE ELECTRIC AND MFG. CO.

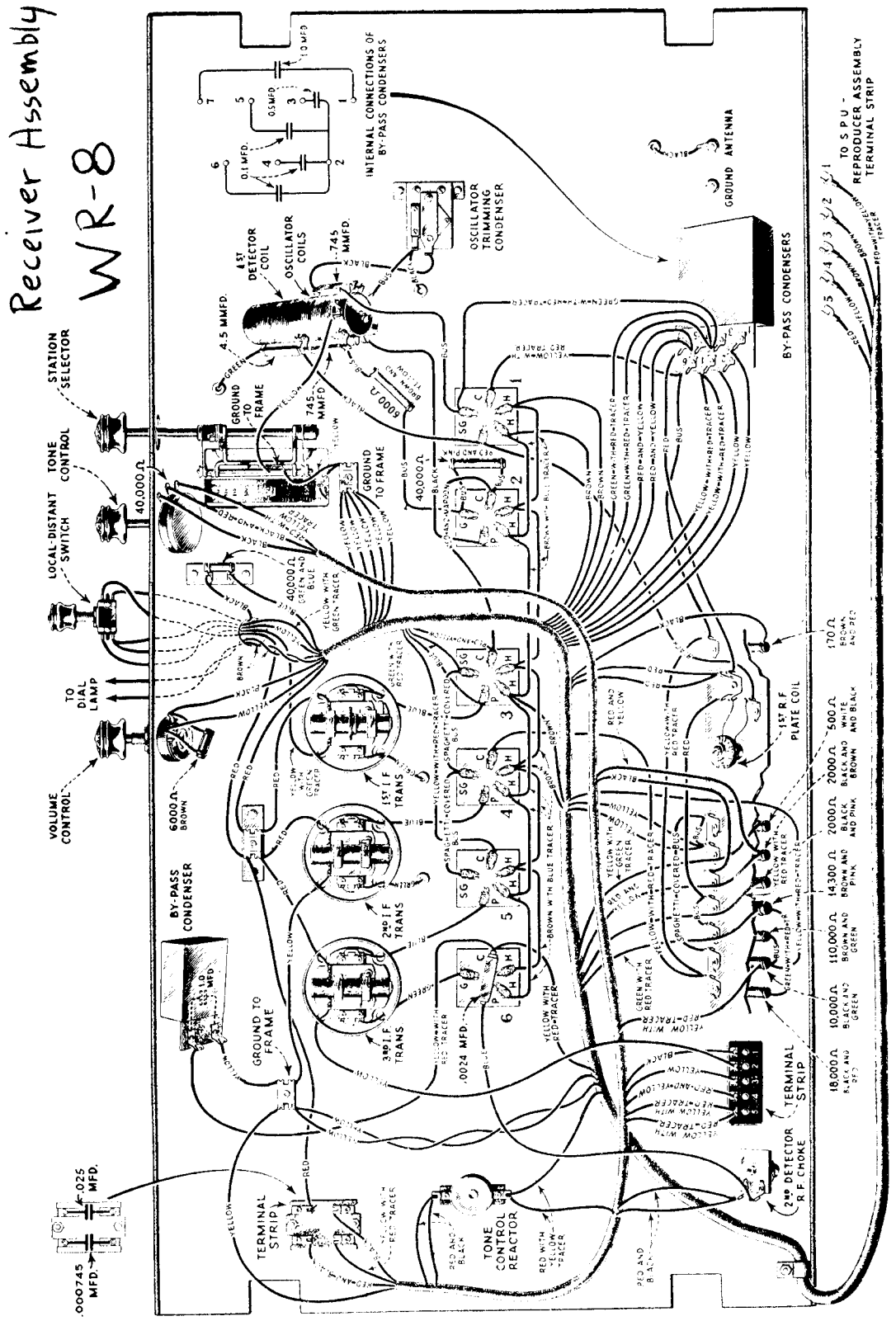


WESTINGHOUSE ELECTRIC AND MFG. CO.



WESTINGHOUSE ELECTRIC AND MFG. CO.

Receiver Assembly WR-8



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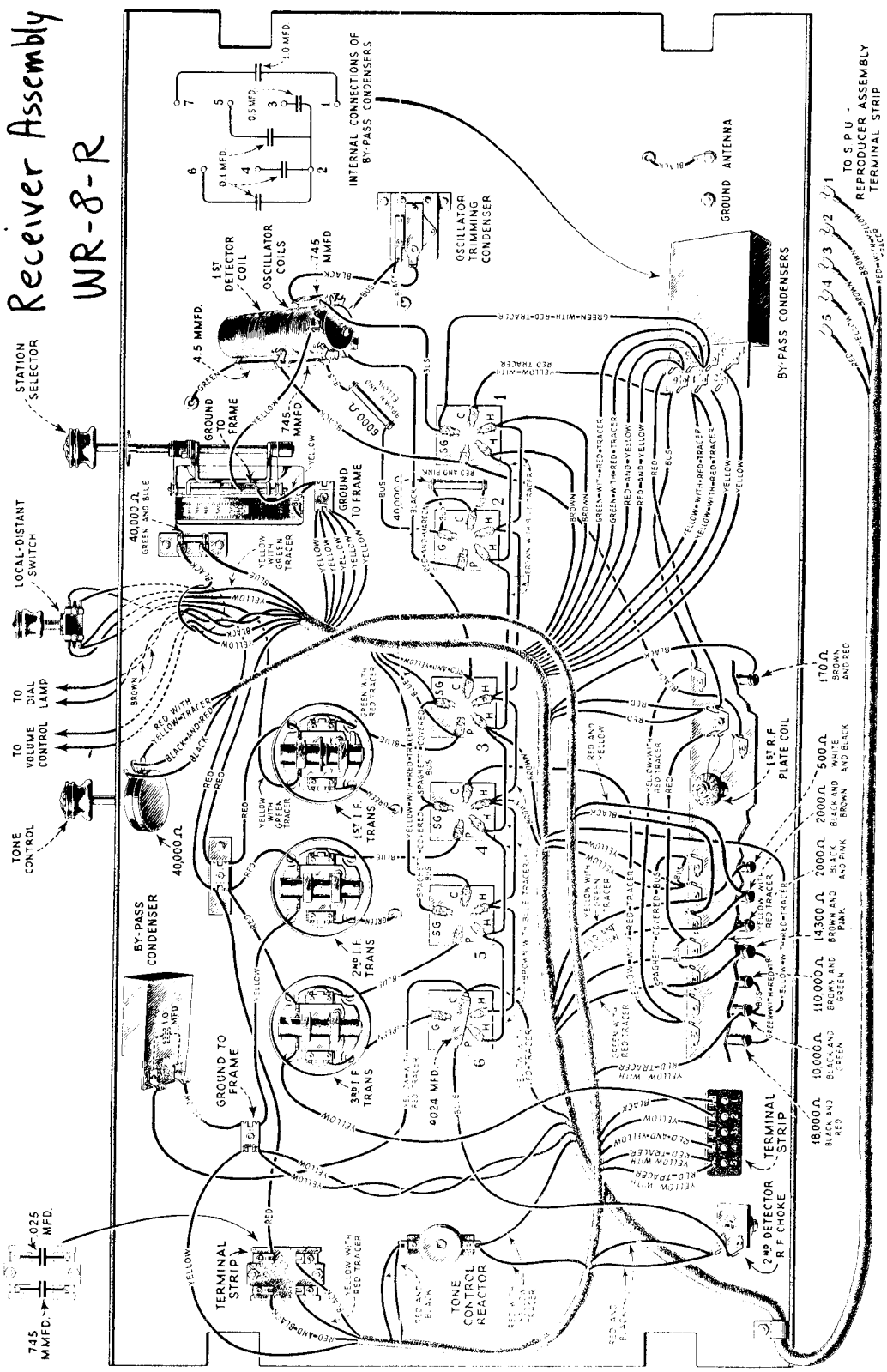

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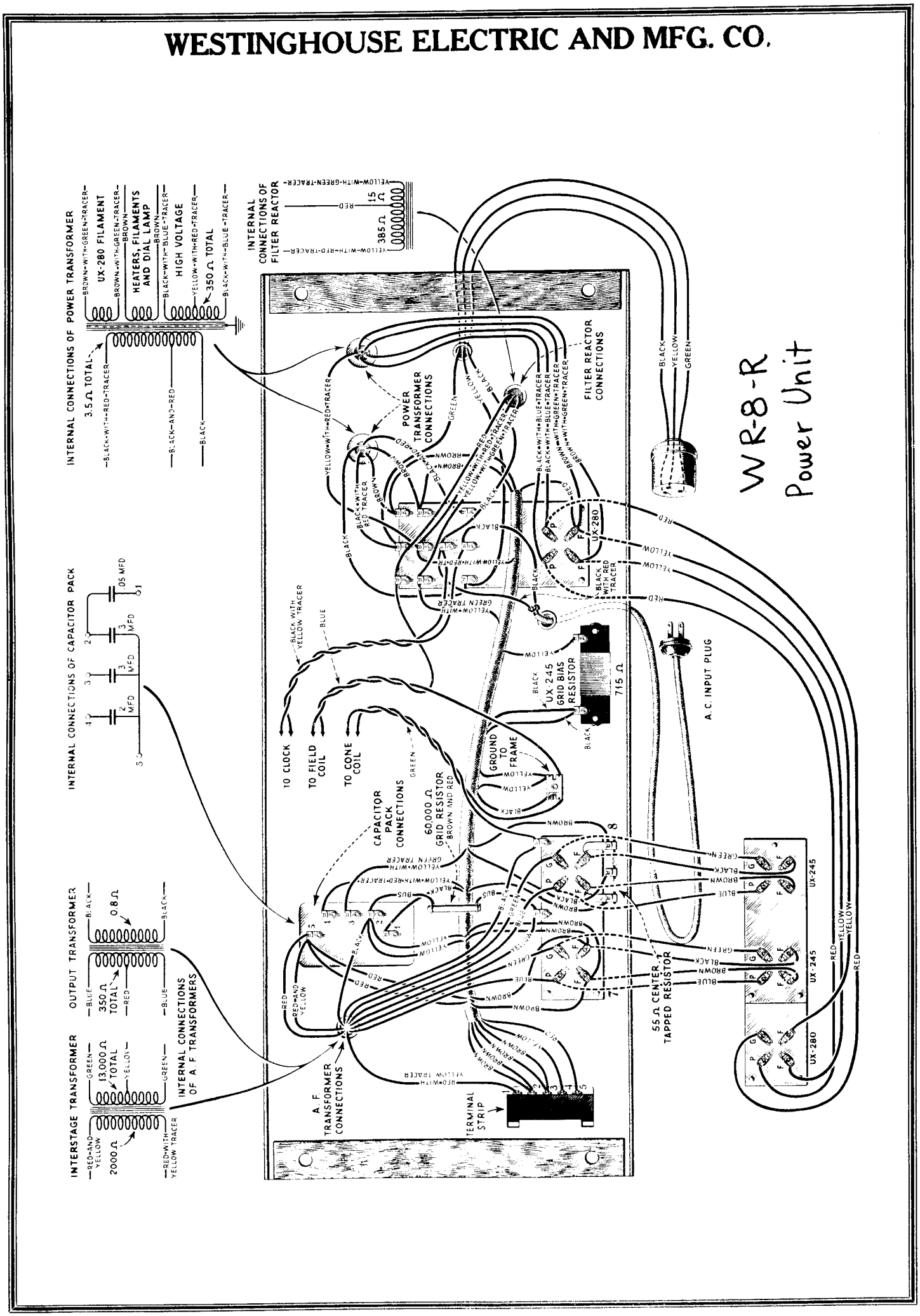

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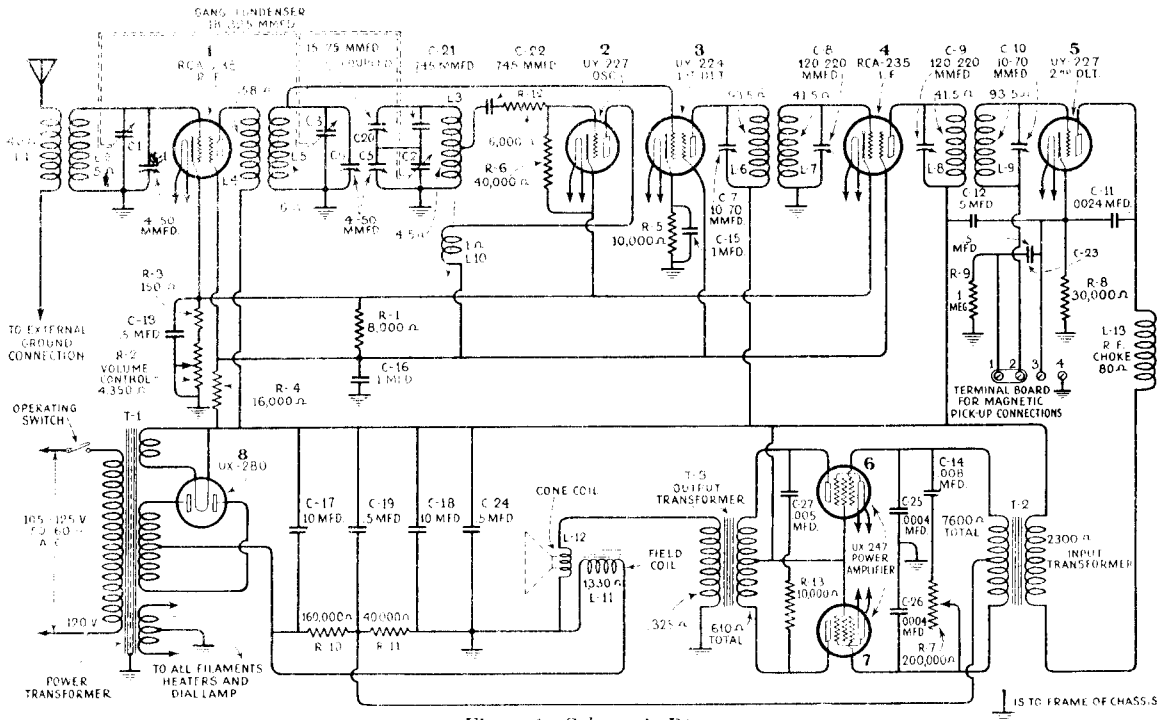
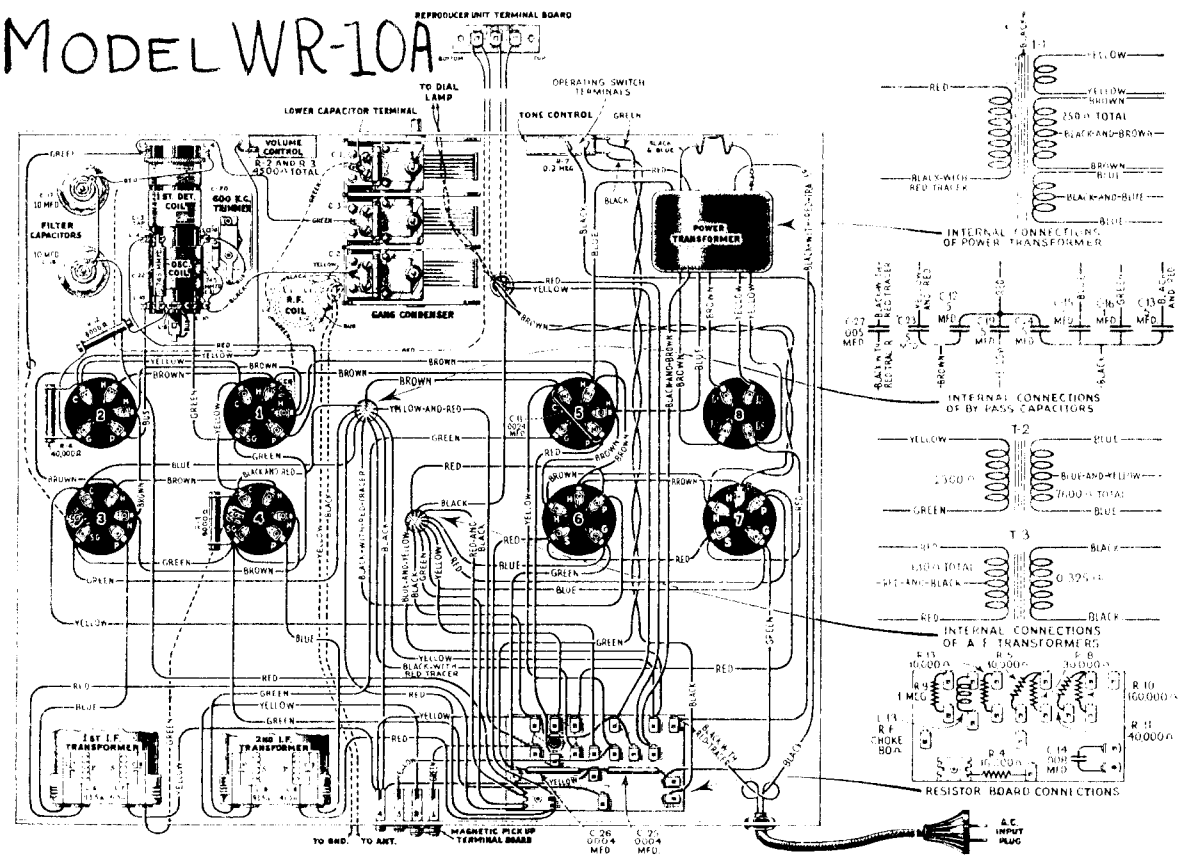


Figure 1—Schematic Diagram

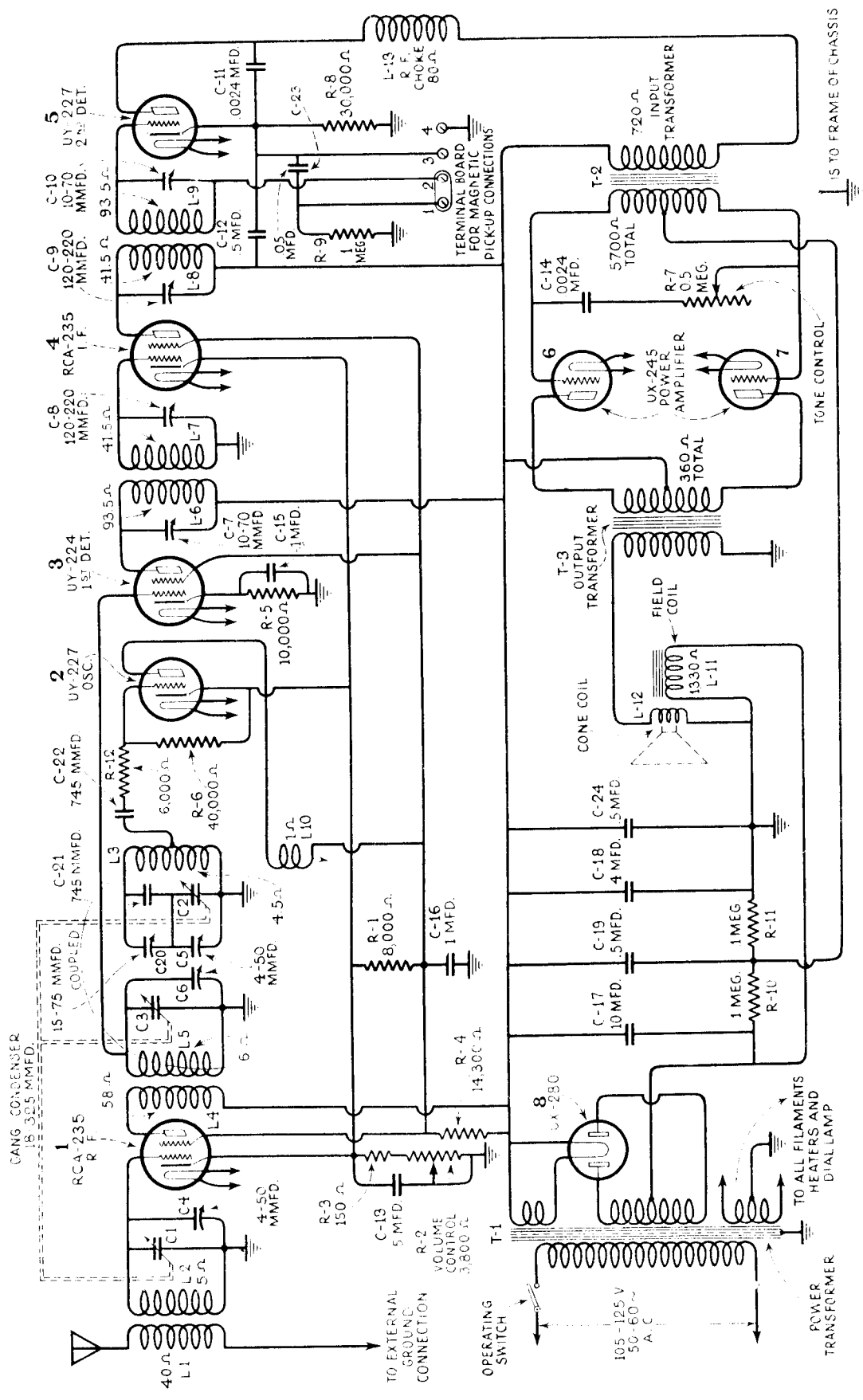
RADIOTRON SOCKET VOLTAGES—110 VOLT A. C. LINE

Radiotron No.	Cathode to Heater Volts D. C.	Cathode or Filament to Control Grid Volts D. C.	Cathode to Screen Grid Volts D. C.	Cathode or Filament to Plate Volts D.C.	Plate Current M. A.	Heater or Filament Volts A. C.
VOLUME CONTROL AT MINIMUM						
1	38	35	50	200	.9	2.2
2	38	0		50	3.5	2.2
3		6	80	235	0.5	2.2
4	38	35	50	200	.9	2.2
5	22	3		210	0.7	2.2
6		12	225	220	30	2.2
7		12	225	220	30	2.2
VOLUME CONTROL AT MAXIMUM						
1	2.0	2.5	60	235	3.5	2.2
2	2.0	0		50	4.5	2.2
3	1.0	1.0	55	230	0.5	2.2
4	2.0	2.5	58	235	3.5	2.2
5	22	3		210	0.7	2.2
6		12	225	220	30	2.2
7		12	225	220	30	2.2

MODEL WR-10A

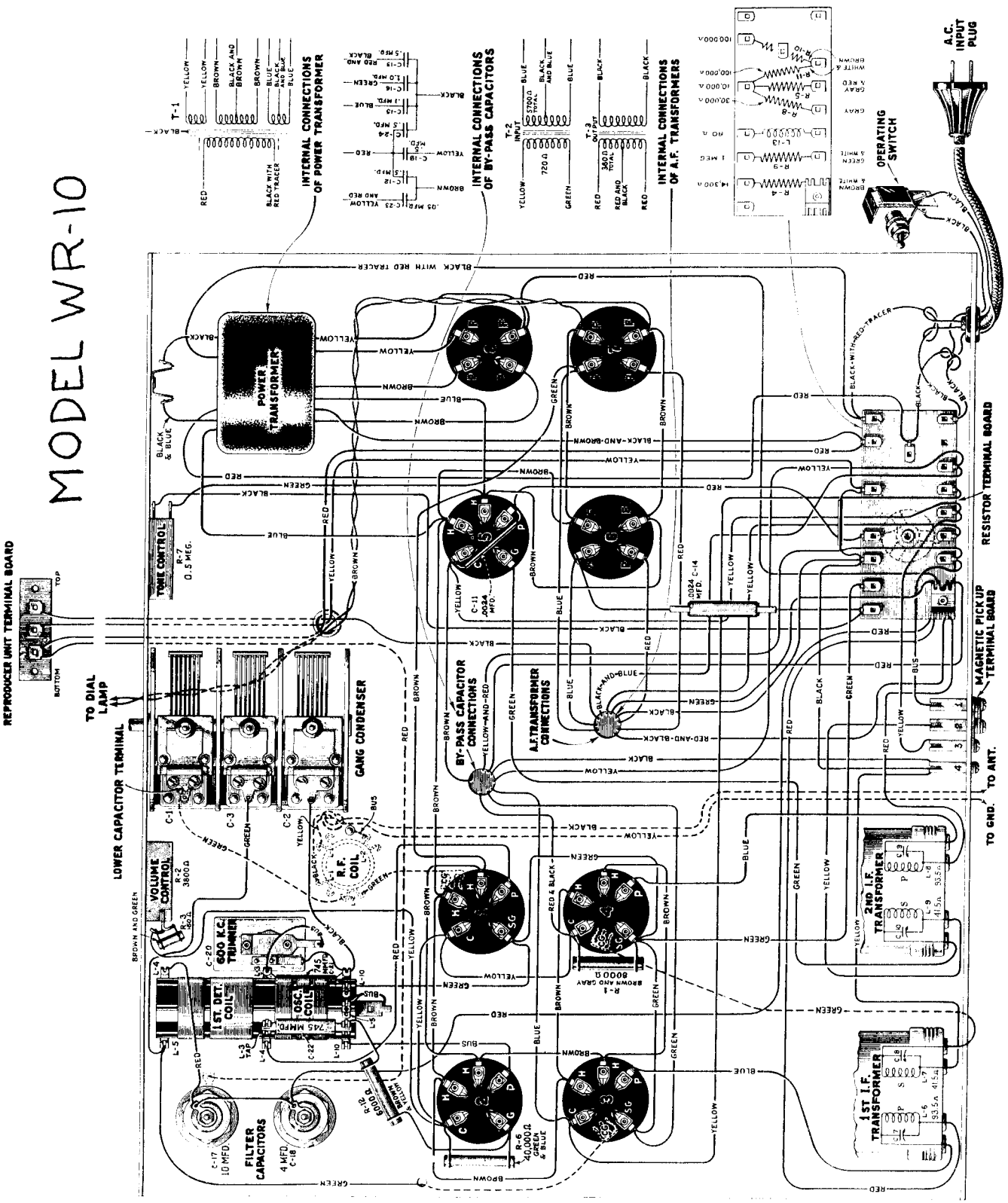


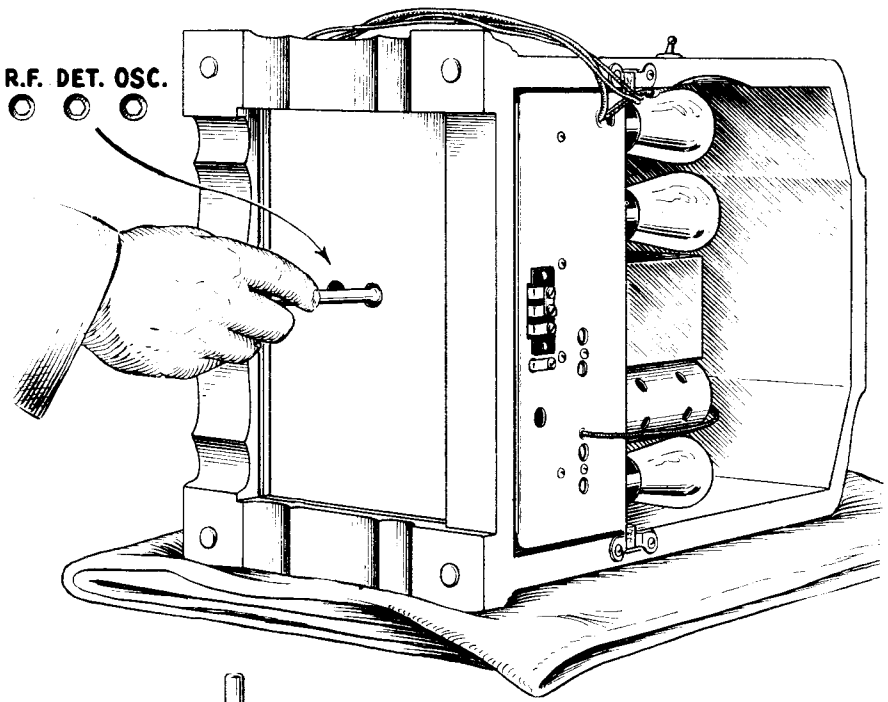
WESTINGHOUSE ELECTRIC AND MFG. CO.



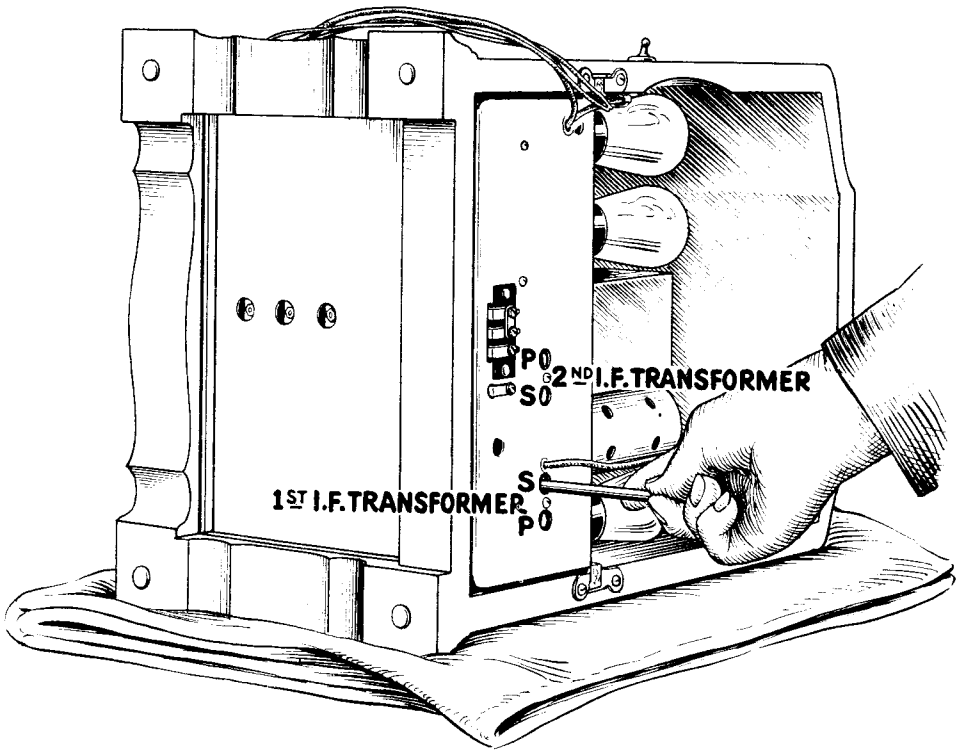
WESTINGHOUSE ELECTRIC AND MFG. CO.

MODEL WR-10

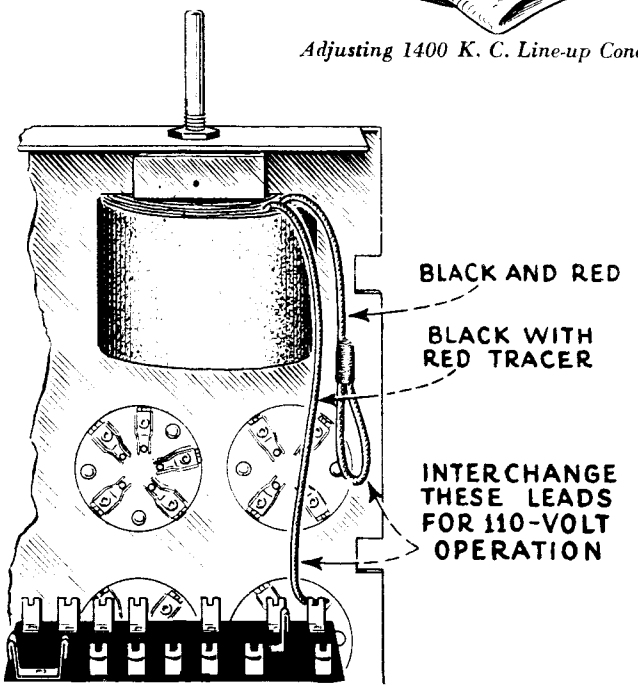




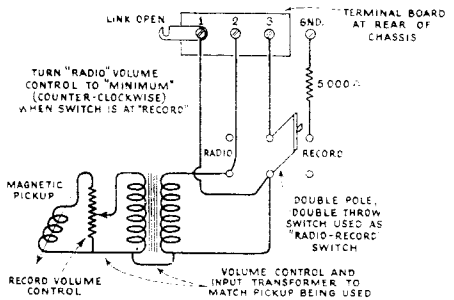
Adjusting 1400 K. C. Line-up Condensers



Adjusting I. F. Transformer Tuning Condenser

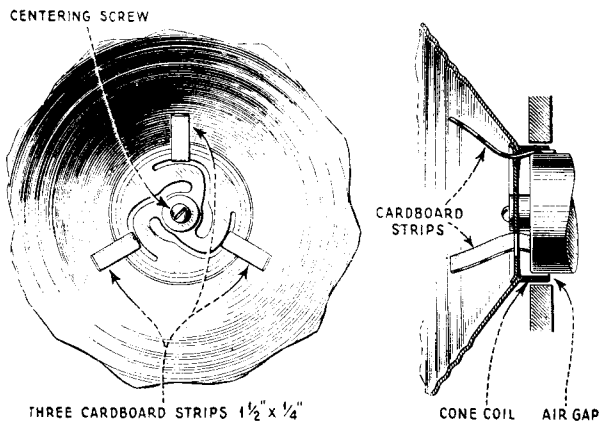


Changes Necessary for 110 Volt Operation on 25 Cycle Models



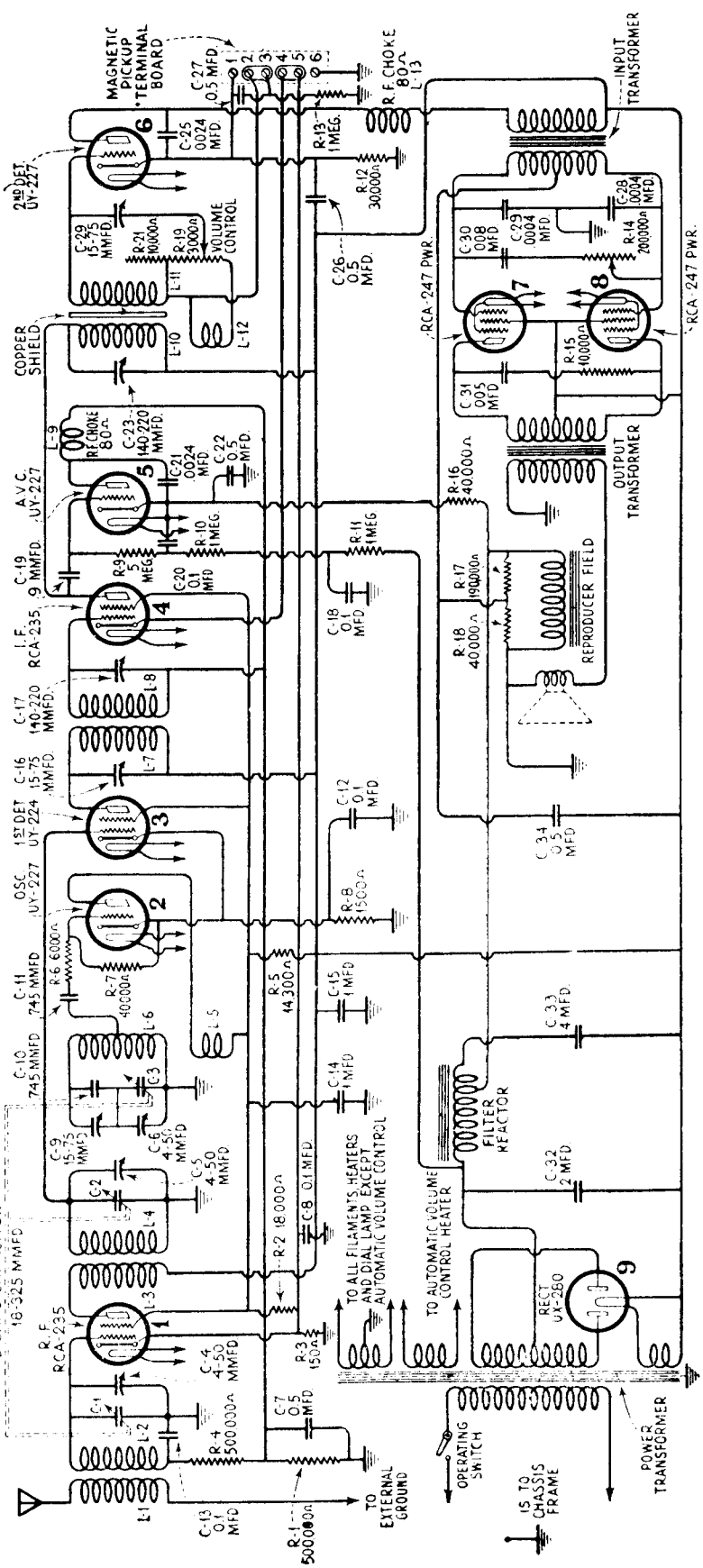
Connections for Attaching Magnetic Pick-up

MODEL WR-10



View of Strips in Place for Centering Cone

WESTINGHOUSE ELECTRIC AND MFG. CO.



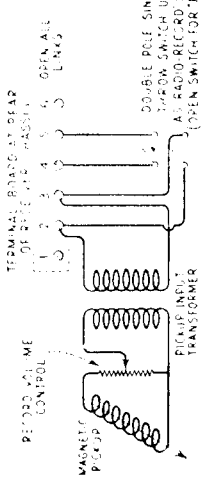
RADIOTRON SOCKET VOLTAGES

110 VOLT A. C. LINE

(Volume Control Setting Does Not Affect Voltages)

Radiotron No.	Cathode to Heater Volts D. C.	Cathode or Filament to Control Grid Volts, D. C.	Cathode or Filament to Screen Grid Volts, D. C.	Cathode or Filament to Plate Volts, D. C.	Plate Current M. A.	Screen Current M. A.	Heater or Filament Volts, A. C.
1	2	*0.1	75	205	5.0	0.5	2.2
2	8	0	—	60	5.0	—	2.2
3	7	7.0	70	200	0.5	0.1	2.2
4	2	*0.1	75	205	5.0	0.5	2.2
5	0	0	—	25	0	—	2.2
6	20	*3.0	—	180	0.5	—	2.2
7	—	10	210	205	25	—	2.2
8	—	10	210	205	25	—	2.2

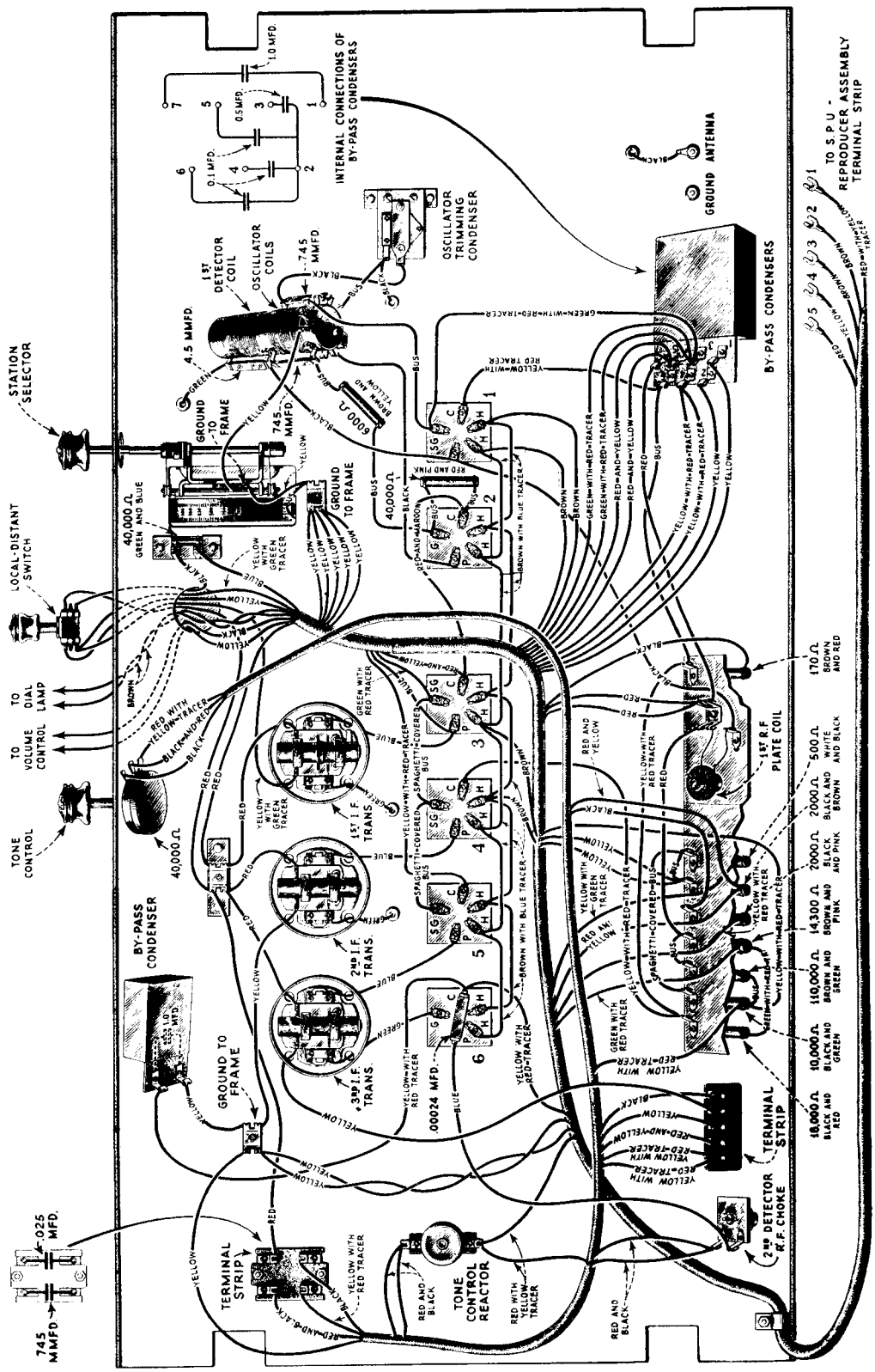
*Not true reading due to resistance in circuit.



Magnetic Pickup Connections

MODEL WR-15

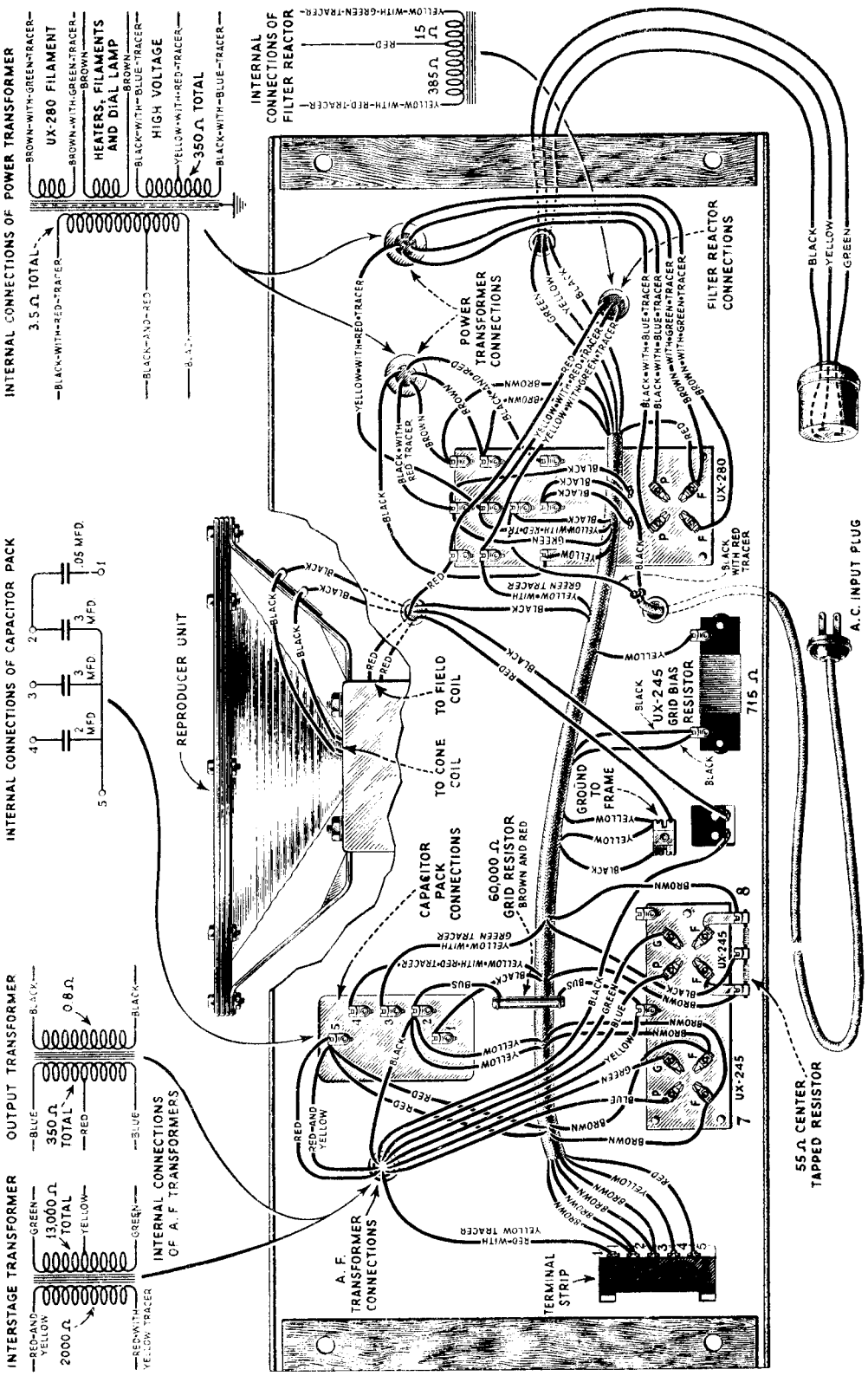
WESTINGHOUSE ELECTRIC AND MFG. CO.



Receiver Assembly

MODELS WR-6-R ; WR-7-R

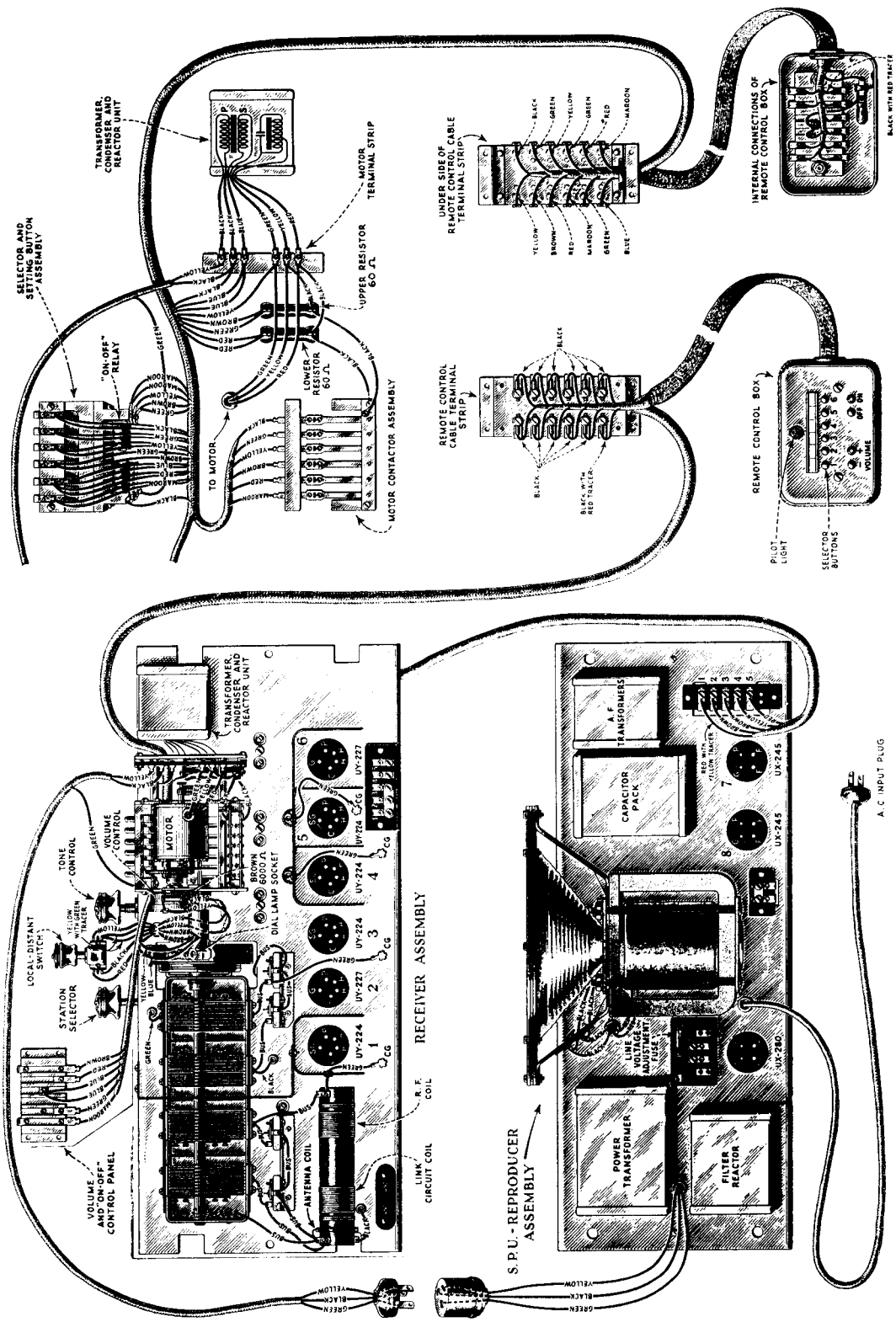
WESTINGHOUSE ELECTRIC AND MFG. CO.



Power Unit

MODELS WR-6-R; WR-7-R

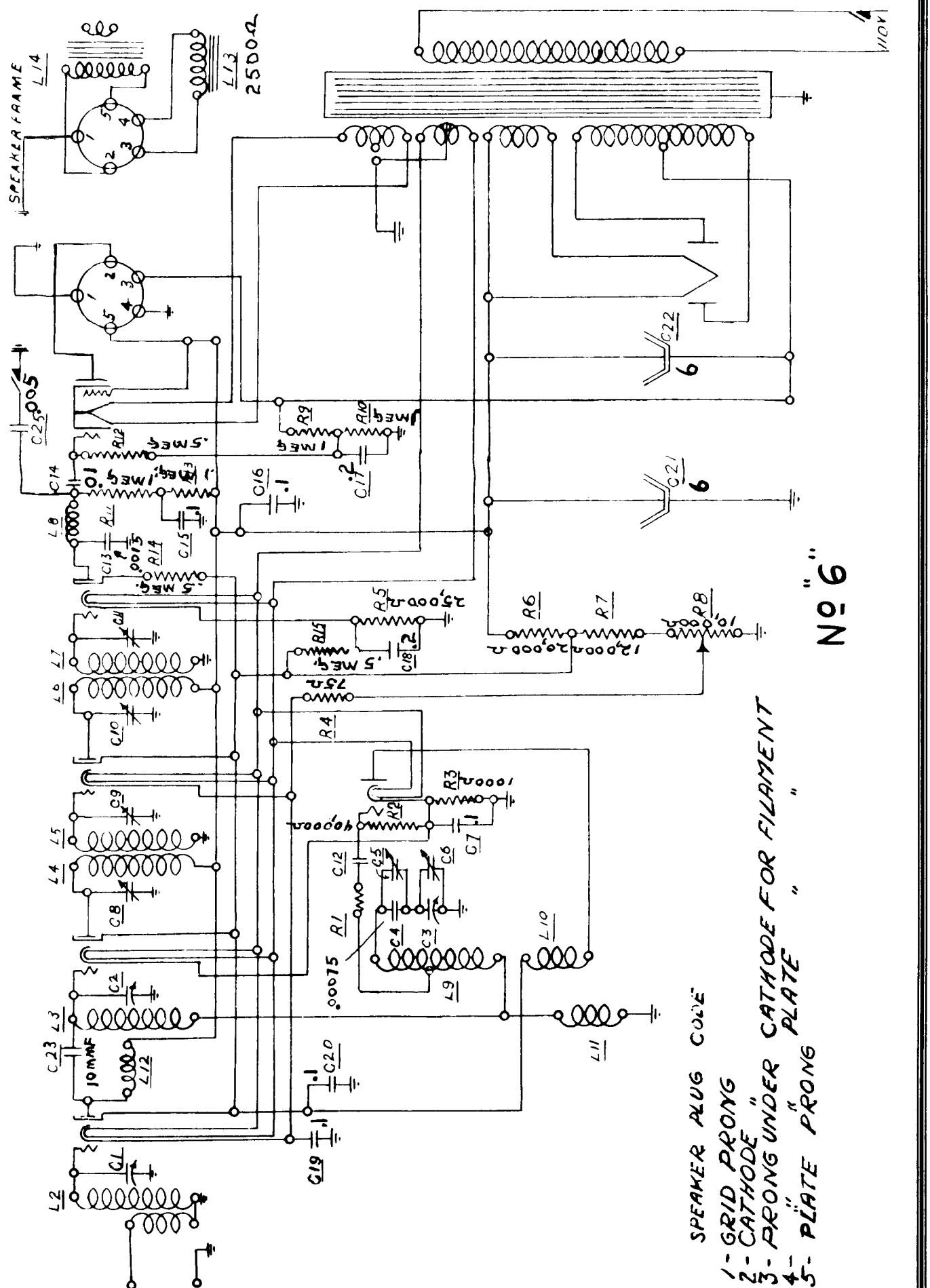
WESTINGHOUSE ELECTRIC AND MFG. CO.



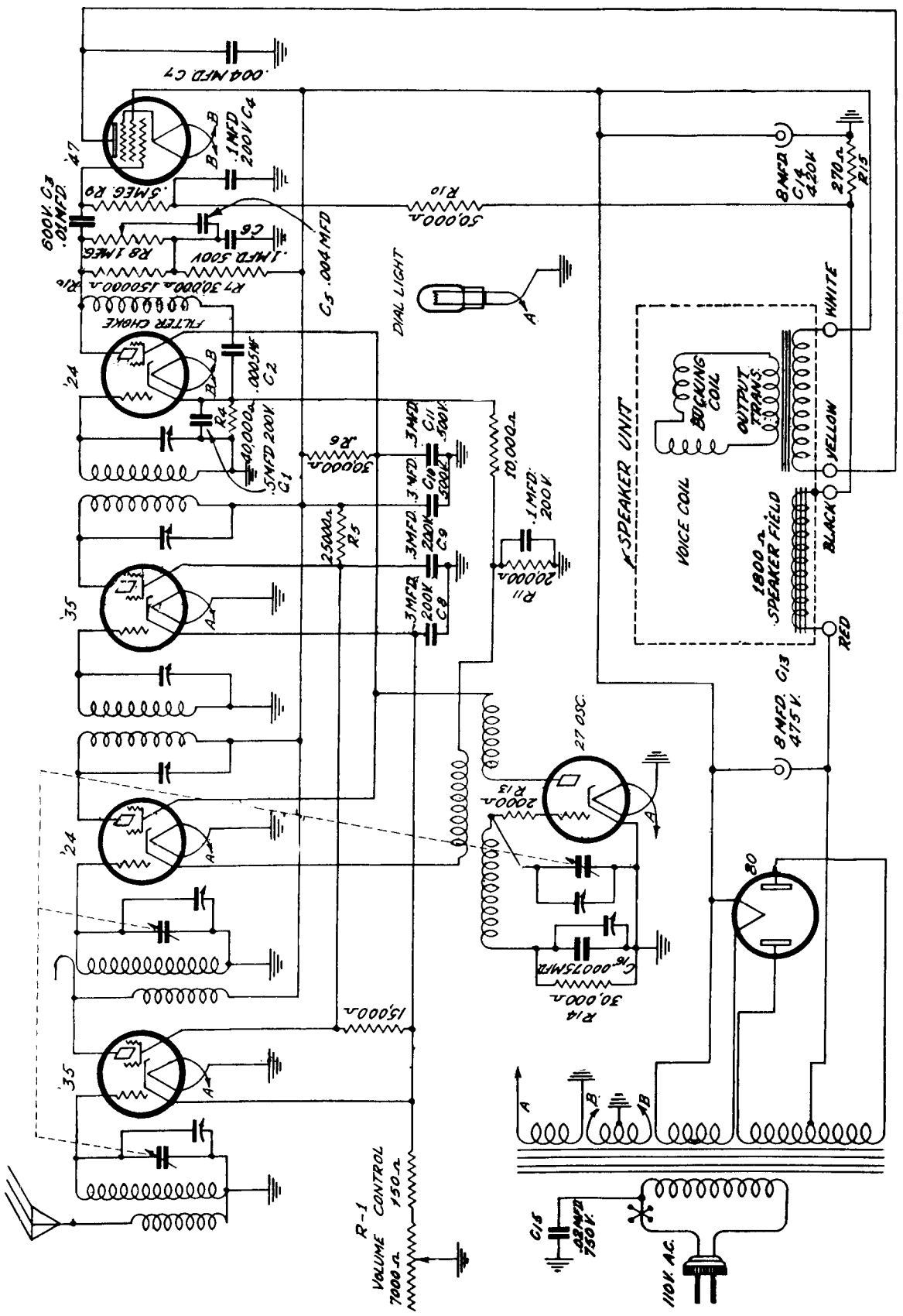
Complete layout and wiring diagram of remote control models

MODELS WR-6-R; WR-7-R

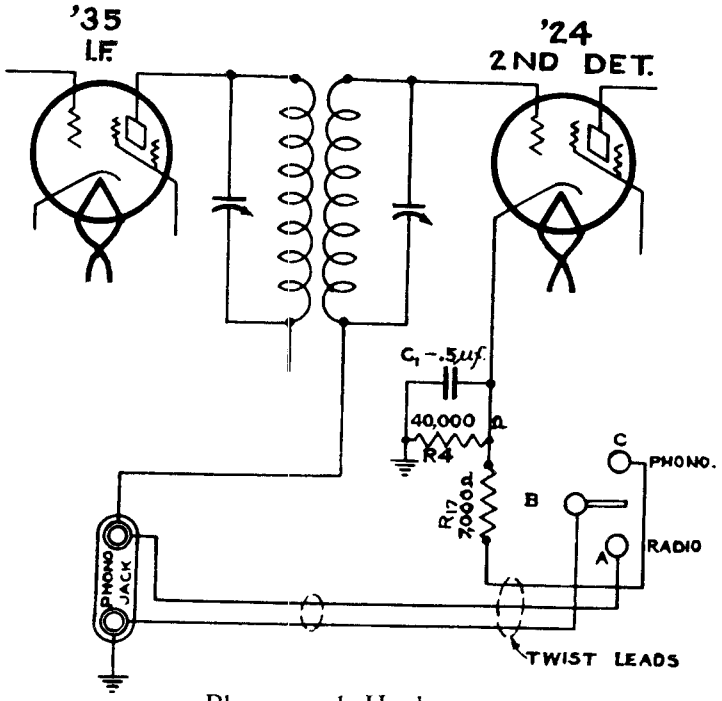
THE WILCOX LABS. INC.



WHOLESALE RADIO SERVICE CO., INC.



WHOLESALE RADIO SERVICE CO., INC.

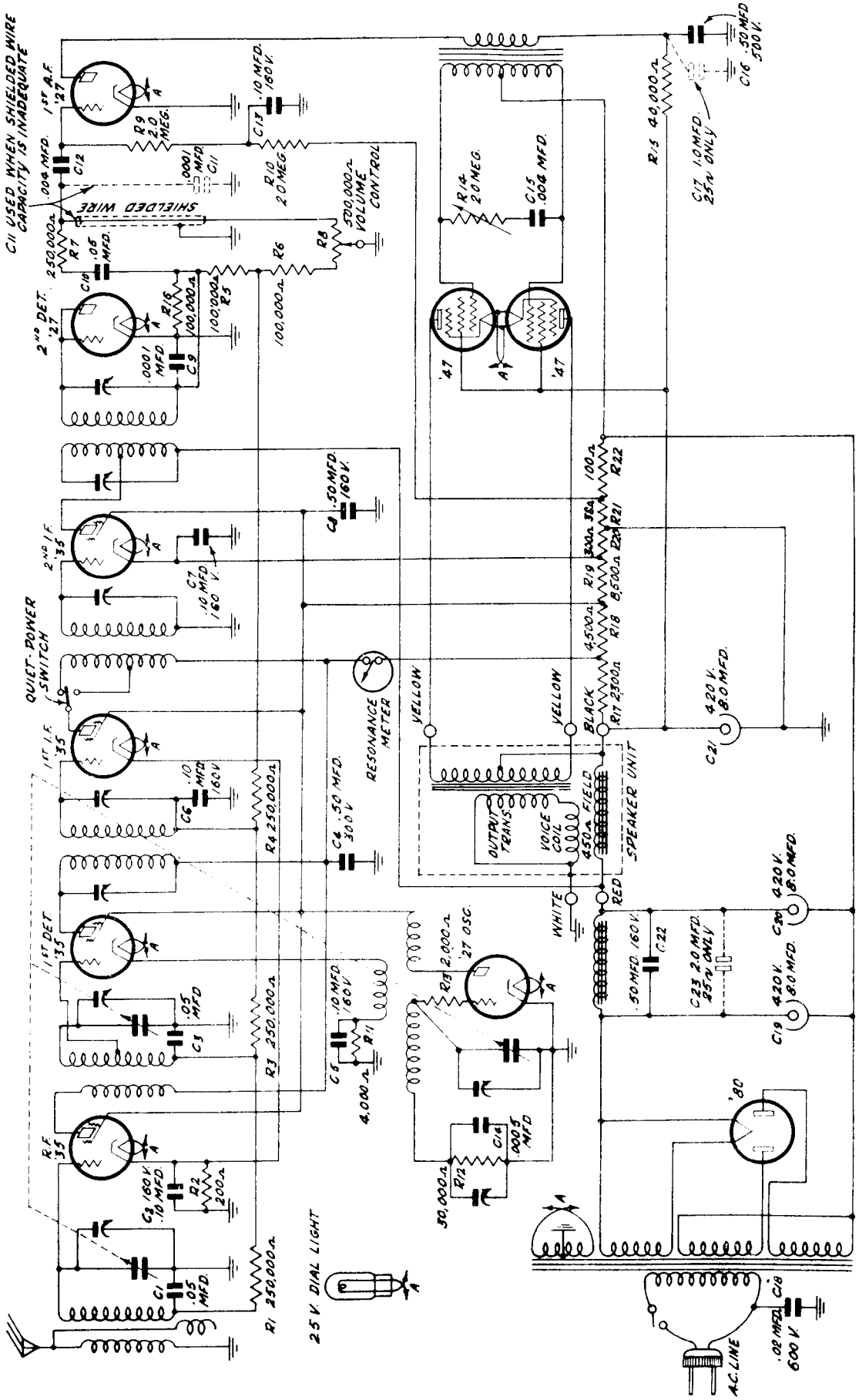


Phonograph Hook-up

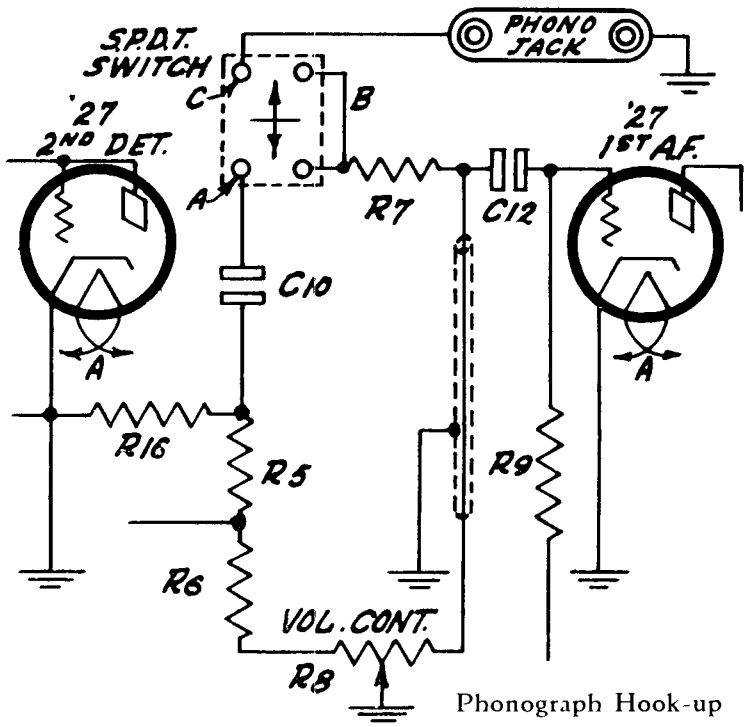
SERIES "10"

Tube	Circuit	Meter Scale	90 V.	100 V.	110 V.	120 V.	130 V.
R.F. (Ant.) '35	Grid	0—10	1.5	1.7	1.9	2.1	2.3
	Screen Grid	0—100	53.	58.	63.	66.	69.
	Plate	0—250	195.	210.	225.	238.	250.
1st Det. '24	Grid	0—25	14.	14.3	14.5	15.	16.
	Screen Grid	0—100	63.	64.	65.	67.	70.
	Plate	0—250	190.	205.	220.	233.	245.
Int. '35	Grid	0—10	1.5	1.7	1.9	2.1	2.3
	Screen Grid	0—100	53.	58.	63.	66.	69.
	Plate	0—250	195.	210.	225.	237.	250.
2nd Det. '24	Grid	0—25	14.	14.3	14.5	15.	16.
	Screen Grid	0—100	63.	64.	65.	67.	70.
	Plate	0—250	110.	123.	135.	145.	154.
Osc. '27	Grid						
	Plate	0—100	76.	78.	80.	82.	84.
Aud. '47 (See Caution Above)	Grid	0—10	2.1	2.4	2.7	3.	3.3
	Accelerating Grid	0—250	188.	210.	225.	240.	250.
	Plate	0—250	170.	190.	205.	220.	230.
'80 Rect.	Filament to Ground	0—1000	198.	215.	233.	250.	263.

WHOLESALE RADIO SERVICE CO., INC.



WHOLESALE RADIO SERVICE CO., INC.



Phonograph Hook-up

SERIES "20"

Tube	Circuit	Meter Scale	90 V.	100 V.	110 V.	120 V.	130 V.
R.F. '35	Screen						
	Grid	0--100	67.	75.	82.	90.	97.
	Plate	0--250	136.	151.	166.	181.	196.
1st Det. '35	Screen						
	Grid	0--100	63.	70.	77.	84.	91.
	Plate	0 250	132.	147.	163.	179.	194.
Oscillator '27	Plate	0--100	70.	77.	85.	92.	100.
1st I.F. '35	Screen						
	Grid	0 100	67.	75.	82.	90.	97.
	Plate	0 250	136.	151.	166.	181.	196.
2nd I.F. '35	Screen						
	Grid	0 100	65.	72.	79.	86.	94.
	Plate	0 1000	227.	252.	277.	303.	328.
1st A.F. '27	Plate	0-100	87.	95.	104.	115.	122.
	Grid	0-25	12.7	14.	15.4	17.	18.3
2nd A.F. '47	Accelerating Grid	0-1000	192.	208.	235.	252.	278.
	Plate	0-1000	180.	200.	220.	240.	261.
'80 Rect.	Current (Both Plates)	0-100	89. M.A.	98. M.A.	108. M.A.	118. M.A.	128. M.A.
(See below)	Plate to Plate voltage	0-1000	547.	568.	690.	712.	733.

The '80 rectifier plate voltages shown are the totals of both plates, measured from each plate to center tap of high voltage secondary.

WHOLESALE RADIO SERVICE CO., Inc.

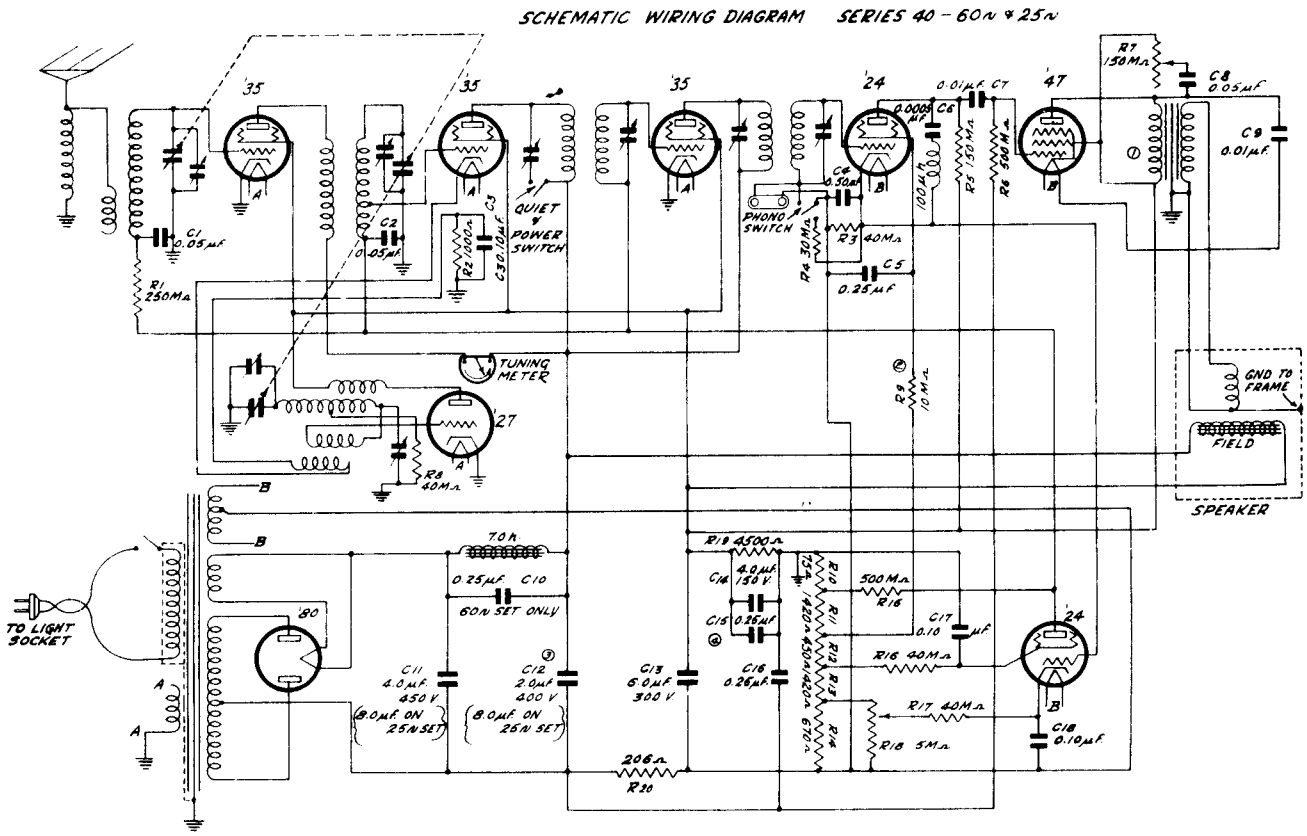


Fig. 1. Schematic Wiring Diagram. Series 40.

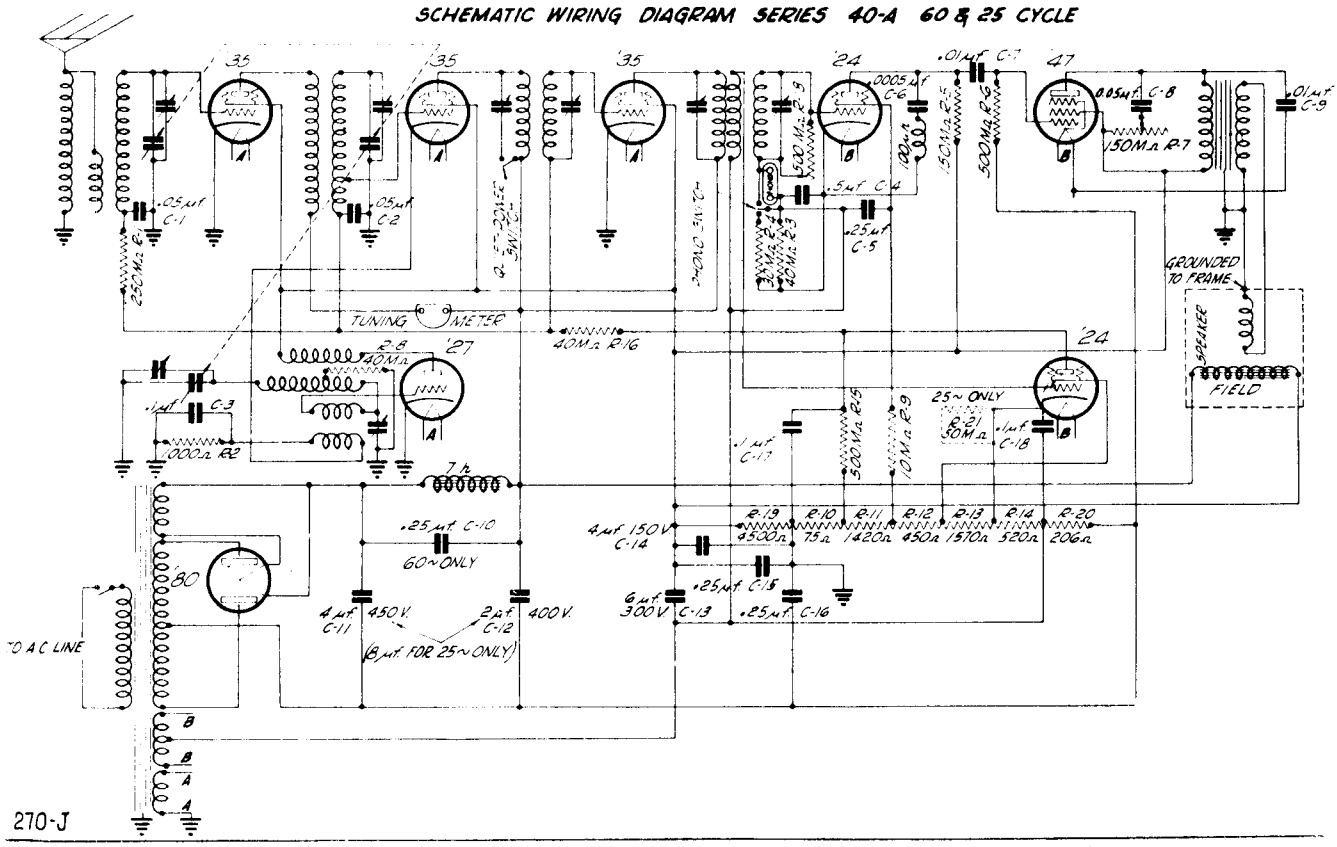


Fig. 2. Schematic Wiring Diagram. Series 40-A.

WHOLESALE RADIO SERVICE CO., Inc.

Tube and Voltage Tests

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

The measurement of grid bias voltages is not recommended as this causes an abnormal rise in plate current which is injurious to the tube. When the receiver does not function properly, and the trouble is apparently due to incorrect grid bias on any tube or tubes, the cause of the incorrect bias may be determined by applying the proper continuity test.

CAUTION: DO NOT ATTEMPT TO TAKE VOLTAGE MEASUREMENTS OR TEST THE '47 PENTODE TUBE WITH A SET ANALYZER WHICH IS NOT DESIGNED TO TEST THAT TYPE OF TUBE. A SPECIAL ADAPTOR IS NECESSARY AND INFORMATION REGARDING SAME MAY BE OBTAINED BY WRITING TO THE MANUFACTURER OF THE SET ANALYZER. THE LATEST TYPE ANALYZERS ONLY ARE DESIGNED TO TEST PENTODE TUBES. THE UY SOCKET IN AN ANALYZER WHICH IS USED TO TEST '24, '35, AND '27 TUBES CANNOT BE USED TO TEST '47 PENTODE TUBES. A break-in adaptor and the external binding posts of the set analyzer may be used to take voltage measurements when an adaptor is not available.

Comparison of the voltage measurements taken and those shown in the chart below will show any irregularities. The cause of any variation may be determined by applying the proper continuity test. REMEMBER: Voltage measurements will vary slightly with different sets of tubes, and also with different chassis. Unless the voltages are radically different than normal, they may be considered satisfactory.

The voltages shown in the chart were taken with a 1,000 ohm per volt voltmeter; voltage measurements taken with a voltmeter having a different resistance will, of course, differ from those shown.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

Tube	Circuit	LINE VOLTAGE 90 V.	100 V.	110 V.	120 V.	130 V.
R. F. '35	Screen-Grid	70	78	85	92	100
	Plate	143	159	175	191	207
1st Det. '35	Screen-Grid	70	78	85	92	100
	Plate	143	159	175	191	207
I. F. '35	Screen-Grid	70	78	85	92	100
	Plate	143	159	175	191	207
Oscillator '27	Plate	70	78	85	92	100
2nd Det. '24	Screen-Grid	66	73	80	87	94
	Plate	127	134	141	148	155
A. V. C. '24	Grid	14	15.5	17	18.5	20
	Screen-Grid	24	26.	28	30	32
Audio '47	Accelerating-Grid	199	221	244	267	289
	Plate	171	190	210	230	250
Rectifier '80	Current (both plates)	67 MA	75 MA	82 MA	89 MA	96 MA
	Plate to Plate Volt.	512	569	625	682	739

Continuity Tests

All these tests are for the Series 40 and the Series 40-A chassis except those which state under the test number "40 ONLY" or "40-A ONLY." The values given are the APPROXIMATE resistance in ohms and are for use with a continuity meter having a high and low scale. "High" or "Low" indicates the meter circuit used to measure high or low resistance. The tubes must be removed when making these tests, the speaker plug must be in its socket, and the volume control turned full on unless stated otherwise under "REMARKS." The possible cause of an incorrect effect is given under "No Deflection" (which indicates an open circuit) or under "No Resistance" or "If Reading Incorrect." The cause of incorrect effects due to loose connections, shorts, and other mechanical faults are not given as it is assumed the service man is capable of locating such faults. The candohm (bleeder) resistor should be tested (Test No. 35) before any circuits of which it is a part are tested as no part of it is given as the possible cause of any incorrect reading.

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
1	Antenna Coil Primary	Antenna wire to chassis		Low .50	Coil open or wire defective	Coil shorted	
2	Ground Wire	Ground wire to chassis		Low 0.0	Ground wire defective or disconnected		
3 #40 only	R. F. Grid	Grid terminal to AVC plate terminal		High 250,010	R1 or antenna Secondary coil open		
		Grid terminal to chassis		High 750,085	R1, R15, or secondary coil open	Gang condenser or its trimmers shorted	Res. of 85 ohms indicates C1 shorted
3 #40A only	R. F. Grid	Grid terminal to AVC plate terminal		High 290,000	R1, R16, or antenna coil secondary open		
		Grid terminal to chassis		High 790,085	R1, R15, R16, or antenna coil secondary open	Gang condenser or its trimmer shorted	Res. of 10 ohms indicates C1 shorted
4	R. F., 1st Det., and I. F. Screen-Grid	Each screen-grid terminal to chassis		High 4,500	Wiring open	Wiring shorted	
5	R. F. Plate	Plate terminal to speaker socket black terminal	Remove speaker plug	High 1,100	Primary coil or resonance meter open		Resonance meter or coil may be shorted
6	R. F., I. F. and Oscillator Cathodes	Each cathode terminal to chassis		Low 0.0	Wiring open		

WHOLESALE RADIO SERVICE CO., Inc.

Continuity Tests—Continued

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
20 #40A	AVC Grid	Grid terminal to chassis		High 4,100	Primary coil (tertiary winding) open		Primary coil shorted
21 #40 only	AVC Screen-Grid	Screen-Grid terminal to chassis		High 41,945	R16 open	C17 shorted	
21 #40A only	AVC Screen-Grid	Screen-Grid terminal to chassis		High 1,945	Wiring open		Wiring defective
22	AVC Plate	Plate terminal to chassis		High 500,075	R15 open		Apply tests Nos. 3, 7, and 10
23 #40 only	AVC Cathode	Cathode terminal to chassis	Volume control full off	High 43,955	R17 or R18 open		C18 shorted
23 #40A only	AVC Cathode	Cathode terminal to chassis		High 8,015	Wiring open		
		Cathode terminal to AVC grid terminal			Should show no deflection		C18 shorted
24	Speaker Voice Coil	Red and green speaker plug terminal	Remove speaker plug	Low very small	Voice coil open	Voice coil shorted	
25	Speaker Coupling Transformer Secondary	Red and green speaker socket terminals	Remove speaker plug	Low 600.	Secondary open	Secondary shorted	
		Red terminal to ground	Remove speaker plug	Low 600	Sec. open or one side of primary not grounded	Secondary shorted	
26	R. F., 1st Det., Oscillator and 1st I. F. Heaters	Prod on each heater terminal		Low, very small	Heater winding on power transformer or wiring open	Heater winding on power transformer or wiring shorted	
27	2nd Det., AVC Heaters and A. F. Filament	Prod on each socket terminal		Low, very small	Winding on power transformer or wiring open	Winding on power transformer or wiring shorted	One side of winding on power transformer or one side of wiring shorted
		Each socket terminal to ground		High 3,955			
28	'80 Filament	Prod in each filament terminal		Low, very small	Winding on power transformer or wiring open	Winding on power transformer or wiring shorted	

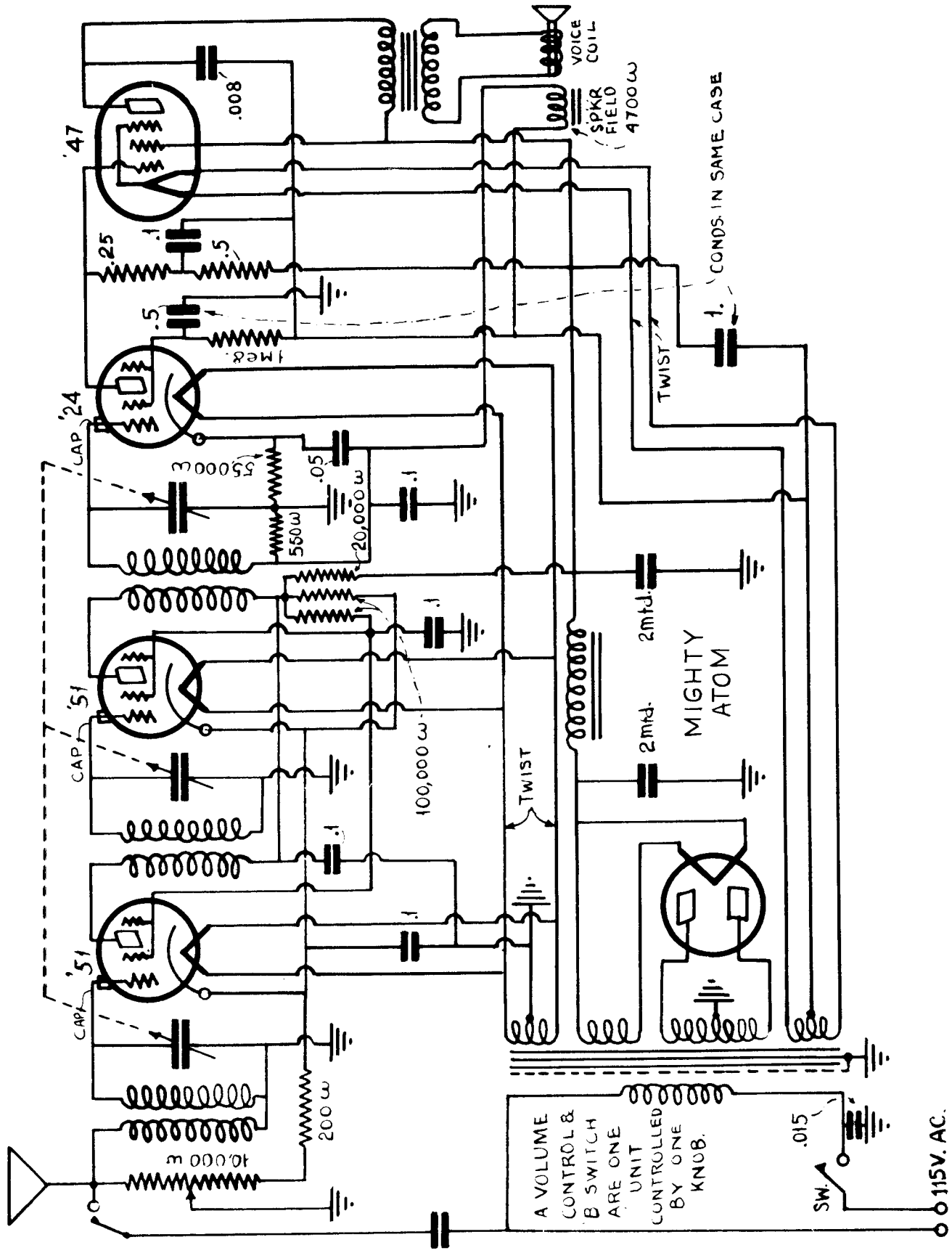
Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
29	'80 Plates	Prod in each plate terminal		Low 300	Power transformer high voltage secondary open	Power transformer high voltage secondary shorted	Half or turns of high voltage secondary shorted
30	Power Supply Choke	One '80 filament terminal and black speaker socket terminal	Remove speaker plug	Low 200	Choke open	C10 shorted	
31	Power Supply Main Filter Condensers (C11 and C12)	On one '80 filament socket terminal and on one '80 plate terminal	Remove speaker plug		Should show no deflection		Resistance of 150 ohm indicates C11 shorted. Resistance of 350 ohms indicates C12 shorted
32	Power Supply Filter Condensers (C13 and C16)	'80 plate socket terminal to chassis		High 4,160	High voltage secondary open		C13 or C16 shorted
33	Speaker Field	Black and yellow terminals on speaker plug	Remove speaker plug	High 1,400	Field open	Field shorted	Turns in field shorted
34	Power Transformer Primary	Each prong on line cord plug	Receiver line switch on	Low 5.0	Primary open or switch, cord, or plug defective	Primary, cord or plug shorted	
35 #40 only	Candohm (Bleeder) Resistor	Yellow speaker socket terminal to chassis	Remove speaker plug	High 4,500	R19 open	C14 or C15 shorted	
		'80 plate terminal to chassis		High 4,311	R10, R11, R12, R13, or R20 or high voltage power trans. winding open	Candohm shorted	R14 or R18 shorted or open. Lower resistance indicates a section shorted
35 #40A only	Candohm (Bleeder) Resistor	Yellow speaker socket terminal to chassis		High 4,500	R19 open	C14 or C15 shorted	
		'80 Plate terminal to chassis		High 4,241	R10, R11, R12, R13, R14, or R20 open	Candohm shorted	Lower resistance indicates a section shorted

WHOLESALE RADIO SERVICE CO., Inc.

Continuity Tests—Continued

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
7 #40 only	1st Detector Grid	Grid terminal to AVC plate terminal		Low 10.	Secondary coil open		
		Grid terminal to chassis		High 500,085	R15 or secondary coil open	Gang condenser, its trimmer, or C2 shorted	
7 #40A only	1st Detector Grid	Grid terminal to AVC plate terminal		High 40,000	Secondary coil or R16 open		
		Grid terminal to chassis		High 540,085	R15, R16 or secondary coil open	Gang condenser or its trimmer shorted	Res. of 2 ohms indicates C2 shorted
8	1st Detector and I. F. Plates	Each plate terminal to speaker socket black terminal	Remove speaker plug. Test with switch on both "QUIET" and "POWER"	Low 80.0	Primary coil open	Primary coil or adjustable tuning condenser shorted	
9	1st Detector Cathode	Cathode terminal to chassis		High 1,000	R2 or pickup coil open	C3 shorted	
10 #40 only	I. F. Grid	Grid terminal to AVC plate terminal		Low 60.0	Secondary coil open	Adjustable tuning condenser or secondary coil shorted	
10 #40A only	I. F. Grid	Grid terminal to AVC plate		High 40,060	Sec. coil open	Adjustable tuning condenser or secondary coil shorted	
11 #40 only	2nd Detector Grid	Grid terminal to AVC grid terminal	"Phono-Radio" switch on "Radio"	High 40,050	R3 or secondary coil open	C4 shorted	
		Grid terminal to wire connecting phono jacks	"Phono-Radio" switch on "Phono"	Low 50.	Secondary coil open	Adjustable tuning condenser shorted	
11 #40A only	2nd Detector Grid	Grid terminal to 2nd detector cathode terminal	Rotate volume control from full off to full on	High 40,050 to 540,050			Sec. coil, volume control, C4, or R3 defective
12	2nd Detector Screen-Grid	Screen-Grid terminal to chassis		High 11,495	R9 open		Check C5, C17

Test No.	Circuit Under Test	Position of Prods	Remarks	Meter Circuit and Resistance	No Reading	No Resistance	If Reading Incorrect
13	2nd Detector Plate	Plate terminal to chassis		High 154,500	R5 open		Check C7, C14, and C15
		Plate terminal to 2nd detector cathode terminal			Should show no deflection	C6 shorted	
14 #40 only	2nd Detector Cathode	Cathode terminal to AVC grid terminal		Low 0.0	Defective wiring		
		Cathode terminal to chassis		High 43,950	R3 open		Check C4, C5, and R18
14 #40A only	2nd Detector Cathode	2nd detector cathode terminal to wire connecting phonograph jacks	"Phono-Radio" switch on "Radio"	High 40,000	R3 open	C4 shorted	Res. of 17,142 ohms indicates "Phono-Radio" switch on "Phono"
15 #40 only	Audio Grid	Grid to chassis		High 504,160	R6 open		
15 #40A only	Audio Grid	Grid terminal to chassis		High 504,241	R6 open		
16	Audio Accelerating Grid	Accelerating grid terminal to chassis		High 4,500		Check C14 and C15. Tone control may be shorted on chassis	Check C8, C9
17	Audio Plate and Speaker Coupling transformer primary	Plate terminal to chassis		High 5,300	Speaker coupling transformer primary may be open		Check R7, C8 and C9 for short on chassis
18	Oscillator Grid	Grid terminal to chassis		High 40,000	R8 open	Oscillator gang condenser, its trimmer, or 600 K. C. tracking condenser shorted	
19	Oscillator Plate	Plate terminal to chassis		High 4,500	Plate coil open	C14 or C15 shorted	
20 #40 only	AVC Grid	Grid terminal to 2nd detector cathode		Low 0.0	Defective wiring		
		Grid terminal to chassis		High 43,950	R3 open		Check C4, C5, R18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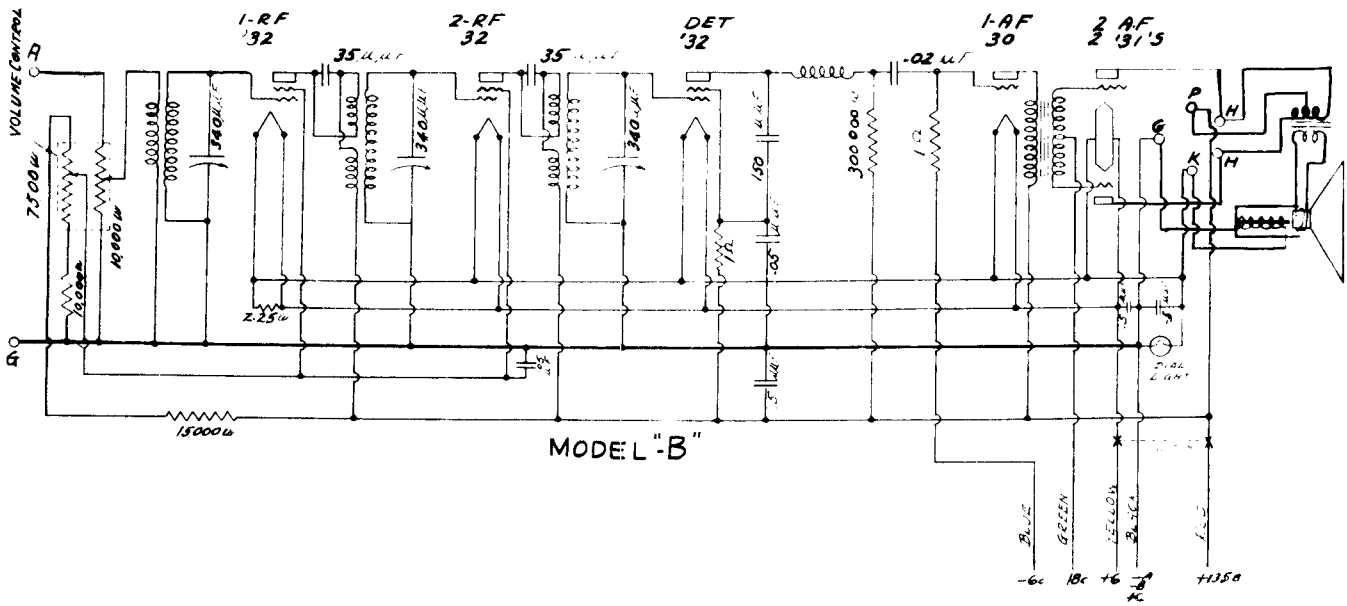
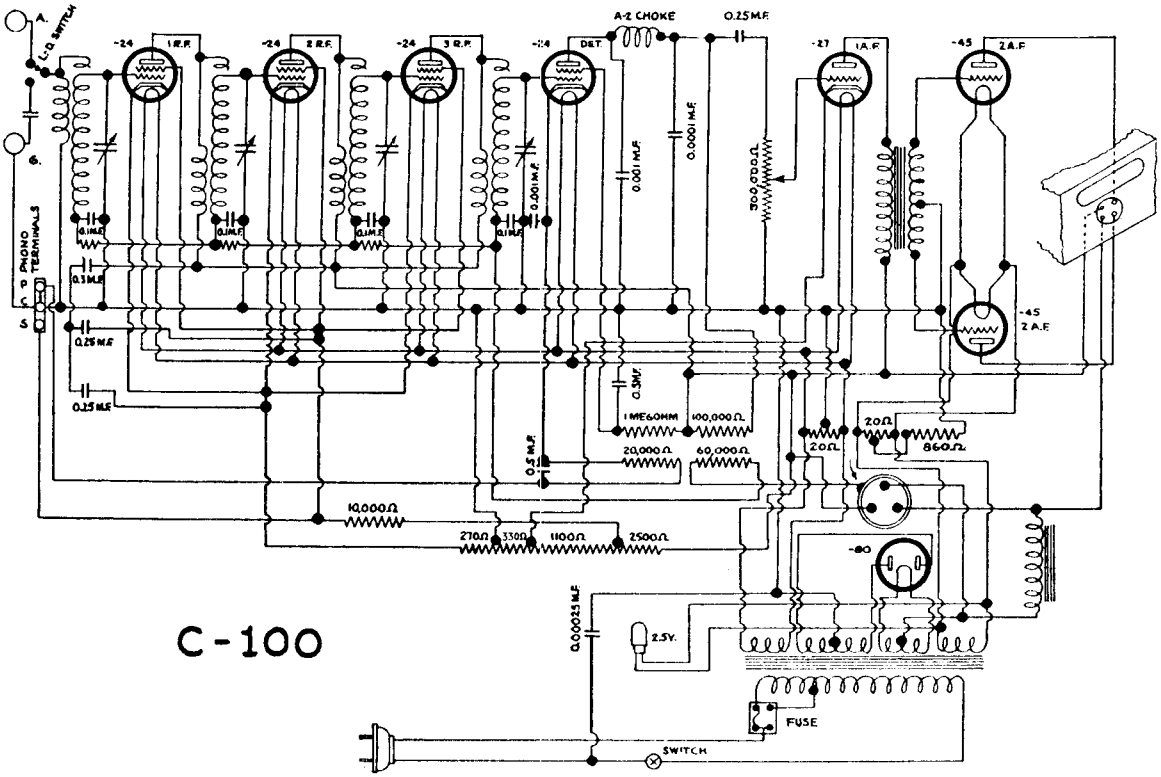
'24
'51
'51
.008
.25
.1
.5
.5
1 meg.
CAP
CAP
CAP
.05
.1
.1
.1
.1
.1
.015
2 mfd.
2 mfd.
MIGHTY ATOM
VOICE COIL
SPKR FIELD 4700 ω
CONDS. IN SAME CASE
TWIST
TWIST
1.
55000 ω
550 ω
20,000 ω
100,000 ω
200 ω
10,000 ω
A VOLUME CONTROL & B SWITCH ARE ONE UNIT CONTROLLED BY ONE KNOB.
SW.
115 V. AC.

WURLITZER



COLUMBIA PHONOGAPH CO., INC.

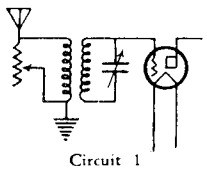


C-100

CENTRAL RADIO LABORATORIES

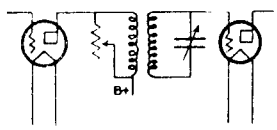
Fundamental Circuits Used for Volume Control

Antenna or R. F. Primary Radiohm



Circuit 1

Circuits numbers one and two were widely used on electric sets during 1928 and early in 1929. The volume control shunts the primary of an R.F. transformer having a tuned secondary, and has essentially, the same resistance taper whether used at the antenna input or between two of the R.F. tubes. Circuit number one is the simplest and best to use in



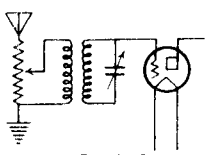
Circuit 2

servicing any type receiver when in doubt about the proper volume control. It always works, and cannot interfere with the proper operation of any circuit.

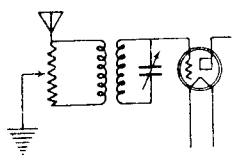
Use Centralab Replacement Control number 70-200.

(A 100,000 ohm left hand tapered Radiohm.)

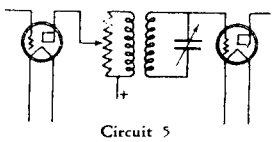
Antenna or R. F. Potentiometer



Circuit 3



Circuit 4



Circuit 5

Circuits numbers three, four and five are quite similar to the first two except that a potentiometer is used rather than a two terminal resistor. Some models may deviate from circuit four by connecting the antenna rather than the ground to the variable contact. These are all circuit arrangements that can be used with the type —26 or type —27 tubes. Adjusting the volume control will have no effect on the apparent A.C. hum, and will not change the selectivity of the set. Use Centralab Replacement Control number 72-100.

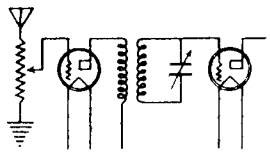
(A 10,000 ohm left hand tapered potentiometer.)

Untuned Antenna Circuit Potentiometer

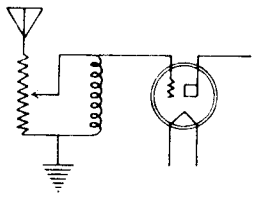
Circuit number six was used on several early A.C. models sold in large quantities, including those of R.C.A. The volume control potentiometer has a resistance of 2,000 ohms, and the grid of the first tube is directly connected without tuning.

Use Centralab Rpelacement Control number 72-101.

(A left hand tapered 2,000 ohm potentiometer.)



Circuit 6



Circuit 7

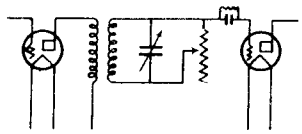
The gain and selectivity of receivers using this control circuit can often be improved by adding an inductance loading coil per circuit number seven.

A potentiometer of 10,000 ohms is then desirable, using Centralab Replacement Control number 72-100.

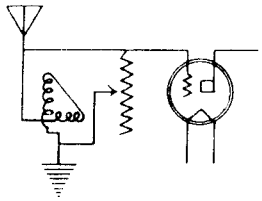
(A left hand tapered 10,000 ohm potentiometer.)

Radiohm in Tuned R. F. Circuits

Circuit number eight proved a helpful and reliable volume control for those —26 type sets that oscilated excessively. The control for this particular circuit has many uses as a replacement control. It is a shunt resistance with a high maximum before going to infinity. It is also used



Circuit 8



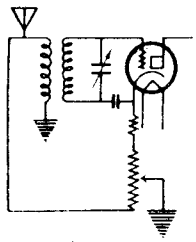
Circuit 9

in the antenna circuit where a high resistance is needed with a tuned coupling transformer, or where a variometer is used per circuit number nine.

Use Centralab Replacement Control number 70-201.

(A left hand Radiohm.)

Potentiometer "C" Bias and Antenna Control



Circuit 10

This circuit is more widely used than any other arrangement using a single control with type 27 or screen grid tubes, as it gives a double control effect at the cost of a single potentiometer. The variable contact is usually grounded through the bushing and the terminal at the clockwise end, is connected through a fixed bias resistor to the cathodes of two or three R.F. tubes or the I.F. tubes in case the circuit is a "Super." The other terminal connects to the antenna, shorting it to ground at minimum volume adjustment to avoid the grid overloading that might otherwise occur on loud signals.

Satisfactory volume controls for this circuit must be carefully tapered and are apt to prove critical or noisy under some extreme conditions. Where the very best control is desired, re-

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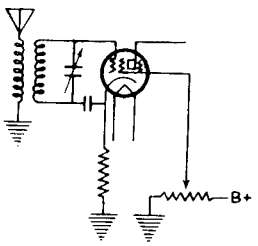
place the single potentiometer with Twin control 74-601 connected as shown by circuit twenty.

Circuit ten uses Centralab Replacement Control number 79-006 or 51-010.

(A 15,000 ohm left-hand tapered potentiometer.)

Screen Grid Potentiometer



Circuit 11

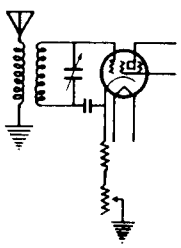
A single potentiometer providing volume control by varying the voltage applied to the screens of the R.F. tubes. Connection to only one tube is illustrated, but the screens of all the R.F. tubes are usually connected to the slider of the control. A 50,000 ohm Centralab has been most used for this service. Some receivers, however, use a wire wound control of such low resistance it passes considerable current and is made part of the voltage divider circuit. Better volume control will result from using a high resistance shunting the voltage divider. When these wire wound controls require replacement because of noise or wear, it is best to use the Centralab 100,000 ohm potentiometer with the two outside terminals bridged with a fixed resistor of approximately the same value as the old wire wound potentiometer.

50,000 ohm potentiometer. Part number 72-103.

100,000 ohm potentiometer. Part number 72-104.

(Straight taper potentiometers.)

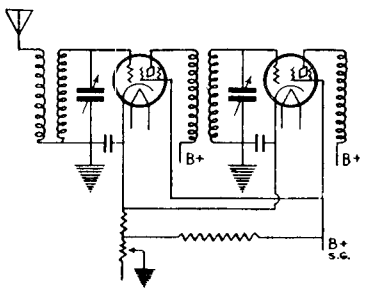
R. F. "C" Bias Radiohm



Circuit 12

A popular circuit used effectively with all heater type of tubes. Circuit 12 was widely used in 1929 and 1930 in tuned R.F. circuits with the type —24 or type —27 tubes. The cathode current of all R.F. tubes passes through the single control and the additional fixed resistor which supplies the bias at maximum volume. Control depends upon the tube characteristic that increasing the negative C-bias beyond the normal three volts, will decrease the plate current and amplification of the tube until the signal is effectively blocked. The variable resistance must be heavily tapered for uniform attenuation since the voltage drop of the cathode current alone is depended upon for full range control. The proper Centralab control for circuit twelve is Centralab number 70-202, a 75,000 ohm right-hand tapered Radiohm.

Variable Mu tubes, such as type —51 or —35, require such a high negative bias to fully control the signal it is customary to obtain the required voltage drop by passing bleeder current through the control in addition



Circuit 12A

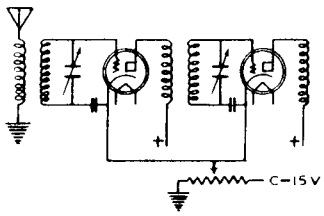
to the cathode current. This arrangement is illustrated as circuit 12A. Two fixed resistors are shown in addition to the volume control variable resistance. The one between the volume control and the cathodes is of low resistance and provides the minimum bias for maximum volume. The other resistor has a two-fold purpose of stabilizing the screen voltage and metering a definite amount of "bleeder" current through the volume control. Its resistance, and that of a third resistance between the screens and the high potential lead, not shown in the print, is normally adjusted to apply about 100 volts on the screens and pass sufficient current through the total resistance of the volume control to provide a drop of about 40 volts across the volume control at minimum volume.

This type control is used on both tuned R.F. and Super heterodyne circuits. On Supers, it is customary to control the bias of the I.F. tubes while tuned R.F. circuits will control two or three tubes. The most popular control is a right-hand tapered Radiohm, maximum resistance 10,000 ohms, Centralab part number 70-205. A few receivers originally used a wire wound control with a much lower maximum resistance. Replace these with a Centralab Potentiometer of similar resistance (see list on page 47) and connect the center and right terminal only.

Volume Control circuits like figure 12 or 12A, sometimes cause distortion or cross talk, due to overloading, in sections where local broadcast stations are powerful and numerous. This may be corrected by using a potentiometer of similar resistance for the replacement control, and connecting the left terminal to the antenna as illustrated in figure 10. Part number 79-006 is correct for most receivers when so changed.

R. F. "C" Bias Potentiometer

Another method of controlling volume by changing the R.F. "C" Bias

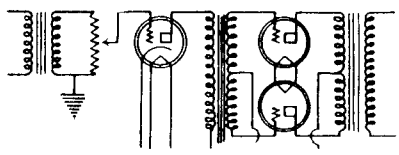


Circuit 13

that will be found on some receivers. Replacements must have the same total resistance of the original to insure the correct voltage drop. This resistance is usually low, such as Centralab part numbers 72-101, 72-107 or 72-108.

This method of control is no longer considered as good as circuit ten or twelve. It is suggested that one of these circuits be substituted in making replacements.

Audio Circuit Volume Level Potentiometer



Circuit 14

Potentiometer across audio stage is a very old form of control dating back to 1926. Yet many modern receivers will be found with this as an auxiliary control to another in the set; as the manual control used with automatic

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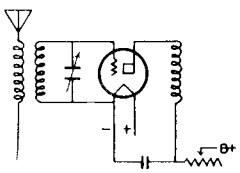
volume control circuits; and as the volume control on amplifiers sold for theatre and school installations. Centralab replacement Part number 72-105.

Where space permits, as on separate amplifiers, use the Centralab Standard M-500 Modulator, having a diameter of 2¼ inches.

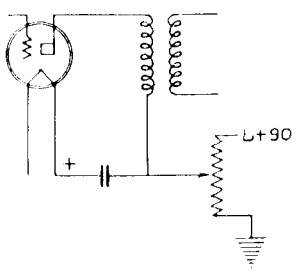
R. F. Plate Circuit Contro'



Circuit 15

These illustrate the plate circuit controls widely used several years ago. Connections for one tube only are shown, but the plates of two R.F. tubes are commonly connected to the control. Circuit number fifteen uses a 500,000 ohm right hand tapered Radiohm. Centralab replacement Part number 70-203.

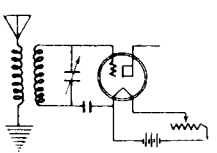
Circuit number sixteen used a 50,000 ohm potentiometer. Centralab replacement Part number 72-103. Both the above circuits may require frequent volume control replacement because a poor tube will practically short circuit the control. A tube with



Circuit 16

loose grid that may accidentally short to plate causes the trouble and this tube is hard to locate because it will normally continue to function and be apparently O.K. It is therefore, desirable to replace these volume controls with the number 70-201 control connected as per circuit number eight or with circuit number one. The former volume control connections are then soldered together and taped

R. F. Filament Rheostat



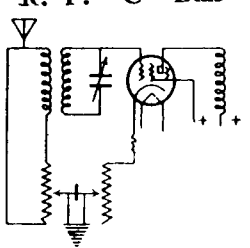
Circuit 18

A Rheostat in the filament circuit to control any one or all of the tubes is the oldest method of volume control. There is a choice of two types of rheostats for replacement, Standard Power or Giant Power. The first is for low voltage and low current control; the second is for low voltage and higher current so that the maximum power does not exceed 50 watts. Smoother volume control for these receivers will always be obtained by fixing the filament voltage and using replacement control number 70-200 as per circuit number one or replacement control number 70-201 as per circuit number eight.

Twin Volume Controls

Volume controls that provide two separate resistances on the same shaft are commonly termed twins and the Centralab replacement controls of this type represent the highest development in radio receiver volume controls. Twin controls were used on many popular receivers during 1929 and are on a majority of the 1930 receivers, since screen grid models now have such high gain per stage that a single control will seldom handle a loud local signal without excessive overloading, distortion, or cross talk. When having any of these troubles with a receiver originally equipped with a single control it will be well to replace the original with a Twin as illustrated in any of the following circuit sketches. Centralab twins have all terminals insulated from each other and from the shaft and bushing.

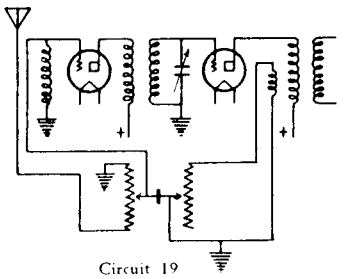
Twin—Antenna and R. F. "C" Bias



Circuit 20

A popular twin control application used on screen grid and high gain type twenty-seven receivers. The control varying the C-bias is usually connected to the cathodes of two or three R.F. tubes, although only one is illustrated. There are two variations from the connections shown in sketch number twenty, both being to the antenna potentiometer. Some sets may have the ground connected to the left terminal and the antenna connected to the center terminal which is the variable contact. Other sets may have one end of the inductance connected to the center terminal. Variations of these antenna potentiometer connections are shown by sketches 3, 4, and 5. The antenna potentiometer is the base with the shaft and bushing in it. Centralab twin replacement control number 74-601.

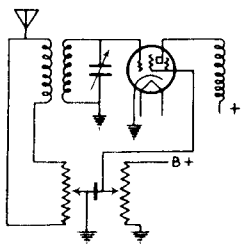
Twin—Antenna and R. F. Primary



Circuit 19

The volume control circuit used on the 1929 and early 1930 Victor receivers. The original control was a twin wire wound potentiometer. The noise and wear of this type may be eliminated by replacing the Centralab especially designed twin control part number 74-600.

Twin—Antenna and Screen Grid



Circuit 21

This twin control has the same antenna potentiometer as the one used for circuit number twenty and the same variation of connections apply. The antenna potentiometer is the one

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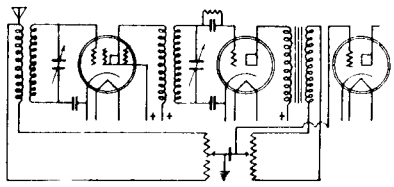
having the shaft and bushing in it The back base is also a potentiometer, used to vary the screen grid voltage of the R F. tubes. These two circuits are insulated from each other in the control. Centralab twin replacement control number 74-602. (Shaft base potentiometer 10,000 ohms. Back base potentiometer 50,000 ohms.)

Twin—Antenna and Audio Secondary

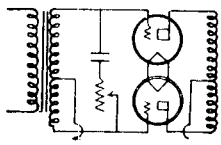


Circuit 22

This twin control reduces volume by varying the antenna input and at the same time reducing volume in the first audio stage. This has the advantage of lowering the hum level with the volume level, but is best used with a power detector circuit as otherwise that tube might overload and cause distortion on some loud signals. The shaft base is the antenna potentiometer with a maximum resistance of 10,000 ohms, and the back base the 500,000 ohm audio potentiometer. Centralab twin replacement control number 74-515.

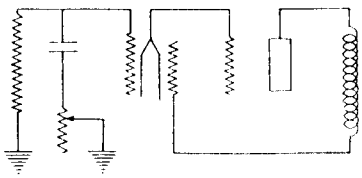
"lows." Actually boosting the "lows" is a difficult problem requiring careful engineering in the original design of the amplifier, and can seldom be accomplished with satisfaction by any attachment made later. Even when incorporated in the original design, it can have no practical advantage over a simple tone control on a full range amplifier when the tone and volume control knobs are properly adjusted.

The most widely used and simple circuit is illustrated at number 23. A Centralab one megohm Radiohm number 41-010 is shunted, in series with a fixed condenser, from grid to grid of the push pull output tubes. The condenser capacity commonly used is .01 mfd. If greater high frequency cut off is desired, use a larger capacity, such as .02 mfd., while less cut off results from a smaller capacity, such as .005 mfd.



Circuit 23

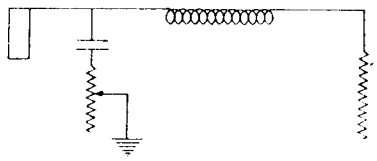
While circuit 23 illustrates a —45 output, the same parts and connections are used with a Pentode push pull, except that the condense capac-



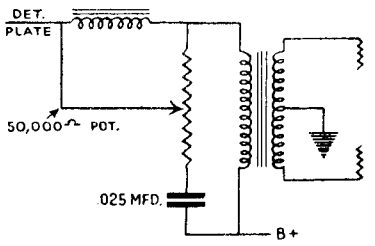
Circuit 24

ity should be about .004 mfd. The proper connection for a single Pentode is shown as circuit 24, and the same connection is used with a single —45 or —50. All of these grid circuit applications, which we recommend as best, use the same Centralab 1 megohm 41-010 control with a condenser capacity of about .01 mfd. for the —45 and about .004 mfd. for the Pentode.

Some receivers locate the tone control in the detector plate per circuit 25. Centralab number 41-050 Radiohm has the correct taper for this location, while the condenser capacity is about .05 mfd. Circuit 26, also located in the detector plate, is designed to boost the "lows" as well as cut the "highs." The inductances and



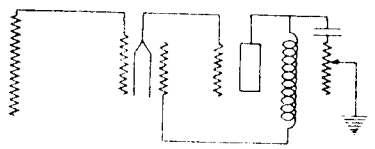
Circuit 25



Circuit 26

capacities are part of the receiver design. The control is a Centralab 72-103 potentiometer.

Some tone controls have been located in the plate circuit of the output



Circuit 27

tubes, either Pentode or —45, as shown by circuit 27. This circuit is not recommended because the high voltage and possible surges in this location may break down the condenser or the control. Where such trouble requires replacement parts, use a Centralab 41-010 located on the grid side per circuit 23 or 24.

CENTRAL RADIO LABORATORIES

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
ACME MANUFACTURING CO.			
A.C. 7	Radiohm across first stage audio secondary	Fourteen	72-105
88	Potentiometer controls screen voltage	Eleven	72-104
AERO COIL CO.			
Unit 6 International Short Wave	Rheostat controls 201A filament circuit	Eighteen	47-006
	Rheostat controls 201A filament circuit	Eighteen	47-006
AERIO PRODUCTS CO.			
Aerio 7	Rheostat controls filament 3-201A R.F. tubes	Eighteen	47-006
Aerio 6	Rheostat controls filament 3-201A R.F. tubes	Eighteen	47-006
Aerio 5	Radiohm controls plate voltage of 3-201A tubes	Fifteen	70-203
Aerio 4	Rheostat controls filament 2-201A tubes	Eighteen	47-006
Aerio Short Wave Set	Rheostat controls 1-201A tubes	Eighteen	47-015
ALL AMERICAN MOHAWK CORP. (LYRIC)			
80-81-84-85-86			
88	Radiohm across detector tuned circuit	Eight	70-201
60-61-62-65-66	Radiohm across detector input circuit, 227 tubes	Eight	70-201
96-90	Potentiometer across antenna coil and varying C-bias	Ten	79-006
THE AMRAD CORP.			
81	Controls screen voltage of 3-224 tubes	Eleven	72-103
70-7100	Potentiometer across aerial coupler coil	Three	72-100
84	Potentiometer shunts audio secondary	Fourteen	72-105
1928	Radiohm varies R.F. C-bias		70-205
1929	Potentiometer controls screen grid voltage	Eleven	72-104
APEX (U. S. RADIO & TELEVISION)			
46	Radiohm across aerial and ground	One	70-200
80	Radiohm across aerial loading coil	One	70-201
44-46-47-41-42-48	400 ohms potentiometer controls C bias	Thirteen	24-110
Battery Models	Radiohm control R.F. plate voltage	Fifteen	26-500
81B	Potentiometer controls antenna and C-bias	Ten	79-005
82A-82B	Potentiometer controls antenna and C bias	Seventeen	41-009
70	Potentiometer antenna to ground controls grid	One	70-100
R Radiotrope	Potentiometer antenna to ground controls grid	One	70-200
26	Potentiometer controls antenna and C-bias	Ten	79-006
ARBORPHONE			
45	Radiohm across primary of second R.F. tube, 226 tubes	Two	70-200
ATCHISON RADIO			
	Potentiometer controls cathode voltage and antenna	Ten	79-006
8430	Potentiometer controls antenna and C-bias (Switch Type)	Ten	62-100
ATWATER KENT MFG. CO.			
10-B	Potentiometer across A battery controls grids of R.F. tubes 201-A		24-110
32-33-35-48-49-12 and 20-30	Rheostat controls 2-201-A R.F. tubes, filament	Eighteen	47-015
33 Series-filament	Potentiometer across secondary of last audio transformer	Fourteen	72-105
36	Radiohm across first and second R.F. primaries	Two	70-200
50	Rheostat controls 4-201-A tubes	Eighteen	47-006
55-55C	Potentiometer controls screen voltage and Radiohm in aerial circuit	Twenty-one	Special
60-60C 67C	Potentiometer controlling screen voltage and grid circuit of 2d R.F. tube. Dual unit	Twenty one	Size Controls should be ordered direct from manufacturer
61-61C-66	Potentiometer in B circuit controlling screen voltage of 3-224 tubes.	Eleven	
	Radiohm controls screen voltage	Eleven	72-104
	Radiohm across first stage audio secondary	Fourteen	72-105
	Potentiometer controls screen grid voltage and potentiometer across pick-up unit	Eleven	74-616
	Potentiometer controls screen grid voltage and radiohm across R.F. secondary	Twelve	25-425

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
BREMER TULLY RADIO CO.			
7-70-7-71	Potentiometer controls C-bias of 2d R.F. tube and aerial coil	Ten	79-006
81-82-14-21-31	Controls C-bias voltage of 3-227 tubes. Power switch	Eight	70-201
8-6-40	Potentiometer across 3rd R.F. secondary stage	Eight	72-105
8-20A	Potentiometer across first stage R.F. secondary	Ten	52-202
85-36	Potentiometer controls screen grid voltage	Eleven	62-108
820-A, 821-A	Potentiometer across secondary and feedback	Eight	24-200
7A, 7B, W81	Potentiometer controls antenna and C-bias	Ten	79-006
BROWNING DRAKE (NATIONAL RADIO CO.)			
34-36-38	Radiohm across aerial and ground	One	70-200
MB30	Potentiometer controls screen grid voltage	Eleven	72-103
69	Potentiometer controls screen grid voltage	Eleven	72-100
70-71	Potentiometer shunts audio secondary	Fourteen	72-105
BRUNSWICK BALKE-COLLENDER CO.			
3-KR8	Potentiometer in antenna circuit	Four	72-100
S-14, S-21, S-31, S-81, S-82	Potentiometer controls screen voltage. Switch type	Ten	52-202
3-5 NC 8	Potentiometer controls R.F. C-bias. Super Het	Four	72-101
2-5-KRO	Potentiometer in antenna circuit	Four	72-100
5-NO	Potentiometer controls, intermediate C-bias. Super Het	Four	72-101
14	Radiohm varies R.F. C-bias (Switch Type)	Eleven	62-102
3N-W8	Potentiometer across aerial and ground, automatic control tube	One	72-101
S-32 Cavac	Potentiometer antenna to ground controls grid	Six	72-101
15-22 R1	Potentiometer controls antenna and C-bias	Ten	79-006
BUCKINGHAM			
1928	Radiohm shunts R.F. primary	Two	72-100
CAVAC CORP. (CRESCENT)			
	Potentiometer controls antenna and C-bias	Ten	79-006
Year 1930	Potentiometer controls screen grid voltage	Eleven	62-103
Year 1929	Radiohm shunts tuned grid	Eight	70-201
	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
10 tube set	Radiohm varies R.F. C-bias	Twelve	70-202
950	Potentiometer shunts antenna primary	Four	72-100
C6, C7	Radiohm shunts tuned antenna circuit	Nine	70-201
	Potentiometer with switch controls screen voltage	Eleven	62-103
	Potentiometer controls aerial and cathode circuits (With Switch)	Ten	79-006
CLARION (TRANSFORMER CORP. OF AMERICA)			
Midget AC61	Potentiometer controls antenna and C-bias	Ten	79-006
60	Potentiometer controls screen grid voltage	Eleven	72-111
Midget 61	Potentiometer controls antenna and C-bias	Ten	72-012
CAMEO			
	Potentiometer controls antenna and C-bias	Ten	79-006
CANADIAN WESTINGHOUSE			
1928	Radiohm shunts R.F. primary	Two	70-204
70	Radiohm varies R.F. C-bias	Eleven	72-107
21	Potentiometer controls screen grid voltage	Eleven	72-110
23	Radiohm shunts tuned antenna circuit	Nine	72-105
80	Pad across aerial coil and pad control C-bias		
89, 90, 99	Radiohm varies R.F. C-bias	Twelve	70-202
110	Radiohm varies R.F. C-bias	Twelve	70-202
CLAGO RADIO			
4131, 5134, 8235, 9342	Radiohm varies R.F. C-bias	Twelve	72-108
CLEARTONE			
110	Twin control	Twelve & Fourteen	74-608
112	Potentiometer across detector secondary	Eight	72-106

Volume controls of many receivers may be replaced to best advantage with Centralab 70-200 shunted from antenna to ground regardless of the circuit location of the original control.

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
ATWATER KENT MFG. CO. Continued			
Battery 222 tubes	Potentiometer controls screen grid voltage to R.F. tubes	Eleven	72-104
37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 52, 53,			
56, 57,	Potentiometer across aerial and ground	Three	72-112
67	Potentiometer shunts audio secondary	Fourteen	72-104
	Potentiometer antenna to ground controls grid	Six	72-101
	Twin: * Potentiometer shunts antenna primary; * potentiometer controls screen grid voltage	Twenty-one	74-615
	Twin: Potentiometer controls screen grid. Potentiometer connected across pickup		74-616
H2	Radiohm across grid of 1st I.F. stage. Potentiometer controls screen grid voltage of R.F. stage	Eight & Eleven	73-609
70, 74, 75, 76,	Potentiometer shunts antenna primary		
72	Super Het radiohm control grid and grid, 1st R.F. and I.F.		
	Midget		
84, 12	Radiohm varies R.F. C-bias	Twelve	72-109
AUDIOLA RADIO CO.			
30-B, 7330	Potentiometer controls screen voltage	Eleven	72-103
51, 52, 72			
82	Potentiometer controls antenna and C-bias	Ten	79-006
AUTOMATIC ELECTRIC CO.			
Tom Thumb Model B	Potentiometer controlling C-bias	Thirteen	24-110
BALDWIN			
Hube	Potentiometer controls cathode voltage and antenna	Ten	79-006
BALKITE (HANSTEEL MFG. CO.)			
A3-A4-A5-A7	Potentiometer across B supply. Controls plate voltage of 3-227 tubes	Sixteen	72-108
Model F-C	Potentiometer in antenna circuit and C-bias control	Ten	79-006
Model C	Potentiometer controls C-bias and antenna	Ten	79-006
BELMONT			
	Potentiometer controls screen grid voltage	Eleven	72-103
BOSCH (AMERICAN-BOSCH MAGNETO CORP.)			
49	Potentiometer across antenna and ground	Four	72-100
54-48-56	Potentiometer controlling screen voltage and	Twenty-one	74-602
28-29	Potentiometer across antenna and ground	Seven	72-102
96	Radiohm across detector secondary	Eight	70-201
146-166-176-46-66-96-107-126-136	Radiohm across detector secondary	Eight	70-201
	Radiohm across aerial coupler	None	72-102
	Radiohm across first stage detector secondary	Eight	70-201
	Radiohm across detector secondary	Eight	72-106
58	Potentiometer across aerial and ground 226 tubes	Four	72-102
85 battery set	Rheostat in filament lead	Eighteen	47-006
48	Potentiometer across aerial and potentiometer controls screen grid voltage	Twenty-one	74-603
54 D.C.	Potentiometer controls aerial and cathode voltage	Ten	72-102
58	Potentiometer controls R.F. C-bias	Thirteen	72-108
60	Potentiometer shunts audio secondary	Fourteen	72-105
5A-58, 73A-73B	Potentiometer controls antenna and C-bias	Ten	79-006
BUSH & LANE			
10	Potentiometer controls R.F. plate voltage	Sixteen	72-103
12	Potentiometer controls screen voltage	Fifteen	72-103
BRANDES RADIO (See Kolster Radio. Models and controls are the same.)			

Volume controls of many receivers may be replaced to best advantage with Centralab 70-200 shunted from antenna to ground regardless of the circuit location of the original control.

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
COLONIAL RADIO CORP.			
26	Rheostat controls R.F. tubes. 5-201A tubes	Eighteen	47-003
S-C, 32	Controls C-bias voltage and aerial coil	Twenty	74-601
D.C. 31	Rheostat controls filament of R.F. tubes	Eighteen	47-020
COLUMBIA RADIO CORP.			
961-902-C-11	Potentiometer across aerial coil which is inductively coupled	Seven	72-102
C4-980-K24-C1-C3-C2	Radiohm across first R.F. secondary coil	Nine	70-201
S-C, 8	Potentiometer controls aerial and cathode circuits	Ten	79-006
C-4, C-6, C-7, SG-5, SG-7	Radiohm shunts tuned grid	Eight	70-201
SG-9, AC-950	Potentiometer shunts antenna primary	Three	72-100
COURIER RADIO (UNITED REPRODUCERS CORP.)			
653	Potentiometer Controls C-bias	Twelve	72-107
CROSLEY RADIO CORP.			
40S 41S 42S-43S 82S-Late Model	2 Potentiometers 15M in antenna circuit and 25M screen voltage Dual unit	Twenty one	72-102
60S 61S 62S D.C.	Potentiometer controlling screen voltage	Eleven	72-103
400-401-90-601 608-704-705	Rheostat controls filament voltage	Eighteen	47-006
706-609-610	Potentiometer across aerial coil	Three	72-100
Roamio	Radiohm controls detector plate		72-107
Chum & Buddy	Radiohm controls C-bias	Twelve	70-202
	Potentiometer controls screen grid voltage	Eleven	72-104
804 A.C.	Radiohm controls C-bias	Twelve	70-202
20-21-22	Radiohm controls C-bias	Twelve	70-202
30S 31S 34S 34S 602-41A and 42AC	Potentiometer controls screen voltage	Eleven	72-103
	Potentiometer across antenna and ground	Three	72-100
40S 41S	2 Potentiometers 15M in antenna circuit and 25M screen voltage Dual unit	Twenty-one	74-601
84	Potentiometer shunts audio secondary	Fourteen	72-105
53, 54, 57, 120	Potentiometer controls antenna and C-bias	Ten	79-006
71A	Spec. Control		70-503
20	Radiohm shunts tuned grid	Eight	70-201
22, 23	Potentiometer shunts antenna primary	Three	72-100
56-DC-57 400, 410, 420	Radiohm varies R.F. C-bias	Twelve	24-110
Midget			
Wigit 48	Potentiometer controls antenna and C-bias	Ten	79-006
Johnny Smoker			
Buddy Boy 54			
Super Buddy 122	Potentiometer controls antenna and C-bias	Ten	72-101
124	Potentiometer Controls C-bias and Antenna (Switch Type)	Ten	62-109
DAYFAN (GENERAL MOTORS RADIO CORP.)			
6 AC	Potentiometer controls R.F. plate and across 1st stage A.F. primary	Fourteen	72-111
22	Radiohm shunts tuned grid	Eight	70-200
5091-48	Radiohm across aerial and ground 226 tubes	One	70-200
8 A.C.	Potentiometer across aerial and ground 226 tubes	Four	72-102
Oem 74-54	Rheostat controls 3-201A R.F. and audio tubes	Eighteen	47-006
8 A.C.	Potentiometer across aerial coil. 226 tubes	Three	72-100
6-DC 12-DC-110-6 M. G.	Potentiometer controls plate voltage to 3-201A R.F. tubes	Sixteen	72-103
DAYTON RADIO CO.			
XL70, XL60, XL30	Radiohm varies R.F. plate voltage	Fifteen	70-203
XL50	Radiohm varies R.F. plate voltage	Fifteen	72-111
A.C. XL61	Radiohm varies R.F. plate	Fifteen	26-500
A.C. Dayton	Controls C-bias voltage to 3-227 tubes	Twelve	70-202
A.C.-63-65-66	Radiohm across R.F. secondary 226 tubes	Eight	72-101

CENTRAL RADIO LABORATORIES

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
DEFOREST CROSLEY RADIO CORP.			
DeForest 700	Potentiometer from A+ to A—		24-110
800-810	Potentiometer controls screen voltage to R.F. tubes	Eleven	72-103
780-800-810	Potentiometer in A.F. secondary circuit	Fourteen	72-105
605	Potentiometer controls screen voltage	Eleven	72-103
Tone Control	Connected in audio secondary circuit	Seventeen	41-010
DIAMOND COIL CO.	Potentiometer across detector R.F. secondary	Eight	72-012
Diamond of Air	Radiohm controls C-bias to 222 tubes	Twelve	70-202
EARL RADIO CORP.			
48S	Twin control	Twenty	74-601
31DC-24DC-33DC	Twin control	Nineteen	72-105
31-32-21-22-41	Twin control—2 controls	Twelve & Fourteen	25-416
315, 371	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
271	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	76-006
ECHOPHONE RADIO MFG. CO.			
S, S, E, F Midget	Radiohm varies R.F. C-bias	Twelve	79-006
S3, S4, S5	Potentiometer controls antenna and C-bias	Ten	79-006
THOS. A. EDISON, INC.			
R-122	Potentiometer used in first R.F. stage	Five	72-101
R-4, R-5	Potentiometer across antenna and ground and R.F. bias	Twenty	74-601
C-4	Potentiometer across antenna and ground and R.F. bias	Twenty	74-601
R-1, R-2			
Chassis, Jr., and Jr. 60 Cycles and 25 Cycles	Radiohm across primary of second R.F. stage (Spec.)	Two	24-008
C-1 Chassis Sc.	Radiohm across primary of second R.F. stage (Spec.)	Two	24-008
R4, R5 DC	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
R6, R7	Potentiometer shunts audio secondary	Fourteen	72-105
280	Radiohm shunts R.F. primary	Two	70-200
ELECTRICAL RESEARCH LABORATORIES (ERLA)			
R-1	Potentiometer across aerial and ground	Three	72-100
224-A.C.	Potentiometer controls screen voltage	Thirteen	72-110
	Potentiometer controls antenna and C-bias (Switch Type)	Eleven	62-101
R61, S61	Potentiometer controls screen grid voltage (Switch Type)	Eleven	62-111
271	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	76-006
	Potentiometer shunts audio secondary	Fourteen	51-105
	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	74-602
224	Potentiometer controls screen grid voltage	Eleven	72-111
EMERSON			
Emerson	Potentiometer controls antenna and C-bias	Ten	79-006
EVEREADY (NATIONAL CARBON CO.)			
All Series 50	Controls C-bias and grid of first R.F. Stage Secondary	Twenty	74-503
1, 2, and 3	Potentiometer across R.F. secondary	Eight	72-106
Series 30, 40	Potentiometer to control C-bias	Eleven	See P. 6
51	Radiohm controls cathode voltage	Twelve	70-202
FADA (F. A. D. ANDREA, INC.)			
16-17-32	Potentiometer control C-bias voltage to 2-227 tubes	Thirteen	72-111
18 D.C.	Potentiometer connected across aerial coil. Arm goes to ground	Four	74-601
S.F. 45/75 UA or CA	Radiohm across secondary of 2d R.F. transformer 227 tubes	Eight	70-20

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Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
GENERAL MOTORS RADIO CORP. (See Day Fan)			
120A	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-602
	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-602
	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-517
	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	74-514
All 1930	Twin potentiometer controls antenna and screen grid		74-602
	Tone control—Spec. Shaft Length		70-019
GILFILLAN RADIO CO.			
10	Potentiometer controlling C-bias to 4-227 tubes and aerial	Ten	79-006
100	Potentiometer across primary of first R.F. transformer	Five	72-100
60	Radiohm controls plate voltage to last stage R.F. tubes	Fifteen	70-203
	Potentiometer controls screen grid voltage	Eleven	72-102
44	Potentiometer controls screen grid voltage	Eleven	72-103
GRAYBAR			
311, 700, 770 900	Radiohm varies R.F. C-bias	Twelve	72-109
A. H. GREBE & CO., INC.			
SK-4, A.C. early and late models	Potentiometer controls C-bias. Radiohm across primary of last R.F. stage	Twenty-two	74-515
SK-4 D.C.	Radiohm controls grid bias	Twelve	70-202
MU-1	Rheostat controls filaments of 201A R.F. tubes	Eighteen	47-006
MU-2	Double resister in rheostat base and controls R.F. and audio tubes	Twenty-two	74-515
No. 5	Rheostat controls filament of R.F. tubes which are 201A	Eighteen	47-006
AC 7, 428 AC 6	Radiohm connected across primary of last R.F. stage	Two	70-200
GULBRANSEN (WELLS GARDNER & CO.)			
Model C 1929	Potentiometer across antenna and ground and Potentiometer controlling grid of first audio. Dual control	Twenty-two	74-509
1930	Twin Control. Controls aerial and screen grid	Twenty-one	74-603
HALLDARSON			
Halldarsen	Radiohm connected across aerial coil	One	70-200
HAMMARLUND MFG. CO.			
H-I-Q 30	Potentiometer controls screen voltage 3-224 tubes	Eleven	72-103
H-I-Q 29	Potentiometer across aerial and ground	Four	72-101
HIGH FREQUENCY LABORATORIES			
Mastertone	Potentiometer controlling screen voltage of 224 tubes	Eleven	72-103
H.F.L. Super	Potentiometer controls screen voltage to 3-222 tubes	Eleven	72-103
HOLMES JORDAN			
A.C.	Potentiometer controls C-bias voltage and antenna	Ten	79-006
Battery	R.F. plate circuit radiohm	Fifteen	70-203
HOLLISTER			
AC 8	Potentiometer controls screen voltage of intermediate stages	Eleven	72-103
A.C. 8	Potentiometer controls aerial input and cathode	Ten	79-006
HOWARD			
	Potentiometer controls screen grid voltage	Eleven	72-104
SGA	Twin radiohm controls C-bias voltage and potentiometer across aerial and ground	Twenty	74-601
35AC	Radiohm varies R.F. C-bias. (Ground Type.)	Twelve	70-202
	Twin Potentiometer shunts antenna primary; Potentiometer shunts audio secondary	Three & Fourteen	74-602
8	Radiohm shunts antenna to ground	One	72-101
	Radiohm varies R.F. C-bias	Twelve	72-113

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Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
FADA (F.A.D.) ANDREA, INC.)—Continued			
50-70-71-72	Radiohm across secondary of 2d R.F. transformer 227 tubes	Eight	70-201
75-77	Potentiometer controlling screen voltage of 3-224 tubes	Eleven	72-103
10-11-30-31	Radiohm across 2d R.F. secondary coil	Eight	70-201
22 D.C.	Rheostat in filament circuit	Eighteen	47-006
35 and 35Z	Potentiometer controlling screen grid voltage	Eleven	72-103
35B	Twin control	Twenty-one	74-602
	Potentiometer controls screen grid voltage	Eleven	72-111
41, 42, 44, 46, 47	Potentiometer shunts audio secondary	Fourteen	72-105
43	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-604
	Potentiometer controls antenna and C-bias	Ten	79-006
35C	Twin potentiometer across aerial and ground controls C-bias voltage	Twenty	72-111
20-20Z	Potentiometer controlling C-bias	Twelve	79-006
	Potentiometer across aerial and ground and potentiometer in C-bias circuit	Twenty	76-007
25-25Z	Potentiometer controls cathode voltage	Twelve	72-106
FEDERAL RADIO CORP.			
Type E 10	Potentiometer controls R.F. plate voltage (Switch Type)	Sixteen	20-053
Type M	Radiohm controls grid of second R.F. stage	Eight	70-201
Type L	Potentiometer varying C-bias voltage to 3-224 tubes and Potentiometer across detector secondary	Eight	74-514
Type D-BA	Potentiometer A— to B70+ controlling plate voltage to 2-201A tubes	Sixteen	24-064
Type H	Potentiometer controlling grid of volume control tube	Fourteen	72-105
E	Potentiometer controls plate voltage	Sixteen	70-203
FREED EISEMANN			
NR-70, NR-57	Potentiometer connected across aerial coupler	Four	72-100
NR 80 DC	Radiohm connected across aerial coupler	One	70-200
NR 95	Radiohm controlling C-bias to 4-227 tubes	Twelve	70-202
NR5-11-FE18-F-10, NR-7, NR-30, 32, 40, 48, 50	Rheostat to control filament	Eighteen	47-006
470	Radiohm shunts antenna to ground	One	70-200
90SAG-NR657, NR879	Potentiometer across first stage R.F. secondary and radiohm controls cathode voltage	Twenty	74-506
NR 60	Radiohm shunts tuned grid	Eight	70-201
CHAS. FRESHMAN CO.			
L-LS-G60S	Potentiometer across first stage audio secondary	Fourteen	51-105
Equaphase	Rheostat controls 2-201A R.F. tubes	Eighteen	47-006
H-M-K-K60S	Potentionmeter across first stage audio secondary	Fourteen	51-105
N-12, N-17, Q15-G-QD16	Radiohm across aerial and ground	One	51-200
	Potentiometer across first R.F. secondary and radiohm controls C-bias voltage	Twenty	74-505
31-32	Radiohm controls C-bias to 227 tubes	Twelve	70-202
21AC-22	Potentiometer across first R.F. secondary and potentiometer across last stage R.F. primary	Twelve & Fourteen	25-416
G	Radiohm shunts antenna to ground	One	70-204
GALVIN			
	Potentiometer controls antenna and C-bias (Switch Type)	Ten	62-102
	Radiohm varies R.F. C-bias	Twelve	70-202
	Potentiometer controls cathode voltage	Twelve	70-202
GAROD			
Garod E-A	Potentiometer across secondary of last A.F. transformer	Fourteen	72-105
GENERAL ELECTRIC			
H31, H51, H71	Radiohm varies R.F. C-bias	Twelve	72-109
T41	Twin: Potentiometer shunts antenna; Potentiometer controls screen grid	Twenty-one	74-525

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
JACKSON BELL			
62	Potentiometer controls antenna and C-bias	Ten	72-101
KELLOGG SWITCHBOARD & SUPPLY CO.			
533, 534, 535, 536	Potentiometer shunts antenna primary	Three	72-100
	Potentiometer controls R.F. C-bias	Thirteen	72-103
	Potentiometer controls screen grid voltage	Eleven	72-103
K24-25-27-28	Potentiometer B supply controls cathode voltage	Ten	79-006
523-526	Potentiometer across aerial and ground and automatic volume control tube	Four	72-104
523-526	Automatic volume control	Fourteen	72-105
KENNETH HARKNESS CO.			
Harkness AC 7	Potentiometer in aerial and grid circuit of first R.F. tube	Ten	79-006
Harkness AC 7	Potentiometer in audio circuit	Fourteen	72-105
COLIN B. KENNEDY CORP.			
Royal 80	Potentiometer across secondary of first audio transformer	Fourteen	72-105
Model 10	Potentiometer controls plate voltage to 3-227 R.F. tubes	Sixteen	76-008
Model 20, 20B	Potentiometer controls screen grid voltage	Eleven	76-008
220	Rheostat controls filament voltage	Eighteen	47-006
1930	Combination twin control	Twenty-one	76-008
30, 32	Potentiometer controls screen grid voltage	Eleven	72-111
42, 526, 826	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	74-602
826 Short wave	Potentiometer controls screen grid voltage	Eleven	72-100
826 Short wave	Radiohm used as tone control	Seventeen	72-103
KR15	Radiohm shunts antenna to ground	One	72-101
12 S.G.	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	76-008
KING ELECTRIC CO.			
53	Potentiometer controls antenna and C-bias	Ten	79-006
SGA	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
10 KI, 25, 71	Rheostat R.F. stages in filament circuit	Eighteen	47-006
E-80-81 FGH 218	Potentiometer across aerial and ground	Four	72-100
82	Radiohm across 2nd R.F. primary	Two	70-204
J & H, 1929	Radiohm across aerial coil	One	70-200
9798, Monarch	Potentiometer across aerial and controls C-bias	Ten	51-010
KOLSTER RADIO CORP.			
1928 K28-24-2-23-20-22-25-27	Radiohm connected across primary of last stage R.F. 226. Radiohm across primary of third R.F. tube—226 tubes	Two	70-200
15 and 16	Potentiometer across aerial coil	Seven	72-102
8-A	Rheostat controls R.F. filament	Eighteen	47-003
44-K 42-43-45 1929	Twin Potentiometer controls screen grid voltage and antenna	Twenty-one	76-006
1930 Models	Radiohm shunts tuned grid	Eight	70-201
40, 60, 7K	Radiohm shunts tuned grid	Eight	70-204
21	Radiohm varies R.F. plate voltage	Fifteen	70-203
1924-1925	Radiohm shunts antenna to ground	Two	72-100
6K-7			
LINCOLN ELECTRIC CO.			
Lincoln 8-80	Potentiometer controls screen voltage to 3-222 tubes	Eleven	72-103
Lincoln 40	Controls C-bias voltage to 2-224 tubes in intermediate	Twelve	70-202
LYRIC (MOHAWK RADIO LTD.)			
90	Potentiometer across antenna and ground to cathode. Single unit	Ten	79-006
D-L	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
H			70-201
280	Radiohm across detector secondary		
B94	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage		74-602

CENTRAL RADIO LABORATORIES

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
LYRIC (MOHAWK RADIO LTD.)—Continued			
Heterodyne	Potentiometer controls R.F. C-bias	Thirteen	72-101
Heterodyne	Tone control, Radiohm in series with condenser between 2 grids or grid to ground	Seventeen	72-106
714AC, 742AC	Radiohm varies R.F. C-bias	Twelve	72-108
712, 722, 39, 41	Potentiometer controls screen grid voltage	Eleven	72-111
MAGNAVOX COMPANY			
Magnavox	Rheostat controls filament voltage	Eighteen	47-003
MAJESTIC (CRICSBY GRUNOW CO.)			
60-70-70B-80	Potentiometer across fixed condenser in aerial circuit		72-100
181	Radiohm controls C-bias voltage of 3-227 and one unit across pick-up		74-618
90-91-92	Radiohm in C-bias circuit connects in series with equalizer controlling 3-227 tubes	Twelve	70-202
130	Potentiometer in divider circuit controls cathode voltage R.F. tubes	Twelve & Fourteen	72-107
100b	Radiohm in C-bias circuit and potentiometer across pick-up of secondary	Twelve & Fourteen	74-612
180-181-90-91-92	Equalizer on condenser shaft (Spec.)		78-007
100B	Radiohm varies R.F. C-bias and Equalizer	Twelve	74-612
50, 51, 52	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-603
30, 31, 131, 132, 233	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-537
90B	Radiohm varies R.F. C-bias	Twelve	70-202
60, 61, 62, 163	Potentiometer controls R.F. C-bias		72-107
Midget 20, 21, 22, 23	Radiohm varies R.F. C-bias (Switch Type)	Twelve	62-004
1930 Midget Super	Antenna potentiometer and C-bias	Twenty	74-603
MANAFORMER A.C. 29	Radiohm controls cathode voltage	Twelve	70-202
MASTER RADIO MFG. CO., LTD. 424 Midget	Potentiometer controls antenna C-bias	Ten	79-006
METRO	Radiohm across aerial and ground	One	70-200
McMILLAN 900	Radiohm across aerial coil choke	One	72-100
MONTGOMERY-WARD Screen Grid 2822, 2827, 3035, 3037, 3065, 3067	Potentiometer controlling C-bias and antenna	Ten	79-006
2895, 2897	Potentiometer controls antenna and C-bias	Ten	79-006
2955, 2957	Potentiometer controls R.F. C-bias	Thirteen	24-110
Battery set	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-606
NATIONAL TRANSFORMER MFG. CO. Mantel	Potentiometer controls antenna and C-bias	Ten	79-006
OZARKA RADIO CORP.	Radiohm across aerial and ground and C-bias potentiometer	Twenty	74-601
	Potentiometer controls screen grid voltage	Eleven	72-103
Lincoln Super	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
31	Radiohm varies R.F. C-bias	Twelve	74-202
DC8	Potentiometer controls screen grid voltage	Eleven	72-103

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Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
RCA (RADIO CORP. OF AMERICA)—Continued			
80, 82, 86	Radiohm varies R.F. C-bias	Twelve	72-109
42, 48	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	74-524
14	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	74-601
Midget	Radiohm varies R.F. C-bias	Twelve	72-109
16-20-25-28-30-32 Radiola 17-18-33	Rheostat controls filament voltage	Eighteen	47-003
Radiola	Potentiometer across aerial circuit	Six	72-101
41 Radiola	Potentiometer across aerial and ground	Four	72-100
50-51 Radiola	Potentiometer controls aerial circuit	Four	72-100
60-62 Radiola	Potentiometer controls C-bias of two intermediate stages	Thirteen	72-000
64 Radiola	Automatic control tube Potentiometer across aerial and ground	Four	72-100
66 Radiola	Radiohm controls C-bias voltage of 3-227 tubes	Twelve	70-202
RADIO NEWS ELCO BATTERY SET Elco	Potentiometer controls screen voltage of 3-224 tubes	Eleven	72-104
REMLER MFG. CO. 111	Controls screen voltage of 3-224 tubes	Eleven	72-103
SCOTT SUPER Scott Super AC10	Rheostat controls 3-222 filament circuits	Eighteen	47-003
	Radiohm varies R.F. C-bias	Twelve	70-202
SEARS-ROEBUCK 55, Silvertone 100	Potentiometer controls antenna and C-bias	Ten	51-010
FG, H, J, F, G	Radiohm shunts antenna to ground	One	30-200
Screen Grid	Potentiometer controlling C-bias and antenna	Ten	51-010
SENTINEL (UNITED AIR CLEANERS)	Radiohm shunts antenna to ground	Sixteen	72-100
29-30	Potentiometer controlling R.F. C-bias and antenna	Ten	79-006
11, 10, 12, 15, 16, 8, 9, 440, 600, 104, 666C, 106	Potentiometer controls antenna and C-bias	Ten	79-006
Portrola 3	Potentiometer across antenna and C-bias (Switch Type) (Spec.)		44-059
Midget 108	Radiohm varies R.F. C-bias	Twelve	72-113
SILVER-MARSHALL CO. 34A, 35, 36A	Potentiometer controls R.F. C-bias	Thirteen	72-108
710 Sargent	Potentiometer controls screen grid voltage	Eleven	72-103
Rayment Seven S M-690	Potentiometer across secondary of input transformer	Fourteen	72-105
Theater Amp. S M-740 and 740 A.C. Coast to Coast S-M-730	Potentiometer controls C-bias	Thirteen	24-110
Around the world 4	Radiohm in cathode circuit	Twelve	70-202
S-M-9 tube set	Potentiometer controls screen voltage of 3-222 tubes	Thirteen	72-108
30	Potentiometer controls screen voltage of 3-224 tubes	Thirteen	72-108
SONORA MFG. CO. A-30, A-32	Radiohm across primary of third R.F. transformer	Two	70-200
B-31	Potentiometer to vary screen voltage	Eleven	72-108
A-36, A-44	Radiohm across primary of fourth R.F.	Two	70-200
A-40	Radiohm across primary of third R.F.	Two	70-200

Volume controls of many receivers may be replaced to best advantage with Centralab 70-200 shunted from antenna to ground regardless of the circuit location of the original control.

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
PEERLESS (UNITED PRODUCERS) Peerless Electrostatic 65	Potentiometer shunted across first audio stage	Fourteen	72-105
K-70	Radiohm in cathode circuit controls C-bias	Twelve	70-202
	Potentiometer across aerial coil and controls cathodes	Ten	79-006
PHILCO No. 40	Potentiometer controls R.F. C-bias	Thirteen	24-110
41, 220A	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Fourteen	74-603
20, 20A, 220	Potentiometer across aerial coil	Nine	72-106
1, 2, 3	Radiohm shunts tuned antenna circuit	Three	72-400
82, 83	Potentiometer shunts antenna primary	Twelve	72-406
3 Transitone	Radiohm varies R.F. C-bias		
92, 95, 99A, 95E, 96E, 96 296, 296A, 111, 211, 11A, No. 3, 30, Superheterodyne Midget	Potentiometer shunts audio secondary	Fourteen	72-105
Baby Grand	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-603
82-83-86-87	Potentiometer connected across aerial coil	Four	72-100
Series 5	Radiohm across aerial and ground	One	70-200
65	Potentiometer controls screen voltage of R.F. tubes 224	Eleven	72-103
95-96-96A	Potentiometer controls grid of first A.F. and automatic control tube	Fourteen	72-105
296-296A	Potentiometer to vary grid bias	Thirteen	24-110
Philco 76	Twin control	Twenty	74-602
41-77-77A	Potentiometer across aerial coil	Four	72-100
511-512-513-514-515-531-551-571			
PHONIX RADIO Midget 31, 32	Potentiometer controls antenna and C-bias (Switch Type)	Ten	62-102
PIERCE-AIRO (UNITED SCIENTIFIC) 724, 727	Potentiometer controls antenna and C-bias	Ten	79-006
732 DC	Potentiometer shunts antenna primary	Three	72-100
624, 747	Radiohm varies R.F. C-bias	Twelve	72-110
PATTERSON	Radiohm across aerial and ground	One	70-200
PILOT ELECTRIC CO. P.E. 6	Potentiometer controls screen grid voltage	Eleven	72-103
Pilot 5	Radiohm controls 2-201A tubes plate voltage	Fifteen	70-203
POWRAD Powrad	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twenty	74-601
	Potentiometer controls screen voltage	Eleven	72-103
RADIETTE F14	Potentiometer controls antenna and C-bias	Ten	72-100
RADIO FINANCE	Potentiometer controls antenna and C-bias	Ten	79-006
R. C. A. (RADIO CORP. OF AMERICA) Victor 60	Potentiometer controls R.F. C-bias	Thirteen	24-110
15, WR4	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	74-526
Radio Royal 21, 22, B2	Potentiometer controls screen grid voltage	Eleven	72-103
Radiola RE17, RE57, R35, R39, RE34	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Twelve	74-524

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
SPARKS WITHINGTON CO. (SPARTON) 49B-39 931, 301	Radiohm in R.F. plate circuit	Fifteen	70-203
D.C., 301 AC. A.C. 89 and 89A, 930, 109-235	Radiohm controls C-bias voltage	Twelve	70-202
AC62-63-7 Kellogg tubes	Radiohm in C-bias circuit	Twelve	70-202
SPARTON 589 or 589	Radiohm varies R.F. C-bias	Twelve	72-110
	Radiohm varies R.F. C-bias	Twelve	72-113
31, 55, 101, 103, 110, AR19	Radiohm controls screen voltage of R.F.	Thirteen	70-203
235, 235DC	Potentiometer controls screen grid	Thirteen	72-103
111, 111A, 564, 570, 574, 589, 591, 593, 600, 610, 620, 600DC, 620DC, 737, 740, 750, 740DC, 750DC, 870	Radiohm controls C-bias	Twelve	70-202
SPLITDORF RADIO CORP. P.A.D. No. 4 M5	Potentiometer shunts R.F. primary	Two	24-008
		Shaft 2¾, Bush ½	
C1	Potentiometer across detector tuned stage	Eight	70-201
R4-R5-C4	Radiohm controls C-bias voltage of 2-227 tubes and aerial circuit. (Dual unit.)	Twenty	74-601
ES-62	Radiohm used in second and first R.F. stages	Two	24-008
STEIN RADIO	Potentiometer controls antenna and C-bias	Ten	79-006
STEINITE MFG. CO. Superheterodyne 40	Potentiometer controls antenna and C-bias		51-012
	Potentiometer controls R.F. C-bias	Thirteen	24-110
261	Radiohm across primary of second R.F. tube	Two	70-200
40-50-102	Radiohm controls C-bias to 3-227 tubes	Twelve	70-202
X927AC990	Rheostat in series with filaments of 199 tubes	Eighteen	47-125
991-992-993	Radiohm controls plate voltage to R.F. tubes	Fifteen	70-203
STERLING 3A-4	Potentiometer controls screen voltage	Eleven	72-103
A2	Potentiometer controls aerial input and cathode voltage	Ten	79-006
Model F	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	74-602
STEWART WARNER CORP. R100 DC	Potentiometer controls screen grid voltage	Eleven	51-102
970, 980	Twin: Potentiometer shunts antenna primary; potentiometer controls screen grid voltage	Twenty-one	74-616
110 series	Potentiometer across aerial coil and controls screen voltage	One-Thirteen	28-031
300 to 500	Rheostat used in filament circuit	Eighteen	47-006
500-520-525	Radiohm in plate circuit of 3-201A tubes	Fifteen	70-203
530-535	Radiohm in L and C circuit of second R.F. tube 226 tube	Eight	70-201
700-705-710	Radiohm in plate circuit of 3-201A tubes	Fifteen	28-031
715-720	Radiohm across aerial coil 226 tube	One	70-200
750	Potentiometer controls L and C circuit of second R.F. and platefeedback circuit of next R.F. tube. Single unit	Requires control of smaller size than standard replacement unit.	

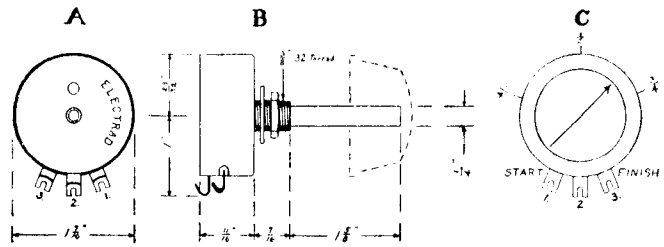
CENTRAL RADIO LABORATORIES

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
STEWART WARNER CORP.—Continued			
801-802	Potentiometer controls L and C circuit of 2d R.F. and aerial coil 226 tube. Single unit	One	72-100
806	Radiohm controls plate voltage to 3-201A tubes	Fifteen	70-203
811	Radiohm controls R.F. C-bias	Twelve	70-202
900 Series	Radiohm controls C-bias to 3-227 tubes	Twelve	70-202
950 Series	Potentiometer controlling screen voltage of 3-224 tubes and series aerial resistance in one unit. Single unit		28-031
305-315-320	Potentiometer across A Battery controls C-bias to 2-201A tubes in R.F. circuit		24-110
300-310-325	Potentiometer across aerial coil controlling C-bias to 2-224 tubes	Ten	79-006
363	Radiohm across antenna and ground	One	70-200
STROMBERG-CARLSON CO.			
501-502	Rheostat controls 2 R.F. 201A filament circuits	Eighteen	47-006
1A-1B-501-502-523-524DC-	Potentiometer across aerial coil and radiohm across primary of last R.F. stage. 2 single controls	Four/Two	72-100
635-636-638			
641-652-634	Potentiometer across inductive coupled aerial coil and Potentiometer controlling C-bias voltage to 2-224 tubes. Dual unit	Twenty	74-001
10-11	Potentiometer in grid circuit of R.F. tubes	Twelve	72-107
523, 524DC	Potentiometer controls plate voltage	Sixteen	72-104
12, 14	Potentiometer shunts audio secondary	Fourteen	72-105
L41A	Potentiometer shunts antenna primary	Three	72-102
846-642	Potentiometer across antenna and ground	Four	72-100
Automatic volume control	Potentiometer across audio secondary	Fourteen	72-105
TEMPLE CORP.			
8-60, 8-80, 8-90	Radiohm across antenna and ground	One	70-200
8-61, 8-91	Potentiometer across aerial coil and potentiometer across		
8-81	first stage audio secondary	Twenty-two	74-515
Battery set	Potentiometer shunts audio secondary	Fourteen	72-105
THOMAS ENGINEERING	Potentiometer controls screen grid voltage	Eleven	72-100
TRAVELER			
C, OX, K	Potentiometer controls antenna and C-bias	Ten	79-006
	Potentiometer controls screen grid voltage	Eleven	72-104
	Potentiometer controls screen grid voltage	Eleven	72-103
TYRMAN RADIO CO.			
Tyrman 60	Rheostat controls filament voltage to 2-222 intermediate tubes	Eighteen	47-006
Tyrman 72-80	Radiohm controls C-bias to 2-227 intermediate tubes	Twelve	70-202
UNITED STATES RADIO & TELEVISION CO.			
Apex 36	Radiohm across aerial and ground	One	70-200
Panatrope 1929 Midget	Potentiometer shunts antenna primary	Two	72-100
27, 32	Potentiometer controls antenna and C-bias	Ten	81-010
UNITED STATES ELECTRIC CORP.			
Workrite 6-8	Rheostat controls second R.F. 201A tubes	Eighteen	70-201
VICTOREEN RADIO CO.			
Victoreen Super	Potentiometer controls C-bias to 3-201A tubes in intermediate stages	Twelve	24-111
Victoreen A.C.	Radiohm controls C-bias to 3-227 intermediate tubes	Twelve	70-202

Volume controls of many receivers may be replaced to best advantage with Centralab 70-200 shunted from antenna to ground regardless of the circuit location of the original control.

Model No.	Volume Control Circuit	Circuit No.	Replacement Control No.
VICTOR RCA CORP.			
1929 & 1930: R 32, R 52, RE 45, RE 75, RE 154	Resistor across aerial coil and losser coil in second stage R.F. transformer	Nineteen	74-600
1930: Screen grid battery set	Potentiometer controls screen voltage	Eleven	72-103
Four Circuit—R15, R17	Twin, controlling screen grid and antenna	Twenty-one	74-526
Five Circuit—R35, R39, RE57	Twin, controlling C-bias and antenna	Twenty	74-524
WALBERT			
27	Plate Circuit Radiohm	Fifteen	70-203
WARE			
T	Rheostat controls filament	Eighteen	47-006
WELLS GARDNER			
1929-30	Potentiometer controls C-bias and shunts antenna	Ten	79-006
1929	Twin radiohm controls cathode voltage and radiohm aerial and ground	Twenty	74-601
1928-29 type, 226 tubes	Radiohm shunts antenna to ground	One	70-204
80A	Radiohm varies R.F. C-bias (Switch Type)	Twelve	52-205
80	Potentiometer controls antenna and C-bias	Ten	79-006
WESTINGHOUSE			
WR5-WR6			
WR7	Radiohm varies R.F. C-bias	Twelve	72-109
WR4	Twin: Potentiometer shunts antenna primary; Potentiometer controls screen grid voltage	Twenty-one	74-526
WURLITZER			
1929-7 tube	Potentiometer across aerial and ground and controls C-bias	Ten	79-006
ZANEY-GILL			
54, Queen Anne, Music Box	Twin: Potentiometer shunts antenna primary; Radiohm controls C-bias	Two & Twelve	70-200
ZENITH RADIO CO.			
52, 53, 54	Potentiometer controls screen grid voltage	Eleven	72-103
41, 42, 412, 422	Potentiometer across aerial and grid		
	Potentiometer controls R.F. Plate voltage	Twenty-three	74-602
50, 60	Potentiometer controls screen grid voltage (Switch Type)	Eleven	62-104
42, 41, 11E, 14E, 70	Potentiometer shunts antenna primary	Three	72-101
	Potentiometer shunts antenna primary (Switch Type)	Four	73-614
10, 11, 12, 17, 33, 362, 342, 352, 352A, 392			
392A	Potentiometer controls plate voltage	Sixteen	72-104
35-36-37A-39-39A-40A-31-32-33-34-362	Potentiometer controls plate voltage	Sixteen	72-104
1929	Twin control shunting antenna and R.F. primary. Specify if wanted with A.C. switch	Nineteen	74-600
All 1930	Tone control	Seventeen	41-009

ELECTRAD INC.



THE above sketches show dimensions of Electrad Replacement Volume Controls. View "A" shows the back view and location of terminals, the numbers of which are referred to in diagrams and tables which follow. View "B" shows depth of unit and lengths of shafts and bushing. The shaft is made long enough for most cases. When a shorter shaft is needed it can be cut to proper length. View "C" shows the knob end and location of terminals after mounting the unit on set.

In order to make each type control as universally applicable as possible, all types are potentiometers except where an off position is desirable as in RI-204. Where a rheostat type is needed only two of the terminals are used. The proper terminals are indicated in circuits. When connecting in receiver, reference should be made to above drawings.

View "C" also indicates quarter positions knob rotation. These positions are used to determine the type of taper of the resistance. When a volume control is used in a series circuit such as Nos. 8 and 9, it has a regular or right-hand taper. This means that the resistance of the first quarter-section is higher than that of the second quarter-section, etc. When control is used in a shunt circuit such as Nos. 2 and 3, it has a reverse or left-hand taper. That is, the first quarter-section has lower resistance than the second quarter-section, etc. When resistance of all sections is equal, the taper is linear or uniform.

All RI and FB type replacement controls have insulated bushings. There is no connection between terminal No. 2 and bushing or shaft. No insulating washers are needed when mounting the unit on metal panel. In circuits Nos. 3, 5, 7 and 8 a connection must be made externally between terminal No. 2 and chassis or ground.

In many receivers the volume control is not smooth, or appears to be defective even when replaced by new control. This may be due to the set having gain which cannot be practically controlled by a single unit, or the fact that at certain volume control positions tube distortion, cross-talk or oscillation occurs. This can be corrected by the addition of a switch and fixed wire resistance as shown in circuit No. 19. The resistor should be a Truvolt Wire Grid Resistor with a nominal value of 50 ohms. *In cases of extremely high gain a 25 ohm resistor should be used.* The switch is then used as a local-distance switch, closed for local and open for distance. A much more convenient method of doing this, however, is to use an RI type resistor with switch attached.

Figure No. 1 shows appearance of RI type volume controls *without* switch. Figure No. 2 shows the same control *with* switch. The switch is so arranged that when the knob is turned completely to the right (*full clockwise position*) the switch opens and stays open until knob is turned completely to the left (*full counter-clockwise position*) when switch will close. This feature makes these units ideally suited for combination local and distance switch and volume control. A representative diagram is shown in circuit No. 20. Circuit No. 19, however, can be used in combination with any one of circuits Nos. 1 to 15 inclusive.

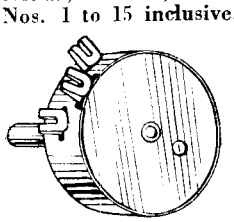


FIG. 1

If it is desired to use the switch as a line switch the locknut on switch should be loosened and switch turned one-half turn in counter clockwise direction which will reverse the operation of the switch. That is, the switch will connect the current to the set when turned fully clockwise and disconnect when turned fully counter-clockwise.

Circuit No. 18 shows use of rheostat and condenser for tone control. RI-206 can be used for replacement in this circuit or can be used to add tone control to any receiver. Circuit shows connections for push-pull audio. Where a single power tube is used, terminal No. 2 should be connected to ground. R207P has the condenser enclosed in unit and is supplied with leads that can be connected to the two grids of push-pull output or to grid and ground of single tube output. R207P is furnished with insulating washers which must be used when mounted on metal panel or chassis.

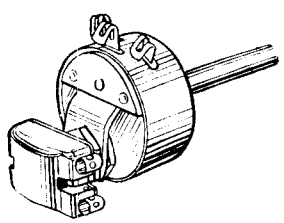


FIG. 2

VOLUME CONTROL	HOW USED	CIRCUIT NUMBER
RI-201 15,000 ohm reverse potentiometer	Antenna Potentiometer—center arm to coil	1
	RF Primary shunt	2
	Antenna and ground rheostat shunt	3
	Untuned Antenna potentiometer — 2000 ohm grid resistor must be connected between terminals No. 1 and No. 3	4
	Antenna Potentiometer—center terminal to ground	5
	RF Primary Potentiometer—center terminal to plate	6
	Antenna Cathode Potentiometer	7
RI-201S	With Switch.	
RI-202 75,000 ohm regular potentiometer	Cathode series resistor	8
	RF Plate Voltage series resistor	9
RI-202S	With Switch.	
RI-203 500,000 ohm reverse potentiometer	RF Secondary shunt	10
	RF Secondary potentiometer — center arm to grid	11
	AF Secondary potentiometer — center arm to grid	12
	AF Secondary shunt	13
RI-203S	With switch.	
RI-204 10 ohm regular rheostat	Filament rheostat	14
RI-205 50,000 ohm Uniform Potentiometer	Screen Grid Potentiometer	15
RI-205S	With switch.	
FB-478-T	Antenna potentiometer and Cathode series resistor	16
FB-479-T	Antenna potentiometer and screen grid potentiometer	17
RI-206	Tone Control rheostat (condenser not supplied)	18
RI-206S	With Switch	18-19
R-207P	Tone Control unit (rheostat and condenser with leads)	18

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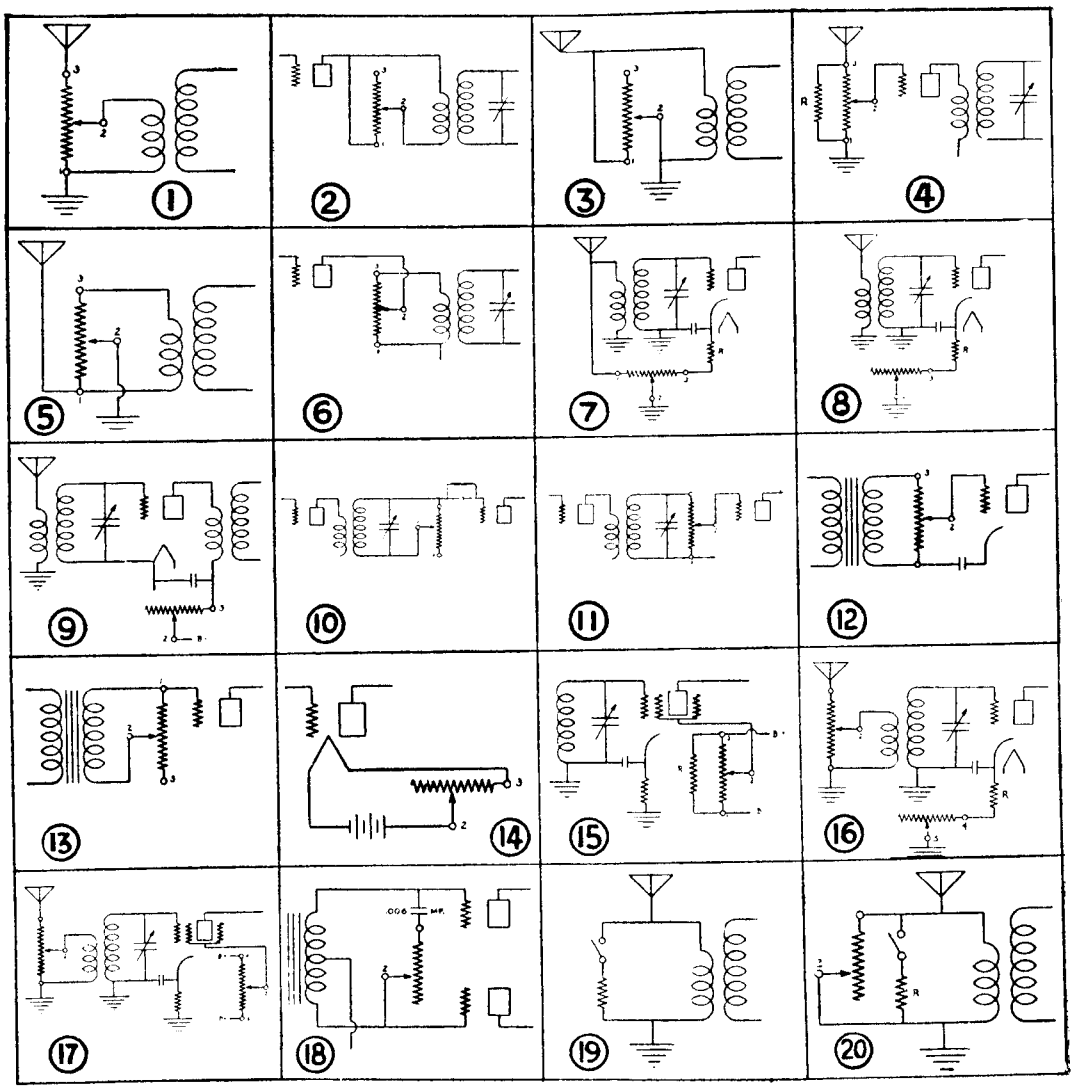
BASIC CIRCUITS For Which Electrad Replacement Volume Controls Are Designed



TYPE NO.	Number of Receivers Listed Using This Control
RI-201	133
RI-202	60
RI-203	67
RI-204	52
RI-205	31
TOTAL	343

ELECTRAD INC.

ELECTRAD VOLUME CONTROLS ARE AVAILABLE FOR THE FOLLOWING RECEIVERS

(Important Note—All controls listed below must be used only in circuit indicated)

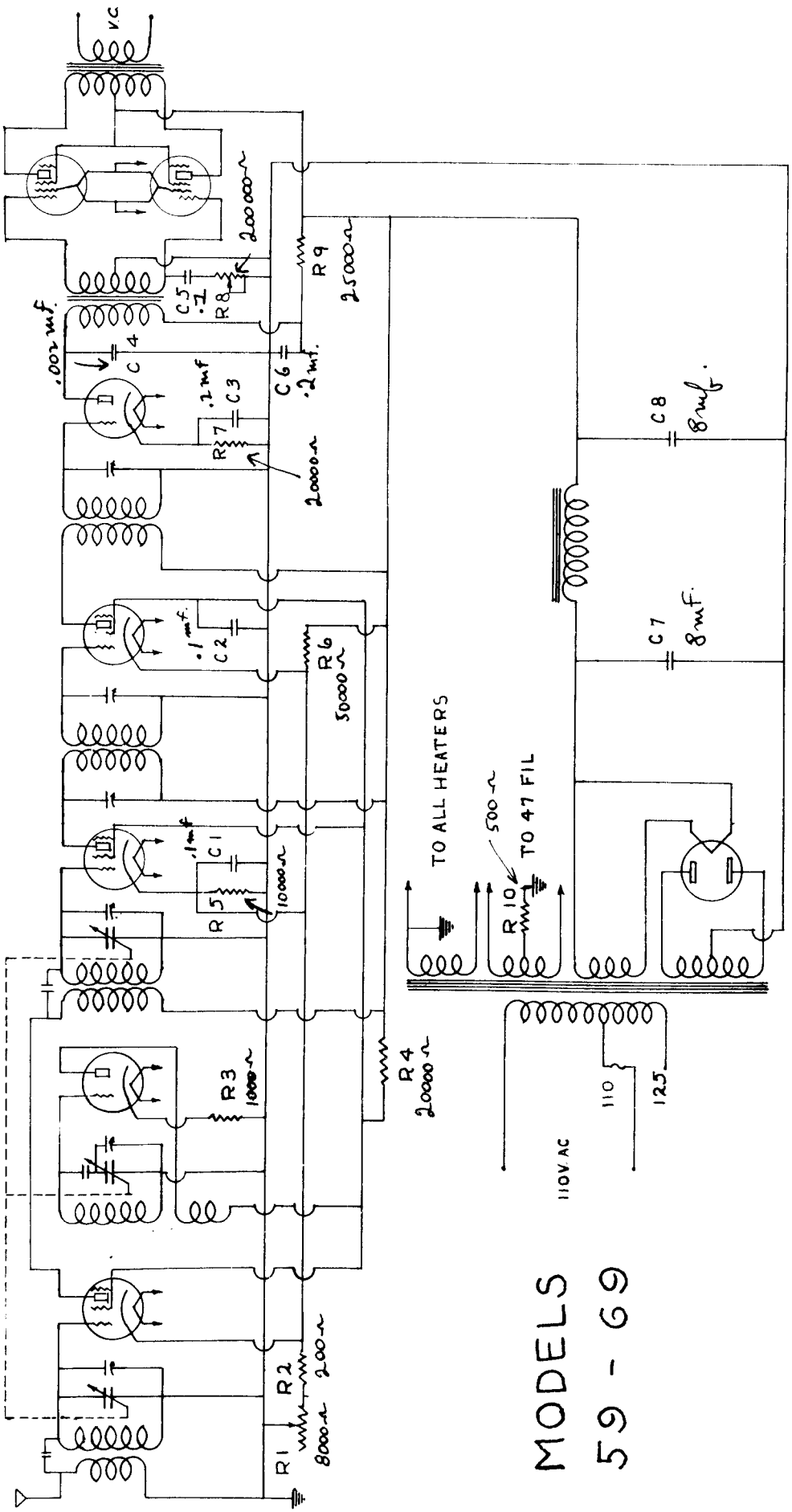
RECEIVERS	MODEL NO.	CIRCUIT NO.	VOLUME CONTROL TYPE NO.
Acme Mfg. Co.	AC 7	12	RI-203
	88	15	★RI-205
Aero Coil Co.	Unit 6, Short Wave	14	RI-204
Aero Prod. Co.	Aero 5	9	RI-202
	Aero 4, 6, 7, Short Wave	14	RI-204
All-Amer. Mohawk	96, 90	7	RI-201
	60, 61, 62, 65, 66, 80, 83, 84, 85, 86, 88	10	RI-203
Amrad	70, 7100	1	RI-201
	81	15	RI-205
Apex	36	7	RI-201
	80	3	RI-201
	Battery Models	9	RI-202
Arborphone	45	2	RI-201
Atwater Kent	37, 38	3	RI-201
	36	2	RI-201
	40, 42, 44, 52	5	RI-201
	33 series filament	12	RI-203
	12, 20, 30, 32, 33, 35, 48, 49, 50	14	RI-204
	61, 61C, 66, Battery 222 Tubes	15	RI-205
Audiola	30B, 7330	15	RI-205
Baldwin		7	RI-201
Balkite	FC, C	7	RI-201
Belmont	Belmont	15	RI-205
Bosch	49	5	RI-201
	28, 29	1	RI-201
	54 DC	7	RI-201
	46, 66, 96, 107, 116, 126, 136, 146, 166	10	RI-203
	35 Battery Set	14	RI-204
	48	15	★RI-205
Bremer-Tully	7-70, 7-71	7	RI-201
	4, 6, 8, 8-20A	11	RI-203
	14, 21, 31, 81, 82	8	RI-202
Browning-Drake	34, 36, 38	3	RI-201
Brunswick	3, KR8, 2, 5, KRO	5	RI-201
Bush & Lane	12	15	★RI-205
Cavac		7	RI-201
Cleartone	112	11	RI-203
Colonial	26, DC31	14	RI-204
Columbia	961, 902, C-11	1	RI-201
	SG8	7	RI-201
Crosley	42AC, 706, 609, 610	1	RI-201
	804AC, 20, 21, 22, Chum, Buddy	8	RI-202
	3R3, 90, 401, 601	14	RI-204
	30S, 31S, 33S, 34S	15	RI-205
Dayfan	5091-48	3	RI-201
	8AC early models	5	RI-201
	8AC late models	1	RI-201
	OEM54, 74	14	RI-204
A. C. Dayton	XL61	9	RI-202
	AC-63, 65, 66	10	RI-203
DeForest-Crosley	605	11	RI-203
	800, 810	12	RI-203
Diamond Coil	Diamond	8	RI-202
Edison	R-122	6	RI-201
	R-1, R-2, C-1, C-2	2	RI-201
Elect. Res. Lab.	R-1	1	RI-201
Eveready	31	8	RI-202
Fada	18DC	5	RI-201
	SF 4575 UA or CA, 10, 11, 30, 31, 50, 70, 71, 72	10	RI-203
Federal Radio	Type M	10	RI-203
	Type H, Type L	11	RI-203
Freed-Eisemann	NR57, NR70	5	RI-201
	NR80, DC470	3	RI-201
	NR95	8	RI-202
	F-10, NR7, 30, 32, 40, 48, 50	14	RI-204
Chas. Freshman	N-12, N-17	3	RI-201
	L, LS, G60S, H, M, K, K60S	12	RI-203
	Equaphase	14	RI-204
Garod	E-A	12	RI-203
Gilfillan	10	7	RI-201
	100	6	RI-201
A. H. Grebe	AC-7, 428, AC-6	2	RI-201
	SK-4DC	8	RI-202
	Syncrophone, MU1, No. 5	14	RI-204
Halldarson		3	RI-201
Hammarlund	HiQ-29	5	RI-201
	HiQ-30	15	RI-205
Kenneth Harkness	AC-7 Control A	12	RI-203
	AC-7 Control B	7	RI-201
High Frequency	Mastertone, HFL Super	15	RI-205
Hollister	AC 8 Control A	15	RI-205
	AC 8 Control B	7	RI-201
Holmes Jordan	AC	7	RI-201
Howard		15	RI-205
Kellogg	K-24, 25, 27, 28	7	RI-201
	523, 526 Control A	5	RI-201
	523, 526 Control B	12	RI-203

RECEIVERS	MODEL NO.	CIRCUIT NO.	VOLUME CONTROL TYPE NO.
Colin B. Kennedy	Royal 80	12	RI-203
	220	14	RI-204
	20	15	RI-205
King Elec. Co.	E-80, 81, FGH	5	RI-201
	82	2	RI-201
	J & H	3	RI-201
	9798, Monarch	7	RI-201
	10K-1, 25, 71	14	RI-204
Kolster	K-20, 22, 23, 24, 25, 27, 28	1	RI-201
	8A	14	RI-204
Lincoln Elec.	Lincoln 40	8	RI-202
	8-80	15	RI-205
Lyric	90	7	RI-201
Magnavox	Magnavox	14	RI-204
Majestic	90, 91, 92, 100B	8	RI-202
McMillan	900	3	RI-201
Metro		3	RI-201
Montgomery Ward	Screen Grid	7	RI-201
Ozarka		15	RI-205
Peerless Courier	K-70	7	RI-201
	65	8	RI-202
	Peerless	12	RI-203
Patterson		3	RI-201
Philco	82, 86, 87, 511, 512, 513, 514, 515, 531, 551, 571	5	RI-201
	Series 5	3	RI-201
	296, 296A	12	RI-203
	65	15	RI-205
Pilot	Pilot 5	9	RI-202
	PE-6	15	RI-205
Powrad		15	RI-205
RCA	17, 18, 33	4	RI-201
	41, 50, 51, 64	5	RI-201
	16, 20, 25, 28, 30, 32	14	RI-204
	44, 46, 47	15	★RI-205
	66 Radiola	8	RI-202
Radio News Elco	Elco	15	RI-205
Remler Mfg. Co.	111	15	RI-205
Scott Super	Scott Super	14	RI-204
Sears, Roebuck	Screen Grid	7	RI-201
Silver-Marshall	Around World 4	8	RI-202
	SM 690	12	RI-203
Sonora	A-30, A-32, A-36, A-40, A-44	2	RI-201
Sparks-Withington	198, 39, 931, 301	9	RI-202
	390, 110, 109, 89, 89A	8	RI-202
Splitdorf	ES 62	2	RI-201
	CI	11	RI-203
Steinite	261	2	RI-201
	40, 50, 102	8	RI-202
	991, 992, 993	9	RI-202
Stewart-Warner	715, 720	3	RI-201
	500, 520, 525, 700, 705, 710, 806	9	RI-202
	811, 900	8	RI-202
	530, 535	10	RI-203
	300 to 500	14	RI-204
Sterling	A2	7	RI-201
Stromberg-Carlson	300, 310, 325	7	RI-201
	363	3	RI-201
	846, 642	5	RI-201
	Automatic Volume Control	12	RI-203
	501, 502	14	RI-204
Temple	860, 880, 890	3	RI-201
Tyrman Radio	Tyrman 72-80	8	RI-202
	60	14	RI-204
Victor-RCA	R-52	7	RI-201
Victoreen	AC	8	RI-202
Walbert	27	9	RI-202
Ware	T	14	RI-204
Wells-Gardner	1929-30	7	RI-201
	1928	3	RI-201
Wurlitzer	1929 Seven Tube	7	RI-201

★ Value of R of Circuit No. 15

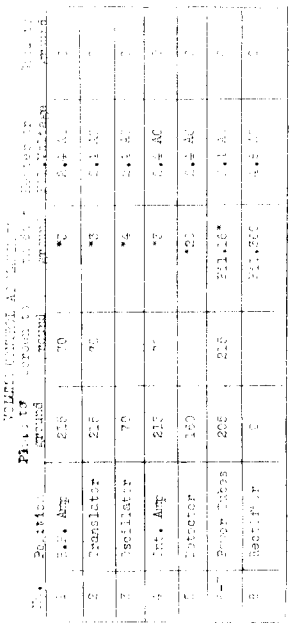
Acme	Model 88	5000 ohms
Bosch	Model 48	5000 ohms
Bush & Lane	Model 12	10000 ohms
RCA	Models 44, 46, 47	3000 ohms

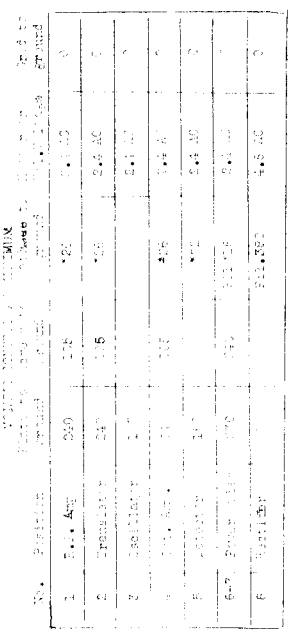
HORN RADIO CO.



MODELS
59 - 69

VOLTAGE READINGS AT TUBE SOCKETS





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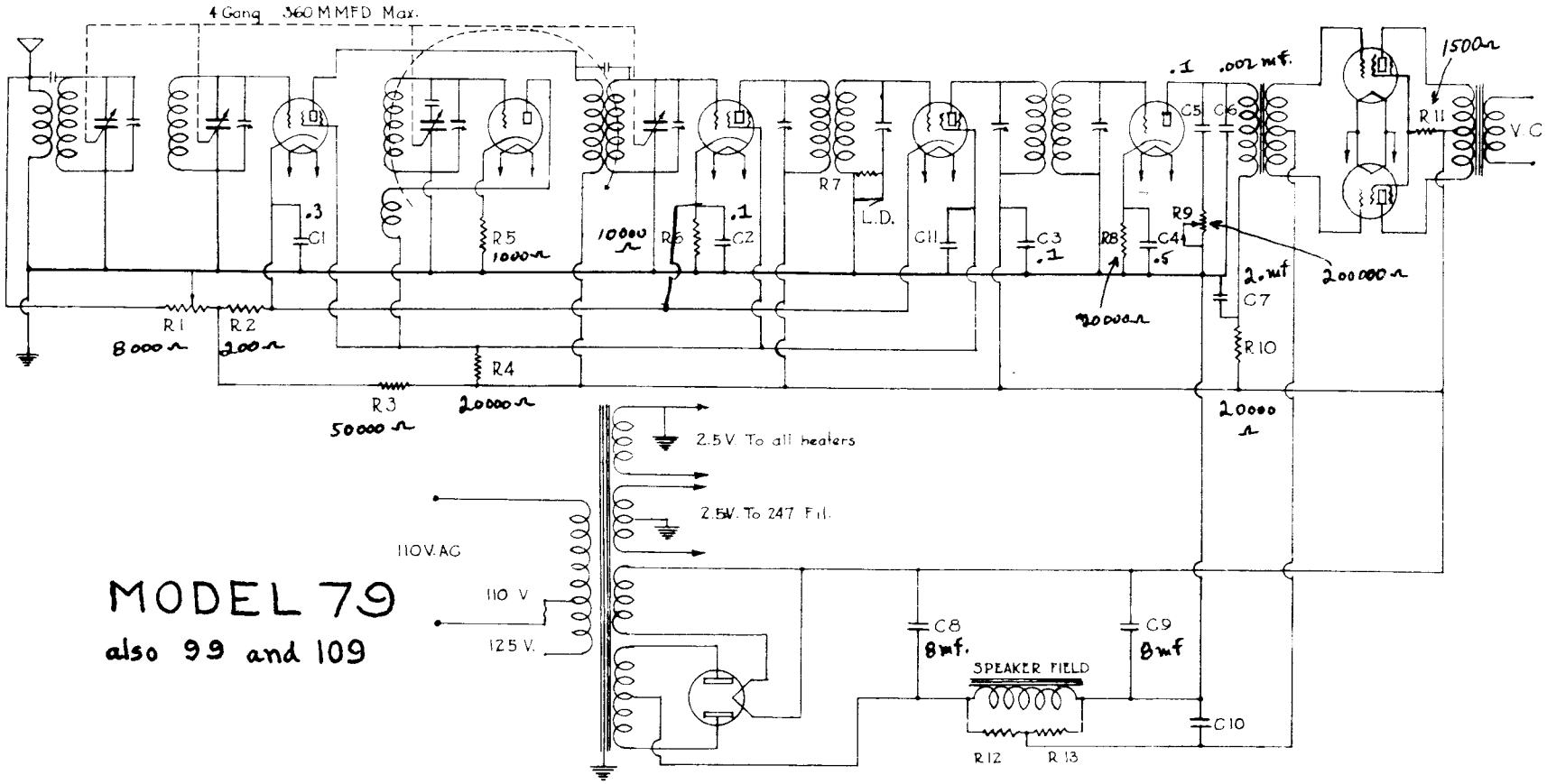

MODEL 79

also 99 and 109

VOLTAGE READINGS AT TUBE SOCKETS

VOLUME CONTROL AT MAXIMUM

No.	Position	Plate to ground	Screen to ground	Cathode to ground	Heater or Fil. Voltage	Grid to ground
1	R.F. Amp	225	94	3.8*	2.1	-
2	Translator	225	94	3.8*	2.1	-
3	Oscillator	94	-	4*	2.1	-
4	Int. Amp.	225	94	3.8*	2.1	-
5	Detector	180	-	20*	2.1	-
6-7	Power Tubes	225	215	16.5*	2.3	-

VOLUME CONTROL AT MINIMUM

No.	Position	Plate to ground	Screen to ground	Cathode to ground	Heater or Fil. Voltage	Grid to ground
1	R.F. Amp	250	112	33*	2.1	-
2	Translator	250	112	33*	2.1	-
3	Oscillator	112	-	8*	2.1	-
4	Int. Amp	250	112	33*	2.1	-
5	Detector	196	-	22*	2.1	-
6-7	Power Tubes	243	235	17.5*	2.3	-

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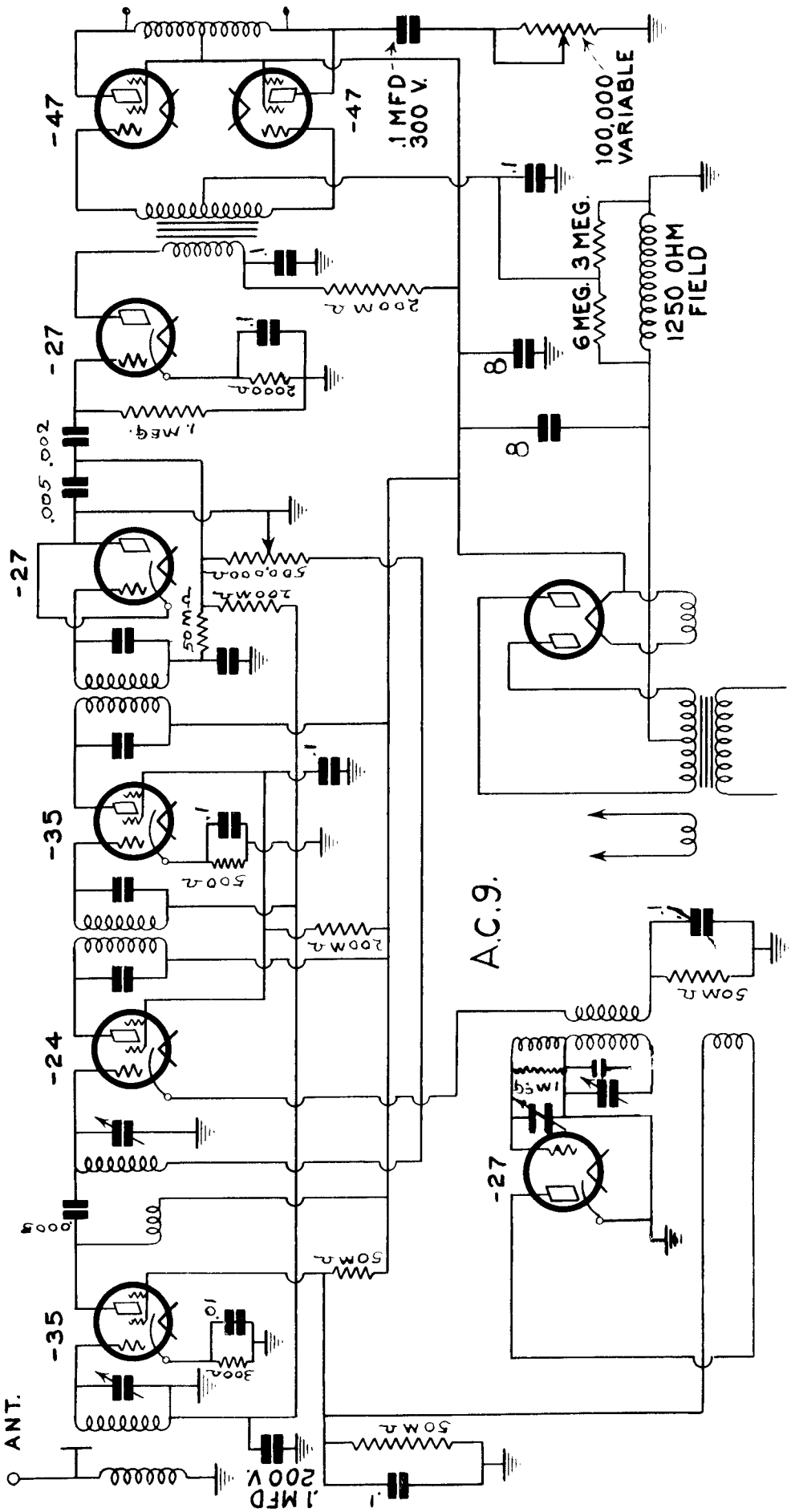

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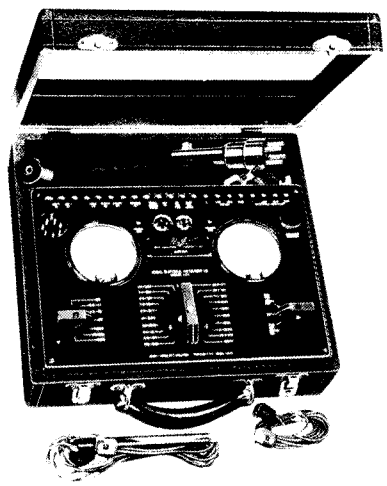

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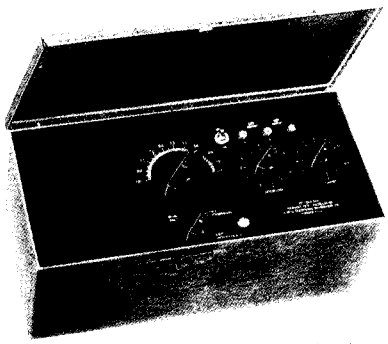
2. Accurately tests all types of A.C. and D.C. tubes under actual working conditions.
3. Any socket test requires setting of but a single switch.
4. Self-contained triple-range output meter.
5. Self-contained triple-range ohmmeter with battery compensator adjustment located on instrument panel.
6. Twenty-four instrument ranges for use with test leads.
7. Test leads connect to pin-jacks molded in panel. All binding posts are eliminated.
8. Complete meter ranges for accurately measuring all receiver voltages and currents.
9. Socket test cord is instantly removable at the panel.

Price to Servicemen.....$84.00

The Pattern 563 Oscillator



Output adjustable to any frequency in the broadcast band from 550 to 1,500 K.C., and in the two intermediate bands of 125 to 185 K.C. and 175 to 350 K.C.

Completely shielded. Metal carrying case and panel form effective shield. The radio frequency coils are separately shielded from rest of the unit.

Operates from self-contained batteries. These are carried within the case for complete shielding.

Output continuously variable from maximum to zero. A separate high output is provided for adjustments such as neutralizing.

Single control adjusts output frequency. Three-position switch allows instant change to any of the three frequency bands.

Calibration curve for each wave band carried in the cover for easy reference.

Filament rheostat and tapped "A" battery provide proper filament voltage for tube at all times and greatly increase the life of the battery.

Trimmer adjustment permits spotting any much used intermediate frequency at a convenient point on the dial.

Completely equipped with shielded output lead, calibration curves, instruction chart, '30 type tube, and batteries.

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Jewell Pattern 559 Output Meter—Price to Servicemen 15.00

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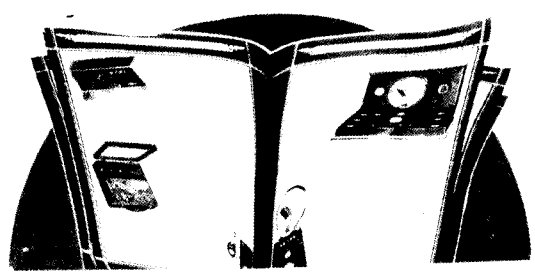

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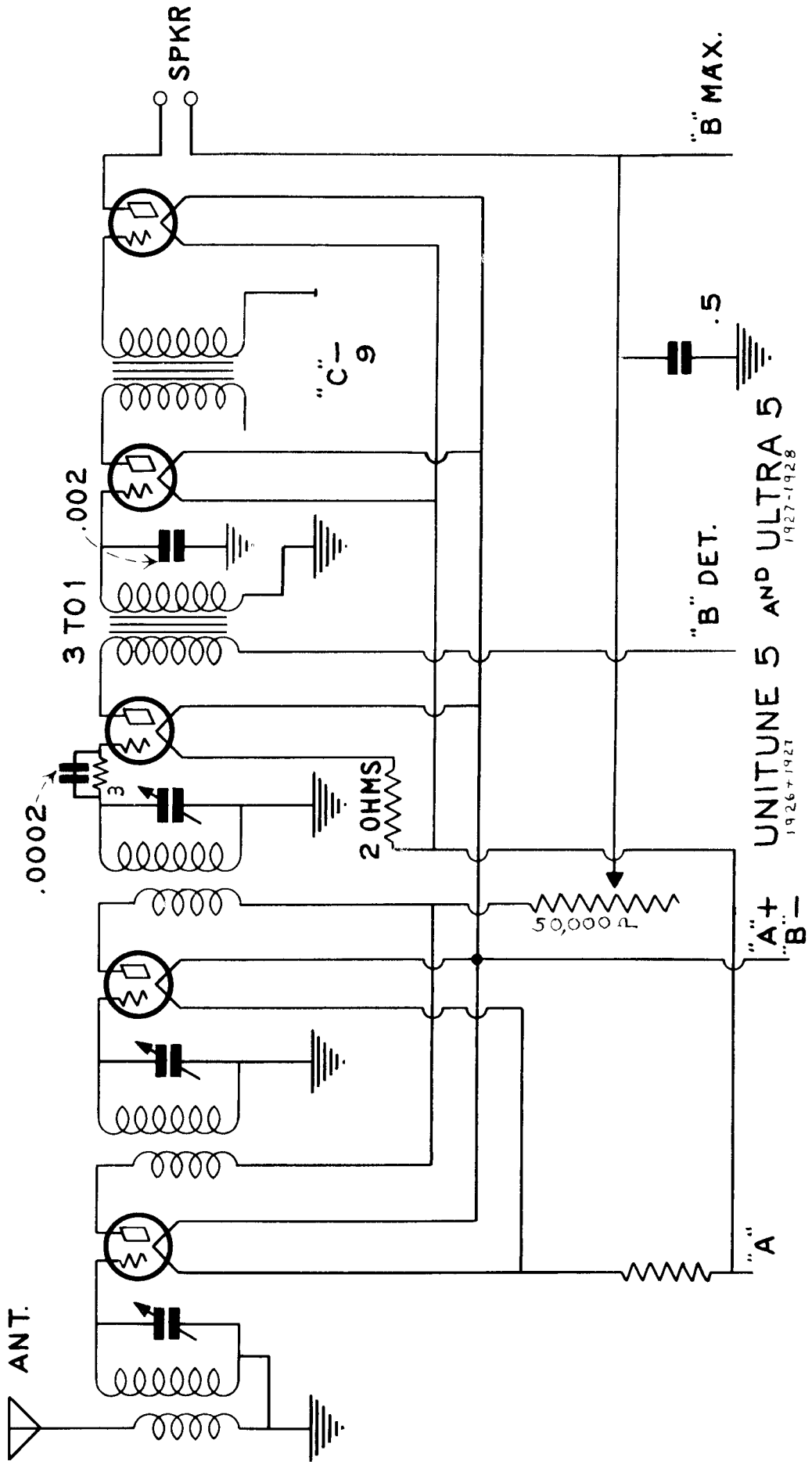

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We will quickly give you the training you need to qualify as a Radio service man . . . certify you . . . furnish you with a marvelous Radio Set Analyzer. This wonder instrument, together with our training, will enable you to compete successfully with experts who have been in the radio business for years. With its help you can quickly diagnose any ailing Radio set. The training we give you will enable you to make necessary analysis and repairs.

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As a member of the Radio Training Association, you receive personal instruction from skilled Radio Engineers. Upon completion of the training, they will advise you personally on any problems which arise in your work. The Association will help you make money in your spare time, increase your pay, or start you in business. The easiest, quickest, best-paying way for you to get into Radio is by joining the Radio Training Association.

This amazing Radio Set Analyzer plus the instructions given you by the Association will transform you into an expert quickly. With it, you can locate troubles in all types of sets, test circuits, measure resistance and condenser capacities, detect defective tubes. Knowing how to make repairs is easy; knowing what the trouble is requires expert knowledge and a Radio Set Analyzer. With this Radio Set Analyzer, you will be able to give expert service and make big money. Possessing this set analyzer and knowing how to use it will be but one of the benefits that will be yours as a member of the R. T. A.

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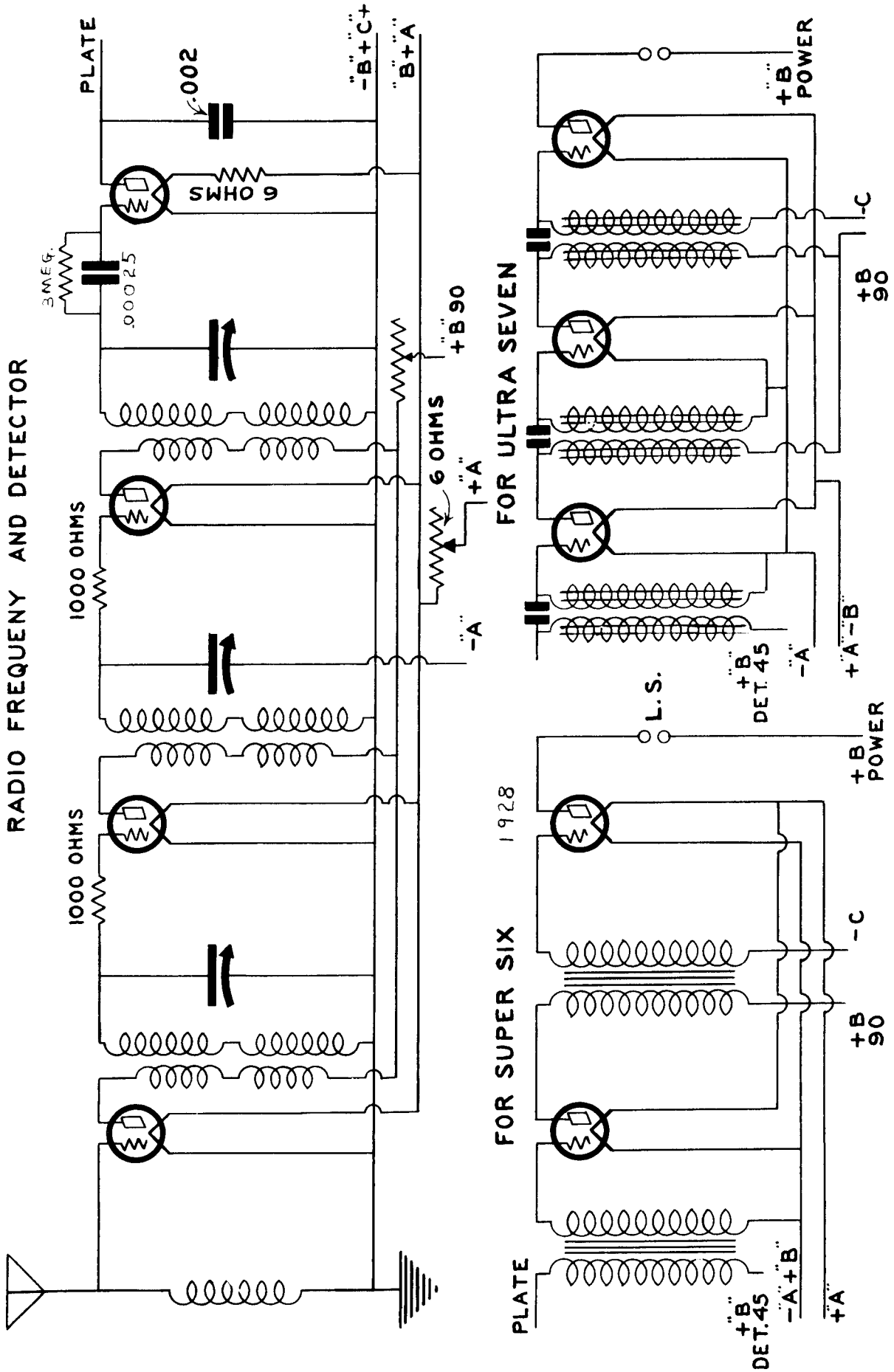

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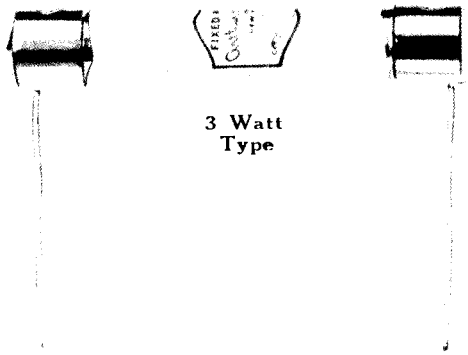
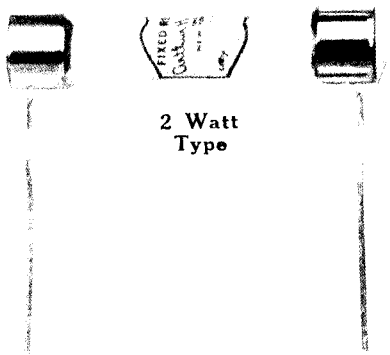
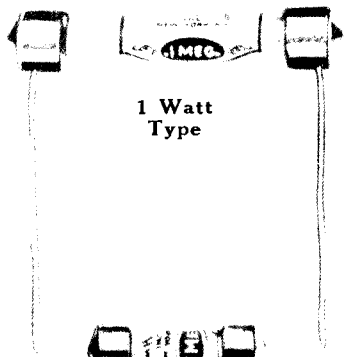


3 Watt Type



2 Watt Type



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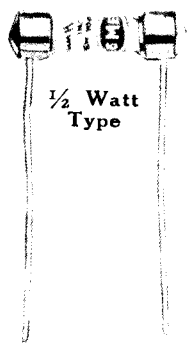

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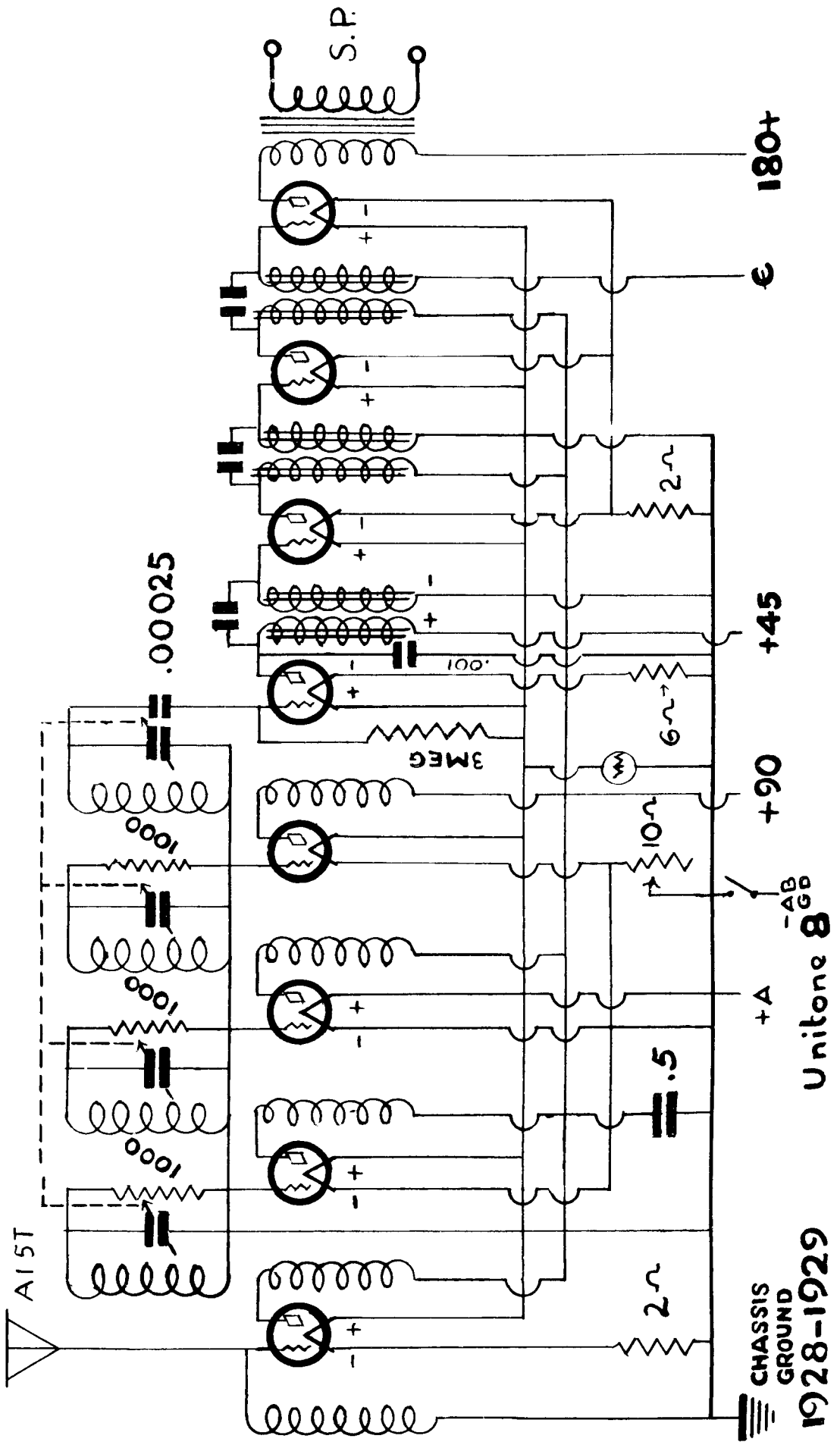

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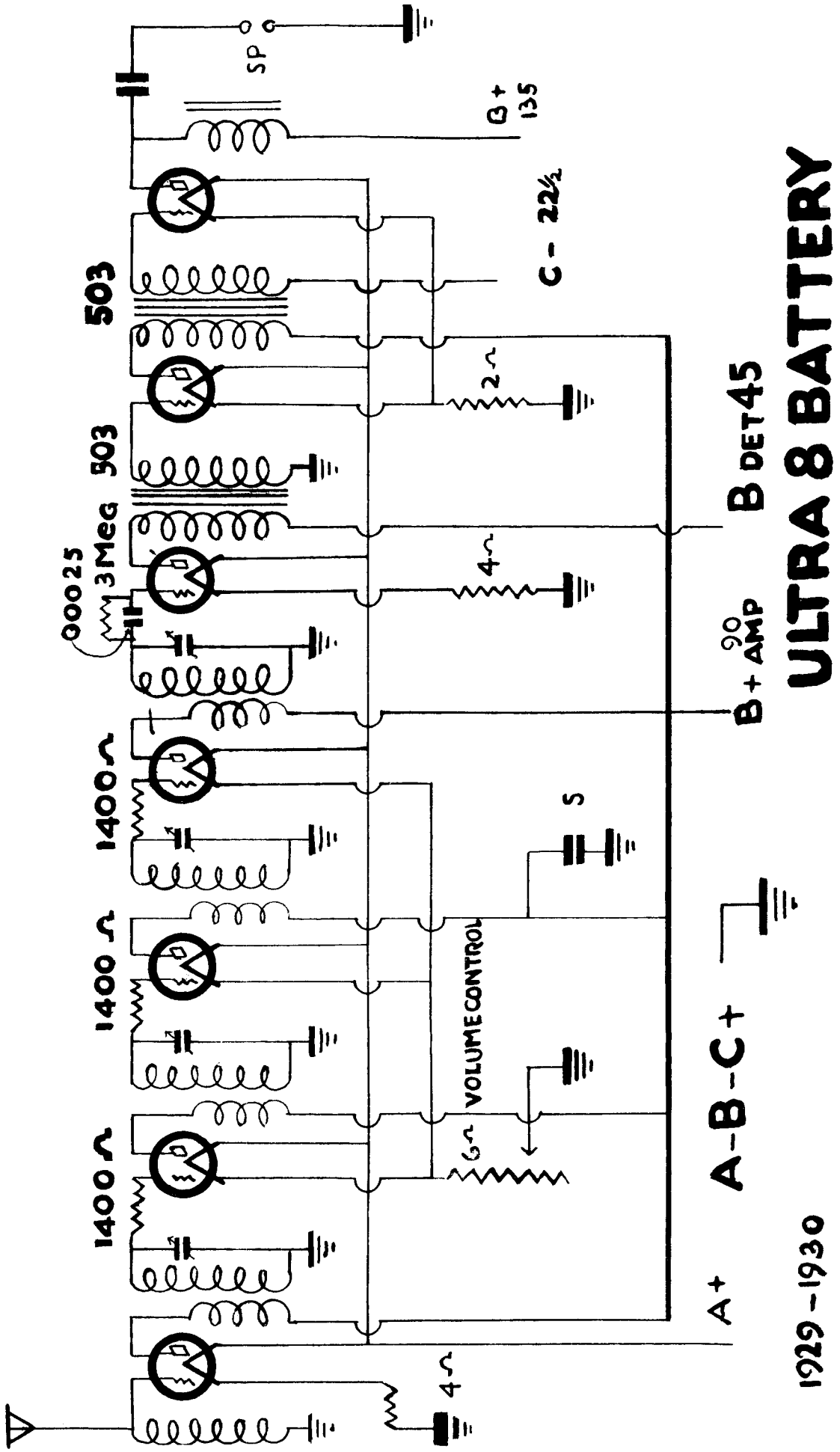

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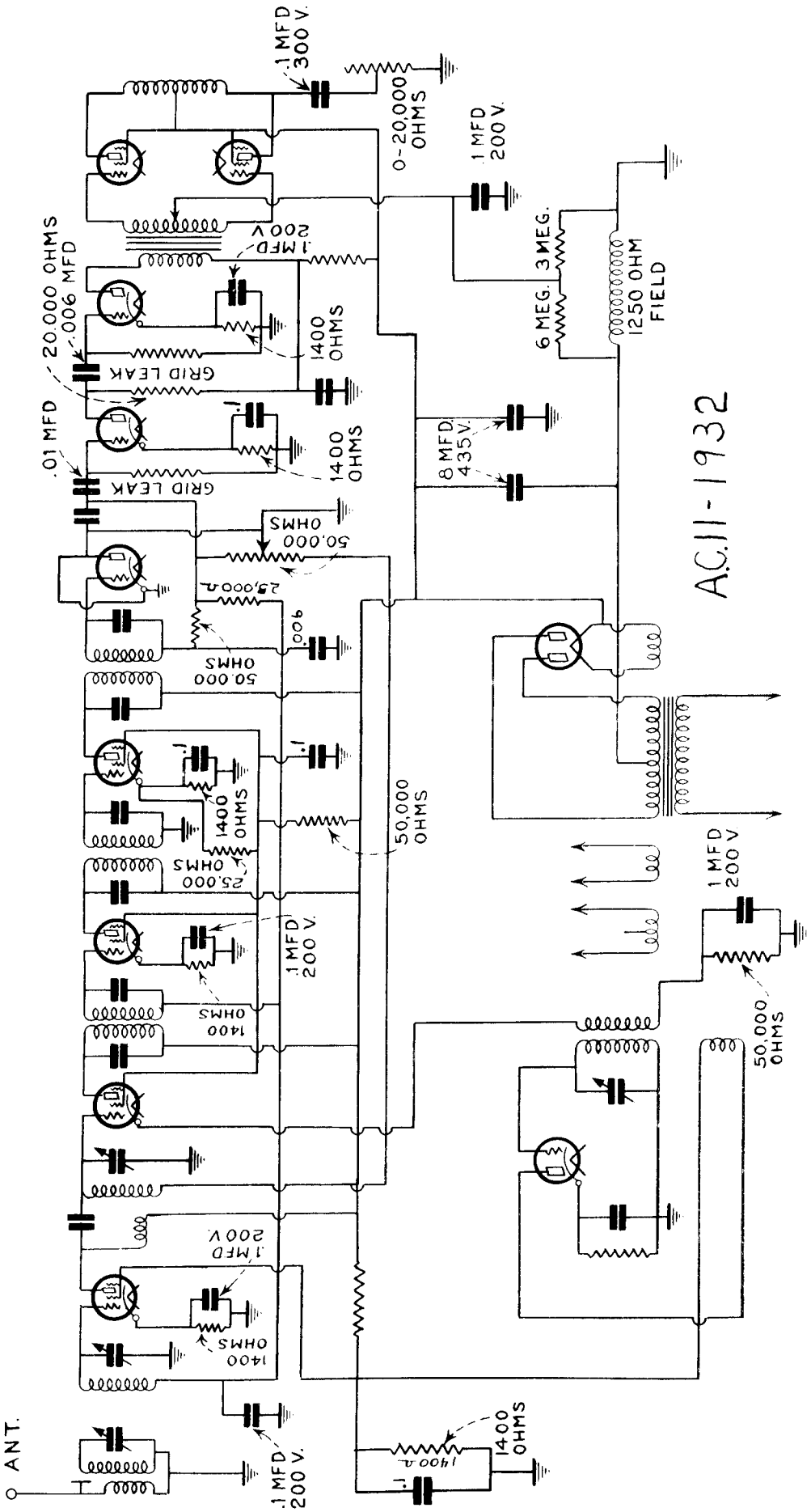

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The contents:

CHAPTER 1

Introduction

The Problems of the Service Man
General Methods of Analyzing Trouble
General Description of Modern Receivers
The Need for a Radio Set Analyzer
What to Expect from an Analyzer

CHAPTER 2

The Analyzer

The Fundamental Requirements of an Analyzer
The Switches or Push Buttons
The Ammeter
Multiscale Ammeters
The Shunt and Its Calibration
The D.C. Voltmeter
The Multiscale D.C. Voltmeter
The Multiplier and Its Calibration
The O.C. Voltmeter
The Design of a Simple Analyzer

CHAPTER 3

Trouble Shooting with the Analyzer

Classification of Trouble—
(1) External to the receiver;
(2) In the receiver proper:
(a) Mechanical troubles;
(b) Electrical troubles.
Detailed Analysis of Electrical Troubles—
(1) Tube testing;
(2) Localizing trouble:
(a) By past experience;
(b) By actual test of circuit.
(3) Interpretation of analyzer readings;
(4) Tube charts (use of);
(5) Circuit diagrams (use of);
(6) Testing the power unit;
(7) The use of the analyzer in testing individual units.
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(3) As an output meter.
Care and Maintenance of Analyzers
Conclusion and Brief Summary

CHAPTER 4

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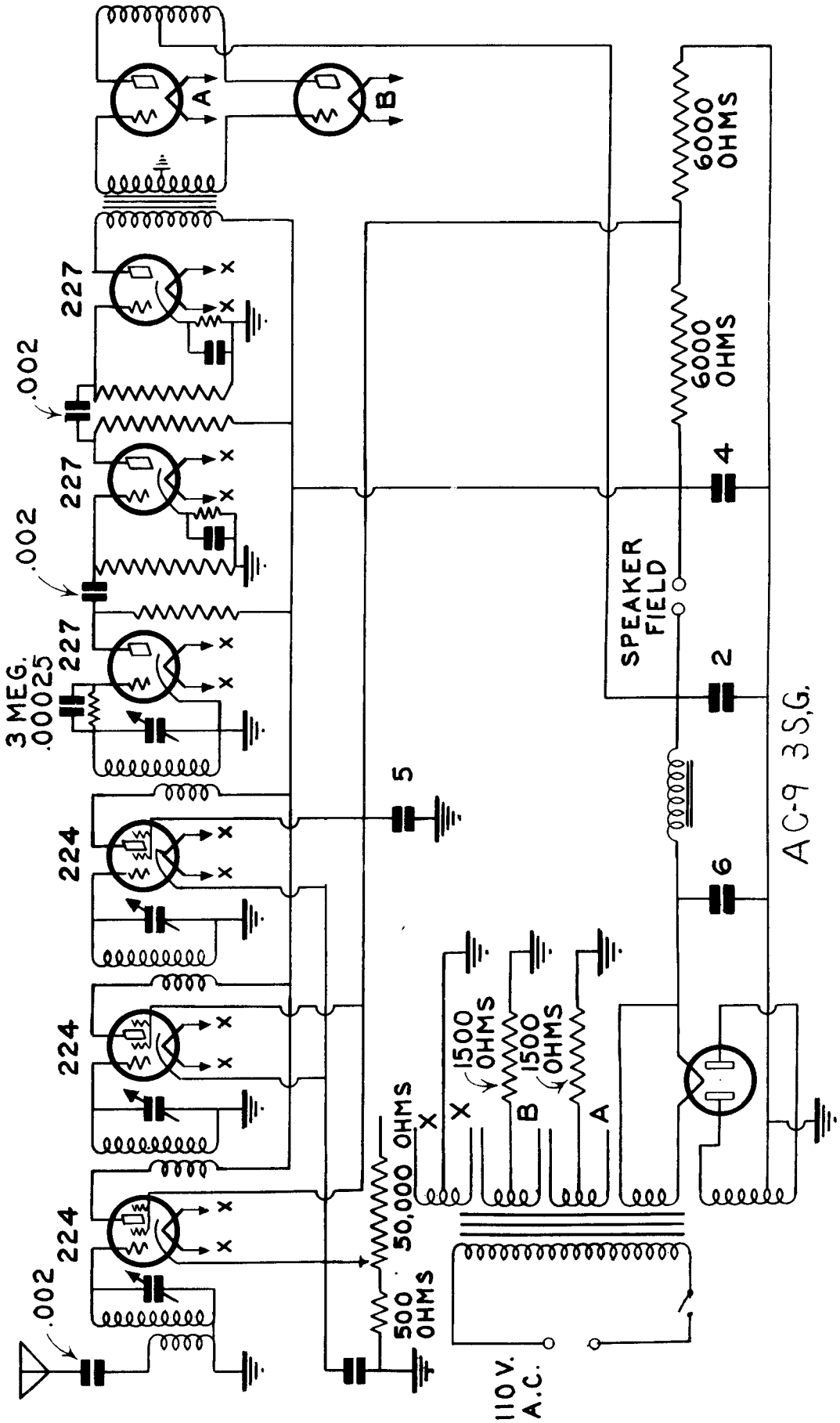

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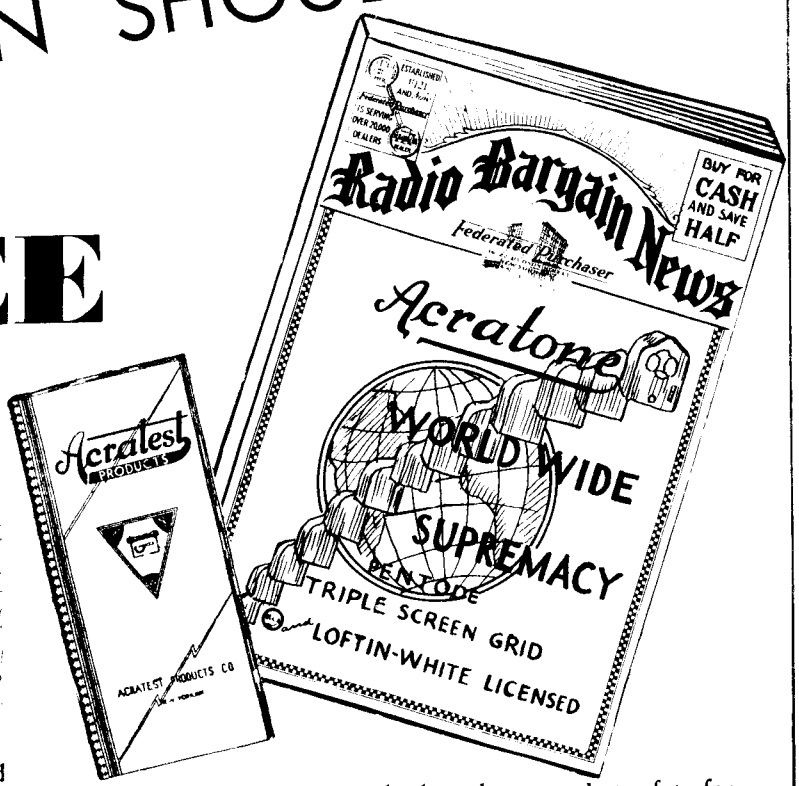

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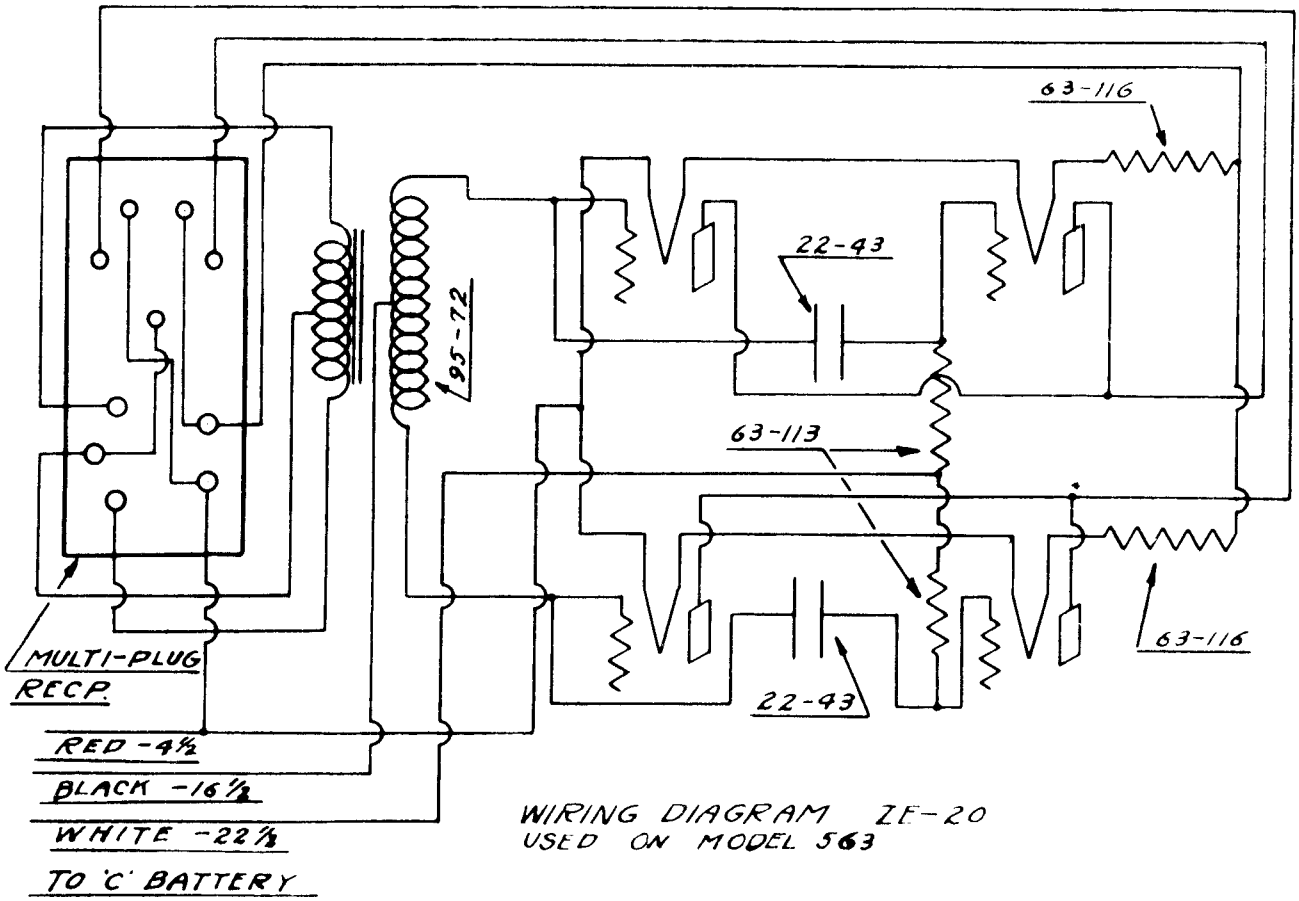
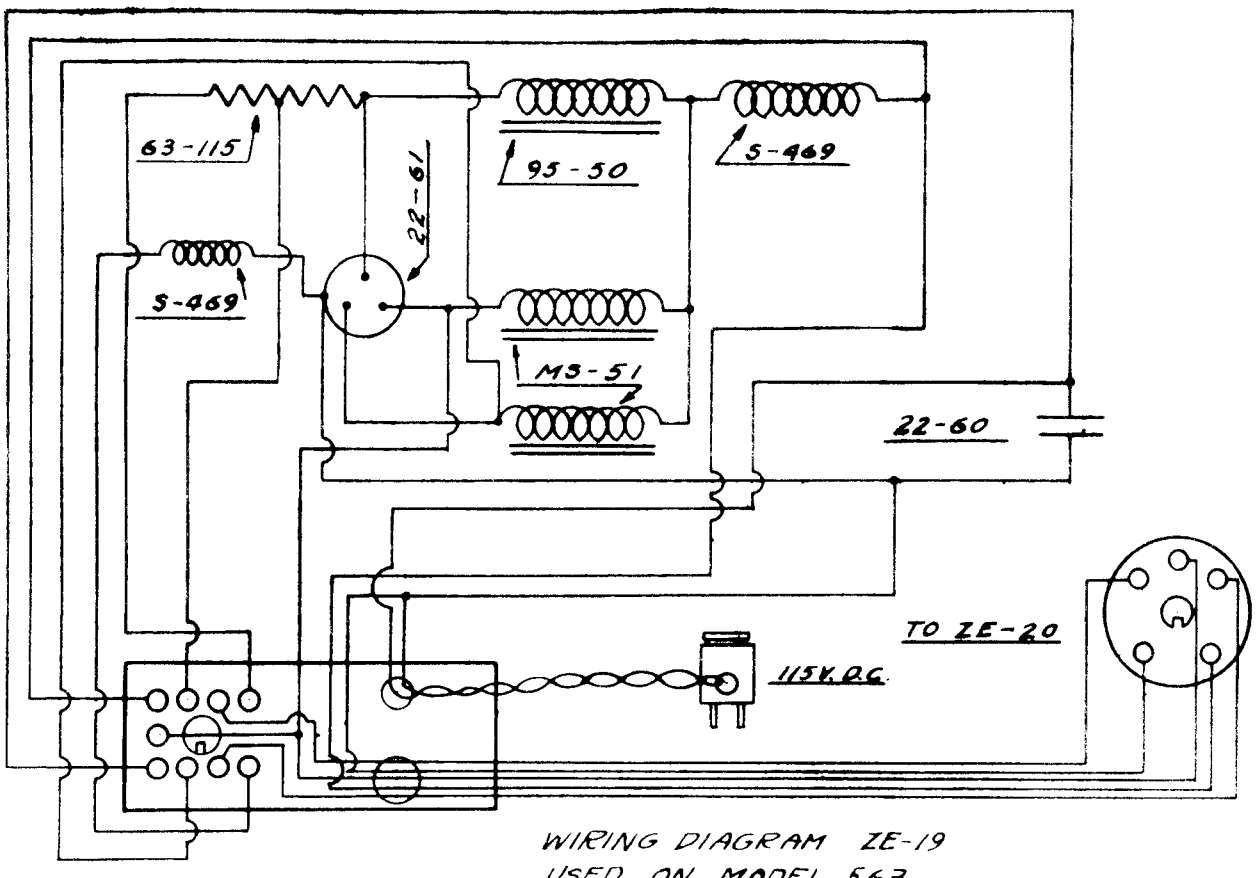
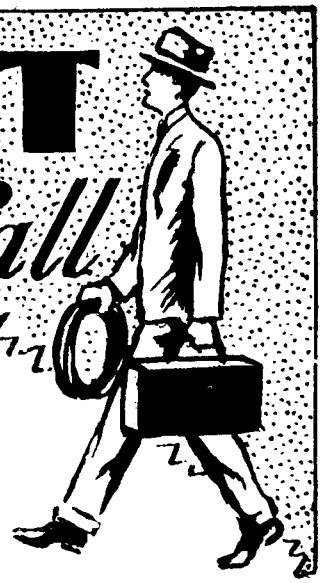


WIRING DIAGRAM ZE-20
USED ON MODEL 563



WIRING DIAGRAM ZE-19
USED ON MODEL 563

Make a PROFIT from Every Service Call



AMPERITE is the radio serviceman's best seller. It pays a quick and easy profit without effort. Just show it "doing its stuff" when you make a service call and *your customer sells himself.*

AMPERITE is the *only* self-regulating line-voltage control. Takes the "bumps" out of the line *automatically.* Saves premature tube, condenser and transformer burn-outs. Eliminates tone distortion and blasting. Can be installed in any radio in five minutes.

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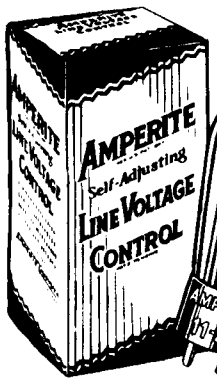

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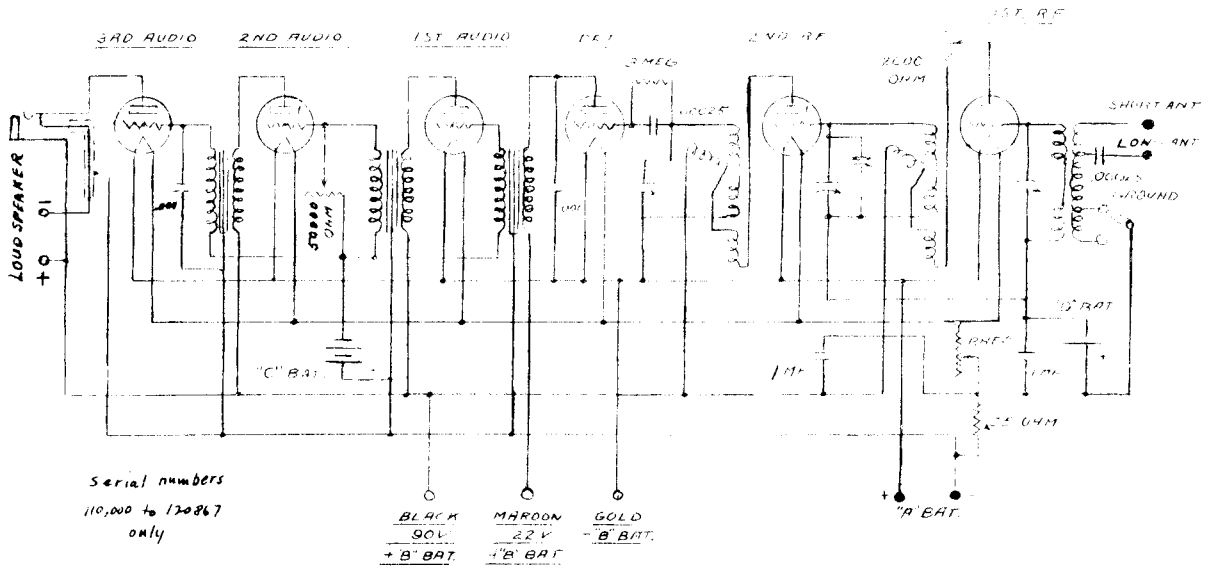
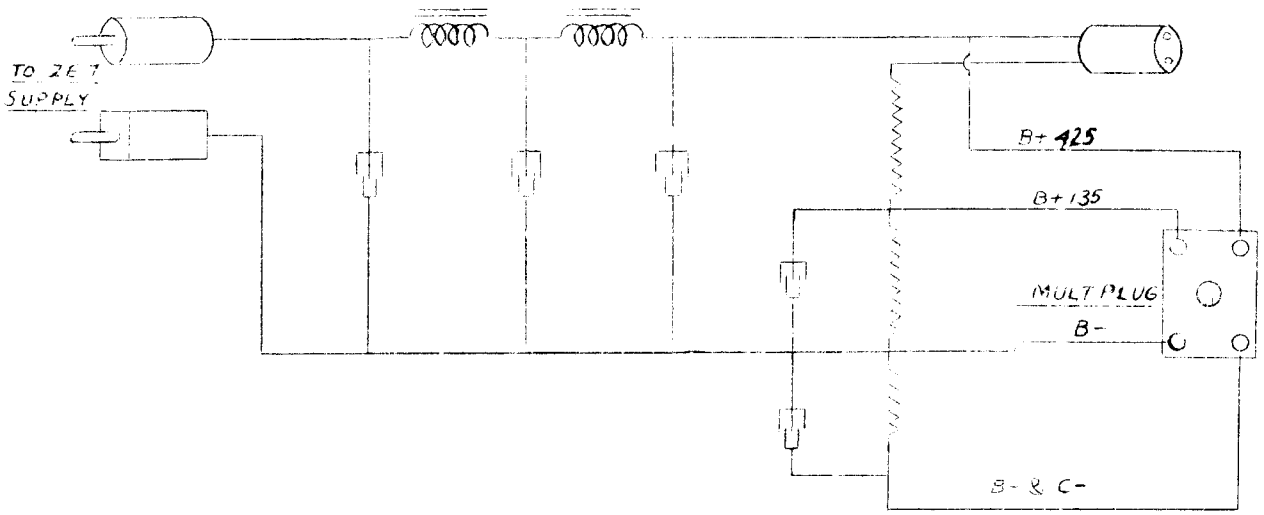
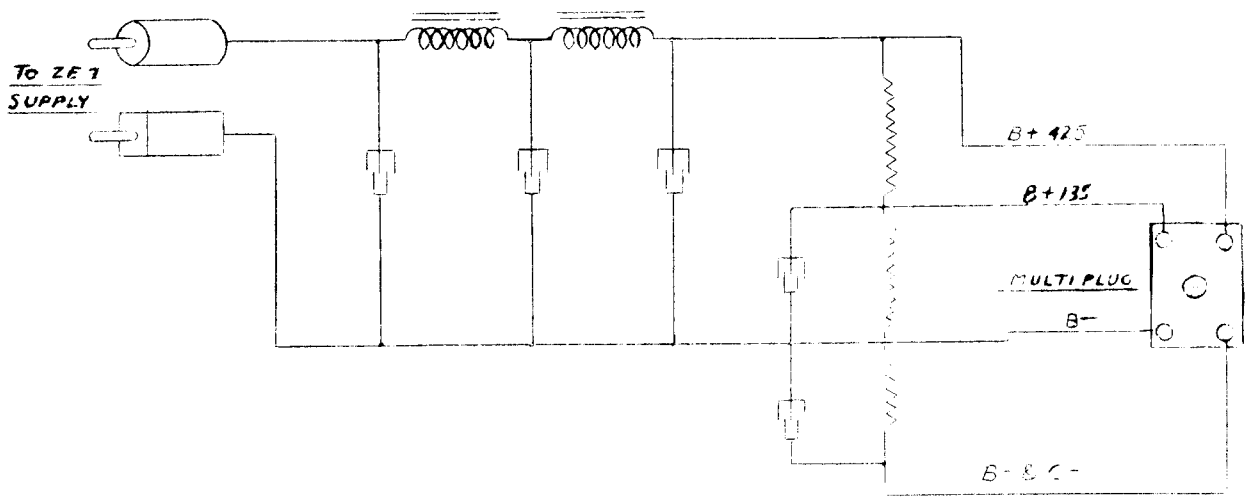




WIRING DIAGRAM
MODEL ZE8P FILTER UNIT For use on 16EP A.C. deluxe models



WIRING DIAGRAM
MODEL ZE 8 FILTER UNIT For use on Model 15E

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THE first volume of the Handybook contains a tremendous amount of the most important servicing data of every kind—hundreds of illustrations, wiring diagrams, and dozens of charts on every conceivable subject pertaining to radio sets, tubes, line voltages, etc. This book contains live "meat" from start to finish, and only *practical information* on which every radio man can cash in on immediately.

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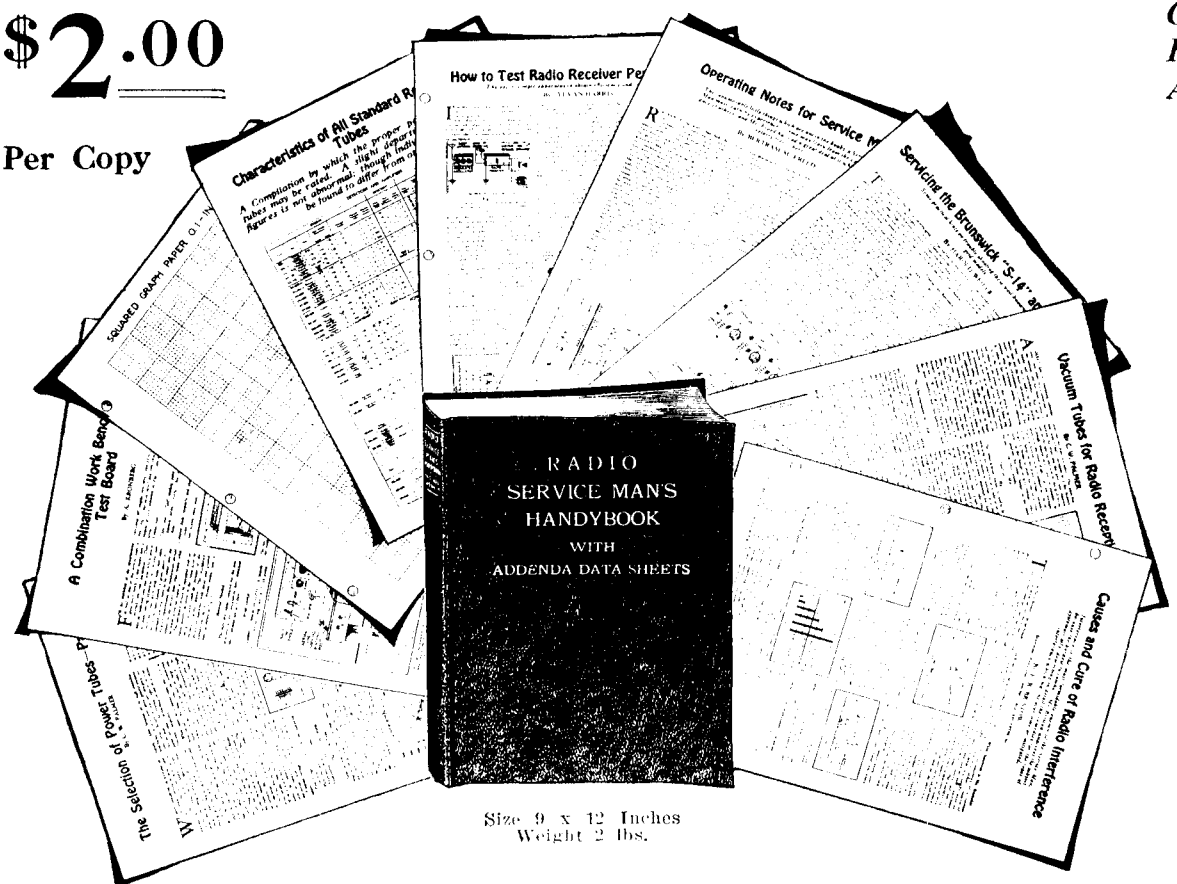

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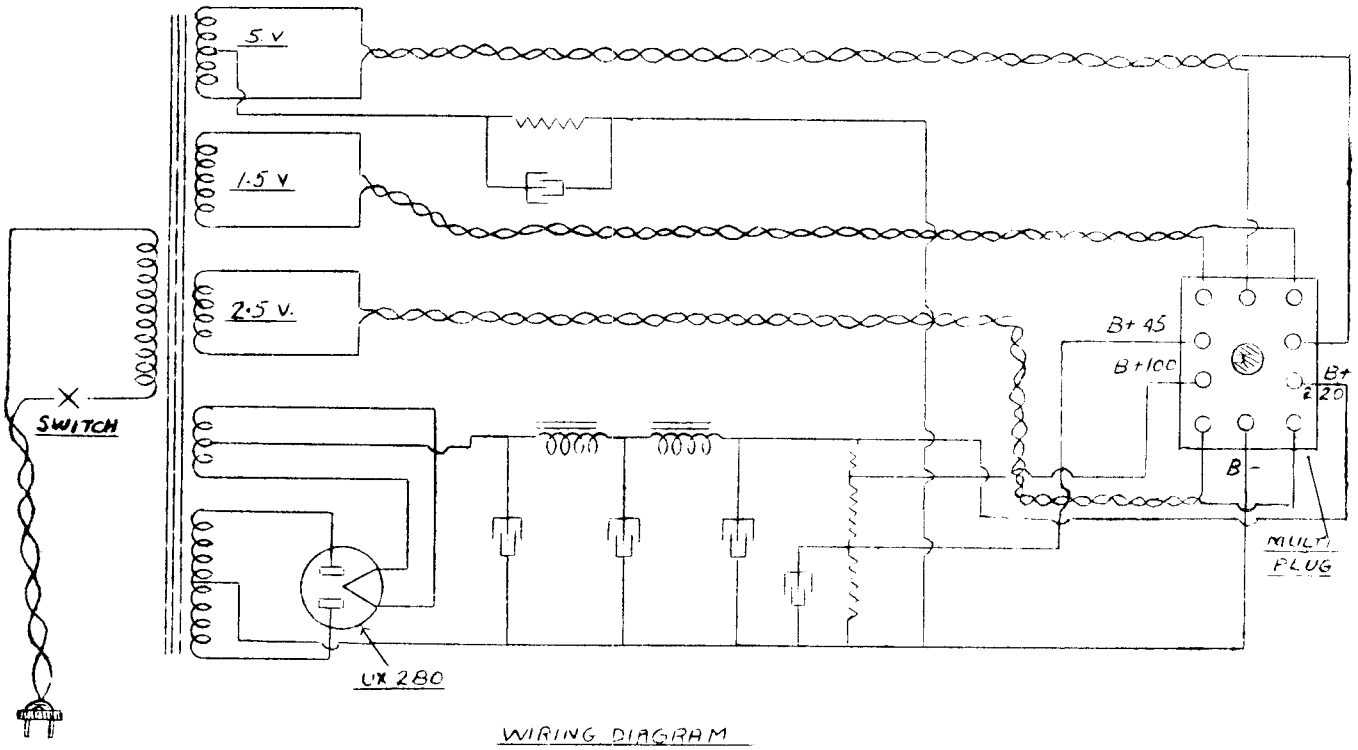
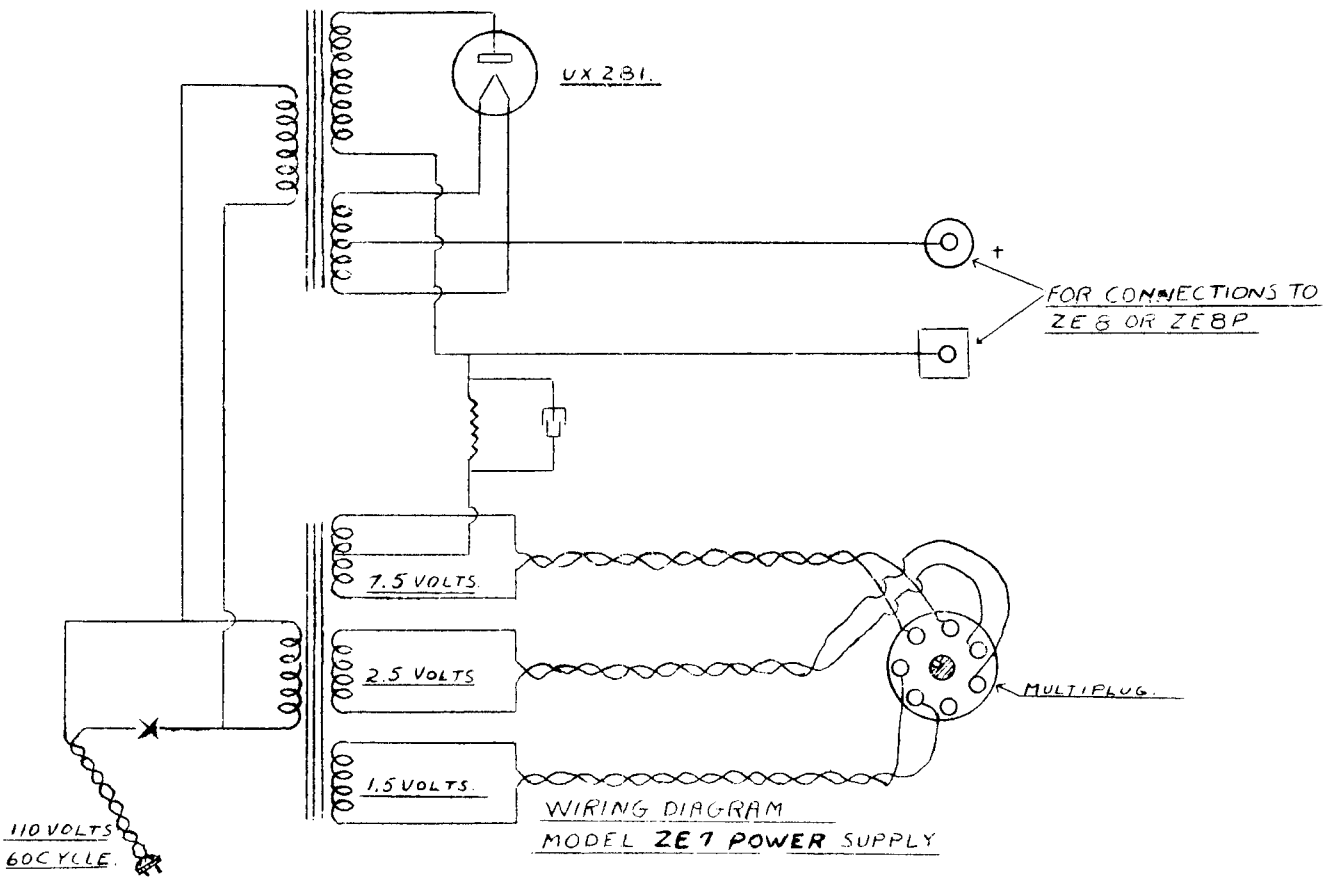


WIRING DIAGRAM
POWER SUPPLY ZE 9



WIRING DIAGRAM
MODEL ZE 7 POWER SUPPLY

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These finely built parts are used by practically all leading radio receiver manufacturers, following thorough and successful laboratory tests.

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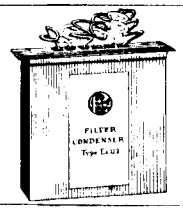

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Built to specification

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Wire-wound Tubular
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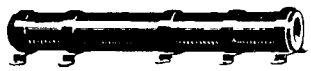

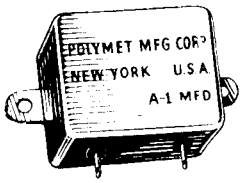

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Carbon Volume Controls
Wire-wound Volume Controls
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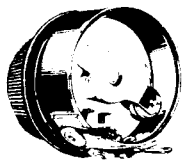

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For repair work

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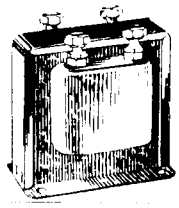
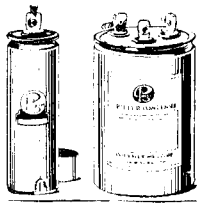
Audio Transformers
Power Transformers
Standard Choke Units





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In single, double and triple units

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All types of coils, except radio frequency, built to specification

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Large Molded
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Enameled Wire
Sizes, 18 to 42—in case lots

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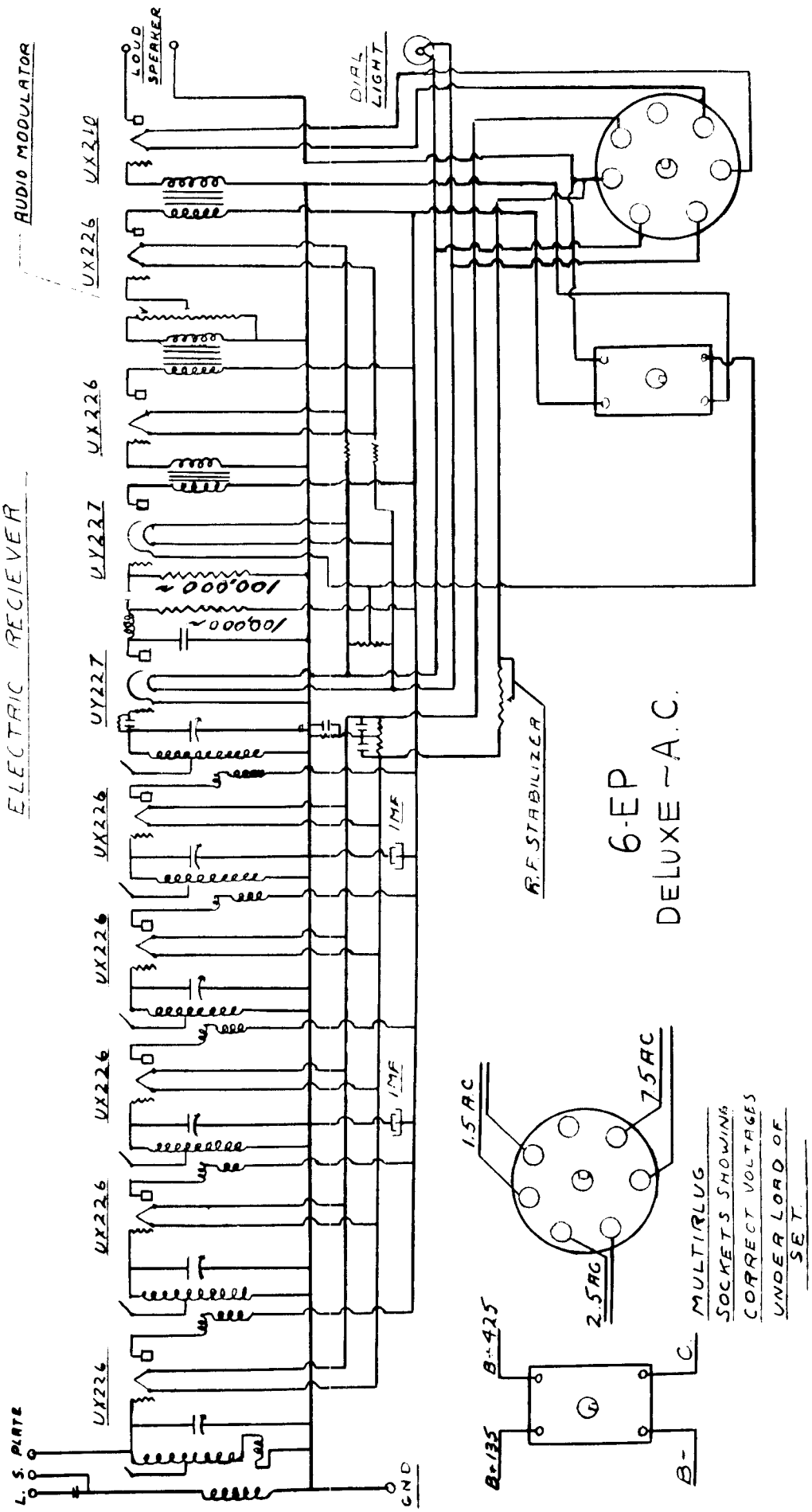

SERVICE—

What Does It Mean?

SERVICE may mean many things to many men.

Say "SERVICE" to some men and they think only of *speed*. To others service means courtesy, accommodation, large stocks, low prices, or exceptional values.

FEW MEN think of service in terms of QUALITY, even though they are sincere in their effort to do their work well.

BUT QUALITY is the very *essence* of service—or *should* be. Nothing else counts for so much in satisfying a customer and retaining his good will. Speed, courtesy and other things help and are valuable—but without QUALITY, they count for little in the long run.

WHEN you have radio building to do, or are called on to replace worn or defective parts in a receiver, it pays to choose parts with a reputation for fine workmanship, accurate performance and long life.

HAMMARLUND CONDENSERS, Chokes and Shields are the highly perfected products of more than thirty years' experience in designing precision instruments for radio, telephone and telegraph use. They are internationally known and respected for their high standard of excellence. Plan to use them in your next service job.

Write Dept. GM for descriptive literature and helpful service data

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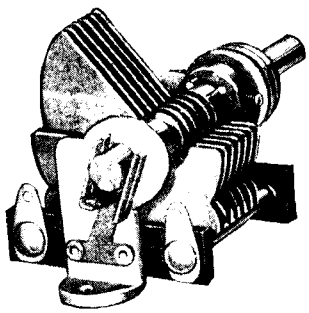
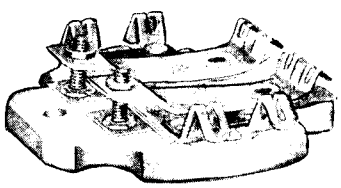
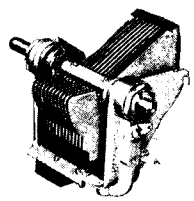


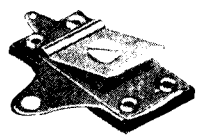
The new Hammarlund Midget Condenser is vibration proof and is particularly suited for aircraft, police car and marine work. Soldered end plates. Aluminum end plates. Fitted bearings. Noiseless brush type contact. Stock sizes, varying 20 to 325 mmf. $1.50 to $3.50



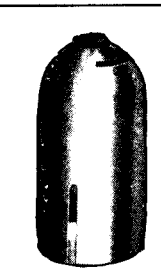
Hammarlund Intermediate Transformer Tuning Condensers are used by the majority of set builders. Insulated to ground. Insulated to base. Phosphor bronze spring strips with self-adjusting adjusting screws. Finest imported mica dielectric. Single and dual models in four stock sizes: 10 to 70 mmf; 50 to 150 mmf; 100 to 220 mmf; and 200 to 1000 mmf. 70c to $1.50.



Four years' leadership crowned by the engineering perfection of Hammarlund "Midline" Condensers. Special shaped end plates. Full floating rotor. Removable shaft. Ball and Cone bearings. Bronze pigtail. Rib reinforced aluminum alloy frame. "Panaflex" low loss insulation. .0002 mfd. .0005 mfd. .001 mfd. .0025 mfd. .005 mfd. $5.00 to $5.50



A Variable Accurate Neutralizing, Balancing or Padding Condenser. May be attached to socket binding post or tuning condenser. 2 to 25 mmf. 50c; 20 to 80 mmf. 60c.



The new Hammarlund Screen Grid Tube Shield is designed with special contacts for maximum cooling of the tube by an up draft of air, and at the same time provides the full extent of shielding required for most efficient operation. Aluminum shell and base with large hole in the top for access to control grid of tube. Designed for use with the panel sockets.

60c each

A radio frequency Choke specially developed for modern high gain screen grid receivers. Aluminum shielded and polarized Mumetal external field. No undesired coupling to cause circuit instability or feed back. High inductance, low self-distributed capacity. Efficient, compact. Sub panel connection.

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Hammarlund
PRECISION
PRODUCTS

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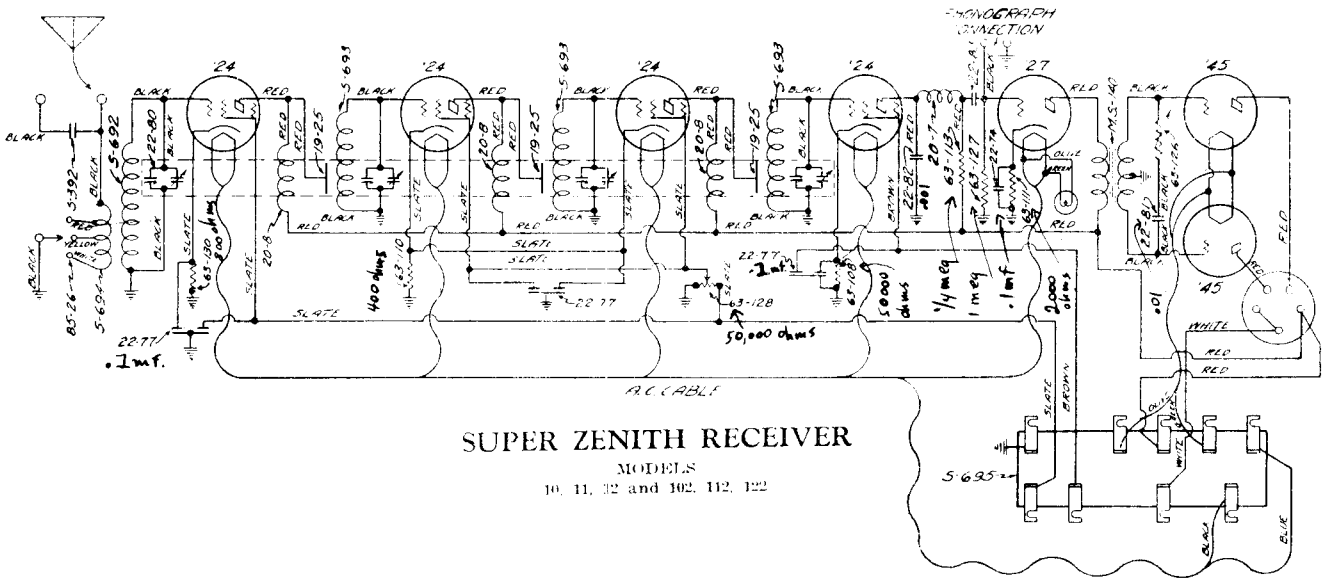
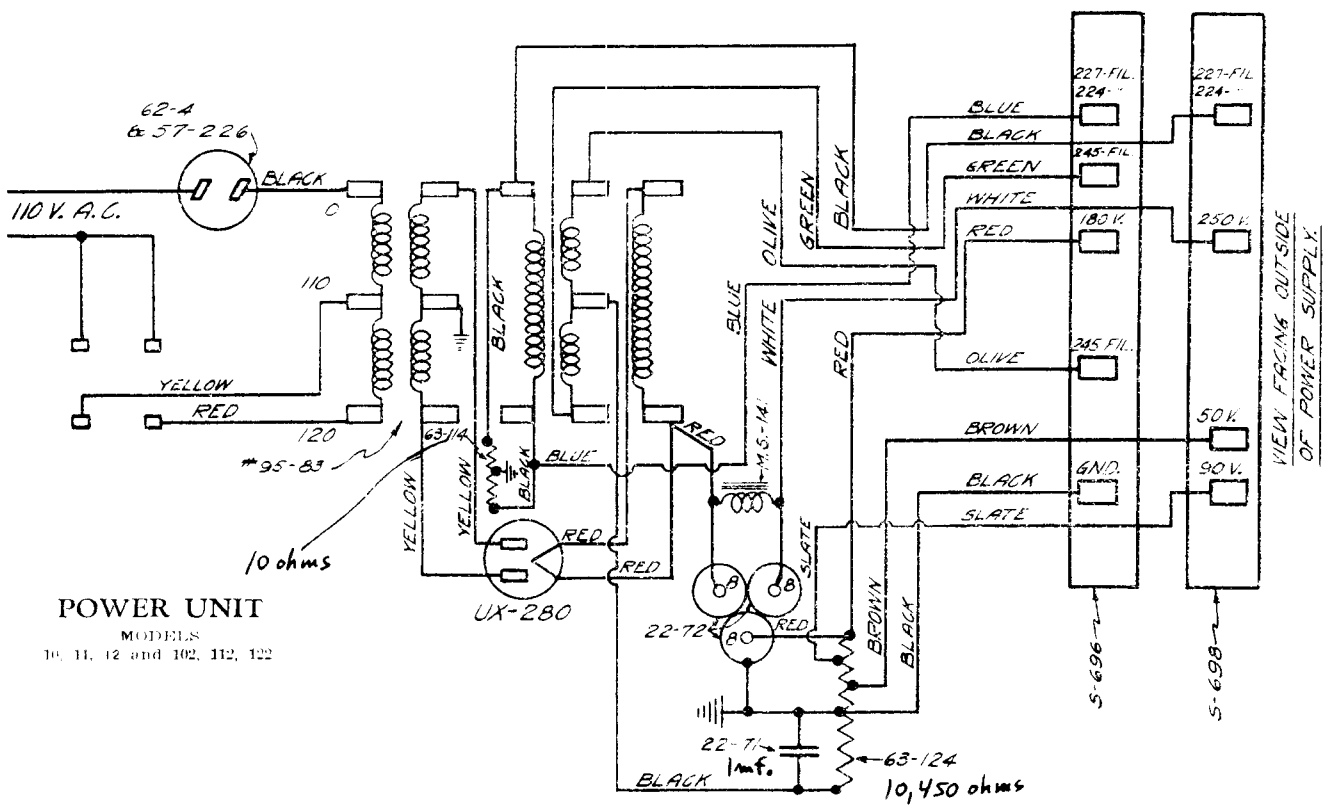


SUPER ZENITH RECEIVER

MODELS
10, 11, 12 and 102, 112, 122



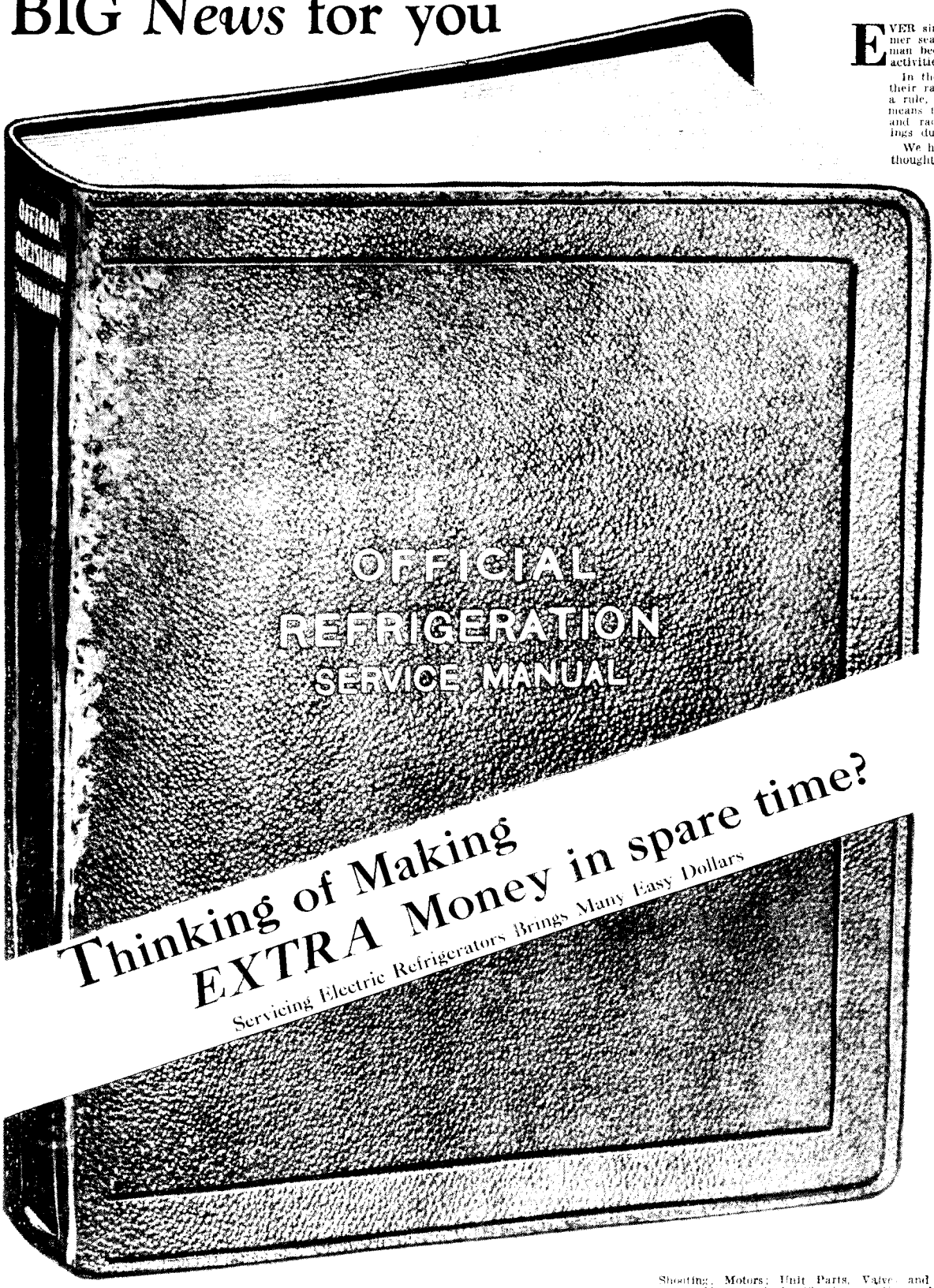
POWER UNIT

MODELS
10, 11, 12 and 102, 112, 122

VOLTAGE READINGS AT SOCKETS USING WESTON 547 ANALYZER
Line Voltage 115. Fuse in 120 Volt Clips.

TYPE	POSITION	FIL. VOLTS	PLATE VOLTS	GRID VOLTS	SCREEN VOLTS	NORMAL PLATE M.A.	GRID TEST M.A.
224	1st R.F.	2.3	185	3.25	90	4	7
224	2nd R.F.	2.3	185	3.4	90	4	7.5
224	3rd R.F.	2.3	185	3.3	90	4	7.5
224	Det.	2.3	90	3	30	.25	.75
227	1st A.F.	2.3	170	12	—	6	7
245	P.P.	2.3	245	50	—	28	37
245	P.P.	2.3	245	50	—	28	37

BIG *News* for you



EVER since the advent of radio, the summer season has been a curse to the radio man because that is the time when radio activities are at their lowest.

In the summer time, people do not use their radio sets so much and there is, as a rule, little servicing to be done. This means that the average radio service man and radiotrician finds pretty slim pickings during the summer months.

We have given this problem considerable thought and for over a year worked quietly on the problem; and **from now on every radio man, service man and radiotrician will have a steady income all the year around, incredible as this may seem.**

The idea of radio people servicing refrigeration units is self-evident and the thought has occurred to perhaps untold thousands of radio men ever since electric refrigeration started. Yet nothing was done, because the average radio man knows little or nothing about refrigeration. Our survey of the field convinces us that, compared with servicing a radio set, the servicing of a refrigerator is absurdly simple, once you get the hang of it; and that is exactly why **the OFFICIAL REFRIGERATION SERVICE MANUAL** is going to be a side partner to the OFFICIAL RADIO SERVICE MANUAL, with which you are well acquainted.

When you are called in to service a radio set, it is easy to find out if your customers own a refrigerator. If they do, you can now tell them that you can service the refrigerator as well. Place your card somewhere near the refrigerator so that, if trouble comes, you will be called in to fix it.

From whatever point you look at it, you will make money. And don't ever lose sight of the fact that refrigerators usually need servicing in the summer time and that **it is here that you will get a new and extra income.**

But don't take our word for all this. Study the situation yourself and see if we are not right. Look around in your locality and find out how many refrigerators there are. At the present time the servicing of these refrigerators goes to other trades when this business might just as well belong to you.

So we say to you, why not go into the refrigeration servicing business at once? Remember, there is big money in it and the refrigeration business is growing enormously every year; and it won't be very long before there will be more refrigerators than radios.

The OFFICIAL REFRIGERATION SERVICE MANUAL has been edited by L. K. Wright, who is an expert and a leading refrigeration authority. He is a member of the American Society of Mechanical Engineers, American Society of Refrigeration Engineers, The National Association of Practical Refrigeration Engineers, etc.

The new Manual, as you will see from the photographic reproduction, is the same size as our OFFICIAL RADIO SERVICE MANUAL. It will be 9 x 12 inches, and will **contain 352 pages**—loose leaf, bound in leatherette, gold-stamped cover; in fact, it is a gold mine of information on the entire art of refrigeration.

Here are the chapter contents: Preface; Introduction; History of Refrigeration; Fundamentals of Refrigeration; Description of All Known Types of Refrigeration; Service Tools and Shop Equipment; Trouble Shooting; Motors; Unit Parts, Valves and Automatic Equipment; Manufacturers, Makes and Specifications of Units; Manufacturers of Cabinets.

Every page is profusely illustrated, every refrigerator part is explained; diagrams are furnished of every known machine, special care is given to the servicing end, of course; all the tools needed are illustrated and their use explained; there are trouble shooting charts, and other service data.

This by no means exhausts the contents of the book, and it would take much more space to give you all of the details. Last year when we brought out the OFFICIAL RADIO SERVICE MANUAL, we made a special pre-publication offer to our friends, which actually saved them thousands of dollars. We are now giving you the same chance again for a very short time.

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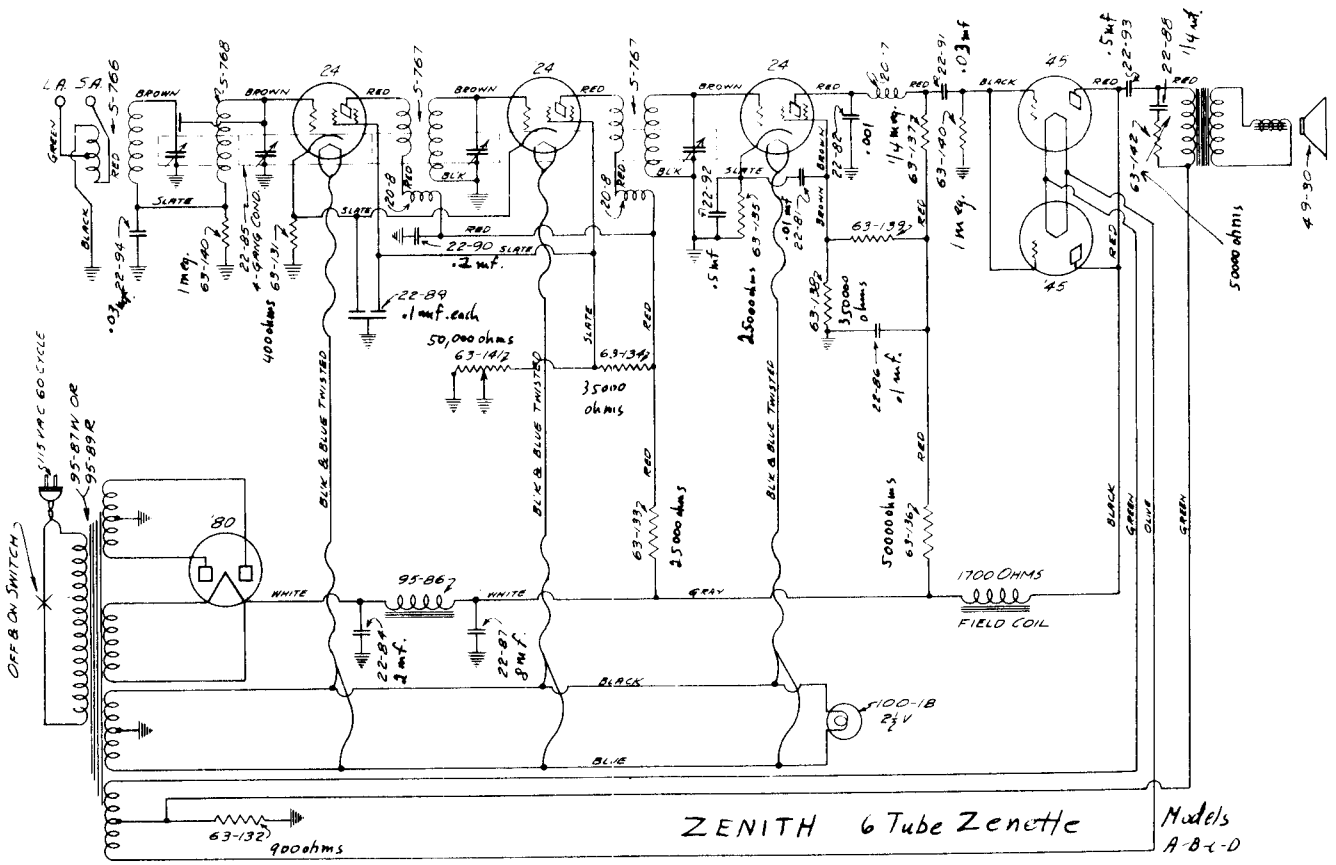
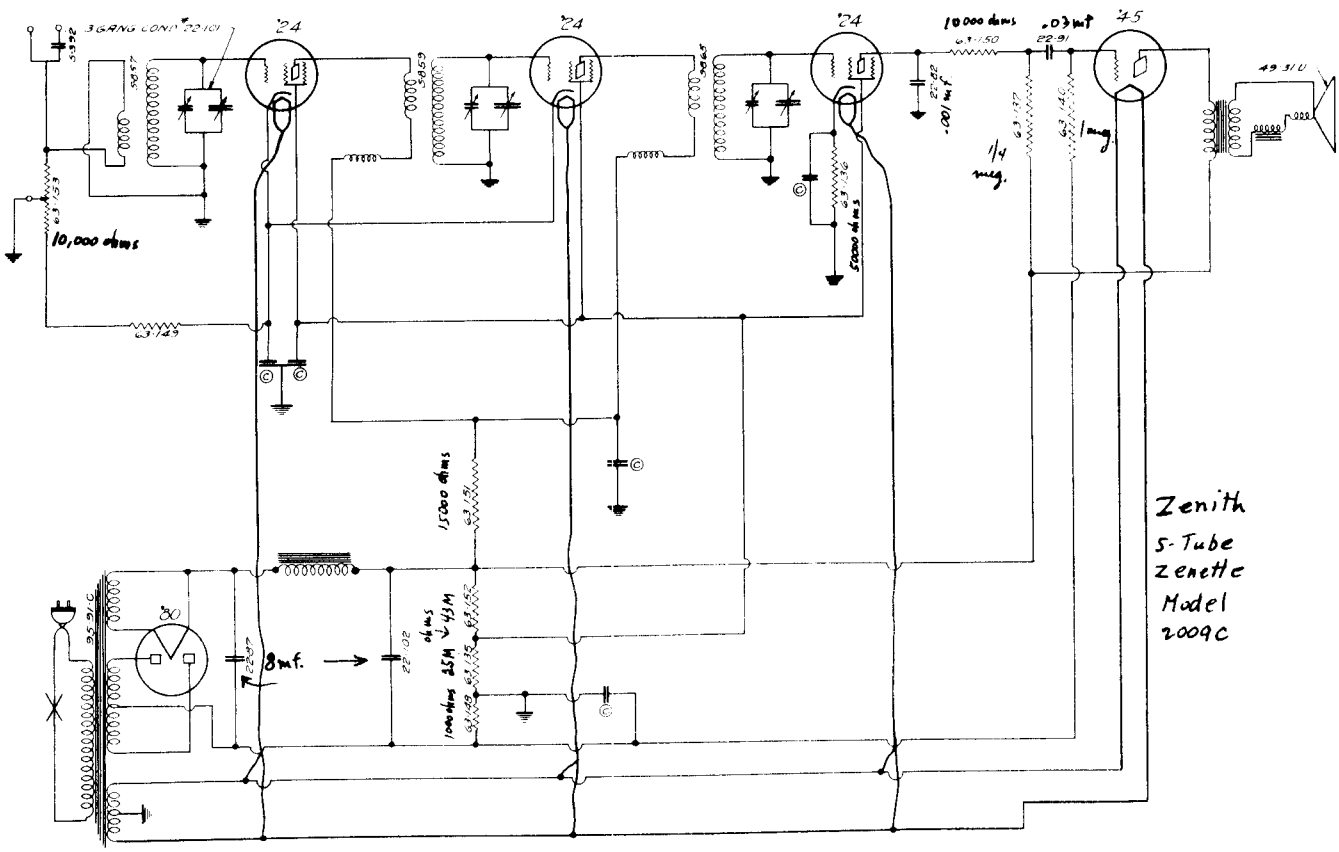
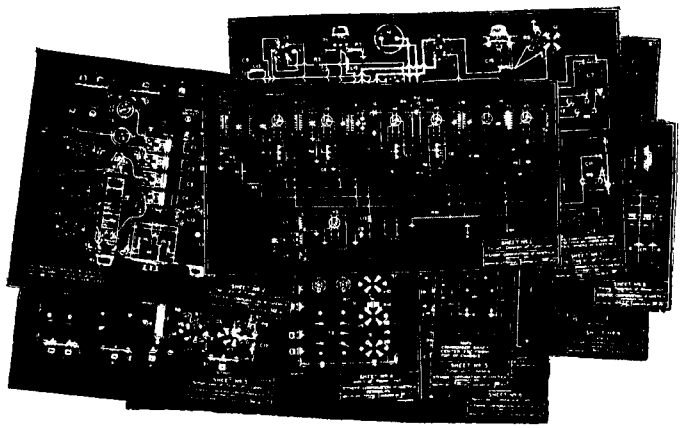




ALL FIXED CONDENSERS MARKED © INCLUDED IN ONE CONTAINER PART # 22-103

All You Need to Know



to Build the World's Best Receiver

STENODE

Designed by Stenode Engineers under the direction of Dr. James Robinson

The absolutely revolutionary receiver which makes possible for the first time Superheterodyne reception so quiet you can hear no noise between stations . . . all musical tones as no other method can reproduce them.

Dr. James Robinson, former Chief of Wireless Research, British Royal Air Force, has given you an *entirely new* principle of radio reception in the STENODE, not merely a rehash of *worn out principles.* Build a STENODE! Be a radio leader in your community. Learn for yourself and prove to your friends what it means to have

500% Better Selectivity

STENODE tuning is so sharp that it requires a 300 to 1 ratio dial. Turned up to full sensitivity there is no noise in tuning the STENODE until a station is reached. Stations come in "crystal clear"—an absolute replica of the studio performance, whether 5 or 500 miles away. There is nothing else like it in all radio. STENODE owners are the envy of their friends—no matter what other circuits they use. A STENODE log is not merely a log of stations painfully identified, but of stations listened to with pleasure. Because—on locals or DX—the STENODE gives—

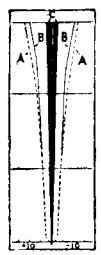
1000% More Freedom from Noise

By the STENODE principle the highest selectivity ever attained does not cut down tonal range or audio quality, which all engineers agree must be the case with other receivers. You can tune out heterodyne whistles on a STENODE while keeping your station clear and full in volume. STENODE gives—

Infinitely Better Quality

The STENODE opens up new fields for short-wave and television work, as well as broadcasting. Full details of all sorts of applications are given in the STENODE Data Book. Nine full-sized diagrams show where to place every part. How to make every connection is clearly told in STENODE Book of Directions. Your finished STENODE will put you into a new field of radio. Fill in and mail the coupon with your money order for the biggest value ever offered custom set builders.

STENODE CORP. OF AMERICA
HEMPSTEAD GARDENS, L. I., N. Y.
(FORMERLY AMERICAN RADIOSTAT CORP.)

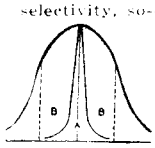


9 Blue Prints Data Book Direction Book

All for ONLY $5

Increased demand for Stenode Data Book, Instruction Book and Blue Prints permits our cutting to mere price in half. Those who have already sent in full price will receive our check for $5. We are not interested in making profit from our engineering service. Our profits come solely from Royalties paid us by our licensees.

STENODE selectivity curve makes 10KC selectivity, so-called, look like broad tuning.



STENODE selectivity is compared, above, to that of ordinary receivers. All background noise is contained in outer curve. Stenodes curve, shaded, contains but 1-10 the total noise.

STENOTUBE. Only one required in each Stenode. This heart of the Stenode circuit consists of a quartz crystal ground to 175KC frequency and mounted in tube form for easy handling. Standard UX socket base. Price $15.

None genuine without the inventor's signature.

Made in England

James Robinson

STENODE CORP. OF AMERICA
Hempstead Gardens, L. I., N. Y.

Enclosed find ☐ Money Order, ☐ Check, for $..... . Please forward me ☐ STENOTUBE, ☐ BLUE PRINTS, DATA BOOK and DIRECTION BOOK for building STENODE.

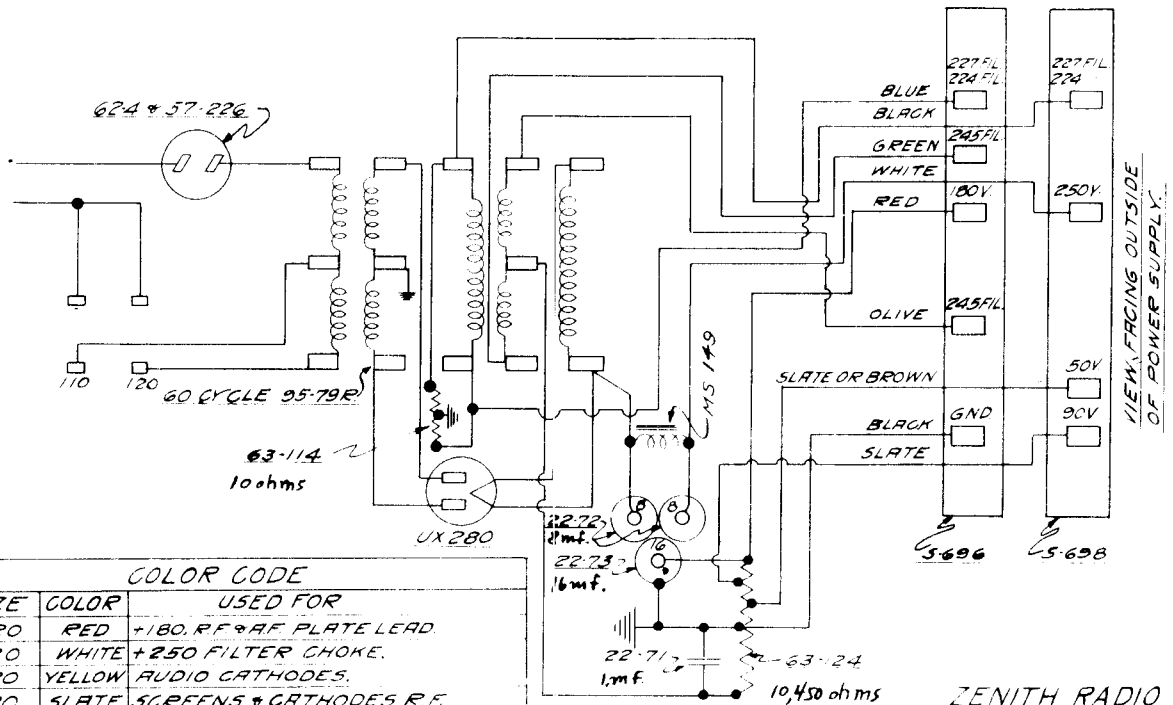
Name .....

Street .....

City ..... State .....

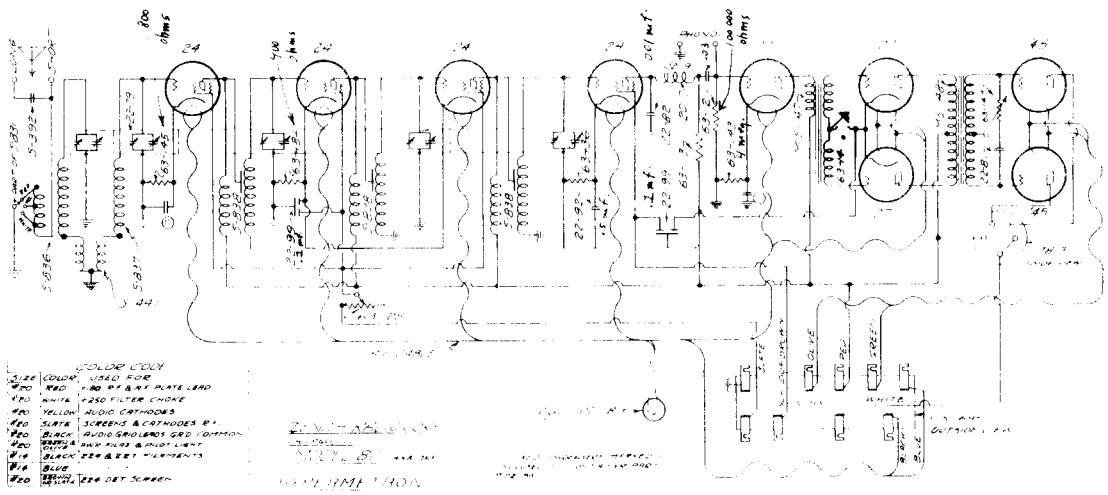
IF IT ISN'T A STENODE IT ISN'T A MODERN RECEIVER

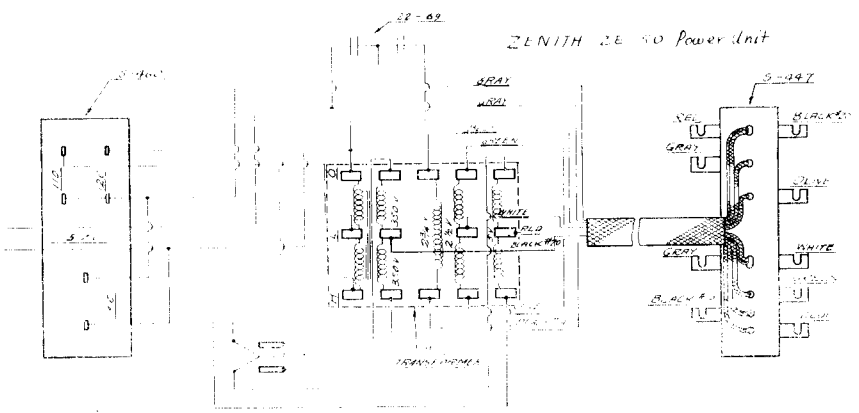
ZENITH RADIO CORP.



COLOR CODE		
SIZE	COLOR	USED FOR
#20	RED	+180, R.F. & A.F. PLATE LEAD.
#20	WHITE	+250 FILTER CHOKE.
#20	YELLOW	AUDIO CATHODES.
#20	SLATE	SCREENS & CATHODES R.F.
#20	BLACK	AUDIO GRID LEADS, GRD COMMON.
#20	GREEN & OLIVE	POWER FILS. & PILOT LIGHT.
#14	BLACK	224 & 227 FILAMENTS.
#14	BLUE	" "
#20	BROWN OR SLATE	224 DET. SCREEN.

ZENITH RADIO CORP.
CHICAGO, ILL.
MODEL 80
Power Unit





ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

Function of the Superheterodyne

Operation of the present day Superheterodyne, as in the case of all previous Superheterodynes, depends entirely on the principle of beat frequencies. A beat frequency is the result of two signals of different frequencies mixing to form a third frequency. To explain this more clearly let us suppose we hear a vibration of one definite frequency and at the same time a second and slightly different vibration is set in motion. In addition to the two separate vibrations we would hear the beat frequency of these or a third vibration equal to the difference in their frequency or pitch. This is essentially what happens in a Superheterodyne except that the frequencies involved are not audible. The beat frequency is produced by action of an oscillator frequency mixing with the incoming signal to form an intermediate frequency which then undergoes further amplification.

It is well known that R. F. Circuits become unstable and have a greater tendency to oscillate as the frequency is increased. In fact, a point may be reached in the usual T. R. F. circuit where even a screen grid tube will prove extremely inefficient. In the Superheterodyne these undesirable conditions are overcome by amplifying the signal at a low but constant frequency.

The sketch in figure 1 at A indicates the action which takes place in the usual T. R. F. set. While figure 1 at B shows that of a Superheterodyne.

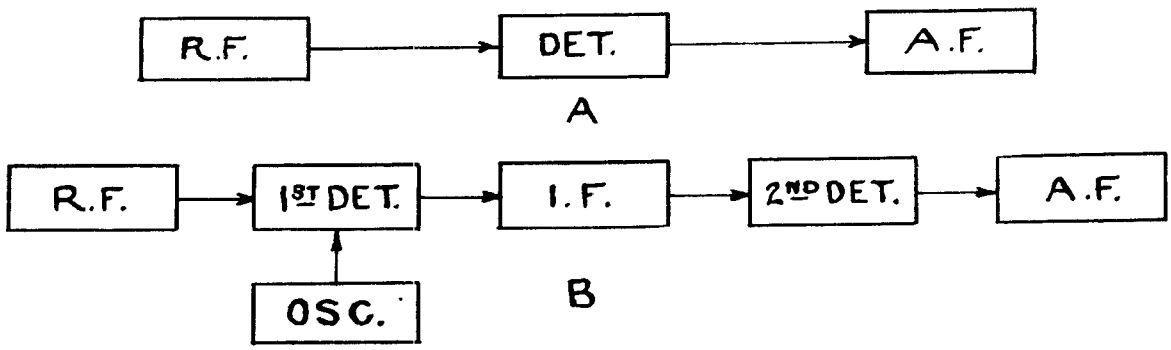


Fig. 1

In the design of a modern Superheterodyne a definite frequency is first chosen to serve in the intermediate amplifier. It is always one which will give the least reaction to the other essentials of the circuit in the form of double-spot tuning, harmonics, etc. Now in order to generate the frequency which has been decided upon the oscillator circuit must have that separation from the frequency of the incoming signal. Supposing we have taken 175 K.C. for the frequency at which we wish our intermediates to operate. Now we have an incoming signal say at 600 kilocycles. The oscillator must be tuned to either 775 K.C. or 425 K.C. to beat with it and create the third or intermediate frequency of 175 K.C. In order to simplify oscillator design, the higher frequency is most usually employed.

The oscillator tuning is made to follow the 1st detector always maintaining a difference of 175 K.C. and for this reason the intermediate frequency remains constant and we have equal amplification for any signal impressed upon the antenna, regardless of its position in the broadcast band. This, however, does not mean that all stations will be received with equal volume since the intensity generated is governed by the initial strength of the signal to which the set is tuned.

In modern Superheterodynes we use an ordinary tuned radio frequency stage before the 1st detector in order to improve selectivity and sensitivity before the intermediate frequency is formed.

In a summary of the foregoing we have a signal entering the antenna amplified at its broadcast frequency by the R. F. tube followed by the 1st detector, which, due to the action of the oscillator tube, converts it to a lower frequency, namely, 175 K. C. for further amplification in the intermediate stages following. The result of this action is a third R. F. signal of a frequency equal to that of the separation. This signal is amplified by the intermediate frequency tube. It is then rectified by a second detector tube and followed by the usual audio amplifier.

ZENITH RADIO CORPORATION

OPERATION

MODELS 91 and 92

The Zenith Models 91 and 92 uses ten tubes in a modern Superheterodyne circuit, employing many refinements. Among these being an antenna resonator, pre-selector stage, four tuned circuits, automatic volume control, and push-pull audio amplification. The following is a list of the various types of tubes used and the circuit duty of each.

R. F.—1 Z-51 Multi-Mu
1st Detector—1 Z-51 Multi-Mu
Oscillator—1 Z-27
I. F.—1 Z-51
2nd Detector—1 Z-27
1st A. F.—1 Z-27
2nd A. F.—2 Z-45
A. V. C.—1 Z-24
Rectifier—1 Z-80

In order to obtain a thorough understanding of how the ten tube Superheterodyne operates, the circuit should be followed from the antenna. A tuned coil and condenser forms the pre-selector stage which is coupled at one end to the antenna through the variable antenna compensating condenser, and from the other end direct to ground. The pre-selector coil is placed in inductive relation to the 1st R. F. tuning coil and condenser so that a transfer of energy occurs from one to the other. The 1st R. F. tuned grid circuit returns its R. F. energy through the path of least resistance, namely a fixed condenser between the coil and ground. The plate circuit of the R. F. stage is capacity coupled to the 1st detector tuned grid circuit. A section of the variable condenser and a coil is also employed here which returns to ground through a fixed condenser in the same manner as the R. F. grid circuit. It should be noted that a pick-up coil is placed in series with the 1st detector cathode by which energy is absorbed and mixed with the signal generated in the oscillator circuit. An oscillator, operates at 175 kilocycles higher in frequency than the R. F. or 1st detector, and employs a grid coil and tuning condenser and also a tickler winding. A small series or padding condenser is connected between the variable condenser section and the oscillator coil return which enables the oscillator circuit to track accurately with that of the other tuned circuits over the entire broadcast scale. (See balancing.)

After the oscillator frequency has mixed with the incoming signal in the 1st detector it is tuned to an intermediate frequency of 175 kilocycles in the 1st detector plate circuit. The 1st detector tuned plate coil is inductively coupled to a tuned grid coil of the intermediate frequency amplifier. This coil is also tuned to a frequency of 175 kilocycles. Remaining at this same frequency the signal is transferred from the intermediate frequency amplifier to the 2nd detector by means of a tuned plate coil inductively coupled to a tuned grid coil in the 2nd detector grid circuit. The 2nd detector is resistance coupled to a Z-27 1st A. F. stage which is, in turn, transformer coupled to a pair of push-pull Z-45's. The tone control, consisting essentially of a variable resistance and fixed condenser, is connected from grid to grid of the Z-45 tubes.

Automatic Volume Control

A Z-24 automatic volume control tube keeps the volume of the incoming signal constant by varying the grid bias voltage on the 1st R. F., 1st detector, and I. F. stages, in relation to the change of R. F. energy amplified before the 2nd detector. The three grid returns mentioned are coupled to the plate of the automatic volume control tube through three limiting resistors, while the 2nd detector grid couples to the volume control tube grid through a small fixed condenser. Any variation in signal strength on the 2nd detector grid is transferred to the automatic volume control tube which, proportionately varies the voltage drop across the volume control tube plate resistor which changes the bias of the three tubes mentioned.

The local distance switch simply shunts a resistor from plate to cathode of the automatic volume control tube when in the local position, thereby placing a constant bias on the three R. F. stages. This has the effect of minimizing the automatic volume control action and, consequently, subdues noise between stations. When the local distance switch is in the distance position it opens the external resistor circuit, thereby, allowing the volume control tube to operate normally.

ZENITH RADIO CORPORATION

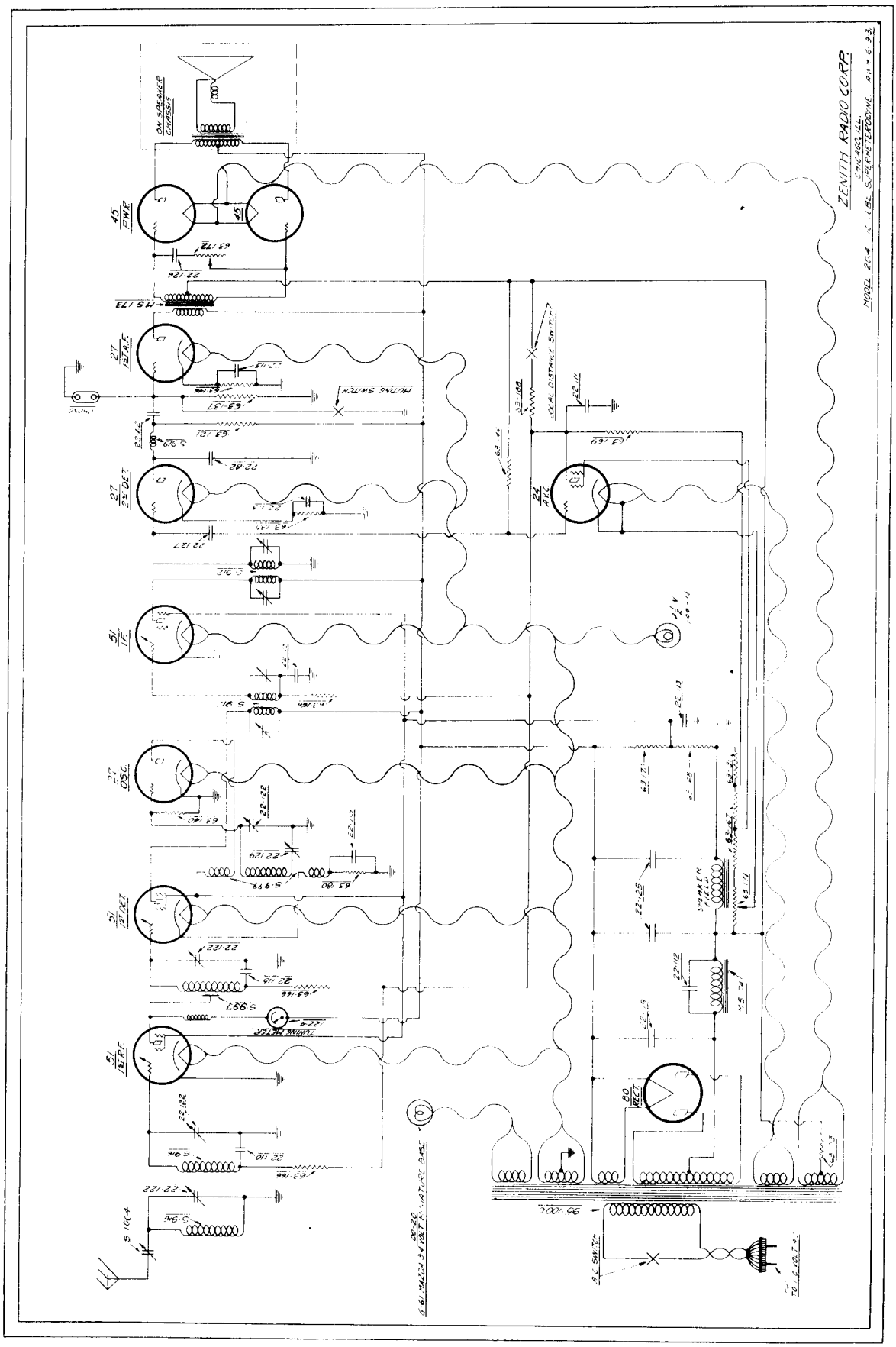


FIG. 2—CIRCUIT DIAGRAM—MODELS 91-92

ZENITH RADIO CORPORATION

Balancing Chassis

Every Zenith Superheterodyne Receiver is carefully balanced on laboratory equipment before leaving the factory and should not require further attention in this respect. However, in the event that some part of the R. F. circuit has been changed, or the adjustments shifted by mishandling, the chassis may be rebalanced as follows:

If an oscillator is available more accurate results will be obtained. It should be accurately calibrated from 1500 to 550 kilocycles and should also have provision for generating a 175 kilocycle signal. In cases where an oscillator is not available a fairly good result may be had by listening to stations which operate as nearly as possible to the extreme ends of the dial. Although an output meter will give most accurate results, satisfactory adjustments can be made simply by listening to the speaker.

The chassis should be removed from the cabinet so that all adjustments are easily accessible. Next place the test oscillator in operation and connect it direct to the antenna and ground posts of the receiver. It should then be set to 1500 kilocycles and the receiver tuned to the same reading on the dial. If the oscillator is not accurate the stations will not be received on their proper calibration. If a station is used for this purpose, the dial pointer should first be set to the exact frequency of the station being received. Beginning with the variable condenser tuning section at the extreme left, which tunes the oscillator circuit, the trimmer should be regulated for maximum response, in either the loud speaker or output meter. It will be noticed that the second section does not employ a vernier adjustment. This stage is resonated by adjusting the antenna compensator knob as explained in the instruction card. The third, or 1st R. F. trimmer, is adjusted in the same manner as the oscillator. If at any time the volume reaches a very high level, so that it is not possible to determine slight changes, it should be reduced by means of the volume control knob so as to be barely audible. The fourth, or 1st detector section, is next in order and its trimmer should also be adjusted for resonance.

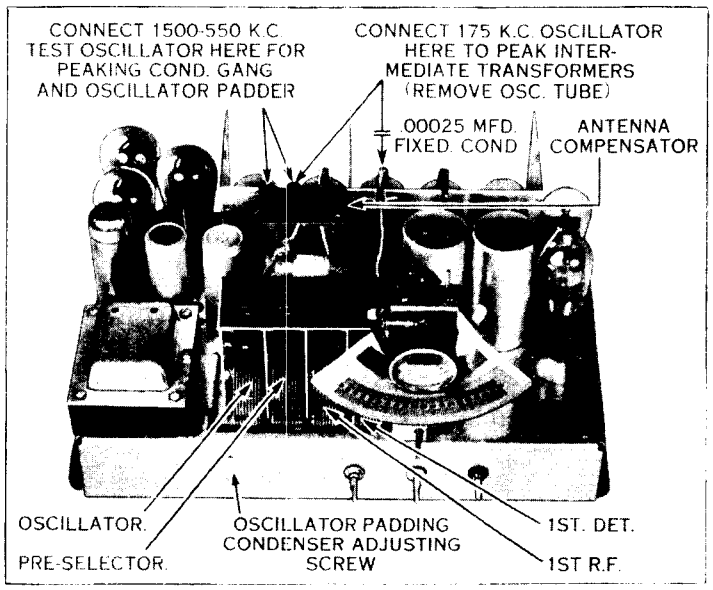


FIG. 3

After the vernier adjustments have been completed the test oscillator should be set at 550 kilocycles and the dial of the receiver turned until the oscillator signal is tuned in. Now the oscillator padding condenser (see fig. 3) should be very carefully adjusted with a screw driver for maximum output of the receiver, while rocking the tuning condenser back and forth over the signal. This padding adjustment brings the oscillating circuit of the receiver in resonance with the remaining tuned circuits and, thereby, enables it to tract accurately over the entire scale. The receiver will now operate at full efficiency and all stations will be received at their proper calibration. If this is not found to be entirely so, the entire balancing operation should be repeated.

The intermediate transformers used in the ten tube Superheterodyne have been accurately peaked at 175 kilocycles on a temperature controlled crystal oscillator before leaving the factory. It is not recommended that their adjustments be tampered with unless an oscillator is available which is very accurately calibrated at 175 kilocycles, or unless the serviceman is absolutely certain the trouble lies in their adjustment. However, if it is necessary to check the adjustments, the 175 K. C. test oscillator may be connected to the grid terminal of the 1st detector through a .00025 fixed condenser. The ground lead of the test oscillator is connected to the ground post of the receiver. The oscillator tube must be removed from the chassis while this operation is being performed. Four adjusting screws are provided under the chassis directly beneath the intermediate transformers, which tune the plate circuit of the 1st detector, grid and plate circuits of the I. F. stage, and grid circuit of the second detector. (See wiring diagram.) Beginning with the 2nd detector grid vernier, each adjusting screw should, in turn, be set for maximum signal output from the speaker or output meter. For best results the verniers should be gone over twice in the same rotation always keeping the output from the test oscillator at the weakest possible strength in order to determine slight variations in volume.

ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

Socket Voltages

Type	Position	Fil. Volts	Plate Volts	Control Grid Volts	Cathode Volts	Plate M. A.	S. G. Volts
Z-51	1st. R. F.	2.25	175	.2	0	7.	100
Z-51	1st. Det.	2.25	175	3.5	.4	3.5	90
Z-27	Osc.	2.2	70	0	0	8.5	0
Z-51	I. F.	2.2	200	4.	0	2.5	115
Z-27	2nd. Det.	2.2	115	0	9.	.5	0
Z-27	1st. Aud.	2.2	145	0	13.	6.5	0
Z-45	P. P.	2.2	275	54.	0	30.	0
Z-45	P. P.	2.2	275	54.	0	30.	0
Z-24	A. V. C.	2.2	35	.4	0	0	54
Z-80	Rect.	4.8	355	0	0	76.	0

Voltage readings taken with a Weston type 566 tester. Manual volume control in maximum position and antenna and ground disconnected. Line voltage 112.

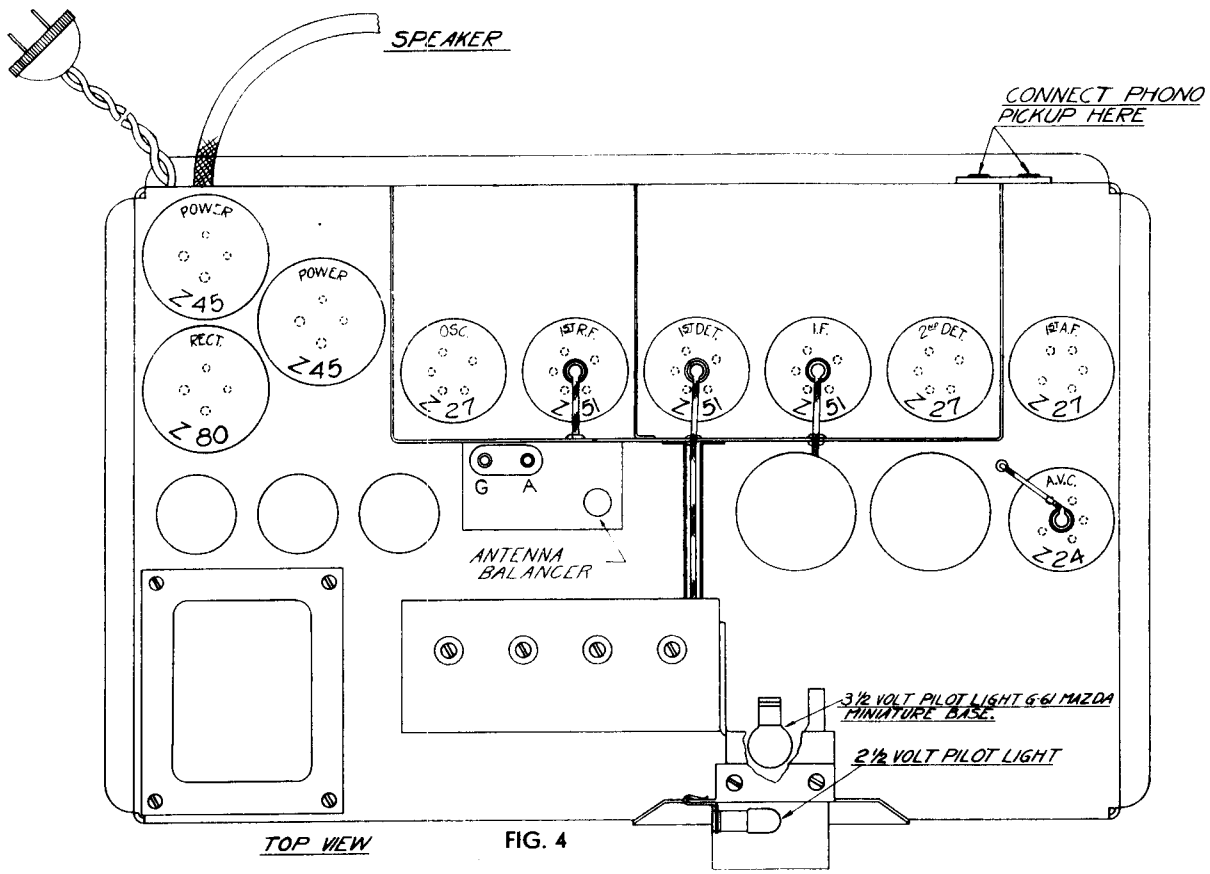


FIG. 4

TUBE LAYOUT - Showing Position and Circuit Function of each.

ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

SERVICE DATA CHART

Before using the service data chart, the service man should make certain that the tubes and antenna and ground system are not at fault.

Nature of Trouble	*Possible Cause*	*Remedy*
No Signals	Defective A. C. Switch.	Replace.
	No power at socket outlet.	Check line fuses and socket voltage.
	One or more defective tubes.	Test and replace.
	Shorted antenna series condenser.	Adjust to relieve short.
	Shorted oscillator padding condenser.	Inspect and adjust or replace if necessary.
	Open windings or broken connections on oscillator or R. F. coils.	Inspect and resolder or replace.
	Shorted section of variable condenser gang.	Clean all sections with a pipe cleaner to remove metal slivers.
	Shorted trimmer on variable condenser gang.	Adjust to relieve short.
	Open tuning meter.	Repair connections or replace.
	Grounded volume control.	Inspect all volume control leads and respace control from chassis.
	2nd detector choke grounded or open.	Remove choke shield and adjust or replace.
Oscillation (Over entire scale)	Open by-pass condenser.	Replace.
	Grounded resistor.	Space from chassis.
	Poor ground returns.	Resolder and tighten.
	Open oscillator plate coil.	Replace oscillator coil.
	Broken connection in oscillator circuit.	Trace and repair or resolder.
	Defective oscillator tube.	Replace.
Oscillation (Low frequency end)	Variable condenser cradle not grounding properly.	Solder three pigtail wires from each end and from center of cradle direct to chassis on the under side.
Hum	Open or shorted power bias resistor.	Replace.
	Loose transformer laminations.	Tighten lamination bolts.
	Grounded pilot light socket (2.5 volt).	Turn socket contacts away from dial bracket.
	Grounded filament lead.	Trace filament wiring and remove ground.
	Shorted filter choke.	Check leads or replace choke.
	Defective electrolytic condenser.	Replace.
	Defective tube.	Locate and replace.
Tuning meter does not read	Open meter.	Replace.
	Grounded meter.	Replace.
	Open R. F. coil.	Resolder or replace.
	Grounded volume control.	Respace from chassis and check connections.
Manual volume control does not operate	Defective A.V.C. tube.	Replace.
	Shorted or grounded volume control	Respace from chassis and check connections or replace.
	Rosin or broken joint in A.V.C. circuit.	Repair or resolder.
	Shorted I.F. transformer.	Replace I.F. unit.

ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

SERVICE DATA CHART

Nature of Trouble—Cont.	*Possible Cause—Cont.*	*Remedy—Cont.*
Weak reception	Resistors touching each other on resistor strip.	Respace.
	Grounded resistor.	Space from chassis.
	High resistance joint on R. F. coils.	Resolder where necessary.
	Defective padding condenser.	Replace.
	Padding condenser not set properly.	See "Balancing."
	Chassis out of balance.	See "Balancing."
	Antenna Compensator not adjusted properly.	See "Balancing."
	Open cathode winding on oscillator coil.	Repair or replace.
	Defective tubes.	Replace.
Flutter or motor-boating	Filament lead cutting into grid terminal of 2nd detector.	Respace from grid terminal.
	Oscillation.	See paragraph on "Oscillation."
	Grounded resistor.	Respace from chassis.
	Poor ground connections.	Tighten resistor brackets to chassis and resolder ground return connections.
	Open by-pass condenser in audio circuit.	Replace.
	Open grid circuit in audio circuit.	Defective push-pull transformer or rosin joint.
	Defective local-distance switch.	Repair or replace.
Fading	Defective A.V.C. tube.	Replace.
	Other tubes defective.	Test and replace.
	Resistor mounting loose on chassis.	Tighten securely.
	Poor ground return.	Tighten and resolder all grounds in chassis.
	Defective local-distance switch.	Repair or replace.
	Defective by-pass condenser.	Locate and replace.
	Rosin joint on R. F. coils or variable condenser.	Resolder.
Intermittent reception	Loose resistor mounting.	Tighten mounting screws securely.
	Defective by-pass condenser.	Locate and replace.
	Broken strands on R. F. coils.	Resolder.
	Rosin or broken connection.	Check all connections and resolder where necessary.
	Defective A. C. switch.	Replace.
	Defective local-distance switch.	Repair or replace.
	Grounded resistor.	Space resistor from chassis.
	Defective tubes.	Replace.
Dial off calibration	Chassis out of balance.	See "Balancing."
	Dial strip bracket pressed against front of cabinet.	Space chassis from front of cabinet.
	Dial cam and drum assembly loose on condenser shaft.	Tighten securely.

ZENITH RADIO CORPORATION

REPLACEMENT PARTS

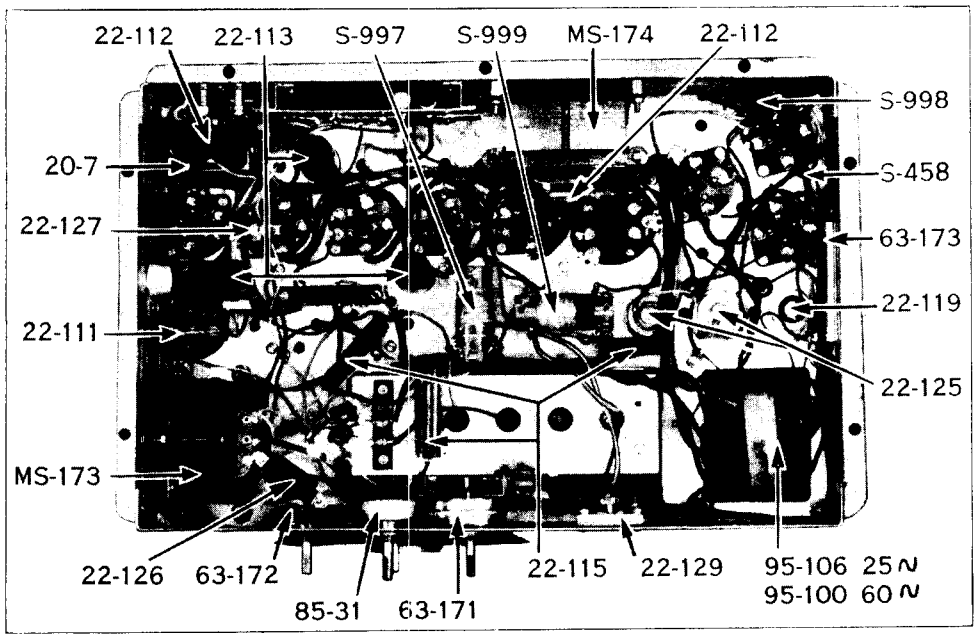


FIG. 5

CONDENSERS

22- 82	.001 Mfd.	(2nd Det. Plate)	$ .30
22-110	.1 Mfd.	(R. F.)	.50
22-111	.03 Mfd.	(A.V.C. Plate)	.30
22-112	.1 Mfd.	(2 Used. See Footnote)	.35
22-113	.5 Mfd.	(3 Used. See Footnote)	.50
22-115	.1 Mfd.	(3 Used. See Footnote)	.30
22-119	6. Mfd.	(High Voltage Electrolytic)	1.50
22-122	Four Gang Variable		7.00
22-125	8. Mfd.	(Low Voltage Electrolytic. 2 Used)	1.50
22-126	.006 Mfd.	(Tone Control)	.55
22-127	.000025 Mfd.	(A.V.C. Coupling)	.35
22-129	Oscillator, Padding		.75

RESISTORS

63-111	2M Ohm 1 Watt	(1st A. F. Cathode)	$ .30
63-121	100M Ohm 1 Watt	(2nd Det. Plate)	.30
63-131	400 Ohm ½ Watt	(A.V.C. Voltage Divider)	.30
63-135	25M Ohm ½ Watt	(2nd Detector Cathode)	.30
63-137	250M Ohm ½ Watt	(1st A. F. Grid)	.30
63-140	1 Meg. Ohm ½ Watt	(Oscillator Grid)	.30
63-144	3 Meg. Ohm ½ Watt	(A.V.C. Grid)	.30
63-146	2M Ohm ½ Watt	(1st A. F. Cathode)	.30
63-166	1400 Ohm ¼ Watt	(3 Used. See Footnote)	.30
63-167	8M Ohm 1 Watt	(A.V.C. Divider)	.30
63-168	3600 Ohm 2 Watt	(Plate Voltage Divider)	.50
63-169	400M Ohm ½ Watt	(A.V.C. Plate)	.30
63-170	2800 Ohm 2 Watt	(Plate Voltage Divider)	.50
63-171	Manual Volume Control and Switch Assembly		1.65
63-172	Tone Control		1.00
63-173	750 Ohm Metal Mounting	(Power Tube Bias)	.40
63-180	1M Ohm ½ Watt	(1st Detector Cathode)	.30
63-188	4½ Meg. Ohm ½ Watt	(A.V.C. Plate)	.30

Note: All resistors employed in this receiver are marked in accordance with R. M. A. standards. Color code charts may be obtained by writing direct to the Erie Resistor Corp., Erie, Pa.

S-912	Intermediate Transformer Complete (2 Used) (Specify with or without grid lead)	$2.50
S-916	Antenna and 1st R. F. Coils	.75
S-997	1st Detector Complete	1.25
S-999	Oscillator Coil Complete	1.25

Note: 22-112 Filter Choke By-pass and 1st Audio Coupling Condensers.
22-113 1st R. F., 1st Det. and I. F. Screen. 2nd Det. and A. F. Cathode.
22-115 2nd Det. and I. F. Grid Return. 1st Det. Cathode.
63-166 1st R. F., 1st Det. and I. F. Grid Return Resistor.

ALL PRICES ARE SUBJECT TO REGULAR DISCOUNT AND CHANGE WITHOUT NOTICE.

ZENITH RADIO CORPORATION

REPLACEMENT PARTS

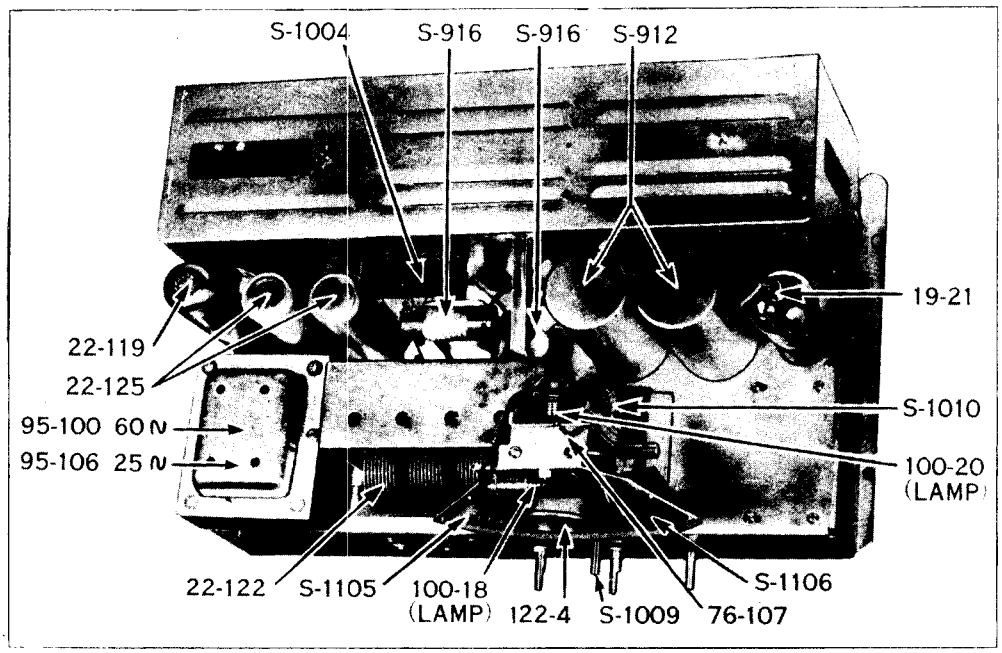


FIG. 6

DIAL ASSEMBLY

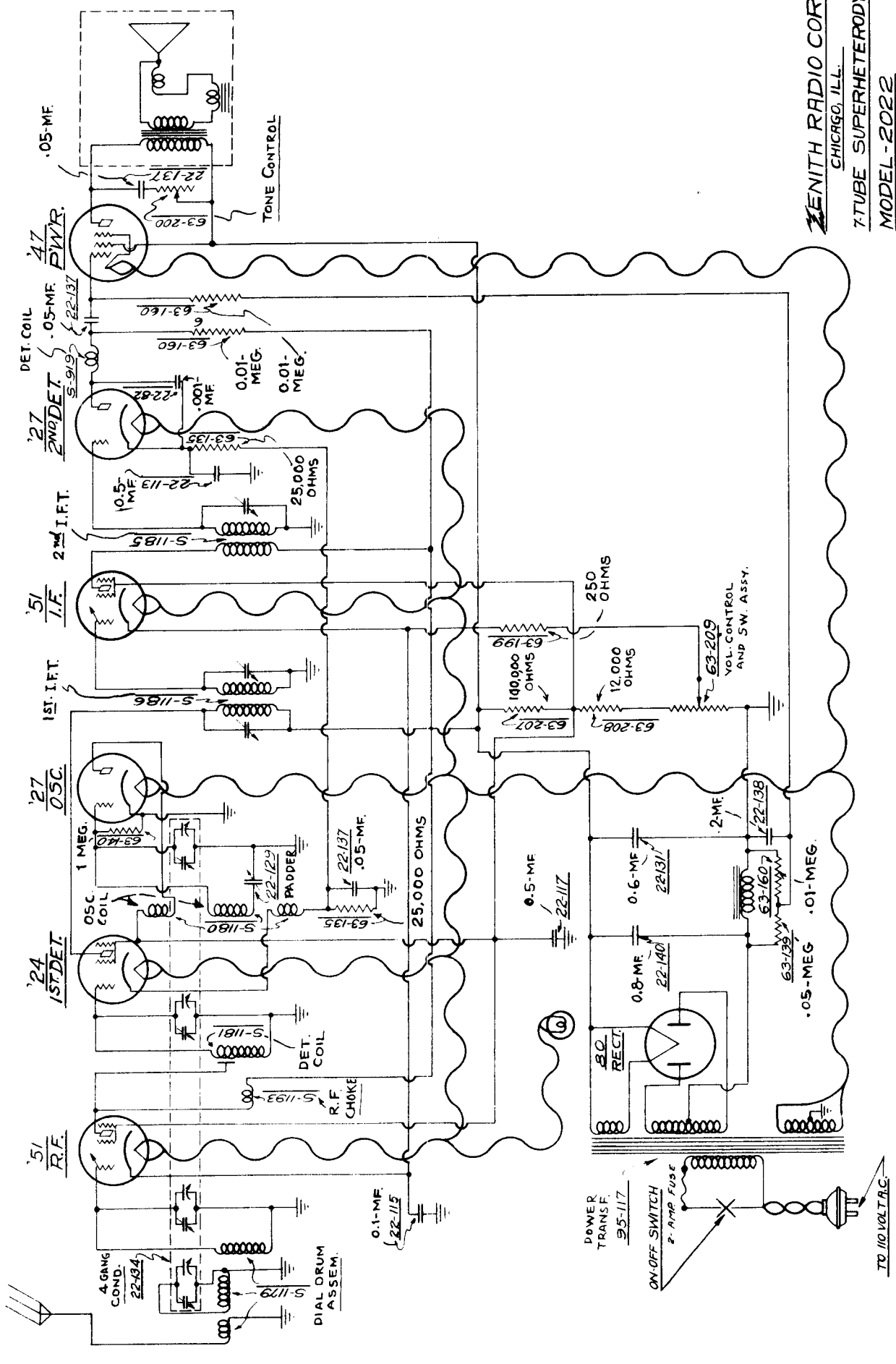
6-14	Pointer Arm Bearing	$ .20
15-12	Dial Light Cap	.35
76-107	Dial Elevator Shaft	.10
80-72	Pointer Arm Tension Spring	.08
94-119	Roller Bushings	.08
100-18	2½V Meter Lamp	.25
100-20	3¼V Dial Lamp	.70
122-4	Tuning Meter and Cord	2.25
148-3	Dial Elevator Arm	.35
S-1003	Dial Lamp Socket and Clip (less Lamps)	.60
S-1009	Tuning Shaft and Bracket Assembly	1.50
S-1010	Drum Gear and Cam	.85
S-1105	Dial Strip and Bracket Assembly	.60
S-1106	Dial Pointer and Reflector Plate	1.50

MISCELLANEOUS

19-21	Grid Lead Clips	$ .02
20-7	2nd Detector Plate Choke	.50
24-24	Electrolytic Condenser Cover	.02
46-53	Knobs (3 Used)	.25
46-54	Knobs	.20
49-37J	Dynamic Speaker	15.00
57-308	Escutcheon Plate for Dial	.80
57-309	Escutcheon Plate for Meter	.35
73-8	Dial Drum Bushing Set Screw	.02
73-11	Knob Set Screws	.03
78-28	Stationary Automatic Pilot Lamp Socket	.35
78-36	Z-51 Socket	.20
78-37	Z-27 Socket	.20
78-38	Z-24 Socket	.20
78-40	Z-80 Socket	.20
78-41	Z-45 Socket	.20
85-31	Local Distance Switch	.85
93-152	Volume Control Washer (Large Insulating)	.05
93-153	Volume Control Washer (Small Insulating)	.01
93-154	Cup Washer for Electrolytic Condenser	.05
93-155	Insulating Washer	.05
95-100	60 Cycle Power Transformer	7.00
95-106	25 Cycle Power Transformer	11.50
112-10	Tube Shield Thumb Screw	.05
S-458	A. C. Line Cord and Plug	.40
S-998	Speaker Cord and Connector Strip	.75
S-1004	Antenna Series Condenser and Binding Post Assembly	1.15
MS-173	Five Lead Push Pull Transformer	4.50
MS-174	Power Choke	3.50

ALL PRICES ARE SUBJECT TO REGULAR DISCOUNT AND CHANGE WITHOUT NOTICE.

ZENITH RADIO CORPORATION



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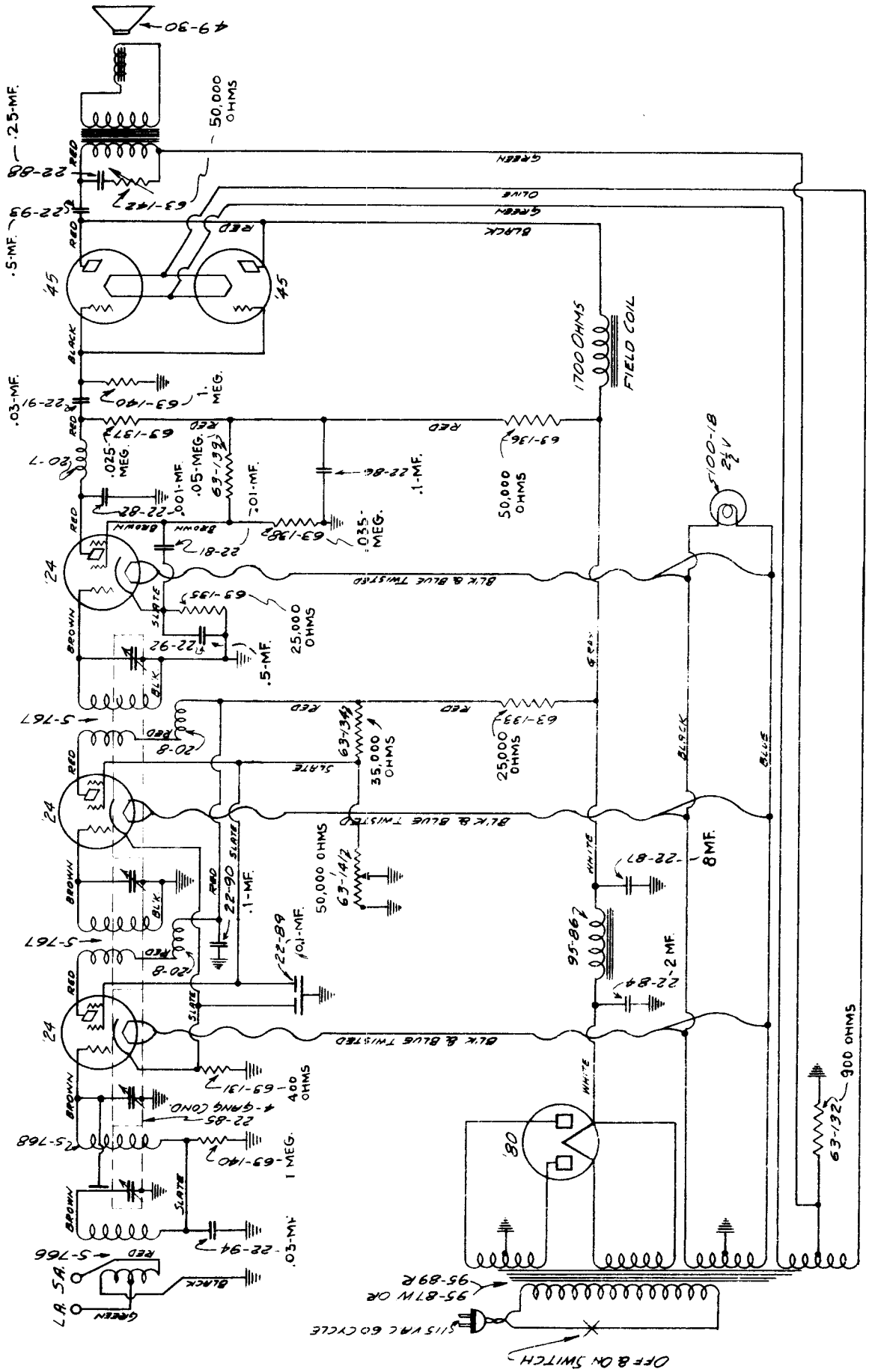

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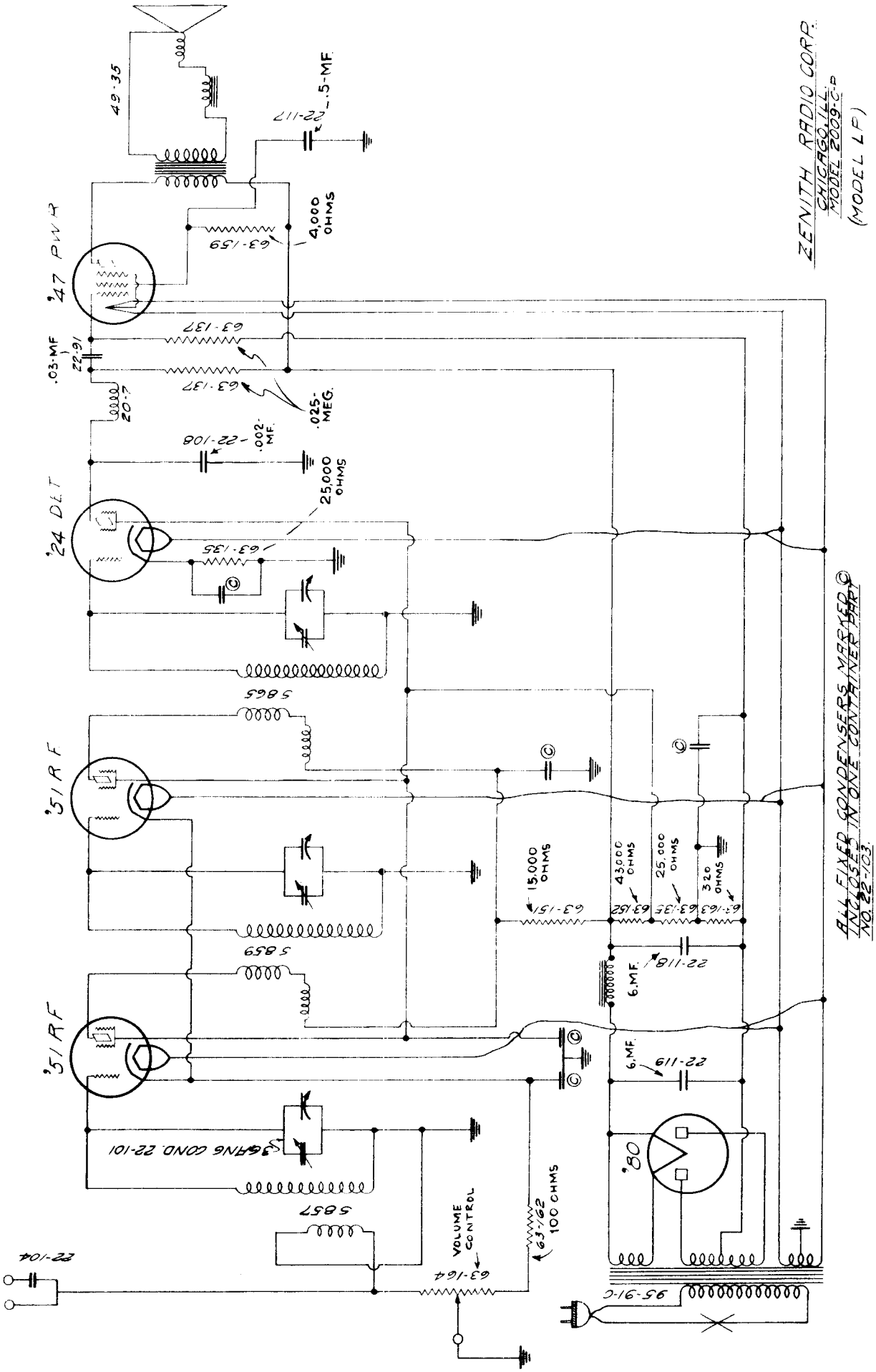

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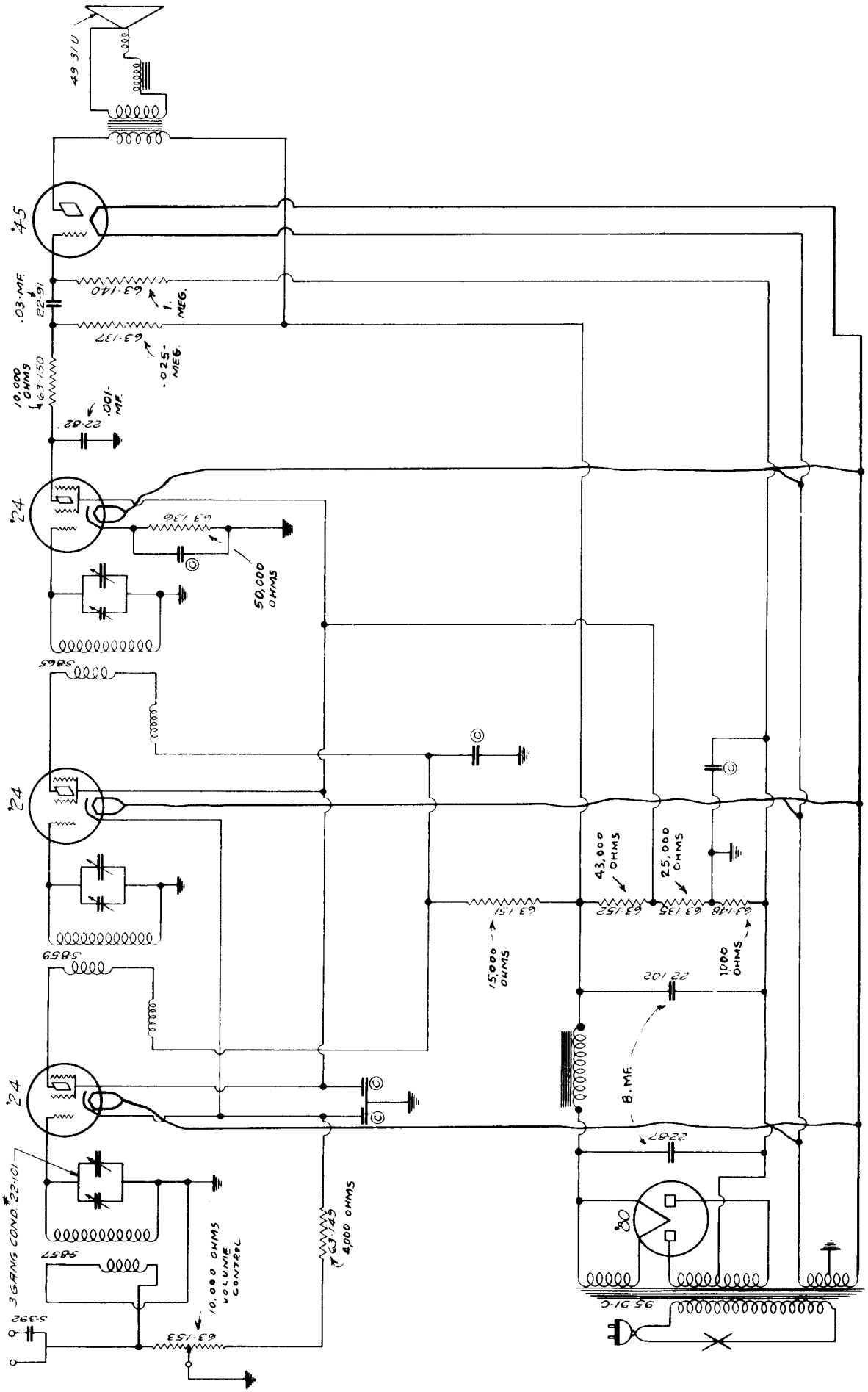

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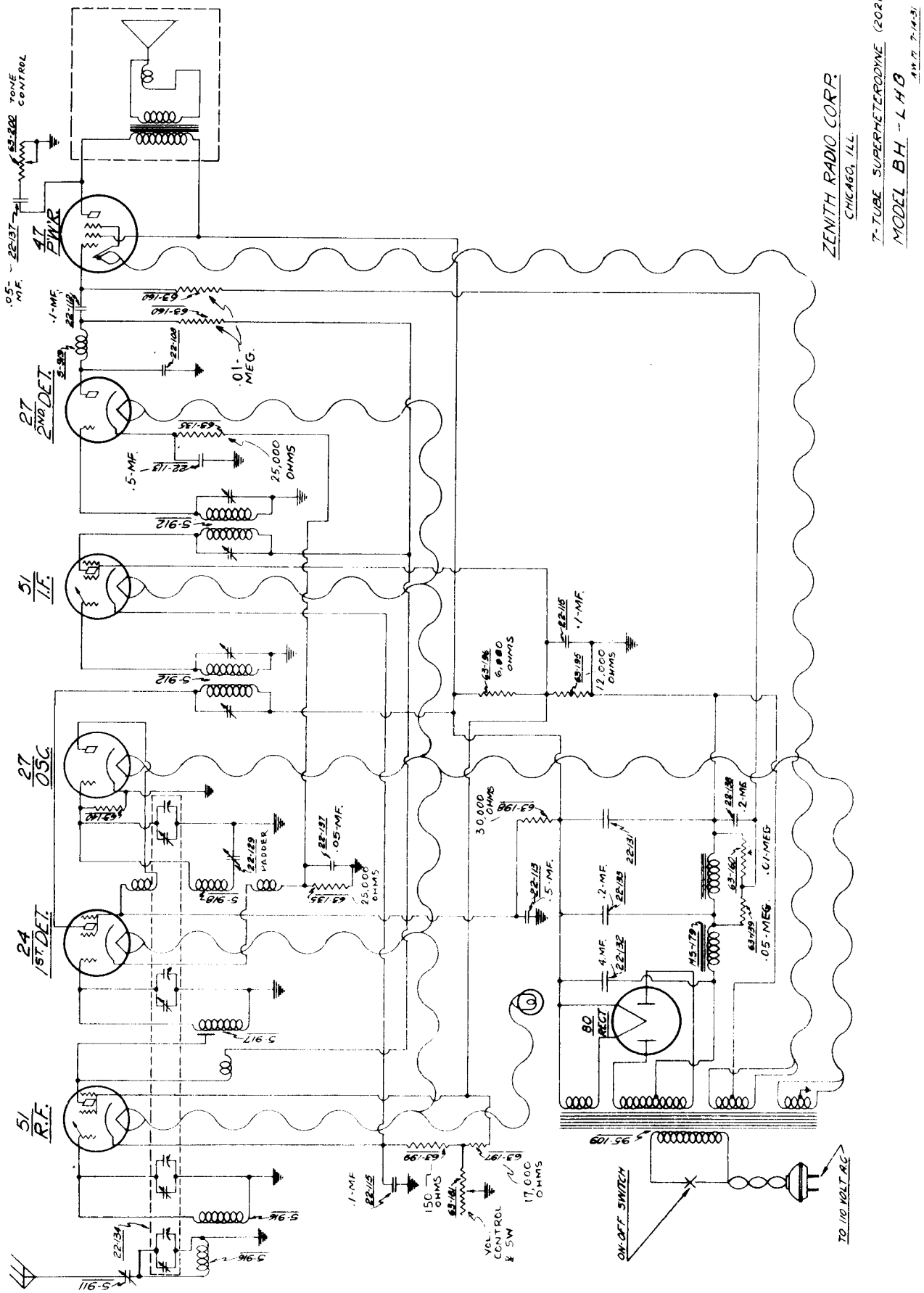
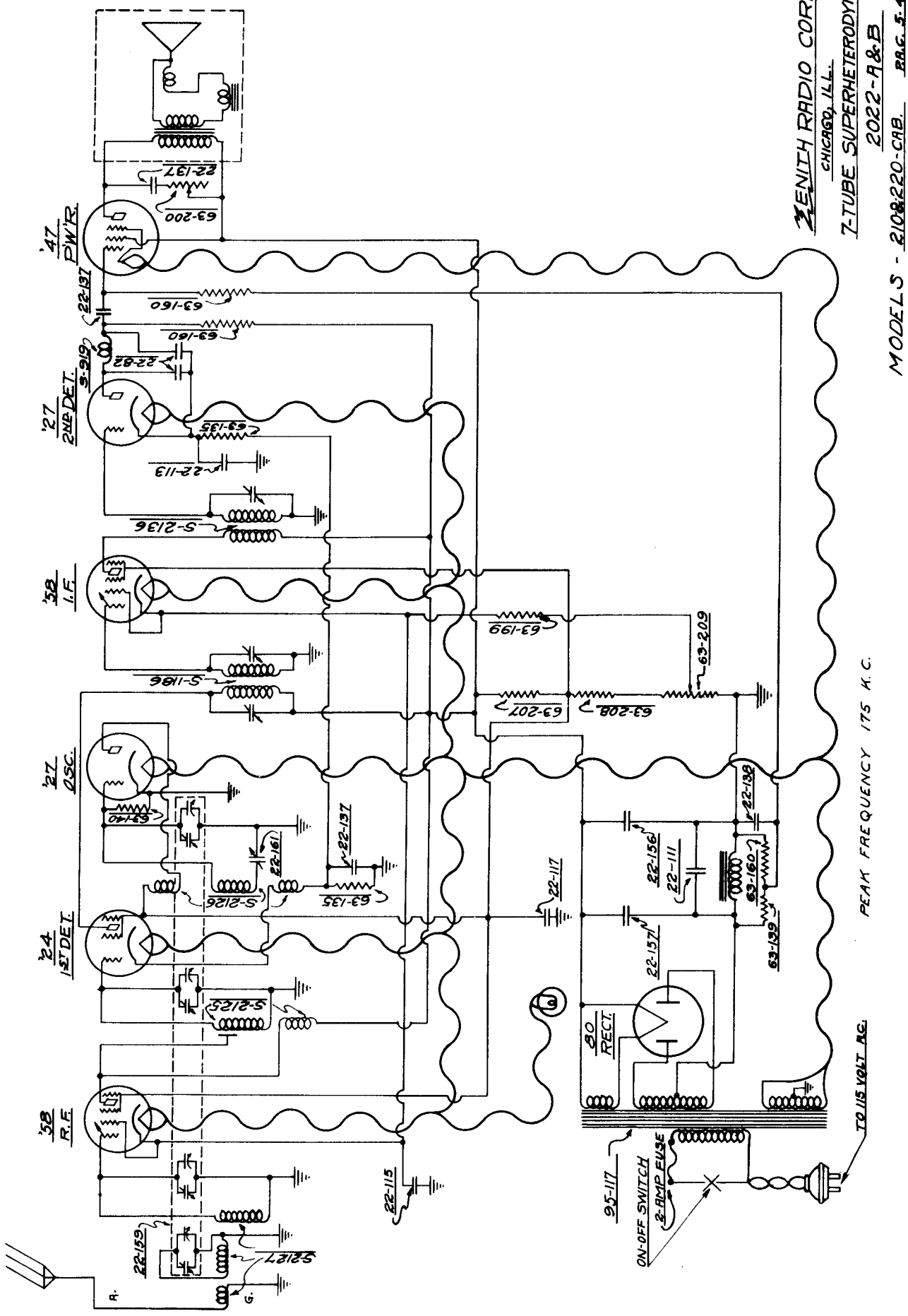


ZENITH RADIO CORPORATION



ZENITH RADIO CORPORATION

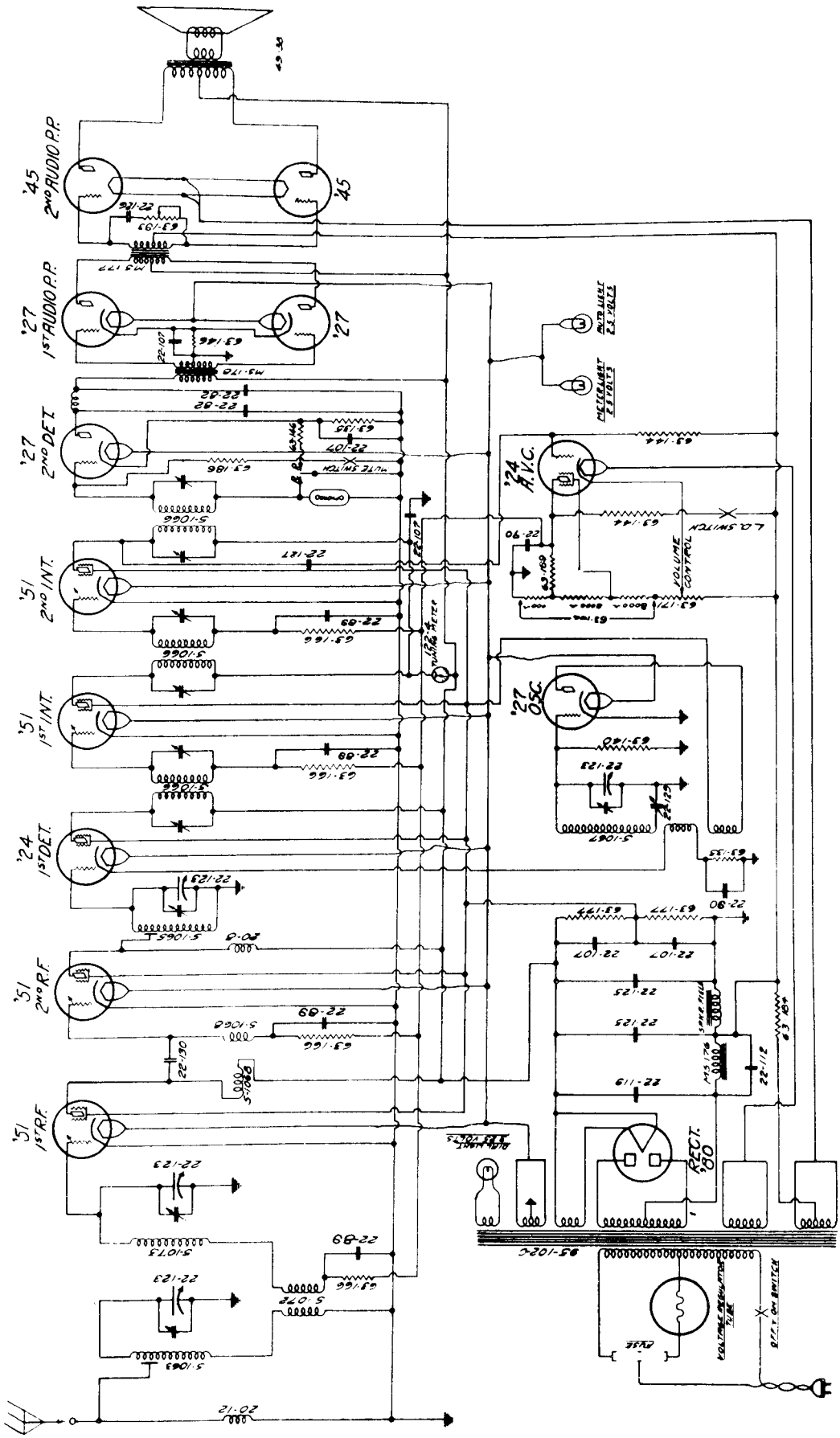
PARTS AND PRICES — MODELS 210-220

	Variable Condenser Assembly	
22-159	Four Gang Condenser	$ 6.00
S-2121	Dial Drum Assembly	.80
11-3	Pulley String per ft	.10
26-34	Dial Strip	.10
100-18	2½ volt pilot Lamp	.12
S-769	Dial Lamp Socket Assembly (Less Lamp)	15
	Fixed Condensers	
22-82	.001 mfd. (2nd Detector Plate)	.30
22-111	.03 " (Filter Choke Bypass)	.30
22-113	.5 " (2nd Detector Cathode)	.50
22-115	.1 " (R.F.& I.F.Cathode)	.35
22-117	.5 " (R.F.& I.F.Detector Screen)	.50
22-161	Padder	.75
22-156	6. mfd. (Power Filter)	1.25
* 22-137	.5 " (3 used, see footnote)	.25
22-138	.2 " (Power Grid)	.25
22-157	8. " (Power Filter)	1.50
	Resistors	
63-135	25M ohm (1st,2nd Detector Cathode)	.30
63-139	500M " (Power Grid)	.30
63-140	1meg " (Oscillator Grid)	.30
63-160	100M " (2nd Det. Plate & Power Grid)	.30
63-199	150 " (R.F.& I.F. Cathode, Flexible)	.30
63-200	Tone Control	1.00
63-207	10M ohm (Voltage Divider, Wire Wound)	.35
63-208	12M " (Voltage Divider)	.30
63-209	Volume control and switch Assembly	1.25
	Coils	
S-919	2nd Detector choke	.60
S-2127	R.F.Pre-selector	1.50
S-2126	Oscillator coil	.90
S-2125	Detector coil	.90
S-1186	1st I.F. transformer (175 K.C.	1.50
S-2136	2nd I.F. " (175 K.C.	1.40
	Miscellaneous	
49-44	Dynamic Speaker	8.00
46-58	Control Knobs, all sets, three used	.10
52-27	Speaker cable	.25
57-326	Escutcheon plate, all sets	.30
78-54	Z-58 Tube Socket	.20
78-37	Z-27 " "	.20
78-38	Z-24 " "	.20
78-39	Z-27 " "	.20
78-40	Z-80 " "	.20
83-228	Speaker cable terminal strip	.15
93-138	Felt Washer for Control Knob	.01
95-127	60 cycle 110 volt Power Transformer	4.50
95-130	25 " 110 " " "	6.75
95-128	60 " 220 " " "	6.75
136-2	2 Amp Fuse	.10
136-4	1 " "	.10
S-2124	Heat Insulating shield	.30
S-1183	Antenna and ground mounting plate complete	.25
S-2120	Variable condenser shield	.85
MS-187	Tube Shield Assembly	.60

IMPORTANT: GIVE SERIAL NUMBER OF RECEIVER ON ALL PART ORDERS

* A.F. COUPLING, TONE CONTROL, AND FIRST DETECTOR CATHODE.

ZENITH RADIO CORPORATION



ZENITH RADIO CORPORATION

Balancing Chassis

Each Zenith Superheterodyne receiver is carefully balanced on a temperature controlled Crystal Oscillator before leaving the factory and should require no further attention in this respect. However, in the event that a part of the R. F. circuit has been changed or the phasing adjustments shifted by mishandling, the chassis may be re-balanced as follows:

A test oscillator will give more accurate results and is, therefore, recommended in preference to use of a broadcast signal. It should be calibrated from 1500 to 550 K. C. and also provide a 175 K. C. signal. An output meter is not required since the tuning meter on the set is connected to the intermediate stages in such a way that it shows a variation during adjustment of any R. F. or intermediate circuit of the set. It is only necessary to watch the tuning meter for greatest swing to the right when adjusting the R. F. and I. F. trimmer condensers.

The chassis should be removed from the cabinet for this operation so that all adjustments are easily accessible. The test oscillator should be set to 1500 K. C. and attached to the antenna and ground posts. If a broadcast signal is used, tune to a station as near to 1500 K. C. as it is possible to hear. In this case the dial must point to the exact frequency on which the station operates.

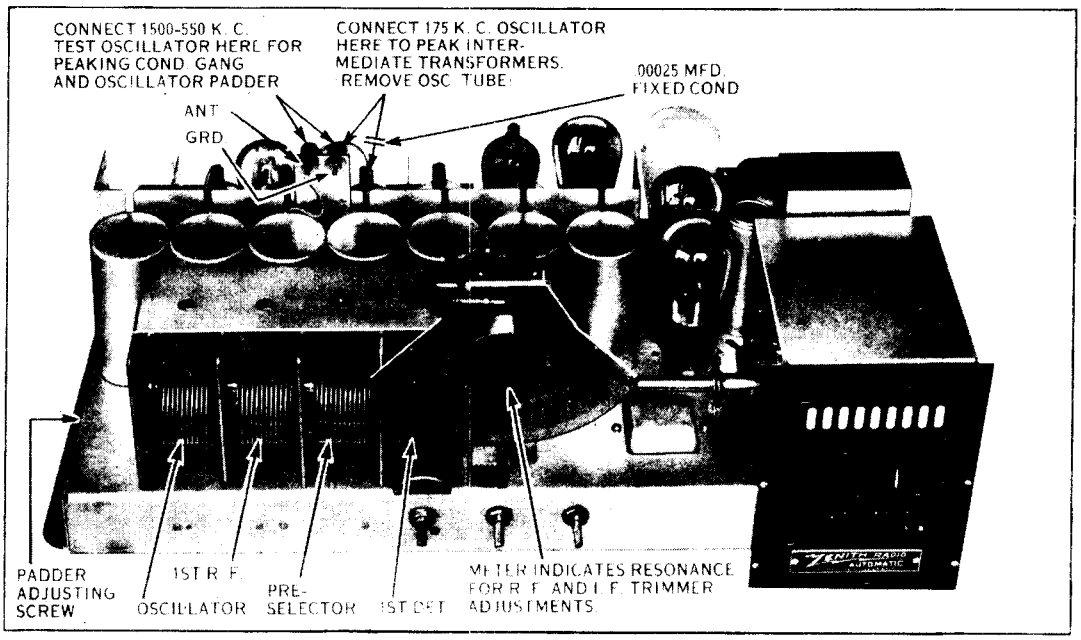


Fig. 2

First turn the trimmer provided on the oscillator section of the condenser gang (See fig. 2) and peak for greatest deflection, to the right, of the tuning meter. The second section from the left tunes the 1st R. F. stage and is next in order. Also peak for the greatest swing of the meter. The preselector or third, and the 1st detector or fourth sections follow in turn and are adjusted in the same manner. The second R. F. stage is of the fixed impedance type and therefore requires no adjustment. The untuned coils are concealed beneath the chassis in a small round shield.

When the trimmers have been resonated, set the dial to 550 K. C. and tune the test oscillator until it is heard clearly in the speaker. This may also be done by tuning to a station at or near 550 K. C. Turn the oscillator padding condenser screw for greatest swing to the right on the tuning meter, while rocking the dial back and forth over the signal. The padder adjusting screw will be found on the left side of the chassis base when looking from the front. (See Figure 2.)

The six intermediate adjusting screws provided beneath the chassis, directly under the intermediate transformers (See fig. 5) are to be used only when it is absolutely certain that trouble lies at that point. If it is necessary to change the setting connect an accurate 175 K. C. test oscillator to the ground post and to the 1st detector grid cap through a .00025 mfd. fixed condenser. The oscillator tube must be removed for this operation. Beginning with the first detector plate screw (the one farthest to the left when viewing the chassis from underneath with the control shafts at the top) each one is tuned for maximum swing of the tuning meter. The procedure applies to all but the last or second detector grid vernier. The meter is not effected by this circuit, therefore, it will be necessary to turn it to a point which gives greatest volume from the speaker.

ZENITH RADIO CORPORATION

ZENITH AUTOMATIC RADIO

Socket Voltages

Type	Position	Fil. Volts	Plate Volts	Control Grid Volts	Cathode Volts	Plate M. A.	S. G. Volts
Z-51	1st. R. F.	2.2	185	— 9.	0.	2.5	80
Z-51	2nd. R. F.	2.2	200	— 3.9	0.	3.	84
Z-24	1st Det.	2.2	185	0.	+ 7.	.25	70
Z-27	Osc.	2.2	80	0.	0.	7.	0
Z-51	I. F.	2.2	185	— 4.	0.	3.	90
Z-51	I. F.	2.2	185	— 4.	0.	2.	90
Z-27	2nd. Det.	2.2	185	0.	+17.5	.5	0
Z-27	1st. P. P.	2.2	165	0.	+12.5	3.	0
Z-27	1st. P. P.	2.2	165	0.	+12.5	3.	0
Z-45	2nd. P. P.	2.3	240	—48.	0.	36.	0
Z-45	2nd. P. P.	2.3	240	—48.	0.	36.	0
Z-24	A. V. C.	2.3	30	— .4	0.	0.	45
Z-80	Rect.	5	350	0.	0.	70.	0
	Vol. Reg.	Con-	tin-	uity	test	only.	

Voltage readings taken with a Weston model 566 type 3 tester. Manual volume control in maximum position and antenna and ground disconnected. Line voltage 112

Fig. 3

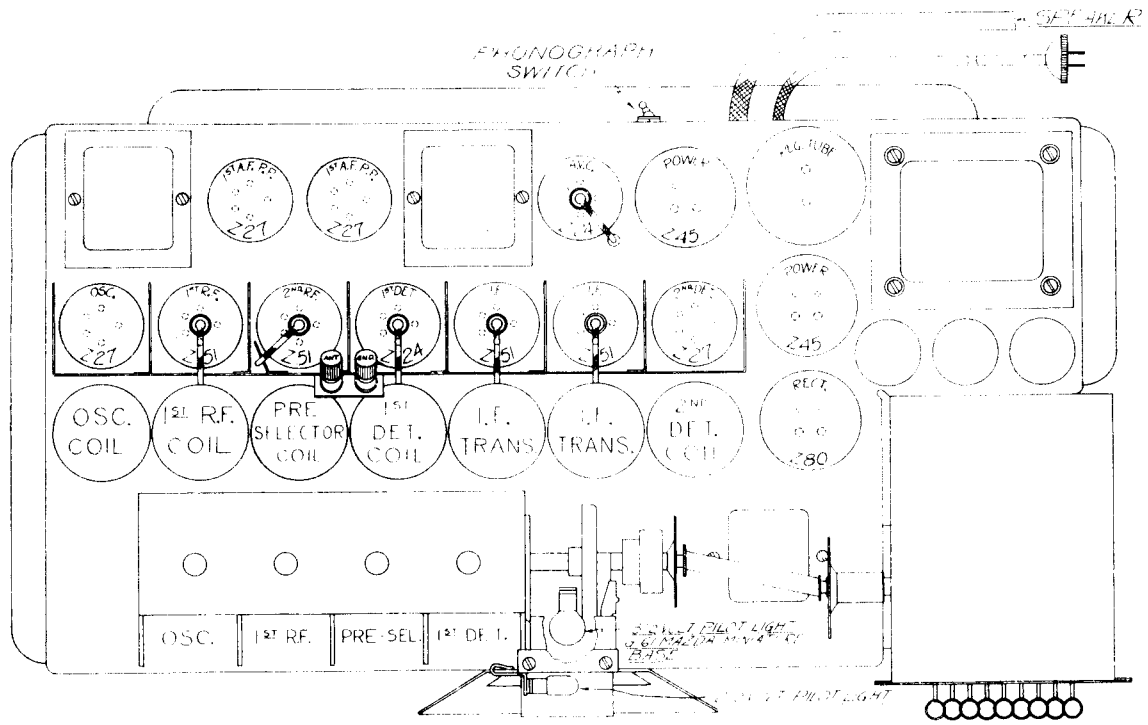
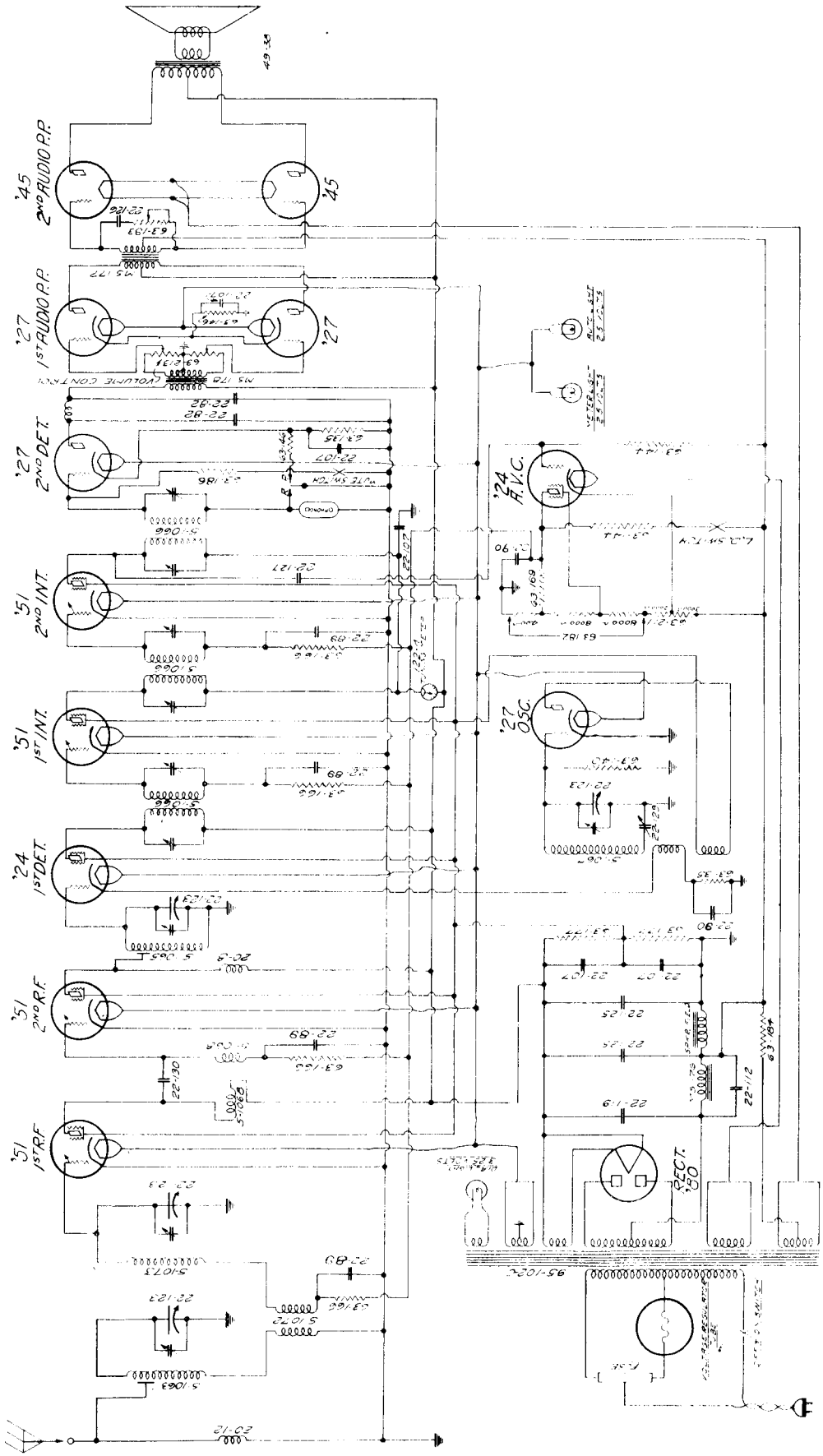


Fig. 4 TUBE LAYOUT - Showing Position and Circuit Function of each.

ZENITH RADIO CORPORATION



MODEL 103 No. 5B

ZENITH RADIO CORP.
CHICAGO, ILL.
4 TUBE SUPERHETERODYNE
MODEL 2017

CIRCUIT DIAGRAM

(SERIAL NOS. AFTER 450,451 ONLY)

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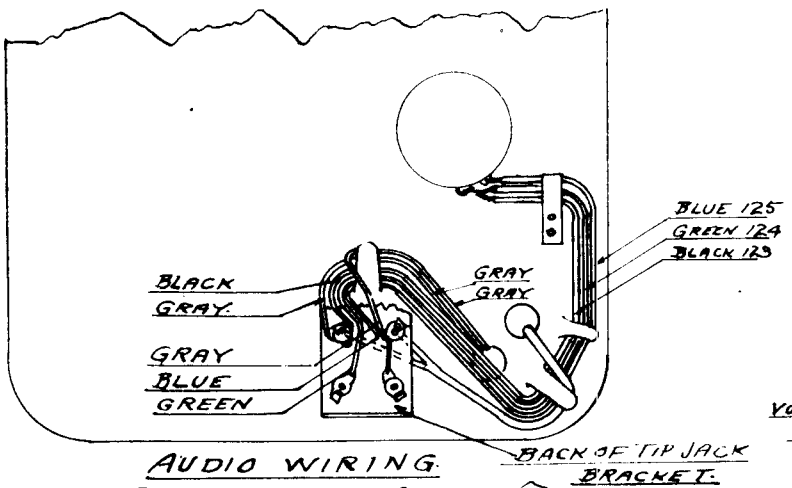
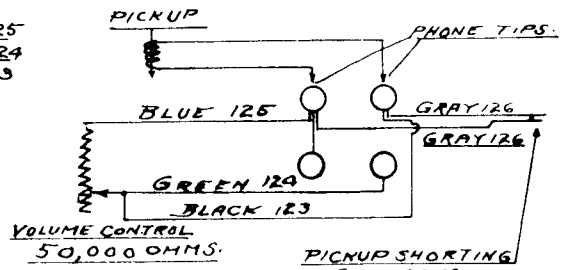
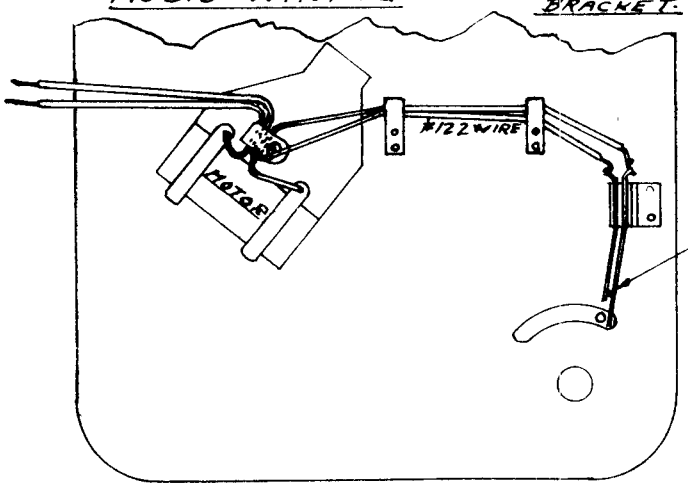


AUDIO WIRING.

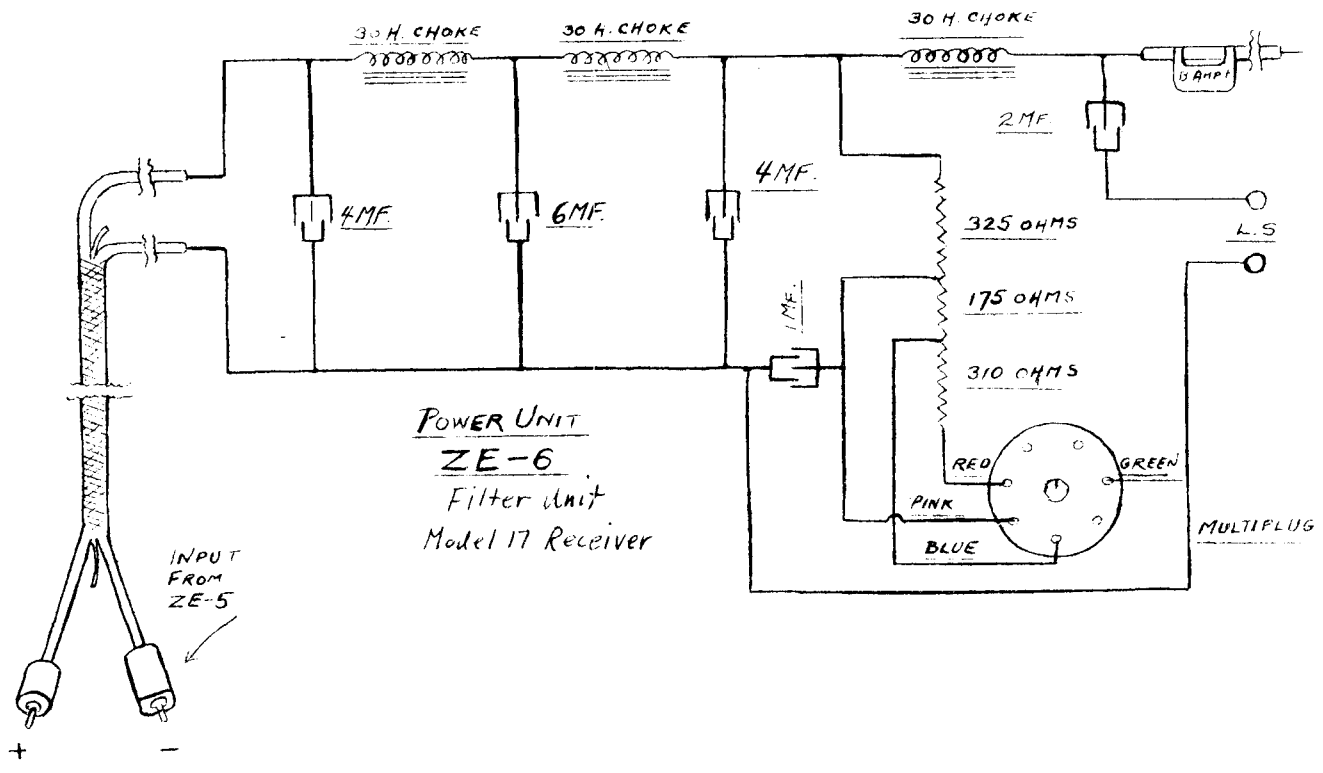


WIRING DIAGRAM.



MOTOR WIRING.

ALLEN HOUGH CARRYOLA CO. MILWAUKEE. WIS.			
APR.	DATE	DRAWN DEON	DATE 8-14-30
ZENITH WIRING DIAGRAM.		ON RECORD CHANGER	
		1-M-9	



POWER UNIT
ZE-6
Filter Unit
Model 17 Receiver

SERVICE-MEN WANTED

There is a real change in every part of the radio business. A change which can bring great benefits to you. Radio Receivers are being sold for a song and unfortunately many of them are filled with inferior tubes, when they are sold. You can make a real friend of the purchaser of every such receiver by filling all his sockets with good tubes. But that is not the whole story.

The Triad Mfg. Co. is the first manufacturer to recognize the vital part you serviceman play in this new radio business. Triad knows that, with your confidence, a greater number of users of Triad tubes can be reached. Therefore, the directors have decided to make actual partners of some of you and permit you to sell them.

TRIADS HAVE ALWAYS BEEN GOOD TUBES

The Directors of the Triad Mfg. Co. have been in the tube business for many years. They are in constant contact with men like you every day. They are very familiar with the problems you have to face. They have always given you tubes you could bank on. They have assisted you in building up satisfied clientele, by giving you the one most important unit of radio service—a good tube.

For example:

Do you know that of the millions of tubes bought from Triad, last year, less than four per cent were defective and that includes those damaged in shipment. When you consider the very broad guarantee behind all Triad Tubes, this return is remarkably low. It must indicate what these tubes can be made to mean to your business.

CERTIFIED TRIAD TUBES

These new tubes are being made specially for servicemen. They are going to you right from the factory. They are packed with an engineering coupon which indicates exactly what their constants are after they have been permitted to age and have then been checked for the second time. This assures you of their being absolutely correct, in every detail. It assures you of satisfied customers. It assures you of a permanent, profitable business.

And you can have these tubes, at no increased cost. In fact, under most conditions you can buy them at a great saving. In other words, TRIAD is offering you an opportunity to give your customers greater satisfaction at the same time you make a greater profit out of every sale.

YOU CAN BECOME A TRIAD REPRESENTATIVE

While it is the purpose of the Triad Company to cooperate with all **Servicemen, it is also** desirable to be sure that **every serviceman who sells** CERTIFIED TRIAD TUBES **will not find that** every other serviceman **in his vicinity can compete with him. YOU ARE TO BE PROTECTED** and we will definitely limit the number of men in any one section, who will be permitted to purchase CERTIFIED TRIADS on this new, money-making plan.

We want you to know all the details of this wonderful new sales plan. It has been designed for the servicemen, in all parts of the country, who can measure up to the TRIAD qualifications. Every assistance will be given to the men selected, but they must be the key men in their territories. Triad has no place for dead wood. Triad wants men who can carry on the Triad tradition and who can render the same quality of Service that Triad is building into every one of the thirty different types of tubes it makes. If you think you can measure up to that standard and you want to assure yourself of a growing, lasting, profitable business, you will find your opportunity waiting for you, below

A CORNER OF THE AUTOMATIC FLARE AND MOUNT DEPARTMENT
Triad Mfg. Co., Plant No. 1

TRIAD MANUFACTURING CO.
TELEVISION MFG. CO.
Pawtucket, R. I.

Gentlemen:

Please send me complete information about your new Sales Plan for servicemen.

I have been a serviceman for ..... years.

I sell ..... tubes per year.

I belong to the ..... Serviceman's Association.

My letterhead or card is attached.

SUPPLEMENT No. 1

Index and Incidental Information

THE index printed below lists all the set diagrams included with the first supplement to the 1932 OFFICIAL RADIO SERVICE MANUAL. Insert the supplement sheets carefully in your Manual, being careful not to disturb the sequence of the present pages. Put page 310A after page 310, and so on. Keep this index page with the other index pages. A completely revised index will be published with the second supplement.

Please look through the index carefully before writing to us for information on a particular receiver. A great many of the diagrams requested by readers are already included in either the 1932 or the 1931 Manual. Also, be specific in referring to any set. Descriptions such as a "seven-tube Philco" or "a late model Zenith with automatic tuning" mean nothing. Mention the full type number and also, if you can find it marked somewhere on the chassis, the serial number. Important changes are sometimes made in receivers during actual factory production, and while the type number is not changed, a record is kept of the revisions according to the serial numbers of the set so altered.

If you are having trouble with a set and want us to help you, please give us some definite information to work on. We are not mind readers or magicians, and cannot guess socket voltages or the condition of tubes if you do not make these tests yourself. A surprising number of letters merely state something like this: "I have a Bloopodyne 8 in for repair. The volume is weak. What's the matter?"

One thing that every user of the Manual must understand is that dozens of once-prominent radio manufacturers have gone out of business without leaving technical service data for the benefit of their former customers. Fortunately we are able to dig many old diagrams out of our files, which are probably the best in the country, but some hook-ups simply cannot be obtained. Even some firms that are still actively in business are unable to supply diagrams or manuals of sets a few years old, because records were lost, misplaced or removed during changes in administration or organization. Several companies frankly admit their inability to furnish service data on some of their older models, and they refer their customers to the OFFICIAL RADIO SERVICE MANUAL because we have been able to obtain many long-lost diagrams.

The names of some sets and manufacturers mentioned in readers' letters are altogether unknown to us and do not appear on any trade lists. Service Men who can supply any information at all on the following receivers will be doing their fellow workers a great favor.

Heritage, Cambridge, Kempa, Falck, Royal, Mayfair, Case, La Salle, Legionaire, and Detrola.

In the great majority of diagrams appearing in this Manual the values of all resistors and condensers are marked, and voltage readings given for all tubes. When this information cannot be obtained we show the bare schematic alone, as we feel that some diagram is better than no diagram at all.

In this supplement you will notice that many tube and chassis drawings are included in addition to the wiring diagrams. We will try to publish such drawings for every set.

A

F. A. D. ANDREA, Inc.
Model 49 .....238F

AUTOMATIC RADIO COMPANY
Model P25 .....176B
Models P34-35 .....176D
Models 44, V45, V46, C45, P46 .....176F
Tom Thumb Midget..176H

B

BALKEIT RADIO COMPANY
Models L7, LC7.....178A
Midget Screen Grid Six; Model E 178B

D

DELCO APPLIANCE CORP.
R33 Console, RC3 junior Console, RA3 Compact 238A

G

GENERAL ELECTRIC COMPANY
Model T-12-D 238B
Models J-70, J-75, 238C, 238D, 238E
Model H-72 ...238F, 238G
Models J-80, J-85, 238H, 238I
Model S-132 .....238J

GRIGSBY-GRUNOW COMPANY
Model 10 SW Converter 258A
Model 25B 258B
Model 35 .....258C
Models 25B and 35 Analyzer charts 258D
Model 55 .....258A
Model 200 chassis ...258E
Model 210 chassis ...258F

GULBRANSEN COMPANY
Model 13 ..... 258G, 258H, 258I
Model 20 ..... 258J, 258K, 258L
Model 80A ..258M, 258N
Model 80A Transformer and Condenser Data.258P
5-Tube DC Model 258O, 258P
8-Tube Chassis. 258Q, 258R

H

HAMMARLUND-ROBERTS, Inc.
All-Wave Comet 258S

HOWARD RADIO COMPANY
Model 45 .....258T
Model SG-T 258U

K

COLIN B. KENNEDY CORP.
Model 24 ....258V, 258W
Model 56 .....258X

KOLSTER RADIO, Inc.
Models B-15 and 16..290A

O

OZARKA, Inc.
Model 91 .....290B

P

PHILADELPHIA STORAGE BATTERY CO.
Model 4 SW Converter 310A
Models 51, 51A.310B, 310C
Models 470, 470A, 310D, 310E
Model 490 ....310F, 310G,

R

REMLER COMPANY, Ltd.
Model 19 .....310H

S

SIMPLEX RADIO COMPANY
Model L 394A

STEWART-WARNER CORP.
Model 900 series 394B
Model 950 series battery operated screen grid receivers 394B

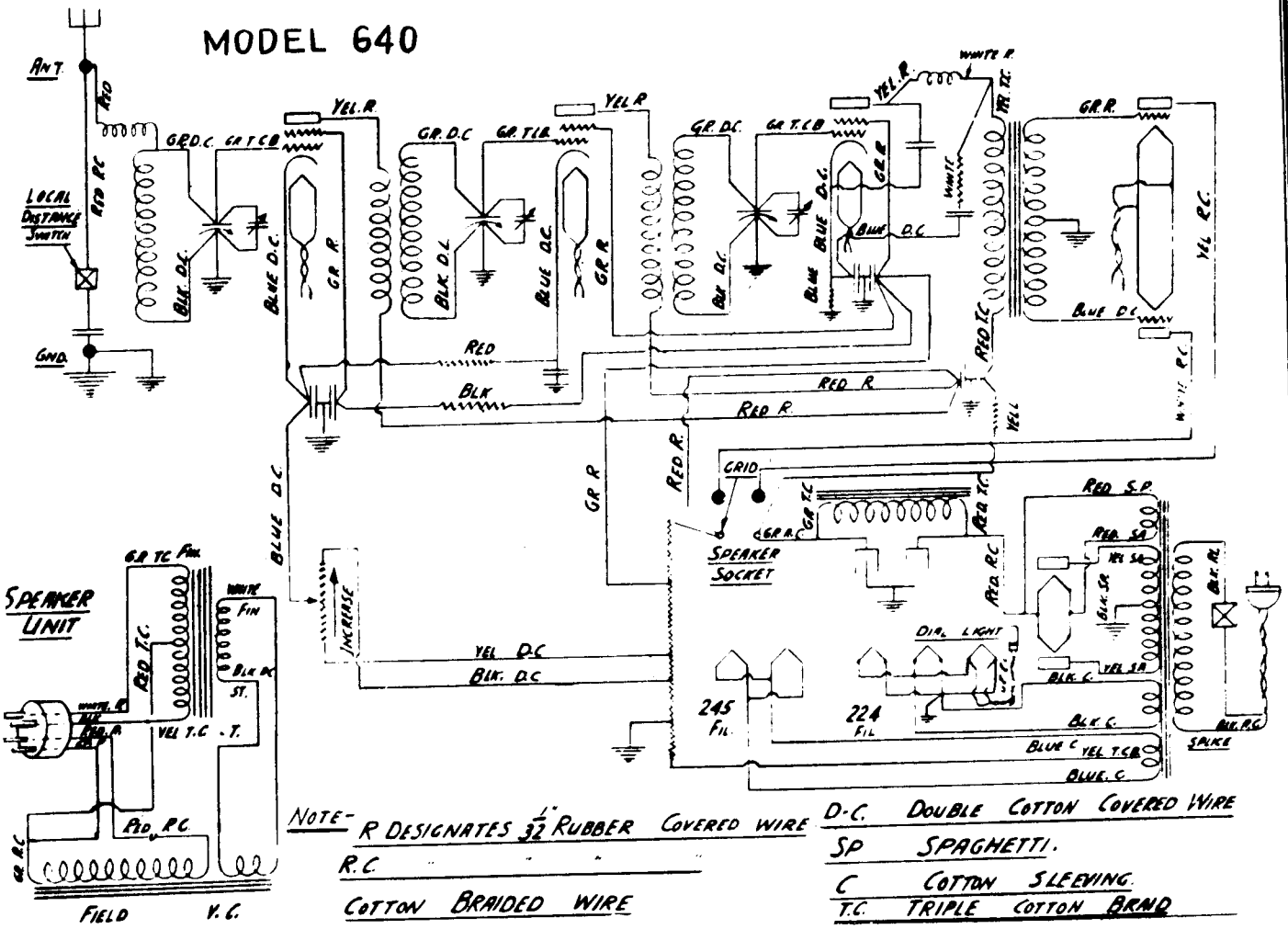
STROMBERG-CARLSON TELEPHONE MFG. CO.
Model 27 ....434A, 434B
Model 29 ..... 434C, 434D, 434E

U

U. S. RADIO & TELEVISION CORP.
Models 99, 99X 434F

STANDARD RADIO MFG. CORP., LTD. (ROGERS)

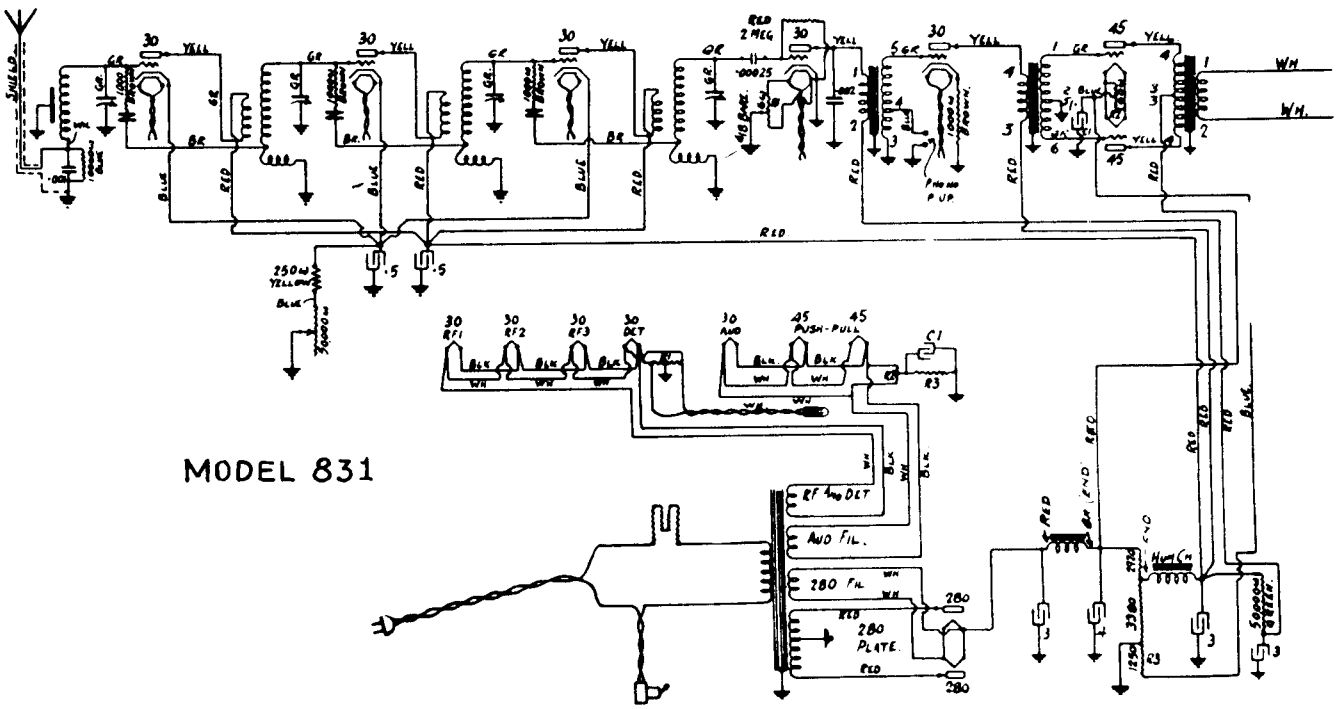
MODEL 640



NOTE- R DESIGNATES 1/32 RUBBER COVERED WIRE
R.C. " " "
COTTON BRAIDED WIRE

D.C. DOUBLE COTTON COVERED WIRE
SP SPAGHETTI.
C COTTON SLEEVING.
T.C. TRIPLE COTTON BRAID

MODEL 831



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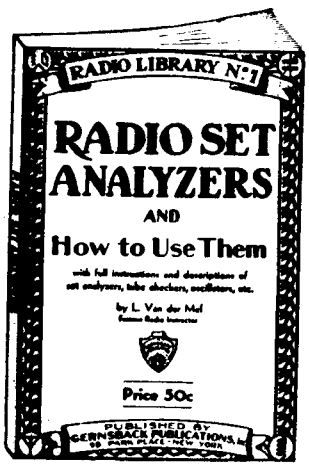

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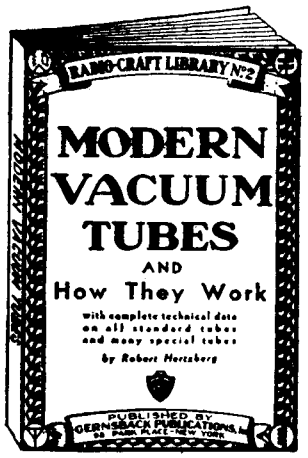
By L. VAN DER MEL

This book explains thoroughly the operation of set analyzers, tube checkers, oscillators and other testing equipment. For every radio man, whether junior grade or expert, this book is extremely helpful. It covers every phase of testing and gives you valuable short cuts; completely illustrated with photographs and diagrams to facilitate the use of modern testing equipment.

The following chapters briefly outline the contents. INTRODUCTION; THE ANALYZER; Fundamentals, Switches, A.C. and D.C. Voltmeters, Calibration and Design; TROUBLE SHOOTING WITH THE ANALYZER; Classification of Trouble, Analysis of Electrical Troubles, Features and Uses of Various Analyzers, Care and Maintenance; CONCLUSION; Summary.

MODERN VACUUM TUBES



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With Complete Technical Data on All Standard and Many Special Tubes

By ROBERT HERTZBERG

MODERN VACUUM TUBES describes the fundamental electron theory which is the basis of all vacuum tube operation, and goes progressively from the simplest two-element tubes right up to the latest pentodes and thyratrons. It is written in clear, simple language and is devoid of the mathematics which is usually so confusing. Valuable reference charts and characteristic curves of standard and special tubes are to be found, also diagrams of sockets and pin connections.

Here are some of the chapters: The Edison Effect and The Electron Theory Electron Emitters and the Ionization Effect; The Three-Electrode Tube; Vacuum Tube Characteristics; Four- and Five-Element Tubes; Light Sensitive Cells and Other Special Tubes.

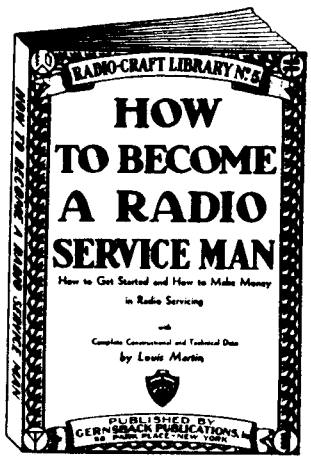
HOW TO BECOME A RADIO SERVICE MAN

How To Get Started and How To Make Money In Radio Servicing

By LOUIS MARTIN

The ambition of many men in radio today is to become a first-grade Service Man, with a business that is flourishing. It is not as difficult as one might believe, but it cannot be done in a few short months. Following very carefully the advise of Mr. Martin, who has dealt with the problems of thousands of Service Men, this book deals very carefully with the essential stages in the preparation for qualifying as a Service Man. The Chapters of the book are so divided that each element is thoroughly covered.

Here are the chapters: The Small Independent Service Man; Advanced Commercial Aspects; The Radio Set; Semi-Technical Considerations; Advanced Service Data. Each chapter is again subdivided to bring out in minute detail every point of importance.



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BRINGING ELECTRIC SETS UP TO DATE

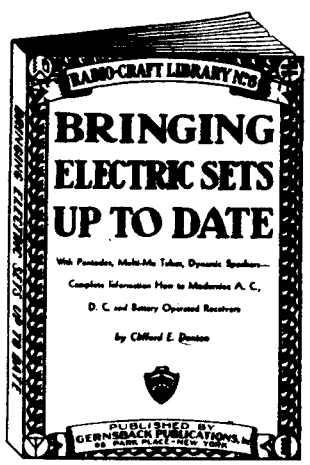
With Pentodes, Multi-Mus, Dynamic Speakers—Complete Information How to Modernize A.C., D.C. and Battery Operated Receivers

By CLIFFORD E. DENTON

In this country there are over ten million electrically operated receivers that could be modernized—by placing in them new type tubes, new speaker equipment and other modern improvements. This business of improving old sets can go to the experimenters and Service Men if they will quickly jump into action.

Read in this book by Mr. Denton, how easily you can modernize any obsolete set. Your clients can retain their expensive cabinets and still have a receiver that is right-up-to-the-minute, and with little additional costs.

Here are the high lights of this book: Tubes Available for Replacements; Electrifying Battery Receivers; Use of the New 2- and 6-Volt Tubes; Operating Sets with Single Control; Conversion of A.C. Sets into D.C., and D.C. into A.C.; Replacing Output Tubes with Higher Output Tubes; Improving Old Supers; Loftin-White Amplifiers; Adapters and Their Use.



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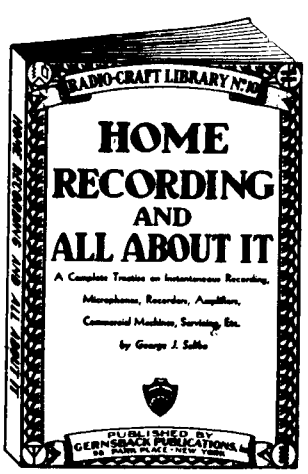
A Complete Treatise on the Subject Covering All Phases from Installing to Servicing and Maintenance

By LOUIS MARTIN

Automobile radio is up and coming, and someone has to service them properly. It is certain that one of these days your turn will come, whether you are an experimenter or Service Man. It therefore behooves you to read this immensely important new book on the art of Automobile Radio. There is no better book in print and none as concise. The book is full of illustrations, photographs, diagrams and hookups.

Here are only a few of some of the really interesting chapters: Introduction; Automotive Radio Installations; Complete Descriptions of Commercial Automotive Receivers; Servicing Automotive Receivers; The Ignition System; General Service Considerations; Effects of Temperature on Power Supply; Conclusion.

HOME RECORDING AND ALL ABOUT IT



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A Complete Treatise on Instantaneous Recording Microphones, Recorders, Amplifiers, Commercial Machines, Servicing, etc.

By GEORGE J. SALIBA

If there is one subject that is fascinating to every radio man, it is that of Home Recording. Of course, this volume is not all on "Home" recording, but the information contained therein is important to commercial radio men, studio operators, engineers and others interested in this phase of radio.

The art of recording and reproducing broadcast selections is becoming more important every day to radio men, experimenters and Service Men. Equipping dance halls, auditoriums, churches, restaurants and homes with public address and amplifiers brings many extra dollars and often an excellent income.

In this book are found such topics as: Short History of the Art; Microphones; Recording Amplifiers; Cutting Heads; Types of Records; Commercial Machines; Adding Recorders to Receivers; Studio Layouts; Mechanical Filters for Turntables.

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capacity. Read these books during your spare time at home. The authors of these books are well-known to everybody. Each one is an expert radio man; an authority on the subject—each is thoroughly familiar with the field which he represents.

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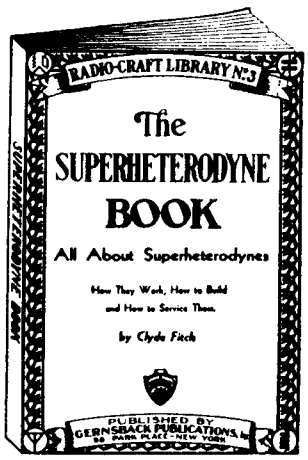
THE SUPERHETERODYNE BOOK

All About Superheterodynes
How They Work, How to Build and How to Service Them

By CLYDE FITCH



There is no more fascinating a subject in the large array of radio circuits than the famous superheterodyne circuit. It has taken the world by storm, and today practically all modern receivers employ this principle of design. Whether you are a Service Man or experimenter, first-hand knowledge about the construction of these receivers is very important. The book on Superheterodynes gives underlying principles of their construction, right from the very first set made. Mastering the fundamentals of this circuit will enable you to build or service any receiver.

The following is a short list of contents: Basic Principles of the Superheterodyne; The Oscillator; First Detector; Single Dial Tuning Systems; Intermediate Amplifier; Second Detector, Audio Amplifier and Power Supply; Commercial Superheterodyne Receivers; Servicing Superheterodynes.

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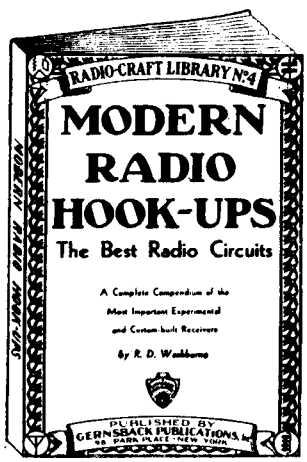
MODERN RADIO HOOK-UPS

The Best Radio Circuits
A Complete Compendium of the Most Important Experimental and Custom-built Receivers

By R. D. WASHBURNE



It is fascinating to the experimenter, or even to the up-to-date Service Man, to take a commercial set and to change it into one using a famous hookup that is not found in any manufactured set; and it is usually worth the trouble because results are far superior than in the original. Many excellent circuits have never been commercialized, but limited only to home-set builders. Thousands of these popular circuits have been requested from time to time, and in this book we have included over 150 circuits, which include the famous Peridyne, Cash-Box A.C.-D.C. Set and others.

The circuits cover the following: BROADCAST RECEIVERS, ALL-WAVE RECEIVERS, SHORT-WAVE RECEIVERS, CONVERTERS AND ADAPTERS, TELEVISION RECEIVERS, HOME RECORDING APPARATUS, AUTOMOBILE RECEIVERS, AUDIO AND POWER AMPLIFIERS, POWER UNITS and MISCELLANEOUS EQUIPMENT.

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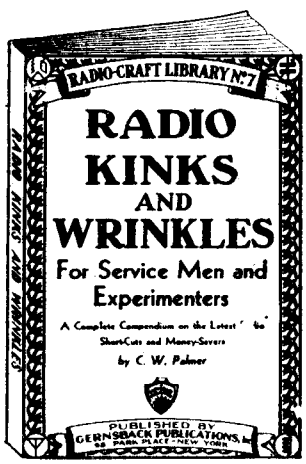
RADIO KINKS AND WRINKLES



For Service Men and Experimenters
A Complete Compendium on the Latest Radio Short-Cuts and Money-Savers

By C. W. PALMER

It often becomes necessary for experimenters and Service Men to call upon their memory for some short cut or radio wrinkle that will solve a problem quickly. In business "short cuts" mean time and money saved, and to the Service Man "time saved" means money earned.

This book is a compilation of important radio kinks and wrinkles; the entire contents of the book has been selected with great care in order to discuss only such items as are constantly used today.

Here are some of the more important chapters: Introduction; Servicing Short-Cuts; Testing Equipment and Meters; Vacuum Tubes and Circuits; Volume-control Methods; Amplifiers and Phonograph Reproducers; Power Supply Equipment; Coils and Tuning Circuits; Short Waves; Loud Speakers; Tools and Accessories.

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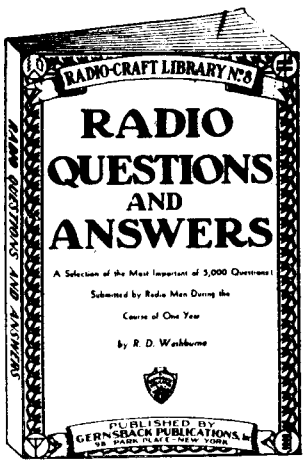
RADIO QUESTIONS AND ANSWERS



A Selection of the Most Important of 5,000 Questions Submitted by Radio Men During the Course of One Year
By R. D. WASHBURNE

There has been collected a wide variety of questions which have come into our editorial offices during the past two years, and only those whose answers would benefit the majority of men engaged in radio have been incorporated in this amazing question and answer book.

The tremendously long list of topics better explains the subjects which are treated. Here are the titles:

Radio Servicing; Receiver Design; Theory; Home Recording; Television; Sound Equipment; Short Waves; Antennas; Operating Notes; Test Equipment; Vacuum Tubes; Engineering; Ultra-Short-Waves; Police Radio; Reproducers; Graphs; Superheterodynes; Automotive Sets; Power Packs; Automatic Volume Controls; Remote Control Devices; Aligning Procedure; Photoelectricity; Tone Control; Coil Construction; Adapters; Measuring Apparatus; Band-Selectors; Meters; Symbols; Microphones; Converters; Definitions; Public Address Equipment; Modernizing Methods; Set Analyzers; Midget Sets; Oscillators; Phonograph Pickups; Tube Testers; Diagrams.

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SUPPLEMENT No. 2

Index and Incidental Information

THE index below lists all the diagrams contained in both the first and second supplements to the 1932 OFFICIAL RADIO SERVICE MANUAL. Place this sheet before page 579, so that it will be as close as possible to the main index. In looking for a particular receiver, be sure to consult both this index *and* the main index.

The completely revised index promised with this supplement could not be completed in time because of the great amount of work involved in its preparation, but it will definitely be included with the third supplement. It will appear in a new and more convenient form, and will include every diagram published in both the 1931 and 1932 MANUALS and in all the supplements. As a record of commercial receivers it will be of great interest and value to all radio Service Men.

G

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Owners of the OFFICIAL RADIO SERVICE MANUAL are requested to observe a few simple rules in regard to the question service. First of all, please bear in mind the fact that it is necessarily limited to matters concerning commercial receivers. Out of justice to the hundreds of Service Men who send in legitimate service inquiries every week, we cannot undertake to do special design work, draw up elaborate diagrams to fit odd collections of parts, enter into involved discussions of radio theory, identify mysterious short-wave stations, or do similar jobs that have no relation to service work.

Answering straight service letters is enough of a problem in itself, as frequently this involves considerable digging through files of service manuals. Sometimes fifteen or twenty minutes of research is necessary merely for a yes or no answer to a question.

We cannot offer opinions on the relative merits of different makes of apparatus, nor can we obtain discounts on any kind of merchandise. If you want catalogs or special data from a manufacturer, write to him directly; if you do not know his address, send your letter, in a stamped envelope, to us, and we will forward it.

Please be reasonable and limit your questions to not more than three or four per letter, and send *one* coupon for *each* question. Please write clearly; use a typewriter if you have one, or at least pen and ink and white paper. We have a "dead letter" file containing dozens of letters that cannot be answered because names or addresses, or both, have been omitted, or the writing is undecipherable, or the language is one that no scholar can identify.

* * *

Many owners of the MANUAL evidently have not read the first section of the book, which contains a wealth of practical service data that answers many of their everyday service problems. For intance, we have had dozens of requests for the R.M.A. standard color code, yet this is fully explained on page 117. Take an evening off sometime and study the section from page 5 to 129. You'll be surprised to see how much you can learn.

* * *

Past issues of RADIO CRAFT have contained articles describing servicing instruments of various kinds. The following list should be remembered for reference. Back copies of the magazine cost 25 cents each and may be obtained from RADIO CRAFT, 98 Park Place, New York, N. Y. Specify the issue you want.

"How to Test the Pentodes", page 155, September, 1931.

"Modernizing the Jewell 133A Analyzer", page 211, October, 1931.

"Mutual Conductance Meter", page 282, November, 1931.

"Magic in Meters", November and December, 1931, and January, 1932. (These articles tell everything you want to know about shunts and multipliers for all kinds of meters.)

"Vacuum Tube Voltmeter", page 466, February, 1932.

"The Supreme Diagnometer", February, March and April, 1932.

"Short-Checkers and Pre-Heaters", page 474, February, 1932, and page 535, March, 1932.

"A Service Test Panel for the Shop", page 533, March, 1932.

"Improving the Weston 537 Analyzer", page 605, April, 1932.

"Combination Oscillator and Tube Tester", page 586, April, 1932.

"Constructing a Simple Set Tester", page 659, May, 1932.

"Servicing Modern Supers", page 670, May, 1932.

"A Modern Tube Checker", page 671, May, 1932.

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INDEX TO COMMERCIAL WIRING DIAGRAMS

WITH the issuance of each set of supplements, a completely revised and up-to-date index is furnished. To use this first remove all of the pages from the cover; throw away the old index pages and replace them with the new ones;and then insert the supplement pages in their numerical and alphabetical order. Then replace the cover and the book is complete.

Often, the trade name of a set is known by the user of this book but the name of the manufacturer not known.

In searching for diagrams, if the particular diagram you desire cannot be found, be sure to look through the Miscellaneous section at the end of this index. If it is not listed there look through the *Trade Name Index;* this gives the name of the manufacturer for each trade name. Since all diagrams are listed in the index in alphabetical order in accordance with the manufacturers' names, it is absolutely necessary to know the name of the manufacturer before a particular diagram can be found.

In the supplements are included diagrams for which we have received requests. Wherever the diagrams that have been requested are not included in one set of supplements, they will appear in the first set published after we receive them. Many diagrams of obsolete sets are difficult to obtain, but we are using every possible effort to procure them.

We wish to express our thanks to the many subscribers who have taken such extreme interest in the MANUAL, and especially to those who have voluntarily submitted diagrams for publication in the supplements.

—THE PUBLISHERS.

A

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Aero—Chas. Hoodwin Co.
Arborphone—Peerless
Allied Radio Co.—Columbia Radio
Acme—Acme Electric Co.
Acratone—Federated Purchaser
Airline—Montgomery, Ward & Co.
Amertran—American Transformer Co.
Amrad—Amrad Corp.
Apex—United States Radio & Television Co.
Arcadia—Wells Gardner Co.
Argus—Argus Radio Corp.
Atchison—Atchison Radio Mfg. Co.
Atwater Kent—Atwater Kent Mfg. Co.
Audiola—Audiola Radio Co.
Autoverter—Radiette
Aztec—Stein, Fred W.
Baldwin—Nathaniel Baldwin Co.
Balkite—National Transformer Mfg. Co.
(Balkite Sales Division)
Bosch—American Bosch Magneto Corp.
Brandes—Kolster Radio Corp.
Bremer Tully—Bremer Tully Mfg. Co.
(Now Brunswick Radio Co.)
Browning Drake—Browning Drake Corp.
Brunswick—Brunswick Balke Collender Co.
(Brunswick Radio Co.)
Buckingham—Buckingham Radio Co.
Bush & Lane—Bush & Lane Piano Co.
Capehart Orchestrope—Capehart Corp.
Webster Elec. Co.
Cardinal—Long Radio Co.
Cardon-Sparks—Cardon-Sparks Phonocraft Corp.
Carteret—Carteret Radio Lab.
Clarion—Transformer Corp. of America
Cleartone—Cleartone Radio Corp.
Div. of Cincinnati Time Recorder
Colonial—Colonial Radio Corp.
Columbia—Columbia Phonograph Co.
(Columbia Radio Co.)
Counterphase—Bremer Tully Mfg. Co.
(Now Brunswick Radio Co.)
Crosley—Crosley Radio Corp.
Daven—Daven Radio Co.
Day Fan—General Motors Radio Corp.
Dayrad—The Radio Products Co.
DeForest—DeForest Radio Co.
Delco—Delco Appliance Corp.
Dewald—Pierce Airo, Inc.
Earl—Freed Radio Corp.
Echophone—Radio Mfg. Co., Ltd.
Edison—Edison, Thomas, A., Inc.
Electrad—Electrad, Inc.
Emerson—Emerson Radio & Phonograph Corp.
Envoy—See I. C. A.
Erla—Electrical Research Laboratories
Eveready—National Carbon Co.
Fada—Andrea, F. A. D., Inc.
Federal—Federal Radio Corp.
Find-All—Find-All Radio Co.
Freed Eisemann—Freed Radio Co.
Freshman—Freed Radio Co.
Genemotor—U. S. Electrical Works
General Motors—General Motors Radio Corp.
Gilbert—Gilbert, R. W.
Gilfillan—Gilfillan Bros., Inc.
Graybar—Graybar Electric Co.
Grebe—Grebe Co., A. H.
Gulbransen—Gulbransen Co.
Hammarlund—Hammarlund Mfg. Co.
Howard—Howard Radio Co.
Hyatt—Hyatt Electrical Corp.
ICA—Insuline Corp. of America.
Jesse French—Jesse French & Sons Piano Co.
Kellogg—Kellogg Swbd. & Supply Co.
Kennedy—Kennedy Corp., Colin B.
King—King Mfg. Corp.
Knight—Wextark Radio Stores, Inc.
Kolster—Kolster Radio Corp.
Kylectron—United Reproducers Corp.
(Now Gray Electric Co.)
Lafayette—Wholesale Radio Service
Leutz—Leutz, Inc., C. R.
Lincoln—Lincoln Radio Corp.
Loftin White—(See Electrad)
Lyric—All American Mohawk Corp.
Majestic—Grigsby Grunow Co.
Marti—Marti Radio Corp.
Master—Master Radio Mfg. Co., Ltd.
McMillan—McMillan Radio Co.
Melo Head—Robertson Davis Co.
Melorad Cathedral—Federated Purchasers.
Minera—Minerva Radio Co.
Miraco—Midwest Radio Corp.
Multicoupler—Amy, Aceres & King, Inc.
National—The National Co., Inc.
National—National Transformer Mfg. Co.
Navigator—A. C. Dayton Co.
Orpheus—Roth-Downs Mfg. Co.
Patterson—Patterson Radio Corp.
Peerless—United Reproducers Corp.
(Now Gray Electric Co.)
Peter Pan—Jackson Bell Co., Ltd.
Pfansteihl—Pfansteihl Products Co.
Philco—Philadelphia Storage Battery Co.
Pierce Airo—Pierce Airo, Inc.
Pilot—Pilot Radio & Tube Corp.
Pioneer—Pioneer Radio Corp.
Priess—Priess Radio Co.
Premier—Premier Electric Co.
Radiette—Keller Fuller Mfg. Co., Ltd.
Radiola—R. C. A. Victor Co.
Radiotrope—U. S. Radio & Television Co.
Ranger—Brown & Manhart
Republic—Republic Radio Co.
Sentinel—United Air Cleaner Co.
Seven Seas—Leutz, Inc., C. R.
Silver—Silver Marshall, Inc.
Silvertone—Sears, Roebuck & Co.
Simplex—Simplex Radio Co.
Sonora—Sonora Phonograph Co., Inc.
Sparton—Sparks Withington Co.
Splitdorf—Edison, Thomas A., Inc.
Star Raider—Continental Radio Co.
Steinite—Steinite Radio Co.
Sterling—Sterling Mfg. Co.
Stewart Warner—Stewart Warner Corp.
Story & Clark—Story & Clark Radio Corp.
Stromberg-Carlson — Stromberg-Carlson Tele. Mfg. Co.
Telmaco—Telephone Maintenance Co.
Temple—Temple Corp.
Tiffany Tone—Horn Radio Co.
Tom Thumb—Automatic Radio & Mfg. Co.
Transitone—See Philco
Trav-Ler—Trav-Ler Mfg. Co.
U. S. Radio—U. S. Radio & Television Corp.
Vagabond—Vaga Radio Corp.
Victor—R. C. A. Victor Co.
Victoreen—Victoreen Radio Co.
Webster—Webster Electric Co.
Westinghouse—Westinghouse Elec. & Mfg. Co.
Wilcox Labs., Inc.—Sterling Mfg. Co.
Willard—Willard Storage Battery Co.
Work-Rite—Work-Rite Radio Corp.
Wurlitzer—(See All American Mohawk Corp.)
Zenith—Zenith Radio Corp.