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.

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.

ATWATER KENT MFG. CO.

MODEL 43, 46, 47 AND 53 CHARTS

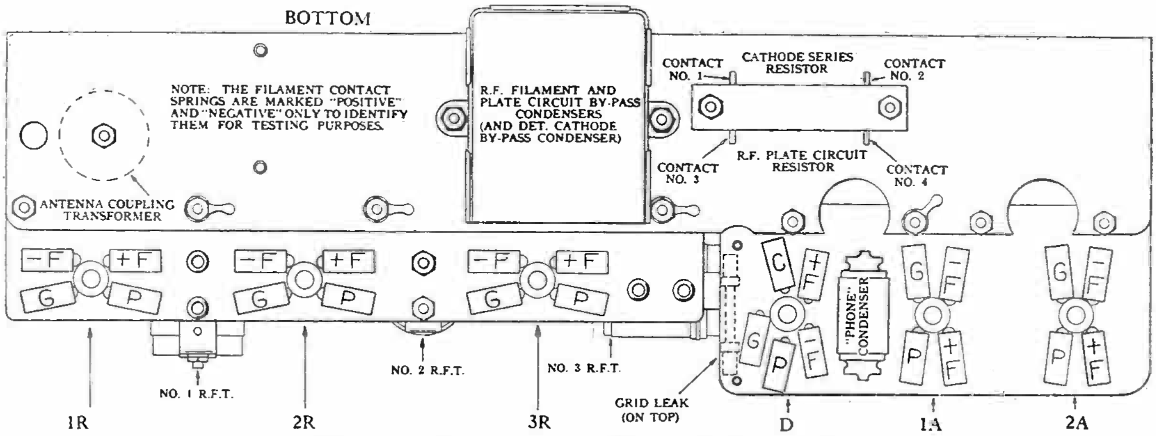


FIG. 113. TEST CHART FOR MODEL 43, 46 AND 53.
Model 47 chart is similar except that it has four separate R. F. sockets.

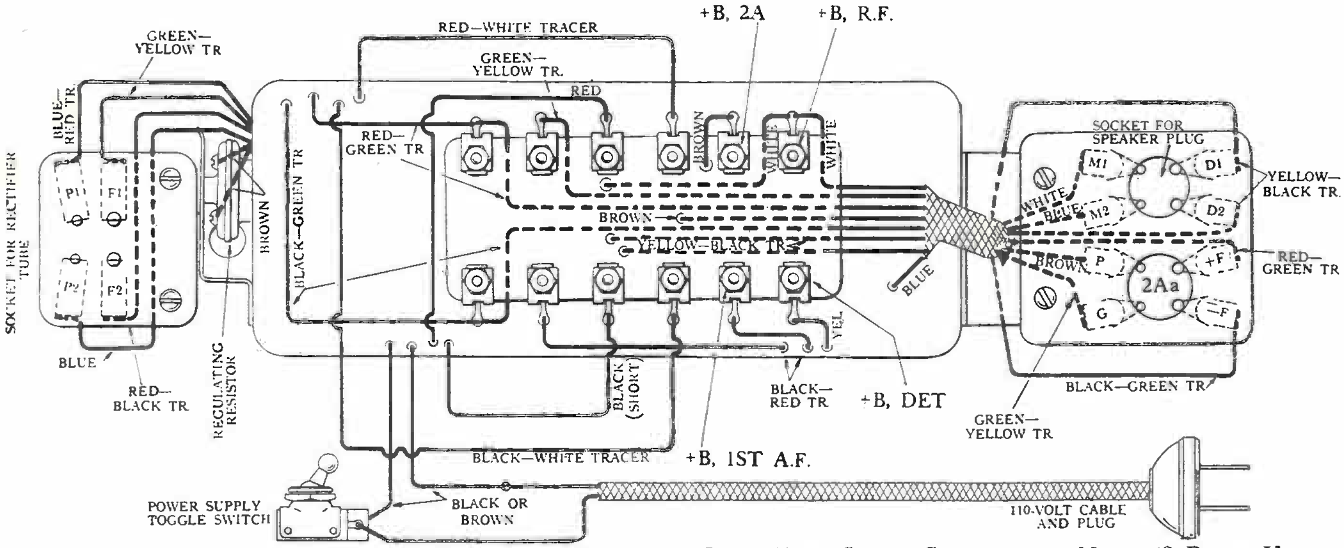


FIG. 114. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN MODEL 43 POWER UNIT.
In early type of power unit for Model 43, two brown leads from the primary-shunt condenser connect to the +B, 2A terminal and to the brown P2Aa lead respectively. In later models these connections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

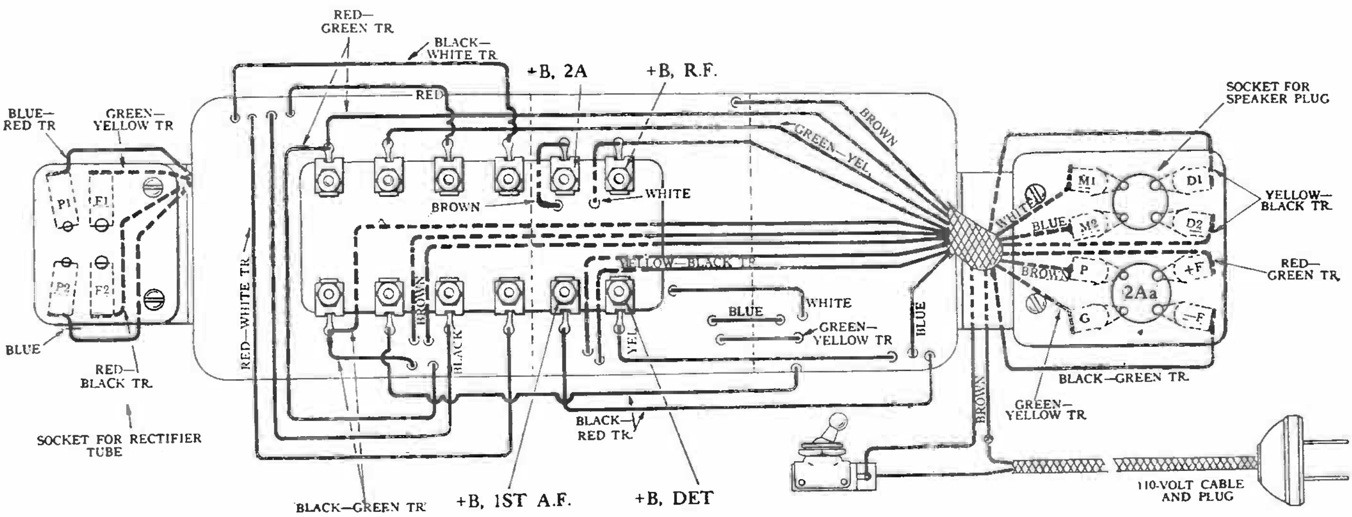


FIG. 115. SHOWING CONNECTIONS AND APPROXIMATE POSITION OF LEADS FROM SEALED CONTAINER IN POWER UNIT FOR MODEL 46, 47 AND 53.

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.

ATWATER KENT MFG. CO.

MODEL 43, 46, 47 AND 53 DIAGRAM

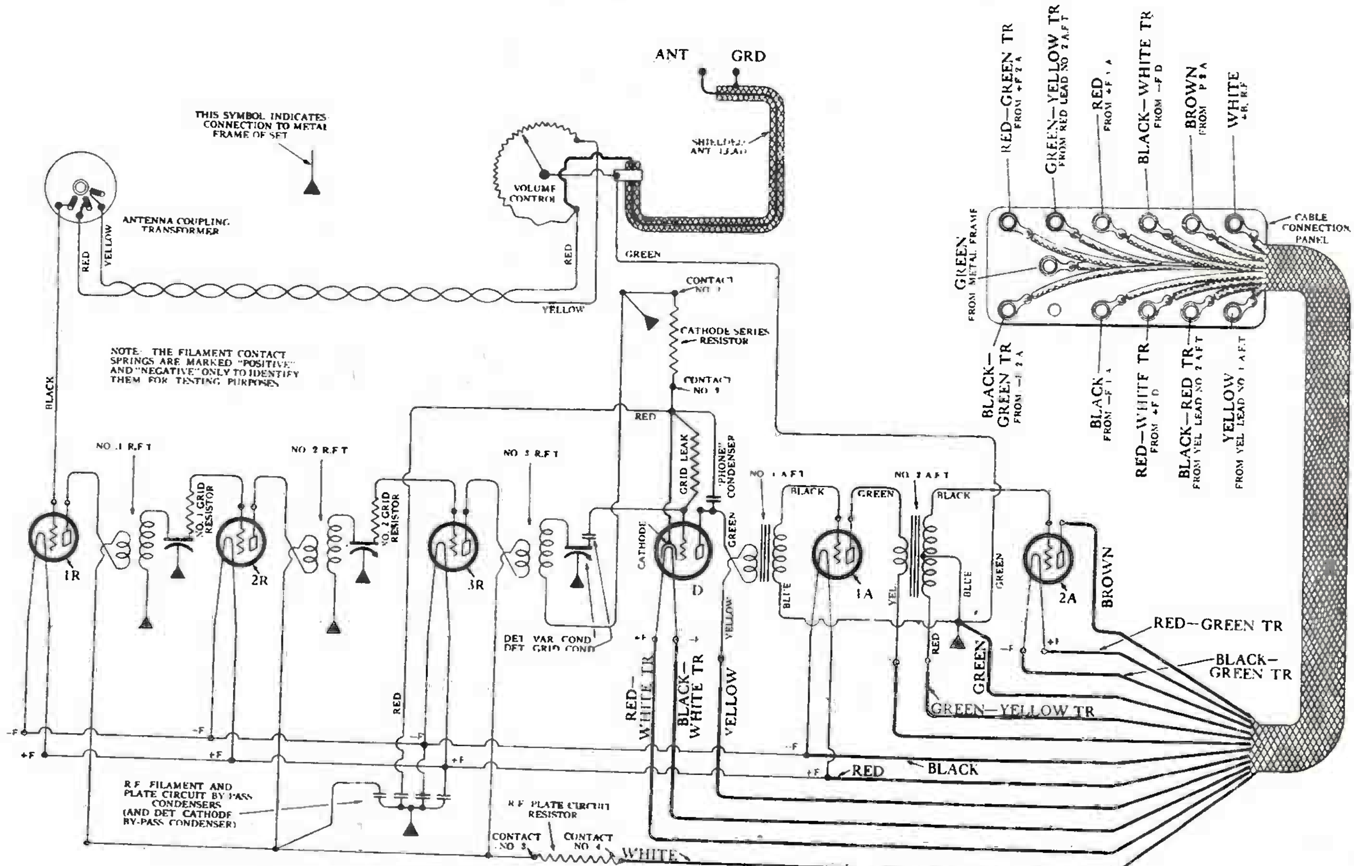


FIG. 111. WIRING DIAGRAM OF MODEL 43, 46 AND 53.
The +B, 1st A. F. cable lead is black with a red tracer.
Model 47 is similar but has one additional stage of R. F. amplification and a local-distance switch like that on Model 44.
See Page 59 for R. F. transformer connections.

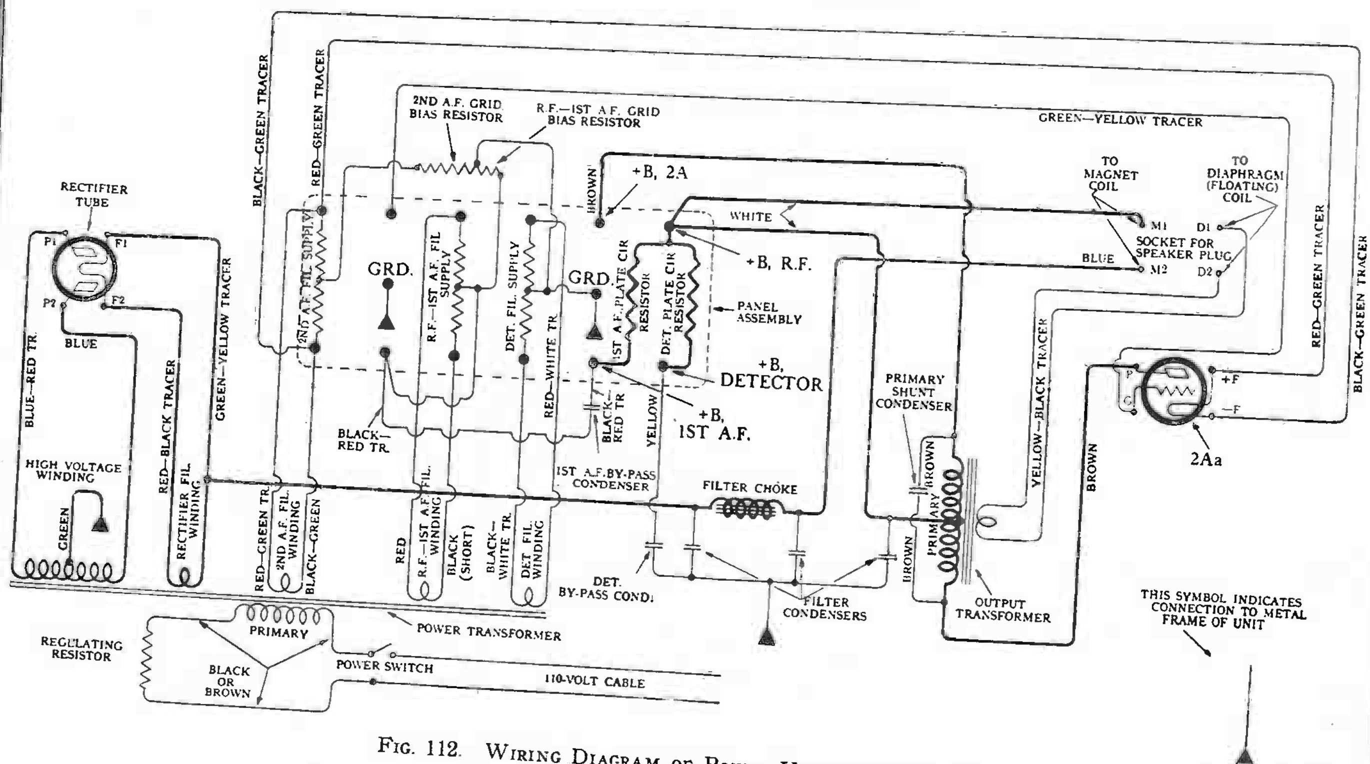


FIG. 112. WIRING DIAGRAM OF POWER UNIT IN MODEL 43.

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); C27, 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;

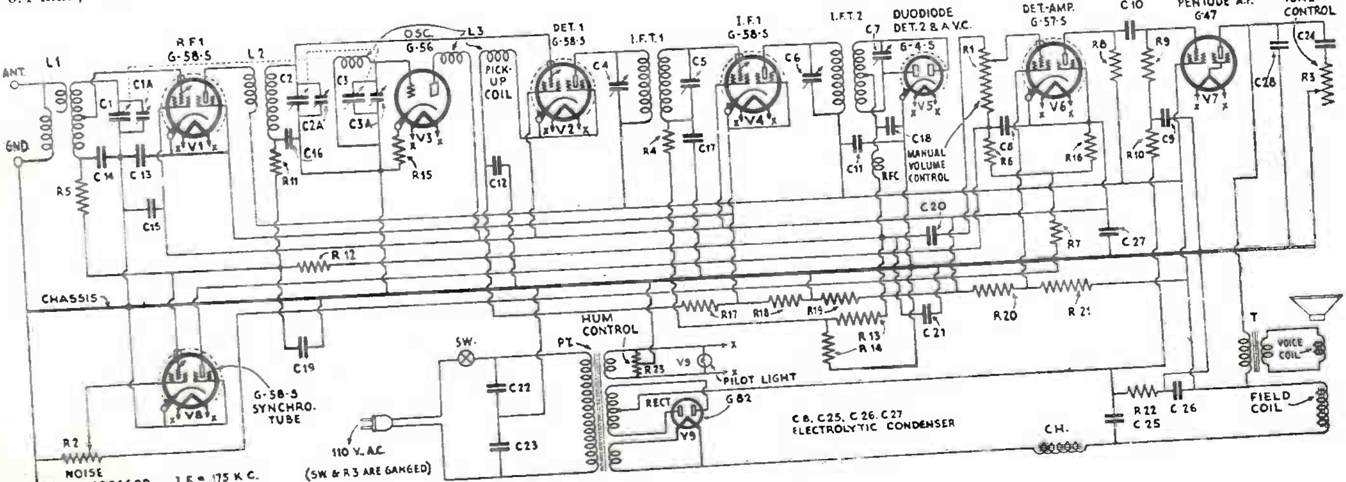
(5). Although the set now is in operating condition, it may be found that in some particular locations the noise is greater at one end of the dial than at the other, so that if the noise suppressor is adjusted to take out noise at the low-frequency end of the dial, some noise may come in at the high-frequency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

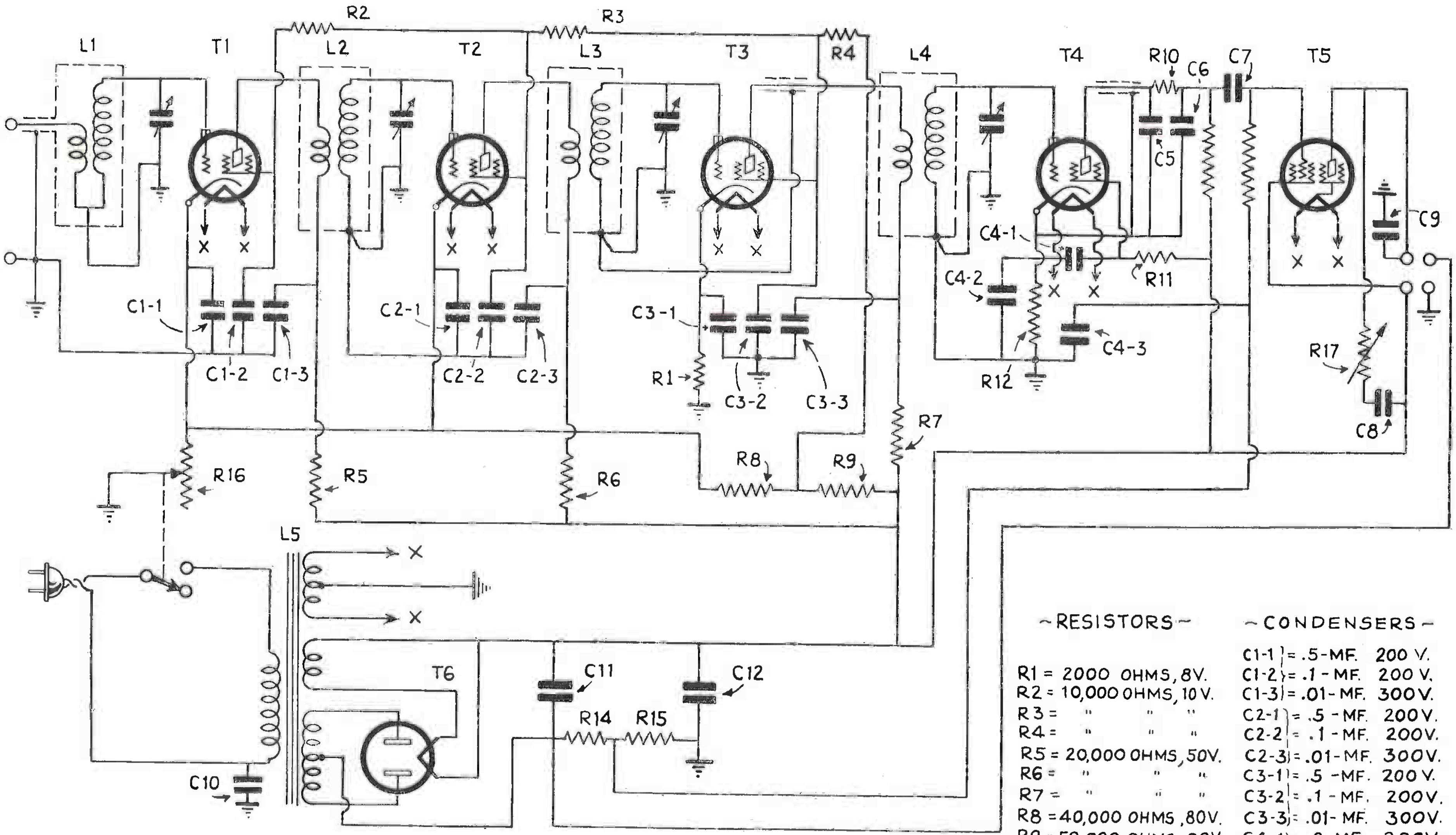
The normal antenna length for this chassis is 40 to 60 feet. The reproducer is a type G-19-A unit having improved characteristics.

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.



BROWNING-DRAKE CORP.



MODEL 20

~RESISTORS~

R1 =	2000 OHMS, 8V.
R2 =	10,000 OHMS, 10 V.
R3 =	" " "
R4 =	" " "
R5 =	20,000 OHMS, 50V.
R6 =	" " "
R7 =	" " "
R8 =	40,000 OHMS, 80V.
R9 =	50,000 OHMS, 80V.
R10 =	20,000 OHMS, 50V
R11 =	2 MEG., 10 V.
R12 =	50,000 OHMS, 10 V.
R13 =	2 MEG., 10V.
R14 =	.5-MEG., 10V.
R15 =	.1-MEG., 10V.
R16 =	VOL. CONTROL
R17 =	TONE CONTROL
R18 =	.25-MEG.

~CONDENSERS~

C1-1 =	.5-MF. 200 V.
C1-2 =	.1-MF. 200 V.
C1-3 =	.01-MF. 300V.
C2-1 =	.5-MF. 200V.
C2-2 =	.1-MF. 200V.
C2-3 =	.01-MF. 300V.
C3-1 =	.5-MF. 200 V.
C3-2 =	.1-MF. 200V.
C3-3 =	.01-MF. 300V.
C4-1 =	.2-MF. 200V.
C4-2 =	.5-MF. 200V.
C4-3 =	.1-MF. 200V.
C5 =	.00025-MF.
C6 =	.00025-MF.
C7 =	.01-MF.
C8 =	.1-MF. TUBULAR
C9 =	.01-MF. "
C10 =	.01-MF. "
C11 =	8 MF. ELECTROLYTIC
C12 =	8 MF. "

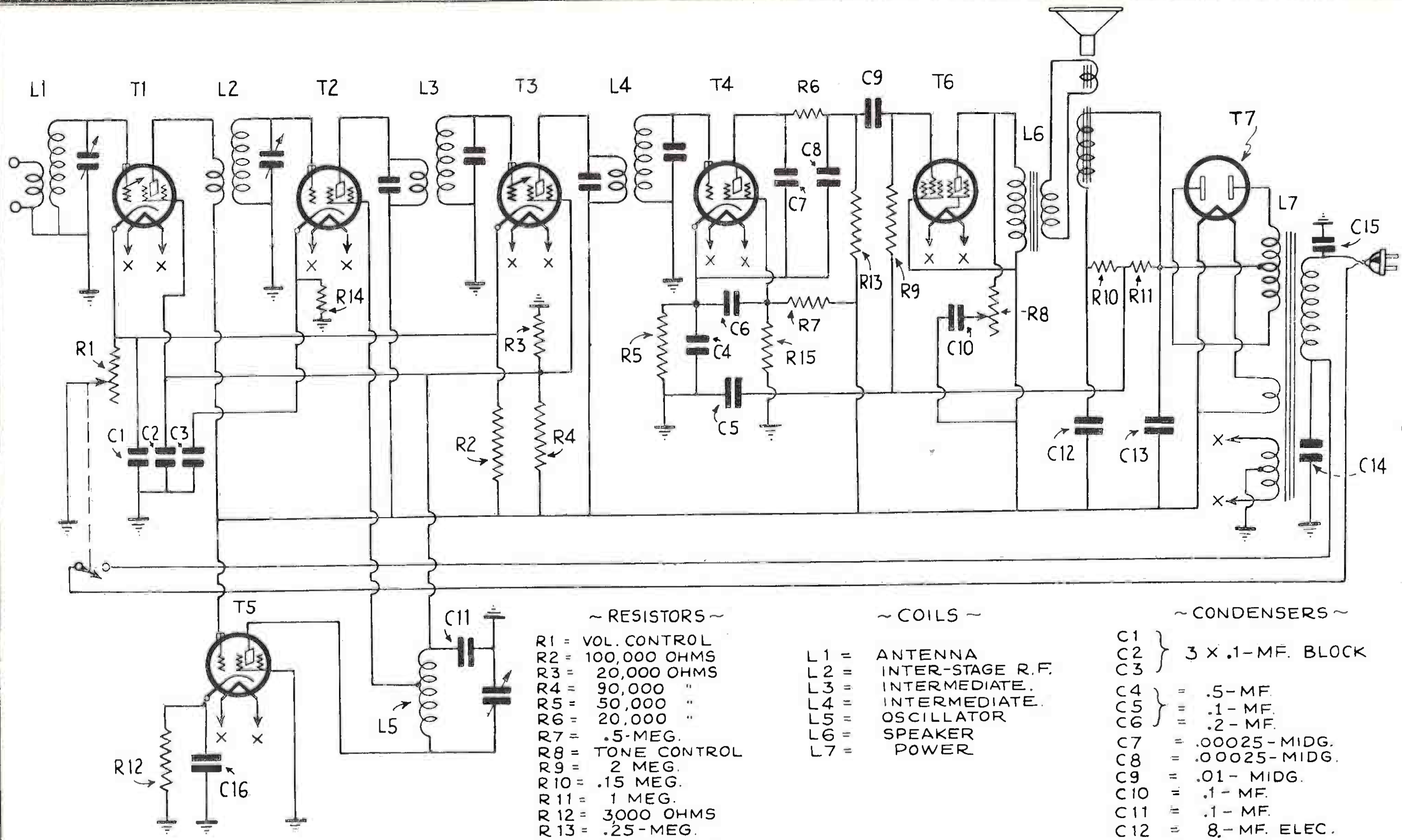
~COILS~

L1 =	R.F. (ANT.)
L2 =	R.F. (INT.)
L3 =	R.F. (INT.)
L4 =	R.F. (INT.)
L5 =	POWER.

~TUBES~

T1 =	224
T2 =	224
T3 =	224
T4 =	224
T5 =	247
T6 =	280

BROWNING-DRAKE CORP.



~ RESISTORS ~

R1 =	VOL. CONTROL
R2 =	100,000 OHMS
R3 =	20,000 OHMS
R4 =	90,000 "
R5 =	50,000 "
R6 =	20,000 "
R7 =	.5-MEG.
R8 =	TONE CONTROL
R9 =	2 MEG.
R10 =	.15 MEG.
R11 =	1 MEG.
R12 =	3000 OHMS
R13 =	.25-MEG.
R14 =	3,000 OHMS
R15 =	.15-MEG.

~ COILS ~

L1 =	ANTENNA
L2 =	INTER-STAGE R.F.
L3 =	INTERMEDIATE.
L4 =	INTERMEDIATE.
L5 =	OSCILLATOR
L6 =	SPEAKER
L7 =	POWER

~ CONDENSERS ~

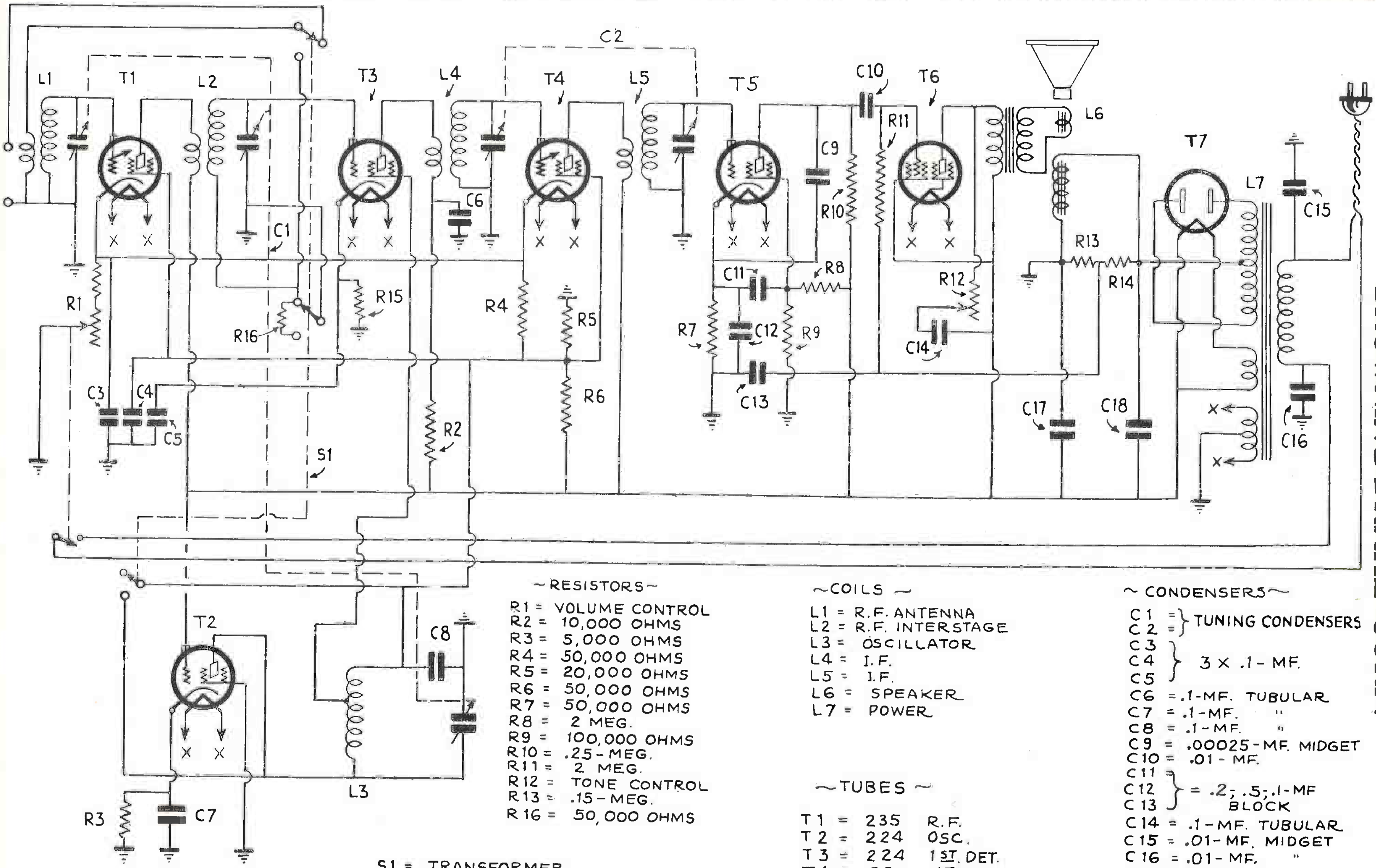
C1, C2, C3	3 X .1-MF. BLOCK
C4 =	.5-MF.
C5 =	.1-MF.
C6 =	.2-MF.
C7 =	.00025-MIDG.
C8 =	.00025-MIDG.
C9 =	.01-MIDG.
C10 =	.1-MF.
C11 =	.1-MF.
C12 =	8.-MF. ELEC.
C13 =	8 MF. ELEC.
C14 =	.01-MF. MIDG.
C15 =	.01-MF. MIDG.
C16 =	.1-MF. TUB.

TUBES

T1 =	235
T2 =	224
T3 =	235
T4 =	224
T5 =	224
T6 =	247
T7 =	280

MODEL — 40

BROWNING-DRAKE CORP.



~RESISTORS~

R1 = VOLUME CONTROL
R2 = 10,000 OHMS
R3 = 5,000 OHMS
R4 = 50,000 OHMS
R5 = 20,000 OHMS
R6 = 50,000 OHMS
R7 = 50,000 OHMS
R8 = 2 MEG.
R9 = 100,000 OHMS
R10 = .25-MEG.
R11 = 2 MEG.
R12 = TONE CONTROL
R13 = .15-MEG.
R16 = 50,000 OHMS

S1 = TRANSFORMER SWITCH

~COILS~

L1 = R.F. ANTENNA
L2 = R.F. INTERSTAGE
L3 = OSCILLATOR
L4 = I.F.
L5 = I.F.
L6 = SPEAKER
L7 = POWER

~TUBES~

T1 = 235 R.F.
T2 = 224 OSC.
T3 = 224 1ST. DET.
T4 = 235 I.F.
T5 = 224 2ND DET.
T6 = 247 OUT.
T7 = 280 RECT.

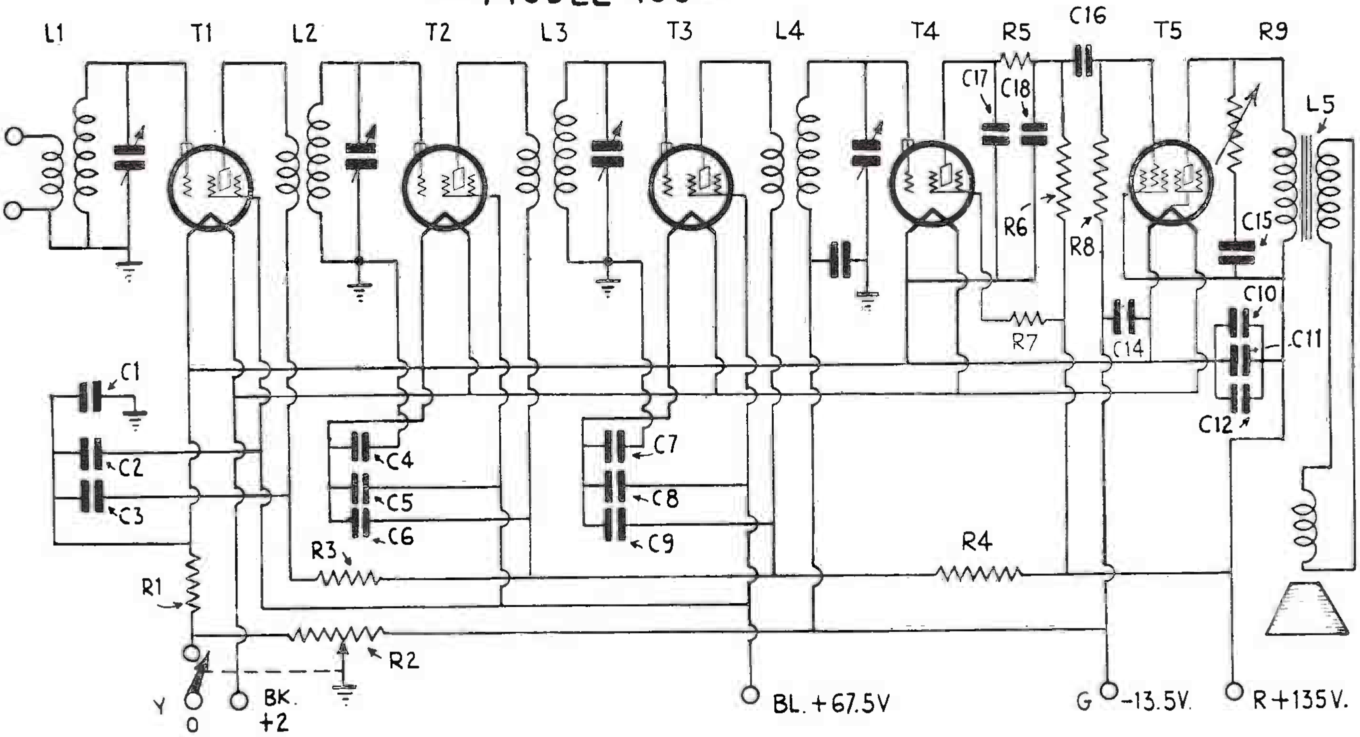
~CONDENSERS~

C1, C2 = TUNING CONDENSERS
C3, C4, C5 = 3 X .1-MF.
C6 = .1-MF. TUBULAR
C7 = .1-MF. "
C8 = .1-MF. "
C9 = .00025-MF. MIDGET
C10 = .01-MF.
C11, C12, C13 = .2; .5; .1-MF BLOCK
C14 = .1-MF. TUBULAR
C15 = .01-MF. MIDGET
C16 = .01-MF. "
C17 = 8 MF. ELECTROLYTIC
C18 = 8 MF "

MODEL - 80

BROWNING-DRAKE CORP.

~ MODEL 100 ~

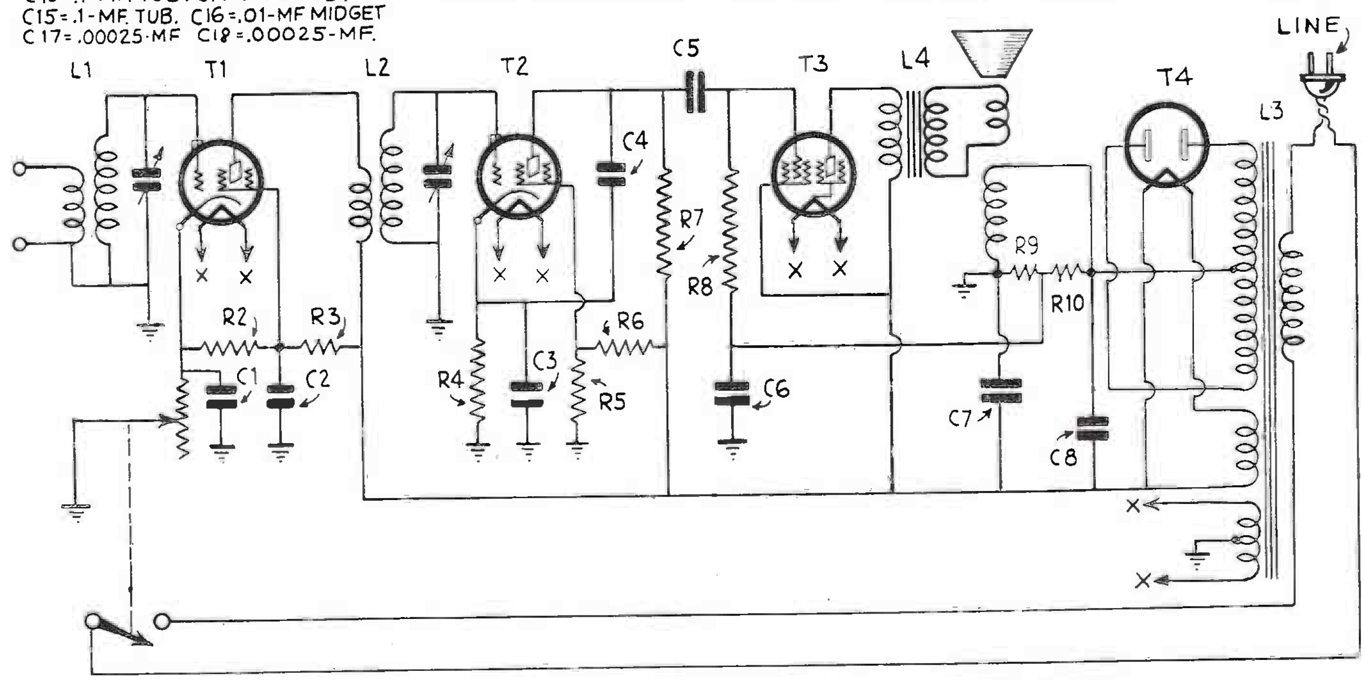


CONDENSERS
- C1, C2, C3 = 3 X .1-MF.
- C4, C5, C6 = 3 X .1-MF.
- C7, C8, C9 = 3 X .1-MF.
- C10, C11, C12 = 3 X .1-MF.
- C13 = .1-MF. TUB. C14 = .1-MF. TUB.
- C15 = .1-MF. TUB. C16 = .01-MF MIDGET
- C17 = .00025-MF. C18 = .00025-MF.

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. ~

ELECTRICAL RESEARCH LABS.

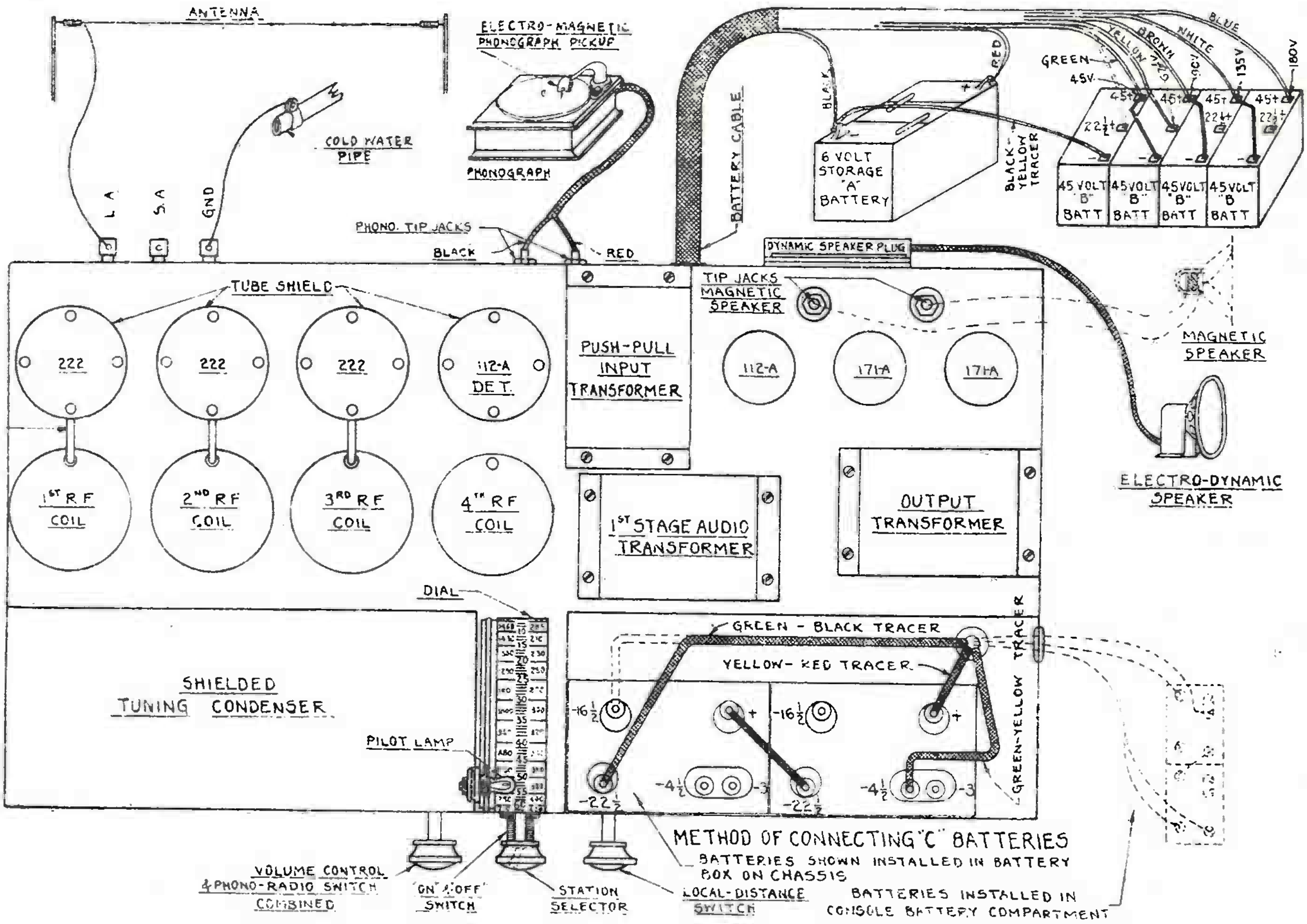


Figure 1
Showing Connections and Tube Arrangement

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.

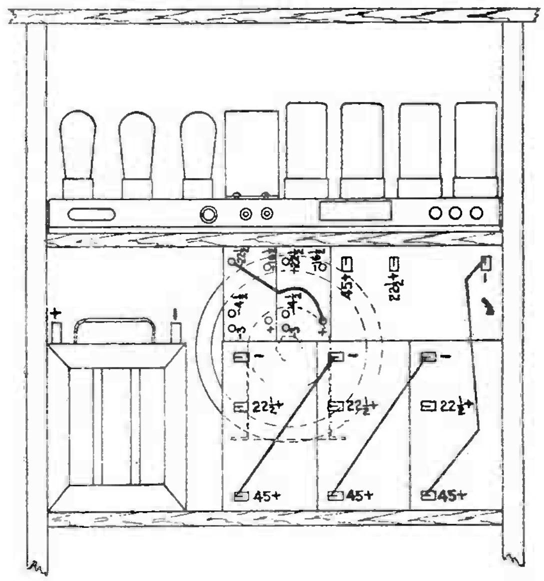


Figure 2
Showing Battery Arrangement in Console Models

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.

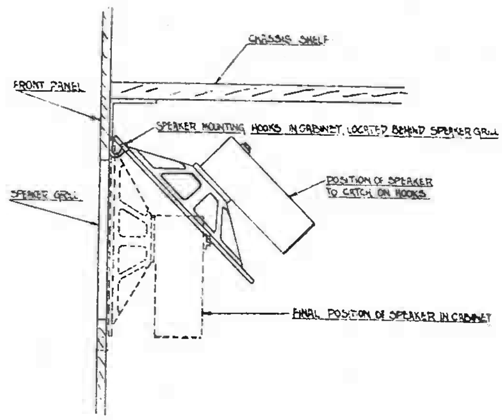


Figure 3

Showing method of mounting speaker in cabinet

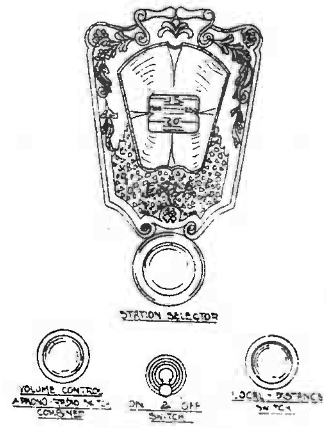


Figure 4

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 he 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 "back-ground" 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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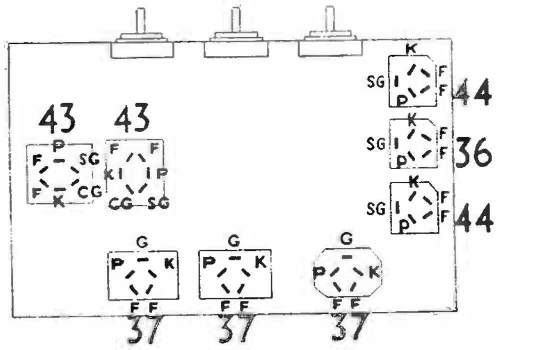
Service Bulletin—No. 131

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
P = Plate
SG = Screen Grid
CG = Control Grid
K = Cathode

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	Color Tip	Color Dot
39	70 & 16		Round Tubular	
45	5,000	Green	Black	Red
15	8,000	Gray	Black	Red
1, 36	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

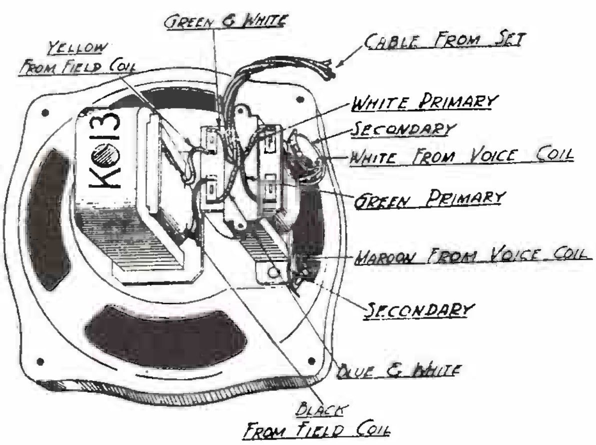


Fig. 1—Single Speaker Connections—121 Code.

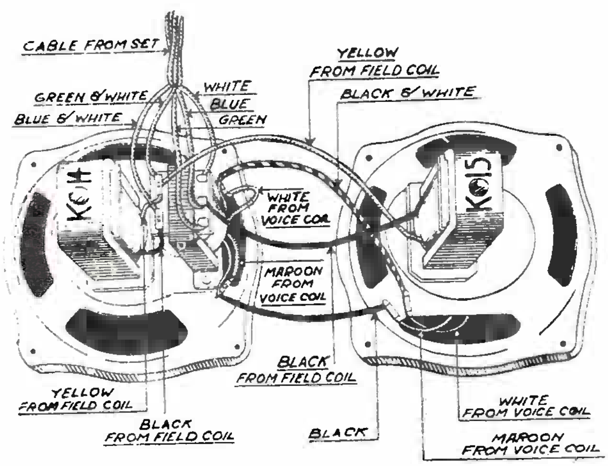


Fig. 2—Twin Speaker Connections—221 Code

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MODEL 47 SERIES

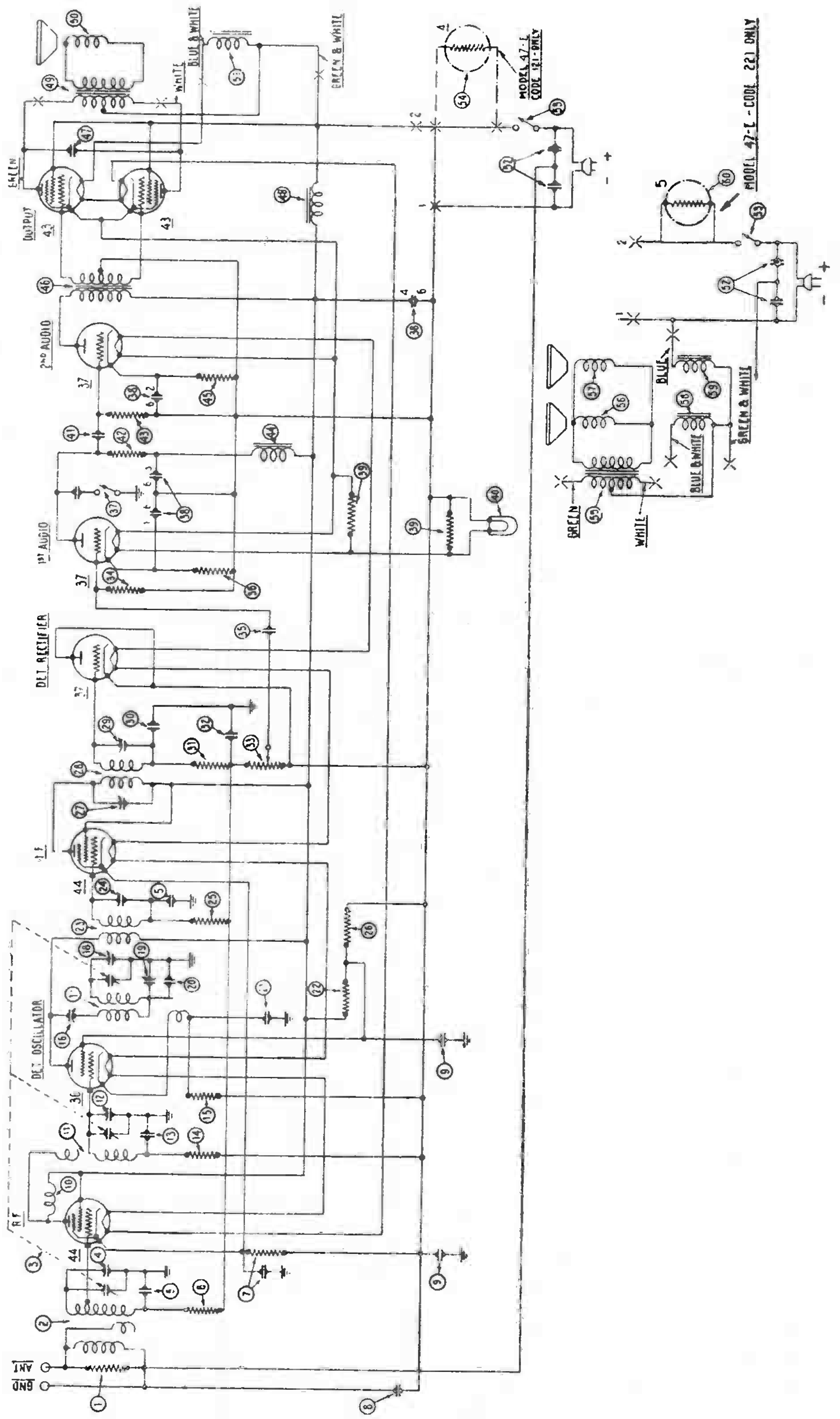

Fig. 3—Schematic Wiring Diagram

PHILCO RADIO & TELEVISION CORP.

PHILCO

No. 131 Service Bulletin Page 3

MODEL 47 SERIES

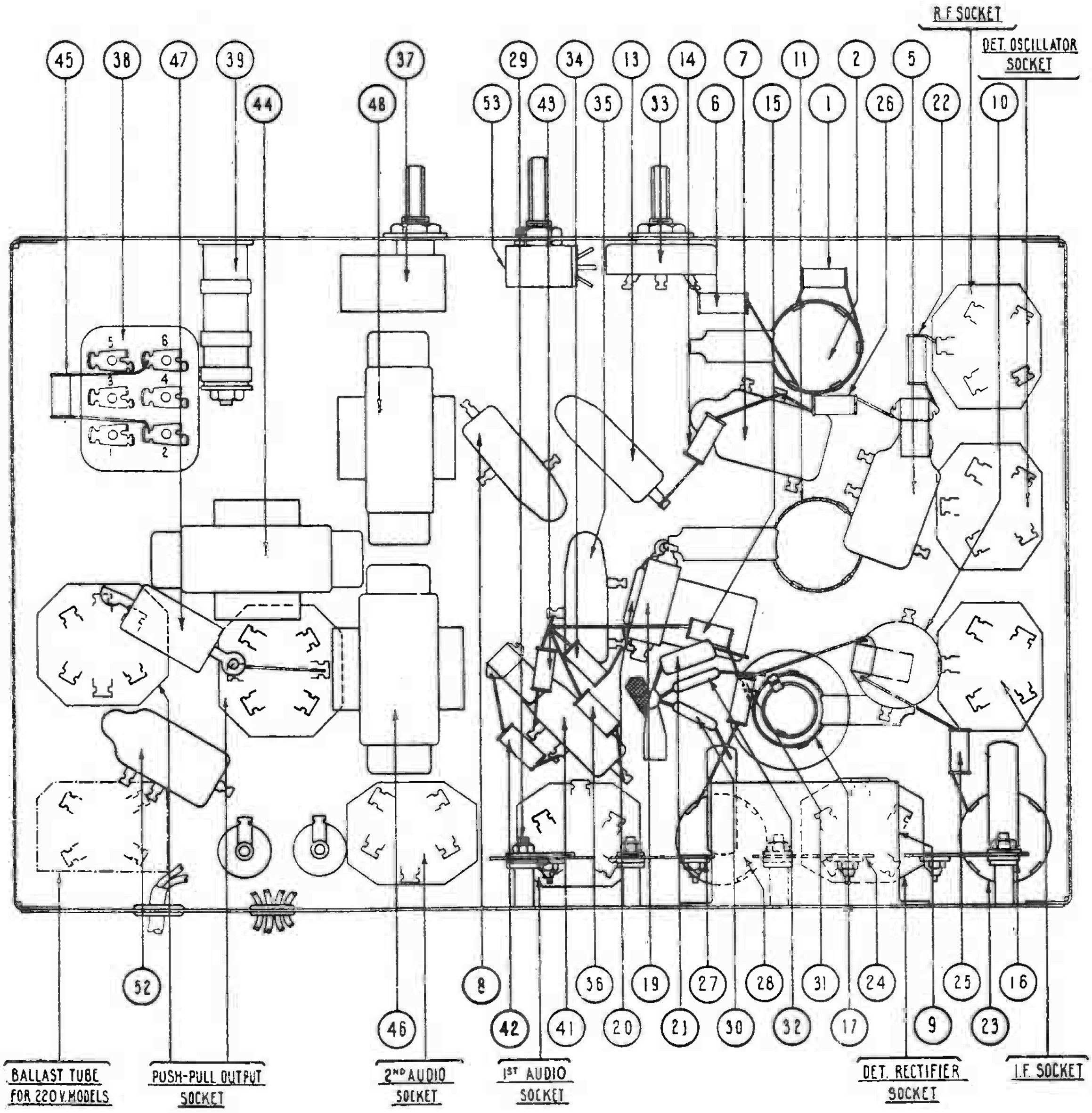

Fig. 4—Parts Diagram

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.

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

No. on Figs. 3 and 4	Description	Part No.
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	13 12
8	03345	I. F.	70	80	90 (Pentode Output) 15	13 38
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 8 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 21
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	34
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 56 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 40A 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 56 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 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 ND-19294
'33*	2.0	1.9	2.4	ND-19625
'34	2.0	4.5	6.5	D-65080 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 #42
'42*	6.3	3.1	4.7	D-65080 #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.	Readings Test	Tube	Adapter Number	Socket	Readings MA.	Readings 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.

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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
'99			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.

STEWART-WARNER CORPORATION

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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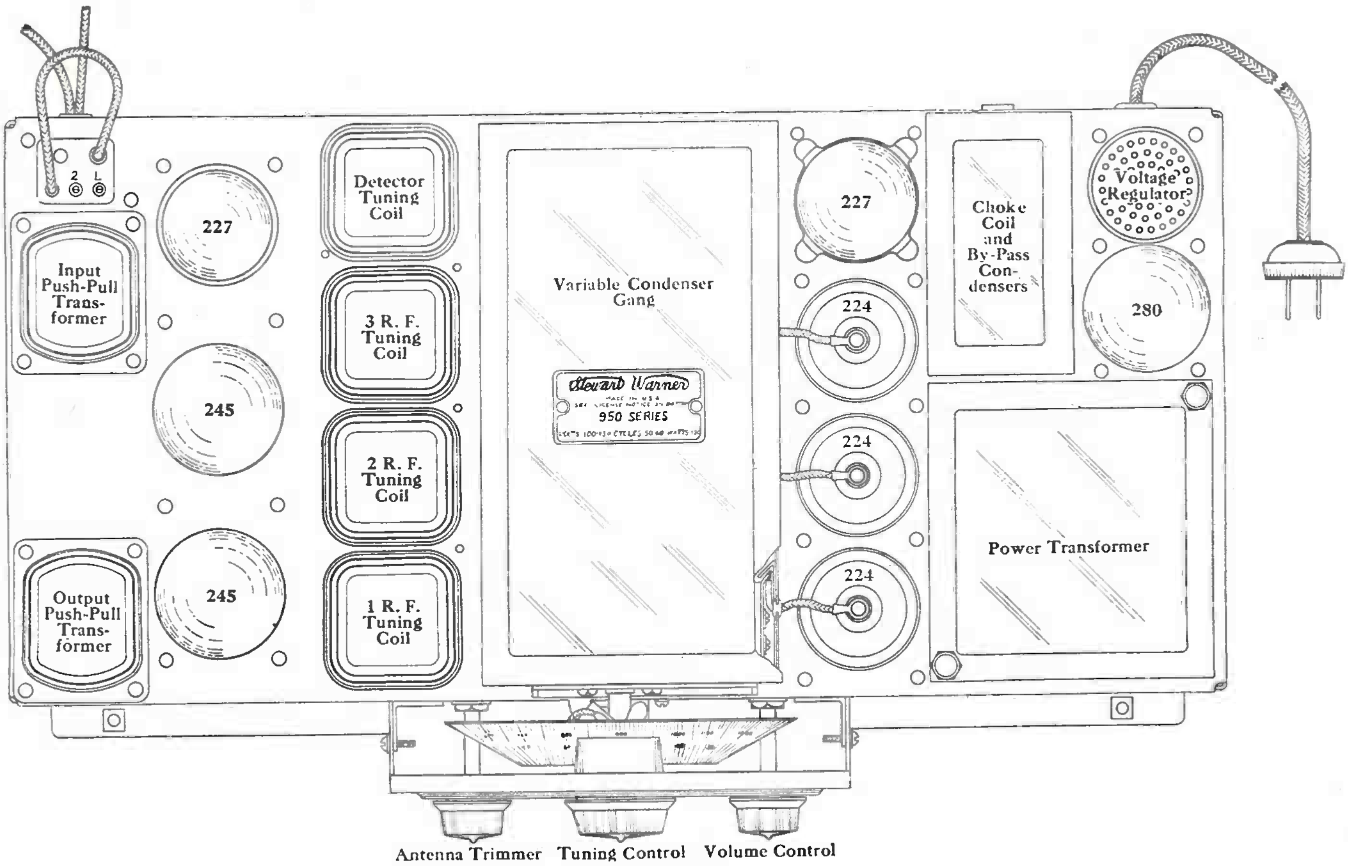

Fig. 1—Top View of Mechanism

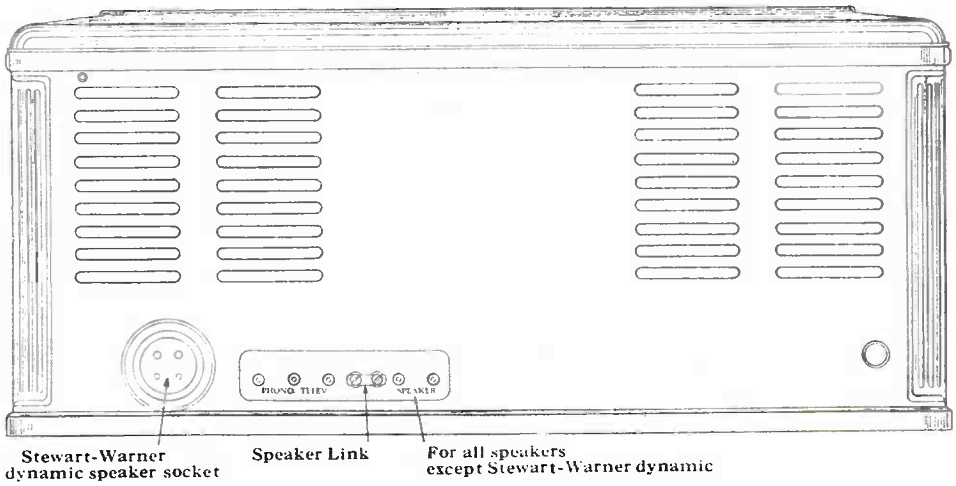

Fig. 2—Rear View, Showing Terminal Layout

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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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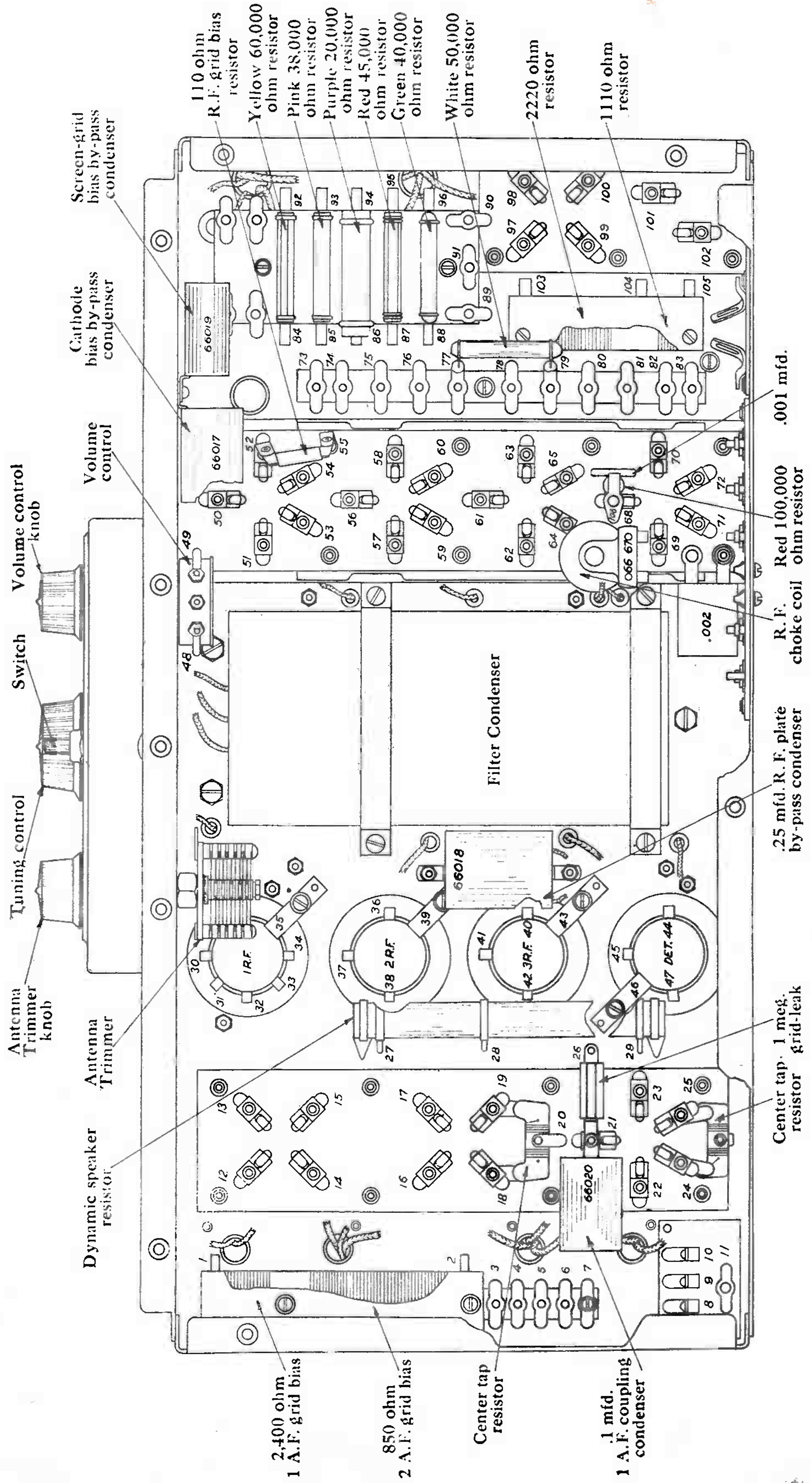

Fig. 3—Bottom View of Set

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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 51 to 103	Full reading About ¾ reading	Open primary of 2nd R. F. transformer 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 69 to 93 69 to 84 69 to 74	Almost full reading About 1/5 full reading Still lower reading Slightly lower reading	Open R. F. choke Open pink resistor Open yellow resistor Open filter choke
Grid	68 to 106 68 to ground	Very low reading Very low reading	Open short red resistor 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 12 to 27	Almost full reading Almost full reading	Open primary of output transformer
Grid	13 to ground 17 to ground	About ⅔ full reading About ⅔ full reading	Open secondary of input push-pull transformer

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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 voltemeter
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 1	TYPE OF TUBE 2	POSITION OF TUBE 1ST R. F. DET., ETC. 3	READINGS, PLUG IN SOCKET OF SET — TUBE IN TESTER: A VOLTS 6	B VOLTS 7	C VOLTS CONTROL GRID 8	CATHODE HEATER VOLTS 9	NORMAL PLATE M. A. 10	PLATE M. A. GRID TEST 11	PLATE CHANGE M. A. 12	SCREEN GRID VOLTS 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 upas 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.

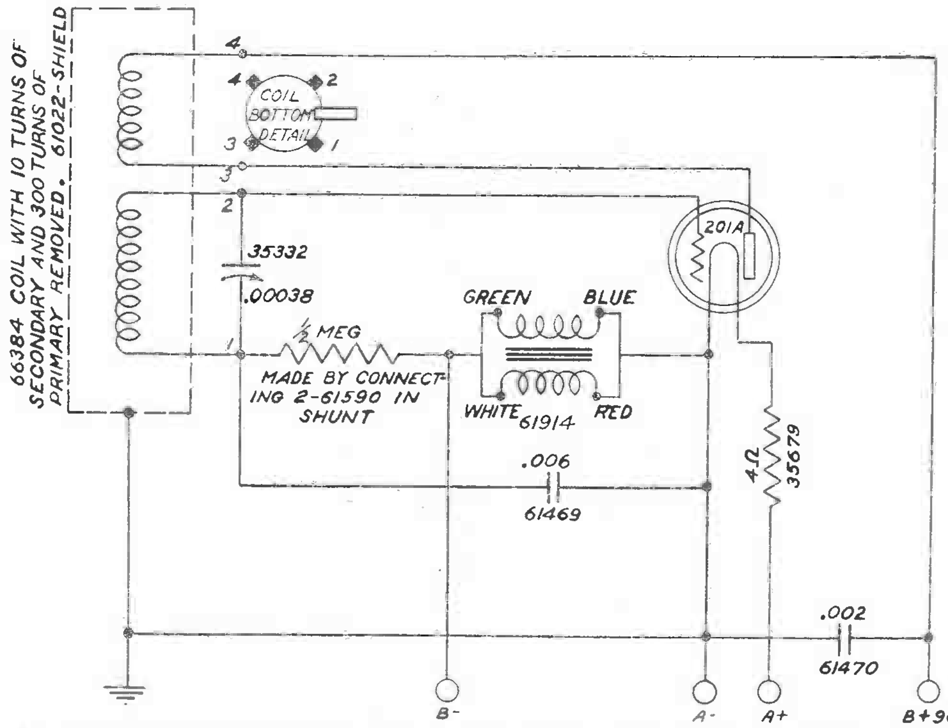

Fig. 5. Circuit Diagram of Modulated Oscillator Using Stewart-Warner Parts

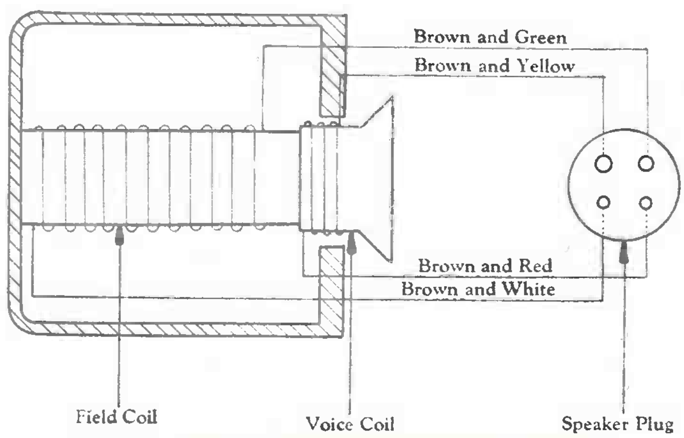

Fig. 6. Circuit of Dynamic Reproducer

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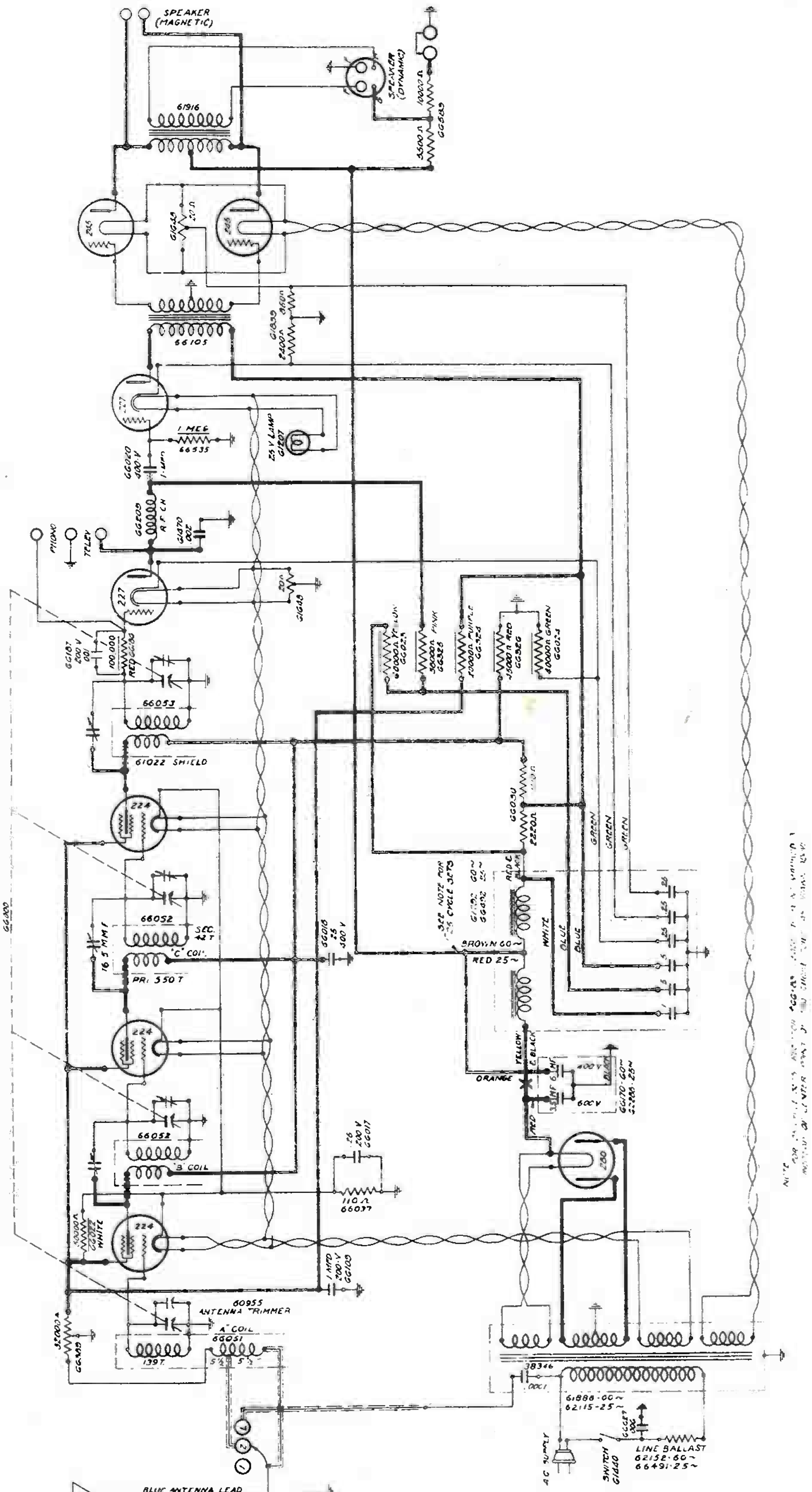

CIRCUIT DIAGRAM FOR STEWART WARNER SERIES 950 & 360 RADIO RECEIVERS

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.)

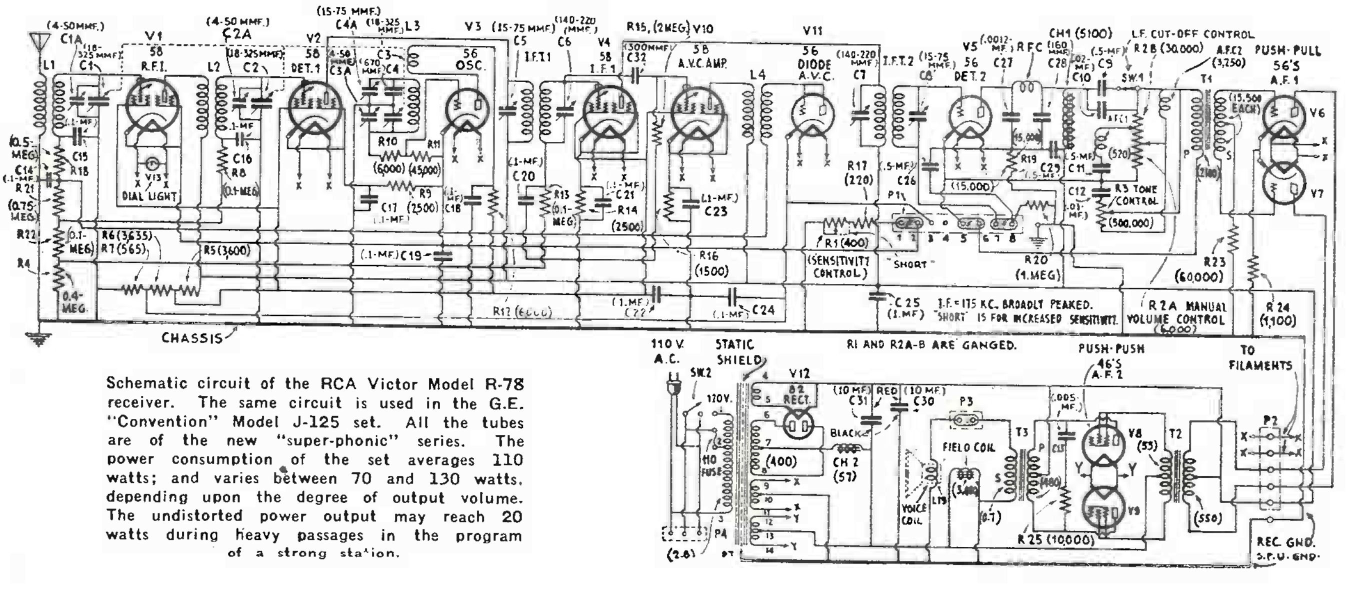
A "dummy" 56-type tube having an open heater circuit is required to replace V11; make certain that the dial pointer reads exactly at the short line on the scale when the gang condenser plates are fully meshed. Then, align the circuits at 1,400 kc., with the volume control in the "maximum" position.

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 station.

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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

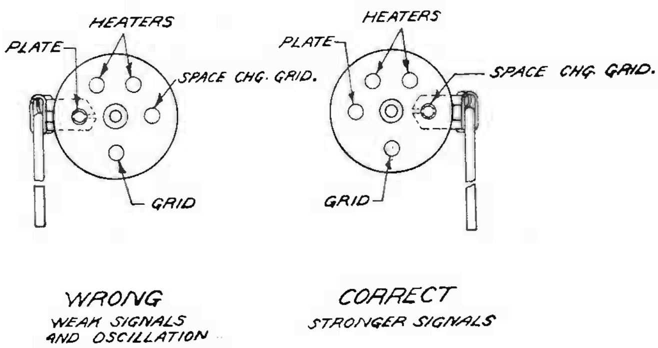
An outdoor antenna up to 150 feet overall, including lead-in should be connected to the post marked ANT on the left hand side of the rear of the chassis. A shorter outside aerial could, of course, be used, but the short wave signals are usually so weak that a long antenna is advisable. An inside aerial also can be used, but this will greatly decrease the distance getting ability of the receiver.

GROUND

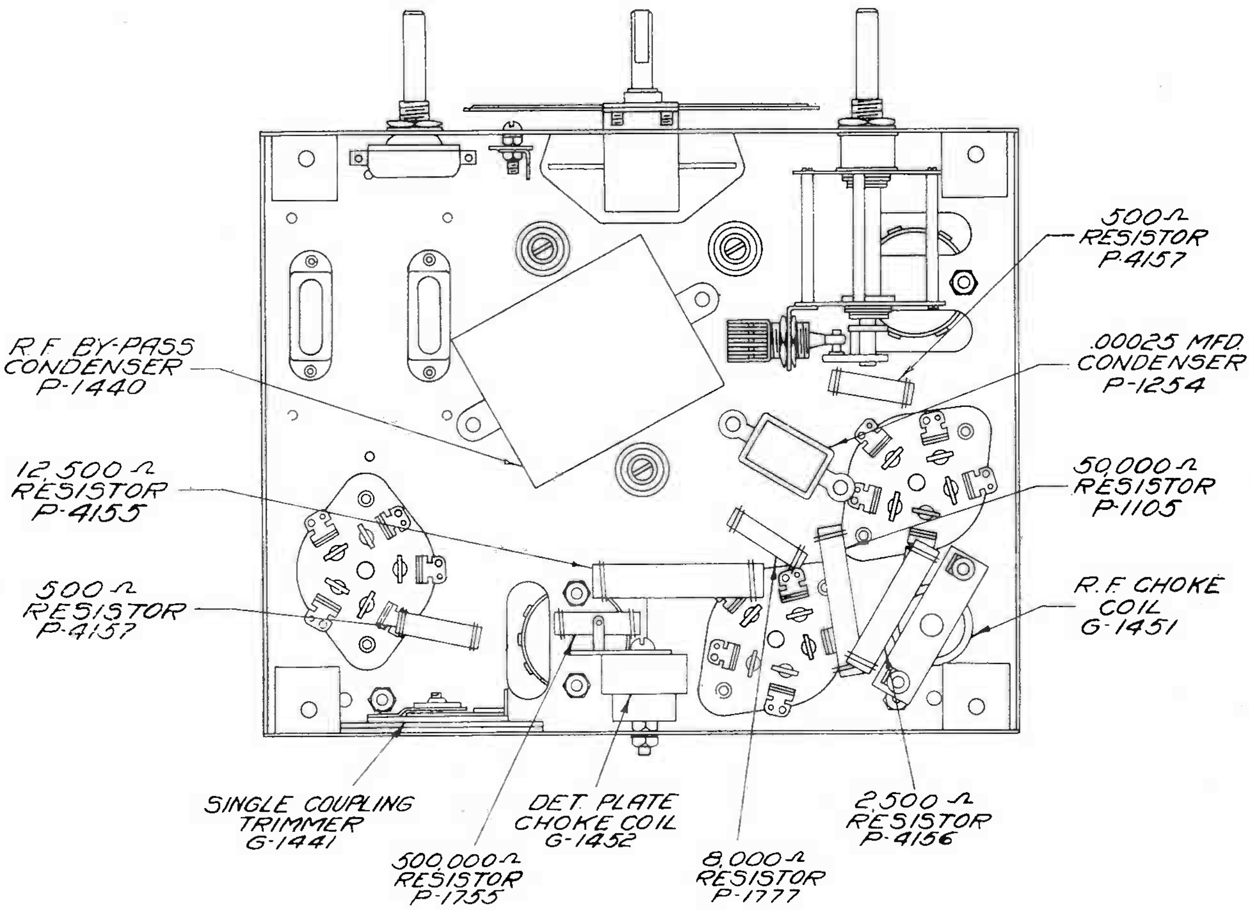
It is very important for satisfactory operation that a good ground be connected to the post marked GND on the left hand side of the rear of the chassis.

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



THE RIGHT AND WRONG WAY THE LUG CAN BE INSERTED IN THE ADAPTER WAFER



G-200 CHASSIS BOTTOM VIEW

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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.

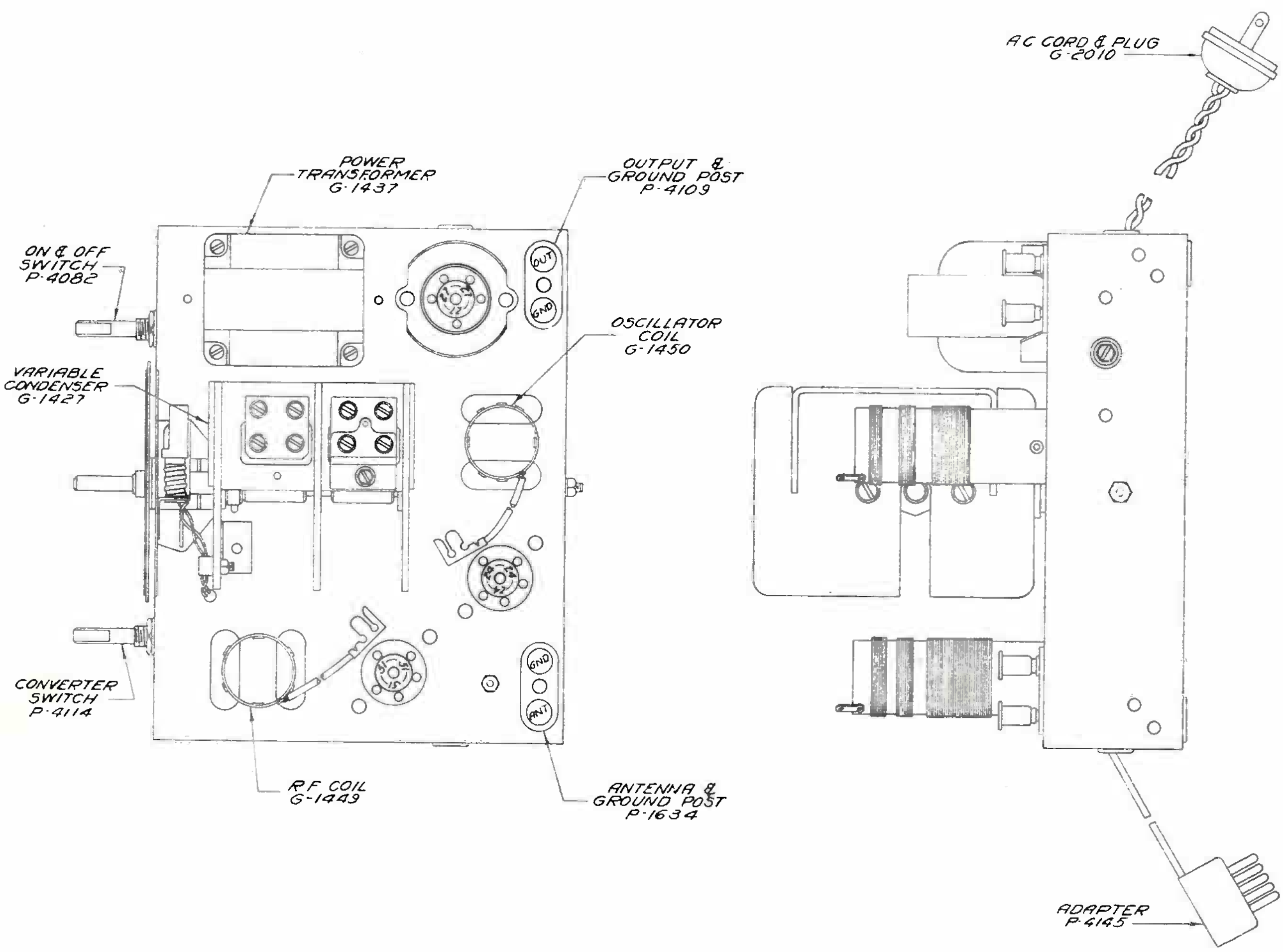
The trimmer adjustment screw on the right rear of the chassis is intended to adjust the output impedance of the unit to the antenna coil of the broadcast receiver into which it operates. This adjusting screw need not be moved if the unit is connected to a model 100 receiver.

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

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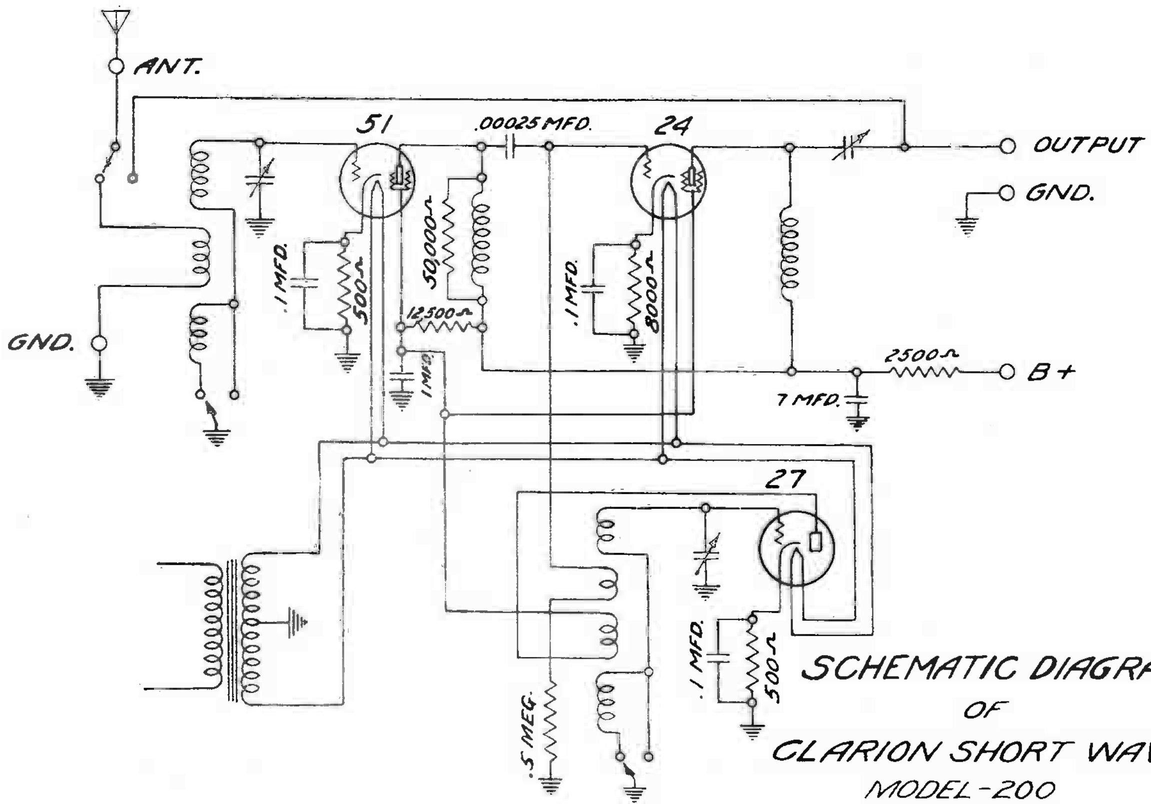
aeroplane, television and amateur phones, the band switch should be turned to the center or "up" position. To receive signals between 5500 and 15,000 K. C., such as foreign stations, the band switch should be thrown all the way over to the right. To assist in tuning we have incorporated diagrams of the 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



SCHEMATIC DIAGRAM
OF
CLARION SHORT WAVE
MODEL-200
DRAWN BY L.J. CHECKED BY
DATE-2-3-32

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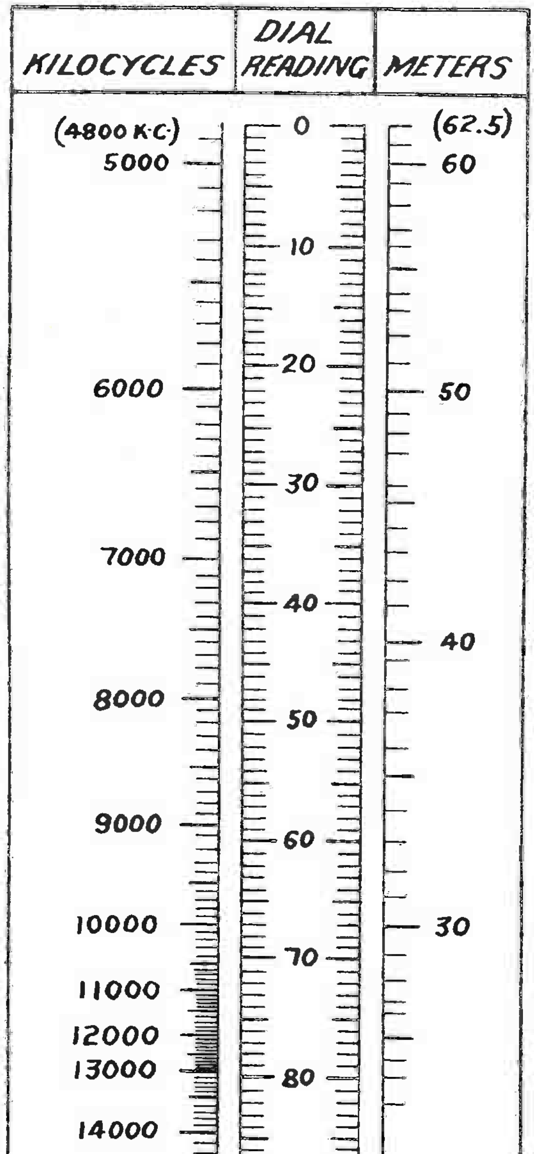
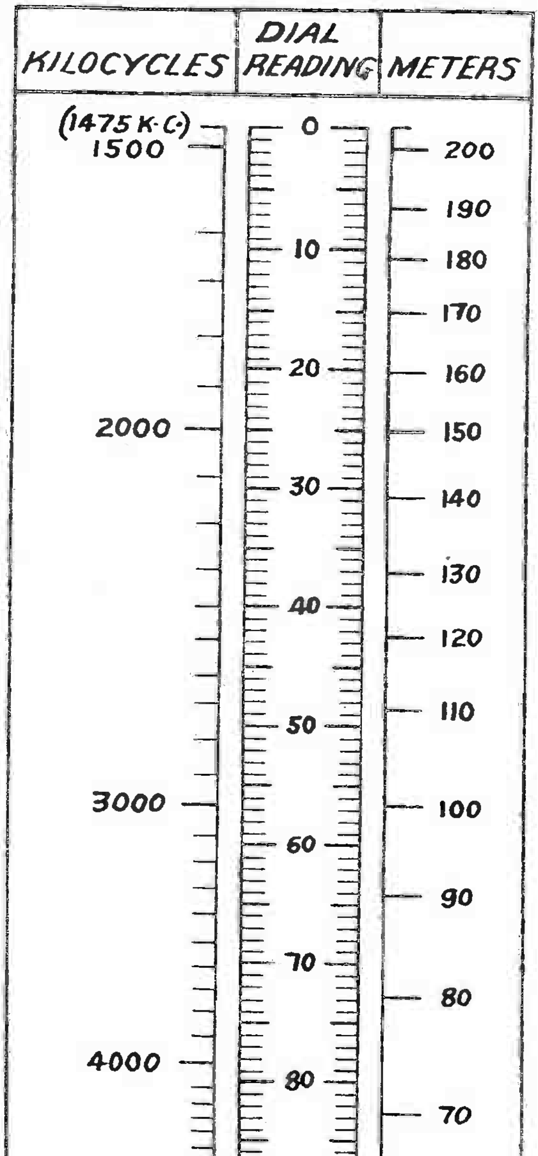
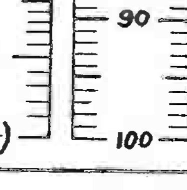


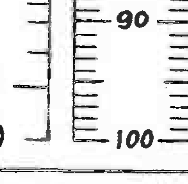




RIGHT

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

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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°	DEGREES OF LONGITUDE WEST OF GREENWICH.
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°	G.M.T.
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°	DEGREES OF LONGITUDE EAST OF GREENWICH.
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													

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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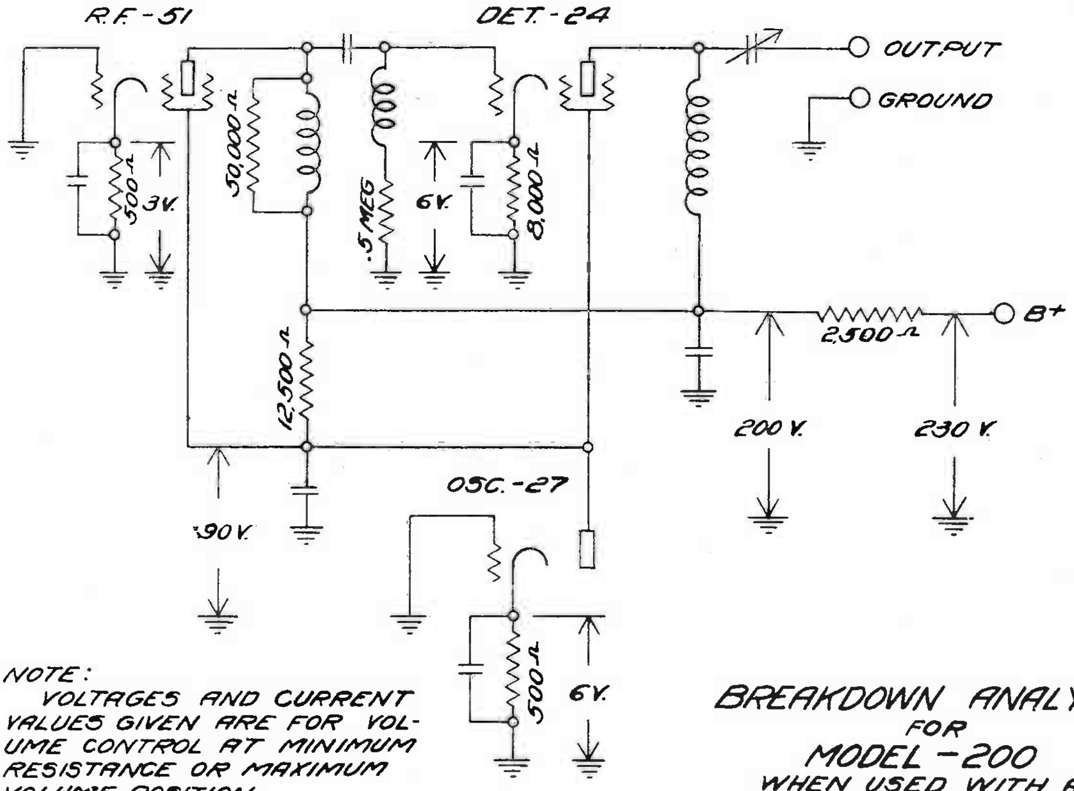
VOLTAGE ANALYSIS

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

TRANSFORMER CORPORATION OF AMERICA

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.

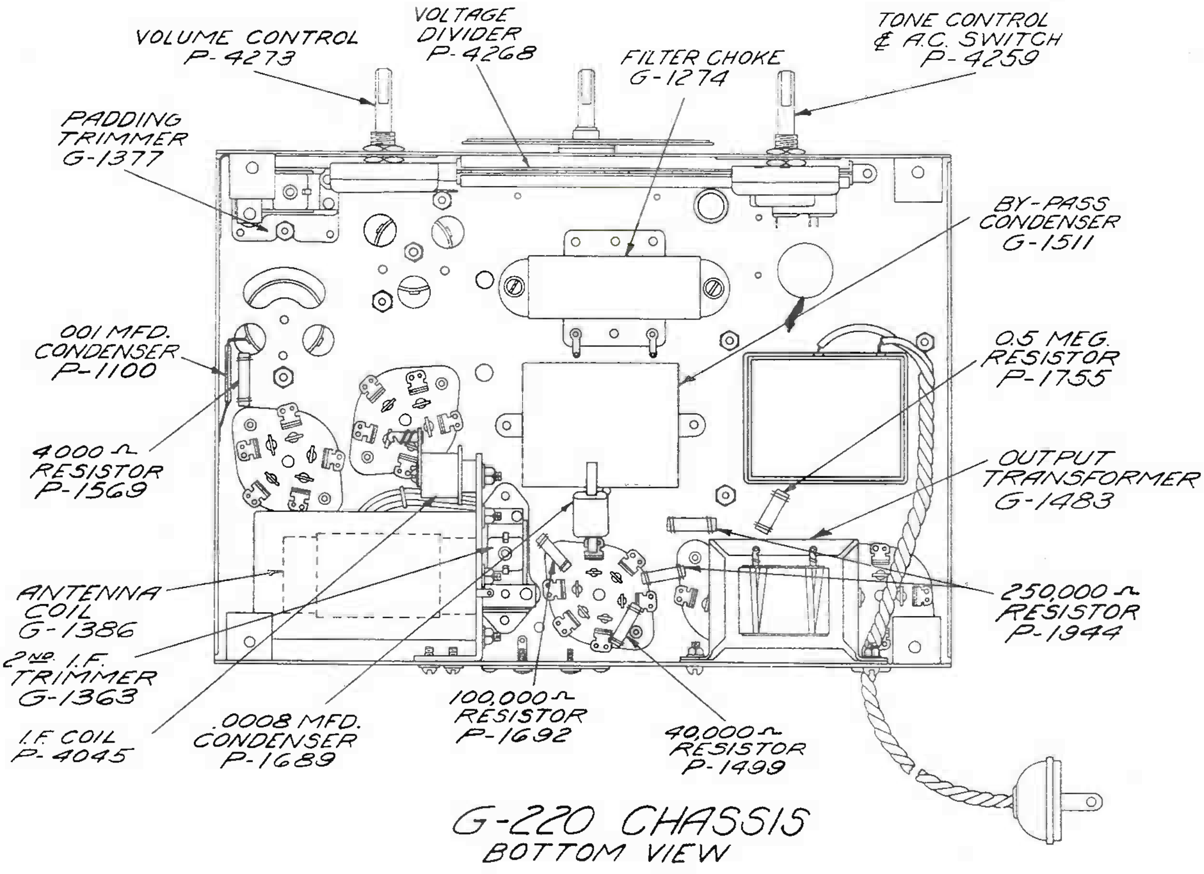


Fig. 1

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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

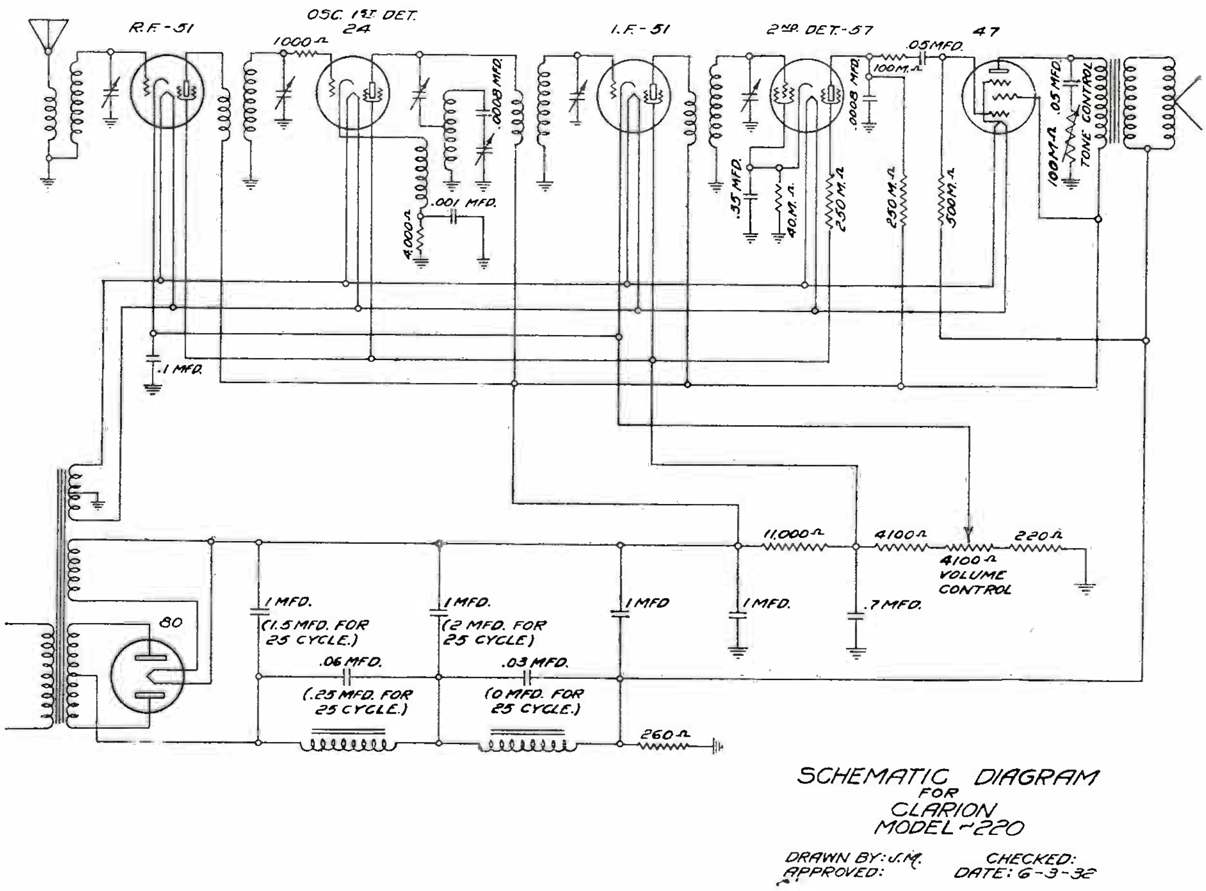

Fig. 2

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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 In-Operative 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

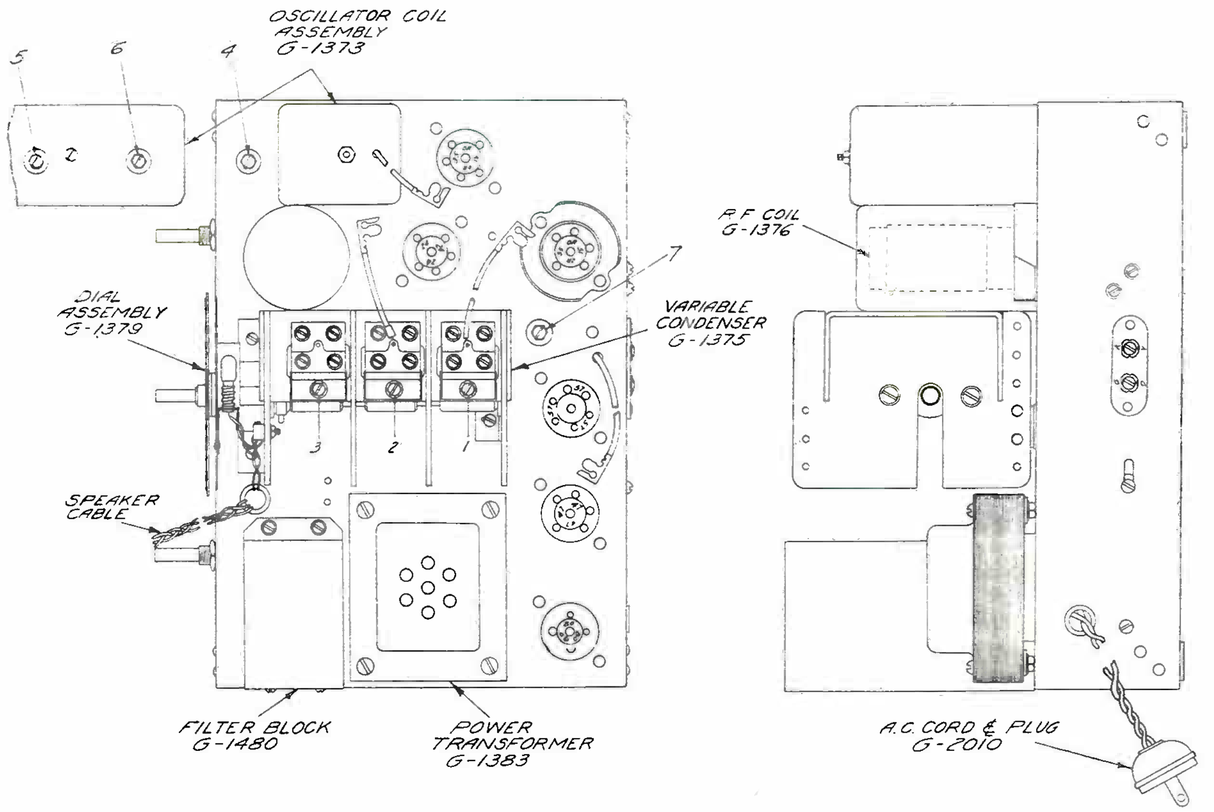
(Applicable to Operative Sets and Circuits Performing Below Normal)

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:



G-220 CHASSIS

Fig. 3

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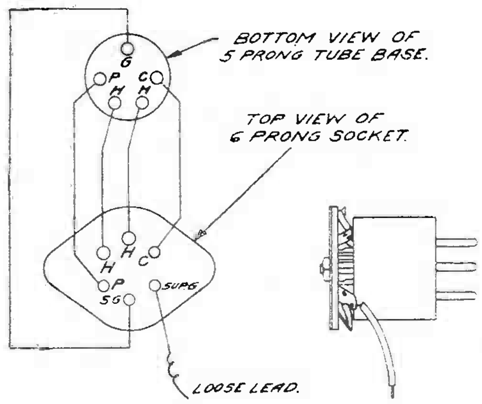
For the plate voltage reading, using the 250 volt scale meter, connect betwen plate and filament prongs. For the control grid voltage, check between the black common lead on the loud speaker voice coil circuit and the ground.

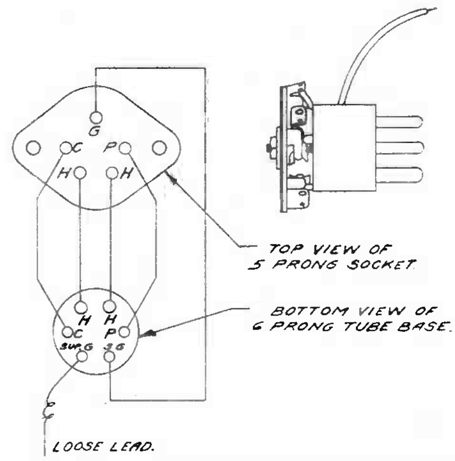
For space charge grid voltage, test between the space charge grid prong and the filament. (It should be noted that the Pentode tube base resembles the type '27 tube base, the prongs having the same connection with the exception of the space charge grid prong on the '47 tube, which will correspond in 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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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

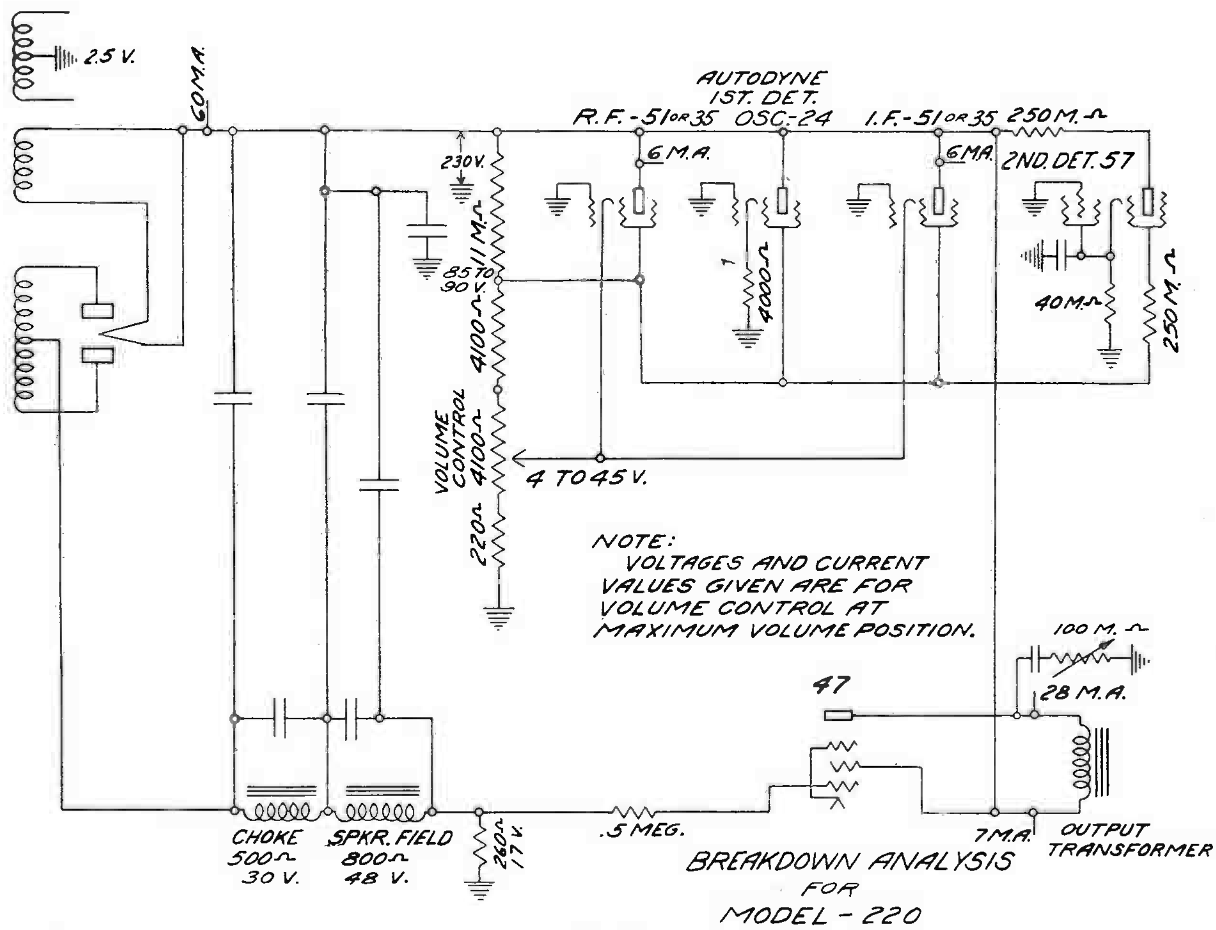

Fig. 5

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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

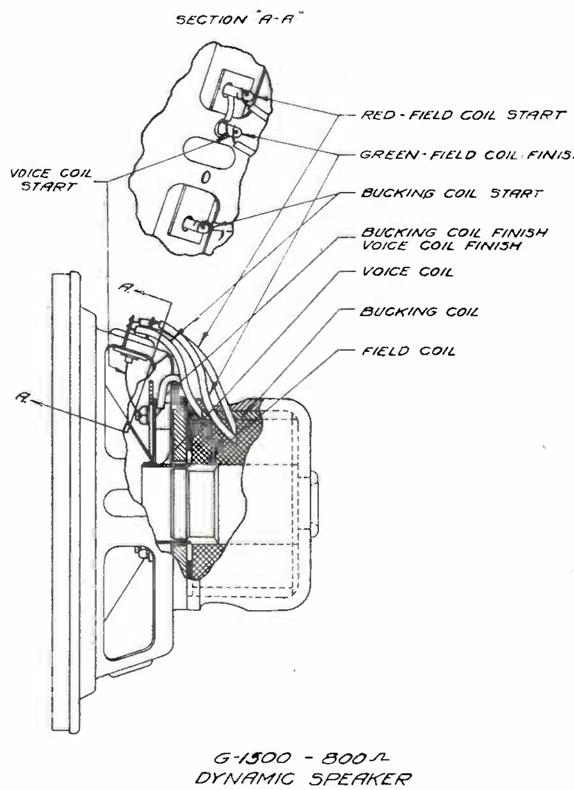

Fig. 6

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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.

ZENITH RADIO CORPORATION

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.

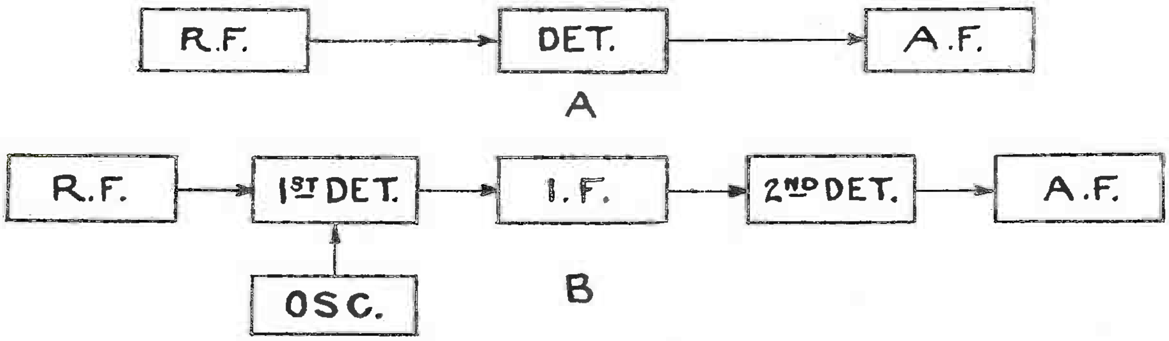

Fig. 1

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

ZENITH AUTOMATIC RADIO

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.

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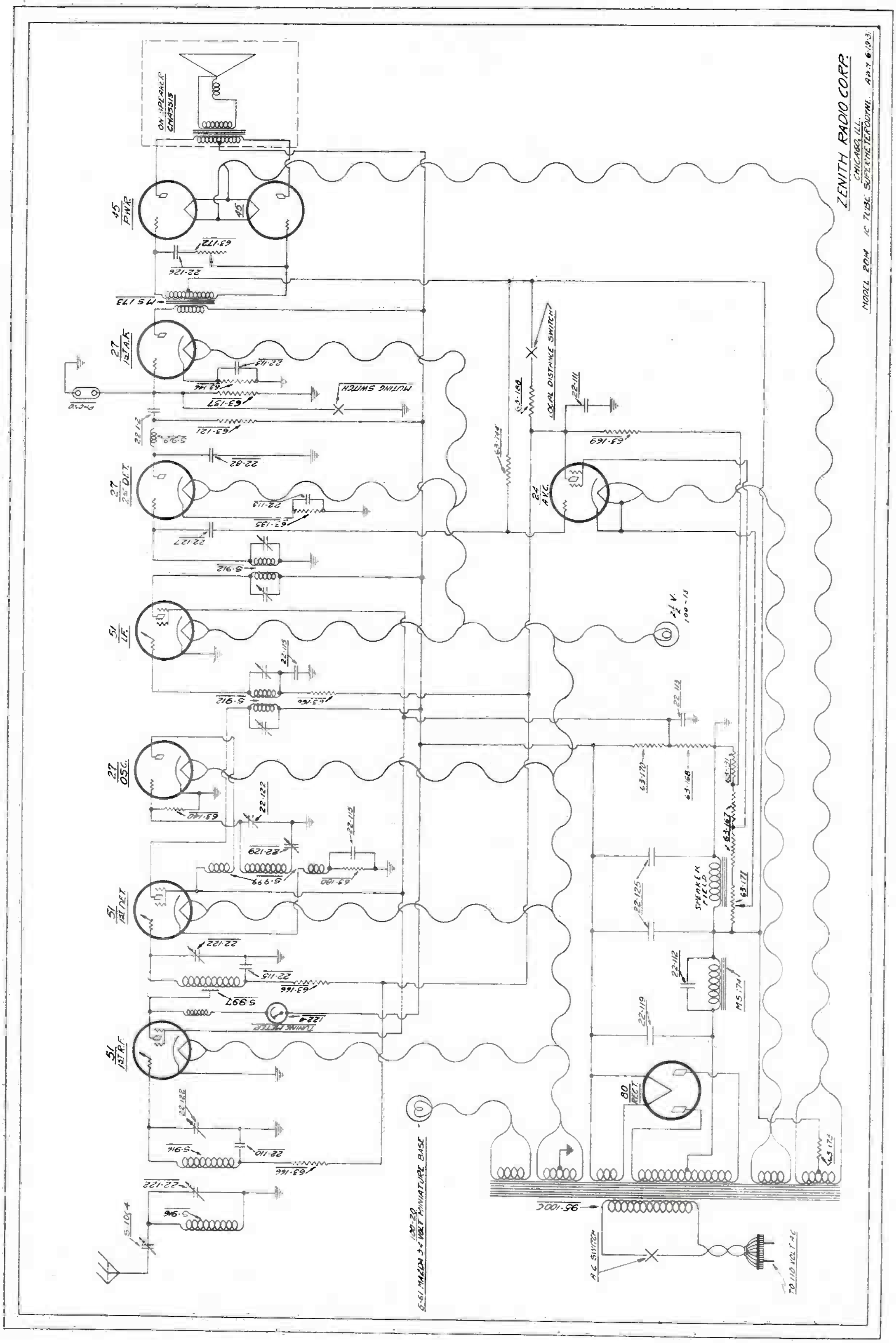

FIG. 2—CIRCUIT DIAGRAM—MODELS 91-92

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ZENITH AUTOMATIC RADIO

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.

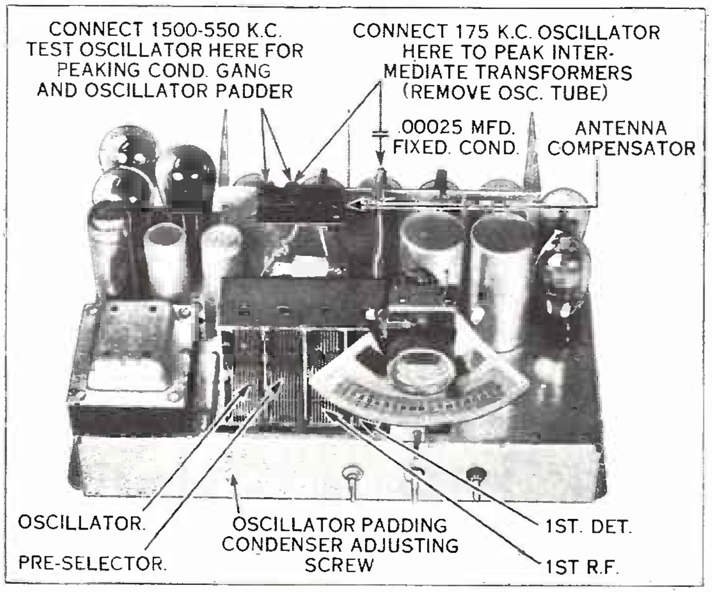

FIG. 3

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.

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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.

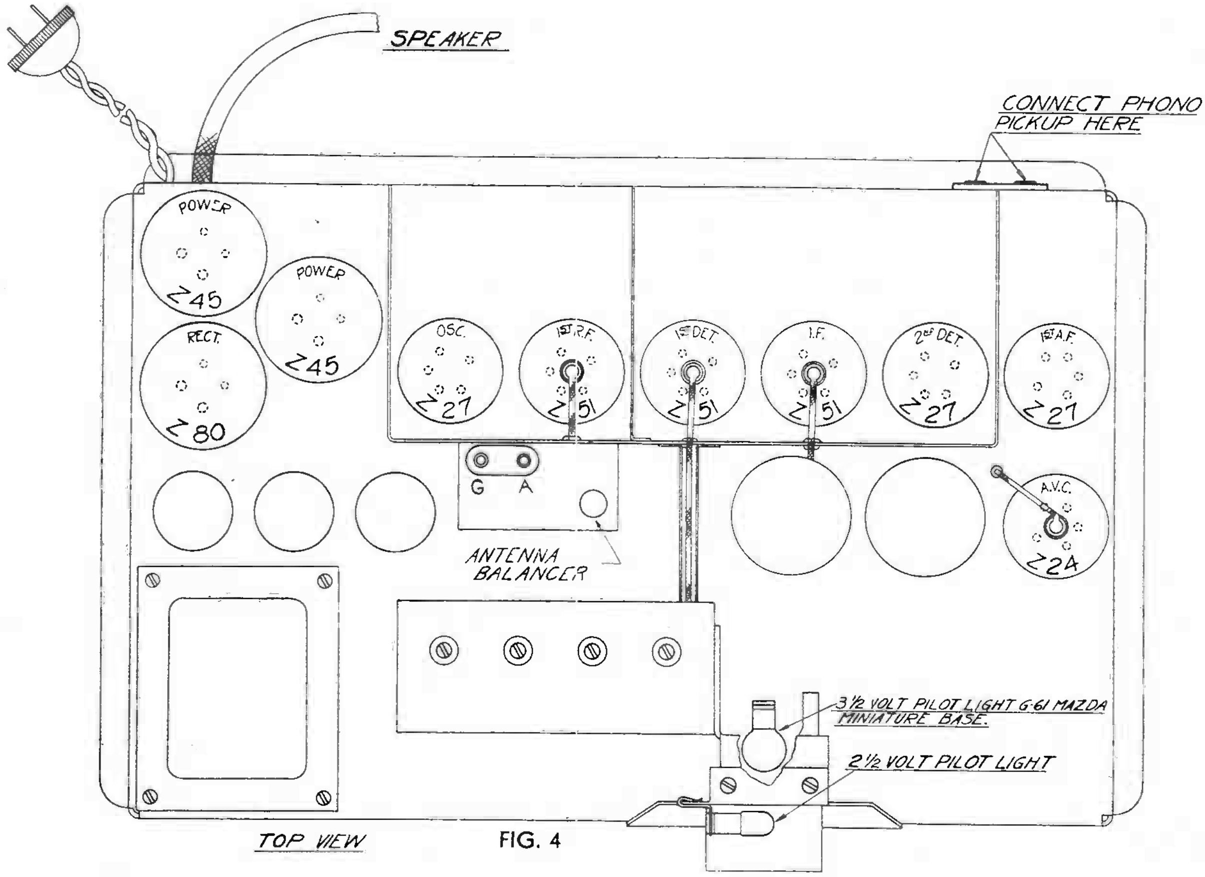

FIG. 4

TUBE LAYOUT - Showing Position and Circuit Function of each.

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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.

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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

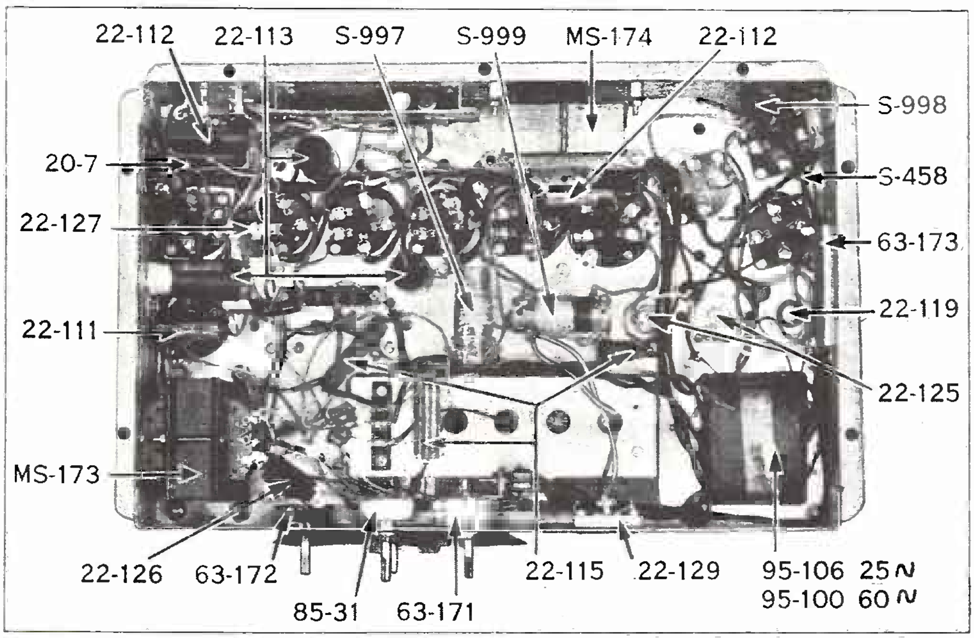

FIG. 5

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.

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REPLACEMENT PARTS

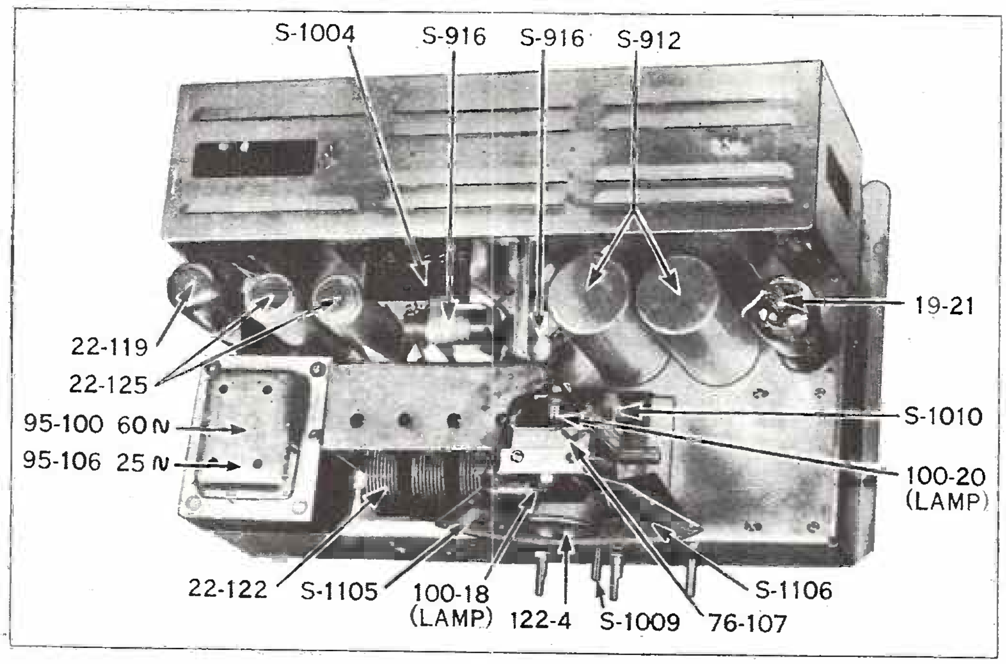

FIG. 6

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

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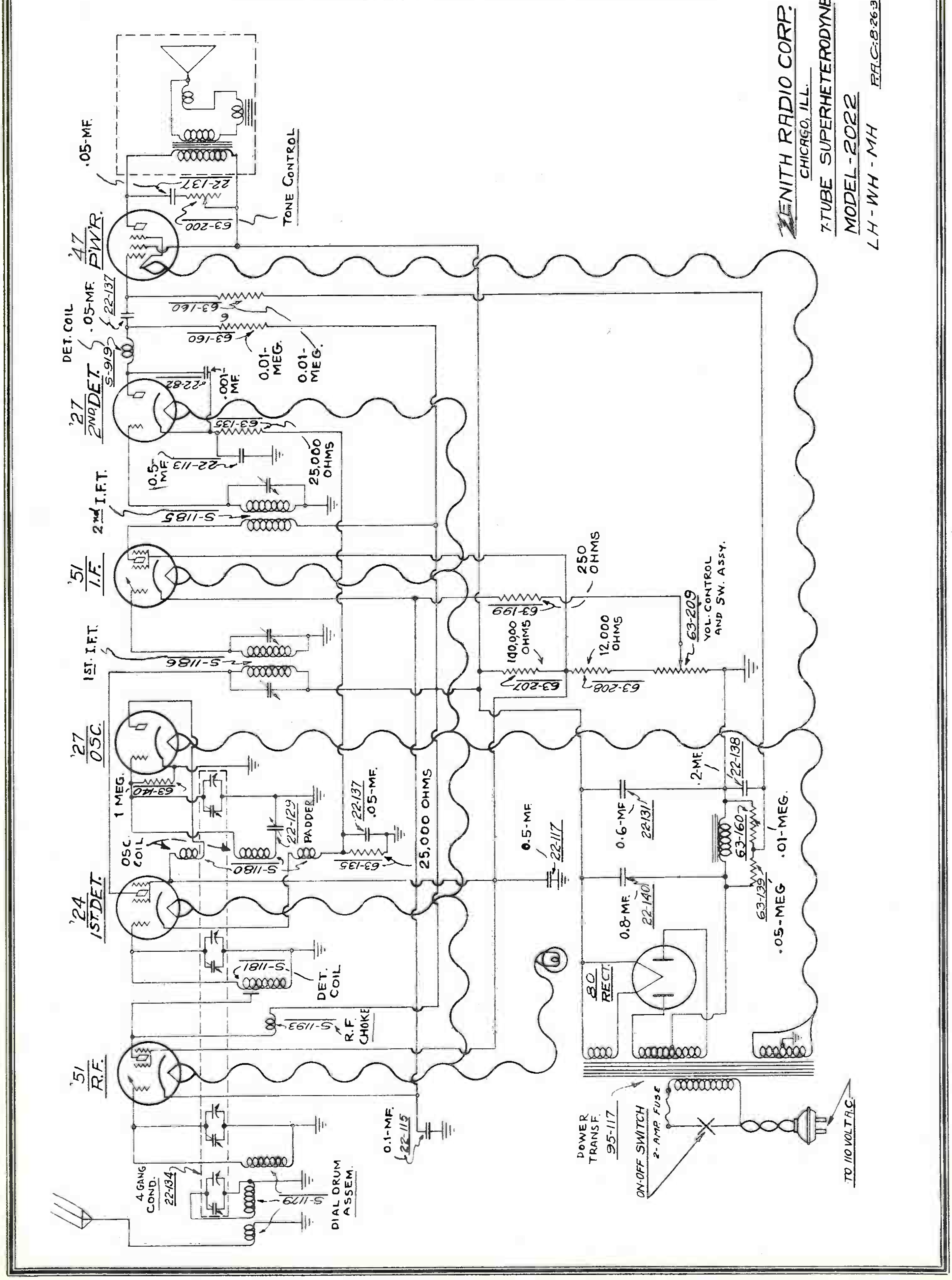

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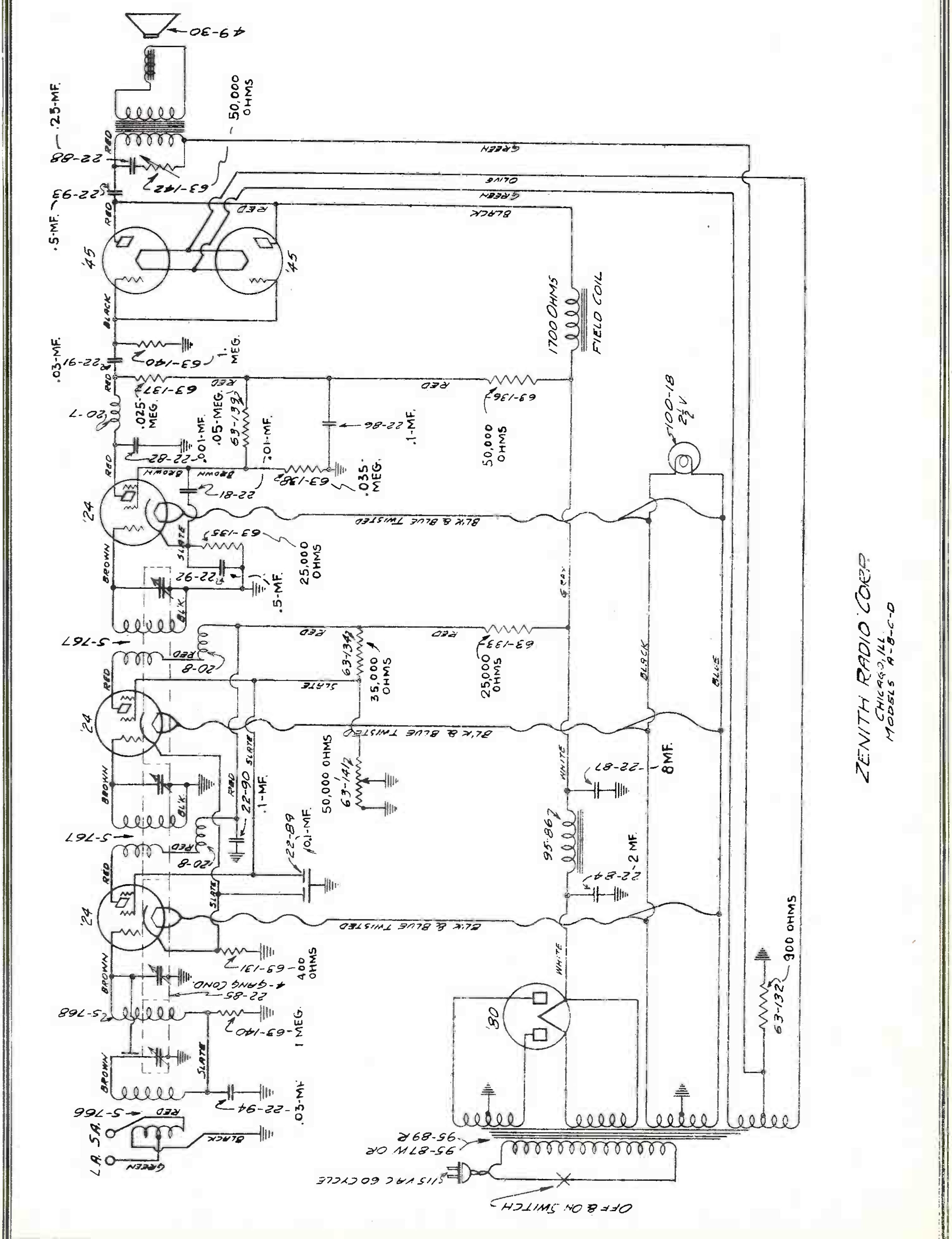

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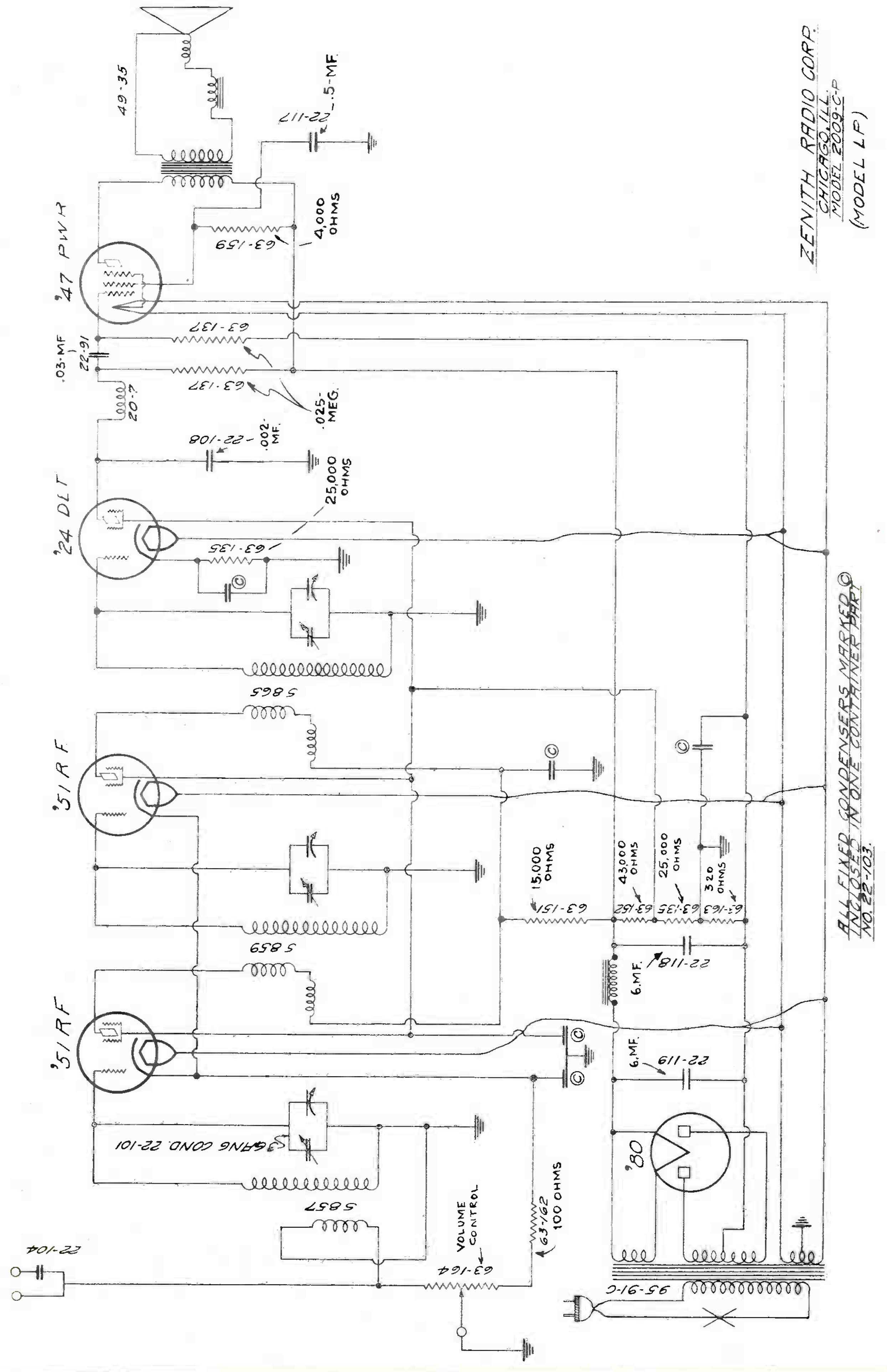

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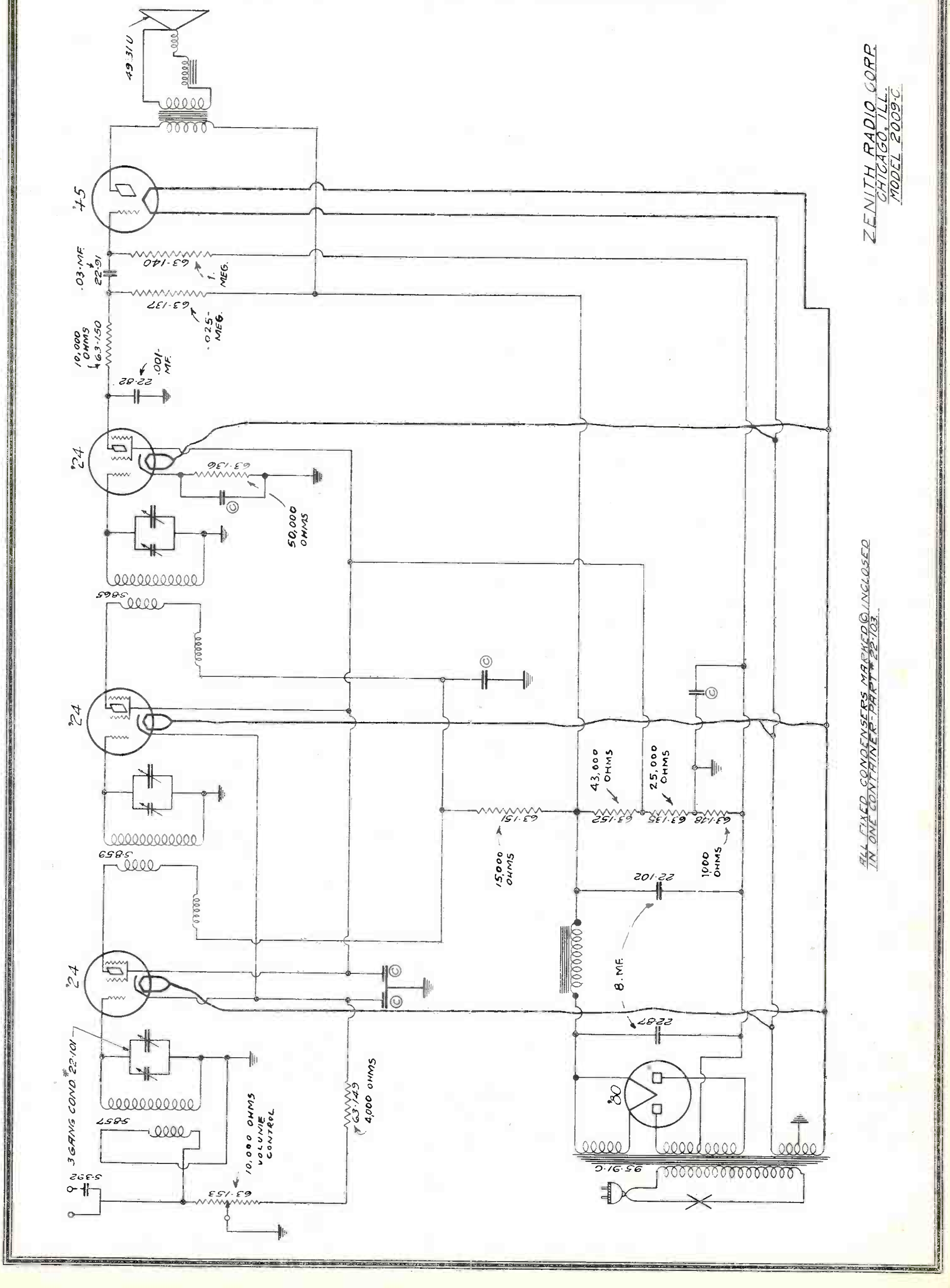

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