RCA 66

GRAYBAR RADIO

600

SERVICE NOTES and REPLACEMENT PARTS

GraybaR
ELECTRIC COMPANY

GRAYBAR RADIO

600

SERVICE NOTES and
REPLACEMENT PARTS

GRAYBAR

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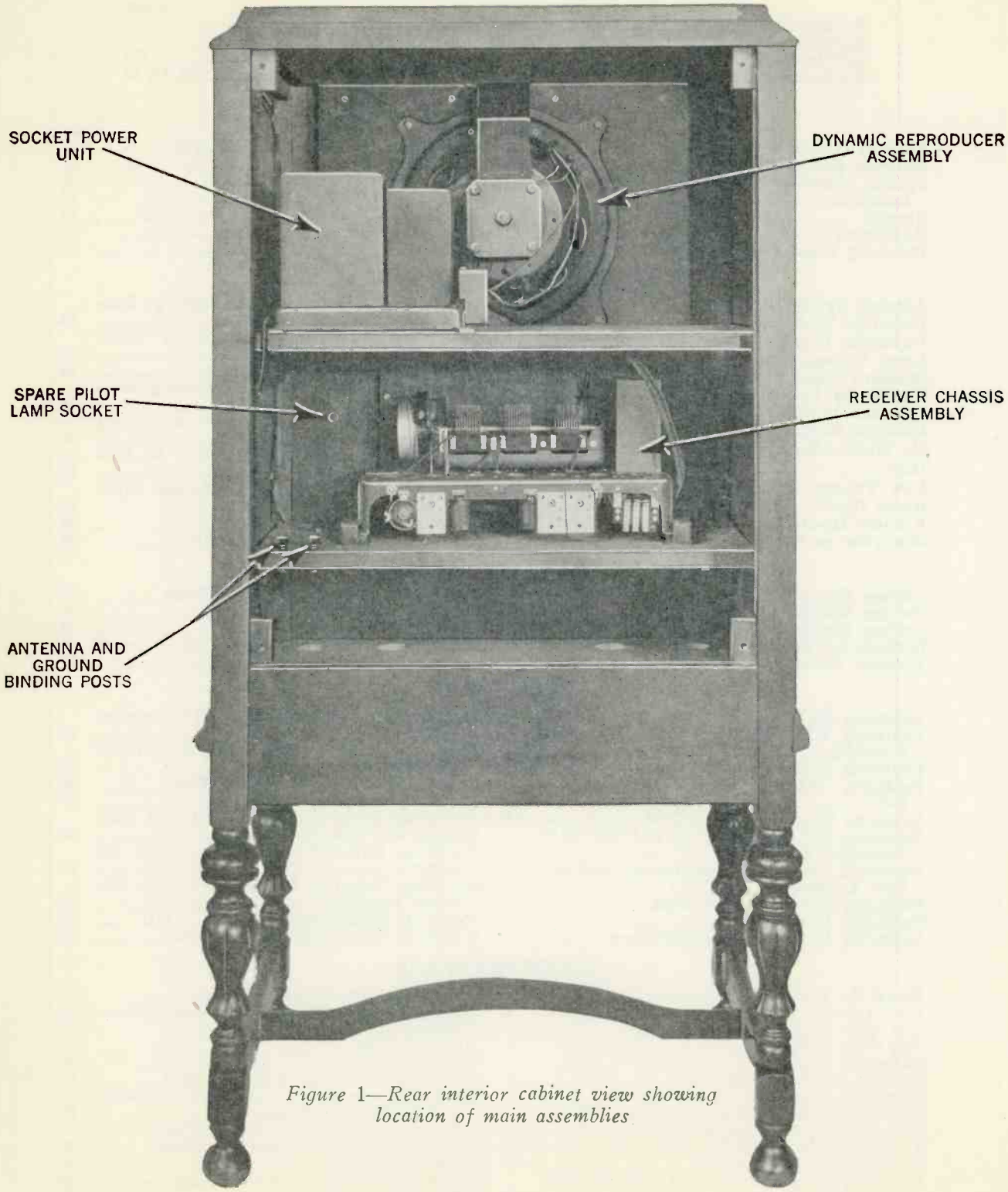


Figure 1—Rear interior cabinet view showing location of main assemblies

GraybaR

No. 600 RECEIVER

SERVICE NOTES

INTRODUCTION

The Graybar No. 600 receiver is a seven-tube socket powered console cabinet model radio receiver utilizing the Super-Heterodyne circuit in its highest development, and employing six UY-227 Radiotrons and the newly developed power amplifier Radiotron, UX-245. The Radiotron UX-280 is used in a socket power unit for supplying all plate, grid, and cathode voltages as well as supplying a high D.C. voltage for the newly developed high voltage, low current dynamic reproducer field used in this receiver. Incorporated in this receiver are the latest developments in Super-Heterodyne engineering in addition to other perfected features such as one-dial control, complete A.C. operation, power detection, single audio amplification stage, with overall balance in sensitivity, selectivity and tonal quality that can best be accomplished in a Super-Heterodyne. Figure 1 illustrates a rear view showing the principal parts. Figure 2 illustrates the top view of the receiver chassis, and Figure 3 is a view of the socket power unit.

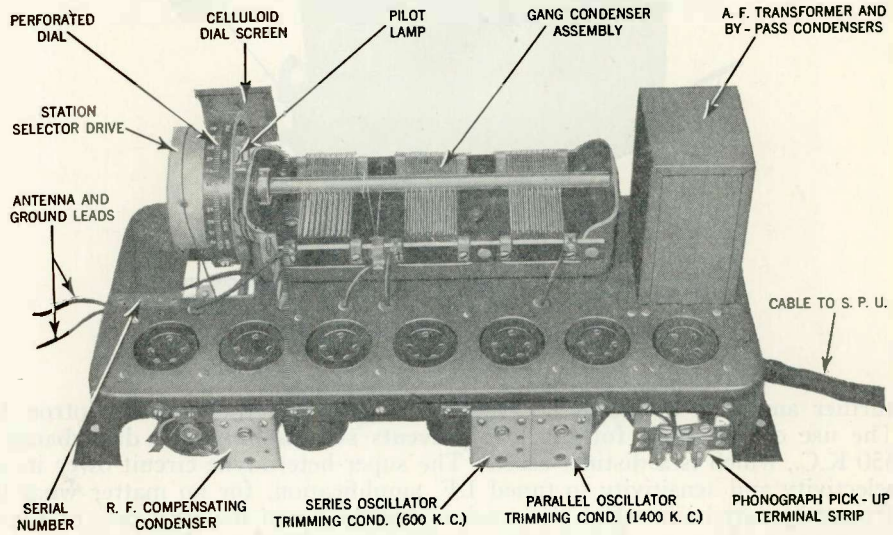


Figure 2—Top view of receiver chassis showing principal parts

The No. 600 receiver is designed to operate on alternating current of 105 to 125 volts, 50 to 60 cycles as used for house lighting. Connection to D.C. lines or to A.C. lines of different rating may damage the receiver or the Radiotrons.

This receiver is also made in models designed for alternating current operation of 105 to 125 volts, 25 to 40 cycles. In this model the power transformer is different from that used in the 50-60 cycle models. All other parts are identical in both models and the Service Notes apply to each equally well.

The following circuit characteristics are incorporated in the No. 600 receiver:

(a) The six UY-227 Radiotrons and one UX-245 Radiotron are connected in a seven-tube super-heterodyne circuit with a UX-280 Radiotron in the S.P.U. for plate, grid, and cathode voltage supply as well as high voltage, low current supply to the field of the new dynamic speaker.

The super-heterodyne circuit consists of one tuned R.F. stage; tuned first detector; two intermediate R.F. stages; an oscillator; a second, or power detector; and the single audio stage using the recently developed power amplifier Radiotron UX-245. The Radiotron sequence is shown in Figure 4.

(b) A "Local-Distant" antenna switch is incorporated in this receiver which permits better control of volume with less distortion, due to the natural condition of overloading on extremely loud local signals together with better selectivity on local stations. This feature with the use of a high impedance semi-tuned primary inductance of the tuned R.F. stage permits the use of a varying length of antenna without materially affecting the tuning of the receiver.

(c) The intermediate radio frequency (referred to as I.F.) which results from the mixing of the incoming modulated radio frequency current with that of the local oscillator is 175 K.C. The audio, or voice, modulation that is present in the radio frequency is carried on through the first detector and in the mixing is impressed on the I.F. After being amplified in two I.F. stages it is detected, or rectified, and

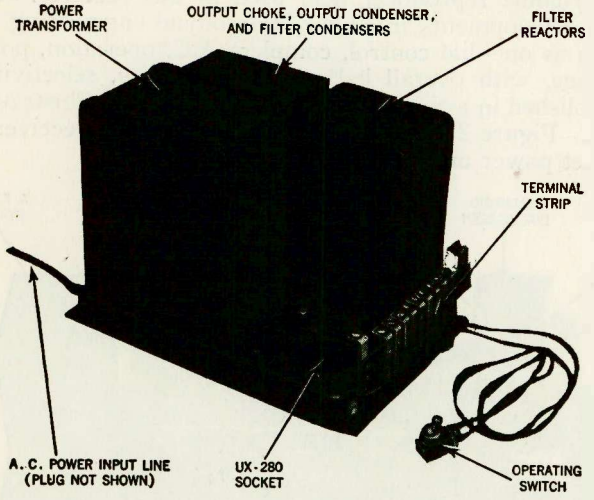


Figure 3—Socket power unit showing principal parts

further amplified in the audio amplifier stage using the new Radiotron UX-245. The use of 175 K.C. for the I.F. prevents serious harmonic disturbance around 550 K.C., which is a distinct asset. The super-heterodyne circuit owes its superior selectivity and sensitivity to tuned I.F. amplification, for no matter what the R.F. frequency may be to which the receiver may be tuned the most part of the over-all amplification is accomplished by the uniform amplification of the I.F. stages. These I.F. stages are also constantly neutralized for 175 K.C. Neutralization, or prevention of oscillation, is then independent of the broadcast frequency, which is practically the ideal condition for radio reception. The I.F. transformers are sharply tuned to give improved over-all selectivity. The tonal quality is maintained by means of certain refinements in the circuit arrangement, especially at high frequencies.

(d) The second detector operates at 235 volts plate potential with proper grid bias. The high plate voltage used gives sufficient undistorted output to operate the single audio power stage using the UX-245 Radiotron directly from the second detector, thus eliminating any possible distortion that might be caused by an intermediate audio stage.

(e) Use of the UX-245 Radiotron with the new dynamic speaker permits an undistorted output which represents an over-all gain over previous receivers. It uses the same

voltage on its filament as the UY-227, and plate and grid voltages that fall within the supply limits of a UX-280.

(f) The volume control regulates the grid bias on the tuned R.F. stage and the first I.F. stage. When loud local signals are received the "Local-Distant" switch in the local position acts very effectively in allowing better control of volume near the maximum volume control setting without over-loading the receiver. The volume, when the over-loading point is reached, will, of course, distort and drop to a small value. This is entirely natural to the over-loading condition in a vacuum tube, as is also the two peaked tuning effect, which is obtained when the dial is detuned to either side of the normal peak setting with resultant less input and hence no over-loading.

(g) The use of a high voltage, low current field in the dynamic loudspeaker employing the 8-inch cone makes a sensitive reproducer with a field that is supplied by the total D.C. voltage output of the UX-280 in the S.P.U., drawing only approximately 46 milliamperes at about 300 volts. This load together with the receiver Radiotron load is much below the load limit of the UX-280. The voltages on the plates, as well as the grid voltages of the R.F. and I.F. Radiotrons, are purposely reduced to make no over-all difference in amplification, but permitting better S.P.U. regulation and stabler operation. Proper cathode voltages are supplied to all the UY-227 Radio-

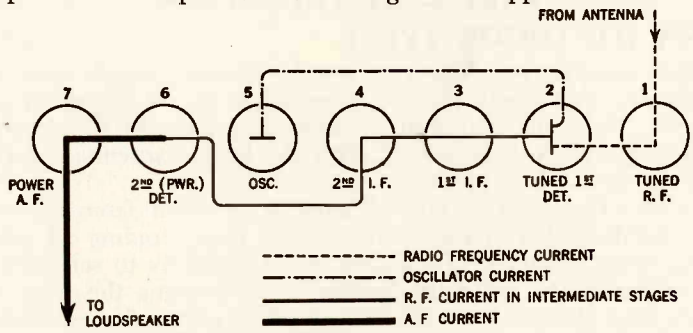


Figure 4—Radiotron sequence

trons to secure quiet operation and insure average Radiotron life. For the most part, the series or parallel resistance method of supplying voltages is used. The line voltage adjustment switch, common in most receivers, has been discarded to make necessary a more careful check of the supply line voltage before making any change. A tap has been provided in the power transformer primary, located under the S.P.U. for lower than 115-volt power supply to which a soldered connection can be made. This will prevent frequent change-over in the power supply and thus will lessen the application of excessive filament voltages.

Mechanical and electrical improvements not mentioned above are:—

(a) Use of "Isolantite" for I.F. transformer adjustable condenser and coil mounting, and also the R.F. compensating and oscillator trimming condenser mounting.

(b) Accessibility of I.F. adjustments. See Part II, Section 16.

(c) Electrostatic shielding between R.F. condensers of the gang tuning condenser and also between socket power unit and receiver chassis.

(d) Simplified construction of the S.P.U.

(e) Projection type of dial scale with kilocycle designation is distinctly a new feature.

(f) A terminal strip is provided for convenient use of a phonograph pick-up.

RADIOTRON SEQUENCE

Figure 4 illustrates the Radiotron sequence. Radiotron No. 1 is a stage of tuned radio frequency amplification. It is coupled to the antenna and ground by a high impedance primary inductive coil. It is tuned by the first of the gang condensers located at the right and facing the receiver from the front.

Radiotron No. 2 is the tuned heterodyne detector. It is tuned by the center of the gang condensers.

Radiotrons No. 3 and No. 4 are the first and second intermediate frequency stages respectively. These stages are tuned to a frequency of 175 K.C., giving ample distance between the two peaks of the oscillator to eliminate any possibility of stations coming in at more than one point on the tuning dial.

Radiotron No. 5 is the oscillator. It is tuned by the third of the gang condensers. Two trimming condensers are provided at the rear of the receiver assembly for adjusting the oscillator circuit to keep the beat note at the correct frequency for the intermediate frequency stages.

Radiotron No. 6 is the second detector. It operates at a plate potential of 235 volts with the proper grid bias and does not use a grid leak or condenser. Its output is sufficient to drive the power amplifier.

Radiotron No. 7 is the power amplifier. A choke and condenser arrangement couples this tube to the step-down transformer that matches the impedance of the output circuit to that of the cone coil of the reproducer unit. This arrangement gives a quality of reproduction not obtainable with the use of an output transformer alone, and prevents flow of the D.C. plate current of the UX-245 through the output transformer primary.

These various principles incorporated in the No. 600 receiver are illustrated in the schematic circuit Figure 6.

PART I—INSTALLATION

[1] ANTENNA (OUTDOOR TYPE)

Due to the high sensitivity of this receiver the antenna length need be only 25 to 50 feet. In remote districts this length may be extended to secure improved pick-up of distant broadcasting stations. However, a natural corresponding decrease in selectivity when receiving from local stations will be experienced with the longer antenna, provided the "Local-Distant" switch is not in the local position.

It should be erected as high as possible and be removed from all obstructions. The lead-in should be a continuation of the antenna itself, thus avoiding all splices which might introduce additional resistance and, in time, corrode sufficiently to seriously affect reception. If it is absolutely necessary to splice the lead-in to the antenna the joint must be carefully soldered to insure a good electrical contact. Clean off all excess flux and tape the connection, to protect it from the oxidation effects of the atmosphere.

High-grade glass or porcelain insulator supports are required, and at no point should the antenna or lead-in wire come in contact with any part of the building. Bring the lead-in wire from the outside through a porcelain tube insulator to the inside of the house for connection to the receiver.

The antenna should not cross either over or under any electric light, traction, or power line and should be at right angles to these lines and other antennas. An outdoor antenna should be protected by means of an approved lightning arrester, in accordance with the requirements of the National Fire Underwriters' Code.

[2] ANTENNA (INDOOR TYPE)

Where the installation of an outdoor antenna is not practical, satisfactory results may generally be obtained by using an indoor antenna of 25 to 50 feet of insulated wire strung around the picture moulding or placed under a rug. In buildings with steel framework or where metal lathing is employed, satisfactory results are not always possible with this tvpe of antenna. However, due to its sensitivity, the No. 600 receiver will generally give entirely satisfactory reception with an indoor antenna.

[3] SPECIAL ANTENNA INSTALLATIONS FOR NOISY LOCATIONS

In line with other receivers, when the No. 600 receiver is installed in some city locations, such as apartment houses, hotels and office buildings, it is possible that the level of noise compared with the signal strength of the desired station may be such that the station cannot be received without an objectionable noise background. This noise may be defined as inductive interference from electrical devices such as elevator motors, generators, violet ray machines, professional equipment, etc. It may have no apparent radio frequency peak, or it may have a broad peak. The effect of the noise may be divided into the following three general classes:

(a) Where the noise level is zero with no antenna or ground, but is equally great on either an indoor or outdoor antenna.
(b) Where the noise is equally great with the antenna and ground either connected or disconnected.
(c) Where the noise level is greater when the outside antenna is connected than when an inside antenna is used; the inside antenna, however, not giving sufficient pick-up for satisfactory reception.

In (a) where the noise level is zero with no antenna or ground connected, but equally great with either an indoor or outdoor antenna, it is at once apparent that the interference is not being brought into the receiver over the power supply lines. It has been found in such cases that an antenna five feet long inside the room picked up as much noise as when an entire outside antenna lead-in were used. This indicates that the noise is within the building and, in the case of the outside antenna, is being picked up on that portion of the lead-in that enters and goes through the building. In such cases the receiver should be located close to the point where the outside lead-in enters the building. If this is impractical it can be placed in any location and a copper braid, such as that manufactured by Belden Mfg. Co. of Chicago, Ill., placed over the inside portion of the lead-in wire. This braid is not grounded. If the noise level is still appreciable a good receiver ground with a short lead must be obtained. A long lead is not desirable, as it may pick up noise.

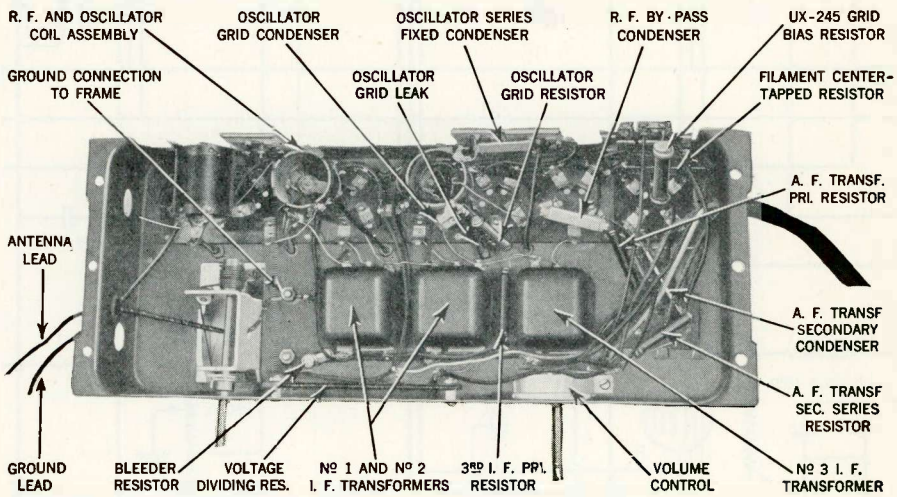


Figure 5—Sub-chassis view of receiver showing principal parts

In (b) the noise is picked up with no antenna or ground connected to the receiver. This indicates the noise is entering the receiver through the power lines. In this case filters must be placed in the power supply at the source of the noise or at the receiver, depending on conditions. If the trouble is cleared up in this manner when the antenna and ground are disconnected, but again appears with the use of the antenna system, the remedies suggested in (a) must also be applied.

In (c) the noise is greater when the outside antenna is connected than when an inside antenna is used. The use of the inside antenna, however, does not give sufficient pick-up for satisfactory reception. In this case the pick-up is probably occurring on the lead-in wire between the receiver and the antenna. Copper braid should be placed over the entire lead-in from the receiver to the flat portion of the antenna. Also changing the direction of the antenna should be tried and the lead-in connected from the end of the antenna that gives the best results. The copper braid should not be grounded. The conditions existing in any locality must be analyzed and placed in its correct category. A little patience and experimenting will usually result in a satisfactory installation.

RCA type "A" line filters may be used where the interfering line apparatus draws up to 2.5 amperes at 110 volts A.C. or D.C. For larger apparatus drawing current from 2.5 amperes to 5.0 amperes, RCA type "B" line filter may be used.

[4] GROUND

A good ground is quite as important as a good antenna. No specific recommendations can be given in this matter as conditions vary in different locations. Water and steam pipes usually make good grounds. Gas pipes usually make poor grounds and, as a rule, are to be avoided. If neither water nor steam pipes are available, a pipe or metal rod may be driven into the ground to a depth of several feet. The success of this type of ground depends upon the moisture present in the soil. The ground lead should be as short as possible and connected by means of an approved ground clamp to a section of pipe that has been scraped and thoroughly cleaned. The connection should be inspected from time to time to make certain that a clean and tight electrical contact exists between the clamp and pipe. The service man should experiment with various grounds, and employ the one giving the best results.

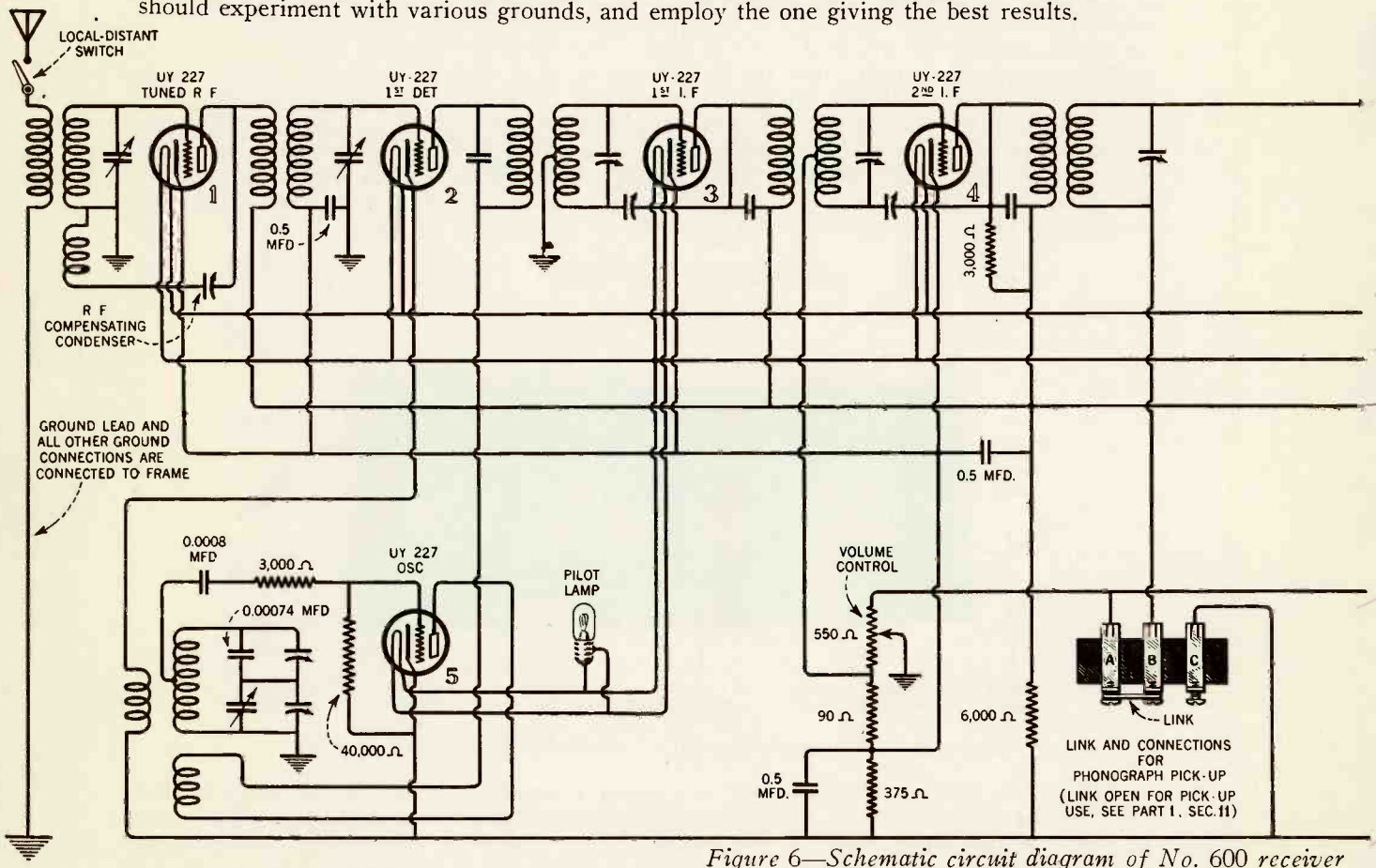


Figure 6—Schematic circuit diagram of No. 600 receiver

[5] RADIOTRONS

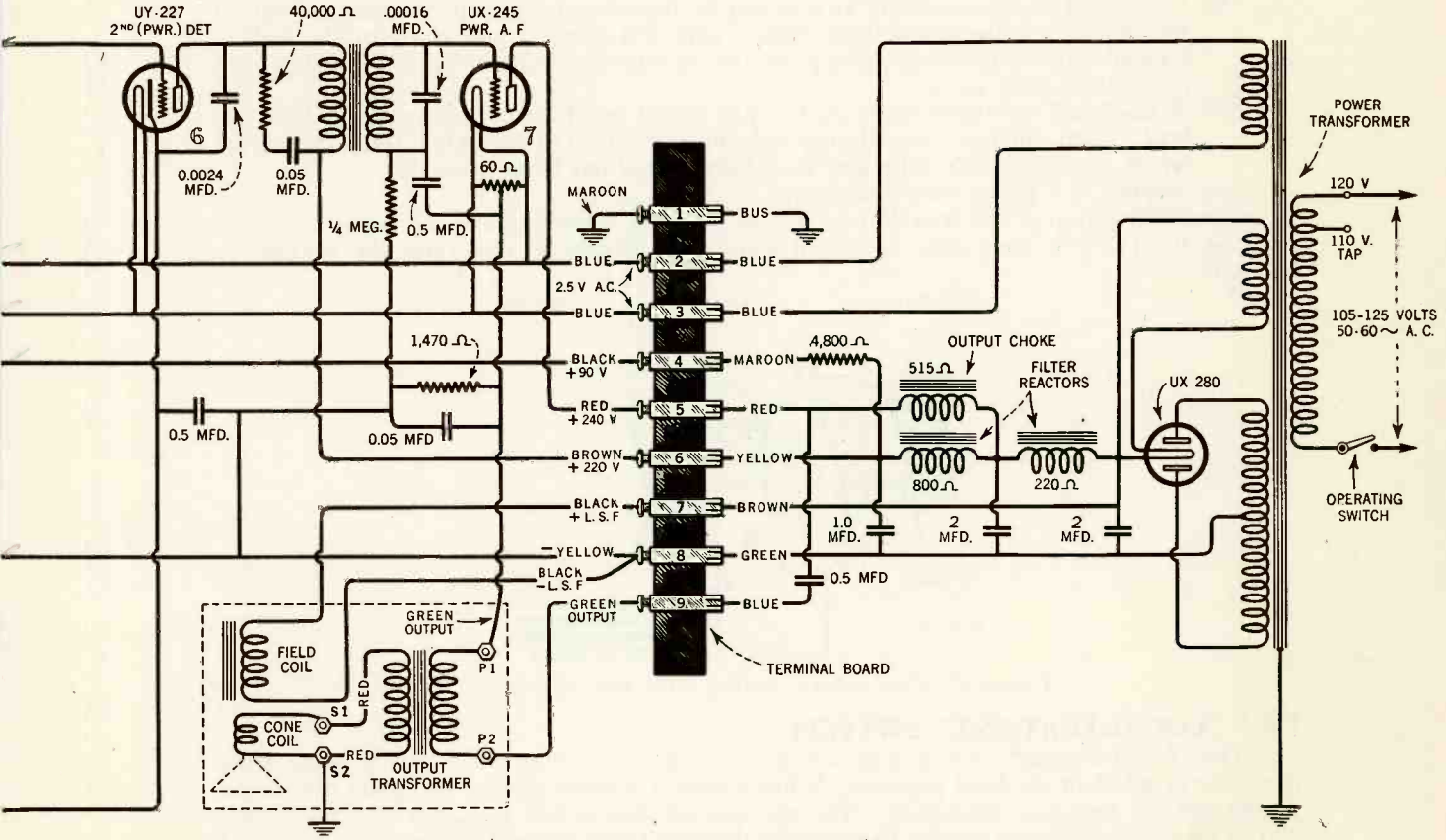
A guide shield is provided on all the receiver Radiotron sockets to facilitate the insertion of the Radiotrons. The six Radiotrons UY-227 are inserted in the five-contact sockets. The Radiotron UX-245 is placed in the four-contact socket in the receiver assembly, and the Radiotron UX-280 is placed in the socket power unit.

In placing the receiver into operation, if no signals are heard when tuning to a station known to be broadcasting, examine the Radiotrons. Possibly one Radiotron has been damaged in transit. Interchanging with one or more of the same type known to be in operating condition will isolate the damaged one.

NOTE.—Socket No. 1 (Figure 4), the tuned R.F. stage, is the most critical for selection of the Radiotrons. Place in this socket the tube which gives the loudest signal and does not go into oscillation throughout the tuning range. If no tube is found that will not oscillate, a slight re-adjustment of the R.F. compensating condenser may be necessary, as described in Part II, Section 14.

Other stages somewhat critical are the oscillator and second detector, sockets No. 5 and No. 6 respectively. The remaining tubes should be interchanged until a tube is found for the oscillator that gives the loudest signal on a given station. The second detector Radiotron should be selected for its ability to handle large volume. Select the tube for this socket that will permit the volume control to be advanced and give the greatest undistorted output without overloading.

The I.F. stages, Radiotrons No. 3 and No. 4, should have tubes chosen for best amplification. When changing Radiotrons it is advisable to change one at a time, so that no unnecessary voltage unbalancing will result, Turn operating switch "Off" when changing UX-280.



including receiver assembly, socket power unit, and reproducer assembly

[6] RECEIVING LOUD LOCAL STATIONS

If excess volume control adjustment is used on local stations the signal will apparently have two peaks on the tuning dial. A further advance of the volume control will decrease the volume abruptly rather than increase it. This is entirely normal, and is caused by tube overloading. The correct method of tuning this receiver on local stations is to reduce the volume control to the position where the station will be received at only one position on the station selector dial, and then adjust the volume control for the desired volume.

On some stations when tuned in with excessive volume, distortion may be experienced. The remedy is to reduce the volume control until the distortion disappears. The "Local-Distant" switch serves a distinct purpose here also. See Part I, Section 8.

If a steady whistle occurs with a powerful local (not a heterodyne between two stations which is a natural condition and impossible to eliminate), it can usually be eliminated or reduced by slightly detuning the station selector. Interference from long wave stations is eliminated in most cases by the new antenna semi-tuned inductance.

This tuning procedure should be explained to the owner when an installation is made.

[7] ADJUSTMENT FOR LOW LINE VOLTAGES

A lead is provided under the S.P.U. for use when the No. 600 receiver is connected to lines, the voltage of which never exceeds 115 volts. A good plan is to allow the lead to remain as connected in manufacture unless unsatisfactory operation is experienced. Should it be determined by measuring the line voltage at intervals with a good A.C. voltmeter (as incorporated in Weston Test Set No. 537) that the line voltage never exceeds 115 volts adjustment may be made as follows:

(a) Remove S.P.U. as described in Part IV, Section 15.

(b) Connected to the operating switch will be found two soldered connections, one of which has a transformer lead (black with red tracer), connected to the switch. Unsolder this connection and tape up the transformer lead so that it will not ground or short to other parts.

(c) A black and red transformer lead will be found taped up and not used. Untape this lead. Clean the end for soldering and solder this lead to the switch connection from which the black with red tracer transformer lead has been removed.

(d) Replace S.P.U. in reverse manner.

The 110-volt tap of the transformer is now properly connected and the receiver may be used on 105-115 volt lines with maximum efficiency. Figure 25 illustrates the changes to be made.

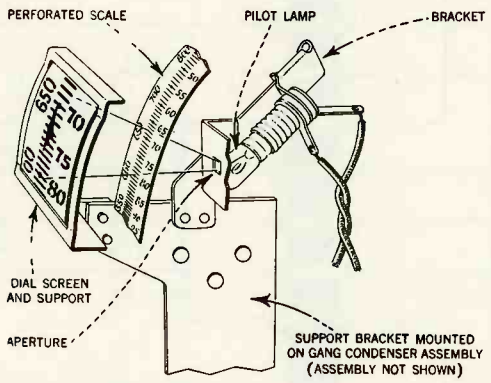


Figure 7—Dial screen, tuning scale and pilot lamp

[8] "LOCAL-DISTANT" SWITCH

The "Local-Distant" switch is an antenna switch, which disconnects the antenna from the receiver when in the local position. When closed it permits distant reception due to the proper normal antenna connection. The purpose of this switch is to prevent the strong carrier of a powerful local station from overloading the tubes, thereby causing distortion and also permit better radio frequency selectivity for local stations close to each other in kilocycle assignment. Keep the switch, as a general rule, at the local position unless sufficient pick-up is not obtained, when the switch may be thrown to the distant position.

[9] JERKY ACTION OF STATION SELECTOR

Should operation of the station selector be stiff or jerky a little oil dropped on each condenser bearing will effectively remedy this condition. When experiencing this trouble it is also well to check the cable tension spring to make sure that suitable tension is being applied to the condenser drive cable.

[10] INSTALLATION OF PILOT LAMP

A projection type of dial lighted by a small concentrated filament lamp is used in this receiver. The lamp is mounted so that its rays pass through the pierced scale of the dial and then project the scale divisions on an amber window on the front of the cabinet. It is therefore important to mount the lamp so that its rays will pass through the correct openings to fully illuminate the scale readings on the window. Figure 7 shows the general arrangement of the pilot lamp and dial.

To install the pilot lamp proceed as follows:

Turn the station selector counter-clockwise to its extreme position so that the pilot lamp mounting will be accessible. Remove the socket clamp from its bracket and screw the lamp firmly into the socket. Replace the socket clamp on its bracket.

Now turn the power "On" at the operating switch. With the station selector in the extreme counter clockwise position adjust the socket clamp on its brackets until the zero mark on the scale projected on the dial screen is about ¼ inch below the index pointer.

To replace a bulb, pull the socket back from its position and remove the old bulb. Place the new one in the socket and screw in tightly. The socket is then pushed down until the front window is properly illuminated. There may be a slight variation in the centering of the filaments of various lamps which might tend to throw the light too much to one side of the window. If this happens pull the socket out and bend the metal arm that holds the socket to one side until the rays of the lamp properly illuminate the scale window. Now tune in a station, the dial setting of which is known. If the dial setting for the station tuned in is different from that formerly obtained pull the lamp back or push it forward until the dial reads the same as that previously obtained for that station. The lamp itself may be out of focus due to excessive or too little solder on the base tip connection. This can be remedied by replacing the lamp with the spare provided, or by taking away a little solder with a hot soldering iron.

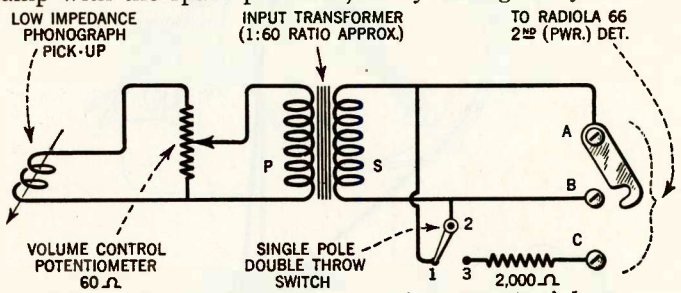


Figure 8—Schematic circuit diagram of phonograph pick-up connections

[11] PHONOGRAPH PICK-UP

Connecting lugs for a phonograph pick-up are provided and are shown specifically in the schematic diagram Figure 6. The proper arrangement of parts and connections for a low impedance type pick-up are schematically shown in Figure 8. If a high impedance type pick-up is used, as is most generally found in the open market, the 1 to 60 step up input transformer as shown in Figure 8 should be changed to a 1:3 input transformer as recommended by the individual manufacturer. The volume control potentiometer should also be changed to that recommended by the manufacturer. It is important to have the resistor connected as shown to the single-pole double-throw switch for changing over from the audio amplifying system for phonograph operation (close switch from contact 2 to contact 3), to that of radio reception (close switch from contact 2 to contact 1). Contacts and switch arrangements, as well as the necessary 2000-ohm resistor, are shown in Figure 8. For phonograph operation the receiver volume control should be at extreme minimum setting as well as "Local-Distant" switch in "Local" position. If a high pitched audio frequency whistle occurs with some types of phonograph pick-ups it is advisable to ground the lower end of the primary of the input transformer (end closest to letter P of diagram shown above) and pick-up suspension arm.

[12] LOCATION OF RECEIVER IN ROOM

As with other musical instruments, the location of the receiver in the room should be chosen with care. Various positions should be tried until the most desirable reproduction is obtained. If this position is outside the radius of the connection cord to the A.C. outlet, an extension cord can be used.

[13] KNOBS

The No. 600 receiver uses an improved type of push knob on the station selector and volume control shafts. This knob is removed by simply pulling it off the shaft, and replaced by pushing it on. Very little trouble should be experienced, as no set screws or other parts that might give trouble are used. Spacers are provided on the shaft to keep the knobs at proper distance from the receiver front, and if removed, should be carefully replaced.

PART II—SERVICE DATA

[1] ANTENNA SYSTEM FAILURES

A grating noise may be caused by poor lead-in connection to the antenna; or the antenna touching some metallic surface, such as the edge of a tin roof, drain pipe, etc. By disconnecting the antenna and ground leads the service man can soon determine whether the cause of complaint is within or external to the receiver and plan his service work accordingly.

[2] RADIOTRON SOCKETS

The sockets used in the No. 600 receiver are a six-gang UY socket assembly and two single UX sockets. One of the UX sockets is used in the socket power unit and is of the same design as that used in the receiver assembly.

The bakelite Radiotron guide shields used in the receiver assembly will prevent any possible shock from contact with high voltages in the socket when inserting the Radiotrons.

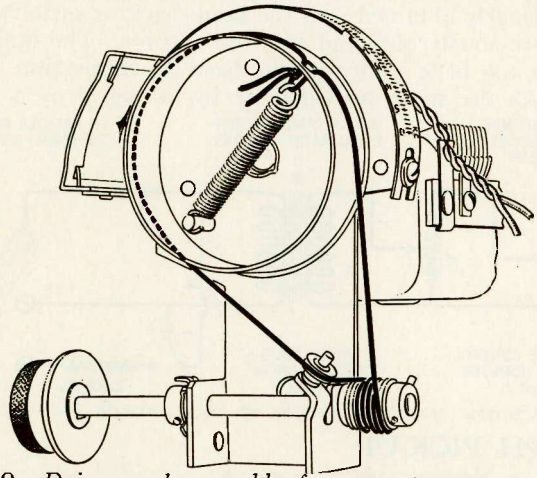


Figure 9—Drive cord assembly for gang tuning condensers

The prongs of the tubes fit into this shield opening very snugly and require only a twist until the prongs find the correct holes into which they fit. This is especially helpful when inserting the five-prong tubes into their sockets.

[3] RADIOTRON PRONGS

Dirty Radiotron prongs may cause noisy operation or change the resistance of the filament circuits sufficiently to cause a hum in the loudspeaker. They should therefore be cleaned with fine sandpaper periodically to insure good contact. The use of emery cloth or steel wool is not recommended. Before re-inserting the Radiotrons in their sockets wipe the prongs and base carefully to make certain that all particles of sand are removed.

If a Radiotron will not fit into a socket without considerable pressure, look for excessive solder on one or more of the prongs. Excessive solder on the prongs may be removed with a file or knife.

[4] LOOSE VOLUME CONTROL

A loose volume control arm may cause noisy or intermittent operation. It should be bent slightly so that it makes firm contact against the resistance strip. To do this it is necessary to remove the chassis from the cabinet as described in Part IV, Section 1. The volume control is then accessible. It can be released by removing the two screws that hold it to the metal frame, after unsoldering connections to its three terminals.

[5] BROKEN CONDENSER DRIVE CORD

The main tuning condensers are controlled by the station selector knob, the motion of which is transmitted by means of a rugged fish line to the drum on the end of the tuning condensers. Should this cord become broken, and a new one not be available, a temporary repair may be made by tying the two ends together by means of a square knot and then replacing the cord in its correct position as shown in Figure 9. The shortening caused by the

knot can be compensated for by untying the knot at the tension spring end and using a part of the spare length. The tying of the knot at the ends of the cord should be the last operation, because the correct amount of tension can then be obtained at the tension spring. Figure 9 shows the arrangement of the drive cord over the drums. This should be followed when replacing the cord. See Part IV, Section 5.

[6] RADIOTRONS FAIL TO LIGHT WHEN OPERATING SWITCH IS "ON"

Should all Radiotrons fail to light when the operating switch is "ON", look for:

(a) House current switched off; loose connection at convenience outlet; or open A.C. input leads.
(b) A.C. input plug to S.P.U. not in position.
(c) Operating switch not functioning properly.
(d) Line voltage tap not connected.
(e) Damaged power transformer in S.P.U.
(f) Burned-out filaments in Radiotrons not lighting.

The remedy for (a), (b), (c), (d), and (f) is apparent. Any external cause, such as D.C. supply, etc., of (e) should be located and eliminated before making replacements.

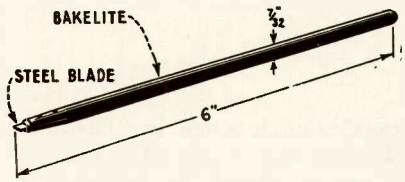


Figure 10—Dimensions of the non-metallic screw driver

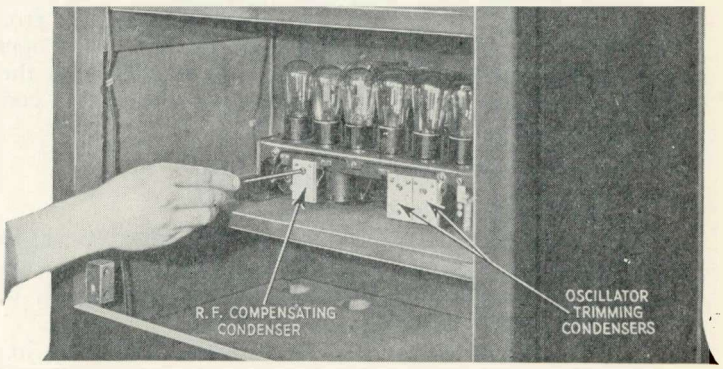


Figure 11—Method of adjusting compensating and oscillator trimming condensers in cabinet

[7] PLATES OF RADIOTRON UX-280 EXCESSIVELY HOT

Should the plates of Radiotron UX-280 become excessively hot, check the following:

(a) Shorted 2 mfd. filter condenser on high voltage side of filter reactor.
(b) Internal short in power transformer. Test for grounds to shield or to core, or short from one winding to another.

[8] NO SIGNAL—RADIOTRONS O.K.

If the Radiotrons appear to be functioning properly and no signals are heard from the loudspeaker with the volume control at maximum, check the following:

(a) Inoperative Radiotrons. Defects other than filament failure are not apparent until the tubes are tested. Inoperative Radiotron UX-280 may cause low voltages at the terminal strip, or at the Radiotron sockets. (See Part III, Sections 2 and 3, for voltage readings.)
(b) Antenna grounded or shielded, or some defectively grounded part.
(c) Open R.F. coils; I.F. transformers defective, etc. Check receiver wiring by inspection for poorly soldered joints, or grounds due to excessive soldering. Then resort to continuity tests and ground tests as outlined in Part III, Sections 5 and 9, to determine defective wiring, or open connections.
(d) Loose connections at S.P.U. terminal strip.
(e) Open movable coil on cone or defective output transformer on reproducer frame. (See Part III, Section 7.)
(f) Defective S.P.U. Check by means of continuity test.
(g) Open field coil in reproducer unit.

[9] HUM

If a pronounced hum develops during operation check the following:

(a) Low emission Radiotron UX-280. A low emission rectifying tube will cause excessive hum and unsatisfactory operation.

(b) Defective center tapped resistance. A short or open of this resistance will cause a loud hum and imperfect operation of the receiver.

(c) Any open of the several grounding connections in the receiver or voltage supply resistances may cause a certain amount of hum. These defects will have a pronounced effect on the general operation which will be more noticeable than the additional hum. Check by means of the continuity test given in Part III, Sections 5 and 6.

(d) An open filter condenser in the S.P.U. may cause a hum. Check by testing condensers as outlined in Part III, Section 8.

(e) Shorted filter reactor will cause excessive hum. Check by resistance test. Part III, Section 6.

(f) A.C. induction may cause hum due to misplaced leads.

(g) Open by-pass condensers may cause excessive hum.

A mechanical hum caused by vibration of loose laminations in the power transformer may be corrected by removing the power transformer from the S.P.U. as described in Part IV, Section 16, and heating it in a slow oven. The open end should be kept up and the compound heated sufficiently to allow it to adhere to the laminations of the transformer. After heating, the transformer should be allowed to cool for at least 24 hours and then returned to the S.P.U.

[10] LOW VOLUME

Low volume may be caused by:

(a) Defective antenna system or defective "Local-Distant" switch when in "Distant" position. A poor antenna and ground in a shielded locality may cause weak signals. The suggestions given in Part I, Sections 1, 2, 3 and 4, should be followed if trouble of this kind is experienced.

(b) Defective Radiotrons. A defective Radiotron in any stage may cause weak signals. Before checking other causes it is a good plan to check all Radiotrons by interchanging them with ones of a similar type known to be in good operating condition.

(c) R.F. compensating condenser out of adjustment. If this condenser is badly out of adjustment it will have the effect of making the receiver very insensitive. To adjust correctly refer to Part II, Section 14. Open or shorted plate winding will prevent regeneration. Refer to continuity tests, Part III, Sections 4 and 5.

(d) Oscillator trimming condensers out of adjustment. Should the oscillator trimming condensers be out of adjustment the receiver may be sensitive at certain portions of the tuning scale and very insensitive at other sections. Also two tuning points may be found for the same station. Should these condensers be badly out of adjustment, only very loud local stations will be heard. The correct method for adjustment of these condensers is given in Part II, Section 17.

(e) Intermediate transformers not correctly tuned or matched or in themselves defective. Should the tuning condensers connected across the secondaries of the intermediate transformers be out of adjustment, weak signals and poor tuning or, in some cases no signals will result. Refer to Part II, Section 16, for the correct method of adjusting the I.F. transformers.

(f) Defective A.F. transformer. Check by means of the continuity test (also Part II, Section 19) and make any replacement that is necessary. (See Part IV, Section 7.)

(g) Low voltage from S.P.U. Check voltages at terminal strip or sockets with readings given in Part III, Sections 2 and 3. Low voltages may be caused by a low emission rectifying tube or defective resistances in the S.P.U. or receiver. Check by means of continuity test.

(h) Open, short or ground of various connections in receiver. Check by means of continuity tests or ground tests and make any repair or replacement that is necessary.

[11] AUDIO HOWL

Audio howl may be caused by:

(a) Incorrect adjustment of the R.F. compensating condenser. A compensating condenser adjusted to the verge of oscillation may cause a howl on nearby stations. Adjust as suggested in Part II, Section 14. Faint beat notes heard when listening to loud stations on frequencies of 875 and 700 are not due to incorrect adjustment, and may be usually avoided by slight detuning until the beat disappears.

(b) A howl may be caused by natural heterodyning of two stations close in frequency. Distortion will also be produced. This, of course, is no fault of the receiver.

(c) Open A.F. condenser connections. An open of the A.F. condenser may cause a howl.

(d) Open by-pass condenser connections. An open of the connections to the by-pass condensers may cause a howl.

(e) Defective volume control resistance. Should there be an open or short in the volume control or in its adjacent resistances an audio howl may develop.

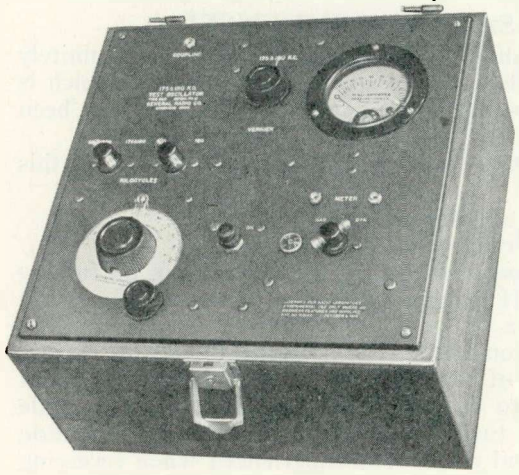


Figure 12—175 *K.C. test oscillator*

175 K.C. and 180 K.C. TEST OSCILLATORS

The General Radio Co. of Cambridge, Mass., can supply the new 175 K.C. Test Oscillator as illustrated. This oscillator, Type 360, has an output meter that may be connected directly to the output terminals in the No. 600 receiver. The broadcast band oscillator completely covers the range of 550-1500 K.C. by means of a calibrated variable condenser. A pilot lamp is incorporated in the set and all necessary leads and tools are supplied.

The General Radio Co. will undertake to add the necessary parts to the 180 K.C. Test Oscillator, Type 320, that any distributors have used for service on the Graybar Super-heterodyne sets, to provide for the 175 K.C. drive which is necessary with the No. 600. Type 320, 180 K.C. Test Oscillator should be forwarded to the General Radio Co. to have these changes made at a nominal cost.

(f) Vibrating elements in receiver Radiotrons. A gradually developed howl may be due to the loudspeaker causing the receiver Radiotron elements to vibrate. Check as described in Part II, Section 12.

(g) Poorly soldered or corroded joints. Any high resistance joint throughout the receiver may cause a howl.

(h) Defective resistance in S.P.U. or the receiver assembly. An open resistance unit may cause howl. Under such conditions it is advisable to turn the set "off" until the trouble is found, otherwise excessive voltage rise may cause further damage.

(i) Neutralizing condensers in intermediate transformers out of adjustment. This may cause oscillation in the I.F. stages which can be conveniently determined by removing Radiotron No. 1 and listening for the familiar oscillation sound when tuned to a loud local station with volume control at maximum setting. This I.F. oscillation will result in a howl when a station is tuned in, especially at loud volume. Adjust the neutralizing condensers as described in Part II, Section 16.

(j) Open of any of the several ground leads in the receiver. This may cause some of the circuits to go into oscillation and result in a howl when a station is tuned "in". Generally a loud hum will also be present. The several grounding leads in the Receiver Assembly and in the Socket Power Unit should be checked and any open or poorly soldered joint should be repaired.

(k) Pilot lamp socket being grounded may cause a howl or excessive hum.

[12] ACOUSTIC HOWL

Acoustic howl is caused by vibration of the elements in the receiver Radiotrons. This is amplified in the reproducer unit. Conditions being favorable the howl may increase in intensity and drown out the broadcast signal.

The No. 600 receiver assembly, after the shipping blocks are removed, is mounted on rubber cushions to prevent any microphonic action. Should trouble of this kind be experienced, examine the rubber cushions in the cushion brackets to make sure the receiver assembly is fully resting on rubber. If this is O.K. the Radiotrons in the receiver should be interchanged until the howl is eliminated.

[13] DISTORTION IN REPRODUCER UNIT ONLY

Distortion in the reproducer unit may be due to any of the following causes:

(a) Cone out of alignment. Refer to Part II, Section 22.
(b) Leads from cone coil broken away from side of cone. Make these leads fast with a little shellac.
(c) Loose grill, grill cloth protector, or baffle board. Any loose part in the cabinet will cause a rattle. Tighten all loose parts.
(d) Foreign material in core space.
(e) Defective output transformer. Check continuity and resistance, Part II, Section 21.

[14] ADJUSTMENT OF R.F. COMPENSATING CONDENSER

The radio frequency compensating condenser should not be touched unless it is definitely ascertained that no other failure exists as a possible cause of receiver insensitivity, which is the most noticeable indication of the need for adjusting, providing different tubes have been tried as pointed out in Part I, Section 5.

An oscillating condition of the receiver may be caused by improper adjustment of this condenser.

A step by step procedure for making proper adjustment follows:

(a) Procure a long, thin, non-metallic screwdriver (See Figure 10).
(b) Place receiver in operation in usual manner and tune in a weak station, preferably at the middle or upper wavelengths. If only a loud signal is available, place "Local-Distant" switch in "Local" position.
(c) Locate the position of the compensating condenser (See Figure 11).
(d) With the volume control at the position of maximum setting adjust the screw of the condenser until the receiver goes into oscillation. This will cause a whistle whenever a station is tuned "in." Then turn the screw in the opposite direction until the set just goes out of oscillation and no howl is experienced when receiving loud local stations. Now tune in stations throughout the range of the receiver and note whether oscillations occur. If they do, it will be necessary to reduce the setting slightly. This is the correct adjustment for the radio frequency compensating condenser.

[15] DISTORTED REPRODUCTION CAUSED BY OTHER THAN REPRODUCER UNIT

Under normal conditions the No. 600 receiver will deliver a strong signal of excellent quality to the loudspeaker. The high sensitivity makes it undesirable to operate the set at full volume when receiving from nearby broadcasting stations. If the normal reproduction is poor, test the output from the receiver. A pair of phones may be used for this purpose. Poor quality or distortion may be due to any of the following causes, other than natural over-loading as explained in Part I, Section 6:

(a) Defective Radiotrons. Though the receiver may be in operating condition a defective Radiotron in any stage will cause distortion. This is especially true of the second detector, audio stage and the rectifier tube.
(b) High or low plate and grid voltages from the Socket Power Unit or a defective resistor in the Receiver Assembly. In the Socket Power Unit distortion may be caused by a defective Radiotron UX-280 or resistance unit.
(c) Defective A.F. transformer. See Part II, Section 19. Check by means of continuity test and replace if necessary.
(d) Trimming condensers out of adjustment. Should the oscillator trimming condensers be out of adjustment the beat signal may not be exactly the frequency to which the intermediates are tuned. This will cause weak signals and distortion of those received. This condition may or may not be present throughout the tuning range of the receiver. Adjust as described in Part II, Section 17.

(e) Receiver oscillation. Should some circuit other than the oscillator be oscillating, distortion will be experienced when tuning in a station. This will be accompanied by a whistle or squeal when the carrier wave of the station is tuned in. To remedy trouble of this kind see Part II, Section 11.

(f) Intermediate transformers out of line or not properly matched or in themselves defective. This will have the effect of giving distorted reproduction and reduce the sensitivity of the receiver to a marked degree. Line up the entire I.F. transformer assembly as described in Part II, Section 16.

(g) Natural heterodyne between stations caused by being close in frequency. This is, of course, no fault of the receiver.

(h) Open by-pass condensers may cause distortion. Check larger ones by method outlined in Part III, Section 8. Smaller capacities should be replaced, if suspected, unless a capacity bridge is available.

(i) Defective connections. Check by continuity and ground tests as outlined in Part III, Sections 5, 6 and 9.

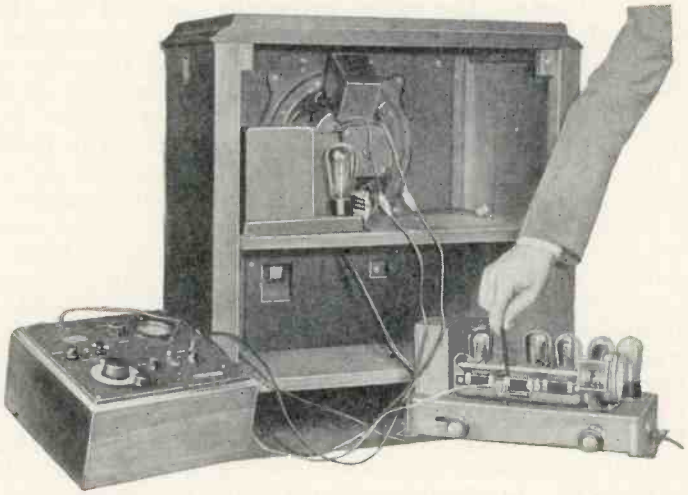


Figure 13—*Method of adjusting I.F. tuning condensers and neutralizing condensers*

While this and other adjustments may be made with the receiver chassis in the cabinet, better accessibility is obtained by removal from the cabinet.

[16] ADJUSTMENT OF I.F. TRANSFORMERS

The three I.F. transformers used are of the air core, tuned primary and tuned secondary type. The primary condenser is of the fixed type, while the secondary is adjustable. Also in I.F. transformers No. 1 and No. 2 an adjustable condenser is provided for neutralizing the I.F. stage. Figure 23 illustrates the internal connections of all the I.F. transformers.

Should a transformer burn out or its primary fixed condenser change in capacity it will be necessary to replace that particular transformer. The correct procedure for making such a replacement is contained in Part IV, Section 10.

A simple method of locating a shorted transformer is to use a resistance bridge or the resistance measuring method described in Part III, Section 7. The approximate transformer primary D.C. resistance is 20 ohms; secondary 100 ohms. Due to the circuit arrangement (See Figure 6) it will only be possible to get a reading of 50 ohms on the secondary as the end connection goes to the neutralizing condenser and the reading must be made at the center tap connection. This condition is true only of I.F. transformers No. 1 and No. 2. I.F. transformer No. 3 has no center tap in its secondary, and therefore can be measured for the full secondary resistance of approximately 100 ohms.

After replacing a defective I.F. transformer, or to make adjustments, the following tuning and neutralizing procedure must be followed for correctly lining up the various circuits. This is of utmost importance, as the entire performance is based on the correct functioning of intermediate stages.

The following equipment is needed:

1. A Test Oscillator (Driver). See Figure 12.
2. A coupling lead for coupling the output of the Driver to the grid or stator of the first detector gang condenser (See Figure 13).
3. A non-metallic screw-driver.
4. A "dummy" Radiotron UY-227—A normal tube with one heater prong removed.

Preliminary steps to be taken before adjusting the tuning, neutralizing and trimming condensers:

(a) Remove receiver assembly as described in Part IV, Section 1, but leave all connecting lugs connected to the S.P.U. terminal strip (the terminal strip cover and insulator should be removed). Place the receiver in the position shown in Figure 13.

(b) Disconnect red leads from output transformer to cone coil binding posts (See Figure 22). To these should be clipped the meter terminal leads as shown in Figure 13. If it is desired to tune to resonance by ear as well as by sight of the meter (the latter, of course, should be used at all times for accurate settings), do not disconnect the red leads, but clip the meter leads to the cone coil binding posts on the loudspeaker frame. The switch under the meter of the "Driver" should be thrown to the dynamic ("Dyn") position. If a General Radio 180 K.C. "Test Driver," altered for 175 K.C., is used, the brown lead from the receiver should be released from Terminal No. 6 and the 0-2 D.C. milliammeter of the "Test Driver" inserted in series with correct polarities. If a separate meter is used a 0-5 D.C. milliammeter should be used, or a 0-2 D.C. milliammeter with 15,000 ohms in series.

(c) Now clip the coupling lead from the "Driver" on the center stator of the R.F. and oscillator gang condenser assembly. This places the output of the "Driver" into the I.F. stages through the first detector (See Figure 13). This connection is recommended for neutralizing with phones, as will be explained later. For the tuning procedure if too much pick-up is obtained the lead with the coupling coil should be placed under the center coil of the R.F. and oscillator assembly.

(d) Replace all Radiotrons except the oscillator, No. 5, and turn operating switch "On."

(e) Place "Driver" in operation by switching "On," and set switches and vernier condenser at 175 K.C. The note from the driver will then be heard in the loudspeaker if connected.

The I.F. transformer tuning condensers may now be adjusted as follows:

(f) Adjust the tuning condensers successively on the first, second and third I.F. transformers (Figure 14), for maximum signal in the loudspeaker and maximum reading on the milliammeter. If pointer should go off milliammeter scale reduce the volume control. After making one adjustment on the transformers it is a good plan to repeat, as slight changes may have occurred in tuning the other circuits. No signal, or a loud howl, indicates neutralizing condensers are out of adjustment and they should be readjusted. If meter swings abruptly off scale it is usually a good indication that the I.F. stages are in an oscillating condition. No further tuning should be attempted until the I.F. stages are correctly neutralized. A maximum reading, without the last mentioned condition, indicates correct tuning of the intermediate stages.

It is now necessary to check the neutralization of the I.F. stages as follows:

(g) Leave all adjustments and apparatus in position on completion of tuning, but substitute a pair of phones for the loudspeaker by disconnecting the red leads (black meter leads of "Driver" also), and connect the phone tips to these terminals by a clip or handy fastener for a good temporary connection. If greater response is desired in the phones, they may be connected to the green (See Figure 22), output transformer leads when removed from their binding posts. This connection is not generally satisfactory, as the A.C. hum for phones at this point is rather high to determine a good minimum neutralizing point. This connection may also be used for the meter of the "Driver" in the tuning procedure, with meter switch thrown to magnetic speaker position ("Mag"). Proceed then by placing the dummy Radiotron in first I.F. socket. Now adjust the neutralizing condenser on the first I.F. transformer for the position of minimum or no signal. This is easily identified and the adjustment is not critical.

(h) Replace the first I.F. tube and place "dummy" tube in second I.F. stage and adjust

the neutralizing condenser on the second I.F. transformer for position of minimum or no signal as described in the preceding paragraph (g). Figure 23 illustrates the internal connections of the I.F. transformers. The third transformer does not require neutralizing.

(i) It is good policy to re-check the tuning of the I.F. transformer stages after neutralization. See paragraph (f).

After the I.F. transformers are properly tuned and neutralized they should perform at their maximum efficiency. It is a good plan to check the adjustments of the two oscillator trimming condensers (See Figure 11) at this point. The correct method for doing this is indicated in Part II, Section 17.

Due to the increased sensitivity of the receiver it may be necessary to reduce the setting of the R.F. compensating condenser to prevent the tuned R.F. stage from oscillating. This can be ascertained by tuning in stations of different wavelengths and noting if the receiver oscillates at any point throughout its tuning range. (See Part II, Section 14.)

[17] ADJUSTMENT OF OSCILLATOR TRIMMING CONDENSERS

Two trimming condensers are provided for adjusting the oscillator circuit so that the beat note will always be 175 K.C. throughout the tuning range of the receiver.

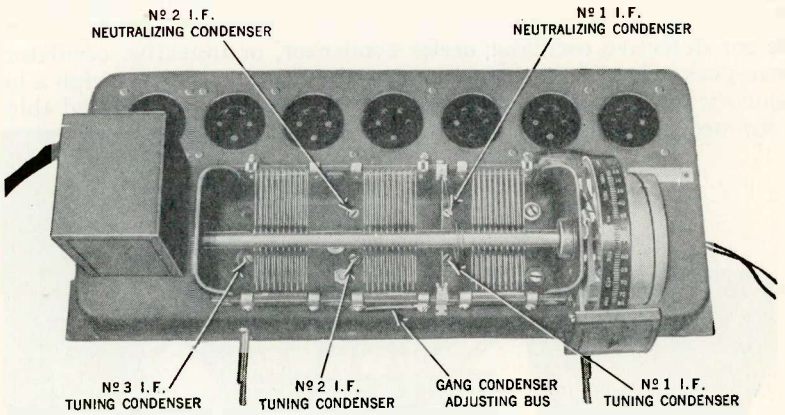


Figure 14—*Condenser adjusting screws for I.F. transformers*

The most noticeable symptom of the oscillator trimming condensers being out of adjustment is insensitivity in some sections or throughout the tuning range. To check the adjustment of the trimming condensers as a possible cause of any noticeable insensitivity in the receiver proceed in the following manner, making sure the I.F. stages are in correct adjustment (See Part II, Section 16).

(a) Procure the following equipment. A modulated oscillator giving signals at 1,400 and 600 Kilocycles. The Test Oscillator shown in Figure 12 is suitable for this purpose as it covers the broadcast band of frequencies 550-1,500 K.C.

A long thin non-metallic screwdriver. Such a screwdriver is shown in Figure 10 with its dimensions.

With the test oscillator shown, the two red output leads of the receiver chassis that normally go from the secondary of the output transformer to the cone coil (See Figure 22) should be removed and connected to the output or meter terminals of the oscillator with the clips provided and meter switch thrown to dynamic ("Dyn") position. If the test oscillator is not used, a 0-5 D.C. milliammeter or a 0-2 D.C. milliammeter with 15,000 ohms in series should be connected in series with the brown lead that connects to lug No. 6 (See Figure 22) on the terminal strip. This places the meter in series with the plate supply of the second detector and serves as a very good resonance indicator, as does also the other mentioned method. The speaker cone coil may be connected at any or all the time if the connection assists in any way in tuning to the modulated output of the test oscillator.

(b) Place in operation with receiver raised by blocks or the rubber cushion supports provided, in order to simulate the conditions when mounted on the cabinet shelf. Then place the oscillator in operation at 1,400 K.C., and with the coupling lead twisted around the antenna lead, tune by adjusting the station selector until a maximum deflection caused by the external oscillator is obtained in the meter, or resonance indicator. Always adjust the volume control so that the deflection is not beyond the scale of the meter.

(c) Now adjust the oscillator trimming condenser on the right, facing rear of the receiver (Figure 15) with the long, thin, non-metallic screwdriver until a maximum deflection is obtained in the milliammeter. The station selector should be moved slightly as adjustment is being made in order to keep correct tuning position, which is indicated by maximum deflection.

(d) Adjust oscillator for 600 K.C. Tune in again carefully, but now for 600 K.C. with station selector and then adjust the trimming condenser to the left for maximum deflection of the milliammeter while tuning through signal.

(e) Now readjust at 1,400 K.C. as indicated in (b) and (c).

With this adjustment the trimming condensers are correctly adjusted for maximum efficiency, that is, so adjusted that the beat signal will be 175 K.C. throughout the tuning range.

(f) If the above fails to line up the trimming condensers, bearing in mind that the right trimmer is more critical than the left trimmer for usual correct adjustment, look for defective oscillator series condenser, or defective oscillator coil assembly. A two-peak effect of meter reading may be due to tuning through a broadcast station frequency that is being picked up. If the speaker is connected this can readily be determined.

Figure 15—*Method of adjusting oscillator trimming condensers*

[18] TESTING ELECTRICAL ALIGNMENT OF TUNING CONDENSERS

The No. 600 receiver uses a three-gang tuning condenser, one condenser being used for the oscillator, one for the tuned radio frequency stage and one for the heterodyne detector. These condensers are accurately aligned electrically at the factory and it is important that they maintain this electrical alignment. Condensers not aligned will cause weak signals, broad tuning and generally unsatisfactory operation. The following procedure may be used for checking and aligning the condensers properly.

(a) A small tool such as illustrated in Figure 17 is necessary. This may be easily constructed from an old condenser plate, a piece of wire and a bakelite rod.

(b) Tune in a weak station or loud local with minimum volume control setting at the upper wavelengths. Then with the condenser end of the tester, touch the rotor plates, see Figure 16, and note if an increase or decrease of signal is obtained in the loudspeaker. Should touching the rotor plates and bring the plate closer to the stator plates increase the signal, then either that particular condenser is low in capacity or the coil it tunes is low in inductance. Should the signal decrease in volume, then the condenser and coil is either normal or high in value.

(c) If it is desired to use the Test Oscillator to provide a signal, and its meter used to show the response, instead of broadcast signal as outlined in (b), this may be readily accomplished by connecting and using the Test Oscillator shown in Figure 12, and outlined in Part II, Section 17. Decrease in signal strength by using the tool mentioned above will be shown by a decrease in meter reading, after signal of oscillator has been properly tuned in.

(d) After checking at the upper wavelengths, the procedure should be repeated at the lower wavelengths.

To check against condensers or coils high in value the other end of the tester which has the wire ring should be placed inside of the coils or near the end of the coil. This reduces the inductance and should the coil be high in inductance or the condenser which tunes it high in capacity, the signal will increase in volume.

By thus checking each condenser and the coil it tunes, a positive check on the electrical alignment of the condensers and coils can be made. Should a circuit be found that is high, the end rotor plate of the particular condenser should be bent farther from the stator plates. The correct amount can be determined by checking as previously described. If the oscillator circuit should be out, a check must first be made of the adjustment of the trimming condensers. See Part II, Section 17.

Should it not be possible to align the circuits by bending the plates or the gang condenser adjuster (See Figure 16), then the R.F. and oscillator coil assembly is not properly matched. In this case this assembly must be replaced as described in Part IV, Section 2.

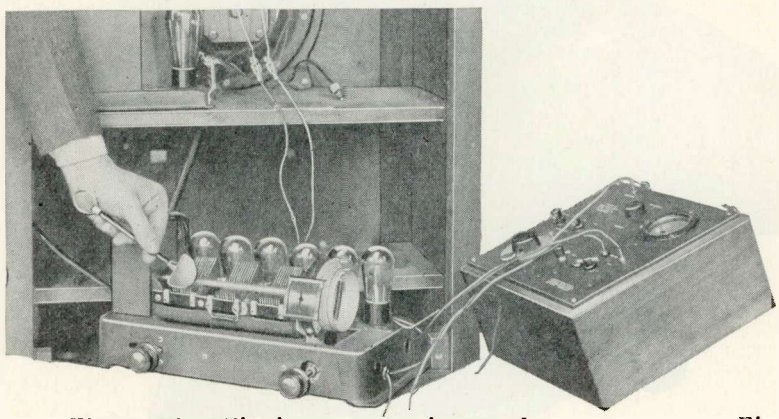


Figure 16—Aligning gang tuning condensers

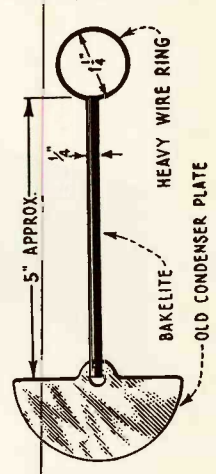


Figure 17—Aligning tool

[19] AUDIO TRANSFORMER AND RECEIVER BY-PASS CONDENSERS

Figure 20 shows the internal connection to external lugs of the single audio transformer and by-pass condensers as well as the correct color coding of the external leads with their correct internal connections.

(a) The transformer windings may be checked by the methods described in Part III, Section 7.

The primary resistance is about 1,000 ohms.

The secondary resistance is about 5,200 ohms.

(b) The by-pass condensers may be checked by the method outlined in Part III, Section 8. Although this method does not give any knowledge as to the exact capacity, it is a valuable, though rough, service check.

[20] OUTPUT CONDENSER, OUTPUT CHOKE, AND FILTER CONDENSERS

Figure 21 shows the internal connections to external lugs of the output condenser, output choke, and filter condensers, together with their respective values.

These should be checked by the methods outlined in Part III, Sections 7 and 8.

An open output condenser or an open or shorted choke will cause weak and distorted reproduction. A defective filter condenser is indicated by excessively hot plates, possibly showing color, in Radiotron UX-280. Shorted output condenser will cause distortion.

[21] REPRODUCER UNIT

The No. 600 receiver uses a new type eight-inch dynamic reproducer rendering excellent quality of reproduction. The field coil is a high-voltage, low-current type, being supplied from the UX-280 in the S.P.U. This field is efficient in operation and marks a distinct advance in dynamic reproducer design.

A check on the continuity of the cone coiler field can be made by disconnecting them from all other terminals and testing for continuity. An open of either coil will indicate a defect which must be remedied by replacing the entire cone or the field coil.

The output transformer also can be tested for continuity by applying methods as outlined in Part III, Sections 4 and 7. The connections for the above parts of the reproducer assembly are clearly shown in Figure 22.

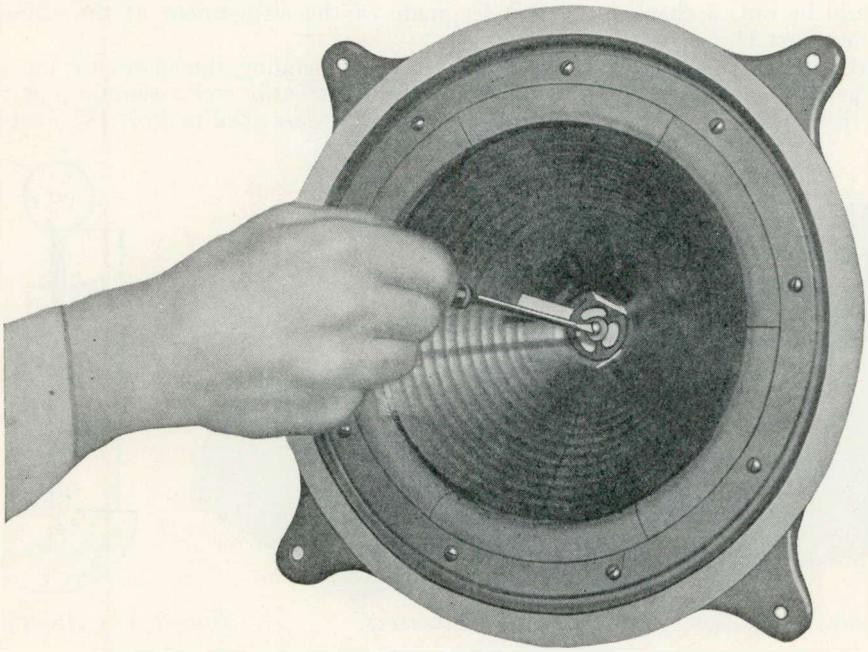


Figure 18—*Centering cone*

Testing the resistance of the cone coil should show approximately 10 ohms for normal condition. Similarly the output transformer primary resistance is 350 ohms, and secondary is 16 ohms. The field coil drain is about 46 milliamperes at 300 volts D.C.

[22] CENTERING CONE OF REPRODUCER UNIT

To properly center a new cone or one out of center use the following procedure:

(a) Remove reproducer unit from cabinet as outlined in Part IV, Section 13.

(b) Loosen center screw of cone, but do not remove it.

(c) Insert three cardboard strips about the thickness of a visiting card, 1½" x ¼" in size, through the center web of the cone into the space between the pole pieces and the cone (Figure 18). This will give the cone coil the same clearance on all sides of the pole piece.

(d) Tighten the center screw holding the web of the cone and remove the three strips. The cone is now properly centered.

(e) Replace reproducer unit in reverse order.

PART III—ELECTRICAL TESTS

[1] VOLTAGE SUPPLY SYSTEM

Figure 19 shows the method of obtaining the plate, grid, cathode and heater voltages and the high voltage field current from the main source. However, in order to give the service man a complete continuity picture of the voltage circuits it is not abridged, but drawn actually as it is found in the receiver, so that the tracing of voltages and currents is actually done, through the various component parts affected, as shown schematically in a straight line manner.

By study of this schematic, the reason for no plate voltage on one I.F. socket with all others O.K. is readily apparent, namely, the primary coil of the I.F. in question must be open. A shorted primary condenser in an I.F. transformer means eliminating the resistance of the primary coil. These conditions as well as effects on voltages from shorted bias resistor condensers, etc., can be determined with study of this voltage supply schematic. The correct values of resistors, condensers, etc., are shown in the ordinary schematic diagram Figure 6.

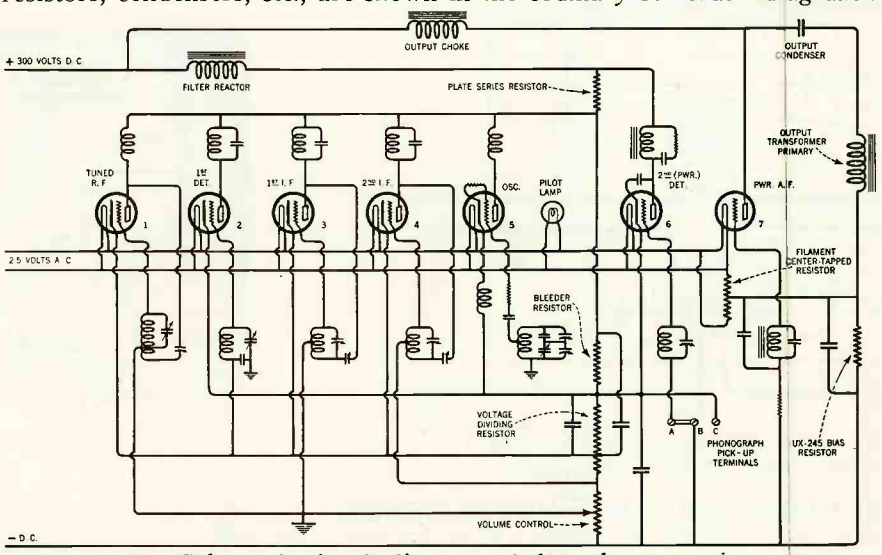


Figure 19—Schematic circuit diagram of the voltage supply system

[2] VOLTAGE READINGS AT TERMINAL STRIP

Use D.C. voltmeter with a 0-300 volt scale and at least 1,000 ohms per scale volt such as incorporated in Weston Model 537, Type 2, test set. Line volts—120 A.C.—Tap at 120 volt connection.

Terminals	*Volts*	*Terminals*	*Volts*
8 to 7	310	8 to 5	275
8 to 6	265	8 to 4	120

Use a 0-5 volt A.C. voltmeter for the following reading: Terminal 2 to 3, 2.7 volts A.C.

[3] VOLTAGE READINGS AT RADIOTRON SOCKETS

The following voltages taken at each Radiotron socket with the receiver in operating condition should prove of value when checking with test sets such as the Weston Model 537, Type 2, or others giving similar readings. The plate currents shown are not necessarily accurate for each tube, as the cable in the test set will cause some circuits to oscillate, due to its added capacity. Small variations of voltages will be caused by different tubes and line voltages. Therefore the following values must be taken as approximately those that will be found under varying conditions. The numbers in column 1 indicate the tube socket numbers shown in Figure 22.

VOLUME CONTROL AT ZERO

120-Volt Line. Tap at 120-Volt Connection

Tube No.	Cathode to Heater (D.C.) Volts	Cathode or Filament to Grid (D.C.) Volts	Cathode or Filament to Plate (D.C.) Volts	Plate (D.C.) Millamps	Filament Or Heater (A.C.) Volts
1	—26	—20	+100	0	2.35
2	—17	— 9	+ 95	1.6	2.35
3	—26	—20	+100	0	2.35
4	—26	— 3	+100	7.3	2.35
5	—16	0	+ 90	8.7	2.35
6	—17	—29	+235	0.7	2.35
7	—	—16*	+225	31†	2.40

VOLUME CONTROL AT MAXIMUM
120-Volt Line. Tap at 120-Volt Connection

Tube No.	Cathode to Heater (D.C.) Volts	Cathode or Filament to Grid (D.C.) Volts	Cathode or Filament to Plate (D.C.) Volts	Plate (D.C.) Millamps	Filament or Heater (A.C.) Volts
1	—24	—3.0	+ 81	4.5	2.35
2	—17	—7.0	+ 77	1.5	2.35
3	—24	—3.0	+ 80	5.0	2.35
4	—24	—3.0	+ 81	4.9	2.35
5	—16	0	+ 75	6.6	2.35
6	—16	—29	+228	0.7	2.35
7	—	—16*	+225	30.5†	2.40

*The reading of 16 volts as herein found is correct. Actually this indicates a bias voltage of about 44 volts on the grid of the UX-245. The actual lower reading is due to the ¼ megohm (250,000 ohms) resistor naturally affecting the scale of the voltmeter.

†This reading is just off the scale of the 0-30 milliammeter used in the Weston 537, Type 2, test set. The 0-150 M.A. scale should be used in case of readings in excess of 30.

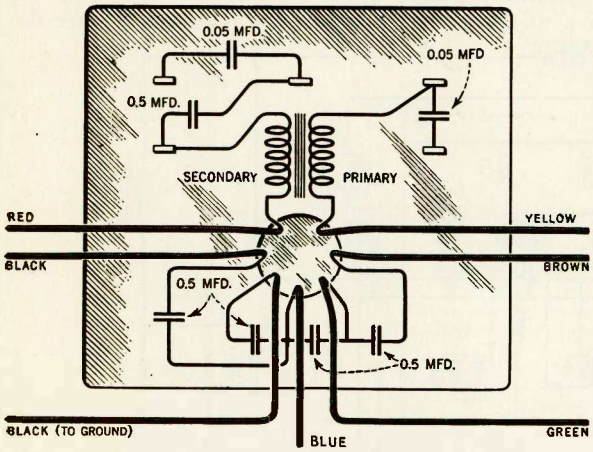


Figure 20—Internal connections of audio transformer and by-pass condensers

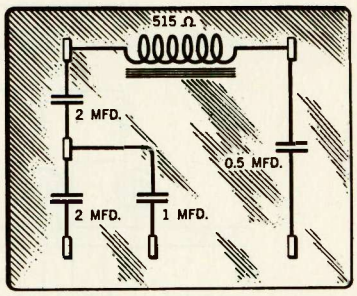


Figure 21—Internal connections of output choke, output condenser and filter condensers

[4] METHODS FOR CONTINUITY TESTS

In making a continuity test whether it be for the complete receiver, S.P.U., or individual parts, as the internal connections and windings of the A.F. transformer shown in Figure 20, or checking the continuity of the I.F. transformers by referring to Figure 23 for schematic representation, the following procedure is recommended:

Disconnect the antenna and ground leads; the cable connecting the socket power unit to the receiver and loudspeaker, and the A.C. supply cord at its outlet.

A pair of headphones with at least 4½ volts in series, or preferably a voltmeter with sufficient voltage to give a full scale deflection when connected across the battery terminals should be used in making these tests, for example, a 0-50 volt meter with a 45 volt "B" battery. The receiver Radiotron socket contacts, numbers and lugs used in these tests are shown in Figure 22. The receiver continuity wiring diagram is illustrated in Figure 23. The S.P.U. terminal numbers are shown in Figures 6 and 24. The voltage supply schematic (Figure 19) will also be a help in studying continuity.

Test leads should be of the flexible insulated type with partially insulated testing tips, so that false readings will not be obtained through contact with the hands. Similarly the hands should not touch the chassis or component parts.

The contacts of the test equipment should be placed across the terminals or leads indicated in the following test table under the column marked "Terminals." If the results are negative the cause of such negative effect will be found in the last column under the heading, "Incorrect Effect Caused By." The second column indicates the correct effect. The third column indicates the approximate correct resistance in ohms of most of the circuits tested.

The R.F. and oscillator coil winding lugs are coded (P) representing primary, (S) secondary, (S′) secondary center-tapped, and (T) tertiary or oscillator plate coil. Refer to Figure 23.

To test for grounded conditions refer to Part III, Section 9.

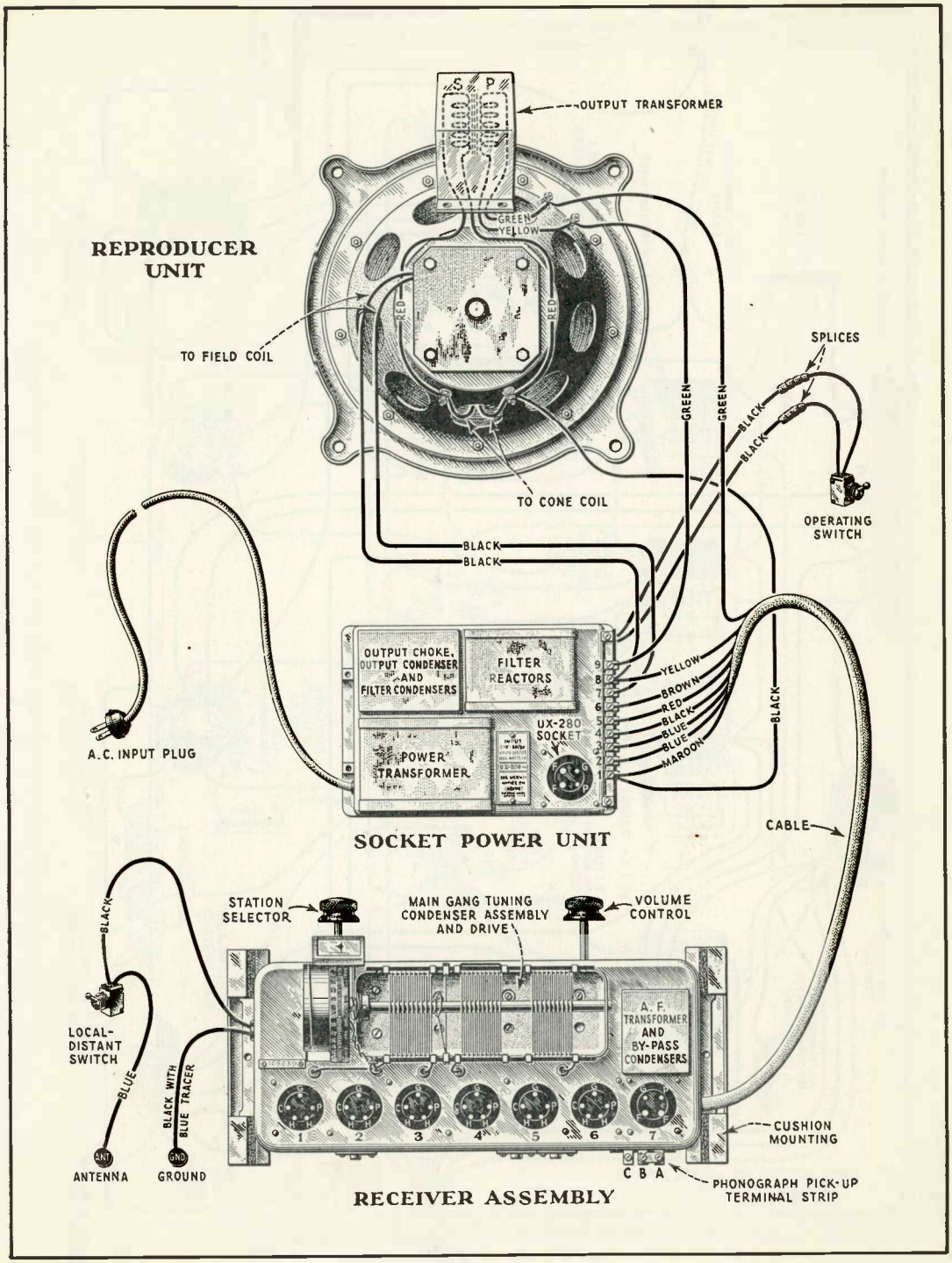


Figure 22—Cable connections, socket contacts, reproducer unit, socket power unit and receiver assembly

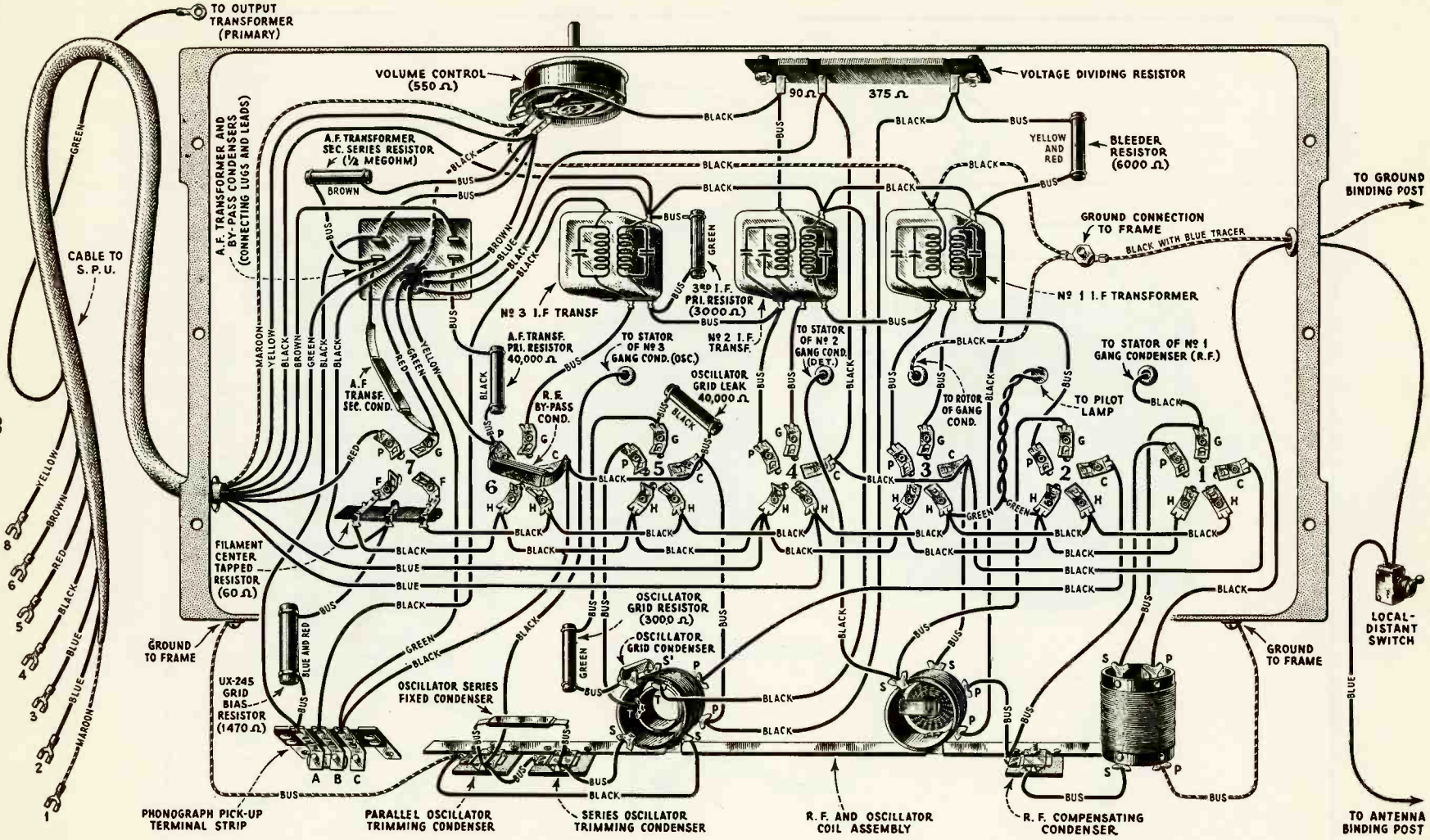


Figure 23—Continuity wiring diagram of receiver sub-chassis

[5] RECEIVER ASSEMBLY CONTINUITY TESTS

Remove all Radiotrons and disconnect cable at terminal strip. Remove all ground connections. Remove pilot lamp. See Figure 22 for cable lugs, terminals, and Radiotron socket contacts. For convenience coloring of lugs as well as numbers are shown. Code—Maroon (M), Black (Bla), Blue (Blu), Red (R), Brown (Br), Yellow (Y), Green (G).

First—Inspect all connections to observe any apparent faulty connection, rosin soldered joint, grounded or shorted lugs. Any connection removed or insulated as outlined below should be replaced before the next successive test.

Circuit	Terminals	Correct Effect	Resistance in ohms (Approx.)	Incorrect Effect Caused by
Antenna	Antenna post to ground post switch in "Distant" position.	Closed	40	Open antenna inductance, or open "Local-Distant" switch
Grid	G1 to ground or Lug No. 1 (M)	Closed	5	Open secondary of 1st R. F. transformer, or open connection
	G2 to C1	Closed	5	Open secondary of 2nd R. F. transformer, or open connection
	G2 to ground (Insulate volume control arm. See P. III, S. 9.)	Open	—	Shorted 0.5 mfd. condenser
	G3 to ground	Closed	50	Open one-half secondary of 1st I. F. transformer
	G4 to Lug 8 (Y)	Closed	600	Open one-half secondary of 2nd I. F. transformer or open volume control
	G4 to C4	Closed	140	Open one-half secondary of 2nd I. F. transformer, or 90-ohm portion of voltage dividing resistor
	G5 to C5	Closed (Weak)	40000	Open grid leak or connection
	G5 to ground (Insulate volume control arm. See P. III, S. 9.)	Open	If 3000	Shorted oscillator grid condenser
	G6 to terminal A or Lug 8 (Y) (Link closed)	Closed	100	Open secondary of 3rd I. F. transformer or open connection
	G7 to Lug 8 (Y)	Closed (Weak)	255,000	Open secondary of A. F. transformer, ¼ megohm resistor, or connection
Plate	P1 to ground (Insulate volume control arm. See P. III, S. 9.)	Open	—	Shorted compensating condenser, or grounded 1st detector primary, or connection
	P1 to Lug 4 (Bla)	Closed	44	Open primary of 2nd R. F. transformer or connection
	P2 to Lug 4 (Bla)	Closed	20	Open 1st R. F. transformer primary coil, or connections
	P3 to Lug 4 (Bla)	Closed	20	Open 2nd I. F. transformer primary, or connections
	P6 to Lug 6 (Br)	Closed	1050 If 1023 40000 Open	Normal A. F. Primary condenser shorted A. F. primary condenser shorted and primary winding open A. F. primary winding open
	P5 to Lug 4 (Bla)	Closed	1.5	Open plate coil (Tertiary) of oscillator or connections
	P4 to Lug 4 (Bla)	Closed	20 If 3000 0 Open	Normal Open primary coil of 3rd I. F. transformer (Resistance O. K.) Shorted primary condenser Open primary of 3rd I. F. transformer and resistor
Cathode and Filament	Cathodes 1, 3 and 4 to terminal "C"	Closed	375	Open connection, or 375-ohm section of the voltage dividing resistor. If low resistance then 0.5 mfd. condenser is shorted.
	Cathodes 2, 5 and 6 to Terminal "C"	Closed	—	Open pick-up winding of oscillator coil, or connections
	One filament contact of Socket 7 to Lug 8 (Y)	Closed	1500	Open one-half of center tapped resistor, or UX-245 bias resistor, or shorted condenser (across biasing resistor) if resistance is low
	Other filament contact of Socket 7 to Lug 8 (Y)	Closed	1500	Open other half of center tapped resistor, or UX-245 bias resistor, or shorted condenser (across biasing resistor) if resistance is low
	UNSOLDER ONE END OF FILAMENT CENTER TAPPED RESISTOR			
	Lug 2 (Blu) to one filament contact Socket 7	Closed	—	Open connections
	Lug 3 (Blu) to other filament contact Socket 7	Closed	—	Open connections
	Lug 2 (Blu) to one heater contact of Sockets 1, 2, 3, 4, 5 and 6	Closed	—	Open connections
	Lug 3 (Blu) to other heater contact of Sockets 1, 2, 3, 4, 5 and 6	Closed	—	Open connections
Misc.	G3 to P3 (Disconnect bleeder resistor)	Open	—	Shorted 1st I. F. neutralizing condenser
	G4 to P4 (Disconnect bleeder resistor)	Open	—	Shorted 2nd I. F. neutralizing condenser
	G7 to output transformer Lug (G)	Closed (Weak)	257,000	Open resistors, or if closed strong, shorted 0.5 mfd. condenser
	Terminal "C" to Lug 8 (Y) (Open connection between volume control and voltage dividing resistor)	Open	—	Shorted 0.5 mfd. condenser
	P6 to C6	Open	—	Shorted 0.5 mfd. condenser
	C2 to C5	Closed	—	Open oscillator pick-up coil
	Lug No. 4 (Bla) to Terminal "C"	Closed	6000	Open bleeder resistor

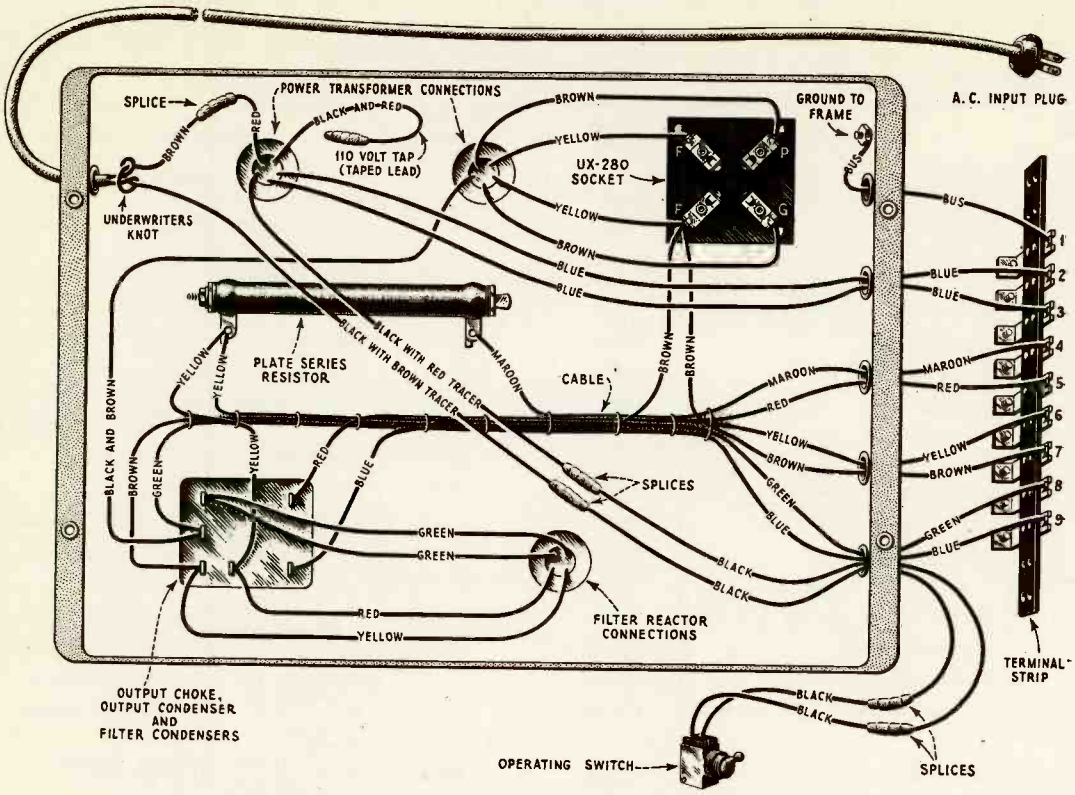


Figure 24—Continuity wiring diagram of socket power unit

[6] SOCKET POWER UNIT CONTINUITY TESTS

Remove Radiotron UX-280—Disconnect Cable at Terminal Strip.

Refer to Figure 24

Terminals	Correct Effect	Resistance In ohms (Approx.)	Incorrect Effect Caused by
G to P of UX-280 socket	Closed	240	Open high voltage winding of power transformer
Across filament contacts of UX-280 socket	Closed	—	Open UX-280 filament winding of power transformer
Terminal 2 (Blu) to Terminal 3 (Blu)	Closed	—	Open 2.5 volt filament winding
Terminal 4 (M) to Terminal 6 (Y)	Closed	4800	Open resistor
Terminal 5 (R) to Terminal 7 (Br)	Closed	735	Open output choke one filter reactor or connections
Terminal 5 (R) to Terminal 6 (Y)	Closed	1315	Open output choke, other filter reactor, or connections
Terminal 1 to ground	Closed	—	Open connection
Terminal 7 (Br) to Terminal 8 (G)	Open	—	Shorted one or more filter condensers
Terminal 9 (Blu) to Terminal 5 (R)	Open	—	Shorted output condenser
Across A. C. input plug terminals (operating switch on)	Closed	—	Open primary winding of power transformer, defective switch, or connection

[7] CHECKING RESISTANCE VALUES

The values of the various resistance units are shown in the schematic diagram, Figure 6. When testing a receiver for defects the various values of resistance should be checked. This may be done by a resistance bridge; the voltmeter-ammeter method shown in previous Service Notes; or by the following method, the results depending upon the care exercised in using the prescribed method.

For resistances of low value, 5000 ohms or less, use a voltmeter not greater than 100 ohms per volt. The rating of 100 ohms per volt means that a meter with 50 volts maximum scale reading, has a total resistance of 50 times 100, or 5000 ohms, when the 50-volt scale is used. For high values of resistance use a meter of 1000 ohms or more per volt. The Weston Meters, Type 301 and 280, each have a resistance of 62 ohms per volt and are satisfactory for low values. For very low resistances below 100 ohms, it is best to use a dry cell—1½ volt—with the 3-volt scale of a Weston, Model 280. For higher resistance up to 5000 and above use sufficient battery to give a good deflection on the meter, for example, a 45-volt "B" for a 0-50 unit meter. Then take two readings, one of the battery alone, and one of the battery with the unknown resistance in series.

Then apply the following formula:

$$\left(\frac{\text{Reading obtained of battery alone}}{\text{Reading obtained with resistance in series}} - 1 \right) \text{Resistance of meter in ohms} = \text{Unknown Resistance in ohms}$$

Example—Using a Weston, Type 301, 30-volt scale, 22½-volt "B" battery. Resistance of meter equals 30x62 or 1860 ohms.

$$\left(\frac{22.5}{8.45} - 1 \right) 1860 = 3091, \text{ or unknown resistance in ohms approx.}$$

The above method may be used in checking the resistance values of the correct closed circuits as shown in the Continuity Test Tables in Part III, Sections 5 and 6.

[8] TESTING BY-PASS CONDENSERS

Proper testing of the 2 mfd., 1 mfd., ½ mfd., or 0.25 mfd. condensers is accomplished by charging them with a handy D.C. voltage, as from "B" batteries connected to give 90 to 157½ volts. If sparking occurs as the charge is applied the condenser is shorted. After a few seconds wait, a strong spark (the strength of the spark being greater, of course, for the mfd. than the .25 mfd.), should appear when the condenser is discharged by shorting the terminals with a screwdriver. If no spark appears the condenser is probably open. If a slight spark occurs the condenser is probably leaky. A condenser having one side normally grounded, as shown in the schematic Figure 6, and tested with the unit in the receiver, if the opposite terminal is defectively grounded, the test will show a false short.

Smaller by-pass condensers as used in the No. 600 receiver, in the order of .05 or .0024 mfd. or less, cannot be successfully tested by the above method except for a shorted condition. For other suspected defects, if unable to measure the capacity, simple trial replacement is the best method.

[9] TESTING FOR GROUNDED PARTS IN RECEIVER ASSEMBLY

Grounded parts may cause various effects, as weak signals or no signals, wrong or no voltages at Radiotron sockets, etc.

The correct and necessary ground leads in the receiver are shown in Figure 6.

In testing for grounds that occur due to defective wiring or assembly, it is necessary to remove all the correct grounding connections in order to discover the wrong grounded part. This can readily be done by temporarily freeing the grounded leads to the frame as indicated by the broken line the wiring diagram Figure 23, and insulating the rotating arm of the volume control by slipping a bit of paper between the arm contact and the resistance strip.

Testing for a ground then may be accomplished by using the continuity testing methods —preferably the method using a D.C. voltmeter with a battery in series. A defective ground will be truly indicated by a closed continuity test between the frame (ground) and a terminal of the suspected unit.

PART IV—MAKING REPLACEMENTS

The various assemblies and parts of the receiver are readily accessible and replacements can be easily made. Figure 5 is a sub-chassis view of the receiver. The following detailed procedure outlines the simplest method to be used in making replacements:

[1] REPLACING THE VOLUME CONTROL

(a) Remove the knobs on the volume control and station selector. These are of the push type, and they are removed by simply pulling them off the shafts. Between each knob and the cabinet will be found a metal spacer. These spacers must also be removed. To replace, merely push the knob on to the shaft, first matching the knob socket with its flat spring to the shaft, after replacing spacers.

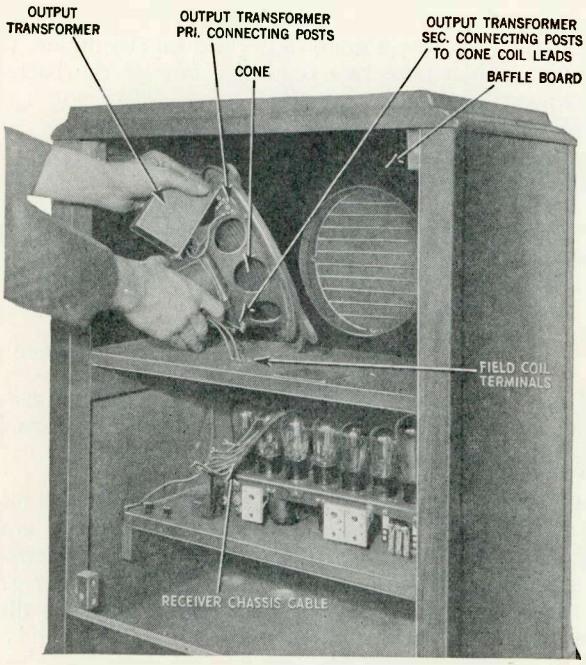


Figure 25—Removing reproducer from cabinet

(b) Remove rear grill by removing the wing nuts holding it in place.

(c) Remove the shield and insulating cover that are over the terminal strip. Then remove all cable connections to strip as well as connection to output transformer.

(d) Carefully remove the clamps that hold the cable and antenna wire to the side of the cabinet.

(e) Remove the antenna and ground wires from their binding posts, and "Local-Distant" Switch.

(f) Pull cable, antenna and ground leads from the shelf until all leads are clear.

(g) Remove the rear two screws and loosen the front two screws that hold the receiver cushion supports to the shelf.

(h) The receiver assembly may now be lifted clear of the supports and removed from the cabinet. See Figure 26.

(i) Place the volume control up and remove the two screws and nuts that hold it in place. The soldered connections must also be removed from the three terminal lugs.

(j) Remove the old volume control and fasten the new one in position by means of the two machine screws and nuts, and resolder the connections. The correct connections of these leads are shown in Figure 23.

(k) Return receiver assembly to cabinet and replace all cables and leads in the reverse manner of that used to remove them and be sure receiver assembly rests on rubber supports properly.

(l) Test receiver and if O.K. return shield and insulator to their original position.

[2] REPLACING R.F. TRANSFORMER AND OSCILLATOR ASSEMBLY

The two radio frequency transformers and the oscillator coils are mounted on a metal strip, together with three small adjustable condensers and two fixed condensers.

This assembly must be replaced as a unit—the matching of the coils being an important point in the operation of the receiver. Use the following procedure:

(a) Remove receiver chassis from cabinet as described in Part IV, Section 1.

(b) Turn chassis on side and unsolder all leads to the assembly being replaced.

(c) Remove the three machine screws and lock washers that hold the supporting strip to the receiver frame.

(d) The assembly may now be removed and the new assembly fastened in position with the three machine screws and washers previously removed.

(e) Resolder all connections in their correct position on the assembly. This is shown in Figure 23.

(f) The receiver assembly may now be returned to the cabinet in the reverse manner of that used to remove it.

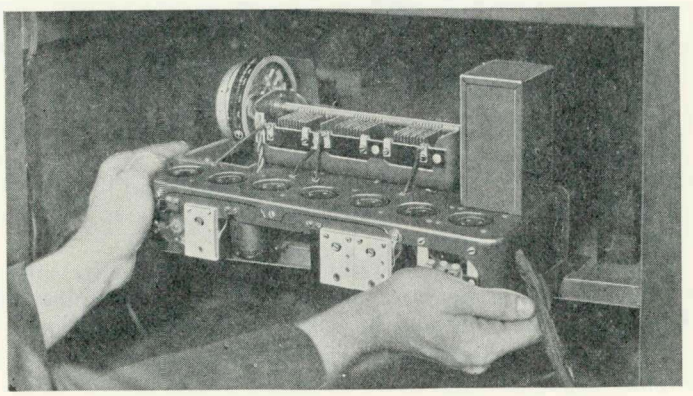


Figure 26—Removing receiver chassis from cabinet

[3] REPLACING RADIOTRON GANG SOCKETS

One socket assembly on the receiver chassis is of the gang variety, the other being a single unit. Both are held in place, together with their shields, by means of rivets which clamp them on the metal chassis frame. Use the following procedure when replacing these sockets:

(a) Remove the receiver assembly from the cabinet as described in Part IV, Section 1.

(b) Unsolder all connections to the particular socket or assembly being removed. The R.F. transformer assembly should be removed as a unit to provide room for replacing the six-gang Radiotron sockets.

(c) Drill out the rivets holding the Radiotron sockets to be replaced. In the case of the single UX or the gang UY the shield overlaps and will be held in place by the socket not removed.

(d) Remove the old Radiotron socket and fasten the new one in position by means of screws, nuts and washers. Resolder all connections and replace the R.F. assembly if removed. The correct connections are shown in Figure 23.

(e) Fasten receiver assembly in cabinet, connect cable and test. If O.K., replace shield over terminal strip.

[4] REPLACING MAIN TUNING CONDENSERS AND DRIVE

The main tuning condensers and drive are replaced in one unit as follows:

(a) Remove receiver assembly from cabinet as described in Part IV, Section 1.

(b) Remove pilot lamp and lead wires from condenser assembly. Remove the three screws, nuts and lock washers that hold the condenser assembly to the metal frame.

(c) Now pull the condensers as far forward as possible and unsolder the four leads connected at the rear. Remove the entire assembly by tilting slightly and pulling clear.

(d) Place the new assembly in the position occupied by the old one and solder the four leads to their proper connections.

(e) Fasten the three screws, nuts and lock washers in their proper position. Make sure that the screw that holds the ground connection on the under side of the chassis makes firm contact. Replace pilot lamp socket and lead wires.

(f) Return the receiver to the cabinet and replace all connections in the reverse order of that used to remove them.

[5] REPLACING CONDENSER DRIVE CORD

Considerable use may wear and break the condenser drive cord.

(a) To replace this cord it will be necessary to remove the gang condenser assembly and drive as explained in Part IV, Section 4.

(b) By following the diagram in Figure 9 tie the two ends of the new cord together to form a square knot; the finished looped length should be 10¾ inches approximately.

(c) Set the station selector so it will be at the minimum (all rotor plates out) position against the stop. This position should not be allowed to change or slip in the following procedure:

(d) Place cord with knot near the hole on the drum, holding the cord with the fingers of the left hand.

(e) By following the drive cord arrangements shown in Figure 9 the cord may be replaced. The cord should be started in the first groove left of center on the drive cord worm as viewed in Figure 9.

(f) When properly threaded, and with the drum still in its minimum position, the portion of the cord near the hole in the drum should be pulled through, and caught with the spring. This will hold the cord in its proper tension.

(g) Rotate station selector to insure cord knot has been set to run clear.

(h) Replace gang condenser and drive assembly in the reverse manner removed.

[6] REPLACING R.F. COMPENSATING AND OSCILLATOR TRIMMING CONDENSERS

The R.F. compensating and oscillator trimming condensers may require replacement. The R.F. compensating condenser and the series oscillator trimming condenser are identical, electrically and mechanically, but the parallel oscillator trimming condenser, located at the right end when viewed from rear, is different electrically.

To replace use the following procedure:

(a) Unsolder connections from unit to be removed.

(b) Remove the two small machine screws, fiber washers and nuts holding unit to R.F. and Oscillator Coil Assembly metal support.

(c) Mount the new unit in reverse manner, soldering connections correctly as shown in Figure 23.

NOTE.—Care should be used in tightening the bolts holding the "Isolantite" mounting, as uneven or excessive pressure may break the "Isolantite." "Isolantite" has very desirable electrical qualities and should be handled with care to prevent breakage. Be sure to replace the fibre washers removed in (b) above.

[7] REPLACING THE AUDIO TRANSFORMER AND BY-PASS CONDENSERS

The No. 600 receiver employs one audio transformer and necessary by-pass condensers, located at the left side of the receiver assembly facing the front. Should a replacement become necessary use the following procedure:

(a) Remove receiver assembly as described in Part IV, Section 1.

(b) Place the receiver chassis on its side and unsolder all connections to the audio transformer and by-pass condenser leads and lugs.

(c) Now turn up the six tabs that hold the transformer in place and remove it. The new one is then fastened in position.

(d) Resolder the leads from the new transformer and by-pass condensers to their correct points of connection as indicated in Figure 23.

(e) Fasten the receiver assembly in the cabinet in the reverse order of that used to remove it.

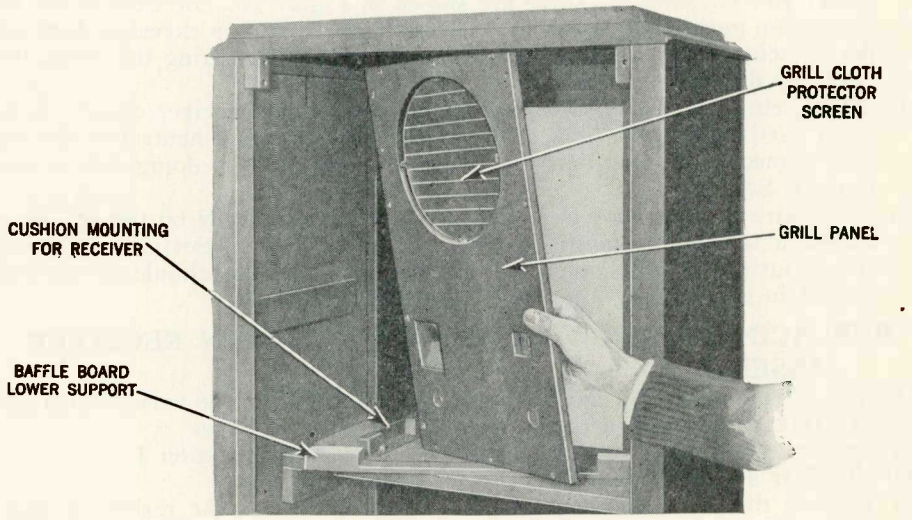


Figure 27—Removing grill panel from cabinet

[8] REPLACING PERFORATED DIAL SCALE

A step-by-step procedure to make replacement follows:

(a) Open rear grill.

(b) Turn dial so that the two screws that hold the dial in place are toward the rear.

(c) Loosen screws, washers and nuts that hold dial in place.

(d) The old dial may now be pulled clear and the new one placed in the position occupied by the old one. Examine dial screen with pilot lamp lighted from the front of the receiver to see that the numbers on the dial are in their correct position.

(e) Tighten screws holding dial in place after adjusting image correctly as outlined in Part I, Section 10. Replace rear grill.

[9] REPLACING POWER CABLE

A laced cable is used for connecting the S.P.U. to the receiver assembly and the reproducer unit. Should it be necessary to replace this cable use the following procedure:

(a) Remove receiver assembly from cabinet as described in Part IV, Section 1.
(b) Turn assembly bottom side up and unsolder all connections to the cable.
(c) Remove old cable and connect up the new cable as indicated in Figure 23, soldering all connections.
(d) Return assembly to cabinet in reverse order of that used to remove it.

[10] REPLACING INTERMEDIATE TRANSFORMERS

The No. 600 receiver has three intermediate frequency transformers. No. 1 and No. 2 are similar mechanically and electrically, but No. 3 is different. See Figure 23. These transformers are mounted on "Isolantite" support board which has very desirable electrical qualities and therefore should be protected against all damage as mentioned in Part IV, Section 6.

A step-by-step replacement procedure follows:

(a) Remove receiver assembly from cabinet as described in Part IV, Section 1.
(b) Remove tuning condenser assembly as described in Part IV, Section 4.
(c) Unsolder the connections of the transformer being replaced. Then turn up the metal tabs on the upper side of the receiver chassis. The old transformer may now be replaced by the new one. Turn over the metal tabs to hold it in place and re-solder all connections. These are shown in Figure 23. Be careful not to heat any connection more than necessary to make a good joint, as excessive heat may change the capacity of the primary fixed condenser, thus rendering the entire transformer assembly defective.
(d) After returning the main tuning condensers to the receiver chassis in the reverse order used in removal, it will be necessary to tune and neutralize the transformer just connected in position. The correct procedure for doing this is contained in Part II, Section 16.
(e) The entire receiver may then be tested and a check made on the adjustment of the oscillator trimming condensers as described in Part II, Section 17., After all tests and adjustments are completed the receiver assembly should be returned to the cabinet in the reverse order of that used to remove it.

[11] REPLACING TAPPED RESISTANCE UNIT IN RECEIVER ASSEMBLY

A tapped resistance unit in the receiver assembly provides the various grid and cathode voltages. To replace this tapped resistance unit proceed as follows:

(a) Remove receiver assembly as described in Part IV, Section 1.
(b) Unsolder all connections to the tapped resistance unit.
(c) Remove the two screws, nuts and washers that hold the resistance unit in place. This will release the unit and the new one can be fastened in place with the screws, nuts and washers previously removed.
(d) Solder all the leads to their correct connections. (See Figure 23.)
(e) Return receiver assembly to cabinet in the reverse order used to remove it.

[12] REPLACING MISCELLANEOUS PARTS IN RECEIVER ASSEMBLY

The parts such as the UX-245 grid bias resistor, center tapped filament resistor, oscillator resistor, second detector plate to cathode by-pass condenser, etc., may be easily removed by unsoldering the connections of the parts themselves.

By observing the wiring diagram in Figure 23 and the photograph in Figure 5, location and wiring of any particular part is readily ascertained for purposes of removal and replacement.

[13] REPLACING CONE OF REPRODUCER UNIT

To replace a cone, remove the entire reproducer unit from the cabinet, using the following procedure:

(a) Remove S.P.U. from upper shelf as outlined in Part IV, Section 15.
(b) Disconnect cable lead to output transformer primary.
(c) Remove the four bolts that hold the reproducer to the baffle board, at the same time supporting the reproducer by hand to prevent it falling. Place the unit in position convenient for work.

(d) Remove the nine nuts and machine screws that hold the cone ring in place. Remove this ring and washers.

(e) Remove the screw and washer that centers the cone. The cone may now be removed and the new one placed in the position occupied by the old one.

(f) Return the centering screw, the ring, washers and nine screws and nuts to position, but do not tighten. The cone should now be centered as described in Part II, Section 22, and all screws tightened.

(g) The unit should now be returned to the cabinet in the reverse manner of that used to remove it.

[14] REPLACING OUTPUT TRANSFORMER

Should it be desirable to replace the output transformer, use the following procedure:

(a) Remove complete reproducer unit as outlined in Part IV, Section 13.

(b) Disconnect output transformer leads from their respective parts on the reproducer frame.

(c) Unscrew the three small bolts and nuts holding the transformer to frame and the unit will be free from the reproducer.

(d) Replace and connect in the reverse manner (See Figure 22).

[15] REPLACING FILTER CONDENSERS, OUTPUT CONDENSER, AND OUTPUT CHOKE

The filter condensers, output condenser and output choke are enclosed as a unit in a metal container. Should replacement be necessary, use the following procedure:

(a) Remove the shield and all connections from the Socket Power Unit terminal strip.

(b) Remove the four machine screws that hold the S.P.U. to the cabinet. The S.P.U. may now be lifted clear of the cabinet.

(c) To prevent damaging the series plate resistor remove it as described in Part IV, Section 18.

(d) Unsolder all connections to the unit being replaced.

(e) Bend up the tabs that hold the unit to the S.P.U. base. Remove the old unit and fasten the new one in position by bending the tabs down so that it is held tightly to the S.P.U. base.

(f) Replace and solder all connections. The correct connections are shown in Figure 24.

(g) Return the S.P.U. to the cabinet in the reverse order of that used to remove it. Replace all connections and test. If O.K., replace shield over terminal strip.

[16] REPLACING POWER TRANSFORMER OR FILTER REACTOR

The power transformer and filter reactors are both held in place by means of tabs which form a part of their case, being turned over on the under side of the S.P.U. base. A step-by-step replacement procedure follows:

(a) Remove S.P.U. from cabinet as described in Part IV, Section 15.

(b) To prevent damaging the series plate resistor remove it as described in Part IV, Section 18.

(c) Unsolder all connections to unit being replaced.

(d) Bend up the tabs that hold the unit to the S.P.U. base.

(e) The old unit may now be removed and the new one placed in position. Bend over the tabs on the new one so that it is fastened tightly to the S.P.U. base.

(f) Solder all connections as shown in Figure 24.

(g) Fasten the S.P.U. in the cainet in the reverse order of that used to remove it.

[17] REPLACING TERMINAL STRIP ON S.P.U. OR RECEIVER ASSEMBLY

Should the terminal strip on the S.P.U. or phonograph pick-up terminal strip require replacement use the following procedure:

(a) Remove the S.P.U. or receiver assembly from cabinet as described in Part IV, Section 1, and Section 15.

(b) Unsolder all leads to the terminal strip.

(c) Release two screws holding strip to S.P.U. base, or receiver assembly.

(d) The strip may now be removed and replaced by a new one.

(e) Fasten new strip in position by means of two machine screws, lock washers and nuts previously removed.

(f) Solder all leads to terminal strip. The color scheme and correct connections are shown in Figures 23 and 24.

(g) Return S.P.U. or receiver assembly to cabinet in the reverse order, and connect cable properly (See Figure 22).

[18] REPLACING MISCELLANEOUS PARTS IN S.P.U.

The plate supply resistor and UX-280 socket may require replacement. The following general outline will apply to these units:

(a) Remove S.P.U. from cabinet as described in Part IV, Section 15.

(b) Unsolder leads from defective unit.

(c) The series plate supply resistor may be easily removed by removing the nut and lock washer holding the resistor to the brackets (riveted to S.P.U. base) by a threaded rod. The UX-280 socket should be removed by drilling out the rivets and replaced as is explained in Part IV, Section 3.

(d) Solder leads to new unit as indicated in Figure 24.

(e) Return S.P.U. to cabinet in reverse order of that used to remove it.

[19] REPLACING FRONT GRILL PANEL OR CLOTH

Should it be necessary to replace the front grill panel or cloth the procedure below should be followed:

(a) Remove S.P.U. as outlined in Part IV, Section 15.

(b) Remove reproducer unit as outlined in Part IV, Section 13.

(c) Remove receiver assembly as outlined in Part IV, Section 1.

(d) Remove upper shelf by removing the wood screws holding shelf to cabinet. Save screws and keep separate, as different length screws are used in this procedure.

(e) Remove reproducer baffle board by removing the wood screws holding it in place.

(f) Remove lower baffle support (See Figure 27) by removing wood screws holding unit.

(g) The front grill panel or board, which carries the grill cloth, grill cloth protector, and escutcheons, may now be removed after removing the wood screws holding it in place.

(h) New cloth may be replaced by using clamps or tacks to hold it in place temporarily while glue is applied to frame and the cloth lined up square and smoothed out to make a permanent job.

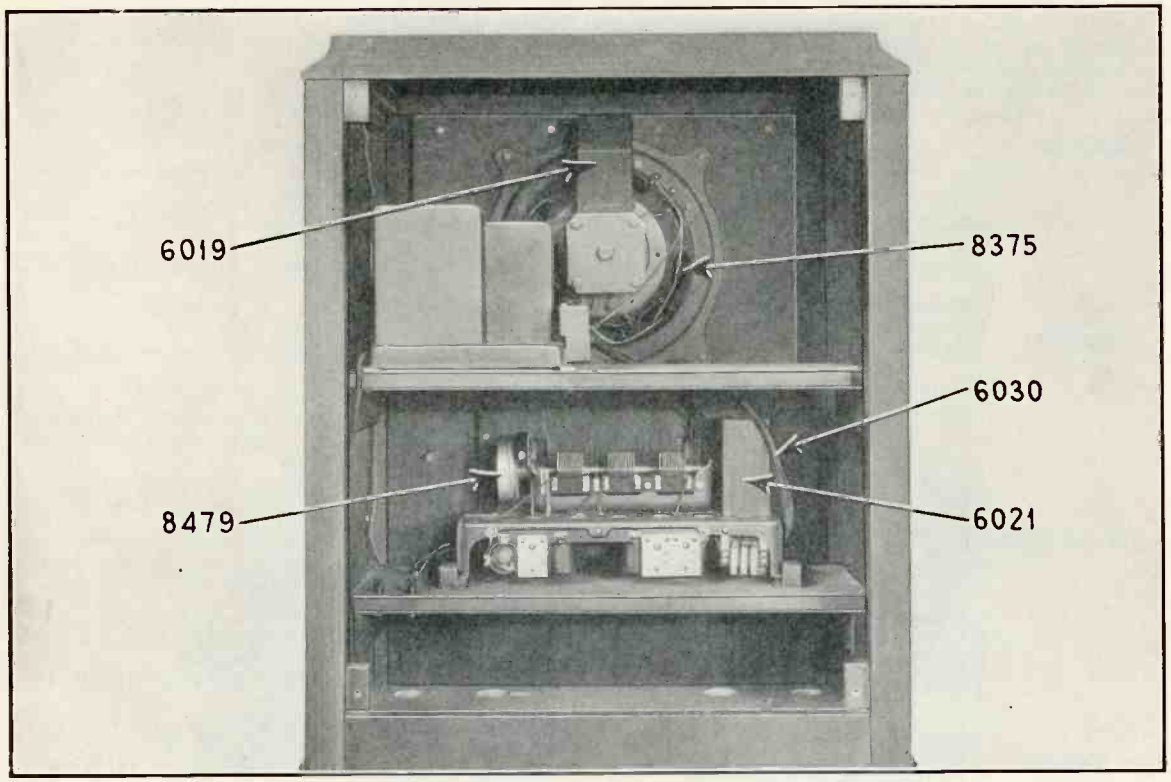
(i) Replace front grill panel in reverse manner.

SERVICE DATA CHART

Before using the following Service Data Chart, when experiencing no reception, low volume, poor quality, noisy or intermittent reception, howling and fading, first look for *defective tubes or a poor antenna system.* If imperfect operation is not due to these causes the "Service Data Chart" should be consulted for further detailed causes. Reference to Part No. and Section No. in the "Service Notes" is also noted for further details.

Indication	*Cause*	*Remedy*
No Reception	Defective operating switch	Repair or replace switch
	Loose volume control arm	Tighten volume control arm, P. II, S. 4
	Defective power cable	Replace power cable, P. IV, S. 9
	Defective R.F. transformer	Replace R.F. and oscillator coil assembly, P. IV, S. 2
	Defective I.F. transformer	Replace I.F. transformer, P. IV, S. 10
	Defective A.F. transformer	Replace A. F. transformer, P. IV, S. 7
	Defective Oscillator coil	Replace R.F. and oscillator coil assembly, P. IV, S. 2
	Defective by-pass condensers	Replace by-pass condensers, P. IV, S. 7
	Defective socket power unit	Check socket power unit by means of continuity test, and make any repairs or replacements necessary, P. III, S. 6
	Defective output transformer	Replace output transformer, P. IV, S. 14
	Open cone coil of reproducer unit	Check cone coil and if open replace cone, P. IV, S. 13
Low Volume	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 14
	Trimming condensers out of adjustment	Adjust trimming condensers, P. II, S. 17
	I.F. transformers not correctly aligned	Align I.F. transformers correctly, P. II, S. 16
	Defective power cable	Repair or replace cable, P. IV, S. 9
	Defective R.F. transformer	Replace R.F. and oscillator coil assembly, P. IV, S. 2
	Defective I.F. transformer	Replace I.F. transformer, P. IV, S. 10
	Defective A.F. transformer	Replace A.F. transformer, P. IV, S. 7
	Dirty prongs of Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Defective by-pass condensers	Replace defective by-pass condensers, P. IV, S. 7
	Defective main tuning condenser	Replace defective tuning condensers, P. IV, S. 4
	Low voltages from socket power unit	Check socket power unit voltages with high resistance D.C. voltmeter and A.C. voltmeter, P. III, S. 2
	Defective socket power unit	Check socket power unit by means of continuity tests and make any repairs or replacements necessary, P. III, S. 6
Poor Quality or Noisy Reception	Defective A.F. transformer	Replace A.F. transformer, P. IV, S. 7
	Defective by-pass condenser	Replace defective by-pass condenser, P. IV, S. 7
	Dirty contact arm of volume control	Clean contact arm on volume control, P. II, S. 4
	Dirty prongs on Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Volume control advanced too far	Reduce setting of volume control, P. I, S. 6
Howling	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 14
	I.F. Neutralizing condenser out of adjustment	Align and adjust I.F. transformers correctly, P. II, S. 16
	Defect in audio system	Check and repair any defect, P. II, S. 11
	Open grid circuit in any stage	Check circuit and repair defect, P. III, S. 5
	Microphonic Radiotrons	Interchange Radiotrons
Excessive Hum	Defective center tapped resistance unit	Replace defective resistance unit, P. IV, S. 12
	Socket plug position	Reverse socket plug
	Line voltage low	Solder line tap for low line voltage, P. I, S. 7
	Defective S.P.U.	Check S.P.U. by continuity tests, P. III, S. 6
Radiotrons Fail to Light	Operating switch not "On"	Turn operating switch "On"
	Defective operating switch	Replace operating switch
	Defective input A.C. cord	Repair or replace A.C. input cord
	Defective power transformer	Replace power transformer, P. IV, S. 16
	No. A.C. line voltage	Turn A.C. line voltage "On"

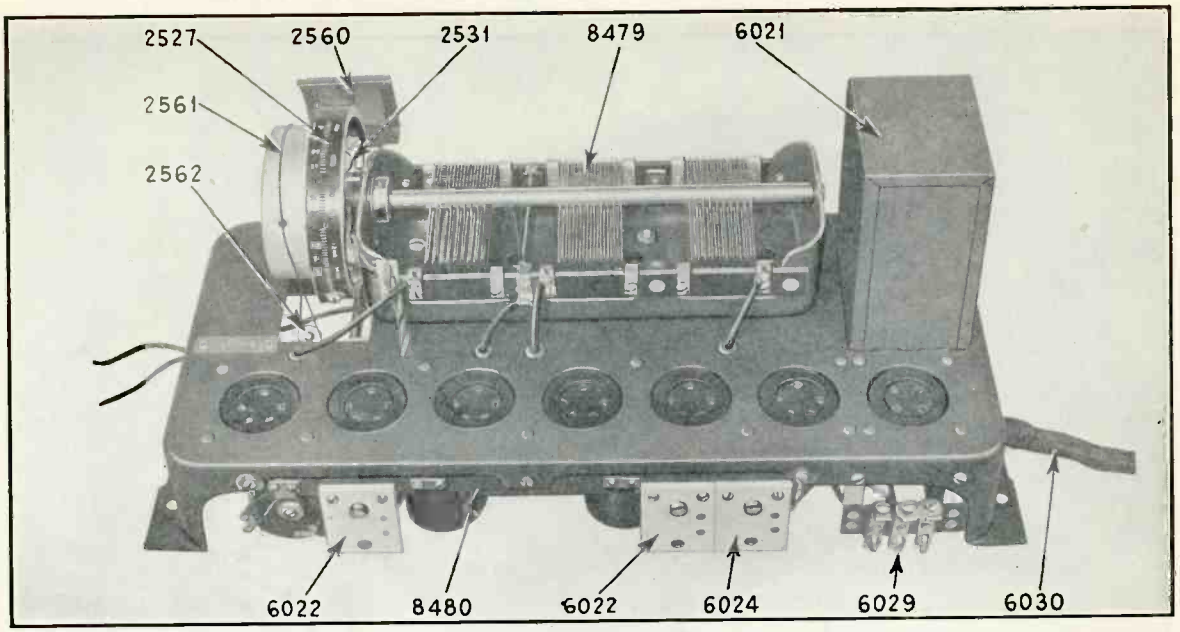
No. 600 Receiver Replacement Parts



No.	Description	*Price
	RECEIVER ASSEMBLIES	
2010	Condenser—Fixed condenser 160 mmfd.—across secondary of audio transformer	$.50
2015	Switch—Antenna switch (not illustrated)	1.15
2267	Socket—Single Radiotron socket with bakelite protective shield for UX-245	.50
2269	Condenser—Fixed condenser—Oscillator series, or oscillator grid condenser—740 mmfd.	.75
2270	Resistor—40,000 ohms—Used as oscillator grid leak, and across primary of audio transformer	.75
2332	Knob—Station selector or volume control knob (not illustrated)	.75
2526	Spring—Spiral tension spring for condenser drive cord—Package of 5 (not illustrated)	1.00
2527	Scale—Tuning condenser perforated metal scale—Package of 5	1.00
2531	Socket—Pilot lamp socket—Less flexible leads—Package of 5	1.65
2549	Resistor—¼ megohm—Carbon type filter resistor—Package of 5	3.00
2560	Screen — Amber colored station selector screen—Package of 5	.60
2561	Drive Cord—Condenser drive cord—Package of 5	1.20
2562	Pulley—Idler pulley for condenser drive cord—Package of 5	$1.60
2563	Resistor—Bleeder resistor 6000 ohms—Package of 5	3.00
2564	Resistor—1460 ohms—Bias resistor for UX-245—Package of 5	3.30
2595	Spacer—Metal spacer for knobs—Package of 10 (not illustrated)	.50
5806	Condenser—Fixed by-pass audio condenser, .0024 mfd.—3 condensers in one unit	1.55
5809	Resistor—Oscillator resistor, and used across primary of 3d I. F. transformer—3000 ohms	.75
6021	Capacitor Pack in metal container—Comprising five ½ mfd., two .05 mfd. condensers, and 1 audio transformer	18.75
6022	Adjustable Condenser—R. F. Compensating condenser or series trimming condenser for oscillator	1.00
6024	Adjustable Condenser—Parallel trimming condenser for oscillator	.90
6025	Resistor—Mid-tapped 60-ohm filament resistor—Package of 5	3.00
6026	Resistor—R. F. bias resistor—465 ohms tapped at 90 ohms	1.10
6027	Volume Control—550 ohms—Porcelain base with ¼ inch shaft, 2 inches long—Package of 5	7.20

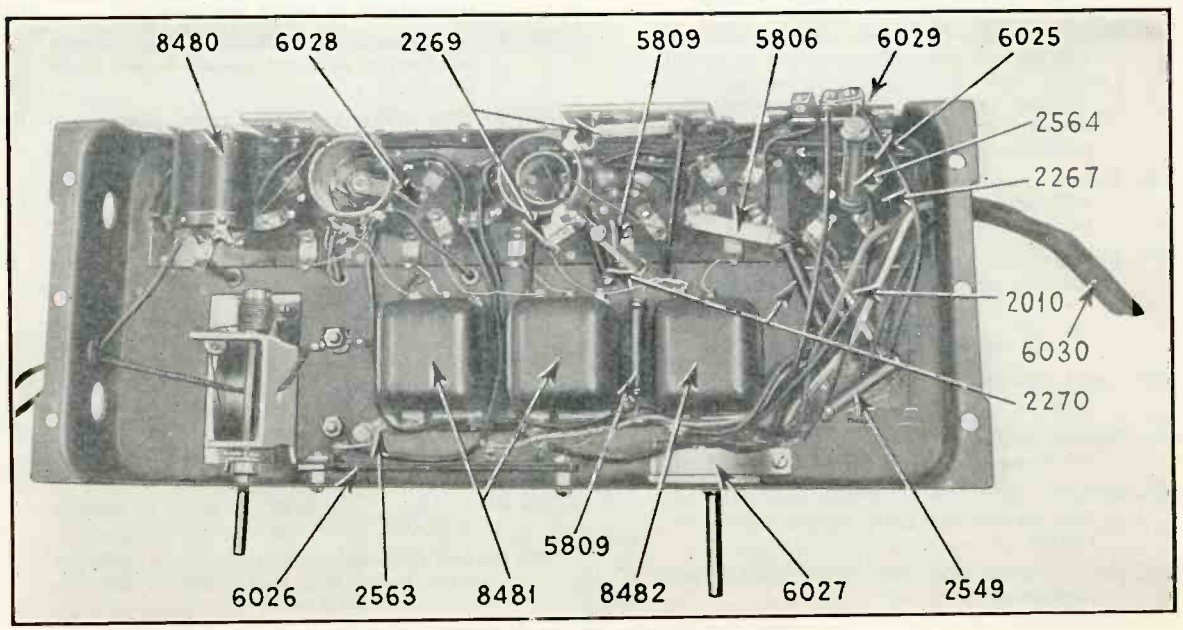
*Prices subject to change at our option

No. 600 Receiver Replacement Parts



No.	Description	*Price
	RECEIVER ASSEMBLIES (Cont'd)	
6028	Socket—6-gang, UY-227 Radiotron socket with seven-gang protective shield	$2.00
6029	Terminal Strip—With mounting brackets, link, 3 terminals and terminal screws	.75
6030	Cable—Cable from receiver to S.P.U.	2.40

No.	Description	*Price
8479	Condensers—Tuning condenser assembly—Comprising 3 condensers, drive, drive cord and spring—screws, washers, and nuts for mounting dial scale—2 screws and lock washers for mounting screen support—Less scale and screen support	$15.00



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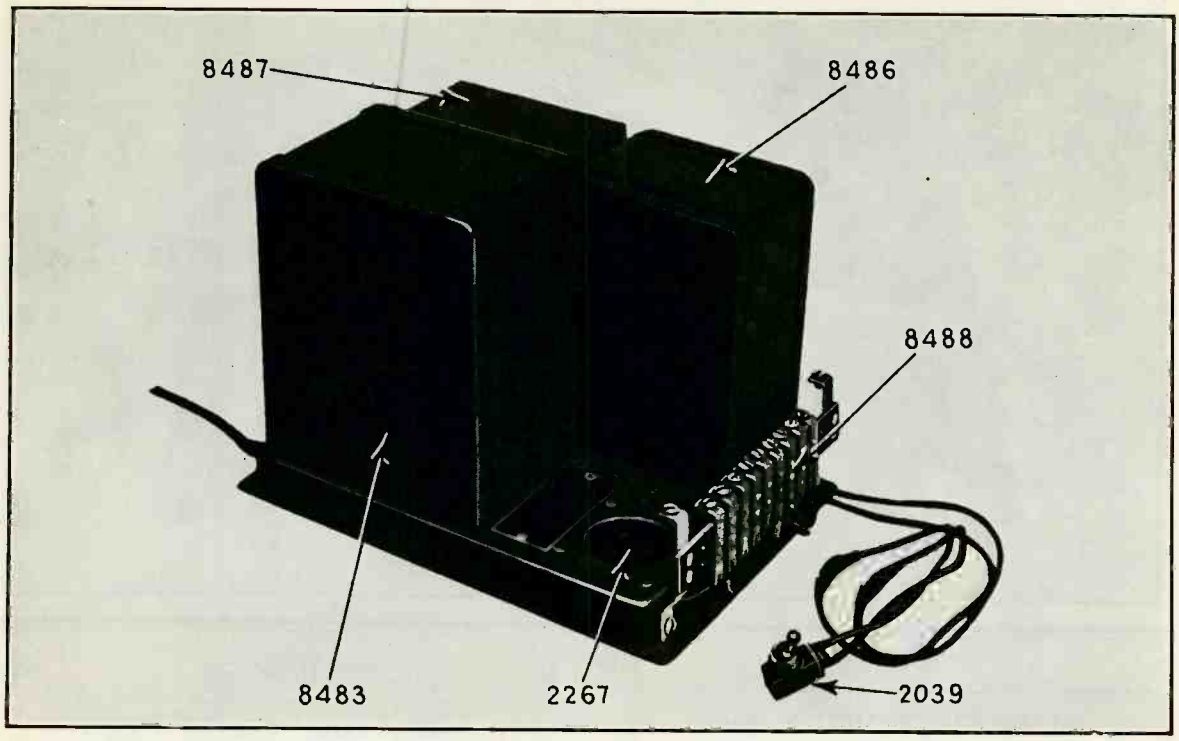
No. 600 Receiver Replacement Parts



No.	Description	*Price
	RECEIVER ASSEMBLIES (Cont'd)	
8480	Coil Assembly—R. F. coil, detector coil, oscillator coil assembly, mounted on metal strip with 2 adjustable trimming condensers and 1 R. F. compensating condenser, 1 oscillator series condenser, and 1 oscillator grid condenser	$6.60
8481	Transformer—1st or 2d I. F. transformer with adjustable condensers in metal container	3.90
8482	Transformer—3rd I. F. transformer with adjustable condenser in metal container	4.20
	S.P.U. ASSEMBLIES	
2039	Switch—Power line operating switch with leads	1.15
2267	Socket—Single Radiotron socket with bakelite protective shield for UX-280	.50
6031	Resistor—4800 ohms—Glazed porcelain series resistor for plate supply (not illustrated)	2.95
6032	Cable—Laced cable for wiring S.P.U. (not illustrated)	2.00
8483	Power Transformer—105-125 Volts—60-cycle transformer in metal container	$12.90
8484	Power Transformer—105-125 Volts—25-cycle transformer in metal container (not illustrated)	24.90
8486	Reactor—Filter reactor in metal container	10.05
8487	Filter Condenser—Comprising filter condenser, by-pass condenser, output coupling condenser and choke in metal container	14.25
8488	Terminal strip with 9 terminals and 7 terminal screws	1.30
	REPRODUCER ASSEMBLIES	
6018	Field Coil—330-volt (not illustrated)	6.60
6019	Transformer—Output transformer in metal container	5.85
8375	Cone—8" Corrugated paper cone with voice coil for dynamic speaker	4.50
8376	Ring—Metal clamping ring for holding cone (not illustrated)	.90
8390	Ring—Cardboard seal ring—Used between baffle board and cone support—Package of 10 (not illustrated)	1.60

*Prices subject to change at our option

1-H-29-5 Printed in U. S. A. G. B. R. 67

RCA 46

GraybaR

550 Radio

"AC" Lighting Circuit Operated

GraybaR

QUALITY

INSTRUCTIONS

GraybaR
ELECTRIC COMPANY
SUCCESSOR TO Western Electric SUPPLY DEPARTMENT

Graybar

550 Radio Receiving Set

"AC" Lighting Circuit Operated

INTRODUCTION

The Graybar 550 Radio Receiving Set is a lighting circuit operated, antenna type, shielded radio receiver, utilizing the new "AC" screen grid Radiotrons and a new power-amplifier Radiotron introduced by the Radio Corporation of America. The receiver, power unit, and electro-dynamic loudspeaker are enclosed in a walnut finished cabinet, the front opening of which is covered with embroidered tapestry. The circuit used in this receiver includes two stages of tuned radio-frequency amplification, a detector, and one stage of audio-frequency amplification.

The two stages of radio-frequency amplification employing "AC" screen grid Radiotrons, UY-224, give performance equal to that of four tubes used in ordinary tuned radio-frequency receivers. "AC" Radiotron UY-224 functions as the detector with a consequent increase in the efficiency of the circuit. Fine quality of reproduction and ample volume are insured by the use of the power-amplifier Radiotron, UX-245, in the single audio-frequency stage.

Radiotron UX-280 is used in the power unit to rectify the "AC" input for the plate and grid supply for all Radiotrons, also for the loudspeaker field supply.

This receiver has a concentric tuning and volume control thereby insuring ease of operation. A Local-Distant Switch is provided to retain the maximum high quality operating characteristics of the receiving set for both strong local stations and weak distant stations.

A pilot lamp illuminates the selector dial when the power is on. As the Selector is rotated, magnified images of the scale markings together with approximate kilocycle (frequency) readings on the selector dial are projected upon a fixed translucent dial screen. Images of the scale markings pass by a fixed index pointer on the screen.

Excellent sensitivity and selectivity are provided over the broadcast range from 550 to 1500 kilocycles (545 to 200 meters). The powerful built-in electro-dynamic loudspeaker furnishes excellent reproduction, the quality of which is equally good at reduced or full volume.

Part I—Installation and Operation

EQUIPMENT

1. One complete set of Radiotrons, as follows:
   Three RCA Radiotrons UY-224.
   One RCA Radiotron UX-245.
   One RCA Radiotron UX-280.
2. Two MAZDA No. 41 pilot lamps (one spare); T-3 bulb, miniature base, concentrated filament, 2.5 volts, 0.45 ampere (packed in instruction book envelope).
3. Antenna and ground equipment (see Part II).

INSTALLATION

Preliminary—After unpacking the set remove the rear cover. Unwrap the power cord and the antenna and ground leads and bring them out through the holes provided in the bottom of the cabinet, as shown in Fig. 1.

Locate the receiver near an electrical outlet, where the antenna lead-in and ground connections will be as short as practicable.

Antenna and Ground—Satisfactory operation is dependent upon proper installation of the antenna and ground (see Part II).

Connect the antenna lead (blue) of the receiver to the lead-in wire, and the ground lead (black with blue tracer) to the ground wire (see Figs. 1 and 5). Both connections should be soldered and insulated.

Loudspeaker—Make certain that all connections are secure at the loudspeaker terminals (see Figs. 3 and 5).

Power Supply—Graybar 550 Radio Receiving Set should never be connected to any circuit supplying other than alternating current, within the rated limits of voltage and frequency (cycles) specified on the rating plate of the power unit (see Fig. 3). Failure to observe this may result in damage to the receiver. If there is any doubt about the rating of the house lighting circuit, consult the Electric Light and Power Company before connecting the receiver. (See also "'AC' Line Voltage", Part II.)

No tube protector or line voltage reducer should be used with this receiver. (See "Tube Protectors", Part II.)

Insert the attachment plug of the power cord in an electrical outlet.

Important—*Never apply power to Graybar 550 Radio Receiving Set unless all the Radiotrons are in the sockets.*

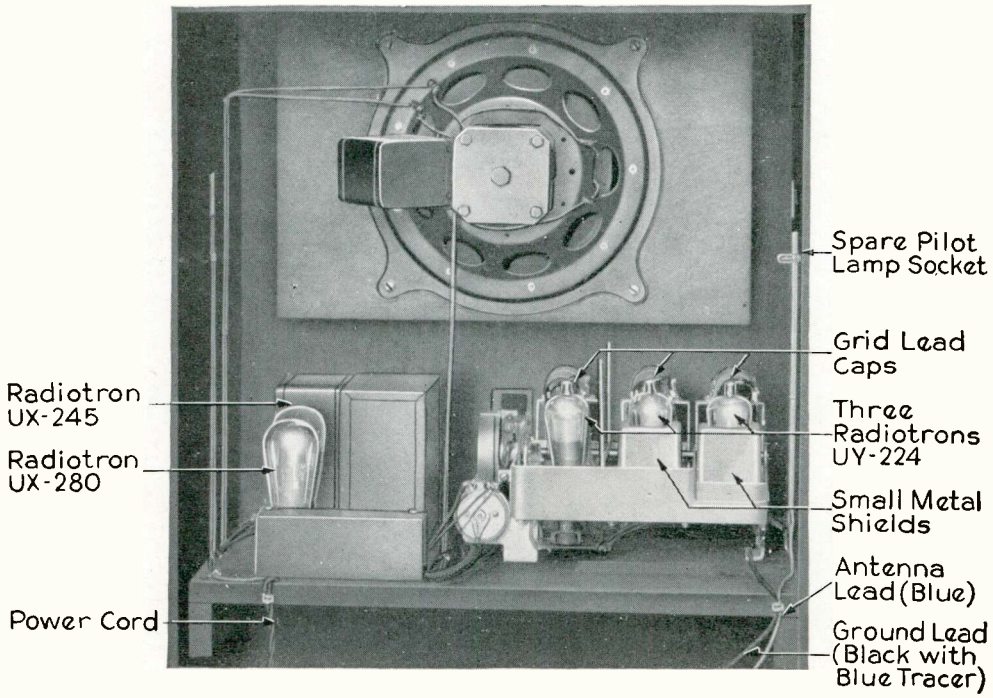


Fig. 1—Rear View with Cover Removed and Large Metal Shields Removed

Metal Shields and Radiotrons—Unscrew the knurled nuts holding the shield clamp (Fig. 3) in place. Remove the shield clamp and lift out the large metal shields. Handle these shields carefully.

Insert the five Radiotrons, which should always be handled carefully, in the proper sockets as shown in Fig. 1. Be sure that the "UX" Radiotrons are so faced that the two large pins enter the large holes, and that the base of each Radiotron rests squarely against the socket. After the Radiotrons are inserted, press the grid lead caps (see Fig. 1) firmly down over the grid contacts of the UY-224 Radiotrons.

Set the Power Switch (Fig. 4) to the "ON" position, upward. Make sure that the five Radiotrons are lighted. Snap the Power Switch "OFF", downward.

Push down on the small metal shields to make certain that they are firmly in place. (See Fig. 1.)

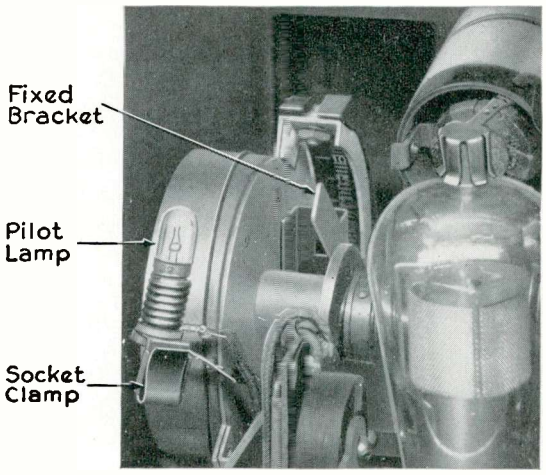


Fig. 2—Pilot Lamp Mounting
Showing Method of Installing Pilot Lamp—Socket Clamp Slides Over Fixed Bracket

Replace each large metal shield carefully in its proper compartment. The shield with one large and one small notch must be placed in the compartment to the left (facing the rear of the cabinet) and with the large notch next to the selector dial.

After both shields are firmly in place, replace the shield clamp over the clamp bolts, and replace the knurled nuts. These nuts should be tightened sufficiently to insure holding the shields firmly in place; but excessive pressure, which may bend the shields, is to be avoided.

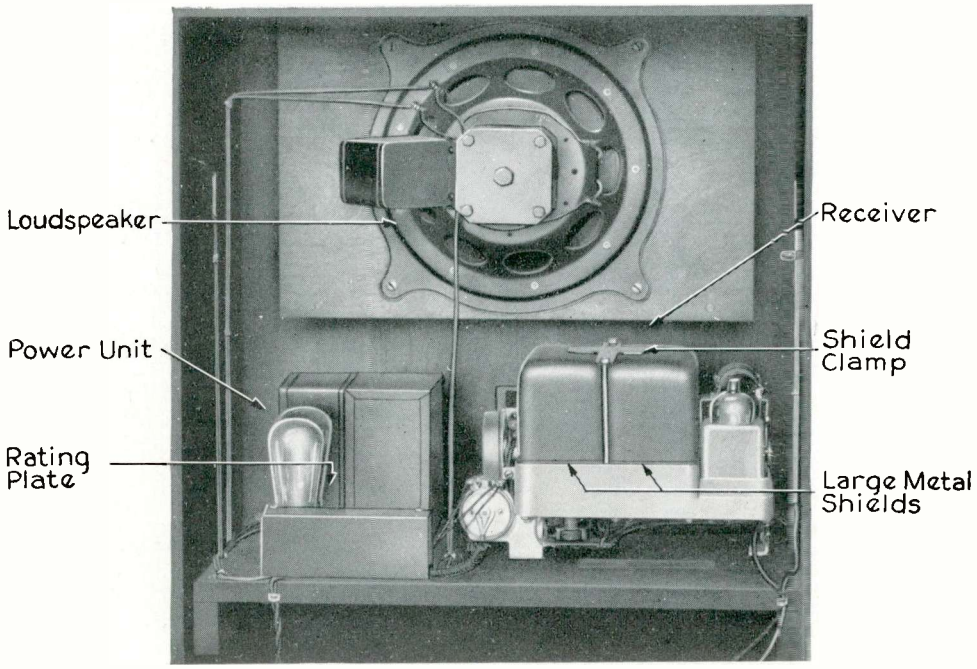


Fig. 3—Rear View with Cover Removed—Large Metal Shields in Place

Pilot Lamp—Turn the Selector (Fig. 4) counter-clockwise to the extreme position, so that the pilot lamp mounting will be accessible. Remove the socket clamp from the fixed bracket and screw one of the pilot lamps firmly into the socket (see Fig. 2). Replace the socket clamp on its bracket. Insert the extra bulb into the spare pilot lamp socket, Fig. 1.

Set the Power Switch to the "ON" position, upward. With the Selector in the extreme counter-clockwise position, adjust the socket clamp on the fixed bracket until the zero mark of the scale, projected on the translucent dial screen (Fig. 4) is approximately ¼ inch below the index pointer. Then switch off the power and replace the rear cover.

OPERATION

To operate Graybar 550 Radio Receiving Set refer to Fig. 4 and proceed as follows:

1. Set the Power Switch to the "ON" position, upward. The pilot lamp should light. An interval of approximately 30 seconds is required for Radiotrons UY-224 to heat before satisfactory reception is possible.
2. Set the Local-Distant Switch to the "DISTANT" position.
3. Set the Volume Control in approximately the middle position. Then turn the Selector slowly in either direction. If no station is heard at any point, advance the Volume Control in the clockwise direction slowly, while rotating the Selector, until a station is heard.
4. Adjust the Selector for maximum signal strength.
5. Adjust to the desired volume by means of the Volume Control. Because of the extreme sensitivity of the Graybar Receiving Set, a more satisfactory adjustment is obtained, when receiving powerful nearby stations, by setting the Local-Distant Switch in the "LOCAL" position.
6. When through operating snap the Power Switch to the "OFF" position.

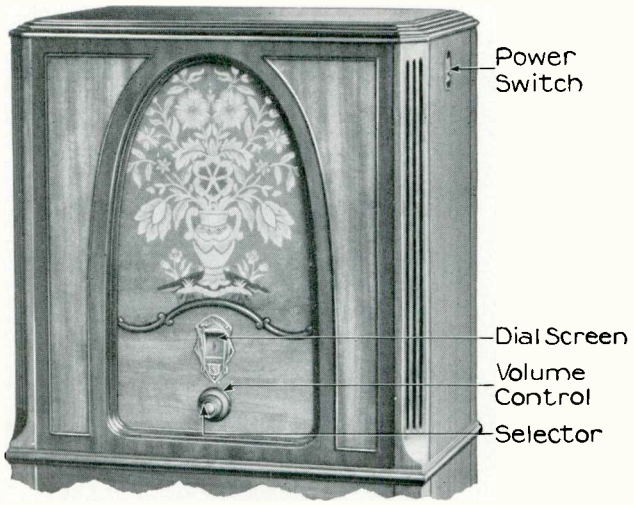


Fig. 4—Panel and Controls
(Local-Distant Switch on Side Opposite Power Switch)

Note—If the Volume Control is too far advanced when receiving strong signals, it may occur that the station can be tuned in over a broad continuous range on the selector dial. In general, best reception of any station is obtained if the tuning is done with the Volume Control set at the furthest counter-clockwise position at which the station can be heard. After the correct setting of the Selector is obtained, the volume may be increased as desired with the Volume Control.

Part II—General Information

The following suggestions are offered to assist the user in obtaining the best performance from Graybar 550 Radio Receiving Set.

"AC" Line Voltage—Both 105/125 volt models (50/60 and 25/40 cycles) of the Graybar 550 Radio Receiving Set are originally connected for normal operation on voltages above 115. The original connection should be left unchanged unless it is definitely determined, by consulting the Graybar Radio Dealer or the Electric Light and Power Company, that the supply voltage is normally below this value. Provision is made for adapting the receiver to voltages below 115 by a simple wiring change within the receiver. When such a change is required, it should be performed by the Graybar Radio Dealer.

Tube Protectors—The power transformer in this receiver is designed to supply correct voltages to the Radiotrons, without the addition of a tube protector or line voltage reducer. A tube protective device of any kind, used in series with the power supply, will reduce the voltage supplied to the receiver so that the Radiotrons will not receive their proper voltages and therefore will not operate at highest efficiency. For this reason it is recommended that no line voltage reducing device be used with this receiving set.

Power Supply—Reception may possibly be improved by reversing the plug (Fig. 5) at the electrical outlet.

Metal Shields—Be sure that the metal shields are always firmly in place.

Radiotrons—Improved results may sometimes be obtained by rearranging the UY-224 Radiotrons, all other Radiotrons remaining in their respective sockets. Before interchanging these Radiotrons, switch off the power. (See "Important", Part I.)

Volume—Adequate control of volume can be obtained with the Volume Control and the Local-Distant Switch. Reduction of volume should never be accomplished by adjustment of the Selector. The Local-Distant Switch should be set in the "LOCAL" position and the Volume Control advanced whenever by so doing the desired volume can be obtained.

Selector Dial—The Selector scale is arbitrarily graduated from "0" to "100". Approximate kilocycle (frequency) values are indicated on the left side of the scale. The dial settings may be recorded on the Station Log, at the end of this book.

Antenna

(a) *Outdoor Type*—A single-wire (No. 14 bare copper is recommended) outdoor antenna 30 to 50 feet long will usually provide good reception. The shorter antenna is preferable in a locality near high-power broadcast stations. A longer antenna may give improved results in a locality distant from broadcast stations.

The antenna should be isolated from other objects. It should be erected as high as possible and at right angles to all electric light and power lines and must not cross either above or below such lines. The antenna and lead-in should be supported by high-grade glass or glazed porcelain insulators, and the lead-in should be spaced a foot or more from the building. All splices should be soldered.

The lead-in and ground connections should be separated from one another and be as short and direct as practicable. It is preferable that the lead-in wire be a continuation of the antenna itself, and where brought through the wall or window frame it should be insulated therefrom by some means, such as a porcelain tube.

An outdoor antenna should be protected by an approved lightning arrester, in accordance with the requirements of the National Board of Fire Underwriters.

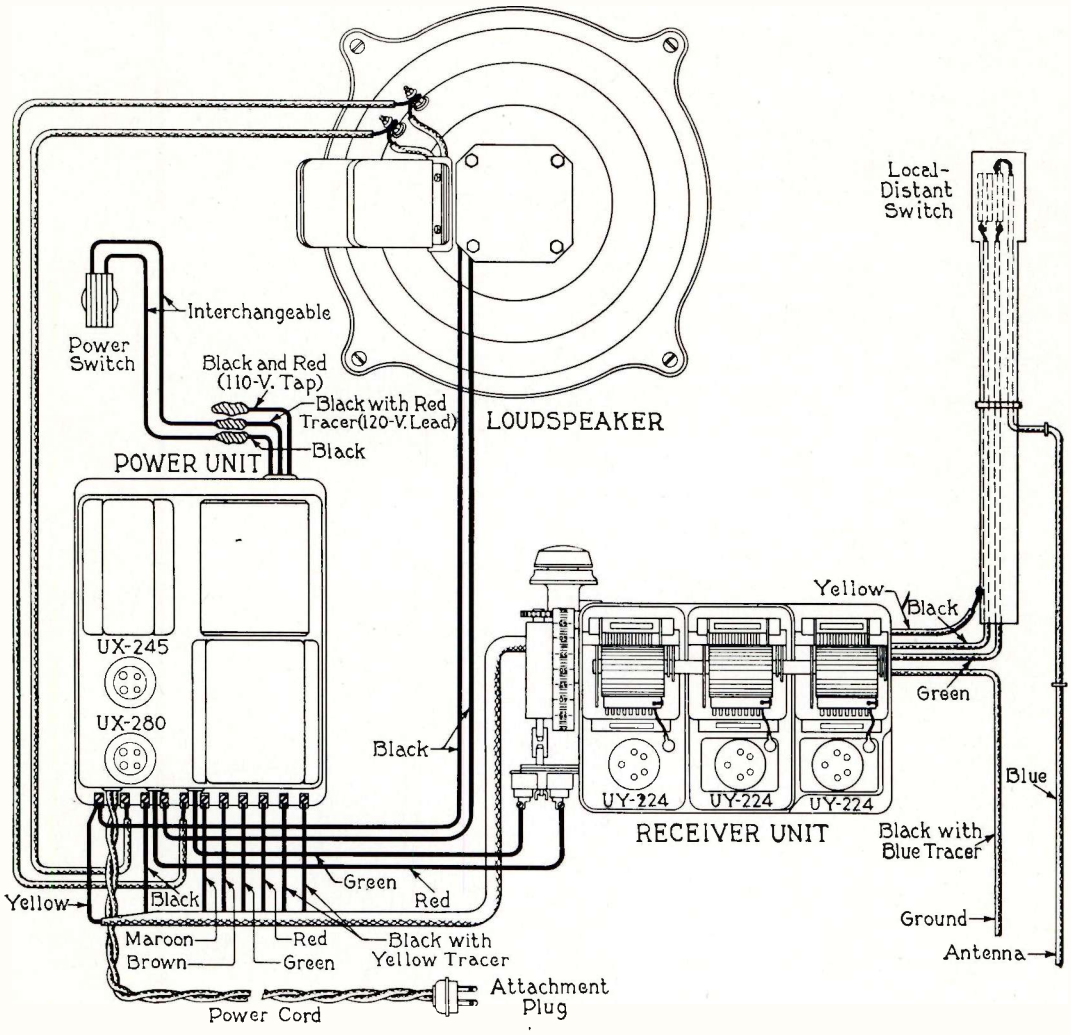


Fig. 5—Cabinet Wiring of Graybar 550 Radio Receiving Set

(b) *Indoor Type*—An indoor antenna is not as effective for distant reception as a properly installed outdoor antenna. Where installation of an outdoor antenna is not practicable, satisfactory results may be obtained by using 30 to 50 feet of insulated wire inside the building. The size of the wire is not particularly important, though No. 18 bell wire is suggested. In buildings with metal lath, satisfactory results are not always possible with this type of antenna. Under such conditions, various arrangements of the indoor antenna may be tried.

Ground—A good connection to ground is as important as a well constructed antenna. Definite instructions cannot be given, as conditions vary in different locations. Water pipes or steam pipes generally make good grounds. The use of gas pipes should be avoided. The ground lead should be connected by means of an approved ground clamp to a section of the pipe that has been scraped thoroughly clean. If water or steam pipes are not available, a pipe or metal rod may be driven into the ground to a depth of several feet. The success of this type of ground depends upon the presence of moisture in the soil.

Part III—Maintenance

Radiotrons—Before inserting or removing Radiotrons always be sure that the current is switched off. (See "Important", Part I.)

The contact pins of all Radiotrons, also the grid contacts at the top of the UY-224 Radiotrons, should be inspected periodically and kept clean.

It is a good plan to have available at least one new RCA Radiotron of each type. Occasionally, the condition of each Radiotron in use should be checked by substituting a new one and comparing results in reception, both local and distant.

Power Supply—Should the pilot lamp and Radiotrons fail to light with the Power Switch in the "ON" position, it is probable that the receiver is not properly connected to the power supply. Make sure that the attachment plug is properly inserted in the electrical outlet and that the current is not switched off at any point.

Volume Control—If the operation of the Volume Control should at times produce a grating sound in the loudspeaker, this may be remedied by turning the control back and forth between the extreme positions a few times in order to remove any foreign material which may have collected on the control resistance.

Antenna and Ground—A decrease in receiving range and volume may be caused by loose or corroded connections in the antenna and ground circuit, or by an accumulation of dirt or soot on the antenna insulators.

Pilot Lamp—Renewal bulbs (see "Equipment", Part I) may be purchased from any Graybar Radio Dealer. Before removing the pilot lamp from its bracket (see "Pilot Lamp", Part I) always switch off the power.

In order that station settings will not be changed when a new bulb is inserted, the socket clamp should be adjusted so that any one station (the previous setting for which is accurarely known) is received at the same scale reading as before.

Graybar Radio Dealer—The Graybar Radio Dealer is required to test this receiver and assure himself that it is in satisfactory operating condition when installed.

This receiver is guaranteed to be free from defects as outlined on the guarantee tag accompanying the instrument. Should any part become defective within the guarantee period, the Dealer will furnish a new part to replace the defective one. A reasonable charge may be made for installing such parts.

If any service on this receiver is needed, either before or after expiration of the 90-day guarantee, the Graybar Radio Dealer from whom it was purchased should be consulted. If this Dealer cannot be reached because of change in location, or other reasons, the nearest Graybar Radio Dealer should be consulted. Graybar Radio Dealers are organized to handle customers' service needs either by their own service department or by arrangement with the Graybar distributing house.

IMPORTANT

The Graybar 90-day guarantee on this Receiver is not effective unless the Graybar Guarantee Tag is countersigned and dated at time of sale by the Graybar Radio Dealer from whom it was purchased. If you have not received the signed Guarantee Tag, be sure to have the Graybar Radio Dealer give it to you immediately.

NOTICE

This device is licensed by the Radio Corporation of America only for certain restricted uses set forth in a notice permanently attached to it.

STATION LOG

Date	Call Letters	Location	Frequency in Kilocycles	Wave-length	Selector Dial Setting

Graybar

ELECTRIC COMPANY

SUCCESSOR TO *Western Electric* SUPPLY DEPARTMENT

Offices in 72 Principal Cities

Akron	Denver	Milwaukee	Roanoke
Albany	Detroit	Minneapolis	Rochester
Asheville	Duluth	Mt. Vernon (N.Y.)	St. Louis
Atlanta	Flint	Nashville	St. Paul
Baltimore	Fort Wayne	Newark	Salt Lake City
Beaumont	Fort Worth	New Haven	San Antonio
Birmingham	Grand Rapids	New Orleans	San Francisco
Boston	Hammond	New York	Savannah
Brooklyn	Harrisburg	Norfolk	Seattle
Buffalo	Hartford	Oakland	Spokane
Charlotte	Houston	Oklahoma City	Syracuse
Chicago	Indianapolis	Omaha	Tacoma
Cincinnati	Jacksonville	Philadelphia	Tampa
Cleveland	Kansas City	Pittsburgh	Trenton
Columbus	Knoxville	Portland	Toledo
Dallas	Los Angeles	Providence	Wichita
Davenport	Memphis	Reading	Worcester
Dayton	Miami	Richmond	Youngstown

GB-R-38

Printed in U.S.A.

RCA Speaker 106

GraybaR

Electro-Dynamic Loud Speaker Table
No. 33

INSTRUCTIONS

GraybaR
ELECTRIC COMPANY
SUCCESSOR TO *Western Electric* SUPPLY DEPARTMENT

GraybaR

Electro-Dynamic Loud Speaker Table No. 33

Introduction

Graybar Electro-Dynamic Loud Speaker Table No. 33 is designed for use with any broadcast receiver having a power output stage or a separate power amplifier unit. Its powerful electro-magnetic field, and its correspondingly large baffle area, provide unusual sensitivity and permit extraordinary volume without distortion or overloading.

The table itself is so designed that it will accommodate practically any type of table model cabinet.

The electro-dynamic speaker mechanism complete with step down output transformer and junction rectifier field supply unit, is solidly mounted to prevent vibration. Flexible cords are provided for connecting to the electrical outlet, and to the output of the radio receiver. A receptacle is provided on the bottom of the table for plugging in an "AC" operated receiver or power amplifier, or an "AC" operated accessory to a battery type receiver.

Installation

Unpacking and Assembling:

After removing the cabinet and the unmounted loudspeaker mechanism from the shipping container, place the table front downward on a rug and remove the back cover, which is fastened by screws at its sides. Place the mechanism in position on the front baffle as shown in Figure 3, and fasten by the four supporting Wing-Nut bolts.—**Be sure to tighten these four Wing-Nuts with a wrench or pliers, to make secure and to prevent vibration.**

Connect the leads of the cable at the top of the cabinet, either way, to the middle terminals of the rectifier stacks, as shown in Figure 3 (see that the lead clamped to the underside at each terminal remains connected). Make sure that the two leads of the input cord A (Figure 3) are securely connected to the terminals at the lower left portion of the loudspeaker frame. Unwrap the input and power cord, placing them through their proper bushings in the bottom of the cabinet. Replace the back cover of the cabinet and fasten with the screws.

Connections to Receiver:

After having placed the receiving set on top of the table, connect the two pin terminals of the Input Cord A (Figure 3) either way to the output pin jacks or binding posts of the receiver (or separate power amplifier if used).

INSTALLATION—*Continued*

No external output transformer is necessary. The step down output transformer (Figure 3) serves to match the output of the power stage to the low impedance coil of the loud speaker.

If the receiver is "AC" lighting socket operated, insert the attachment plug of its power cord in the receptacle "C" (Figure 3) on the bottom of the baffle board.

If a battery type receiver with a "B" battery eliminator is used, the power cord of the eliminator should be plugged into receptacle "C" (Figure 3). Trickle chargers when used with storage batteries should not be connected to this receptacle.

If the loudspeaker No. 33 is operated from an "AC" power amplifier unit, the power cord of the amplifier should be plugged into the receptacle "C". If the receiver is entirely battery operated, the receptacle "C" (Figure 3) will not be used.

Connection to Power Supply:

Graybar Electro-Dynamic Loud Speaker Table No. 33 is to be connected to 25 to 60 cycle, 110-125 volt alternating current *only—not direct current.* Failure to comply with this requirement may result in damage to the unit. If there is any doubt about the rating of the house lighting current consult the Electric Light and Power Company before connecting Loud Speaker Table. The voltage and frequency rating of the "AC" receiver, power amplifier, or "B" eliminator should conform to the rating of the house lighting circuit.

Set the switch "B" (Figure 3) to the "off" position. Insert the attachment plug of the cord "D" (Figure 3) in an electrical outlet.

Important — The back cover should never be removed without first disconnecting the power cord from the electrical outlet.

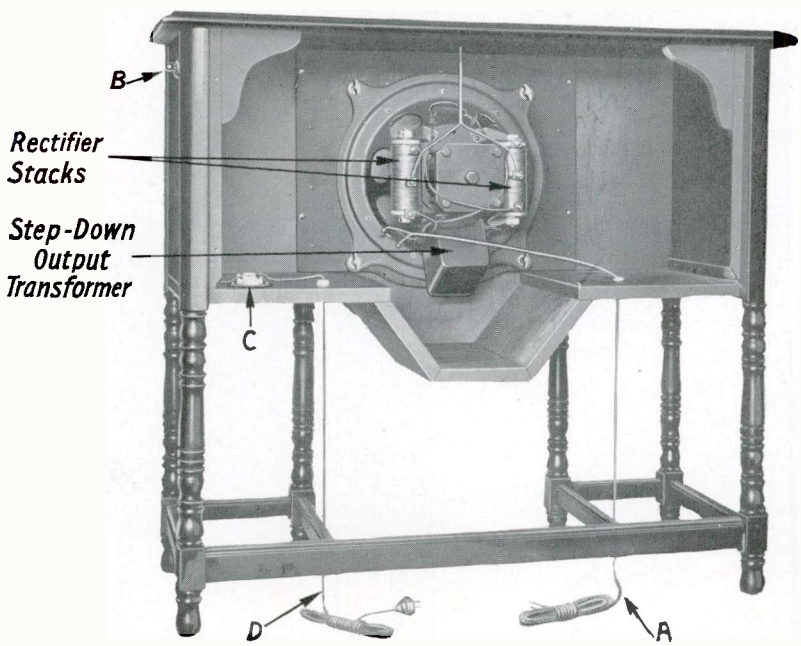
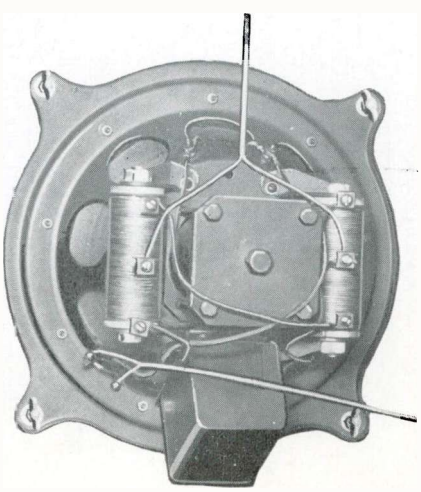


FIGURE 3

Rear view of Graybar Loud Speaker Table No. 33 with back cover removed showing manner of wiring.



INSTALLATION—*Continued*

Operation:

Graybar Loud Speaker Table No. 33 is placed in operating condition (field excited) by setting the switch "B" to the "on" position. The switch on the radio set, if either "AC" or battery type, must also be turned on to obtain reception. If a power amplifier or "B" battery eliminator is used, the switch on the receiving set may also control the current to either. This feature varies with the type of equipment used.

Caution—The switch on the loudspeaker table and the switch on the receiving set operate separately, so that it is always necessary to place both switches in an "off" position when no reception is desired. Switch "B" (Figure 3) as connected cannot be used to control the receiving set or any accessories connected to receptacle "C".

Maintenance

Graybar Loud Speaker Table No. 33 should require no attention. If it fails to operate at any time check the following:

1. Be sure the attachment plug is securely plugged into the electrical outlet.
2. Be sure the radio set is properly inserted into the receptacle "C" (Figure 3).
3. Check all connections on Input Cord "A" (Figure 3).
4. Be sure all switches are turned "on".

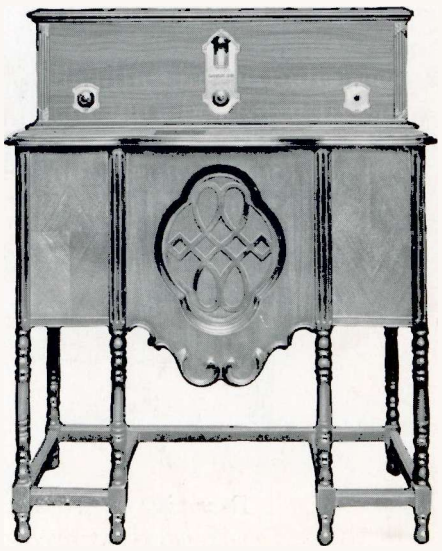
If faulty reproduction should develop, look first for difficulties in the radio receiver (and power amplifier unit if used). The receiving equipment may be tested by substituting another loudspeaker.

If any difficulty arises which is not readily traceable to the power supply or receiving apparatus, the Graybar Radio dealer, from whom you purchased the Loud Speaker Table should be consulted.

License Notice.

This device is licensed by the Radio Corporation of America only for certain restricted uses set forth in a notice permanently attached to it.

Graybar Loud Speaker Table No. 33 makes a splendid combination with any radio receiving set of suitable size to fit on top. It is especially designed to accommodate the Graybar 330 and Graybar 310, as pictured.



GRAYBAR RADIO
311

SERVICE NOTES & REPLACEMENT PARTS

Graybar
ELECTRIC COMPANY
SUCCESSOR TO *Western Electric* SUPPLY DEPARTMENT

CONTENTS

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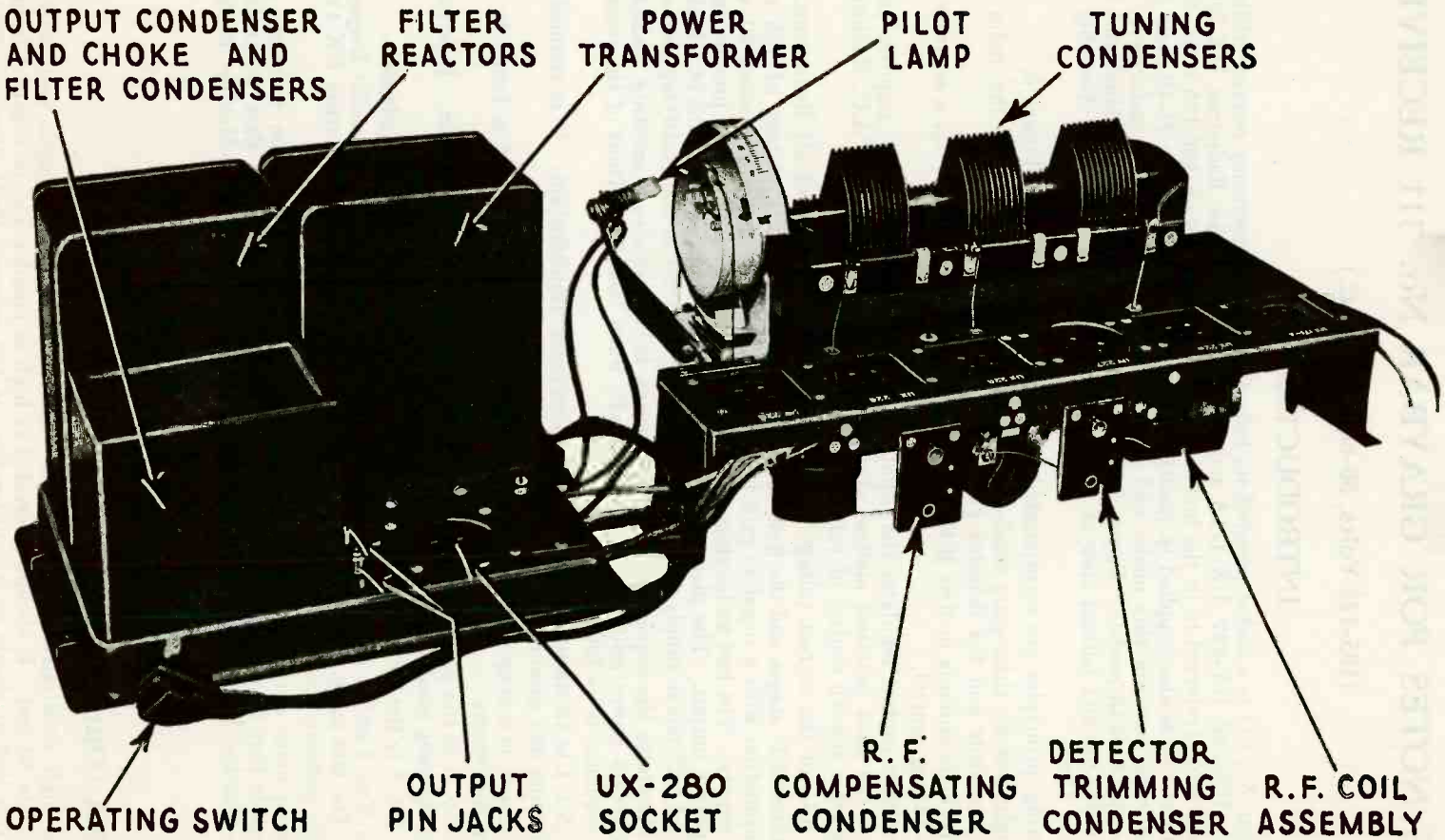
PART II—SERVICE DATA

PART III—ELECTRICAL TESTS

PART IV—MAKING REPLACEMENTS

PART V—NO. 311 RECEIVER REPLACEMENT PARTS

ILLUSTRATIONS



Figures 2 and 3—Top view of receiver assembly and socket power unit showing location of parts

SERVICE NOTES FOR GRAYBAR No. 311 RECEIVER

(105-125 Volts, 50-60 Cycle A. C.)

INTRODUCTION

The Graybar No. 311 is a socket powered six-tube, tuned radio frequency receiver utilizing RCA Radiotrons UX-226, UY-227, UX-171A and the full wave rectifier Radiotron UX-280 in the Socket Power Unit (referred to in the text as S.P.U.) It operates on 105-125 volts, 50 to 60 cycle A.C. lines. It is also supplied in models designed for 105-125 volts, 25-40 cycle A.C. lines. The difference between this model and the 50-60 cycle is the power transformer. The Service Notes apply to both models. Figure 1 illustrates a front view of the cabinet and Figures 2, 3, 4 and 5 a top and bottom view of the various units in the Receiver Assembly and the Socket Power Unit.

The following principles are incorporated in the circuit design—See Figure 6.

(a) A single control, three-gang condenser is employed to tune two of the radio frequency circuits and the detector circuit.

(b) An aperiodic antenna or first R.F. circuit, eliminates the necessity for a separate antenna tuning control.

(c) The volume control regulates the input grid voltage to the first R.F. amplifier stage. This is the most practical method of volume control for use with A.C. Radiotrons and gives a smooth control of volume without distortion.

(d) Raw A.C. of the correct voltage is used for filament heating of all Radiotrons.

(e) The three R.F. stages and the first audio stage receive a plate voltage of 135 volts in conjunction with a negative grid bias of 9 volts. The detector receives 30 volts plate supply. The last audio stage receives a plate voltage sufficient to provide ample loudspeaker output. The plate and grid voltages are supplied by means of a built-in "B" and "C" power supply unit using Radiotron UX-280 as the rectifying device.

Figure 7 illustrates the sequence of the Radiotrons in the receiver, omitting Radiotron UX-280 in the socket power unit. From right to left, when facing the front of the receiver, the Radiotron sequence is as follows:

Radiotron No. 1 is an untuned stage of radio frequency amplification. It is coupled directly to the antenna and ground.

Radiotron No. 2 is a stage of tuned radio frequency amplification, and is tuned by the first of the gang condensers.

Radiotron No. 3 is the second stage of tuned radio frequency amplification. It is tuned by the second of the gang condensers.

Radiotron No. 4 is the detector and is tuned by the third of the gang condensers.

Radiotrons Nos. 5 and 6 are respectively, the first and second stages of audio frequency amplification. The last stage, Radiotron No. 6, employs power amplifier Radiotron UX-171A. An output filter protects the loudspeaker windings from any D.C.

The following notes are published for the guidance of those called upon to locate and remedy any trouble that may occur. The text is divided into four parts, Part I—Installation; Part II—Service Data; Part III—Electrical Tests, and Part IV—Making Replacements.

PART I—INSTALLATION

[1] ANTENNA (Outdoor Type)

Due to the high sensitivity of the No. 311 receiver the antenna length need only be approximately 25 to 50 feet. It should be erected as high as possible and be removed from all obstructions. The lead-in should be a continuation of the antenna itself, thus avoiding all

splices which might introduce additional resistance and in time corrode sufficiently to seriously affect reception. If it is absolutely necessary to splice the lead-in to the antenna, the joint must be carefully soldered to insure a good electrical contact. Clean off all excess flux and tape the connection to protect it from the oxidation effects of the atmosphere.

High grade glass or porcelain insulator supports are required and at no point should the antenna or lead-in wire come in contact with any part of the building. Bring the lead-in wire through a porcelain tube insulator to the inside of the house for connection to the receiver.

The antenna should not cross either over or under any electric light, traction or power line and should be at right angles to these lines and other antennas. An outdoor antenna should be protected by means of an approved lightning arrester, in accordance with the requirements of the National Fire Underwriters' Code.

[2] ANTENNA (Indoor Type)

Where the installation of an outdoor antenna is not practical, satisfactory results may generally be obtained by using an indoor antenna of about 20 to 40 feet of insulated wire strung around the picture moulding or placed under a rug. In buildings where metal lathing is employed, satisfactory results are not always possible with this type of antenna. Under such conditions various arrangements of the indoor antenna should be tried to secure satisfactory results. An indoor antenna is not as efficient as a properly installed outdoor antenna.

[3] GROUND

A good ground is quite as important as the antenna. No specific recommendations can be given in this matter as conditions vary in different locations. Water and steam pipes usually make good grounds. Gas pipes usually make poor grounds and, as a rule, are to be avoided. If neither water nor steam pipes are available, a pipe or metal rod may be driven into the ground to a depth of several feet. The success of this type of ground depends upon the moisture present in the soil. The ground lead should be connected by means of an approved ground clamp to a section of pipe that has been scraped and thoroughly cleaned. The connection should be inspected from time to time to make certain that a clean and tight electrical contact exists between the clamp and pipe. The service man should experiment with various grounds, and employ the one giving the best results.

[4] RADIOTRONS

Four Radiotrons UX-226, one UY-227, one UX-171A and one UX-280 are used. The locations of these Radiotrons are plainly designated on each socket. Be careful not to insert a Radiotron UX-226 in the UX-171A socket, as immediate filament burn-out will result when the current is turned "ON."

Connect the loudspeaker to the output pin terminals and insert the A.C. input plug into a socket outlet of correct voltage and frequency. Turn "ON" the operating switch. After about 30 seconds the Radiotron UY-227 will glow dimly, indicating that the receiver is in operating condition. If no signals are heard when tuning to a station known to be broadcasting, examine the Radiotrons. Possibly one Radiotron has been damaged in transit. Interchanging with one or more known to be in operating condition will isolate the damaged one.

If there is an excessive hum present during operation:

(a) Reverse the A.C. input plug at the socket outlet.

(b) Interchange the Radiotrons UX-226 in the R.F. stages with the one in the first A.F. stage, and use the combination that gives least hum. Then interchange the three in the R.F. stages for the best results while tuned to a broadcast station.

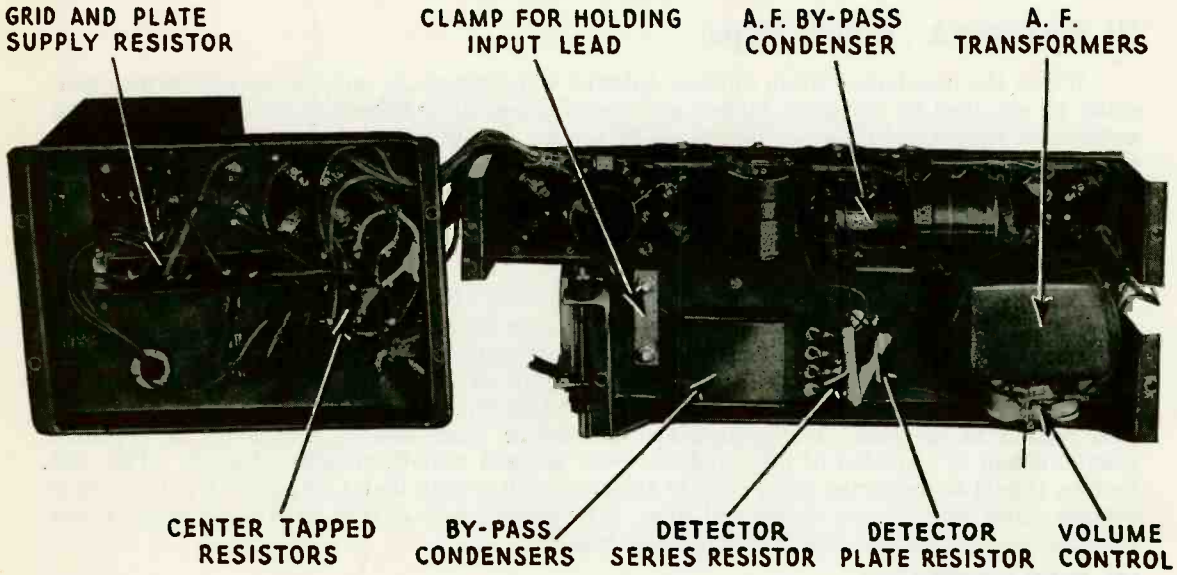
[5] ADJUSTMENT FOR LOW LINE VOLTAGES

A lead is provided on the side of the S.P.U. for use when the No. 311 receiver is connected to lines, the voltage of which never exceeds 115 volts. A good plan is to allow the lead to remain as connected in manufacture unless unsatisfactory operation is experienced. Should such adjustment be necessary, however, proceed as follows:

(a) Remove top from metal cabinet.

(b) Connected to the operating switch will be found two taped connections, one of which has a transformer lead (black with red tracer) connected to a black switch lead. Untape and unsolder this connection and then tape up the black with red tracer lead so that it will not ground or short to other parts.
(c) A black and red lead will be found taped up and not used. Untape this lead and clean the end for splicing.
(d) Splice this lead just untaped to the black lead from the switch that has been released. Solder and tape securely.

The 110-volt tap of the transformer is now properly connected and the receiver may be used on 105-115 volt lines with maximum efficiency. Figure 15 illustrates these changes to be made.



Figures 4 and 5—Sub-chassis view of receiver and socket power unit showing location of parts

[6] ATTACHING LEGS TO CABINET

Four legs are provided with the No. 311 receiver that must be attached by the dealer or the purchaser.

The following step-by-step procedure may be used:

(a) Remove the cover and place the cabinet upside down on a soft blanket or rug in a place convenient for work.
(b) Place the hollow leg section over the foot on the cabinet so seam is toward back.
(c) Insert the short cast leg terminal in hollow section so one side with design faces toward the front.
(d) Thread long bolt through center of casting and leg and screw tightly into threaded section provided in cabinet foot.
(e) Insert metal plug, flanged side inward, into hole over bolt head and tap lightly to secure it.
(f) Repeat the procedure on each leg.

[7] REFINISHING MARRED SURFACES

Should the surface of the No. 311 cabinet become scratched or marred either when installing or after use, it may be easily refinished in the same manner that wood is refinished. In other words, it may be stained, lacquered, varnished and polished.

[8] KNOBS

The No. 311 set uses an improved type of push knob on the station selector similar to that used on the Graybar No. 330 and two pendant type push knobs on the operating switch and volume control. These knobs may be removed by simply pulling them from their shafts and replaced by pushing them on. Care should be taken when replacing the knobs to make sure the small dielecto spacing washers are placed over the shaft before the knob is put on so the knob will not bind against the cabinet.

[9] WAVE TRAP

Due to wide variations in broadcast receiving conditions in different sections of the country, the performance of any radio receiver in any given location depends upon the local receiving conditions existing at that point.

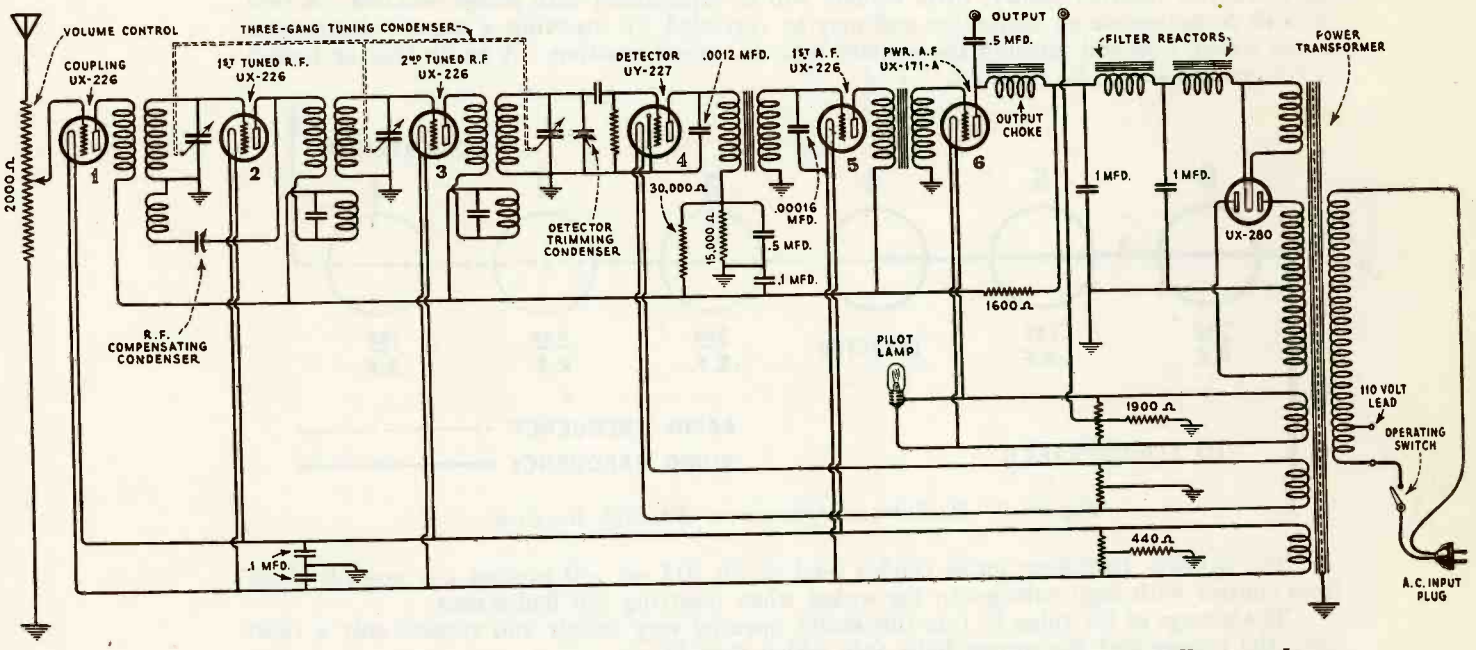


Figure 6—Schematic circuit diagram of receiver and socket power unit—all grounds are connected to frame and metal cabinet

Receivers located in the vicinity of powerful broadcasting stations receive the signal from such stations with great intensity over a large number of scale divisions of the receiver. If it is desired to receive a relatively distant station whose frequency assignment is comparatively close to that of the local station, it is impossible to do so without interference.

To satisfy the No. 311 set user located in districts where bad receiving conditions exist, a Wave Trap has been designed and will be carried by Graybar Distributing Houses as an accessory.

The function of the wave trap is to absorb a large portion of the energy of the powerful local signal picked up by the antenna, thereby reducing the effect of the powerful local signal to a value comparable with that of more distant stations.

This wave trap is very efficient in design, is neat in appearance, and is simple to install and adjust. It may be adjusted to absorb a strong signal at any point on the No. 311 dial scale. After it has once been adjusted to absorb the strong local signal causing interference at a particular location, it needs no further adjustment or attention.

It is intended that this Wave Trap shall be located on the top of the chassis frame at the extreme left end viewing the set from the front. Installation can be made in five or ten minutes without removing the chassis from the cabinet. Complete installation and adjustment instructions accompany each unit.

PART II—SERVICE DATA

[1] ANTENNA SYSTEM FAILURES

A grating noise may be caused by a poor lead-in connection to the antenna or the antenna touching some metallic surface, such as the edge of a tin roof, drain pipe, etc. By disconnecting the antenna and ground leads the service man can soon determine whether the cause of complaint is within or external to the receiver and plan his service work accordingly.

[2] RADIOTRON SOCKETS

The sockets in No. 311 receiver are the standard gang UX and UY type. Care must be exercised when inserting Radiotrons in their sockets. A socket contact may not be in its correct position and forced insertion of a tube will bend or break it. If care is exercised and the Radiotron inserted gently, little trouble will be experienced with socket contacts. A bent one will be noticeable on inspection and may be corrected by inserting a narrow instrument in the socket hole and pushing the contact into its correct position. A badly bent or broken socket contact should be replaced.

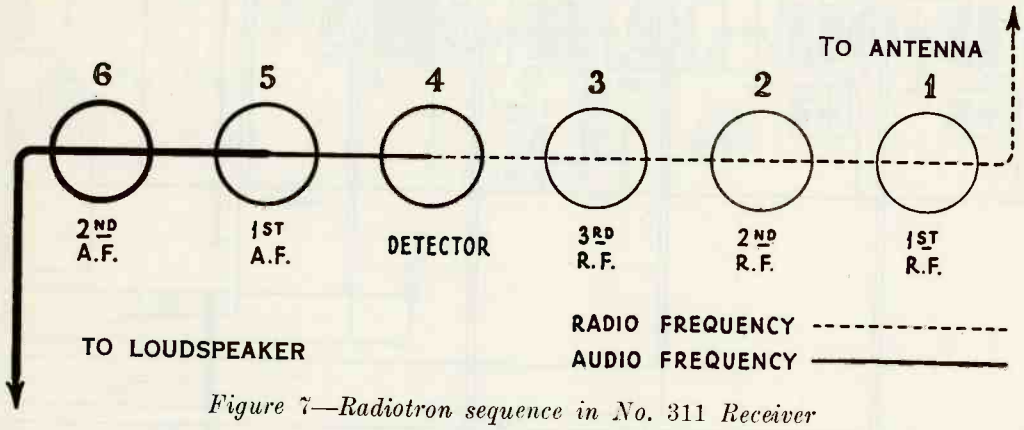


Figure 7—Radiotron sequence in No. 311 Receiver

The bakelite Radiotron guide shields used in No. 311 set will prevent any possible shock from contact with high voltages in the socket when inserting the Radiotrons.

The prongs of the tubes fit into this shield opening very snugly and require only a twist until the prongs find the correct holes into which they fit.

[3] RADIOTRON PRONGS

Dirty Radiotron prongs may cause noisy operation or change the resistance of the filament circuit sufficiently to cause a hum in the loudspeaker. They should therefore be cleaned with fine sandpaper periodically to insure good contact.

The use of emery cloth or steel wool is not recommended. Before reinserting Radiotrons in their sockets wipe the prongs and base carefully to make certain that all particles of sand are removed.

Care should be exercised to see that the two large pins and two small pins of the Radiotrons match the socket holes. The UY-227 Radiotron has five prongs, all of the same size, and will fit in the socket only one way. If a Radiotron will not fit into a socket without considerable pressure, look for excessive solder on one or more of the prongs. Excessive solder on the prongs may be removed with a file or knife.

[4] LOOSE VOLUME CONTROL AND LOW VOLUME

A loose volume control contact arm may cause noisy or intermittent operation. It should be bent slightly so that it makes firm contact against the resistance strip. To do this it is necessary to remove the receiver assembly and S.P.U. from the cabinet as described in Part IV, Section 1. The volume control is then accessible. It can be released by removing the two screws that hold it to the metal frame.

Low volume even on local stations may be due to one of the following causes:

(a) Defective antenna and ground system. A poor antenna and ground system or one in a shielded locality may cause weak signals. The suggestions given in Part I, Sections 1, 2 and 3 should be followed if trouble of this kind is experienced.

(b) R.F. compensating condenser out of adjustment. If this condenser is badly out of adjustment it will have the effect of making the receiver very insensitive. To adjust correctly refer to Part II, Section 10.

(c) Defective R.F. transformers. Should the R.F. transformers become damaged so that they do not properly match, weak signals may be the result.

(d) Defective A.F. transformer. An open or short in the A.F. transformers may cause weak signals and distorted reproduction.

[5] TUNING CONDENSERS OUT OF ALIGNMENT

If the tuning condensers are out of alignment, line up as follows:

(a) Procure or construct a tool as illustrated in Figure 8.

(b) Remove the receiver assembly and S.P.U. from the cabinet as described in Part IV, Section 1, and place in operating condition. Tune in a signal, either broadcast or a modulated oscillator of about 1400 K.C. and adjust the volume control so that the signal is very weak.

(c) With the condenser plate end of the tool touch the rotor of each of the three tuning condensers and note if an increase of signal is experienced. If the condensers are in alignment the signal should decrease. If the signal increases, that particular condenser is slightly low in capacity, which can be corrected by bending the two end rotor plates toward their adjacent plates slightly until the test with the "paddle" gives a decrease rather than an increase in signal.

(d) After checking the condenser for low capacity they may be checked for high capacity by taking the ring of the tool and inserting it successively in the center of the three R.F. coils. This should give a decrease of signal. If it increases then the end rotor plate of the condenser that tunes the coil should be bent away from its adjacent rotor plate. This should be bent until inserting the ring in the coil will give a decrease of signal rather than an increase. The detector tuning condenser is provided with a small trimming condenser for aligning this circuit. Instead of bending the plate of the condenser adjustment should be first attempted at the trimming condenser. In most cases this will cover all aligning adjustments required in the detector stage.

(e) After checking at 1400 K.C. a station or oscillator signal about 600 K.C. should be tuned in and the condensers completely checked at this frequency. Any additional necessary adjustments should be made.

(f) After completion of all tests, return the receiver to its cabinet in the reverse manner of that used to remove it.

[6] HUM

Part I, Section 4, describes the method to eliminate ordinary hum in a No. 311 receiver when making an installation. If a pronounced hum develops during operation check the following:

(a) Low emission Radiotron UX-280. A low emission rectifying tube will cause excessive hum and unsatisfactory operation.

(b) Shorted filament condenser. There are two .1 mfd. condensers hooked in series across the UX-226 filaments with the center tap grounded. A short of either of these condensers will cause loud hum and imperfect operation of the receiver.

(c) Defective center tapped resistance. A short or open in any of the center tapped resistances connected across the various filament supplies will cause a loud hum.

(d) Any open of the several grounding connections in the receiver or defective voltage supply resistances may cause a certain amount of hum. These defects will have a pronounced effect on the general operation of the receiver which will be more noticeable than the additional hum. Check by means of the continuity test given in Part III, Section 3.

A mechanical hum caused by vibration of loose laminations in the power transformer may be corrected by removing the power transformer from the S.P.U. as described in Part IV, Section 10, and heating it in a slow oven. The open end should be kept up and the compound heated sufficiently to allow it to adhere to the laminations of the transformer. After heating, the transformer should be allowed to cool for at least 24 hours and then returned to the S.P.U.

[7] LOUDSPEAKER POLARITY

The use of an output filter in the No. 311 receiver makes unnecessary any adjustment for polarity of the output current. Any type of loudspeaker (either horn, magnetic type cone or dynamic type cone) can be connected in the manner that gives the most pleasing reproduction.

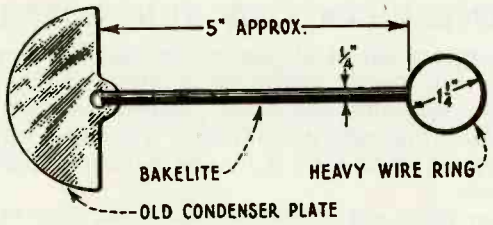


Figure 8—Tool for testing electrical alignment of gang tuning condensers

[8] AUDIO HOWL

Audio howl may be caused by:

(a) Open A.F. condenser connections. An open connection to either of the A.F. condensers, one connected from plate to cathode of the detector and the other from grid to filament of the first A.F. tube, may cause a howl.

(b) Open by-pass condensers. An open .5 mfd. by-pass condenser connected across the detector plate resistor connection may cause a howl.

(c) Vibrating elements in receiver Radiotrons. A gradually developed howl is probably due to the loudspeaker causing the receiver Radiotron elements to vibrate. To overcome this condition, interchange the Radiotrons in the receiver or change the relative angle between the loudspeaker and the receiver. In extreme cases it will be necessary to increase the distance between the receiver and the loudspeaker.

[9] UNCONTROLLED OSCILLATION

Uncontrolled oscillations in any part of the tuning range may be caused by:

(a) Poor ground. Install ground system as indicated in Part I, Section 3.

(b) An open connection in any of the several ground leads in the receiver.

(c) Poorly soldered or corroded joints. Any high resistance joint throughout the receiver may cause oscillation.

(d) A defect in the R.F. coil system. A short in any of the concentrated primary coils or the condenser shunted around them may cause the receiver to oscillate.

(e) Incorrect adjustment of compensating condenser. The correct procedure for adjusting the compensating condenser is given in Part II, Section 10.

[10] ADJUSTMENT OF R. F. COMPENSATING CONDENSER

The R.F. compensating condenser in the No. 311 receiver is provided to allow adjustment of the receiver to compensate for variations of tube characteristics and thereby allow the receiver to function in its most sensitive condition. Before readjusting this condenser, the Radiotrons should be interchanged and satisfactory operation secured by this means if possible. The interchanging of tubes should be made with the idea of getting a tube in socket No. 2 that will not go into oscillation and gives the loudest signal on a weak station. If satisfactory sensitivity cannot be secured by this means an adjustment of the compensating condenser may be made as follows:

(a) Put receiver in operation in usual manner and tune in a station preferably at the middle or upper wave lengths.

(b) Locate the compensating condenser adjusting screw which is accessible through the hole near the center at the back of the receiver cabinet.

(c) With the volume control at the position of maximum intensity, turn the screw to the right until the set goes into oscillation. Then turn the screw to the left until all oscillation and howl is eliminated with the volume control at maximum. In some cases interchanging the tubes in the R.F. stages will facilitate this adjustment.

(d) Tune in stations with maximum volume and note if the receiver goes into oscillation at any wavelength. If it does, turn the screw still further to the left.

(e) When the adjusting screw has been turned to the right as far as possible without oscillation occurring at any wavelength, the correct adjustment has been found for best sensitivity.

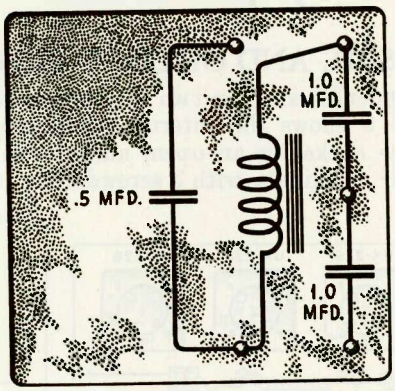


Figure 9—Internal connections of output condenser and choke and filter condensers

[11] DISTORTED REPRODUCTION

Under normal conditions the No. 311 receiver will deliver a strong signal of good quality to the loudspeaker. The high sensitivity of this set makes it undesirable to operate the set at full volume when receiving from a nearby broadcasting station. The volume control should be adjusted to secure best quality, with the desired volume. If the loudspeaker reproduction is poor, test the loudspeaker output from the receiver. A pair of phones or loudspeaker of known quality may be used for this purpose. If the loudspeaker is O. K. poor quality or distortion may be due to any of the following causes:

(a) Defective Radiotrons. Though the receiver may be in operating condition a defective Radiotron in any stage will cause distortion. This is especially true of the detector, 1st and 2nd audio stages and the rectifier tube.

(b) High or low plate and grid voltages from the Socket Power Unit. The cause may be a defective Radiotron UX-280 or resistance unit. Replace the Radiotron UX-280 with one of known quality and check the various resistances for a possible short or open.

The cause of noisy operation and intermittent signals with periods of hum or no reception may be traced in the following manner:

(a) Disconnect the antenna and ground leads. If reception becomes quiet and signals from local stations, though weak, are received the trouble is in the antenna system, or is caused by nearby interfering electrical apparatus. In the first case repair the antenna system and in the second case place radio frequency chokes on any offending nearby apparatus. The location of interfering electrical machinery will require patience, skill and experimenting.

(b) If disconnecting the antenna and ground does not eliminate the noise, the trouble is in the receiver. A defective tube, one having poorly welded elements will cause a disturbance of this kind, and this point should be checked by interchanging the Radiotrons in the receiver with others of the same type. If it is definitely established

that the Radiotrons are O.K. the Radiotron prongs and the socket contacts should be examined for dirt or poor contact. The volume control should be examined for poor contact between the contact arm and the resistor strip.

[12] PILOT LAMP

The No. 311 set is equipped with a small pilot lamp operating from the UX-171A filament winding. Its purpose is to illuminate the tuning dial and act as a current supply indicator. The latter use is quite important because the time required for Radiotron UY-227 to develop normal operation, which is approximately 30 seconds, can be checked.

The pilot lamp is mounted on a small lever that can be pulled clear of the dial for inserting the lamp and then pushed in place to give proper illumination to the translucent dial. If the lamp is not in its proper place, insufficient illumination of the dial will be experienced.

[13] FILTER CONDENSER, AND OUTPUT CONDENSER AND CHOKE

The output choke and condenser and the two filtering condensers are located in one container in the S.P.U. Figure 9 shows the internal connections. The procedure for testing this unit is to "click test" the choke for an open, and charge and discharge the condensers individually by shorting their terminals with a screwdriver. A condenser that will not retain

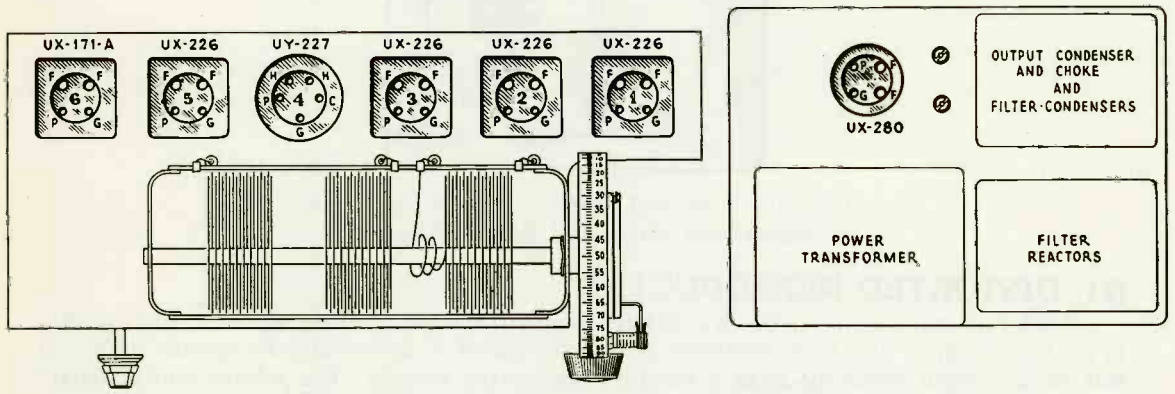


Figure 10—Diagram showing location of Radiotron socket contacts

its charge is defective. Approximately 200 volts D.C. should be used when making this test.

An open output condenser or an open or shorted choke will cause weak and distorted reproduction. A defective filter condenser is indicated by excessively hot plates, possibly showing color, in Radiotron UX-280.

PART III—ELECTRICAL TESTS

[1] VOLTAGE READINGS

Voltage readings of the No. 311 set may best be checked at individual tube sockets with a Weston Model 537, Type 2, test set or others giving similar readings. The following readings taken at the sockets are correct when connected to a 120-volt A.C. line. There is no voltage between the detector heater and cathode in this receiver.

[2] VOLTAGE SUPPLY SYSTEM

It is well to understand the various voltage supply systems incorporated as they differ somewhat from the systems normally used. Generally speaking, the No. 311 receiver uses what is known as the series resistance method of obtaining its various voltages. This series arrangement makes it possible to use small filter condensers. Figure 11 shows the schematic circuit. The grid bias voltages are obtained by using the drop across a resistance connected in the plate return lead.

With this arrangement the correct grid or plate voltage is dependent on the Radiotrons being in good condition. A low emission tube will cause the voltage to rise on all tubes. It

Tube No.	*Filament to Grid Volts*	*Filament or Cathode to Plate Volts*	*Plate Current Milliamperes*	*Filament Voltage*
1	9	130	4.5	1.5
2	9	130	4.5	1.5
3	9	130	4.5	1.5
4	—	30	2.0	2.5
5	9	130	4.5	1.5
6	30	135	17.0	5.0

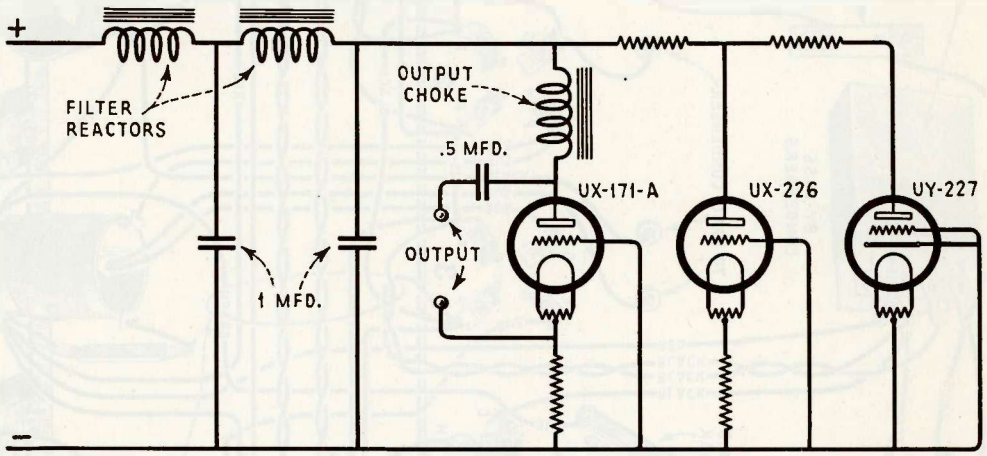


Figure 11—*Schematic circuit diagram of voltage supply system*

is important to note that when interchanging Radiotrons all tubes should be in their respective sockets before turning "on" the current supply.

[3] CONTINUITY TESTS

The following tests will show complete continuity for the receiver assembly (Figure 12) and the Socket Power Unit (Figure 13). Disconnect the antenna and ground leads and the A.C. supply cord at its outlet.

A pair of headphones with at least 4½ volts in series or a voltmeter with sufficient voltage to give a full scale deflection when connected directly across the battery terminals should be used in making these tests. The receiver sockets, numbers and lugs used in these tests are shown in Figure 10. The S.P.U. terminals are shown in Figure 13.

PART IV—MAKING REPLACEMENTS

The various assemblies and parts of the No. 311 receiver are easy of access and replacements can be made quickly.

[1] REPLACING VOLUME CONTROL

The following procedure should be used when replacing the volume control.

(a) Remove the eight screws that hold the receiver assembly and S.P.U. to the bottom of the cabinet.

(b) Remove the metal lid and release the screw holding the ground lead to the back of the cabinet.

(c) Remove the three control knobs. All the knobs are of the push type and can be removed by simply pulling off.

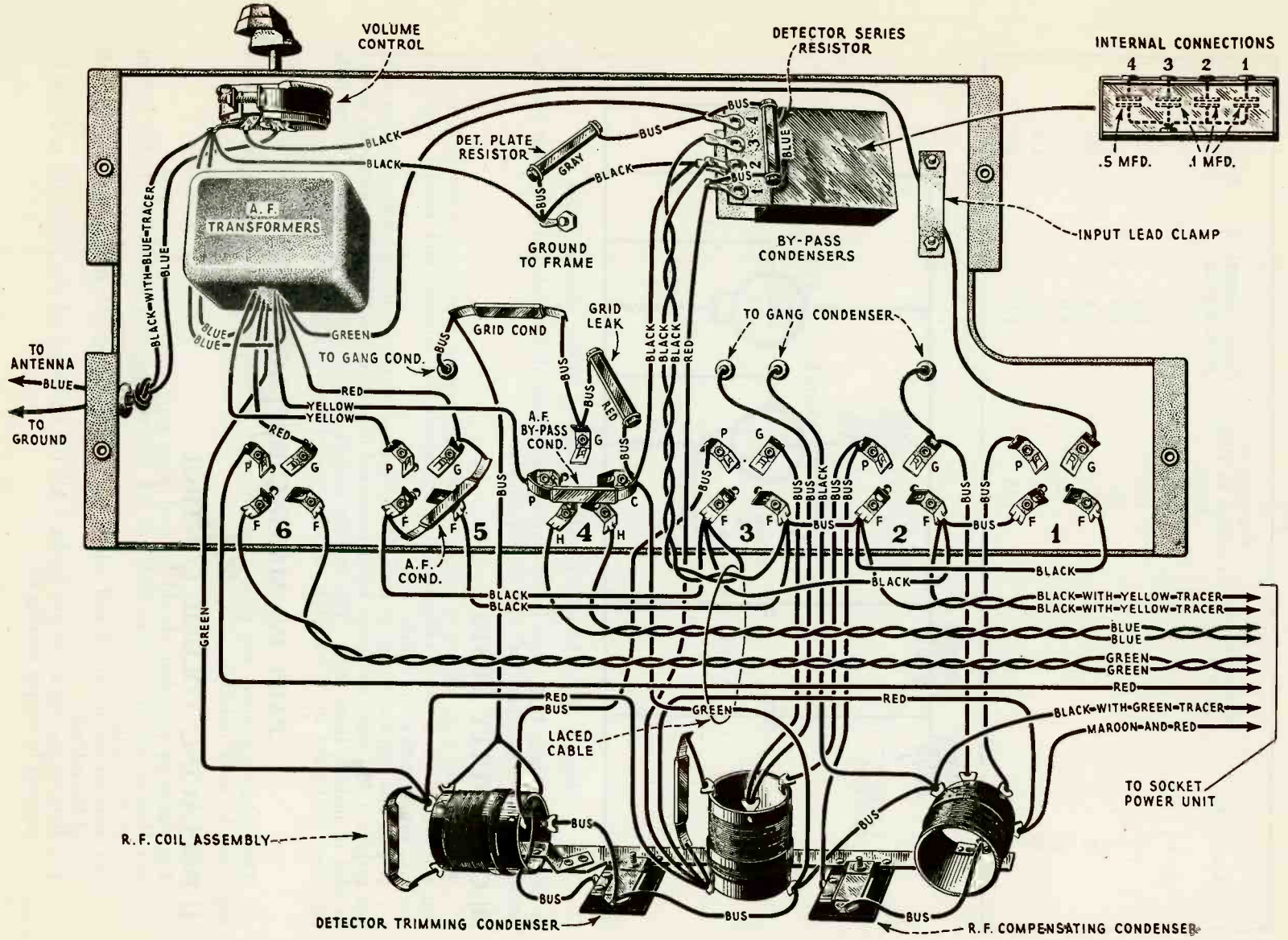


Figure 12—Wiring diagram of receiver assembly—grid leak in some models is connected from grid of socket No. 4 to ground connection of frame instead of as shown

RECEIVER ASSEMBLY AND S. P. U. CONTINUITY TESTS

Remove All Radiotrons and Disconnect A. C. Input Plug

Circuit	*Terminals*	*Correct Effect*	*Incorrect Effect Caused by*
Grid	Antenna to ground	Closed	Open volume control
	Antenna to G1	Closed	Open volume control or contact arm
	G2 to Gnd.	Closed	Open secondary of 1st R.F. transformer
	G3 to Gnd.	Closed	Open secondary of 2d R.F. transformer
	Stator condenser No. 3 to Gnd.	Closed	Open secondary of 3d R.F. transformer
	G4 to Gnd.	Closed (Very Weak)	Open grid leak or if loud, shorted grid condenser
	G5 to Gnd.	Closed	Open secondary of 1st A.F. transformer
	G6 to Gnd.	Closed	Open secondary of 2d A.F. transformer
Plate	P1 to P6	Closed	Open primary of 1st R.F. transformer, 1,600 ohm resistor or output choke
	P2 to P6	Closed	Open primary of 2d R.F. transformer, concentrated primary coil, 1600 ohm resistor or output choke
	P3 to P6	Closed	Open primary of 3d R.F. concentrated primary coil, 1600 ohm resistor or output choke
	P4 to P6	Closed	Open primary of 1st A.F. transformer, 30,000 ohms resistor or output choke
	P4 to Ground	Closed	Open primary of 1st A.F. transformer or 15,000 ohm plate resistor
	P5 to P6	Closed	Open primary of 2d A.F. transformer, 1600 ohm resistor or output choke
	P6 to either UX-280 filament contact	Closed	Open output choke, filter reactor UX-280 filament winding
Filament	Across filament contacts of sockets Nos. 1, 2, 3 and 5*	Closed	Open UX-226 filament winding of power transformer and center tapped resistor or wiring
	Across heater contacts of socket No. 4*	Closed	Open UY-227 heater winding of power transformer and center tapped resistor or wiring
	Across filament contacts of socket No. 6*	Closed	Open UX-171A filament winding of power transformer and center tapped resistor or wiring

* In making these tests if the filaments light, the center tapped resistances should be checked by releasing all connections to them. An open center tapped resistor is generally indicated by excessive hum.

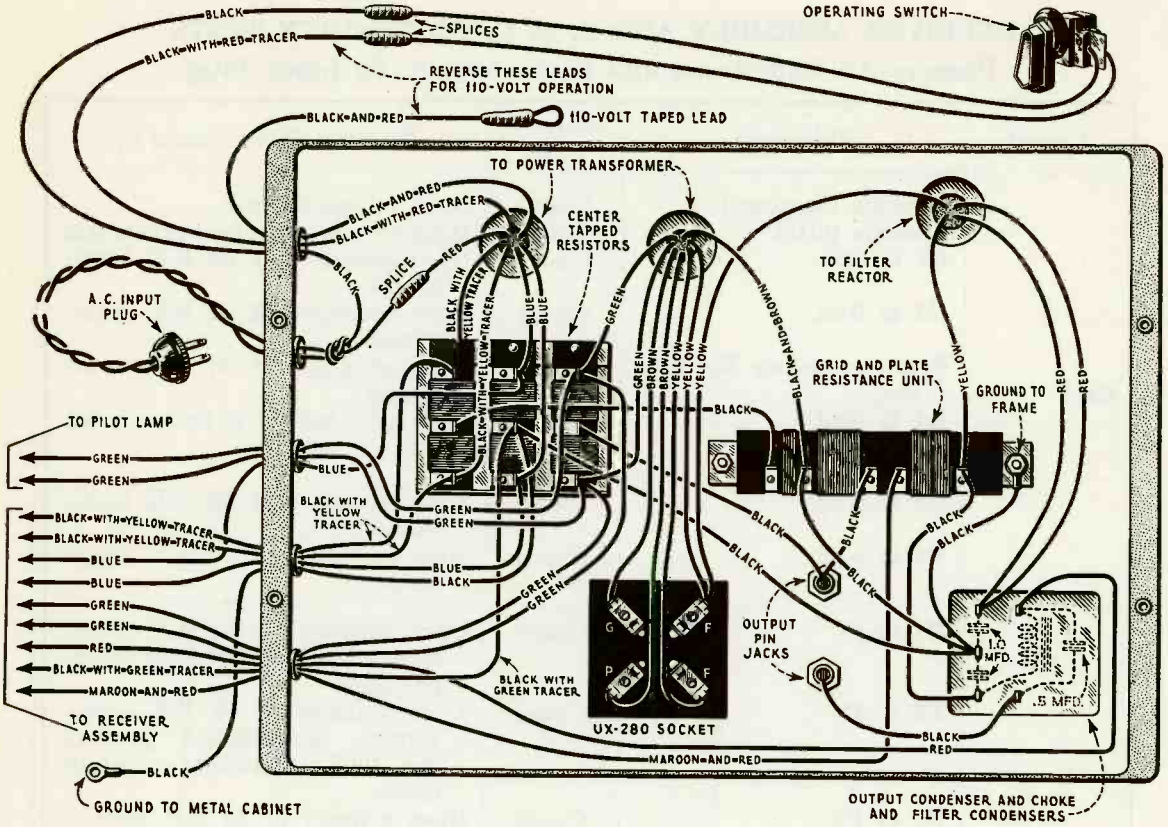


Figure 13—Wiring diagram of socket power unit

RECEIVER ASSEMBLY AND S.P.U. CONTINUITY TESTS—Con'd

Circuit	*Terminals*	*Correct Effect*	*Incorrect Effect Caused by*
	Across UX-280 filament contacts	Closed	Open UX-280 filament winding
	Across A.C. input plug with operating switch "On"	Closed	Open primary of power transformer
S.P.U.	G to P of UX-280 socket	Closed	Open high voltage winding of power transformer
	Either F5 to Ground	Closed	Open 440-ohm bias resistance
	Either F6 to Ground	Closed	Open 1900-ohm bias resistance
	P6 to one output pin terminal (next to rear of cabinet)	Open	Shorted .5 mfd. output condenser

(d) Remove the collar that holds the switch to the front of the cabinet. The switch should now be pulled clear of the cabinet.
(e) Pull the input A.C. cord through the large hole in the bottom of the cabinet and let it hang over the cabinet side so that it will be clear when the receiver assembly and S.P.U. are removed. Pull the antenna and ground leads clear.
(f) Grasping the receiver assembly by the tuning condenser assembly and the S.P.U. by the power transformer or filter reactor, lift the two assemblies clear of the cabinet. The S.P.U. can be lifted straight up, but the receiver assembly must first be pulled back slightly so the volume control and tuning control clear the front of the cabinet. Place the two assemblies on a suitable support for work.
(g) Unsolder the leads to the volume control.
(h) Remove the two screws that hold the volume control to the metal chassis. It may now be removed and the new one fastened in place. The connections should be soldered to the new volume control. These connections are shown in Figure 12.
(i) The receiver is now reassembled in the reverse manner of that already given.

[2] REPLACING RADIO FREQUENCY COILS

The three radio frequency transformers together with small fixed condensers across the concentrated primary coils and R.F. compensating and detector trimming condensers are mounted on one strip and must be replaced as a unit. The following procedure is used:

(a) Remove the chassis assembly from the cabinet as described in Part IV, Section 1.
(b) Unsolder all connections to the three transformers.
(c) Remove the three screws that hold the mounting strip to the metal chassis. The entire assembly can now be removed. The new assembly is placed in the position occupied by the old one.
(d) Replace the screws that hold the mounting strip to the metal chassis.
(e) Replace and resolder all leads to the three transformers. These connections are shown in Figure 12. When making this replacement be careful not to disturb the two condensers connected across the concentrated coils. Placing these condensers closer to the coils than their normal position will affect the inductance of the coil with a resulting decrease of sensitivity.
(f) Return chassis assembly to cabinet and replace all screws and knobs. Adjust the compensating condenser to the correct position as indicated in Part II, Section 10. Also adjust the detector trimming condenser as described in Part II, Section 5.

[3] REPLACING RADIOTRON GANG SOCKETS

The Radiotron sockets of the No. 311 receiver are of the gang variety, using one detector socket; two A.F. socket strips, and one three-gang socket strip for the radio frequency amplifying tubes. There is a small Bakelite shield placed over all sockets. This shield is supplied separately and does not come with the socket. The sockets are riveted to the metal chassis. To replace them, drill out the old rivets and use screws, nuts and lock washers for securing the new sockets. A step by step procedure follows:

(a) Remove chassis assembly from cabinet as described in Part IV, Section 1.
(b) Remove all leads to the terminals of the sockets.
(c) Drill out the rivets holding the sockets to the metal chassis frame. In some cases it may be necessary to loosen the R.F. transformer assembly in order to slip the socket strips out.
(d) The socket assembly is now removed and the new one placed in the position occupied by the old one.
(e) Fasten new socket in place by using small round head machine screws, nuts and lock washers in place of the rivets previously removed.
(f) Replace connections as indicated in Figure 12 for the correct socket connections.
(g) Return chassis to cabinet.

[4] REPLACING MAIN TUNING CONDENSERS AND DRIVE

The main tuning condensers and the driving mechanism are replaced as one complete unit. The step by step procedure follows:

(a) Remove chassis assembly from housing as described in Part IV, Section 1.
(b) Unsolder four connections to condensers.
(c) Remove three screws, nuts, lock washers and insulating strip on under side of chassis that holds the assembly to the frame.
(d) The assembly may now be removed and the new assembly placed in the position occupied by the old one. Be sure and connect the ground wire previously connected under the nut and washer to one screw.
(e) Replace the three screws, nuts and lock washers and resolder the leads.
(f) Replace chassis assembly in cabinet.

[5] REPLACING BY-PASS CONDENSER

This condenser, located on the under side of the chassis frame is held in place by four metal tabs that are a part of the condenser case and are bent over on the upper side of the

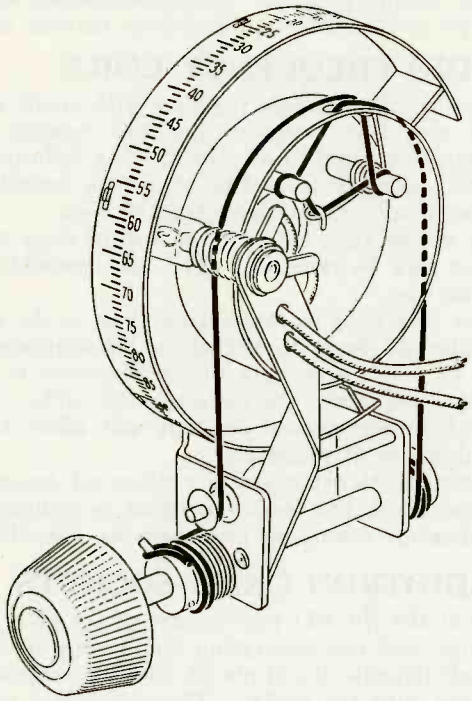


Figure 14—Gang tuning condenser drive mechanism and cable

metal chassis. A step by step procedure for making this replacement follows:
(a) Remove chassis from cabinet as described in Part IV, Section 1.
(b) Remove tuning condenser assembly from chassis as described in Part IV, Section 4.
(c) Unsolder the leads and resistor connected to the defective condenser.
(d) The four tabs holding the condenser to the chassis may now be bent up with a screw-driver and the old condenser replaced by the new one. Insert the tabs in the holes and bend them over on the upper side of the chassis assembly. Resolder the leads and resistors to their correct terminals. The connections are shown in Figure 12.
(e) Replace the tuning condenser assembly as described in Part IV, Section 4.
(f) Return chassis assembly to cabinet in reverse order of that used to remove it.

[6] REPLACING AUDIO FREQUENCY TRANSFORMERS

The audio transformers are built together in one unit. In making a replacement the following procedure should be used:

(a) Remove chassis from cabinet as described in Part IV, Section 1.
(b) Unsolder all leads to the audio transformers.
(c) Use a screw-driver to turn up the tabs that hold the transformer assembly to the chassis frame and remove it.
(d) Place the new transformer in the position occupied by the old one, bend over the tabs and resolder all connections. The correct connections are shown in **Figure 12.**
(e) Replace chassis in cabinet in the reverse order of that used to remove it.

[7] REPLACING CONDENSER DRIVE CABLE

The condenser drive cable is of rugged fishline and should give good service. If replacement becomes necessary proceed as follows:

(a) Remove the chassis from the cabinet as described in Part IV, Section 1. Place chassis on table with controls to the front.
(b) Remove the old cable from large drum and grooved drums completely.
(c) By referring to Figure 14 the new cable may be placed in the position occupied by the old one.
(d) Re-assemble the receiver in the reverse manner of that used to disassemble it.

[8] REPLACING TUNING DIAL

After considerable use a tuning dial may become dirty or illegible and a new scale desired. A step by step procedure for making replacement follows:

(a) Open lid of cabinet.
(b) Turn dial so that the small clamp that holds the dial in place is on top.
(c) Remove the clamp and pull the dial clear.
(d) Replace old dial with new one and clamp in place.
(e) Close lid of cabinet.

[9] REPLACING FILTER CONDENSER, OUTPUT CHOKE AND CONDENSER ASSEMBLY

The filter condensers, together with the output choke and condenser, are all contained in one metal container and must be replaced as a unit. The replacement procedure follows:

(a) Remove the receiver assembly and S.P.U. as described in Part IV, Section 1.
(b) Unsolder the connections to the filter condenser unit.
(c) Turn up the tabs that hold this unit to the S.P.U. base with a screw-driver. The entire assembly may now be removed and the new one placed in the position occupied by the old one.
(d) Clamp the assembly in place by turning the tabs over on the under side of the base. Solder the connections as indicated in Figure 13.
(e) Return the S.P.U. to the cabinet and re-assemble in the reverse order of that used to remove it.

[10] REPLACING EITHER POWER TRANSFORMER OR FILTER REACTOR

The power transformer and the filter reactor are each encased in a metal container. Either unit may be replaced in the following manner:

(a) Remove receiver assembly and S.P.U. from cabinet as described in Part IV, Section 1.
(b) Unsolder the leads of the unit being replaced.
(c) Bend up the tabs holding the unit to the base. It may be necessary to remove the resistance unit in order to bend all the tabs. The particular assembly being replaced may now be removed and the new assembly placed in the position occupied by the old one.
(d) The tabs on the new assembly should be bent so as to properly fasten the unit to the S.P.U. base.
(e) Connect all the leads from the assembly to the points of connection as in Figure 13 which should be followed exactly when any S.P.U. parts are replaced.
(f) Return to cabinet in the reverse order, and connect to receiver assembly.

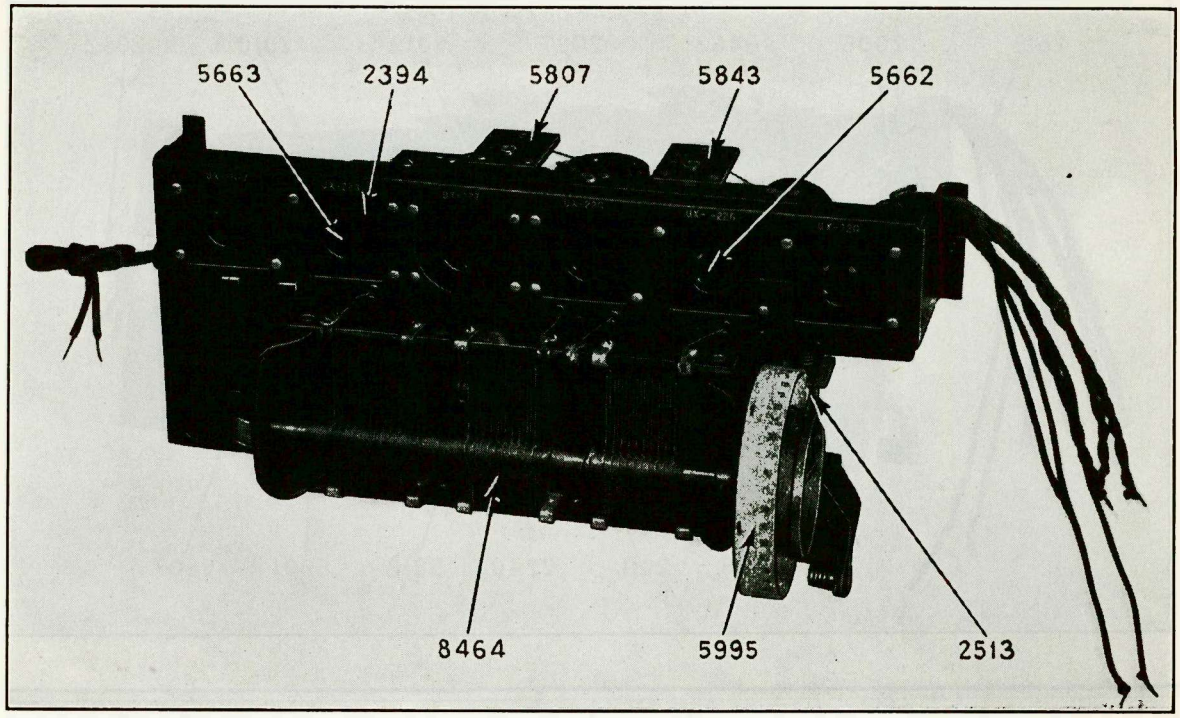
SERVICE DATA CHART

Before using the following Service Data Chart, when experiencing no signals, weak signals, poor quality, noisy or intermittent reception, howling and fading, first look for defective tubes, or a poor antenna system. If imperfect operation is not due to these causes the "Service Data Chart" should be consulted for further detailed causes. Reference to Part No. and Section No. in the "Service Notes" is also noted for further details.

Indication	*Cause*	*Remedy*
No signals	Defective operating switch	Repair or replace switch
	Loose volume control arm	Tighten volume control arm, P. II, S. 4
	Defective R.F. transformer	Replace R.F. transformer assembly, P. IV, S. 2
	Defective A.F. transformer	Replace A.F. transformer assembly, P. IV, S. 6
	Defective By-pass condenser	Replace By-pass condenser, P. IV, S. 5
	Defective socket power unit	Check socket power unit by means of continuity test and make any repairs or replacements necessary, P. III, S. 3
Weak Signals	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 10
	Defective R.F. transformer	Replace R.F. transformer assembly, P. IV, S. 2
	Defective A.F. transformer	Replace A.F. transformer assembly, P. IV, S. 6
	Dirty prongs of Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Defective By-pass condenser	Replace defective By-pass condenser, P. IV, S. 5
	Defective main tuning condensers	Replace defective tuning condensers, P. IV, S. 4
	Low voltages from socket power unit	Check socket power unit voltages with high resistance D.C. voltmeter and A.C. voltmeter, P. III, S. 1
	Defective socket power unit	Check socket power unit by means of continuity test and make any repairs or replacements necessary, P. III, S. 3
Poor Quality	Defective A.F. transformer	Replace A.F. transformer assembly, P. IV, S. 6
	Defective By-pass condenser	Replace defective By-pass condenser, P. IV, S. 5
	Dirty prongs on Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Defective output condenser or choke	Replace output condenser and choke, P. IV, S. 8
Howling	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 10
	Defect in audio system	Check and repair any defect, P. III, S. 3
	Open grid circuit in any stage	Check circuit and repair defect
	Receiver in oscillation	Correct cause of oscillation, P. II, S. 9
Excessive Hum	Defective center tapped resistance unit	Replace defective resistance unit
	Socket plug position	Reverse socket plug, P. I, S. 4
	Line voltage low	Reconnect transformer for low line voltage, P. I, S. 5
	Defective filter condenser	Replace defective condenser
Radiotrons fail to light	Operating switch not "On"	Turn operating switch "On"
	Defective operating switch	Replace operating switch
	Defective input A.C. cord	Repair or replace A.C. input cord
	Defective power transformer	Replace power transformer, P. IV, S. 10
	No A.C. line voltage	Turn A.C. line voltage "On"

PART V

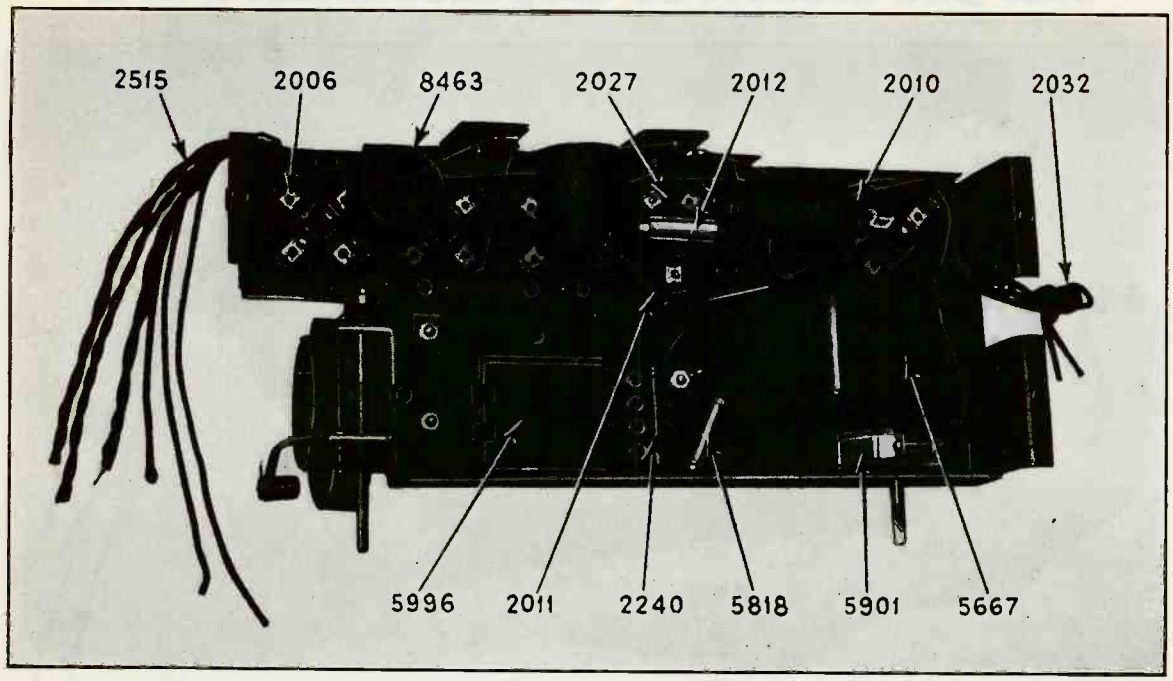
No. 311 Receiver Replacement Parts



No.	Description	*Price
	RECEIVER ASSEMBLIES	
2006	Radiotron socket contact—Package of 10	$0.50
2010	Condenser—Fixed condenser 160 mmfd. connected across concentrated coil and secondary of 1st audio transformer and used as grid condenser	.50
2011	Grid leak—4 Megohm—Carbon type	.70
2012	Condenser—Fixed condenser .0012 mfd. connected to primary of 1st audio transformer	.55
2027	Radiotron socket—UY-227 type	.60
2032	Antenna and ground leads—5 feet long—One set	.50
2240	Resistor—Series resistor for detector plate supply—30,000 ohms—Carbon type	$0.70
2349	Knob—Station selector—Push-on type with holding spring to fit ¼" shaft	.60
2394	Shield—Insulating shield (black) for UX Radiotron socket	.50
2513	Cord—Gang condenser drive cord	.50
2514	Knob—Volume control or rotary operating switch knob—Push-on pendant type with holding spring—To fit ¼" shaft	.50
2515	Cable—Laced wiring cable from receiver chassis to S. P. U.	1.50

* These prices are subject to change at our option without notice.

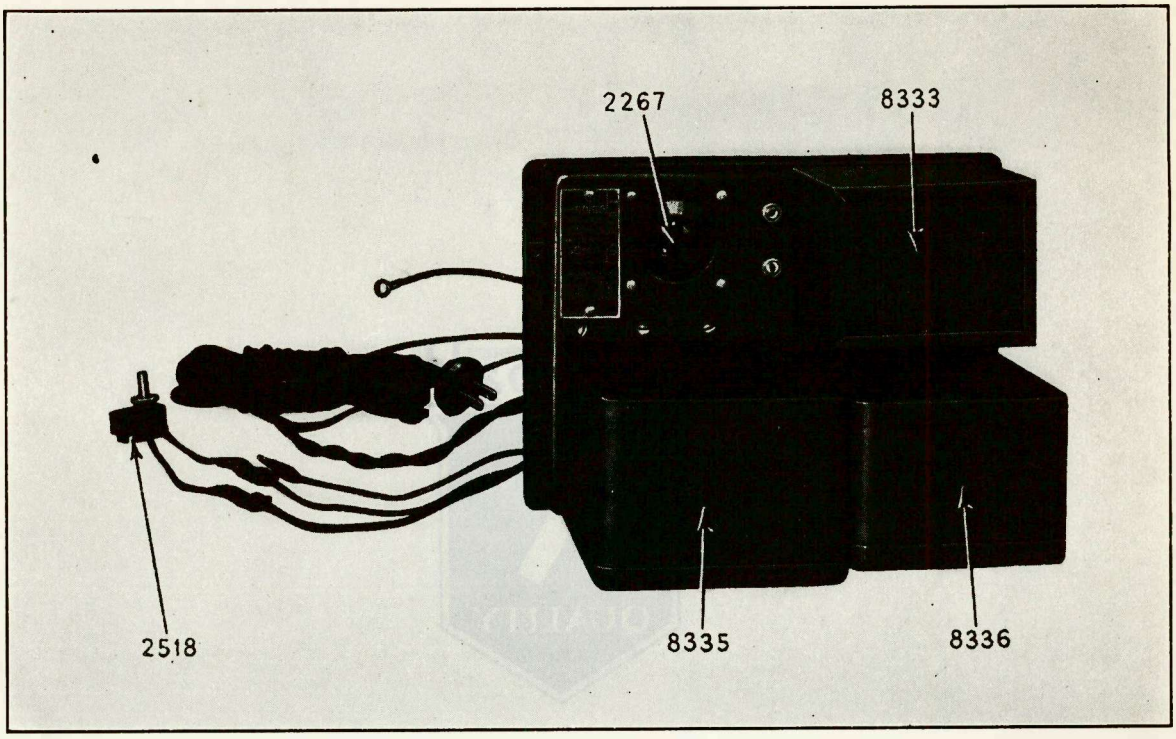
No. 311 Receiver Replacement Parts



No.	Description	*Price
	RECEIVER ASSEMBLIES—Continued	
5662	Sockets—3-Gang UX Radiotron sockets	$0.75
5663	Sockets—2-Gang UX Radiotron sockets	.55
5667	Transformers—2-Audio transformers—1st and 2d stage—In metal container	6.75
5807	Condenser—Detector trimming condenser	1.20
5818	Resistor—14300 ohms—Detector plate supply resistor	.90
5843	Condenser—R. F. compensating condenser	1.20
5901	Volume control—2000 ohms—¼" shaft—For push-on type knob	1.95
5995	Scale—Translucent dial scale with spring clamp—Package of 5	$1.80
5996	Condenser—Tapped—Comprising one ½ and three .1 mfd. condensers—Has one terminal board containing 1 terminal and a second terminal board containing 4 terminals	3.00
8463	R. F. Coil Assembly—Comprising 3 coils, 2 fixed condensers, 2 concentrated coils and 2 adjustable condensers mounted on a metal strip	5.40
8464	Condensers—3-Gang tuning condensers with drive, cord, pilot lamp socket and bracket —Less scale, scale clamp and lamp	11.25

* These prices are subject to change at our option without notice.

No. 311 Receiver Replacement Parts



No.	Description	*Price
	S. P. U. ASSEMBLIES	
2242	Resistance Unit—3940-ohm resistor tapped at 1600, 1900 and 440 ohms—Has 2 mounting brackets and 5 soldering terminals—Plate and grid supply (Not illustrated) . .	$0.80
2243	Resistance Unit—3 Resistance units mid-tapped—Mounted on S. P. U. base under power transformer (Not illustrated) . .	1.25
2267	Socket—Single UX Radiotron socket without protective shield	.50
2518	Switch—Rotary operating switch with two 8" leads	$1.10
8333	Output choke and condenser and 2 filter condensers in metal container	7.40
8335	Power Transformer—60-cycle, 110 volts—In metal container	12.90
8336	Choke Coil in metal container	10.05
8340	Power Transformer—25-cycle, 110 volts—In metal container (Not illustrated) . .	18.75

* These prices are subject to change at our option without notice.


GraybaR
QUALITY

RCA-62

GRAYBAR RADIO

340

Service Notes and Replacement Parts

Graybar

ELECTRIC COMPANY

SUCCESSOR TO *Western Electric* SUPPLY DEPARTMENT

CONTENTS

GRAYBAR 340

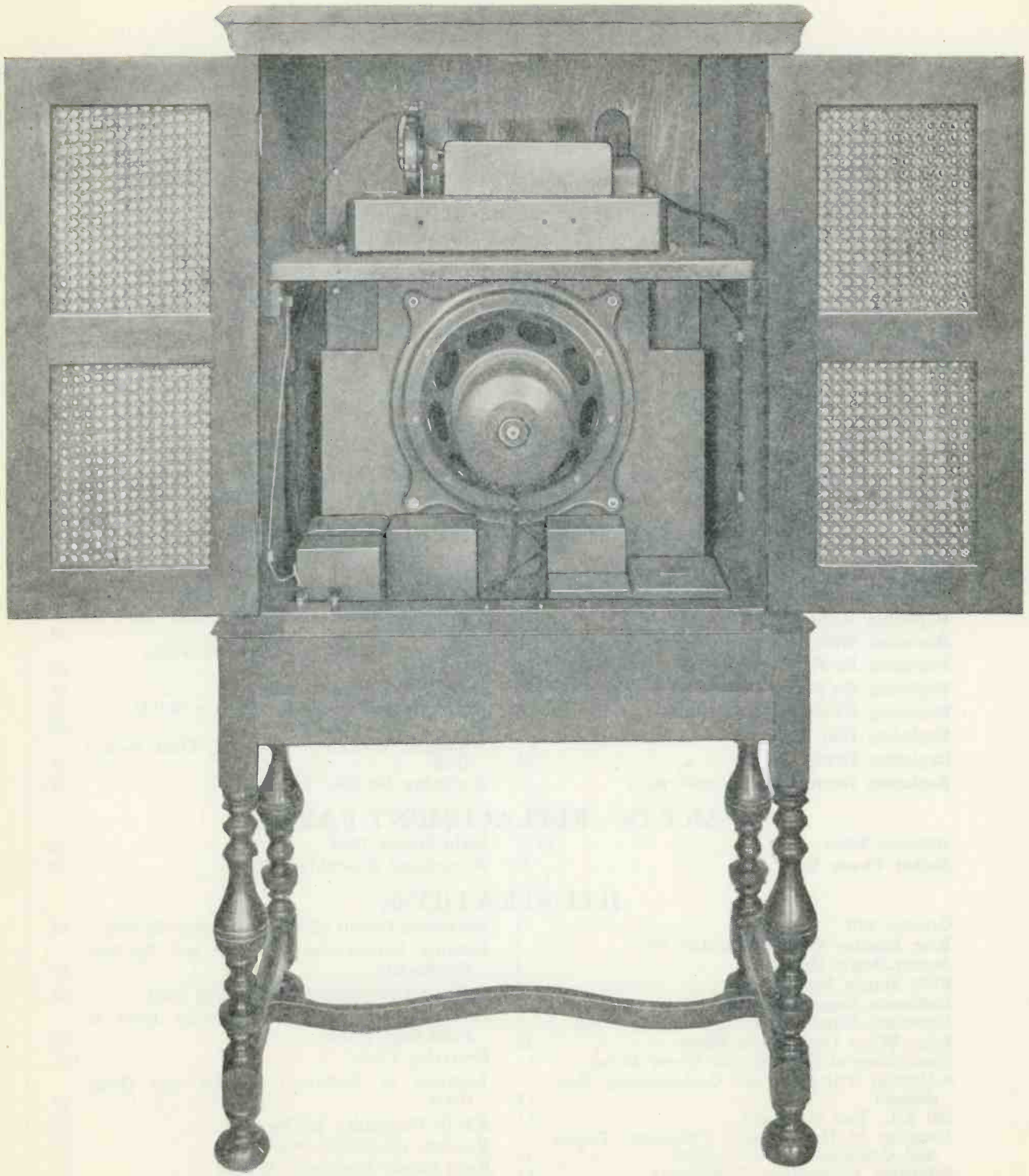


Figure 1—Rear interior view of Graybar 340, showing Receiver Chassis at top, Reproducer below shelf and S.P.U. at bottom left and Field Supply Unit at bottom right

GRAYBAR 340

(105-125 Volts. 50-60 Cycle A. C.)

SERVICE NOTES

INTRODUCTION

Graybar 340 is an eight-tube socket powered radio receiver employing seven UY-227 Radiotrons and one UX-171A Radiotron. One Radiotron UX-280 is used in a socket power unit for supplying all grid and plate voltages. A dry disc type rectifier furnishes direct current of the correct voltage to the field of the reproducer unit. Graybar 340 is fundamentally a console cabinet model of Graybar 330, utilizing a new type dynamic reproducer and having such circuit changes as are necessary for use with a speaker of this type. Figure 1 illustrates a rear view showing the principal parts. Figure 2 illustrates the socket power unit and Figure 3 shows the field supply unit.

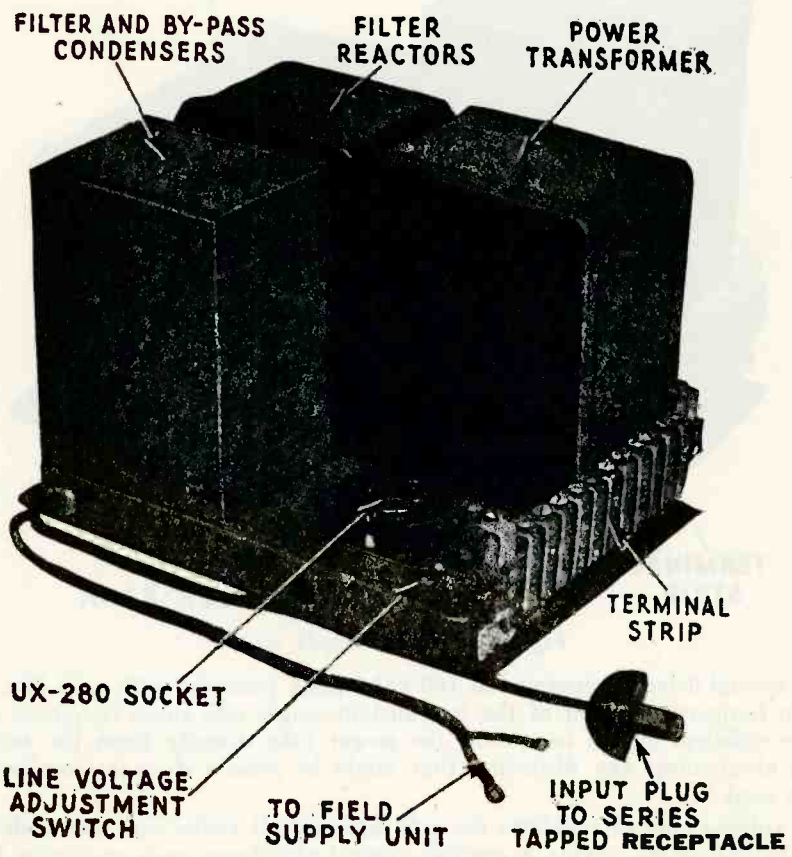


Figure 2—Socket power unit

Graybar 340 is designed to operate on alternating current of 105 to 125 volts, 50 to 60 cycles, such as is used for house lighting. Connection to D. C. lines or to A. C. lines of different rating may damage the receiver or the Radiotrons.

Graybar 340 is also made in models designed for 105-125 volts, 25-40 cycles A. C. operation. In this model the power transformer is different from that used in the 50-60 cycle models and the condenser shunted across the output of the disc rectifier has a capacity of 6 mfd. instead of 4 mfd., as used in the 50-60 cycle sets. All other parts are identical in both models and the Service Notes apply to each equally well.

The following circuit characteristics are incorporated in Graybar 340:

(a) As already stated, Graybar 340 uses seven Radiotrons UY-227 and one Radiotron UX-171A connected up in an eight-tube super-heterodyne circuit with a UX-280 in the S. P. U. for grid and plate supply.

(b) A new type dynamic reproducer unit is used, the field current for this unit being obtained from a dry disc type of rectifier, thus keeping the load on the Radiotron UX-280 at a minimum value.

(c) The circuit consists of one untuned coupling stage, one tuned R.F. stage, a tuned heterodyne detector, two intermediate R.F. stages, an oscillator, a second detector and a power amplifier.

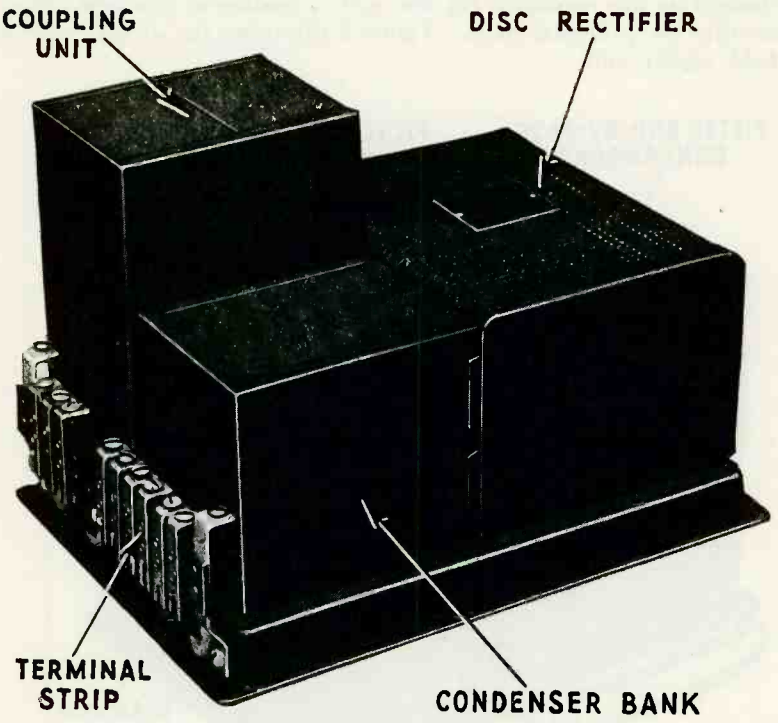


Figure 3—Field supply unit

(d) The second detector, operated at 160 volts plate potential with grid bias, changes the radio frequency current of the intermediate stages into audio frequency current. This gives sufficient output to operate the power tube directly from the second detector, thus eliminating any distortion that might be present if an intermediate audio stage were used.

(e) The volume control regulates the grid bias on all radio and intermediate frequency amplifying stages, giving a positive control of volume, even on nearby local stations, without distortion.

(f) By means of a baffle board mounted several inches from the front of the cabinet, all cabinet resonance effects are eliminated, thus making the output even and natural.

Figure 4 illustrates the sequence of the Radiotrons in the receiver, omitting Radiotron UX-280 in the socket power unit. From right to left, when facing the front of the receiver, the Radiotron sequence is as follows:

Radiotron No. 1 is an untuned stage of radio frequency amplification. It is coupled directly to the antenna and ground across a 2000-ohm resistance and functions as a coupling tube to the antenna system.

Radiotron No. 2 is a stage of tuned radio frequency amplification. It is tuned by means of the first of the gang condensers.

Radiotron No. 3 is the tuned heterodyne detector. It is tuned by the center of the gang condensers.

Radiotrons No. 4 and No. 5 are the first and second intermediate frequency stages. These stages are tuned to a frequency of 180 K.C., giving ample distance between the two peaks of the oscillator to eliminate any possibility of stations coming in at more than one point on the tuning dial.

Radiotron No. 6 is the oscillator. It is tuned by the third of the gang condensers. Two trimming condensers are provided at the rear of the receiver assembly for adjusting the oscillator circuit to keep the beat note at the correct frequency for the intermediate stages.

Radiotron No. 7 is the second detector. It operates at a plate potential of 160 volts with the proper grid bias and does not use a grid leak or condenser. Its output is sufficient to drive the power amplifier.

Radiotron No. 8 is the power amplifier. A choke and condenser arrangement couples this tube to the step-down transformer that matches the impedance of this output circuit to that of the cone coil of the reproducer unit. This arrangement gives a quality of reproduction not obtainable with the use of an output transformer alone.

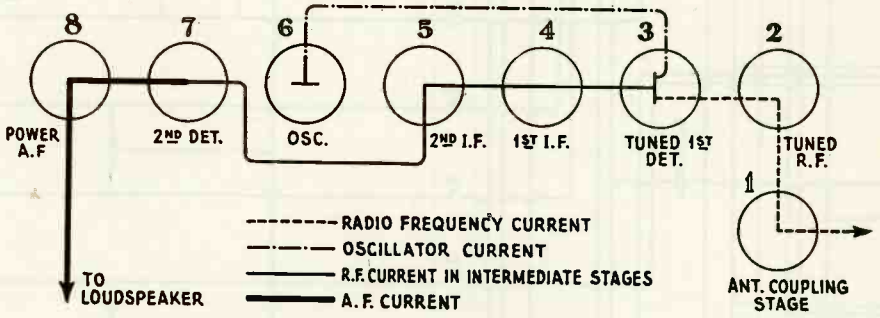


Figure 4—Radiotron sequence

These various principles incorporated in Graybar 340 and illustrated in the schematic circuit Figure 5, provides a radio receiver of advanced design, excellent performance and good tone quality.

PART I—INSTALLATION

[1] ANTENNA (Outdoor Type)

Due to the high sensitivity of Graybar 340 the antenna length need only be approximately 25 feet. It should be erected as high as possible and be removed from all obstructions. The lead-in should be a continuation of the antenna itself, thus avoiding all splices which might introduce additional resistance and, in time, corrode sufficiently to seriously affect reception. If it is absolutely necessary to splice the lead-in to the antenna the joint must be carefully soldered to insure a good electrical contact. Clean off all excess flux and tape the connection, to protect it from the oxidation effects of the atmosphere.

High-grade glass or porcelain insulator supports are required, and at no point should the antenna or lead-in wire come in contact with any part of the building. Bring the lead-in wire from the outside through a porcelain tube insulator to the inside of the house for connection to the receiver.

The antenna should not cross either over or under any electric light, traction, or power line and should be at right angles to these lines and other antennas. An outdoor antenna should be protected by means of an approved lightning arrester, in accordance with the requirements of the National Fire Underwriters' Code.

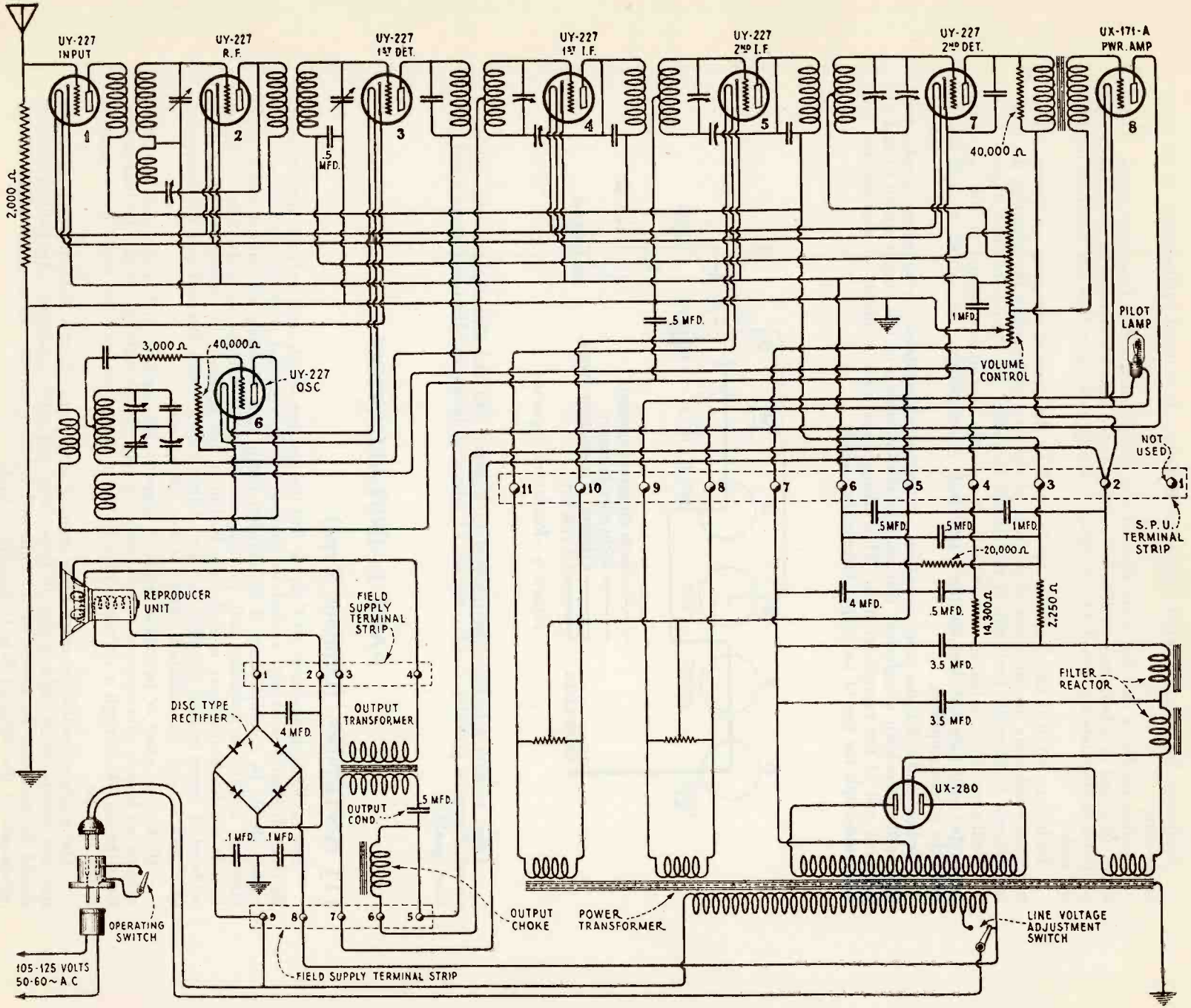


Figure 5—Schematic circuit diagram of Graybar 340

[2] ANTENNA (Indoor Type)

Where the installation of an outdoor antenna is not practical, satisfactory results may generally be obtained by using an indoor antenna of about 25 feet of insulated wire strung around the picture moulding or placed under a rug. In buildings where metal lathing is employed, satisfactory results are not always possible with this type of antenna. However, due to its sensitivity, Graybar 340 will generally give entirely satisfactory reception with an indoor antenna.

[3] GROUND

A good ground is quite as important as a good antenna. No specific recommendations can be given in this matter as conditions vary in different locations. Water and steam pipes usually make good grounds. Gas pipes usually make poor grounds and, as a rule, are to be avoided. If neither water nor steam pipes are available, a pipe or metal rod may be driven into the ground to a depth of several feet. The success of this type of ground depends upon the moisture present in the soil. The ground lead should be connected by means of an approved ground clamp to a section of pipe that has been scraped and thoroughly cleaned. The connection should be inspected from time to time to make certain that a clean and tight electrical contact exists between the clamp and pipe. The service man should experiment with various grounds, and employ the one giving the best results.

A spark will occur if the power supply is "on" when making the ground connection. This action is normal, being caused by the discharge of one of the .1 mfd. condensers connected across the power input to the disc rectifier. No current is consumed as no load is being drawn through the condenser.

[4] RADIOTRONS

A guide shield is provided on all the receiver Radiotron sockets to facilitate the insertion of the Radiotrons. The seven Radiotrons UY-227 are inserted in the five-contact sockets. The Radiotron UX-171A is placed in the four-contact socket in the receiver assembly, and the Radiotron UX-280 is placed in the socket power unit.

In placing Graybar 340 into operation, if no signals are heard when tuning to a station known to be broadcasting, examine the Radiotrons. Possibly one Radiotron has been damaged in transit. Interchanging with one or more of the same type known to be in operating condition will isolate the damaged one.

Socket No. 2 (Figure 4), the tuned R.F. stage, is the most critical for selection of the Radiotrons. Place in this socket the tube which gives the loudest signal and does not go into oscillation throughout the tuning range. If no tube is found that will not oscillate, a slight readjustment of the R.F. compensating condenser may be necessary, as described in Part II, Section 13.

Other stages somewhat critical are the oscillator and second detector, sockets No. 6 and No. 7, respectively. The remaining tubes should be interchanged until a tube is found for the oscillator that gives the loudest signal on a given station. The second detector Radiotron should be selected for its ability to handle large volume. Select the tube for this socket that will permit the volume control to be advanced and give the greatest output without overloading.

[5] LINE SWITCH

A two-way switch is provided in the S.P.U. for adjustment to line voltages. A shield over the terminal strip holds this switch in the 120-volt position. Unless it is definitely known that the line is always below 115 volts the switch should be left in its original position. It is a good plan to leave this switch at the 120-volt position on all lines unless unsatisfactory operation is experienced. If the switch is set at the 110-volt position on supply lines exceeding 115 volts the Radiotrons in the receiver will be damaged.

[6] KNOBS

Graybar 340 uses an improved type of push knob on the station selector and volume control shafts. This knob is removed by simply pulling it off the shaft, and replaced by pushing it on. Very little trouble should be experienced, as no setscrews or other parts that might give trouble are used.

When placing this knob on its shaft care must be exercised not to push it tight against the washer between the knob and cabinet, as then it will bind. Sometimes in handling new sets the knob will have become pushed against the washer and bind. The remedy is merely to pull the knob out until it does not bind.

[7] RECEIVING LOUD LOCAL STATIONS

If excess volume control adjustment is used on local stations the signal will apparently have two peaks on the tuning dial. A further advance of the volume control will decrease the volume rather than increase it. This is entirely normal, and is caused by tube overloading. The correct method of tuning Graybar 340 on local stations is to reduce the volume control to the position where the station will be received at only one position on the station selector dial, and then adjust the volume control for the desired volume.

On some stations when tuned in with excessive volume a howl may be experienced. The remedy is to reduce the volume control until the howl disappears.

This tuning procedure should be explained to the set owner when an installation is made.

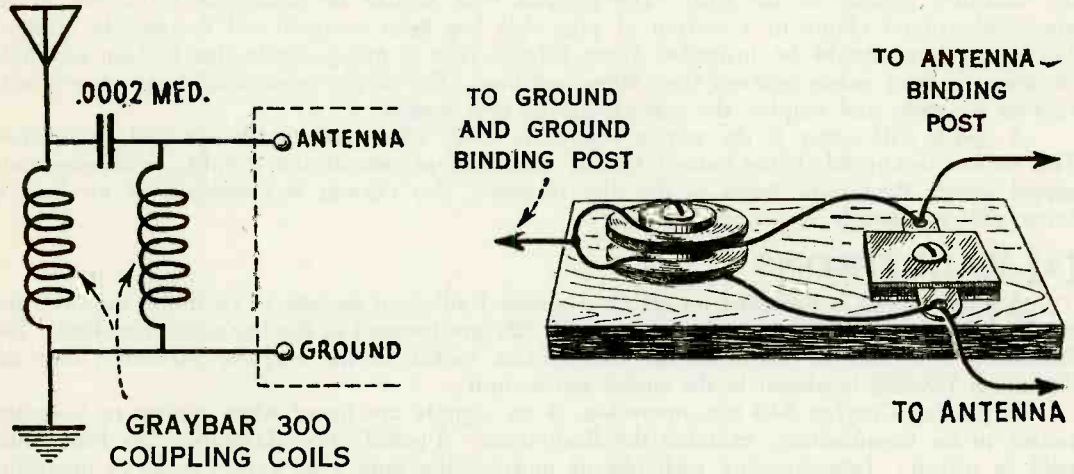


Figure 6—Long wave interference filter

[8] DISTORTION DUE TO LOUD SIGNALS

In some localities extremely close to powerful broadcasting stations, reproduction may be distorted when reducing volume to a point satisfactory to the listener. When installing a set, determine by a listening test whether this condition exists or not and apply the following remedy if the reproduction is distorted.

Procure a single-pole single-throw switch (any type will do) and connect it in series with the antenna lead of the receiver. The switch may be located either inside or outside the cabinet in any convenient position. Opening the switch will disconnect the antenna and allow satisfactory reception on signals that would otherwise be distorted. The switch should be closed for reception from other stations.

[9] PICK-UP FROM LONG WAVE HIGH POWER CODE STATIONS

Should Graybar 340 be installed very close to long wave, powerful code stations, it is possible that a certain amount of pick-up and interference from them will be experienced. Trouble of this kind may be eliminated in the following manner:

(a) Procure the following equipment:
Two Graybar 300 antenna coils (Stock No. 5658).
One .0002 Mfd. fixed condenser.

(b) Connect as shown in Figure 6.

(c) This apparatus may be placed inside of the cabinet of the receiver or made up in a separate unit and placed in any convenient location. It acts as a filter, allowing frequencies of the broadcast band only to reach the receiver.

{10} LOCATION OF RECEIVER IN ROOM

As with other musical instruments, the location of Graybar 340 in the room should be chosen with care. Various positions should be tried until the most desirable reproduction is obtained. If this position is outside the radius of the connection cord to the A.C. outlet, an extension cord can be used.

{11} SHIPPING BRACKET FOR REPRODUCER UNIT

Graybar 340 is shipped with a metal yoke and wooden support to hold the reproducer unit in place during shipment. This wooden block and the metal yoke holding it should be removed when placing receiver into operation as it may resonate at audible frequencies and affect the reproducing qualities of the set. The front flange of the reproducer offers ample support for the reproducer unit on all occasions except when shipping.

PART II—SERVICE DATA

{1} ANTENNA SYSTEM FAILURES

A grating noise may be caused by a poor lead-in connection to the antenna; or the antenna touching some metallic surface, such as the edge of a tin roof, drain pipe, etc. By disconnecting the antenna and ground leads the service man can soon determine whether the cause of complaint is within or external to the receiver and plan his service work accordingly.

{2} RADIOTRON SOCKETS

The sockets used in Graybar 340 are a six-gang UY socket assembly, a single UY socket, and two single UX sockets. One of the UX sockets is used in the socket power unit and is of a different design than that used in the receiver assembly.

The bakelite Radiotron guide shields used in the receiver assembly will prevent any possible shock from contact with high voltages in the socket when inserting the Radiotrons. The prongs of the tubes fit into this shield opening very snugly and require only a twist until the prongs find the correct holes into which they fit. This is especially helpful when inserting the five-prong tubes into their sockets.

{3} RADIOTRON PRONGS

Dirty Radiotron prongs may cause noisy operation or change the resistance of the filament circuits sufficiently to cause a hum in the loudspeaker. They should therefore be cleaned with fine sandpaper periodically to insure good contact. The use of emery cloth or steel wool is not recommended. Before re-inserting the Radiotrons in their sockets wipe the prongs and base carefully to make certain that all particles of sand are removed.

If a Radiotron will not fit into a socket without considerable pressure, look for excessive solder on one or more of the prongs. Excessive solder on the prongs may be removed with a file or knife.

{4} LOOSE VOLUME CONTROL

A loose volume control arm may cause noisy or intermittent operation. It should be bent slightly so that it makes firm contact against the resistance strip. To do this it is necessary to remove the chassis from the cabinet as described in Part III, Section 1. The volume control is then accessible. It can be released by removing the two screws that hold it to the metal frame.

{5} ADJUSTMENT FOR SLACK DRUM CONTROL

The main tuning condensers are controlled by a cable and drum arrangement giving a smoothly acting vernier movement that has no back lash.

After considerable wear or extreme changes of temperature the cable may become slack. To take up this slack open lid of cabinet and turn the cable adjusting screw with clamp until the cable is taut. This screw may become seated after several adjustments are made, thus allowing no further tightening of the cable. When this condition occurs it will be necessary to slip the cable a half turn on the grooved drum. To make this adjustment it is necessary to remove the chassis from the cabinet as described in Part III, Section 1. Remove the cable adjusting screw and clamp. This cable will then have approximately one inch slack. By removing the tapered pin holding the front grooved drum to its shaft and replacing it on the opposite side (180 degrees) the one inch slack in the cable can be taken up by using the new position of the pin for anchoring the cable. It will be noted that the tapered pin in the new position cannot be inserted as far as originally. However, it can be inserted far enough to lock the grooved drum to the control shaft and clear the metal housing. If the cable again is stretched to the maximum adjustment of the cable adjusting screw the tapered pin can be returned to its original position and an additional half turn slipped on the drum which will provide for taking up all slack. A sufficient number of grooves are provided on the drum for this purpose.

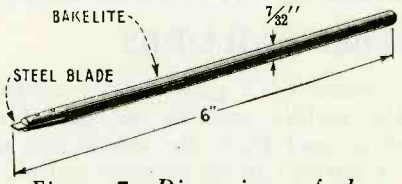


Figure 7—Dimensions of the non-metallic screw driver

[6] BROKEN CONDENSER DRIVE CABLE

A broken condenser drive cable can be replaced in the manner described in Part III, Section 7. However, if a new cable is not immediately available a temporary repair can be made in the following manner, provided the break in the cable is not in that section that passes over the small grooved drums.

Splice and solder the two ends together. Splicing consists of interweaving the strands, as with rope, and not just twisting the cable ends together as in an electrical wiring splice. Splicing gives greater strength and forms a smaller body on the cable. When soldering use plenty of flux and a small amount of solder. Heat sufficiently so that the solder adheres to all the strands of the cable. Placing the splice in an alcohol or bunsen flame affords sufficient heat and allows excess solder to drip away. This is but a temporary repair to be used only until a new cable can be procured.

[7] HUM

If a pronounced hum develops during operation check the following:

(a) Low emission Radiotron UX-280. A low emission rectifying tube will cause excessive hum and unsatisfactory operation.

(b) Defective center tapped resistance. A short or open of either of these resistances will cause a loud hum and imperfect operation of the set.

(c) Any open of the several grounding connections in the receiver or voltage supply resistances may cause a certain amount of hum. These defects will have a pronounced effect on the general operation of the receiver which will be more noticeable than the additional hum. Check by means of the continuity test given in Part II, Section 22.

(d) Use of Radiotron UX-171 instead of Radiotron UX-171A may cause an increase of hum. It is recommended that only Radiotron UX-171A be used as a power amplifier in Graybar 340.

(e) Defective disc rectifier or condenser across output of rectifier may cause excessive hum and faulty operation. A check of this condition can be made as described in Part II, Section 19.

(f) Antenna and ground leads reversed. Reversing these leads opens the condenser center ground connection in the field supply unit and causes hum.

A mechanical hum caused by vibration of loose laminations in the power transformer may be corrected by removing the power transformer from the S.P.U. as described in Part III, Section 14, and heating it in a slow oven. The open end should be kept up and the compound heated sufficiently to allow it to adhere to the laminations of the transformer. After heating, the transformer should be allowed to cool for at least 24 hours and then returned to the S.P.U.

[8] DISTORTION IN REPRODUCER UNIT

Distortion in the reproducer unit may be due to any of the following causes:

(a) Cone out of alignment. Refer to Part II, Section 21.

(b) Leads from cone coil broken away from side of cone. Make these leads fast with a little shellac.

(c) Loose grille, escutcheons or baffle board. Any loose part in the cabinet will cause a rattle. Tighten all loose parts.

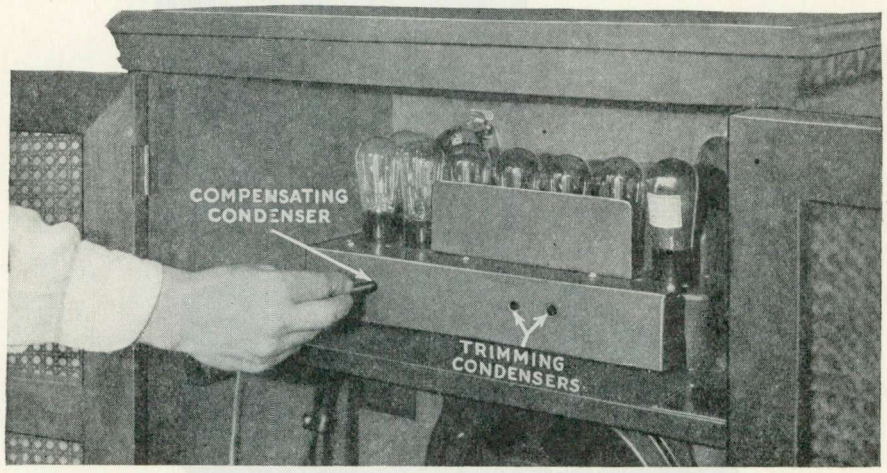


Figure 8—Method of adjusting trimming and compensating condensers

[9] LOW VOLUME AND WEAK SIGNALS

Low volume or weak signals may be caused by:

(a) Defective antenna system. A poor antenna and ground or one in a shielded locality may cause weak signals. The suggestions given in Part I, Sections 1, 2 and 3, should be followed if trouble of this kind is experienced.

(b) Defective Radiotrons. A defective Radiotron in any stage may cause weak signals. Before checking other causes it is a good plan to check all Radiotrons by interchanging them with ones of a similar type known to be in good operating condition.

(c) R.F. compensating condenser out of adjustment. If this condenser is badly out of adjustment it will have the effect of making the receiver very insensitive. To adjust correctly refer to Part II, Section 13.

(d) Oscillator trimming condensers out of adjustment. Should the oscillator trimming condensers be out of adjustment the receiver may be sensitive at certain portions of the tuning scale and very insensitive at other sections. Should these condensers be badly out of adjustment, only very loud local stations will be heard. The correct method for adjustment of these condensers is given in Part II, Section 12.

(e) Intermediate transformers not correctly tuned or matched. Should the tuning condensers connected across the secondaries of the intermediate transformers be out of adjustment, weak signals and poor tuning or, in some cases, no signals will result. Refer to Part II, Section 14, for the correct method of adjusting the I.F. transformers.

(f) Defective A.F. transformer or output condenser and choke. A defect in any of these parts will cause weak signals and abnormal operation. Check by means of the continuity test and make any replacement that is necessary.

(g) Low voltage from S.P.U. Check S.P.U. voltages at terminal strip with readings given in Part II, Section 17. Low voltages may be caused by a low emission rectifying tube or defective resistances in the S.P.U. or receiver. Check by means of continuity test.

(h) Open or short of various connections in receiver. Check by means of continuity tests and make any repair or replacement that is necessary.

Figure 9—180 K.C. Test Oscillator

[10] AUDIO HOWL

Audio howl may be caused by:

(a) Incorrect adjustment of R.F. compensating condenser. A compensating condenser adjusted to the verge of oscillation may cause a howl on nearby stations. Adjust as suggested in Part II, Section 13.

(b) Open A.F. condenser connections. An open of the A.F. by-pass condenser may cause a howl.

(c) Open large by-pass condenser connections. An open of the connections to the large by-pass condensers may cause a howl.

(d) Defective volume control resistance. Should there be an open or short in the volume control or in its adjacent resistances an audio howl may develop.

(e) Vibrating elements in receiver Radiotrons. A gradually developed howl may be due to the loudspeaker causing the receiver Radiotron elements to vibrate. To overcome this condition, interchange the Radiotrons in the receiver, especially the second detector.

(f) Poor ground. Install ground system as suggested in Part I, Section 3.

(g) Poorly soldered or corroded joints. Any high resistance joint throughout the set may cause a howl.

(h) Defective resistance in S.P.U. or the receiver assembly. An open resistance unit may cause howl. Under such conditions it is advisable to turn the set "off" until the trouble is found, otherwise excessive voltage rise may cause further damage.

(i) Neutralizing condensers in intermediate transformers out of adjustment. These condensers being out of adjustment might cause an I.F. stage to oscillate which will result in a howl when a station is tuned in, especially at loud volume. Adjust the neutralizing condensers as described in Part II, Section 14.

(j) Open of any of the several ground leads in the set. This may cause some of the circuits to go into oscillation and result in a howl when a station is tuned "in". Generally a loud hum will also be present. The several grounding leads in the Receiver Assembly and in the Socket Power Unit should be checked and any open or poorly soldered joint should be repaired.

[11] DISTORTED REPRODUCTION

Under normal conditions Graybar 340 will deliver a strong signal of excellent quality to the loudspeaker. The high sensitivity of the set makes it undesirable to operate the set at full volume when receiving from nearby broadcasting stations. If the loudspeaker production is poor, test the output from the receiver. A pair of phones may be used for this purpose. Poor quality or distortion may be due to any of the following causes:

(a) Defective Radiotrons. Though the receiver may be in operating condition a defective Radiotron in any stage will cause distortion. This is especially true of the second detector, audio stage and the rectifier tube.

(b) High or low plate and grid voltages from the Socket Power Unit or a defective resistor in the Receiver Assembly. In the Socket Power Unit distortion may be caused by a defective Radiotron UX-280 or resistance unit.

(c) Defective A.F. transformer. Check by means of continuity test and replace if necessary.

(d) Trimming condensers out of adjustment. Should the oscillator trimming condensers be out of adjustment the beat signal may not be exactly the frequency to which the intermediates are tuned. This will cause weak signals and distortion of those received. This condition may or may not be present throughout the tuning range of the receiver. Adjust as described in Part II, Section 12.

(e) Receiver oscillating. Should some circuit other than the oscillator be oscillating, distortion will be experienced when tuning in a station. This will be accompanied by a whistle or squeal when the carrier wave of the station is tuned in. To remedy trouble of this kind see Part II, Section 10.

(f) Intermediate transformers out of line or not properly matched. This will have the effect of giving distorted reproduction and reduce the sensitivity of the receiver to a marked degree. Line up the entire I.F. transformer assembly as described in Part II, Section 14.

[12] ADJUSTMENT OF OSCILLATOR TRIMMING CONDENSERS

Two trimming condensors are provided for adjusting the oscillator circuit so that the beat note will always be 180 K.C. throughout the tuning range of the receiver.

The most noticeable symptom of the oscillator trimming condensers being out of adjustment is insensitivity of the receiver in some sections or throughout the tuning range. To check the adjustment of the trimming condensers as a possible cause of any noticeable insensitivity in the receiver proceed in the following manner:

(a) Procure the following equipment:

A modulated oscillator giving signals at 1,400 and 600 Kilocycles. The test oscillator shown in Figure 9 is suitable for this purpose.

A long, thin, non-metallic screwdriver. Such a screwdriver is shown in Figure 7 with its dimensions.

A 0-10 milliammeter. Connect the milliammeter in series with the red lead that turns to the receiver assembly as it enters the braided cable and connecting to lug No. 2 of the S.P.U. terminal strip. This places the meter in series with the plate supply of the second detector.

(b) With the set in operation, place the oscillator in operation at 1,400 K.C. close to the antenna lead and tune the set by adjusting the station selector until a deflection caused by the external oscillator is obtained in the milliammeter. Adjust volume control so that deflection is not beyond scale of meter.

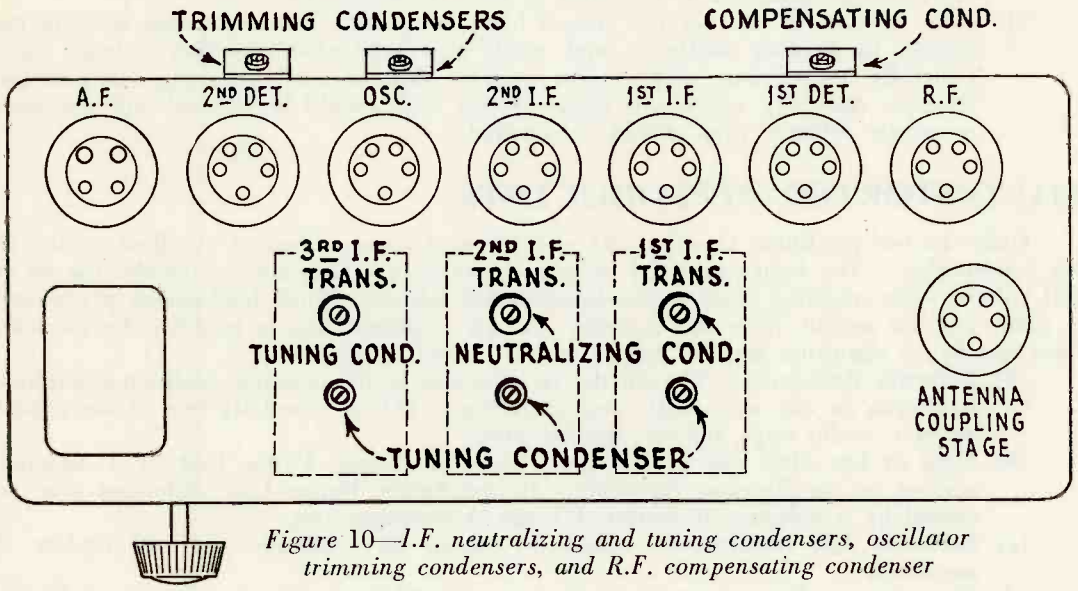


Figure 10—I.F. neutralizing and tuning condensers, oscillator trimming condensers, and R.F. compensating condenser

(c) Now adjust the oscillator trimming condenser on the right, facing rear of Graybar 340 (Figure 8) with the long, thin, non-metallic screwdriver until a maximum deflection is obtained in the milliammeter.

(d) Adjust oscillator for 600 K.C. Tune in the set with station selector and then adjust the trimming condenser to the left for maximum deflection of the milliammeter.

(e) Now readjust at 1,400 K.C. as indicated in (b) and (c).

With this adjustment the trimming condensers are correctly adjusted for maximum efficiency, that is, so adjusted that the beat signal will be 180 K.C. throughout the tuning range.

[13] ADJUSTMENT OF R. F. COMPENSATING CONDENSER

The radio frequency compensating condenser should not be touched unless it is definitely ascertained that no other failure exists as a possible cause of receiver insensitivity, which is the most noticeable indication of the need for adjusting the compensating condenser.

An oscillating condition of the receiver may be caused by improper adjustment of this condenser.

A step by step procedure for making proper adjustment follows:

(a) Procure a long, thin, non-metallic screwdriver (see Figure 7).

(b) Place receiver in operation in usual manner and tune in a weak station, preferably at the middle or upper wavelengths. If only a loud signal is available, disconnect the antenna.

(c) Locate the position of the compensating condenser (see Figure 8).

(d) With the volume control at the position of maximum setting adjust the screw of the condenser until the set goes into oscillation. This will cause a whistle whenever a station is tuned "in". Then turn the screw in the opposite direction until the set just goes out of oscillation and no howl is experienced when receiving loud local stations. Now tune in stations through the range of the receiver and note whether oscillations occur. If they do, it will be necessary to reduce the setting slightly. This is the correct adjustment for the radio frequency compensating condenser.

{14} ADJUSTMENT OF I. F. TRANSFORMERS

The three I.F. transformers used in Graybar 340 are of the air core, tuned primary and tuned secondary type. The primary condenser is of the fixed type, while the secondary is adjustable. Also in each assembly an adjustable condenser is provided for neutralizing the I.F. stage.

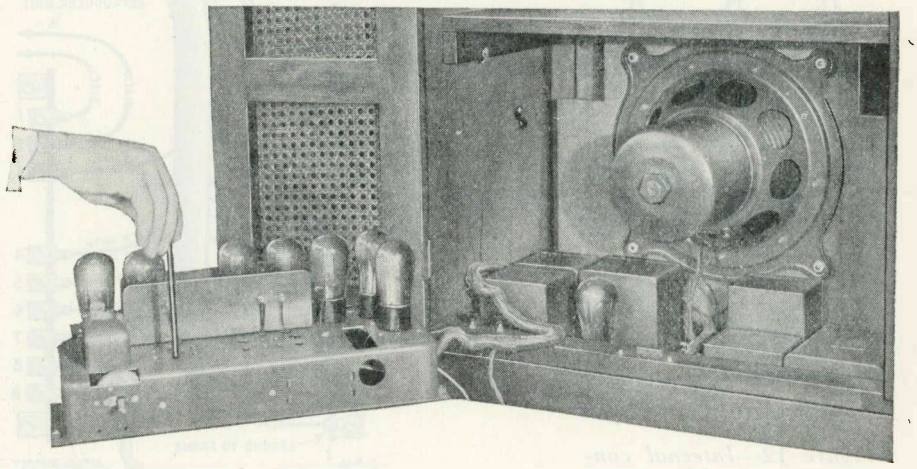


Figure 11—*Adjusting tuning condensers in I.F. stages*

Should a transformer burn out or its primary fixed condenser change in capacity it will be necessary to replace that particular transformer. The correct procedure for making such a replacement is contained in Part III, Section 10.

A simple method of locating a shorted transformer is to use a resistance bridge or the resistance measuring method. The approximate transformer primary D.C. resistance is 20 ohms; secondary 100 ohms. Due to the circuit arrangement it will only be possible to get a reading of 50 ohms on the secondary as the end connection goes to the neutralizing condenser and the reading must be made at the center tap connection. This test can be made from the underside of the chassis. (See wiring continuity diagram, Figure 20.)

After replacing a defective I.F. transformer or to make adjustments, the following tuning and neutralizing procedure must be followed for correctly lining up the various circuits. This is of utmost importance, as the entire performance of Graybar 340 is based on the correct functioning of its intermediate stages.

The following equipment is needed:

1. A Test Oscillator (Driver). See Figure 9.
2. A coupling lead for coupling the output of the Driver to the grid coil of the first detector.
3. A non-metallic screwdriver.
4. A "dummy" Radiotron UY-227—a normal tube with one heater prong removed.

This Driver, together with all the above items, can be ordered from the nearest Graybar House.

Preliminary steps to be taken before adjusting the tuning, neutralizing and trimming condensers:—

(a) Remove receiver assembly as described in Part III, Section 1.

(b) Remove main tuning condenser assembly as described in Part III, Section 4.

(c) Replace screw holding ground lead on under side of receiver assembly and make certain that ground lead makes good contact with the chassis frame.

(d) Connect all lugs to the S.P.U. and field supply terminal strips. Unsolder the red lead—connected to lug No. 2—that turns to the receiver assembly as it enters the braided cable and connect it to the clip from the Driver. The other lead with the spade terminal from the Driver should also be connected to terminal No. 2 on the S.P.U. terminal strip. These connections merely place the milliammeter in the Driver test set, in series with the plate supply to the second detector.

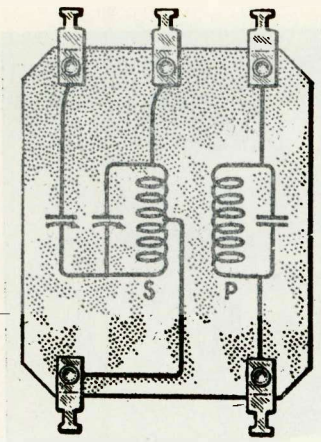


Figure 12—Internal connections of I.F. transformers

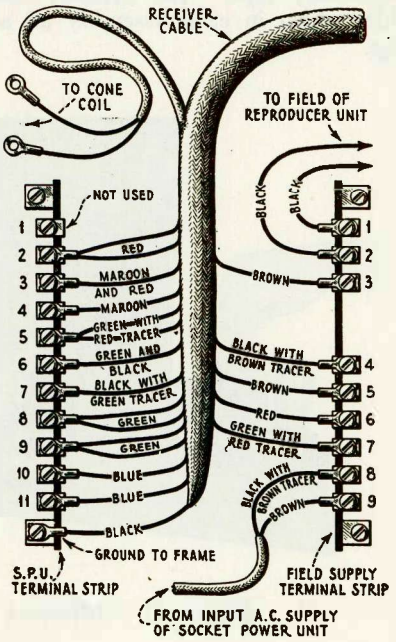


Figure 13—Receiver Cable connections to the S.P.U. and Field Supply terminal strips

(e) Now place the coupling coil from the Driver under the center coil of the R.F. and Oscillator assembly. This is the transformer between the tuned R.F. stage and the first detector. Replace all Radiotrons except the Oscillator and turn operating switch "ON".

(f) Place Driver in operation by switching "ON", and set switches and vernier condenser at 180 K.C. The note from the Driver will then be heard in the loudspeaker.

The I.F. transformer tuning condensers may now be adjusted as follows:

(a) Adjust the tuning condensers successively on the third, second and first I.F. transformers (Figures 10 and 11), for maximum signal in the loudspeaker and maximum reading on the milliammeter. If pointer should go off milliammeter scale reduce the volume control. After making one adjustment on the transformers it is a good plan to repeat, as slight changes may have occurred in tuning the other circuits. No signal, or a loud howl indicates neutralizing condensers are out of adjustment and they should be readjusted.

A maximum reading by adjusting all three tuning condensers indicates correct tuning of the intermediate stages.

It is now necessary to check the neutralization of the I.F. stages as follows:

(a) Leave all adjustments and apparatus in position on completion of tuning, but substitute a pair of phones for the loudspeaker by disconnecting leads to terminals 3 and 4 of the field supply unit and connect phone tips to these terminals. Place dummy Radiotron in first I.F. socket. Now adjust the neutralizing condenser on the first I.F. transformer for the position of minimum or no signal. This is easily identified and the adjustment is not critical.

(b) Replace the first I.F. tube and place "dummy" tube in second I.F. stage and adjust the neutralizing condenser on the second I.F. transformer for position of minimum or no signal as described in the preceding paragraph (a). Figure 12 illustrates the internal connections of the I.F. transformers. It will be noted that the two condensers on the third transformer are connected in parallel for tuning. This stage does not require neutralizing.

After the I.F. transformers are properly tuned and neutralized they should perform at their maximum efficiency. It is a good plan to check the adjustments of the two oscillator trimming condensers (See Figure 20) at this point. The correct method

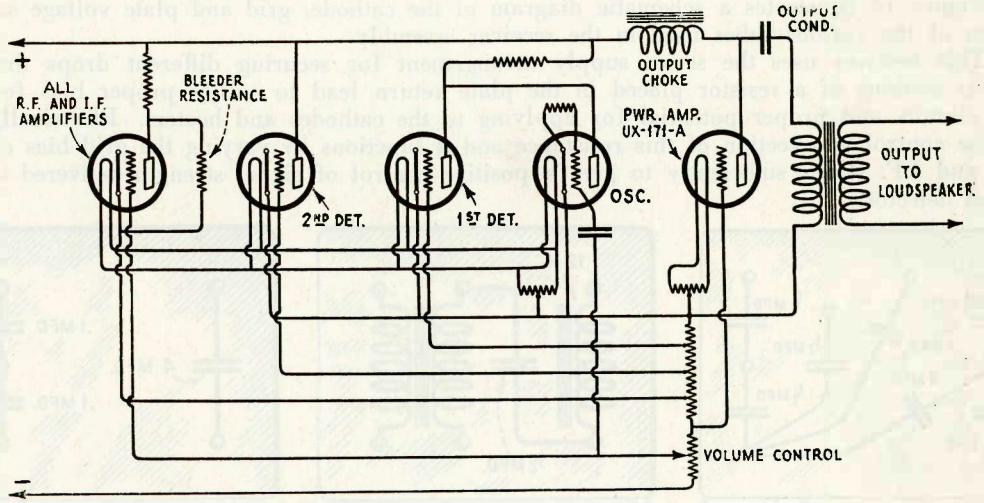


Figure 14—Schematic circuit diagram of the voltage supply system

for doing this is indicated in Part II, Section 12. The Driver illustrated in Figure 9 may be used for this adjustment. The procedure for adjusting the trimming condensers follows:

(a) Replace main tuning condensers and solder all connections in place. Place coupling lead of the oscillator near the receiver antenna lead.

(b) Set Driver switches and vernier condenser for 1,400 K.C.

(c) With all Radiotrons in place in the receiver tune for Driver signal with main tuning condensers. If reading goes off milliammeter scale reduce volume control.

(d) Adjust trimming condenser on right (facing rear of Graybar 340, Figure 8) for a maximum reading.

(e) Shift frequency of Driver to 600 K.C. and tune in with main tuning condensers. Adjust trimming condenser on left for maximum milliammeter reading. This is the condenser on the left of the other trimming condenser.

(f) After adjusting at 600 K.C., check again at 1,400 K.C., and make any readjustment necessary.

This check of the trimming condensers completes the adjustments to be made in Graybar 340 with the Driver. The receiver assembly should now be returned to the cabinet (Figure 13 shows the cable connections) and the Graybar 340 returned to normal operation.

Due to the increased sensitivity of the receiver it may be necessary to reduce the setting of the R.F. compensating condenser to prevent the tuned R.F. stage from oscillating. This can be ascertained by tuning in stations of different wavelengths and noting if the receiver oscillates at any point throughout its tuning range. (See Part II, Section 13.)

[15] OUTPUT CONDENSER AND CHOKE, OUTPUT TRANSFORMER AND FILTER CONDENSERS

The filter condensers are located in one container in the S.P.U. (See Figure 2) and their internal connections are shown in Figure 15. The output condenser and choke and output transformer comprising the coupling unit in the field supply, are located in another unit. The internal connections are shown in Figure 15A. The procedure for testing the choke or transformer windings is to "click test" for an open. To test the condensers they should be charged and then discharged by shorting their terminals with a screwdriver. A condenser that will not retain its charge is defective. Approximately 200 volts D.C. should be used when making this test.

An open output condenser or an open or shorted choke will cause weak and distorted reproduction. A defective filter condenser is indicated by excessively hot plates, possibly showing color, in Radiotron UX-280. Shorted by-pass condensers will cause abnormal operation or inoperation.

[16] VOLTAGE SUPPLY SYSTEM

Figure 14 illustrates a schematic diagram of the cathode, grid and plate voltage supply system of the various tubes used in the receiver assembly.

This receiver uses the series supply arrangement for securing different drops through various sections of a resistor placed in the plate return lead to secure proper bias for the grid circuits and proper potential for applying to the cathodes and heaters. Electrically the volume control is a section of this resistance and it functions by varying the grid bias on the R.F. and I.F. stages sufficiently to give a positive control of signal strength delivered to the second detector.

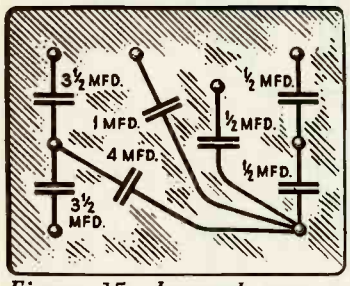


Figure 15—Internal connections of filter and by-pass condensers

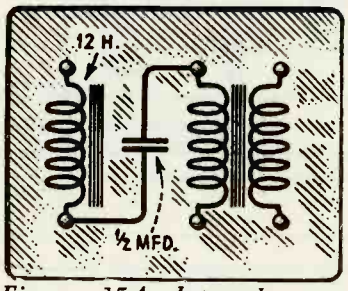


Figure 15A—Internal connections of the coupling unit

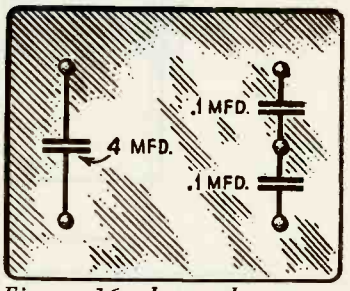


Figure 16—Internal connections of condenser bank for field supply unit

A bleeder resistor of 20,000 ohms is provided across the supply circuit at the 135-volt position. The use of this resistor prevents any excessive rise in voltage that would otherwise occur upon removal of all Radiotrons or if some failure resulting in reduced load occurred in the receiver.

[17] VOLTAGE READINGS

When checking Graybar 340 for possible defects it is good practice to check the voltage of the various sources of current. To do this a service man will need both an A.C. and D.C. Voltmeter, the D.C. meter being 600 ohms per volt or higher in resistance. The following voltages at the terminal strip of the S.P.U. are correct with all tubes in place, the line adjustment switch in the correct position for that particular location and the set in operating condition. The tubes must be in good condition otherwise the D.C. voltages may be excessively high.

The shield over the terminal strip must be removed before any readings can be made. The terminal numbers are counted from front to rear of the set, No. 1 being near the front and No. 11 near the rear.

Terminals	*Correct Voltage*
2 to 7	210 D.C.
3 to 7	160 D.C.
4 to 7	110 D.C.
8 to 9	5 A.C.
10 to 11	2.5 A.C.

{18} CHECKING RESISTANCE VALUES

When checking a Graybar 340 for possible trouble it is always a good plan to check the various resistance values of different strips used both in the receiver assembly or in the socket power unit. These values are shown in the schematic circuit diagram, Figure 5. A resistance bridge should be used for checking these values. It will give good results for the lower values of resistance. The high values, such as 14,300 and 20,000 ohms may be checked by measuring the voltage drop across them, after ascertaining that all other circuits are in correct operating condition.

{19} TESTING DISC RECTIFIER

The disc rectifier may be checked by measuring the output voltage that is delivered to the field of the reproducer unit. This should be 100 volts with the field connected. With the field disconnected it should rise slightly to about 140 volts.

Across the output of the rectifier is connected a 4 mfd. condenser. (See Figure 16.) Should this condenser become shorted, the fuses on the line will probably blow and the set

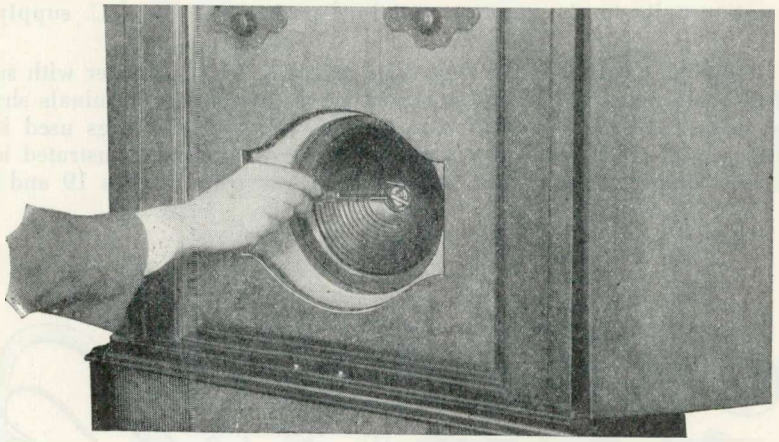


Figure 17—*Adjusting the position of the cone*

become inoperative. If the fuses do not blow immediately, the rectifier will be damaged. A shorted condenser can be located by means of a click test and it should be replaced as described in Part III, Section 18.

Precaution—The operation of the disc rectifier depends on the pressure to which the discs are held. *Do not* loosen the bolts that hold them together as it is highly improbable they can be returned to normal operation without special instruments. Should replacement become necessary, remove the bracket and unit together. The replacement part is supplied with brackets so that replacement is comparatively easy.

{20} REPRODUCER UNIT

Graybar 340 uses a new type eight-inch dynamic reproducer which makes possible excellent quality of reproduction. The field coil assembly is the same as that used in Loudspeaker 105 with the exception that the mounting bracket is not used. The flange, however, is larger and is designed so that the entire unit may be supported by it from the baffle board. The cone is an eight-inch corrugated type, giving a smooth response to all frequencies and having a treatment to make it weatherproof and free from rattle.

A check on the continuity of the cone coil or field can be made by disconnecting them from all other terminals and click testing for continuity. An open of either coil will indicate a defect which must be remedied by replacing the entire cone or the field coil.

{21} CENTERING CONE OF REPRODUCER UNIT

To properly center a new cone or one out of center use the following procedure:

(a) Remove the grille by pulling the left side when facing the front of the set.

(b) Loosen center screw of cone, but do not remove it.

(c) Insert three cardboard strips about the thickness of a visiting card, 1½" x ¼" in size, through the center web of the cone into the space between the pole piece and the cone (Figure 17). This will give the cone coil the same clearance on all sides of the pole piece.

(d) Tighten the center screw holding the web of the cone and remove the three strips. The cone is now properly centered. Replace the grills previously removed.

{22} GRAYBAR 340 CONTINUITY TESTS

The following tests will show complete continuity for the receiver assembly, socket power unit and field supply unit of Graybar 340. Disconnect the antenna and ground leads; the cable connecting the power units to the receiver and loudspeaker and the A.C. supply cord at its outlet.

A pair of headphones with at least 4½ volts in series, or a voltmeter with sufficient voltage to give a full scale deflection when connected across the battery terminals should be used in making these tests. The receiver Radiotron sockets, numbers and lugs used in these tests are shown in Figure 18. The receiver continuity wiring diagram is illustrated in Figure 20. The S.P.U. and field supply unit terminal numbers are shown in Figures 19 and 21.

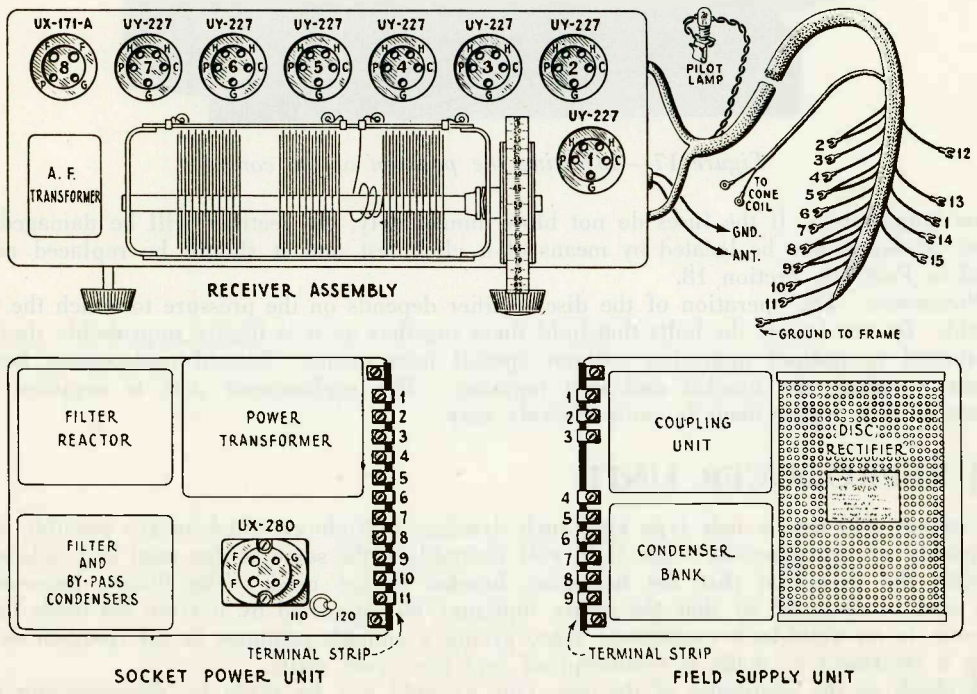


Figure 18—Radiotron socket contacts, location of parts, connection lugs and terminal strips of the socket power and field supply units

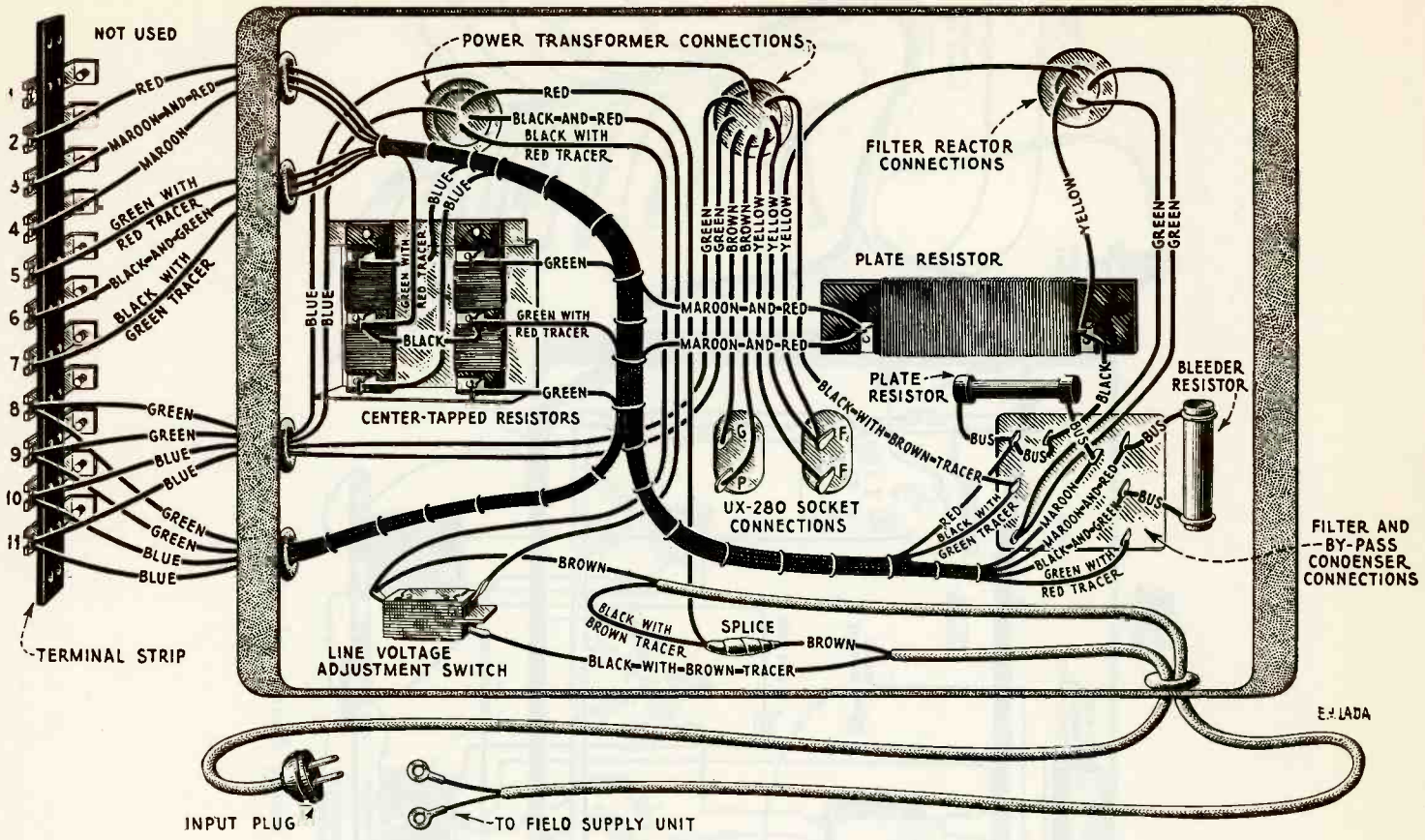


Figure 19—Continuity wiring diagram of the socket power unit

SOCKET POWER UNIT CONTINUITY TESTS

Remove Radiotron UX-280 and Disconnect Cable at Terminal Strip

Terminals	*Correct Effect*	*Incorrect Effect Caused by*
G to P of UX-280 socket	Closed	Open high voltage winding of power transformer
Across filament contacts of UX-280 socket	Closed	Open UX-280 filament winding of power transformer
One filament contact of UX-280 socket to No. 2	Closed	Open filter reactors
Terminal No. 2 to No. 3	Closed	Open resistance unit
Terminal No. 2 to No. 4	Closed	Open resistance unit
Terminal No. 2 to No. 5	Open	Shorted 1 mfd. condenser
Terminal No. 2 to No. 7	Open	Shorted 3½ mfd. condenser
Terminal No. 3 to No. 6	Closed	Open resistance unit
Terminal No. 4 to No. 5	Open	Shorted .5 mfd. condenser
Terminal No. 5 to No. 6	Open	Shorted .5 mfd. condenser
Terminal No. 5 to No. 7	Open	Shorted .4 mfd. condenser
Terminal No. 8 to No. 9	Closed	Open UX-171A filament winding and resistance unit
Terminal No. 10 to No. 11	Closed	Open UY-227 filament winding and resistance unit.

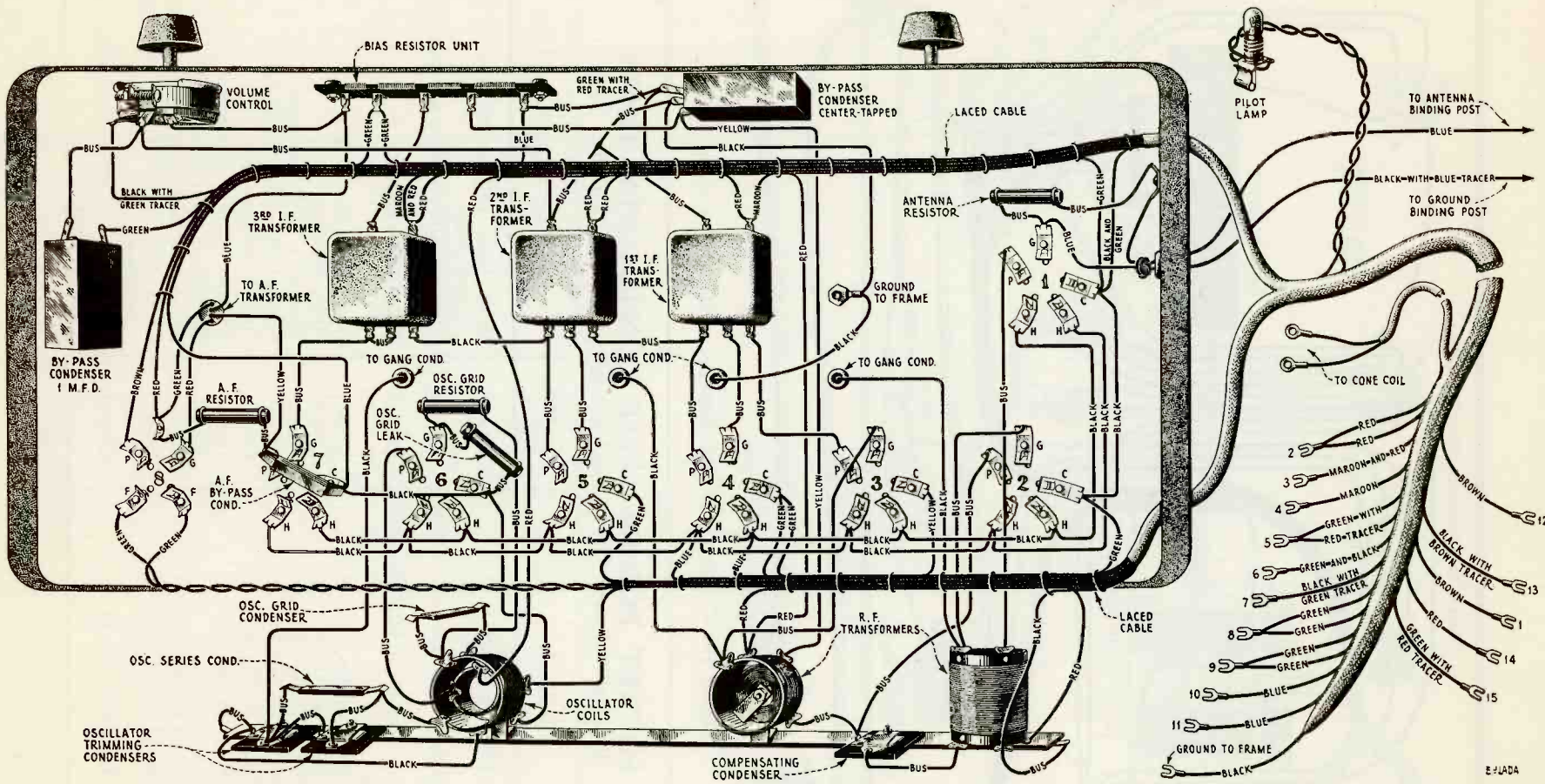


Figure 20—Continuity wiring diagram of receiver

RECEIVER ASSEMBLY CONTINUITY TESTS

Remove all Radiotrons and Disconnect Cable at Terminal Strips
See Figure 18 for cable lugs, terminals, and Radiotron socket contacts

Circuit	*Terminals*	*Correct Effect*	*Incorrect Effect Caused by*
Grid	Antenna lead to ground lead	Closed	Open antenna resistor
	Antenna lead to G1	Closed	Open connection
	G2 to ground	Closed	Open secondary of 1st R.F. transformer
	G3 to Lug No. 5	Closed	Open secondary of 2nd R.F. transformer or resistance unit
	G4 to ground	Closed	Open secondary of 1st I.F. transformer
	G5 to ground	Closed	Open secondary of 2nd I.F. transformer
	G7 to ground	Closed	Open secondary of 3rd I.F. transformer or resistance unit
	G8 to Lug No. 6	Closed	Open secondary of audio transformer or resistance unit
	Lug No. 5 to Lug No. 7	Closed	Open resistance unit or volume control
	Ground to Lug No. 7	Closed	Open volume control contact arm or poor connection
Plate	P1 to Lug No. 3	Closed	Open primary 1st R.F. transformer
	P2 to Lug No. 3	Closed	Open primary 2nd R.F. transformer
	P3 to Lug No. 4	Closed	Open primary 1st I.F. transformer
	P4 to Lug No. 3	Closed	Open primary 2nd I.F. transformer
	P5 to Lug No. 3	Closed	Open primary 3rd I.F. transformer
	P6 to Lug No. 4	Closed	Open plate coil of oscillator coils
	P7 to Lug No. 2	Closed	Open primary of audio transformer
	P8 to Lug No. 1	Closed	Open connection
Filament	Cathodes No. 1, No. 2, No. 4 and No. 5 to Lug No. 6	Closed	Open connection
	Cathodes No. 3, No. 6 and No. 7 to Lug No. 5	Closed	Open pick-up winding of oscillator or connection
	Lug No. 8 to one filament contact Socket No. 8	Closed	Open connection
	Lug No. 9 to other closed filament contact Socket No. 8	Closed	Open connection
	Lug No. 10 to one heater contact of Sockets Nos. 1, 2, 3, 4, 5, 6 and 7	Closed	Open connections
	Lug No. 11 to other heater contact of Sockets Nos. 1, 2, 3, 4, 5, 6 and 7	Closed	Open connections
Miscellaneous	G2 to P2	Open	Shorted compensating condenser
	G4 to P4	Open	Shorted neutralizing condenser
	G5 to P5	Open	Shorted neutralizing condenser
	G6 to Cathode 6	Closed (Weak)	Open oscillator grid leak
	G8 to Lug No. 5	Closed	Open resistance unit or secondary of A.F. transformer
	G8 to Lug No. 7	Closed	Open secondary of A.F. transformer or open volume control
	Lug No. 12 to Lug No. 13	Closed	Open cone coil of reproducer unit
	Lug No. 14 to Lug No. 2	Closed	Open connection
	Lug No. 15 to Lug No. 5	Closed	Open connection

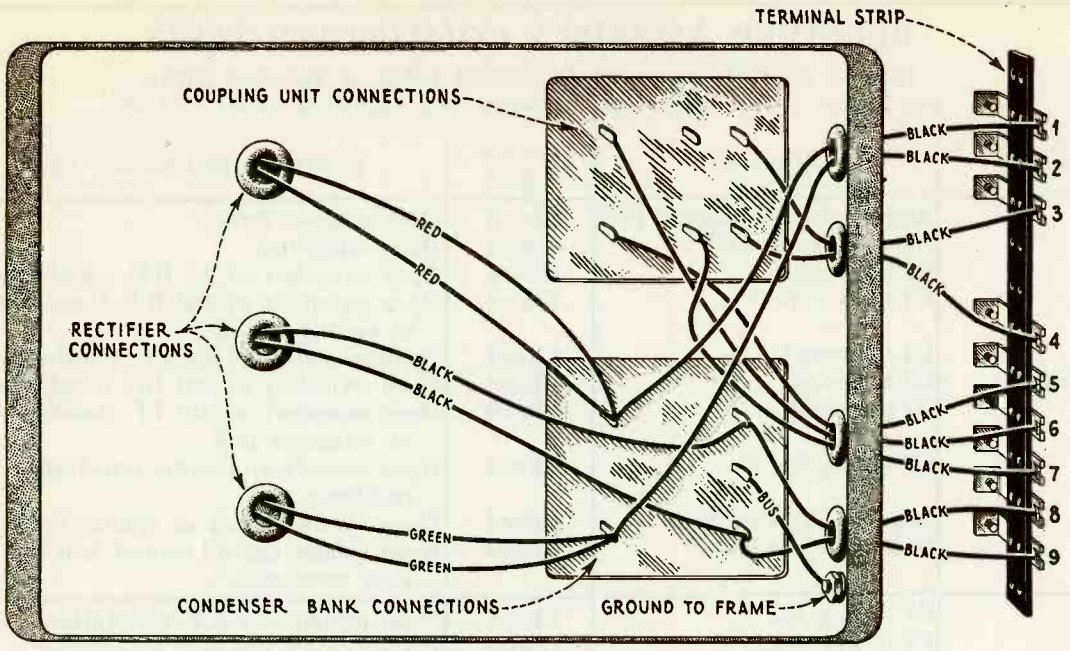


Figure 21—Continuity wiring diagram of field supply unit

FIELD SUPPLY UNIT CONTINUITY TESTS

Remove all Cable Connections

Terminals	*Correct Effect*	*Incorrect Effect Caused by*
3 to 4	Closed	Open secondary of output transformer
5 to 6	Closed	Open output choke
5 to 7	Open	Shorted output condenser

VOLTAGE READINGS AT FIELD SUPPLY UNIT

Connect all Cables and turn power "On"

Terminals	*Voltage*
1 to 2	100 D.C.
5 to 6	10 D.C.
5 to S.P.U. No. 7	200 D.C.
8 to 9	120 A.C.

[23] VOLTAGE READINGS AT RADIOTRON SOCKETS

The following voltages taken at each Radiotron Socket with the receiver in operating condition should prove of value when checking is done with test sets such as the Weston Model 537, Type 2, or others giving similar readings. The plate currents shown are not necessarily accurate for each tube, as the cable in the test set will cause some circuits to oscillate, due to its added capacity. Small variations of voltages will be caused by different tubes and line voltages. Therefore the following values must be taken as approximately those that will be found under varying conditions. These readings are equally applicable to Graybar 340. The numbers in column 1 indicate the tube socket numbers shown in Figure 18.

VOLUME CONTROL AT ZERO

110-volt line. Switch at 110-volt position.

Tube No.	*Cathode to heater. Volts*	*Cathode or filament to Grid. Volts*	*Cathode or filament to Plate. Volts*	*Plate Current Milliamps.*	*Filament or heater. Voltage*
1	30	30	165	—	2.5
2	30	30	165	—	2.5
3	—	11	90	.75	2.5
4	30	30	165	—	2.5
5	30	30	165	—	2.5
6	—	—	75	7.0	2.5
7	—	20	175	1.0	2.5
8	—	37	160	18.0	5.0

VOLUME CONTROL AT MAXIMUM

110-volt line. Switch at 110-volt position.

Tube No.	*Cathode to heater. Volts*	*Cathode or filament to Grid. Volts*	*Cathode or filament to Plate. Volts*	*Plate Current Milliamps.*	*Filament or heater. Voltage*
1	27	10	130	3.5	2.5
2	27	10	130	3.5	2.5
3	—	10	70	.5	2.5
4	25	10	130	9.0	2.5
5	25	10	130	9.0	2.5
6	—	—	65	7.5	2.5
7	—	20	165	.75	2.5
8	—	35	150	6.0	5.0

PART III—MAKING REPLACEMENTS

The various assemblies and parts of Graybar 340 are readily accessible and replacements can be easily made. Figure 22 illustrates the parts in the receiver assembly, Figure 2 in the S.P.U. and Figure 3 in the field supply unit. The following detailed procedure outlines the simplest method to be used in making replacements.

[1] REPLACING THE VOLUME CONTROL

(a) Remove the knobs on the volume control and station selector. These are of the push type, and they are removed by simply pulling them off the shafts. Between each knob and the cabinet will be found a dilecto washer. These washers must also be removed. To replace, merely push the knob on to the shaft, first matching the knob socket with its flat spring to the shaft.

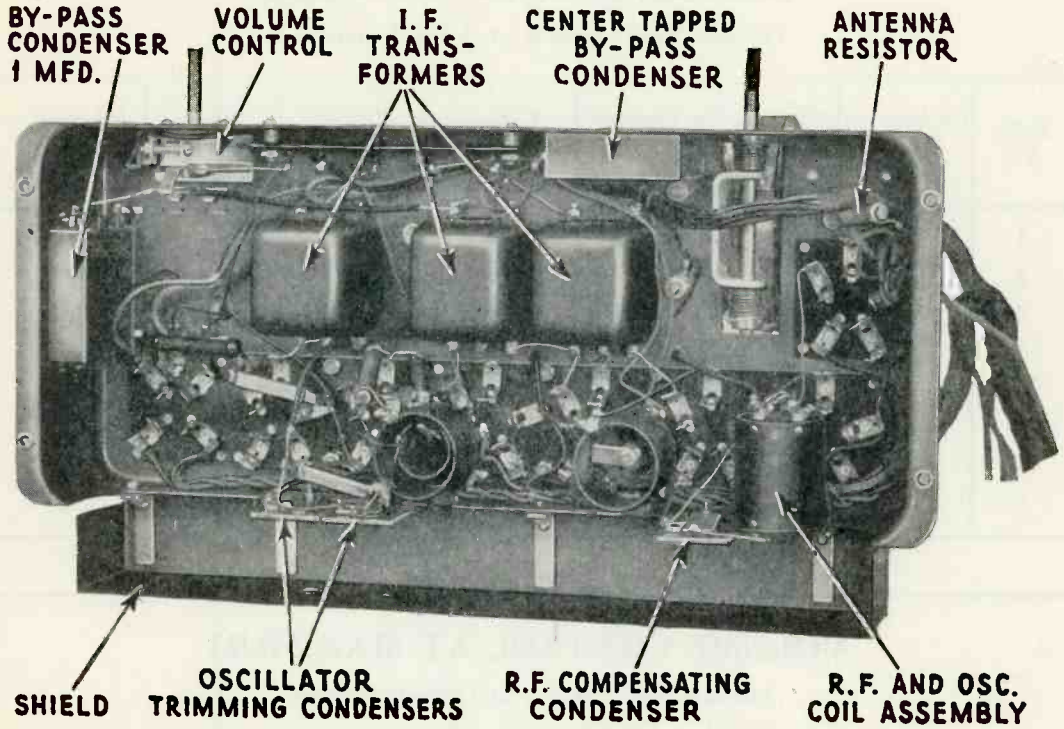


Figure 22—Receiver sub-Chassis showing principal parts

(b) Open rear doors and release the pilot lamp and socket by pulling it from the small angle bracket to which it is clipped in place. A slight pull, upward and backward, will release it.
(c) Remove the shield and insulating cover that are over the two terminal strips. Then remove all cable connections to each strip.
(d) Release the two connections to the cone coil terminals from the cable. These are located on the loudspeaker flange.
(e) Remove the clamps that hold the cable and antenna wire to the side of the cabinet.
(f) Remove the antenna and ground wires from their binding posts.
(g) Pull cable, antenna and ground leads through the hole in the shelf until all leads are clear.
(h) Remove the four screws that hold the receiver assembly to the shelf.
(i) The receiver assembly may now be lifted clear of the cabinet. (See Figure 23.) Place the volume control up and remove the two screws and nuts that hold it in place. The three soldered connections must also be removed.

(j) Remove the old volume control and fasten the new one in position by means of the two machine screws and nuts, and resolder the three connections. The correct connections of these leads are shown in Figure 20.

(k) Return receiver assembly in cabinet and replace all cables and leads in the reverse manner of that used to remove them.

(l) Test receiver and if O. K. return shield to its original position.

[2] REPLACING R. F. TRANSFORMER AND OSCILLATOR ASSEMBLY

The two radio frequency transformers and the oscillator coils are mounted on a metal strip, together with three small adjustable condensers and two fixed condensers.

This assembly must be replaced as a unit—the matching of the coils being an important point in the operation of the receiver. Use the following procedure:

(a) Remove receiver chassis from cabinet as described in Part III, Section 1.

(b) Turn chassis on side and unsolder all leads to the assembly being replaced.

(c) Remove the five machine screws and lock washers that hold the metal supporting strip to the receiver frame.

(d) The assembly may now be removed and the new assembly fastened in position with the five machine screws and washers previously removed.

(e) Resolder all connections in their correct position on the assembly. This is shown in Figure 20.

(f) The receiver assembly may now be returned to the cabinet in the reverse manner of that used to remove it.

[3] REPLACING RADIOTRON GANG SOCKETS

One socket assembly on the receiver chassis is of the gang variety, the others being two single units. All are held in place, together with their shields, by means of rivets which clamp them on the metal chassis frame. Use the following procedure when replacing these sockets:

(a) Remove the receiver assembly from the cabinet as described in Part III, Section 1.

(b) Unsolder all connections to the particular socket or assembly being removed. The R.F. transformer assembly should be removed as a unit to provide room for replacing the six-gang Radiotron socket.

(c) Drill out the rivets holding the Radiotron socket to be replaced. The socket and shield will be released together, in the case of the single UY socket. In the case of the single UX or the gang UY the shield overlaps and will be held in place by the socket not removed.

(d) Remove the old Radiotron socket and fasten the new one in position by means of screws, nuts and washers. Resolder all connections and replace the R.F. assembly if removed. The correct connections are shown in Figure 20.

(e) Fasten receiver assembly in cabinet, connect cable and test. If O. K., replace shield over terminal strip and return the set to normal operation.

[4] REPLACING MAIN TUNING CONDENSERS AND DRIVE

The main tuning condensers and drive are replaced as one unit as follows:

(a) Remove receiver assembly from cabinet as described in Part III, Section 1.

(b) Remove the three screws, nuts and lock washers that hold the condenser assembly to the metal frame.

(c) Now pull the condensers as far forward as possible and unsolder the four leads connected at the rear. Releasing the condensers and pulling them forward provides ample space in which to do the unsoldering job and keeps solder material clear of the tube shield. Remove the entire assembly by tilting slightly and pulling clear.

(d) Place the new assembly in the position occupied by the old one and solder the four leads to their proper connections.

(e) Fasten the three screws, nuts and lock washers in their proper position. Make sure that the screw that holds the ground connection on the under side of the chassis makes firm contact.

(f) Return the receiver to the cabinet and replace all connections in the reverse order of that used to remove them.

[5] REPLACING BY-PASS CONDENSERS

Graybar 340 employs two by-pass condensers in the receiver assembly. They are both located on the under side of this assembly, and replacement is made in the following manner:

(a) Remove receiver assembly as described in Part III, Section 1.

(b) Unsolder the connections to the condenser it is desired to replace.

(c) With a screwdriver bend up the metal tabs holding the condenser to the side of the receiver frame. These tabs bend easily, and when turned up make possible the removal of the condenser.

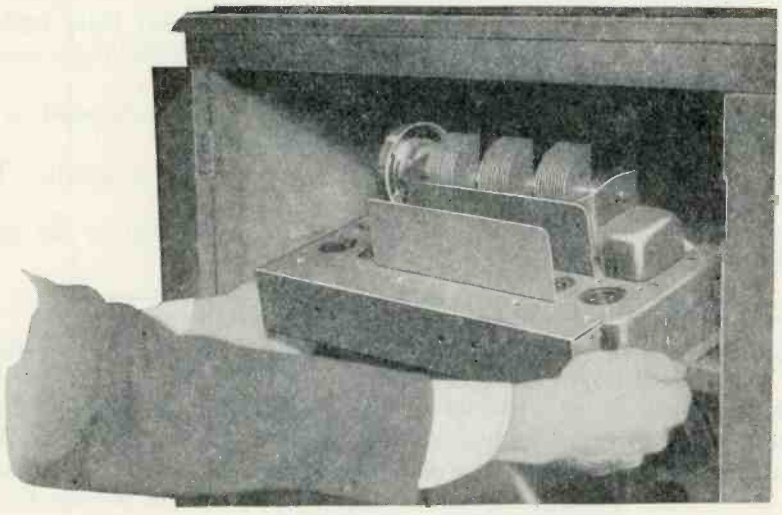


Figure 23—Removing receiver chassis from cabinet

(d) The new condenser should now be fastened in place in the position formerly occupied by the old one.

(e) Resolder the connections as shown in Figure 20.

(f) Fasten the receiver assembly in the cabinet in the reverse order of that used to remove it.

[6] REPLACING THE AUDIO TRANSFORMER

Graybar 340 employs one audio transformer, located at the left side of the receiver assembly facing the front of the receiver. Should a replacement become necessary use the following procedure:

(a) Remove receiver assembly as described in Part III, Section 1.

(b) Place the receiver chassis on its side and unsolder all connections to the audio transformer.

(c) Now turn up the four tabs that hold the transformer in place and remove it. The new one is then fastened in position.

(d) Resolder the leads from the new transformer to their correct points of connection as indicated in Figure 20.

(e) Fasten the receiver assembly in the cabinet in the reverse order of that used to remove it.

[7] REPLACING CONDENSER DRIVE CABLE

(a) Remove receiver assembly from cabinet as described in Part III, Section 1. Place chassis on a table so that the cable on the grooved drums is accessible.

(b) Release the cable adjusting screw and clamp, and remove old cable from drums completely.

(c) Starting from the rear grooved drum, place eye of new cable over pin, which should be in a horizontal position and next to side of the assembly that is closest to the Socket Power Unit when in the cabinet, and wind on three complete turns and then bring cable up to large drum.

(d) Now pass cable over large drum. Turn the drum so the cable adjusting screw is on top. Pass cable over groove until point is reached where there is a slot in the drum for passing the cable to the track on the other side of the drum.

(e) Follow on around other track in same direction until a point is reached where cable is directly above front grooved drum.

(f) Starting on the third groove back from the front of the drum, wind on two and a half turns and slip eye over pin. The cable is now in its correct position, although probably slack.

(g) The cable adjusting screw and clamp that were previously removed to allow the cable to pass along the grooves are replaced. By slipping the clamp over the cable and gradually turning up on the cable adjusting screw, the cable may be tightened until there is no lost motion in any of its controls. Care should be taken not to take up too much, as the cable may be stretched or possibly broken.

(h) Return receiver assembly to cabinet in the reverse order of that used to remove it.

[8] REPLACING DIAL SCALES

After considerable use a dial scale may become soiled or illegible and a new scale desired. A step-by-step procedure to make replacement follows:

(a) Open rear door of Graybar 340.

(b) Turn dial so that the two screws that hold the dial in place are toward the rear.

(c) Loosen screws, washers and nuts that hold dial in place.

(d) The old dial may now be pulled clear and the new one placed in the position occupied by the old one. Examine dial from the front of the set to see that the numbers on the dial are in their correct position.

(e) Tighten screws holding dial in place and close doors of cabinet.

[9] REPLACING POWER CABLE

A combination laced and braided cable is used in Graybar 340 for connecting the S.P.U. and field supply unit to the receiver assembly and the reproducer unit. Should it be necessary to replace this cable use the following procedure:

(a) Remove receiver assembly from cabinet as described in Part III, Section 1.

(b) Turn assembly bottom side up and unsolder all connections to the cable.

(c) Remove old cable and connect up the new cable as indicated in Figure 20, soldering all connections.

(d) Return assembly to cabinet in reverse order of that used to remove it.

[10] REPLACING INTERMEDIATE TRANSFORMERS

Graybar 340 has three intermediate frequency transformers, all three being exactly the same mechanically, and interchangeable electrically after the correct adjustments have been made for their particular position in the circuit. A step-by-step replacement procedure follows:

(a) Remove receiver assembly from cabinet as described in Part III, Section 1.

(b) Remove tuning condenser assembly as described in Part III, Section 4.

(c) Unsolder the connections of the transformer being replaced. Then turn up the metal tabs on the upper side of the receiver chassis. The old transformer may now be replaced by the new one. Turn over the metal tabs to hold it in place and resolder all connections. These are shown in Figure 20. Be careful not to heat any connection more than necessary to make a good joint, as excessive heat may change the capacity of the primary fixed condenser, thus rendering the entire transformer assembly defective.

(d) Before returning the main tuning condensers to the receiver chassis it will be necessary to tune and neutralize the transformer just connected in position. The correct procedure for doing this is contained in Part II, Section 14.

(e) The procedure given in Part II, Section 14 may now be carried out. Then return the tuning condenser assembly in the reverse order of that used to remove it. The entire receiver may now be tested and a check made on the adjustment of the oscillator trimming condensers as described in Part II, Section 12. After all tests and adjustments are completed the receiver assembly should be returned to the cabinet in the reverse order of that used to remove it.

[11] REPLACING TAPPED RESISTANCE UNIT IN RECEIVER ASSEMBLY

A tapped resistance unit in the receiver assembly of Graybar 340 provides the various grid and cathode voltages. To replace this tapped resistance unit proceed as follows:

(a) Remove receiver assembly as described in Part III, Section 1.

(b) Unsolder all connections to the tapped resistance unit.

(c) Remove the two screws, nuts and washers that hold the resistance unit in place. This will release the unit and the new one can be fastened in place with the screws, nuts and washers previously removed.

(d) Solder all the leads to their correct connections. (See Figure 20.)

(e) Return receiver assembly to cabinet in the reverse order used to remove it.

{12} REPLACING CONE OF REPRODUCER UNIT

Should it be desirable to replace a cone, the entire reproducer unit must be removed from the cabinet. In order to do this use the following procedure:

(a) Remove the cover over the terminal strip and remove the field supply leads from terminals 1 and 2 of the field supply unit.

(b) Remove the two cone coil leads and the connections from the power cable that are connected to the terminals on the flange of the reproducer unit.

(c) Remove the four nuts that hold the reproducer to the baffle board, at the same time supporting the reproducer by hand to prevent it falling on the S.P.U. Place the unit in some position convenient for work.

(d) Remove the nine nuts and machine screws that hold the cone ring in place. Remove this ring.

(e) Remove the screw and washer that centers the cone. The cone may now be removed and the new one placed in the position occupied by the old one.

(f) Return the centering screw; the ring and its nine screws and nuts to position, but do not tighten. The cone should now be centered as described in Part II, Section 21 and all screws tightened.

(g) The unit should now be returned to the cabinet in the reverse manner of that used to remove it.

{13} REPLACING FILTER CONDENSERS AND BY-PASS CONDENSERS

The filter condensers and by-pass condensers are enclosed as a unit in a metal container. Should replacement be necessary, use the following procedure:

(a) Remove the shield and all connections from the Socket Power Unit terminal strip.

(b) Remove the four machine screws that hold the S.P.U. to the cabinet. The S.P.U. may now be lifted clear of the cabinet.

(c) Unsolder all connections to the unit being replaced, also release the two resistors attached to its connecting terminal.

(d) Bend up the tabs that hold the unit to the S.P.U. base. Remove the old unit and fasten the new one in position by bending the tabs down so that it is held tightly to the S.P.U. base.

(e) Replace and solder all connections and the resistance units previously removed. Their correct connections are shown in Figure 19.

(f) Return the S.P.U. to the cabinet in the reverse order of that used to remove it. Replace all connections and test. If O. K., replace shield over terminal strip and return receiver to normal operation.

{14} REPLACING POWER TRANSFORMER OR FILTER REACTOR

The power transformer and filter reactor are both held in place by means of tabs which form a part of their case, being turned over on the under side of the S.P.U. base. A step-by-step replacement procedure follows:

(a) Remove S.P.U. from cabinet as described in Part III, Section 13.

(b) Unsolder all connections to unit being replaced. If the power transformer is being replaced release the two screws that hold the center tapped resistance units in place, so they may be pulled clear when bending the tabs on the power transformer.

(c) Bend up the tabs that hold the unit to the S.P.U. base.
(d) The old unit may now be removed and the new one placed in position. Bend over the tabs on the new one so that it is fastened tightly to the S.P.U. base.
(e) Solder all connections as shown in Figure 19.
(f) Fasten the S.P.U. in the cabinet in the reverse order of that used to remove it.

[15] REPLACING TERMINAL STRIP

Should the terminal strip on the S.P.U. require replacement use the following procedure:
(a) Remove the S.P.U. from cabinet as described in Part III, Section 13.
(b) Unsolder all leads to the terminal strip.
(c) Release two screws holding strip to S.P.U. base.
(d) The strip may now be removed and replaced by a new one.

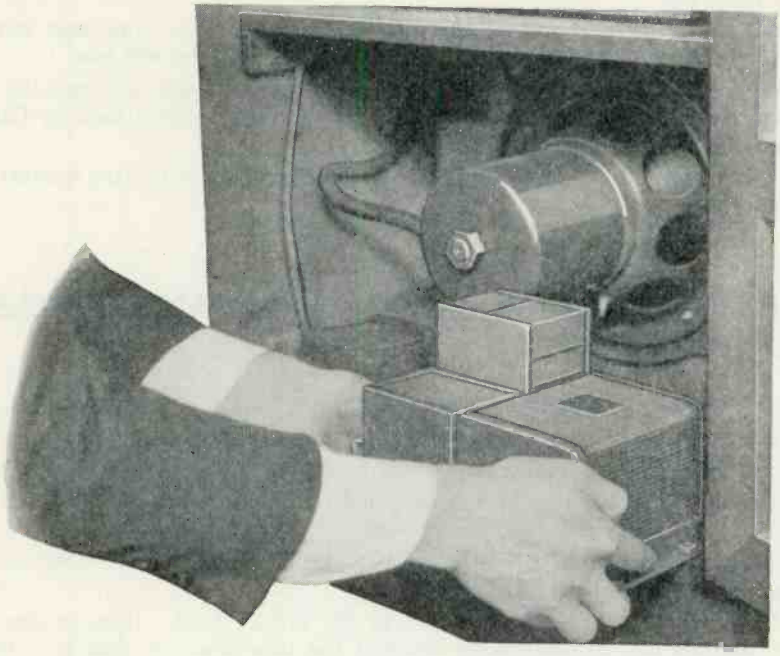


Figure 24—Removing the field supply unit from the cabinet

(e) Fasten new strip in position by means of two machine screws, lock washers and nuts previously removed.
(f) Solder all leads to terminal strip. The color scheme and correct connections are shown in Figure 19.
(g) Return S.P.U. to cabinet in the reverse order, and connect to receiver assembly.

[16] REPLACING MISCELLANEOUS PARTS IN S. P. U.

The center tapped resistors, plate supply resistors, line switch and UX-280 socket in Graybar 340 may require replacement. They are all attached to the base by means of machine screws and nuts, and replacement is very simple. The following general outline will apply to all these units:

(a) Remove S.P.U. from cabinet as described in Part III, Section 13.
(b) Unsolder leads from defective unit.
(c) Remove defective unit from base and replace with new unit.
(d) Solder leads to new unit as indicated in Figure 19.
(e) Return S.P.U. to cabinet in reverse order of that used to remove it.

[17] REPLACING COUPLING UNIT

A choke and condenser together with a step-down transformer are used to couple the output of the Radiotron UX-171A to the cone coil of the reproducer unit. Should replacement become necessary, proceed as follows:

(a) Remove the shield and insulating strip over the field supply terminal strip.

(b) Remove all connections to this strip and then remove the four machine screws used to hold the unit in place.

(c) Remove the field supply unit to a place convenient for work. (See Figure 24.)

(d) Unsolder all connections to the coupling unit being replaced. Turn up the tabs holding it in place and remove the defective unit from base.

(e) The new unit should now be placed in the position occupied by the old one and fastened in place by bending its tabs. All connections should be soldered in place as shown in Figure 21.

(f) The field supply unit is then returned to the cabinet in the reverse manner of that used to remove it and the set returned to normal operation.

[18] REPLACING CONDENSER BANK OF FIELD SUPPLY UNIT

Across the output of the disc rectifier there is a 4 mfd. condenser. Also across the input A.C. supply are two .1 mfd. condensers connected in series with the mid-point grounded. These condensers are contained in one unit and are replaced as follows:

(a) Remove field supply unit from cabinet as described in Part III, Section 17.

(b) Unsolder the connections to the condenser bank being replaced. Turn up the tabs that hold it in place and remove from field supply unit base.

(c) Place the new unit in the place occupied by the old one and turn tabs to hold unit in place.

(d) Resolder all connections in their correct positions. These are shown in Figure 21.

(e) The unit is then returned to the cabinet in the reverse order of that used to remove it.

[19] REPLACING RECTIFIER STACK

The disc rectifier used in Graybar 340 is made in two units, either of which may be replaced independently of the other. The replacement procedure follows:

(a) Remove the field supply unit from the cabinet as described in Part III, Section 17.

(b) Remove the protective screen over the rectifier unit by bending up the tabs that hold it in place.

(c) Unsolder all connections to the defective unit.

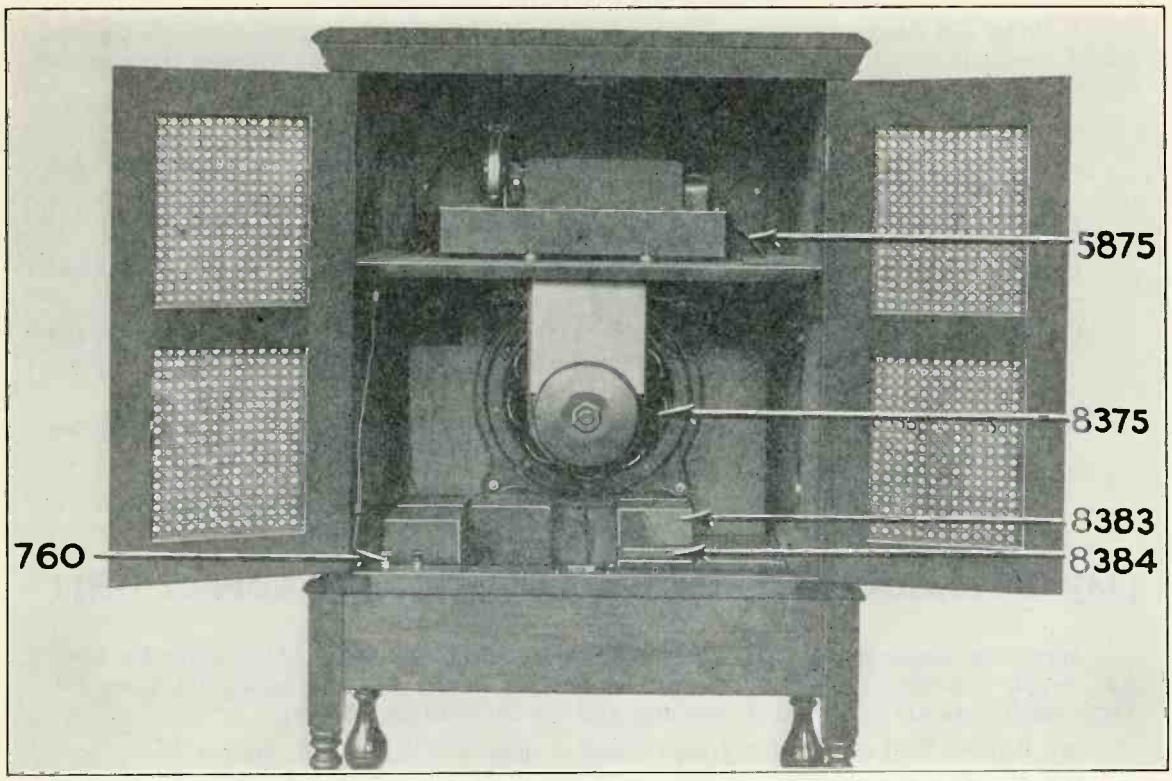
(d) Release the unit by removing the bolts and nuts that hold it in place. Place the new unit in the position occupied by the old one and fasten in place.

(e) Resolder all connections removed. These are shown in Figure 21.

(f) Return shield to its correct position and fasten in place by turning down its tabs.

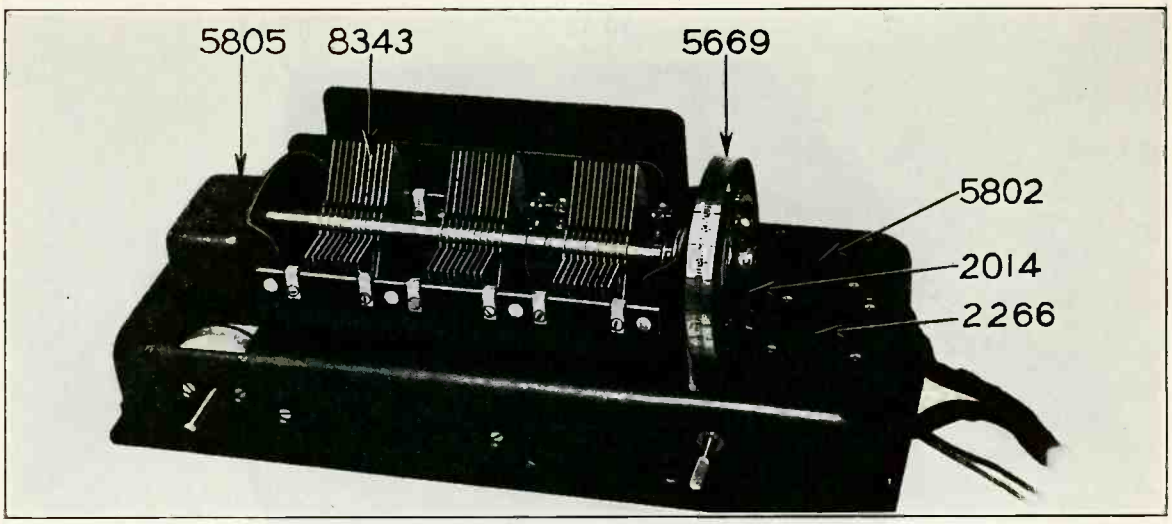
(g) Return field supply unit to cabinet in reverse manner of that used to remove it and return set to normal operation.

Graybar 340 Replacement Parts

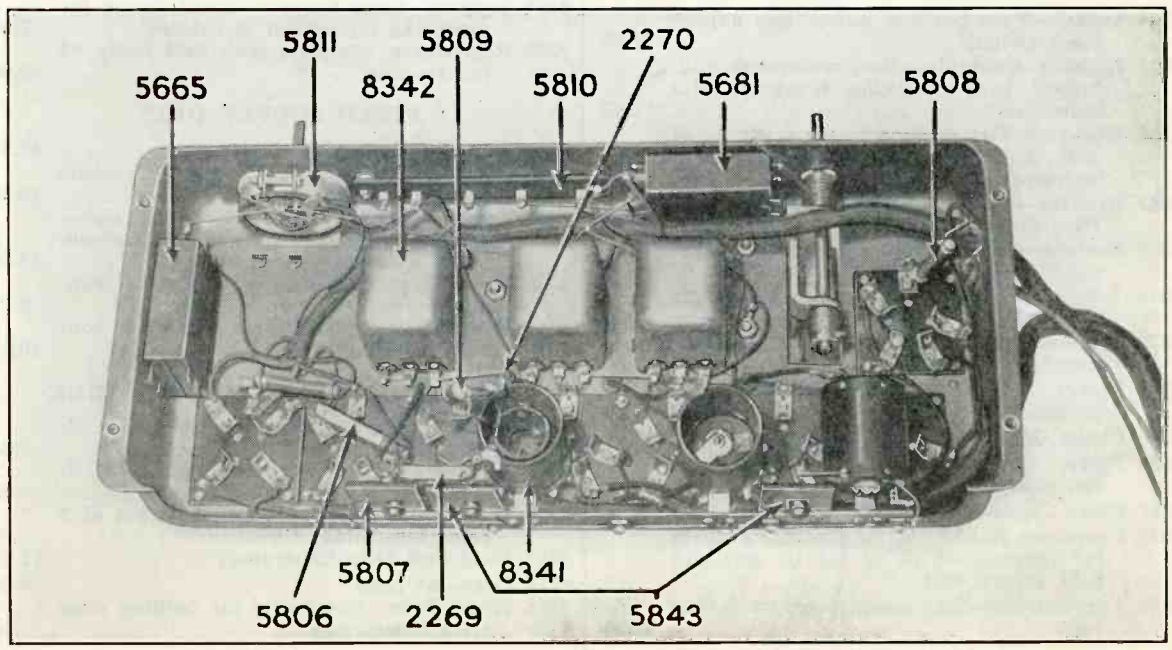


No.	Description	Price
	RECEIVER PARTS	
760	Binding Post—Knob	$1.00
2014	Cable—Tuning condenser assembly drive Cable	.75
2022	Socket—Single socket for Radiotron UX-280 in S.P.U.	1.85
2032	Leads—Antenna and ground leads (1 set) (Not illustrated)	.50
2039	Switch—Power line operating switch	1.15
2266	Socket—Single Radiotron UY-227 socket with bakelite protective shield for UY-227 tube	.50
2267	Socket — Single Radiotron UX-171A socket with bakelite protective shield (Not illustrated)	.50
2269	Condenser—Fixed condenser 740 mmfd. oscillator series or oscillator grid condenser	.75
2270	Resistance—40,000 ohms—used as oscillator grid leak or across primary of input transformer	.75
2272	Pilot Lamp Socket (Not illustrated)	.75
2333	Washer—Bakelite spacing washer for volume control knob or tuning control knob—Package of 10 (Not illustrated)	.60
2349	Knob—Tuning control	.60
2350	Knob—Volume control with pointer	.60
5665	Condenser—Fixed condenser—1 mfd.	1.80
5669	Scale—Dial scale for tuning condenser assembly—Package of 10	2.40
5681	Condenser—Fixed Condenser, midtapped, ½ mfd. on each side of midtap	2.00
5753	Receptacle—Service current tap combination receptacle and plug (Not illustrated)	1.20
5802	Socket—6-gang UY-227 Radiotron Socket with 7-gang bakelite protective shield for Radiotrons UY-227 and UX-171A	1.90
5805	Audio Transformer	4.80
5806	Condenser — Fixed by-pass audio frequency—3 condensers in one unit	1.55
5807	Condenser—Parallel trimming condenser for oscillator	1.20
5808	Antenna resistance—2,000 ohms	.75
5803	Tube Shield—Metal shield, mounted vertically	.65
5872	Guard—Metal guard at rear of receiver chassis	.60

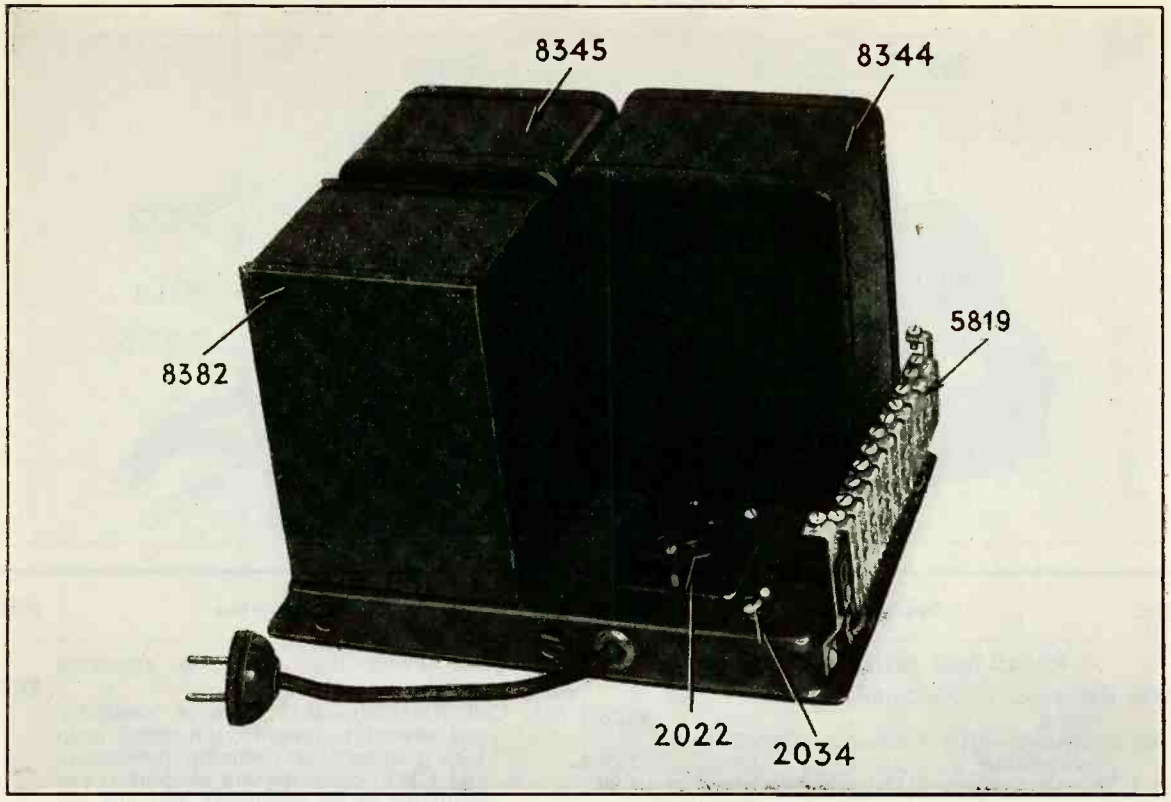
Graybar 340 Replacement Parts



No.	Description	Price
	RECEIVER PARTS—Continued	
5809	Resistance — Oscillator resistance—3,000 ohms	$0.75
5810	Resistance—Flat resistance, tapped voltage divider	1.20
5811	Volume Control—less knob—450 ohms	1.90
5843	Condenser—Series trimming condenser for oscillator or R.F. compensating condenser	1.20
5874	Cable—Power cable from receiver to S.P.U. (Not illustrated)	7.20
5875	Cable—From input plug to operating switch	$2.25
8341	Coil Assembly—R.F. detector, oscillator coil assembly, mounted on metal strip with 2 adjustable trimming condensers and 1 R.F. compensating condenser, one oscillator series condenser and one oscillator grid condenser (2269)	6.00
8342	Transformer—I.F. Transformer with condensers	3.60
8343	Tuning Condenser Assembly—with drive	15.00



Graybar 340 Replacement Parts



No.	Description	Price
	SOCKET POWER UNIT	
2034	Switch—Two position power line adjustment switch	$1.20
5815	Resistor Assembly—Two resistances, mid-tapped with mounting brackets (Not illustrated)	1.40
5816	Resistor—Flat resistor in plate supply of R.F., I.F. and A.F. amplifiers (Not illustrated)	.90
5817	Resistor—Bleeder resistor 20,000 ohms (Not illustrated)	.90
5818	Resistor—Plate supply resistor for oscillator 14,300 ohms (Not illustrated)	.90
5819	Terminal Strip—With mounting brackets and screws	1.05
5876	Cable—Laced cable for S.P.U. (Not illustrated)	1.50
8344	Power Transformer—60-cycle—in metal container	12.90
8345	Choke Coil—in metal container	10.05
8350	Power Transformer—25-cycle—in metal container (Not illustrated)	18.75
8382	Filter Capacitor—In metal container	16.50
5877	Protective Shield—Metal protective shield for terminal strips of S.P.U. unit and field supply unit	.60
8381	Transformer—Step down transformer, 220 volts	19.50
5879	Rectifier Cover	1.30
8374	Support—Cone support—metal flange for mounting reproducer in cabinet	2.00
9240	Reproducer, complete with field leads, 45 inches long	60.00
	FIELD SUPPLY UNIT	
2244	Terminal Strip (Not illustrated)	$1.30
5878	Rectifier Stack—with mounting brackets (Not illustrated)	10.50
8383	Capacitor Pack—Output coupling unit—choke—condenser and transformer—in metal container	12.00
8384	Filter Capacitor—60-cycle—in metal container	8.25
8385	Filter Capacitor—25-cycle—in metal container (Not illustrated)	10.05
	REPRODUCER ASSEMBLY 8" CONE	
793	Washer—Copper washer—large (Not illustrated)	.85
1401	Washer—Copper washer—small (Not illustrated)	.65
2261	Washers—Cardboard washers—1 set of 2 (Not illustrated)	.50
5757	Field Coil (Not illustrated)	13.95
8375	Cone—8" cone	4.50
8376	Ring—Front metal ring for holding cone (Not illustrated)	.90

SERVICE DATA CHART

Before using the following Service Data Chart, when experiencing no signals, weak signals, poor quality, noisy or intermittent reception, howling and fading, first look for defective tubes, or a poor antenna system. If imperfect operation is not due to these causes the "Service Data Chart" should be consulted for further detailed causes. Reference to Part No. and Section No. in the "Service Notes" is also noted for further details.

Indication	*Cause*	*Remedy*
No signals	Defective operating switch	Repair or replace switch
	Loose volume control arm	Tighten volume control arm, P. II, S. 4
	Defective power cable	Replace power cable, P. III, S. 9
	Defective R.F. transformer	Replace R.F. and oscillator coil assembly, P. III, S. 2
	Defective I.F. transformer	Replace I.F. transformer, P. III, S. 10
	Defective A.F. transformer	Replace A.F. transformer, P. III, S. 6
	Defective Oscillator coil	Replace R.F. and oscillator coil assembly, P. III, S. 2
	Defective by-pass condenser	Replace by-pass condenser, P. III, S. 5
	Defective socket power unit	Check socket power unit by means of continuity test, and make any repairs or replacements necessary, P. II, S. 22
	Defective Field Supply Unit	Check field supply unit and make any repairs or replacements necessary
	Open cone coil of reproducer unit	Check cone coil and if open replace coné
Weak Signals	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 13
	Trimming condensers out of adjustment	Adjust trimming condensers, P. II, S. 12
	I.F. transformers not correctly aligned	Align I.F. transformers correctly, P. II, S. 14
	Defective power cable	Repair or replace cable, P. III, S. 9
	Defective R.F. transformer	Replace R.F. and oscillator coil assembly, P. III, S. 2
	Defective I.F. transformer	Replace I.F. transformer, P. III, S. 10
	Defective A.F. transformer	Replace A.F. transformer, P. III, S. 6
	Dirty prongs of Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Defective by-pass condenser	Replace defective by-pass condensers, P. III, S. 5
	Defective main tuning condenser	Replace defective tuning condensers, P. III, S. 4
	Low voltages from socket power unit	Check socket power unit voltages with high resistance D.C. voltmeter and A.C. voltmeter, P. II, S. 17
	Defective socket power unit	Check socket power unit by means of continuity tests and make any repairs or replacements necessary, P. II, S. 22
Poor Quality	Defective A.F. transformer	Replace A.F. transformer, P. III, S. 6
	Defective by-pass condenser	Replace defective by-pass condenser, P. III, S. 5
	Dirty contact arm of volume control	Clean contact arm on volume control, P. II, S. 4
	Dirty prongs on Radiotrons	Clean prongs with fine sandpaper, P. II, S. 3
	Volume control advanced too far	Reduce setting of volume control, P. I, S. 7
Howling	Compensating condenser out of adjustment	Adjust compensating condenser correctly, P. II, S. 13
	Defect in audio system	Check and repair any defect, P. II, S. 10
	Open grid circuit in any stage	Check circuit and repair defect
	Microphonic Radiotrons	Interchange Radiotrons
Excessive hum	Defective center tapped resistance unit	Replace defective resistance unit, P. III, S. 16
	Socket plug position	Reverse socket plug
	Line voltage low	Set line switch for low line voltage, P. I, S. 5
	Antenna and ground leads reversed	Connect antenna and ground leads correctly
Radiotrons Fail to Light	Operating switch not "On"	Turn operating switch "On"
	Defective operating switch	Replace operating switch
	Defective input A.C. cord	Repair or replace A.C. input cord
	Defective power transformer	Replace power transformer, P. III, S. 14
	No. A.C. line voltage	Turn A.C. line voltage "On"


GraybaR
QUALITY

GRAYBAR RADIO

500

SERVICE NOTES

(Advance Edition)

GraybaR

ELECTRIC COMPANY

SUCCESSOR TO *Western Electric* SUPPLY DEPARTMENT

GRAYBAR RADIO

500

SERVICE NOTES

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PART III—ELECTRICAL TESTS

PART IV—MAKING REPLACEMENTS

ILLUSTRATIONS

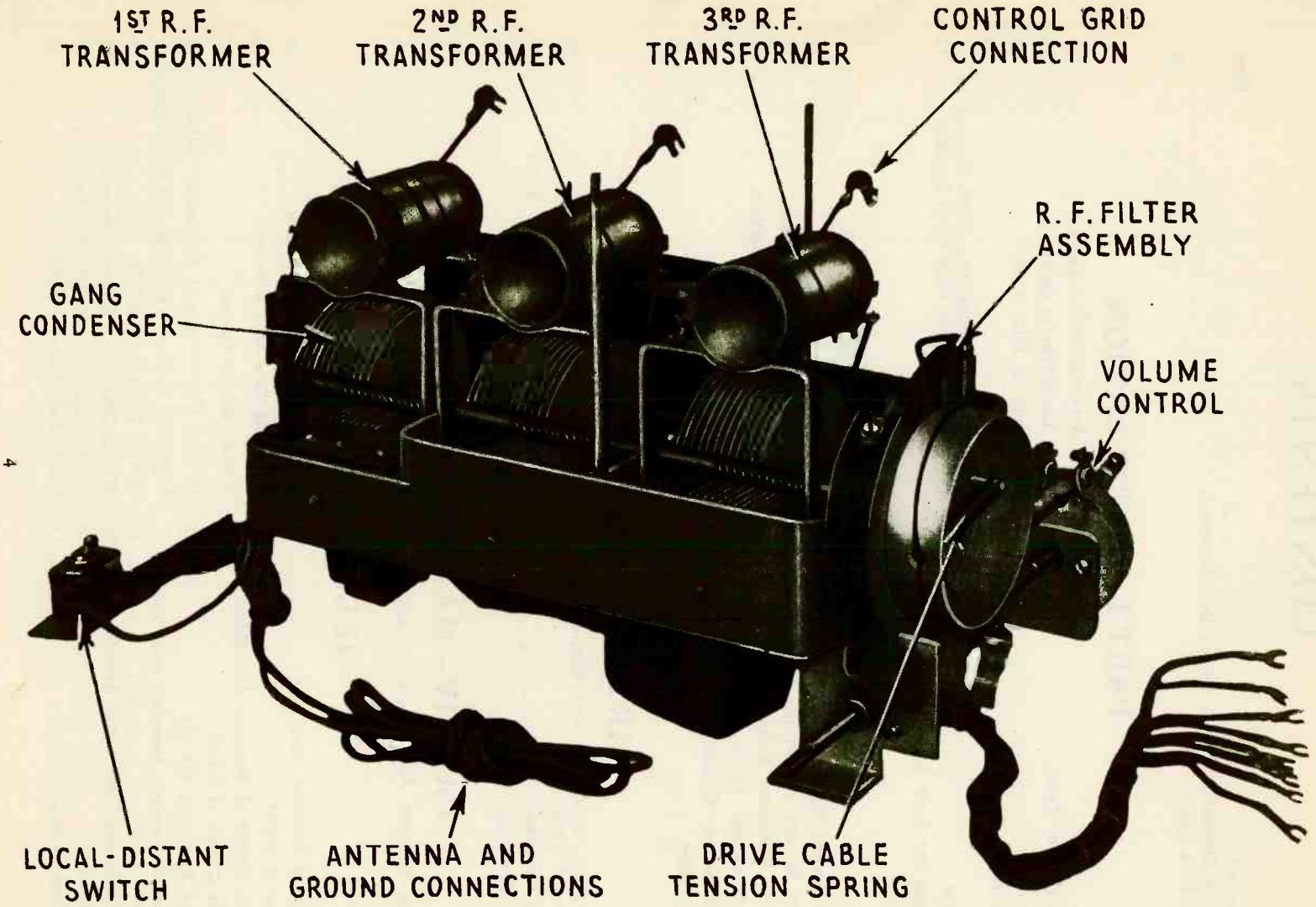

Figure 1—Top view of receiver assembly with shields removed

GRAYBAR No. 500 Receiver

SERVICE NOTES

RATING

105-125 Volts—50-60 Cycles—100 Watts

Models are also available for 105-125 volt 25-40 cycle A.C. lines. The difference between the 50-60 cycle models and the 25-40 cycle models is the power transformer.

INTRODUCTION

The Graybar No. 500 Receiver utilizes the new A.C. screen grid Radiotrons UY-224, the new power amplifier Radiotron UX-245, and the full wave rectifier Radiotron UX-280. It is a table model receiver which may be used with either a magnetic or dynamic type loudspeaker, and has special provision for energizing the field of a dynamic speaker that uses 40 milliamperes at 300 volts. Figure 1 shows the parts in the receiver assembly and Figure 2 those in the Socket Power Unit.

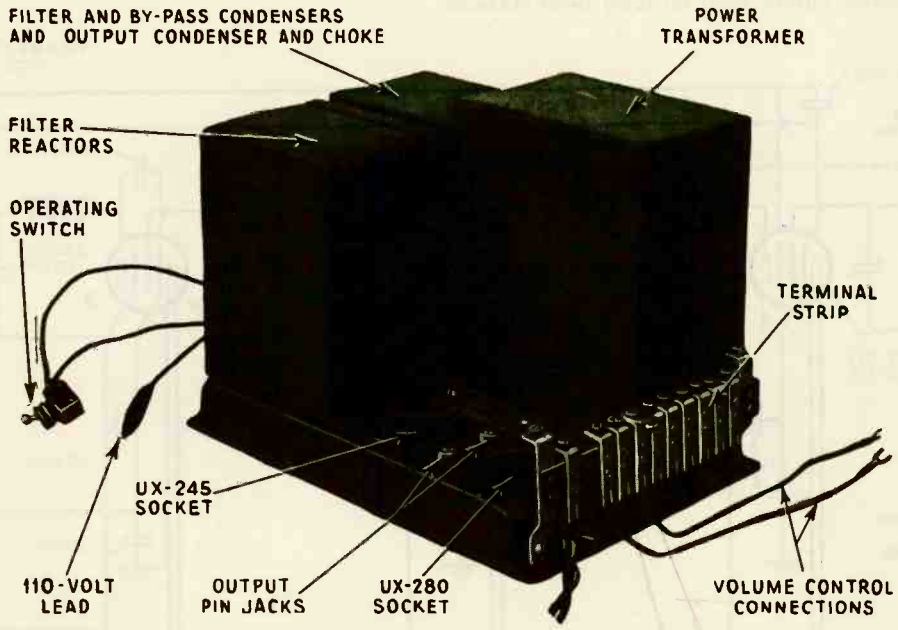

Figure 2—Top view of socket power unit

The sensitivity and selectivity of the No. 500 Receiver is all that can be desired and the fidelity is exceptionally good. The use of the power amplifier Radiotron UX-245 gives a large reserve of power rarely needed, but contributing to the quality of reproduction at any volume.

The following principles are incorporated in the design. Figure 3 shows the schematic circuit diagram.

(a) Three Radiotrons UY-224, one Radiotron UX-245 and one Radiotron UX-280 are used. Two Radiotrons UY-224 are tuned R.F. amplifiers and one Radiotron UY-224 is the power detector. The Radiotron UX-245 is the power amplifier and the UX-280 is the full wave rectifier for converting the A.C. to D.C. for use as plate and grid supply to all other Radiotrons, and field supply to the reproducer unit.

(b) The circuit consists of two tuned radio frequency stages, a power detector and a power amplifier. The detector has sufficient output to drive the power amplifier without an intermediate audio stage.

(c) By using a high inductance antenna loading coil, variations in antenna constants have little effect on the tuning of the circuits. This eliminates the necessity for a coupling tube or different antenna length connections.

(d) A Local-Distant Switch is provided which disconnects the antenna at the local position and connects a condenser in its place from the antenna end of the loading coil to ground. The use of this switch gives the best possible operation from both local and distant stations.

(e) The use of screen grid tubes together with proper shielding eliminates the necessity of neutralizing, or other methods of stabilizing.

(f) A high voltage type detector gives improved quality and sufficient output to directly drive the power amplifier. No audio transformer is used in this receiver. The detector is coupled to the power amplifier by means of impedance coupling which eliminates any distortion that might occur if a transformer were used.

(g) The volume control varies the voltage on the screen grid of the two R.F. amplifiers. This provides a smooth means of controlling volume without distortion and gives a positive cut-off even on loud local stations.

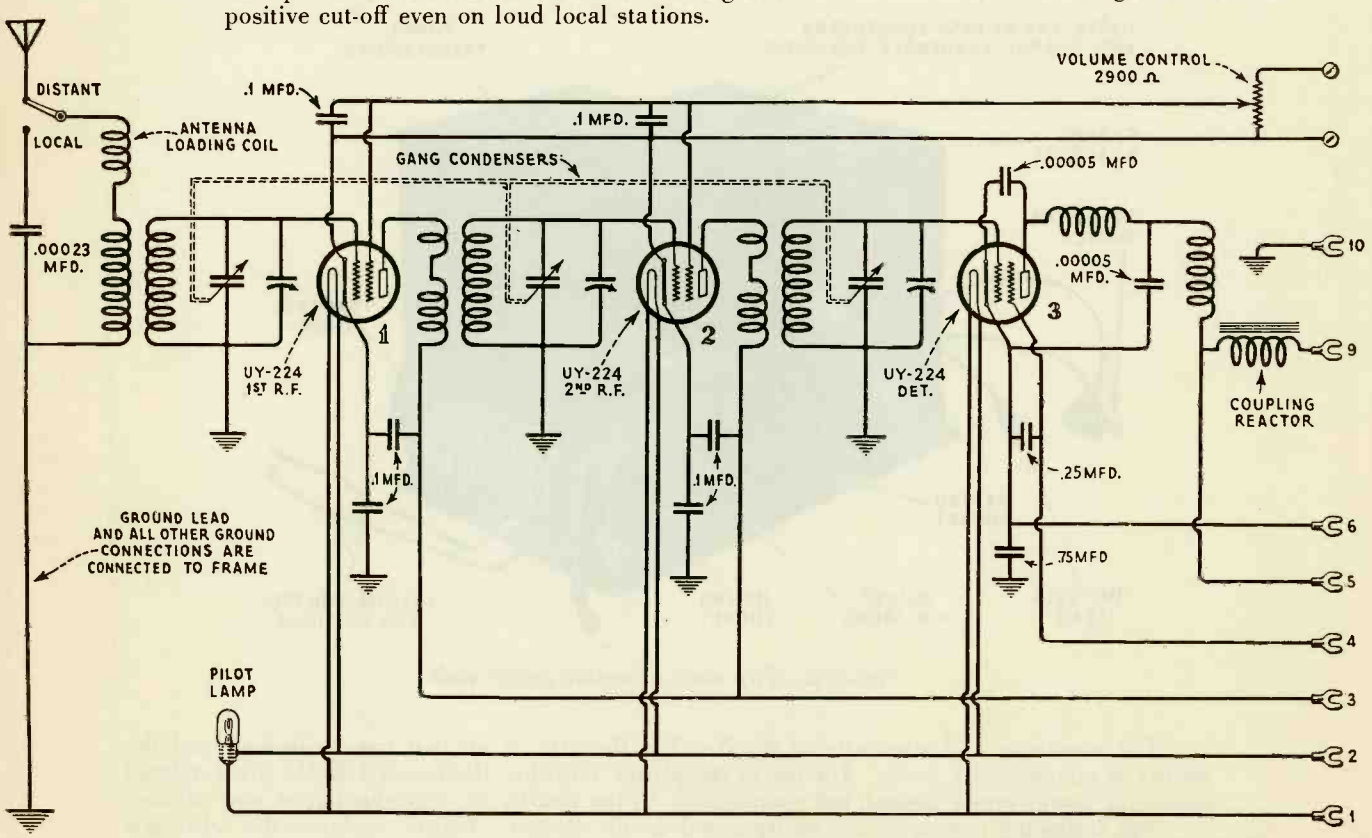

Figure 3—Schematic circuit diagram of

Figure 3 shows the sequence of the Radiotrons. The first and second tuned radio frequency stages and the tuned detector, using Radiotrons UY-224, are in the receiver assembly. The power amplifier UX-245 and the full wave rectifier UX-280 are in the Socket Power Unit.

THEORY OF OPERATION OF A.C. SCREEN GRID RADIOTRON

n grid Radiotron UY-224 is a new type of tube a brief discussion and the surrounding circuits operate will give the service man an nciples involved in the design of No. 500 Receiver.

s five elements compared with the usual three in battery, or ampli- the UY-227 indirectly heated cathode type. These elements are de—both similar with that used in Radiotron UY-227—a plate, a grid placed on both the inside and outside of the plate. Figure ruction of Radiotron UY-224.

es of the screen grid tube are as follows:

effectively shields the plate from the control grid and thereby reable feed back effects from grid to plate capacity in the tube.

rol grid close to the cathode and relatively far from the plate plification constant of the tube enormously which, together with he screen grid, increases the A.C. plate resistance. The plate ance is so high that it is difficult to design an output circuit to obtain full advantage of the amplification of the tube. However, while actual amplification is less than the amplification constant of the tube it is much greater than that obtained

RCA Radiola 46

Intermittent reception in this model has been caused by a faulty 8400-ohm voltage divider that would open and close at irregular intervals within the 900-ohm section. As space is at a premium in this power pack it is best to replace the entire voltage divider. When replacing 24-A tubes with the dome-top type the half shields will not allow the tubes to be inserted because of the tight fit near the middle of the bulb. These shields are made of soft aluminum and the circular opening can easily be enlarged by a little judicious crinkling with a small pair of pliers.

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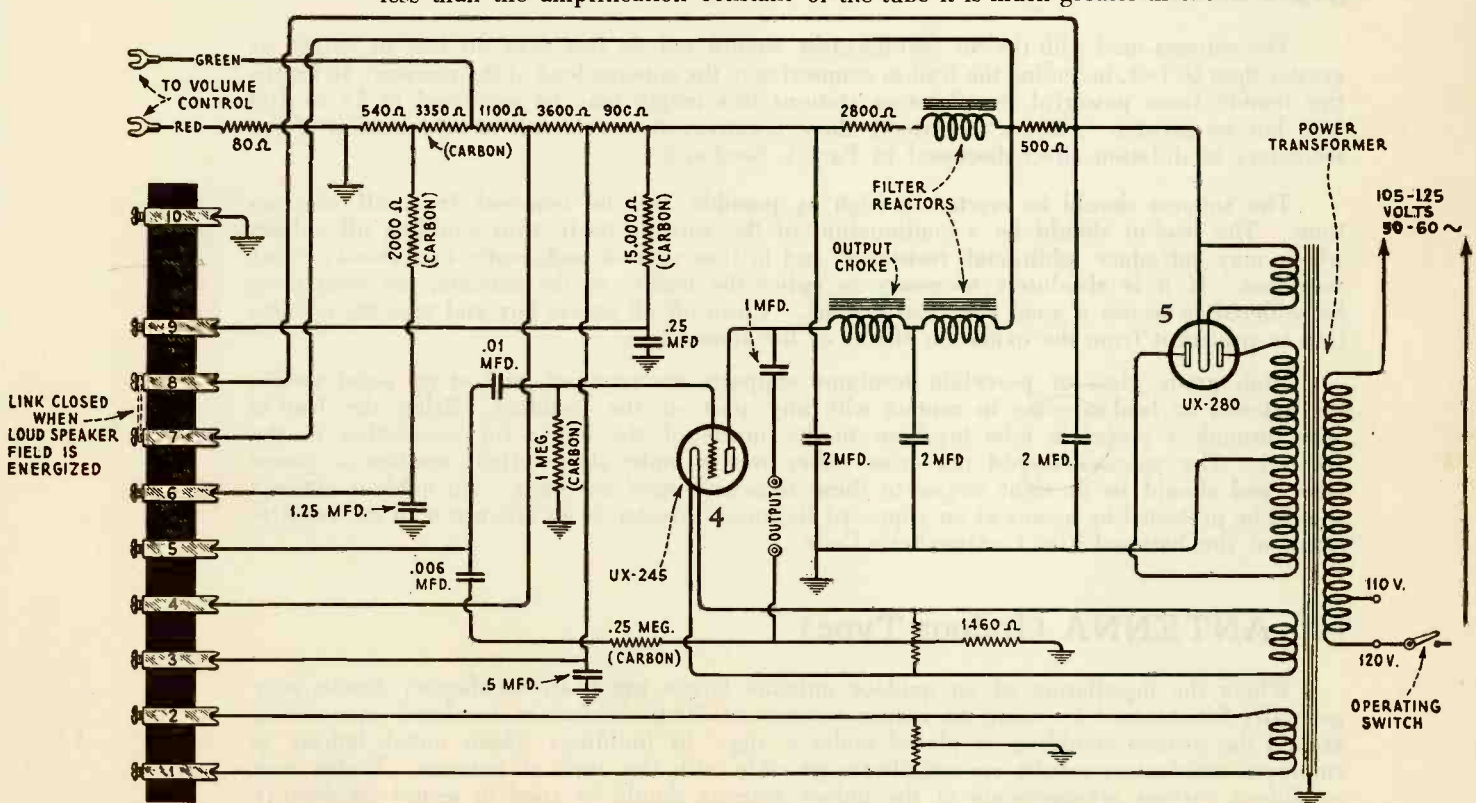

receiver and socket power unit

with other types of tubes. An example of this amplification in practice is presented in the No. 500 Receiver which with two R.F. stages, has a sensitivity approximately the same as receivers using other tubes in four R.F. stages. This high plate resistance and high impedance output circuit also causes the grid circuits to have considerably less R.F. resistance which, together with decreased coupling between the primary and secondary of the R.F. transformer, gives the receiver good selectivity.

(c) A positive potential on the screen grid in relation to cathode is necessary. Variations of this voltage affect the mutual conductance of the tube to the extent that varying this voltage is the means of controlling the volume in No. 500 Receiver. The variation is from 0 volts at minimum volume to 45 volts positive at maximum volume.

The advantage of the effect noted in (a) is that, provided all external circuits are shielded, there is no feed-back or regeneration, which might cause oscillation in any of the circuits. This eliminates the need for neutralizing condensers, grid resistors and other methods of preventing oscillation in the R.F. circuits. As most of these methods reduce the efficiency of the circuits, their absence means a distinct gain in the performance of the receiver.

PART I—INSTALLATION

[1] ANTENNA

The antenna used with the No. 500 Receiver should not be less than 30 feet in length or greater than 50 feet, including the lead-in connection to the antenna lead of the receiver. In localities remote from powerful broadcasting stations this length may be increased to 75 to 100 feet, but no greater. Failure to observe these requirements may result in accentuation of the secondary modulation effect discussed in Part 1, Section 8.

The antenna should be erected as high as possible and be removed from all obstructions. The lead-in should be a continuation of the antenna itself, thus avoiding all splices which may introduce additional resistance and in time corrode sufficiently to seriously affect reception. If it is absolutely necessary to splice the lead-in to the antenna, the joint must be soldered to insure a good electrical contact. Clean off all excess flux and tape the connection to protect it from the oxidation effects of the atmosphere.

High grade glass or porcelain insulator supports are required, and at no point should the antenna or lead-in come in contact with any part of the building. Bring the lead-in wire through a porcelain tube insulator to the inside of the house for connection to the receiver. The antenna should not cross either over or under electric light, traction or power lines, and should be at right angles to these lines and other antennas. An outdoor antenna should be protected by means of an approved lightning arrester in accordance with the requirements of the National Fire Underwriter's Code.

[2] ANTENNA (Indoor Type)

Where the installation of an outdoor antenna is not practical, satisfactory results may generally be obtained by using an indoor antenna of 30 to 50 feet of insulated wire strung around the picture moulding or placed under a rug. In buildings where metal lathing is employed satisfactory results are not always possible with this type of antenna. Under such conditions various arrangements of the indoor antenna should be tried to secure satisfactory results. An indoor antenna is not as efficient as a properly installed outdoor antenna.

[3] GROUND

A good ground is quite as important as the antenna. No specific recommendations can be given in this matter as conditions vary in different locations. Water and steam pipes usually make good grounds. Gas pipes usually make poor grounds, and as a rule, are to be avoided. If neither water nor steam pipes are available, a pipe or metal rod may be driven into the ground to a depth of several feet. The success of this type of ground depends upon the moisture present in the soil. The ground lead should be connected by means of an approved ground clamp to a section of pipe that has been scraped and thoroughly cleaned. The connection should be inspected from time to time to make certain that a clean and tight electrical contact exists between the clamp and pipe. The service man should experiment with various grounds, and employ the one giving the best results.

[4] SPECIAL ANTENNA INSTALLATIONS FOR NOISY LOCATIONS

In line with other receivers, when the No. 500 Receiver is installed in some city locations, such as apartment houses, hotels and office buildings, it is possible that the level of noise compared with the signal strength of the desired station may be such that the station cannot be received without an objectionable noise background. This noise may be defined as inductive interference from electrical devices such as elevator motors, generators, violet ray machines, professional equipment etc. It may have no apparent radio frequency peak, or it may have a road peak. The effect of the noise may be divided into the following three general classes:

(a) Where the noise level is zero with no antenna or ground, but is equally great on either an indoor or outdoor antenna.

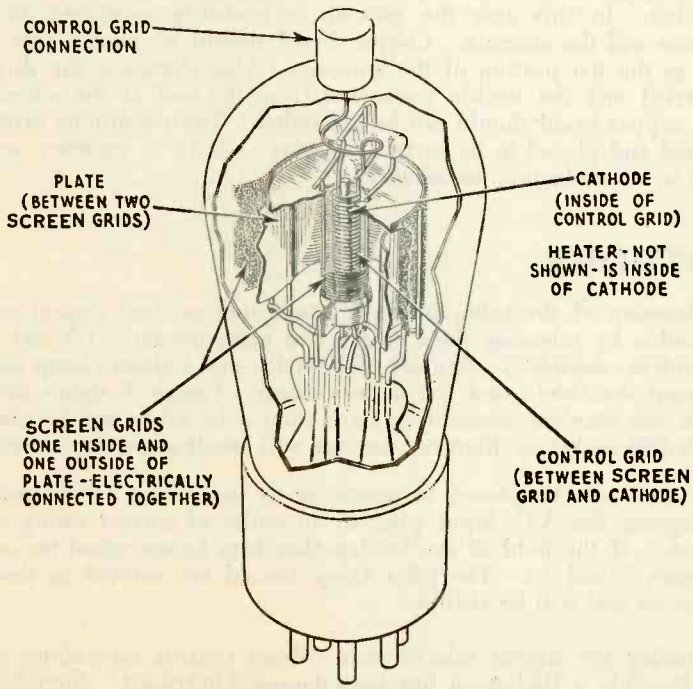

Figure 4—Layout of Radiotron UY-224

(b) Where the noise is equally great with the antenna and ground either connected or disconnected.

(c) Where the noise level is greater when the outside antenna is connected than when an inside antenna is used; the inside antenna, however, not giving sufficient pick-up for satisfactory reception.

In (a) where the noise level is zero with no antenna or ground connected, but equally great with either an indoor or outdoor antenna, it is at once apparent that the interference is not being brought into the receiver over the power supply lines. It has been found in such cases that an antenna five feet long inside the room picked up as much noise as when an entire outside antenna lead-in were used. This indicates that the noise is within the building and, in the case of the outside antenna, is being picked up on that portion of the lead-in that enters and goes through the building. In such cases the receiver should be located close to the point where the outside lead-in enters the building. If this is impractical the Receiver can be placed in any location and a copper braid placed over the inside portion of the lead-in wire. This braid is not grounded. If the noise level is still appreciable a good receiver ground with a short lead must be obtained. A long lead is not desirable, as it may pick up noise.

In (b) the noise is picked up with no antenna or ground connected to the receiver. This indicates the noise is entering the receiver through the power lines. In this case filters must be placed in the power supply at the source of the noise or at the receiver, depending on conditions. If the trouble is cleared up in this manner when the antenna and ground are disconnected, but again appears with the use of the antenna system, the remedies suggested in (a) must be applied.

In (c) the noise is greater when the outside antenna is connected than when an inside antenna is used. The use of the inside antenna, however, does not give sufficient pick-up for satisfactory reception. In this case the pick-up is probably occurring on the lead-in wire between the Receiver and the antenna. Copper braid should be placed over the entire lead-in from the receiver to the flat portion of the antenna. Also changing the direction of the antenna should be tried and the lead-in connected from the end of the antenna that gives the best results. The copper braid should not be grounded. The conditions existing in any locality must be analyzed and placed in its correct category. A little patience and experimenting will usually result in a satisfactory installation.

[5] RADIOTRONS

The correct location of the tubes is plainly indicated on their respective sockets. Remove the two copper shields by releasing their clamp and place the three UY-224 Radiotrons in the sockets of the receiver assembly. Replace the shields and tighten clamp sufficiently to make good contact between the shield and the main casting. Figure 5 shows the shields in their correct position in the receiver assembly. Care should be taken not to place the Radiotron UX-245 in the UX-280 socket as filament damage will result when the current is turned "On."

The Receiver may now be placed in operation by connecting a loudspeaker to the output pin jacks and plugging the A.C. input plug to an outlet of correct rating and turning "On" the operating switch. If the field of the loudspeaker is to be energized the connections should be made to terminals 7 and 10. The pilot lamp should be inserted as described in Part 1, Section 9, otherwise no dial will be visible.

If, when adjusting the station selector and volume control, no stations are heard examine the Radiotrons. Possibly a Radiotron has been damaged in transit. Interchanging with others of the same type known to be in good condition will isolate the damaged one.

[6] ADJUSTMENT FOR LOW LINE VOLTAGES

A lead is provided on the side of the S.P.U. for use when the No. 500 Receiver is connected to lines, the voltage of which never exceeds 115 volts. A good plan is to allow the lead to remain as connected in manufacture unless unsatisfactory operation is experienced. Should adjustment be necessary, however, proceed as follows:

(a) Open the top of the Receiver.

(b) Connected to the operating switch will be found two soldered connections, one of which has a transformer lead (black with red tracer) connected to the switch. Unsolder this connection and then tape up the black with red tracer lead so that it will not ground or short to other parts.

(c) A black and red lead will be found taped up and not used. Untape this lead and clean the end for soldering.

(d) Solder this lead just untaped to the switch connection from which the black with red tracer lead has been removed.

The 110-volt tap of the transformer is now properly connected and the Receiver may be used on 105-115 volt lines with maximum efficiency. Figure 14 illustrates the changes to be made.

[7] JERKY ACTION OF STATION SELECTOR

Should operation of the station selector be stiff or jerky a little oil dropped on each condenser bearing will effectively remedy this condition. When experiencing this trouble it is also well to check the cable tension spring to make sure that suitable tension is being applied to the condenser drive cable.

[8] USE OF LOCAL-DISTANT SWITCH

A switch is provided on the No. 500 Receiver termed the Local-Distant Switch. This switch at the local position disconnects the antenna and connects a .00023 mfd. condenser across the

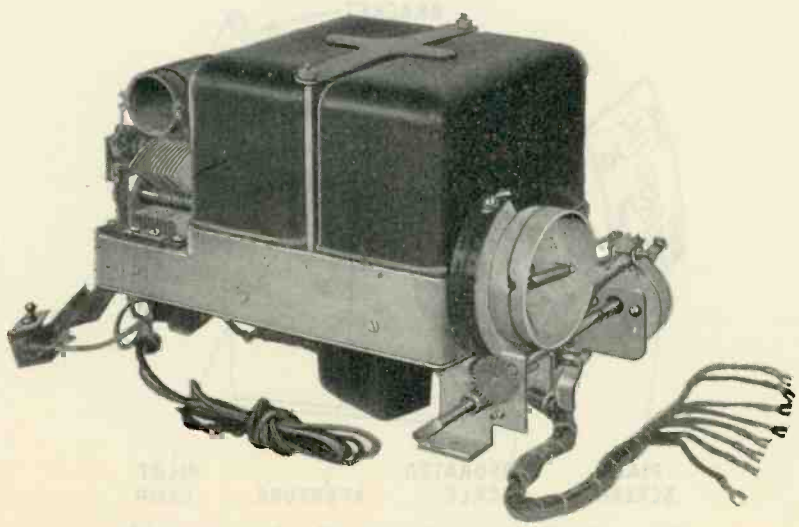

Figure 5—Top view of receiver assembly with shields in place

antenna point of connection to ground. The purpose of this switch is to prevent the strong carrier of a local station from overloading the tubes, thereby causing distortion. Also under certain conditions a very powerful local station may impose its modulation frequency upon the carrier wave of a station to which the receiver is tuned. Both of these conditions happen only when the switch is improperly operated. Keep the switch as a general rule at the local position, unless sufficient pick-up is not obtained to receive the desired signal, when the switch may be thrown to the distant position.

[9] INSTALLATION OF PILOT LAMP

A projection type of dial lighted by a small concentrated filament lamp is used in the No. 500 Receiver. The lamp is mounted so that its rays pass through the pierced scale of the dial and then project the scale divisions on an amber window on the front of the cabinet. It is therefore important to mount the lamp so that its rays will pass through the correct openings to fully illuminate the scale readings on the window. Figure 6 shows the general arrangement of the pilot lamp and dial.

To install the pilot lamp proceed as follows:

Turn the station selector counter-clockwise to its extreme position so that the pilot lamp mounting will be accessible. Open the lid and remove the socket clamp from its bracket and screw the lamp firmly into the socket. Replace the socket clamp on its bracket.

Now turn the power "On" at the operating switch. With the station selector in the extreme counter clockwise position adjust the socket clamp on its brackets until the zero mark on the scale projected on the dial screen is about ¼ inch below the index pointer.

To replace a bulb, open the lid of the receiver and pull the socket back from its position and remove the old bulb. Place the new one in the socket and screw in tightly. The socket is then pushed down until the front window is properly illuminated. There may be a slight variation in the centering of the filaments of various lamps which might tend to throw the light too much to one side of the window. If this happens pull the socket out and bend the metal arm that holds the socket to one side until the rays of the lamp properly illuminate the scale window. Now tune in a station, the dial setting of which is known. If the dial

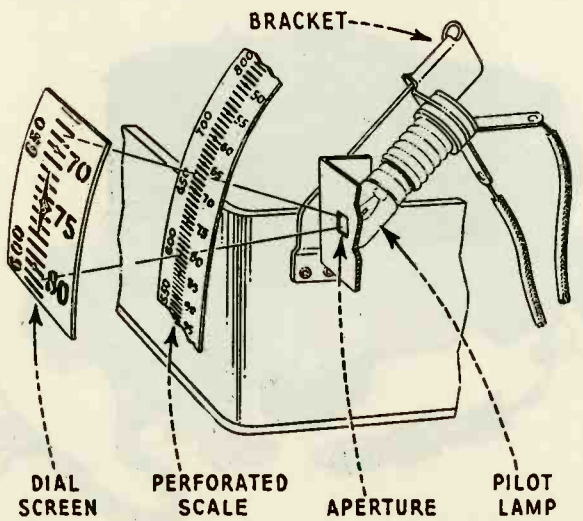

Figure 6—Tuning scale and pilot lamp assembly

setting for the station tuned in is different from that formerly obtained pull the lamp back or push it forward until the dial reads the same as that previously obtained for that station.

[10] SHIELDS

Two large shields are used in the No. 500 Receiver to cover the second R.F. and detector stages. Also two tube shields are placed around the first and second R.F. tubes. The two shields fit snugly in palce into the base casting. The two large shields over the second R.F. and detector stages have clamps on each side that make contact with the rotor shaft of the gang condenser. Also an external clamp is provided to hold the shields in place.

The proper placing of the shields is very important, because unless the circuits are shielded as intended oscillation will occur. Therefore, whenever replacing tubes, or whenever the shields are removed for any reason, see that they are properly returned to their normal position.

[11] CONNECTIONS FOR SUPPLYING FIELD CURRENT TO EXTERNAL DYNAMIC TYPE LOUD SPEAKERS

Provision is made in the No. 500 Receiver for supplying the field current to a dynamic loud-speaker the field of which has a rating of 300 volts, 40 milliamperes. In order to make such a connection to the receiver proceed as follows:

(a) Lift lid of cabinet and remove the cover of the S.P.U. terminal strip.

(b) Close the link between terminals 7 and 8, counting from the terminal nearest the front of the Receiver.

(c) Connect the loudspeaker field leads to terminals 7 or 8 (connected by link) and terminal No. 10. Be careful not to disturb the connection already connected to terminal No. 10.

The field is now properly connected and the terminal strip cover should be replaced and the lid closed. The output of the receiver is connected in the usual way to the loudspeaker by connecting the loudspeaker input to the out-put pin jacks on the S.P.U.

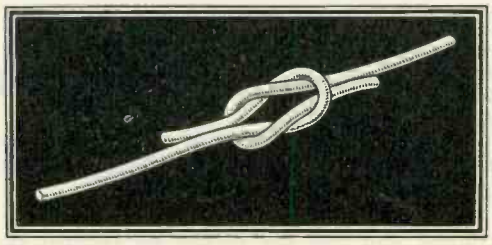

Figure 7—Square knot in repairing drive cord

PART II—SERVICE DATA

[1] ANTENNA SYSTEM FAILURES

A grating noise may be caused by a poor lead-in connection to the antenna, or the antenna touching some metallic surface, such as the edge of a tin roof, drain pipe, etc. By throwing the "local-distant" switch to the "local" position and noting whether the noise decreases or not, the service man can determine whether the cause of the noise is within or external to the receiver and plan his work accordingly.

[2] RADIOTRON SOCKETS AND PRONGS

The sockets used in the No. 500 Receiver are three single UY sockets in the receiver assembly and a two-gang UX socket used in the S.P.U. A socket contact may not be in its correct position and the forced insertion of a tube will bend or break it. If care is exercised and the Radiotron inserted gently, little trouble will be experienced with socket contacts. A bent one will be noticed on inspection and may be corrected by inserting a narrow instrument in the socket hole and pushing the contact into its correct position. A badly bent or broken socket contact must be replaced either individually or by replacing the socket.

In addition to the tube contacts there are provided small spring clips that connect to the control grid connection at the top of the Radiotrons UY-224. These must fit snugly and make good connection. Whenever a tube is replaced care should be taken to make sure that the spring clip is replaced on the tube and that it makes a good clean tight connection.

Dirty Radiotron prongs or contacts may cause noisy or intermittent operation in the receiver. It is therefore advisable to periodically clean them with fine sandpaper to insure good contact. The use of emery cloth or steel wool is not recommended. Before re-inserting the Radiotrons in their sockets wipe the prongs carefully to make certain that all particles of sand are removed.

If a Radiotron will not fit into a socket without considerable pressure, look for excessive solder on one or more of the prongs. Excessive solder on the prongs may be removed with a file or knife.

[3] IMPROPERLY OPERATING VOLUME CONTROL

The volume control in the No. 500 Receiver is operated through a gear arrangement, half of which is the control knob. The shaft is divided with an insulating strip as the rotating arm is not at ground potential.

Should the volume control slip and not follow the control knob first make sure the knob is tight against the cabinet and the station selector knob tight against the volume control knob. Then examine the insulating strip and make sure it is still in its correct position.

Noise or grating noises occurring when the volume control is adjusted can generally be remedied by turning the control knob to each extreme position several times. If this does not clear up the trouble a little alcohol applied with a smoking pipe cleaner to the resistance strip will dissolve any dirt or rosin.

Excessive pressure applied after the control has been moved to the stop position may bend the moving arm and subsequent use may wear and cut the wire. Users should therefore be cautioned not to try to turn the knob beyond the stops at each extreme.

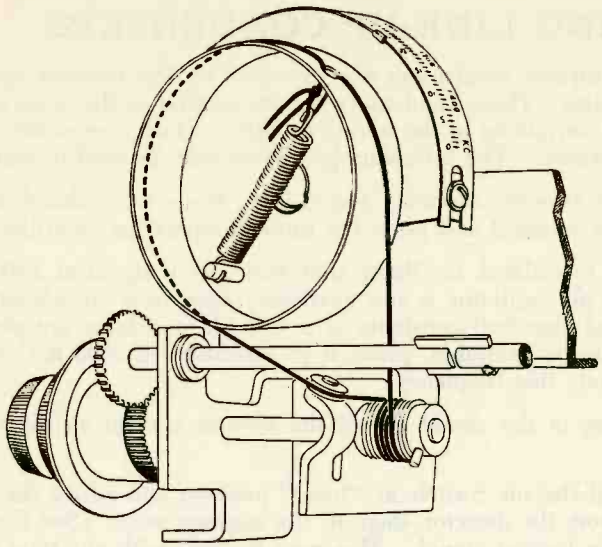

Figure 8—Drive cord arrangement

[4] BROKEN CONDENSER DRIVE CORD

The main tuning condensers are controlled by the station selector knob, the motion of which is transmitted by means of a rugged fish line to the drum on the end of the tuning condensers. Should this cord become broken, and a new one not be available, a temporary repair may be made by tying the two ends together by means of a square knot (see Figure 7), and then replacing the cord in its correct position as shown in Figure 8. The shortening caused by the knot can be compensated for by untying the knot at the tension spring end and using a part of the spare length. The tying of the knot at the ends of the cord should be the last operation, because the correct amount of tension can then be obtained at the tension spring. Figure 8 shows the arrangement of the drive cord over the drums. This should be followed when replacing the cord.

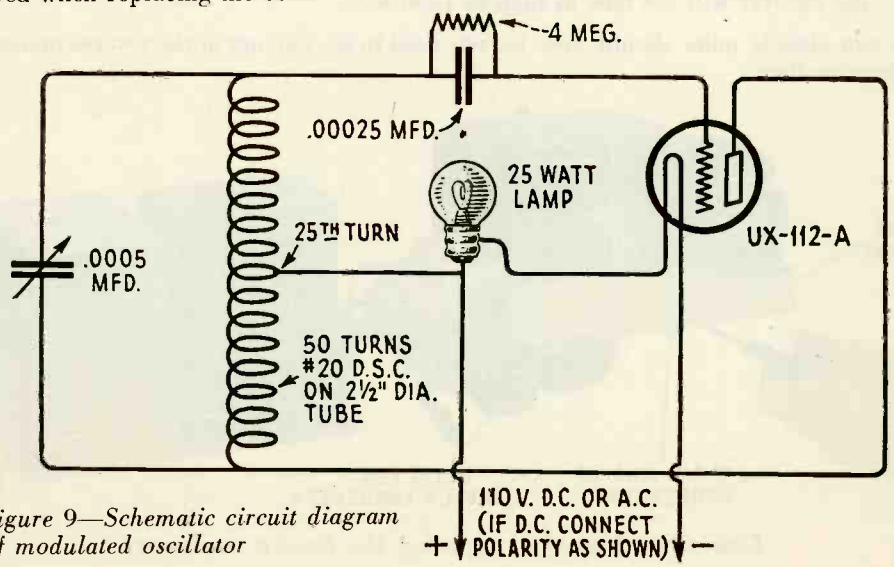

Figure 9—Schematic circuit diagram of modulated oscillator

[5] ADJUSTING LINE-UP CONDENSERS

Three small adjustable condensers are provided on the receiver assembly for lining up the three tuning circuits. These condensers are in parallel to the main tuning condensers and compensate for small variations in the tuning circuits—which are made noticeable by the receiver becoming insensitive. The following procedure may be used to readjust them.

(a) Remove the receiver assembly and S.P.U. from the cabinet as described in Part IV, Sections 1 and 2 and place the units in operating condition.

(b) Procure a modulated oscillator that will give a signal at 1500 K. C. and 600 K.C. or, if such an oscillator is not available, tune to a broadcast signal. The circuit diagram and electrical constants of a suitable oscillator are shown in Figure 9. If the oscillator is available, place it in operation at 1500 K.C. or tune in a signal of approximately this frequency.

(c) After tuning in the signal adjust the volume control so the signal is of moderate strength.

(d) Place Local-Distant Switch at "local" position and adjust the three condensers successively from the detector stage to the antenna stage (See Figure 10), for the position of the loudest signal. This may be done with any type of screwdriver, as the adjusting screws are at ground potential.

(e) After adjusting at 1500 K.C. the various adjustments should be checked at 600 K.C. Should an increase (turning condenser to the right) or a decrease of capacity be necessary at 600 K.C. leave the line-up condensers in the position previously found at 1500 K.C. The adjustment required should then be made by removing the second R.F. and detector stage shields, and bending the end plates of the tuning condensers. Bending the end plate toward the adjacent plate increases the capacity of the condenser and bending it in the opposite direction decreases its capacity.

(f) After lining up at 600 K.C. by bending the condenser plates a re-check should be made at 1500 K.C. Any re-adjustments found necessary should be made. The use of a 1500 K.C. signal is very important because if the adjustment is made at a lower frequency the amount of capacity used at the line-up condensers may be such that the receiver will not tune as high as 1500 K.C.

The two chassis units should now be returned to the cabinet in the reverse manner of that used to remove them.

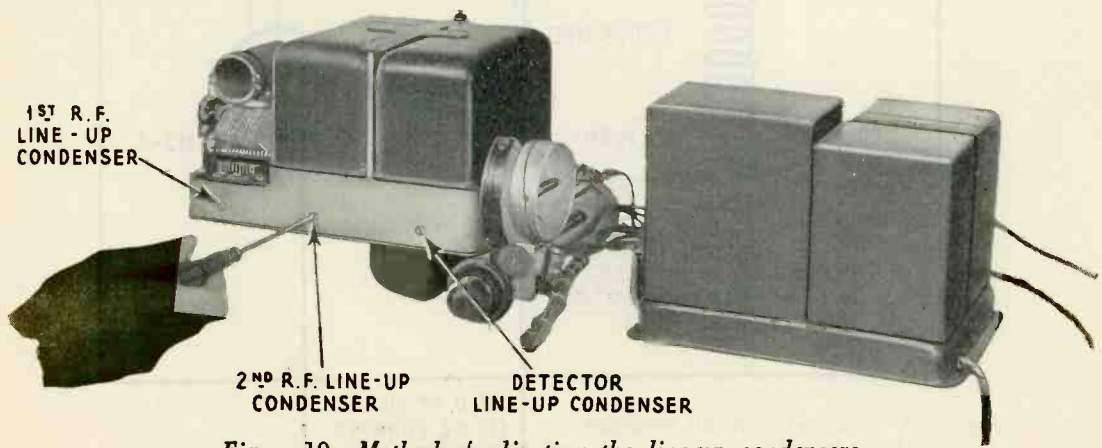

Figure 10—Method of adjusting the line-up condensers

[6] EXCESSIVE HUM

Should excessive hum develop during operation it may be caused by one of the following conditions:

(a) A.C. input plug reversed. Try reversing its position.

(b) Open center tapped resistance unit in S.P.U.

(c) Shorted by-pass and filter condensers. This will generally be accompanied by inoperation in addition to hum.

(d) Low emission Radiotron UX-280.

(e) Defective dynamic speaker, if used.

(f) Open resistance unit. This will generally be accompanied by inoperation.

(g) External pick up. Throw switch to "local" position and see if hum disappears.

[7] ACOUSTIC HOWL

Acoustic howl is caused by the sound waves generated by the loudspeaker vibrating the elements in the Radiotrons. This vibration is amplified electrically and reproduced in the reproducer unit. Conditions being favorable the howl may increase in intensity and drown out the broadcast signal.

This can be remedied by changing the position of the loudspeaker or its relative angle in relation to the receiver. Also interchanging the Radiotrons in the receiver assembly will help.

[8] LOW VOLUME AND WEAK SIGNALS

Low volume and weak signals may be caused by any of the following conditions:

(a) Defective Radiotrons. Check and make any replacement necessary.

(b) Poor antenna system. Install antenna as suggested in Part I, Section 1.

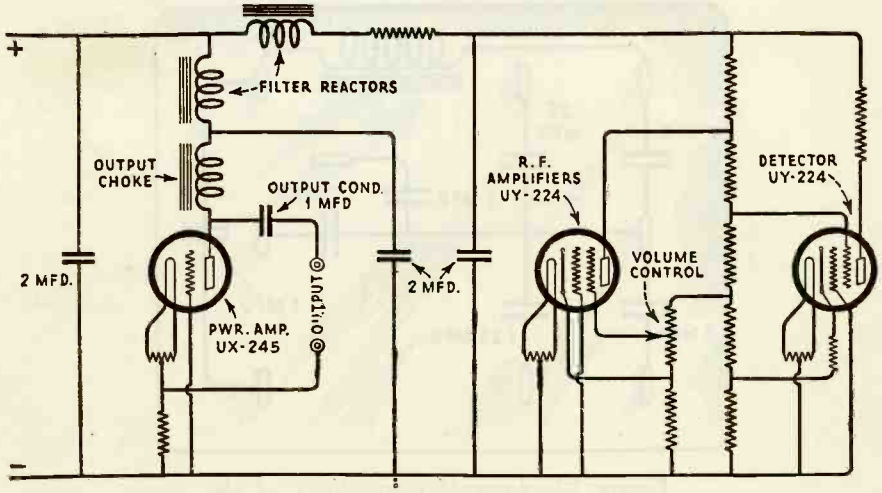

Figure 11—*Abridged schematic circuit diagram of voltage supply system*

(c) Defective receiver assembly. Check by means of continuity test and make any replacement necessary. Also check adjustments of line-up condensers as described in Part II, Section 5.

(d) Defective S.P.U. Check by means off Continuity Test, Part III, Section 4, and make any repairs necessary.

(e) Defective loudspeaker. Check the loudspeaker by substituting one known to be in good condition.

[9] DISTORTED OR NOISY REPRODUCTION

Poor quality or noisy reproduction may be caused by:

(a) Defective Radiotrons. Though the Receiver may be in operating condition a defective Radiotron in any stage will cause distortion. Excessive noise may be due to a defective Radiotron UX-245.

(b) Defective coupling choke, output choke, output condenser, coupling condenser, UX-245 grid resistor or the resistor and condenser used to tune the coupling choke. These parts are all associated with the output tube and a defect in any of them will cause distortion.

(c) Receiver Oscillation. Should the Receiver be oscillating, all signals will be weak, distorted and accompanied by a whistle. Part II, Section 11, gives the various causes of uncontrolled oscillations.

(d) Defective loudspeaker. Make the necessary repairs.

(e) Defective S.P.U. Check by means of continuity test as described in Part III—Section 4.

[10] AUDIO HOWL

Audio howl may be caused by any of the following conditions:

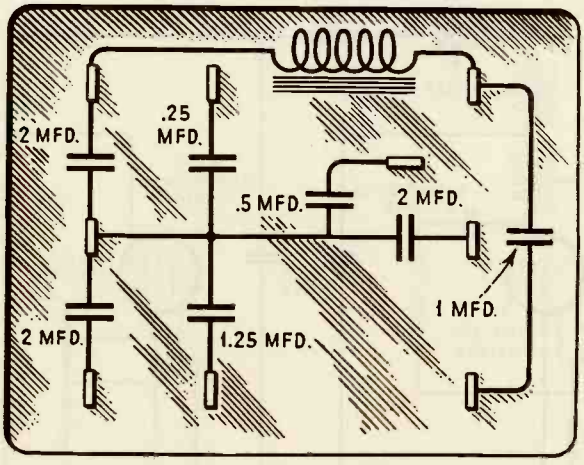

Figure 12—Internal connections of the condenser bank

(a) Receiver oscillation. Check as described in Part II, Section 11.

(b) Open by-pass condensers. An open in any of the by-pass condensers may cause howl.

(c) Vibrating elements in the receiver Radiotrons. A gradually developed howl may be due to the loudspeaker causing the receiver Radiotron elements to vibrate. Check as described in Part II, Section 7.

[11] UNCONTROLLED OSCILLATIONS

Should oscillation occur throughout or in any part of the tuning range, it may be due to:

(a) Shields not properly in place or not making contact with the base. The correct placing of the shields both around the tubes and over the entire stage is important to prevent oscillation.

(b) Shield over antenna lead to local distant switch not grounded or properly covering the leads.

(c) Defective R.F. filter in detector plate cirrcuit. There are two filters, one of which is shunted by two condensers in the plate circuit of the detector. Should the filters become defective or the condensers open, oscillation will occur.

(d) Contact clips between shield and condenser shaft broken or not making good contact.

(e) Open by-pass condenser. Should any of the by-pass condensers in the receiver assembly be open, oscillation will occur.

(f) Defective Radiotron UY-224. Replace by a Radiotron known to be in good operating condition.

[12] VOLTAGE SUPPLY SYSTEM

The voltage supply system used in the No. 500 Receiver is a combination parallel arrangement, with some circuits also using series resistors. Figure 11 is an abridged schematic circuit that illustrates the method employed to obtain the correct potentials.

PART III—ELECTRICAL TESTS

[1] TESTING FILTER CONDENSERS AND OUTPUT CONDENSER AND CHOKE

The filter condensers and output condenser and choke are all in one metal container. Their internal wiring diagram is shown in Figure 12.

The choke can best be tested by clicking from each end. The condensers are tested by charging them with approximately 200 volts D.C. and then noting their ability to hold the charge. After charging, short circuiting the condenser terminals with a screwdriver should produce a flash, the size of the flash depending on the capacity of the condenser and the voltage used for charging. A condenser that will not hold its charge, or a choke that clicks open is defective and requires replacement of the entire unit.

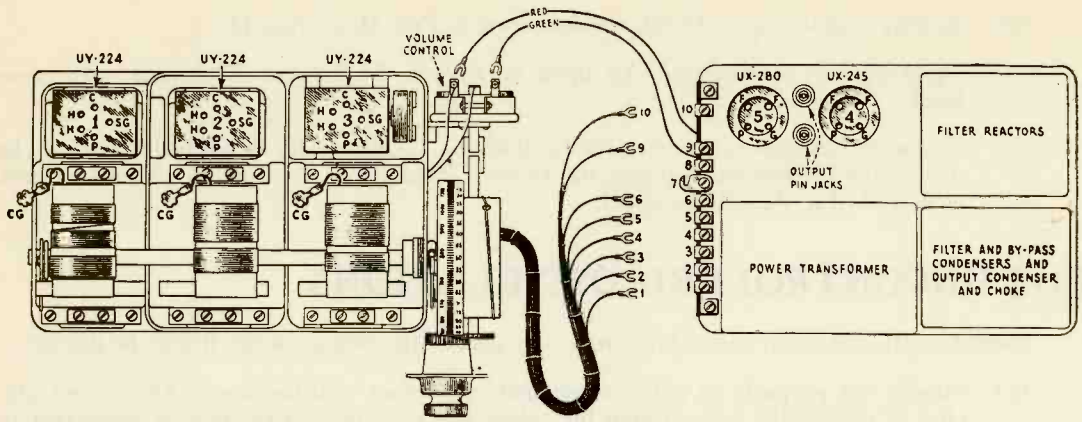

Figure 13—*Layout showing location of the various Radiotron sockets, S.P.U. terminal numbers, and main parts of the set*

[2] CHECKING RESISTANCE VALUES

The values of the various resistance units of the No. 500 Receiver are shown in the schematic diagram, Figure 3. When testing a receiver for defects the various values of resistance should be checked. This may be done by a resistance bridge; the voltmeter-ammeter method shown in previous Service Notes, or by the following method.

For resistances of low value, 5000 ohms or less, use a voltmeter having a resistance not greater than 100 ohms per volt. For high values of resistance use a meter of 1000 ohms or more per volt. The Weston Meters, Type 301 or 280, each have a resistance of 62 ohms per volt and are satisfactory for the low values. Use sufficient battery to give a good deflection on the meter, for example, a 45-volt "B" battery for a 0--50 volt meter. Then take two readings, one of the battery alone, and one of the battery with the unknown resistance in series. Then apply the following formula.

$$\left(\frac{\text{Reading obtained of battery alone}}{\text{Reading obtained with resistance in series}} - 1 \right) \text{Resistance of meter} = \text{Unknown Resistance}$$

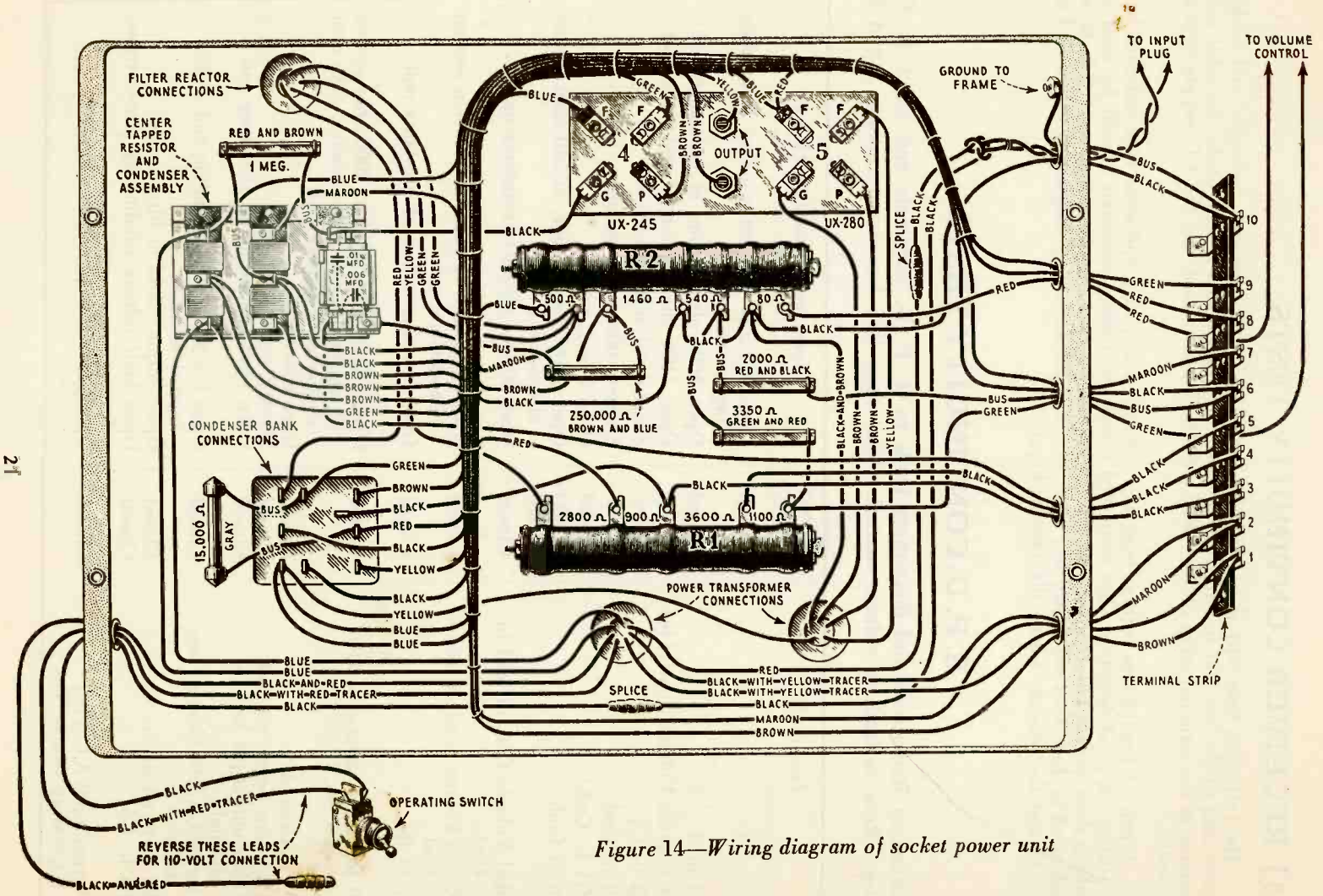

Figure 14—Wiring diagram of socket power unit

[3] RECEIVER CONTINUITY TESTS

The following tests will show complete continuity for the receiver assembly and socket power unit of the No. 500 Receiver. Disconnect the antenna and ground leads; the cable connections at the terminal strip of the S.P.U.; the loudspeaker cord, and the A.C. supply cord at its outlet.

A pair of headphones with at least 4½ volts in series; or a voltmeter with sufficient battery to give a good deflection when connected across the battery terminals should be used in making these tests. The receiver and S.P.U. Radiotron sockets, numbers, lugs and S.P.U. terminals used in these tests are shown in Figure 13. The S.P.U. wiring diagram is shown in Figure 14 and the receiver wiring diagram in Figure 15.

S. P. U. CONTINUITY TESTS

Remove Radiotrons and disconnect leads to S. P. U. terminals and input A. C. plug. Remove leads to volume control. Also open link between terminals 7 and 8.

Terminals	*Correct Effect*	*Incorrect Effect Caused by*
1 to 2	Closed	Open UY-224 filament winding and center tapped resistance
3 to 4	Closed	Open 3600 ohm section of resistance unit
4 to green Volume Control lead	Closed	Open 1100 ohm section of resistance unit
5 to G4	Open	Shorted .01 mfd. condenser
5 to Gnd.	Open	Shorted .006 mfd. condenser
G4 to Gnd.	Closed	Open 1 meg. resistor
6 to Gnd.	(Weak) Closed	Open 2000 ohm resistor, or 540 ohm section of resistance unit
Red Volume Control lead to Gnd.	Closed	Open 80 ohm section of resistance unit
Green Volume Control lead to Gnd.	Closed	Open 3350 ohm resistor or 540 ohm section of resistance unit
7 to 8	Closed	Open 500 ohm section of resistance unit
9 to one filament contact of socket No. 5	Closed	Open 15,000 ohm registor, 2800 ohm section of resistance unit filter reactor, 500 ohm section of resistance unit
10 to Ground	Closed	Open connection
P4 to one output pin jack	Open	Shorted output condenser
Other output pin jack to ground	Closed	Open 1460-ohm section of resistance unit
Across UX-245 filament contacts	Closed	Open UX-245 filament winding and center tapped resistor
P4 to terminal No. 7	Closed	Open output choke or filter reactor
P5 to G5	Closed	Open high voltage winding of power transformer
Across input A.C. plug (Operating switch "On")	Closed	Open primary of power transformerr

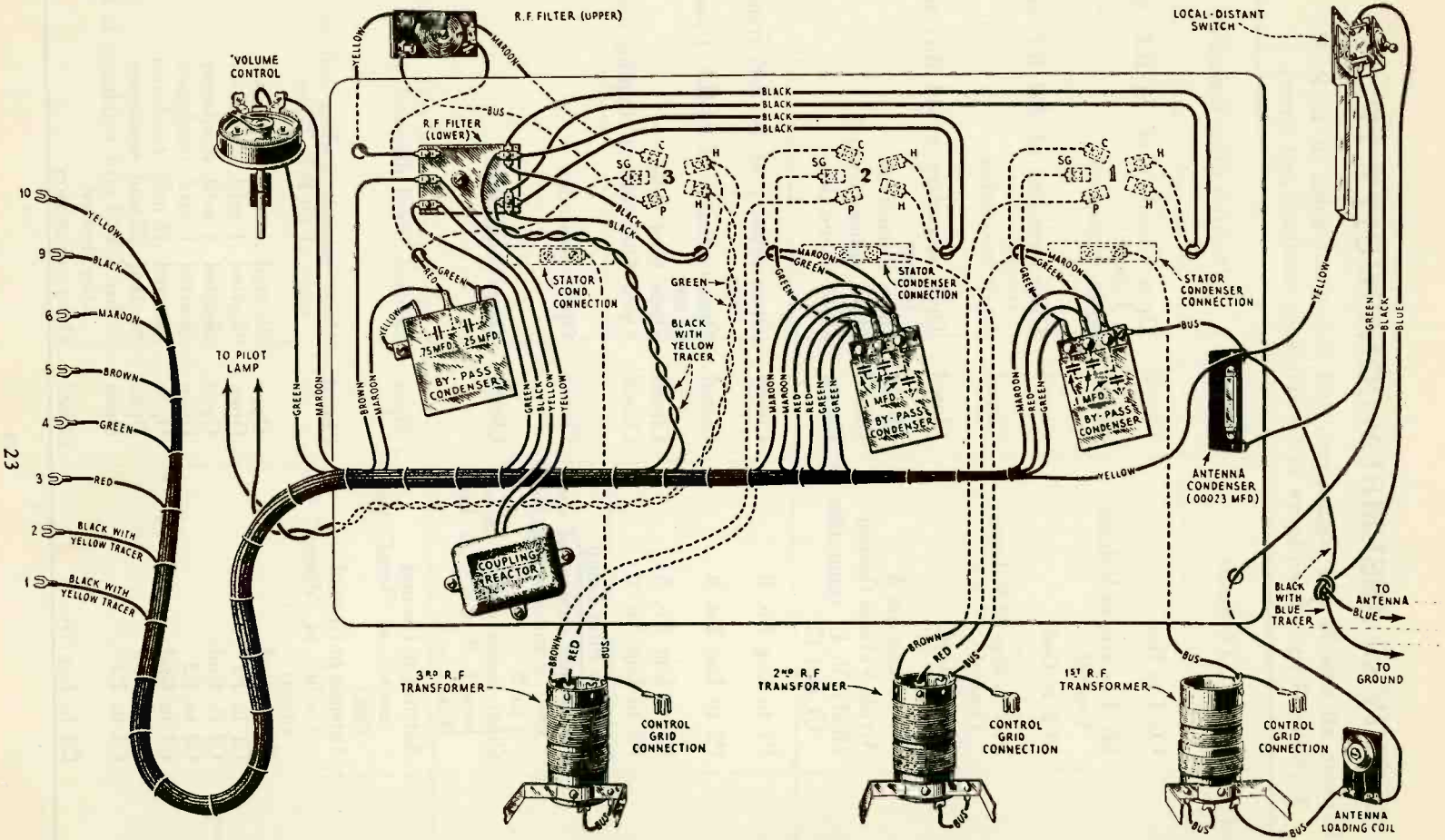

Figure 15—Wiring diagram of receiver assembly

RECEIVER ASSEMBLY CONTINUITY TESTS

Remove all shields and Radiotrons, and disconnect cable at S. P. U. Terminal Strip. See Figure 13 for reference numbers and letters.

Circuit	*Terminals*	*Correct Effect*	*Incorrect Effect Caused by*
Grid	CG 1 to Gnd.	Closed	Open secondary of 1st R.F. transformer
	SG 1 to arm of Volume Control	Closed	Open connection
	CG2 to Gnd.	Closed	Open secondary of 2nd R.F. transformer
	SG2 to arm of Volume Control	Closed	Open connection
	CG3 to Gnd.	Closed	Open secondary of 3d R.F. transformer
	SG3 to Lug No. 4	Closed	Open connection
	Across Volume Control	Closed	Open volume control
	(Red) V. C. connection to C1 and C2	Closed	Open connection
Plate	P1 to Lug No. 3	Closed	Open primary of 1st R.F. transformer
	P2 to Lug No. 3	Closed	Openn primary of 2d R.F. transformer
	P3 to Lug No. 5	Closed	Open filter coils
	P3 to Lug No. 9	Closed	Open filter coils or coupling reactor
Heater	Unscrew Pilot Lamp		
	One heater contact of sockets 1, 2 and 3 to Lugs Nos. 1 or 2	Closed	Open connection
	Other heater contact of sockets 1, 2 and 3 to Lugs Nos. 1 or 2	Closed	Open connection
Miscellaneous	Antenna to Ground (Switch at "local" position)	Open	Shorted "local distance" switch
	Antenna to Ground (Switch at "distant" position)	Closed	Open antenna loading coil or primary of 1st R.F. Trans.
	C1 to Gnd.	Open	Shorted .1 mfd. condenser
	C1 to P1	Open	Shorted .1 mfd. condenser
	C2 to Gnd.	Open	Shorted .1 mfd. condenser
	C2 to P2	Open	Shorted .1 mfd. condenser
	C3 to Gnd.	Open	Shorted .75 mfd. condenser
	C3 to SG3	Open	Shorted .25 mfd. condenser
	C3 to P3	Open	Either .00005 mfd. condenser in R.F. filter shorted
	C3 to Lug No. 6	Closed	Open connection

[4] VOLTAGE READINGS

Due to the type of tube used in the No. 500 Receiver the use of a test set, such as Weston Model 537, Type 2, is not very satisfactory means of checking socket voltages to obtain a rough continuity check of the circuits. The following voltages are taken at the terminal strip of the S.P.U. with all the tubes and shields in place and the receiver in normal operating condition.

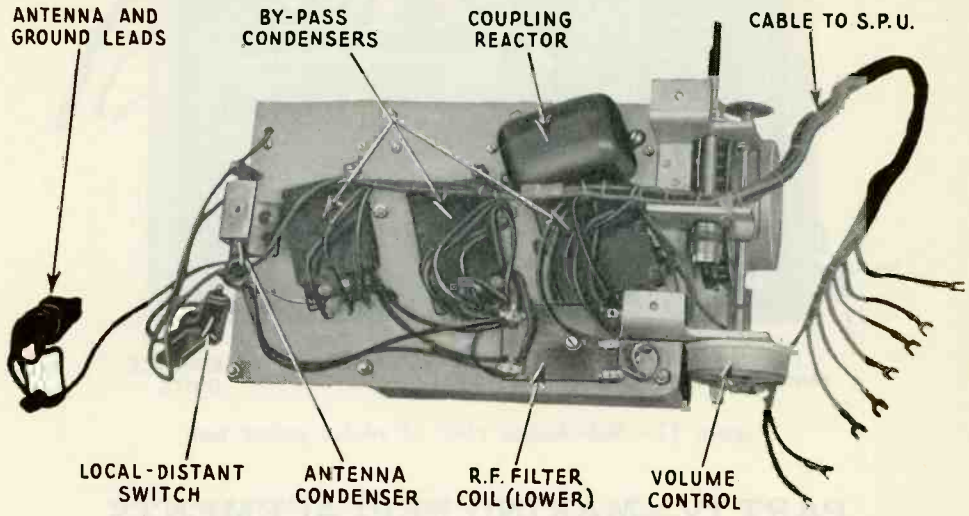

Figure 16—Sub-chassis view of receiver assembly

VOLTAGE READINGS

Terminals	*Volume Control at*	
	Minimum	*Maximum*
1 to 2	2.5 A.C.	2.5 A.C.
3 to 10	175 D.C.	165 D.C.
4 to 10	75 D.C.	70 D.C.
5 to 10	185 D.C.	175 D.C.
6 to 10	10 D.C.	8 D.C.
7 to 8	30 D.C.	30 D.C.
7 to 10	330 D.C.	330 D.C.
8 to 10	360 D.C.	350 D.C.
9 to 10	185 D.C.	185 D.C.

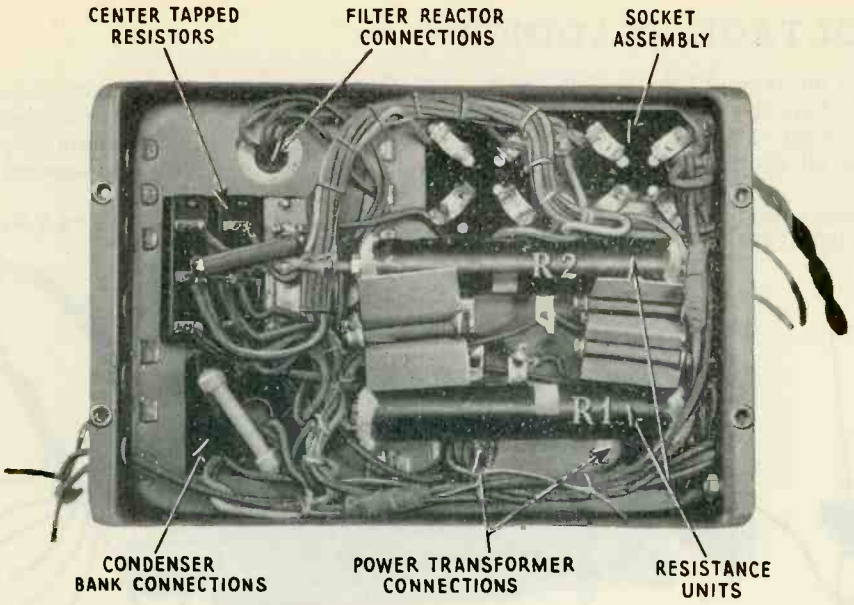

Figure 17—Sub-chassis view of socket power unit

PART IV—MAKING REPLACEMENTS

The various assemblies and parts of the No. 500 Receiver are readily accessible and replacements can be made easily. Figure 16 illustrates the sub-chassis parts on the receiver assembly and Figure 17 the sub-chassis parts in the socket power unit. The following detailed procedure outlines the simplest methods to be used when making replacements.

[1] REMOVING RECEIVER ASSEMBLY FROM CABINET

When making any replacements in the receiver assembly it is first necessary to remove it from the cabinet. The following procedure should be used:

(a) Remove the escutcheon that holds the Local-Distant Switch in place and then remove the switch and shield from the escutcheon by removing the collar that holds the switch.

(b) Remove the cable connections to the S.P.U. terminal strip. Also remove the two S.P.U. connections to the volume control.

(c) Remove the two knobs from the station selector shaft. These are just pulled off.

(d) Remove the three machine screws and washer that hold the receiver assembly to the bottom of the cabinet. The chassis may now be lifted clear of the cabinet and placed in a position convenient for work. After the replacement has been made it should be returned to the cabinet in the reverse manner of that used to remove it. Make sure the gear teeth on the volume control knob mesh with the gear on the control shaft.

(e) Just before tightening the screws that hold the receiver assembly to the cabinet place the Receiver in operation and note whether or not the dial screen is properly illuminated. Should the light be off to one side the chassis may be shifted slightly until the screen is properly illuminated. The screws are then tightened.

[2] REMOVING S. P. U. FROM CABINET

To remove the S.P.U. from the cabinet proceed as follows:

(a) Remove the operating switch from its escutcheon plate by removing the escutcheon and then twisting the switch mechanism until the collar and the switch will come clear of the escutcheon.

(b) Remove all connections to the S.P.U. terminal strip and the two leads to the volume control.

(c) Remove the four machine screws that hold the S.P.U. to the bottom of the cabinet. The S.P.U. may now be lifted clear of the cabinet and placed in a position convenient for work. It is replaced in the cabinet in the reverse manner of that used to remove it.

SERVICE DATA CHART

Before using the following Service Data Chart, when experiencing no signals, weak signals, poor quality, noisy intermittent reception, howling and fading, first look for defective tubes or a poor antenna system. If imperfect operation is not due to these causes the "Service Data Chart" should be consulted for further detailed causes. Reference to Part No. and Section No. in the "Service Notes" is also noted for further details.

Indications	*Cause*	*Remedy*
No. Signals	Defective operating switch	Repair or replace switch
	Defective volume control	Replace volume control
	Defective R.F. transformer	Replace R.F. transformer
	Defective coupling reactor	Replace coupling reactor
	Defective by-pass condenser	Replace by-pass condenser
	Defective S.P.U.	Check S.P.U. and replace any defective part. P. III, S. 4
Weak Signals	"Local Distant" switch not on "Distant" position	Throw switch to "Distant" position P. I, S. 8
	Line-up condensers not adjusted properly	Adjust line-up condensers properly. P. II, S. 5
	Defective main tuning condensers	Check main tuning condensers and make adjustments necessary. P. II, S. 5
	Defective parts in receiver assembly	Replace any defective parts in receiver assembly
	Defective parts in S.P.U.	Replace any defective parts in S.P.U.
	Low line voltage	Adjust transformer for low line voltage. P. I, S. 6
Poor Quality	Defective coupling reactor, condenser or resistor in coupling circuit	Replace any defective parts
	Defective output condenser or choke	Replace output condenser and choke
	"Local Distant" switch not properly operated	Operate "Local Distant" switch correctly. P. I, S. 8
Audio Howl	Receiver oscillating	Correct cause of oscillation. P. II, S. 11
	Defective audio system	Correct and repair any defect. P. II, S. 4
	Open grid in any stage	Check circuit and repair defect. P. II, S. 4.
Uncontrolled Oscillation	Shields not in place or making good contact	Place shield correctly and secure good contact. P. I, S. 10
	Tube shields not in place	Place tube shield correctly. P. I, S. 10
	Defective R.F. filter	Replace defective .F. filter. P. II, S. 11
Radiotrons fail to light	No. A.C. line voltage	Turn A.C. line voltage "On"
	Operating switch not "On"	Turn operating switch "On"
	Defective A.C. input cord	Repair or replace defective cord
	Defective power transformer	Replace defective power transformer

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