MODEL E-89

Eight-Tube, Three-Band, A-C Radio-Phonograph

Electrical Specifications

Frequency Ranges		Alignment Frequencies	
"Standard Broadcast"	530- 1,800 kc	"Standard Broadcast"	600 kc (osc.), 1,500 kc (osc., ant.)
"Medium Wave"	1,800- 6,300 kc	"Medium Wave"	6,000 kc (osc., ant.)
"Short Wave"	6,300-22,000 kc	"Short Wave"	20,000 kc (osc., ant.)

Intermediate Frequency ..... 460 kc

Radiotron Complement

(1) Type -6L7	First Detector
(2) Type -6J7	Oscillator
(3) Type -6K7	Intermediate Amplifier
(4) Type -6H6	Second Detector and A.V.C.
(5) Type -6F5	Audio Voltage Amplifier
(6) Type -6F6	Power Output
(7) Type -5Z4	Full-Wave Rectifier
(8) Type -6E5	Tuning Tube

Pilot Lamps (3) ..... Mazda No. 46, 6.3 volts, 0.25 amperes

Power-Supply Ratings

Rating A ..... 105-125 volts, 50-60 cycles, 85 watts
Rating B ..... 105-125 volts, 25-60 cycles, 88 watts

Power Output		Loudspeaker	
Undistorted	2 watts	Type	Electrodynamic
Maximum	4.5 watts	Impedance (V.C.)	2.2 ohms at 400 cycles

Phonograph

Type	Manual	Type of Pickup	High-impedance magnetic
Turntable Speed	78 r.p.m.	Pickup Impedance	1,400 ohms at 1,000 cycles

Mechanical Specifications

Height ..... 42 ½ inches
Width ..... 27 5/8 inches
Depth ..... 15 5/8 inches
Weight (net) ..... 98 pounds
Weight (shipping) ..... 128 pounds
Chassis Base Dimensions ..... 12 inches x 7 inches x 2 1/2 inches
Over-all Chassis Height ..... 8 3/8 inches
Operating Controls. (1) Power switch–Tone, (2) Tuning, (3) Volume, (4) Range selector, (5) Radio–Phono-volume
Tuning Drive Ratios ..... 10 to 1 and 50 to 1

General Description

This Radio-Phonograph Combination consists of an eight-tube radio receiver and a manually-operated phonograph combined in one cabinet. The superheterodyne circuit is used with such features of design as built-in doublet antenna coupler; improved plunger-type air-dielectric adjustable trimming capacitors in the antenna and oscillator coil circuits; high-efficiency first detector (converter) with separate oscillator; magnetite core adjusted i-f transformers, low-frequency oscillator tracking, and wave-trap; aural compensated volume control; continuously variable tone control with music-voice switch; automatic volume control; band selective indication of dial scales; and a dust-proof electro-dynamic loudspeaker.

The tuning range is continuous through the "Standard broadcast," "Medium wave," and "Short wave" bands. This extensive range includes the important short-wave broadcast bands at 49, 31, 19, 16, and 13 meters in addition to channels assigned for

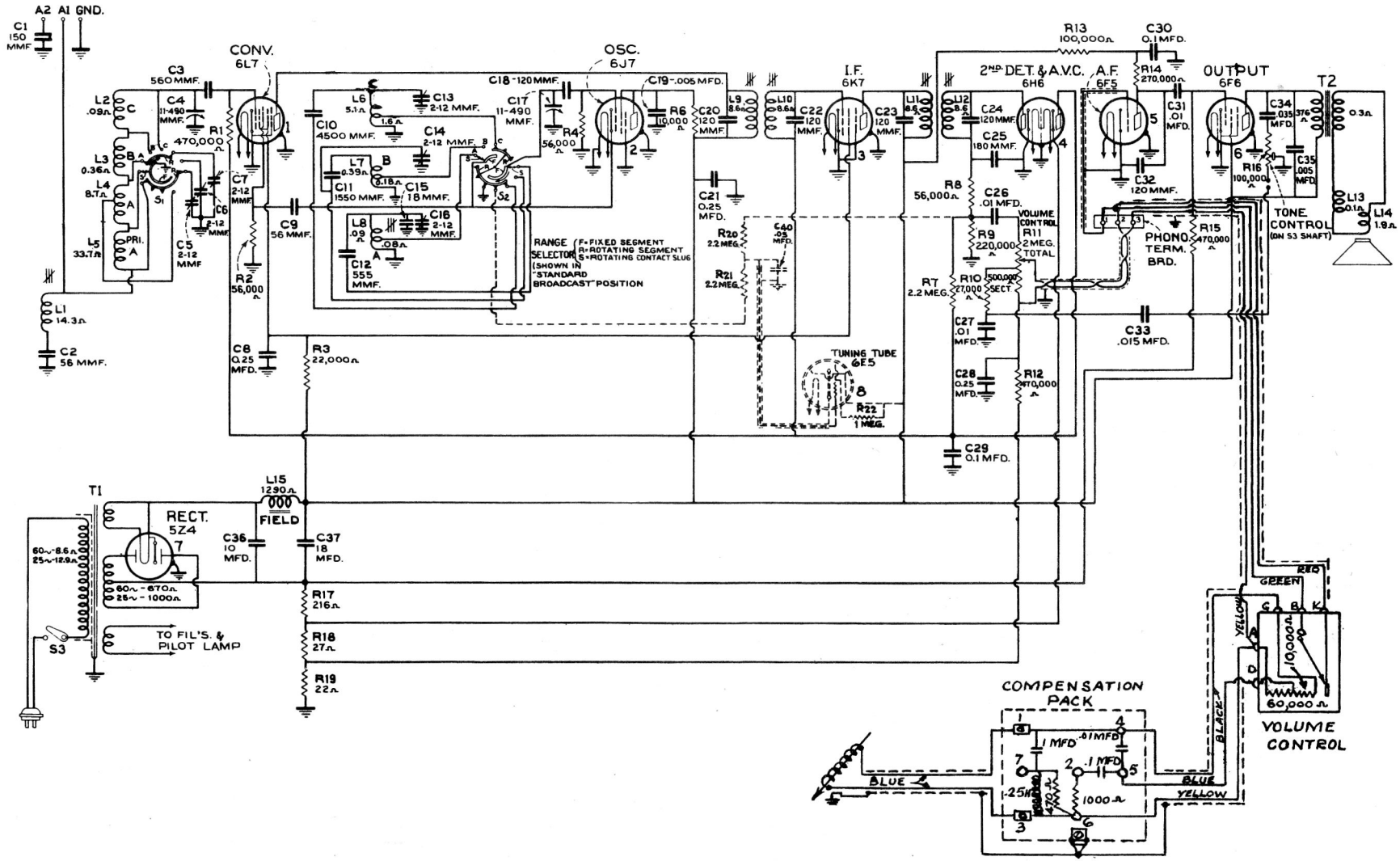

Figure 1—Schematic Circuit Diagram

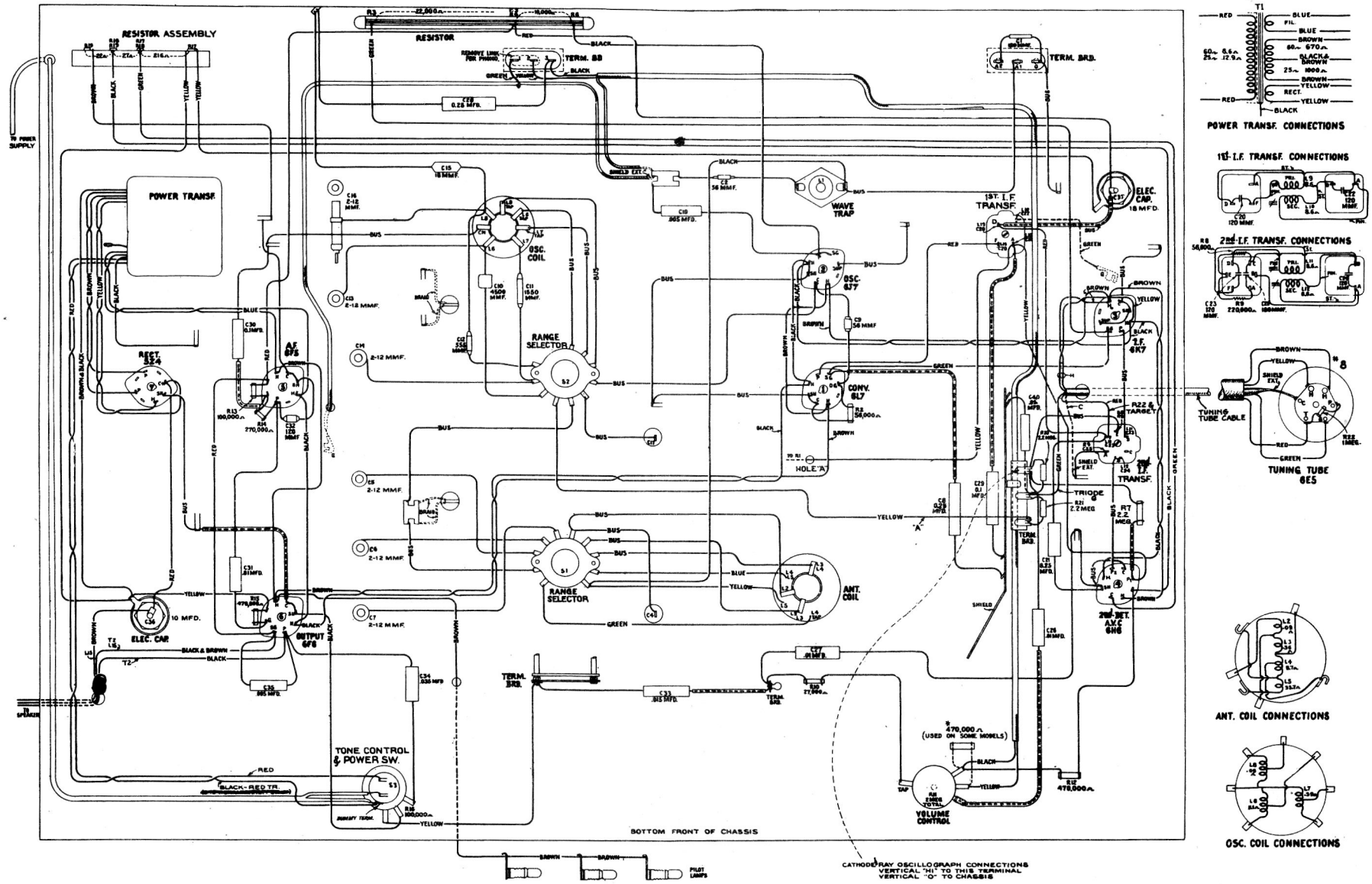

Figure 2—Chassis Wiring Diagram

police, amateur, and aviation communication. Trimming adjustments are located at accessible points. Their number is reduced to the least that is consistent with efficient operation. A double tuning knob arrangement permits the choice of either a ten-to-one or a fifty-to-one dial ratio, the latter permits ease of tuning, especially in the "Medium wave" and "Short wave" bands.

Circuit Arrangement

The conventional type of superheterodyne circuit is used. It consists of a first-detector (converter) stage, separate oscillator stage, a single i-f stage, a diode-detector — automatic-volume-control stage, an audio voltage-amplifier stage, a pentode power-output stage, a full-wave rectifier stage and Cathode Ray Tuner.

A single-wire antenna, or a doublet antenna, when connected to the proper input terminals of the receiver, is coupled to control grid No. 1 of the Type-6L7 through a tuned r-f transformer. This transformer is tapped so that the range selector increases the range of tuning by decreasing the amount of inductance. A unique method of switching causes L5 to become the primary with L4, L3, and L2 as secondary, L4 to become the primary with L3 and L2 as secondary, and L3 to become the primary with L2 as secondary, for range selector positions "Standard broadcast," "Medium wave," and "Short wave" respectively. Separate windings are employed

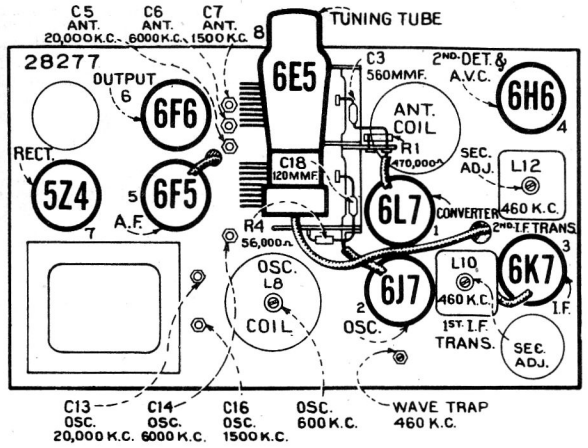

Figure 3—Radiotron, Coil, and Trimmer Locations

in the oscillator stage for each position of the range selector. All unused portions of the antenna and oscillator coils are shorted out to prevent undesirable interaction. Air-dielectric trimming capacitors are used for obtaining exact alignment. Proper low-frequency tracking of the oscillator for "Standard broadcast" is accomplished by adjusting the inductance of the respective coil with a molded magnetite core.

The intermediate-frequency amplifier consists of an Type-6K7 in a transformer-coupled circuit. The windings of these transformers are resonated with fixed capacitors, and are adjusted by molded magnetite cores (both primary and secondary) to tune to **460 kc.**

Detector and A.V.C.

The modulated signal as obtained from the output of the i-f stage is detected by an Type-6H6 twin-diode tube. The audio frequency secured by this process is transferred to the a-f system for amplification and final reproduction. The d-c voltage which results from detection of the signal is used for automatic volume control. This voltage, which develops across resistor R9, is applied as automatic control-grid bias to the first-detector and i-f tubes. The second (auxiliary) diode of the Type-6H6 is used to supply residual bias for the controlled tubes under conditions of little or no signal. This diode, under such conditions, draws current which flows through resistors R7 and R9, thereby maintaining the desired operating bias on such tubes. On application of signal energy above a certain level, however, the auxiliary bias-diode ceases to draw current and the a.v.c.-diode takes over the biasing function.

Audio System

The manual volume control consists of an acoustically tapered potentiometer in the audio circuit between the output of the detector diode and the input grid of the audio voltage-amplifier tube. This control has a tone-compensating filter connected to it so that the correct aural balance will be obtained at different volume settings. Phonograph terminals are inserted at this point for feeding the output of an external phonograph pickup to the control grid of the audio amplifier. Resistance-capacity coupling is used between the first-audio stage and the power-output stage. The power-output stage is transformer-coupled to the electrodynamic loudspeaker. Continuously-variable tone control is effected by means of capacitor C34 and variable resistor R16 shunting the plate circuit of the output tube. Extreme clockwise rotation of this tone control disconnects the resistor R16 from the circuit and places an additional capacitor C33 in shunt with capacitor C27, thereby reducing the low-frequency response of the amplifier. This point is known as the "Speech" position and provides optimum intelligibility of speech.

Tuning Indicator

A Type-6E5 cathode-ray tuning tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube consists of an amplifier section and a cathode-ray section built in the same glass envelope. Maximum sensitivity of the tuning indicator is acquired in the "Short wave" position of the range selector S2 by removing the ground connection from resistor R21. In this position, resistors R20 and R21 no longer act as a voltage divider and maximum voltage is applied to the grid of the tuning tube.

SERVICE DATA

Alignment Procedure

There are eight adjustments required for the alignment of the antenna, oscillator, and wave-trap tuned circuits. Six of these adjustments are made with plunger-type air trimming capacitors, and require the use of an **G.E. Stock No. 12636 adjusting tool.** The other two adjustments are screws attached to molded magnetite cores and are used to adjust the wave-trap and to align the oscillator at **600 kc.** Before adjusting the plunger-type air trimmers, they must be unlocked by loosening their hexagon lock nuts. The lock nuts should be tightened upon completion of adjustments.

The i-f transformer adjustments are made by means of four screws attached to molded magnetite cores.

All of the adjustable circuits of this receiver have been properly aligned at the factory to give correct performance, and their settings should remain intact indefinitely when the receiver is used under ordinary

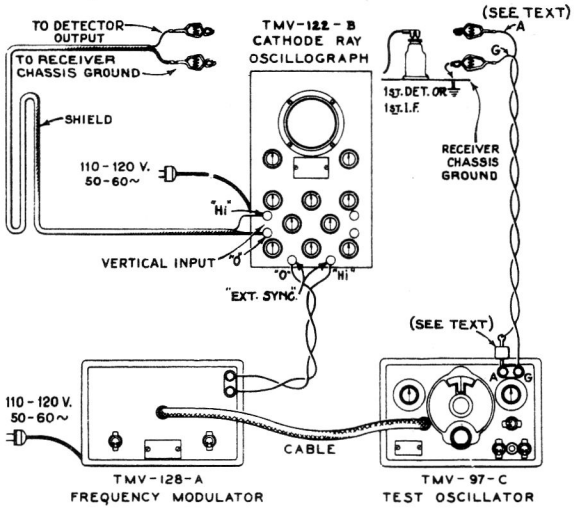

Figure 4—Alignment Apparatus Connections

conditions. However, necessity for re-adjustment may occasionally occur from continued extremes of temperature, climate, tampering, or purported alteration for services, or after repairs have been made to the r-f or i-f tuned circuits. Improper alignment usually causes the impairment of sensitivity, selectivity, and tone quality. Such conditions will generally exist simultaneously.

In re-adjusting the tuned circuits, it is important to apply a definite procedure and to use adequate and reliable test equipment. A standard test oscillator, such as an **G.E. Stock No. 9595,** will be required as the source of signal at the specified alignment frequencies. Means for indication of the receiver output during alignment is also necessary to accurately show when the correct point of adjustment is reached. Two indication methods are applicable—one requires use of the cathode-ray oscillograph, and the other requires a voltmeter or glow-type indicator. The cathode-ray alignment method is advantageous in that the indication provided is in the form of a wave image which represents the resonance characteristics of the circuits being tuned. This type of alignment is possible through use of apparatus such as the **G.E. Stock No. 9558 Frequency Modulator** and the **G.E. Stock No. 9545 Cathode-Ray Oscillograph.** The output indicator method should be performed with an instrument such as the **G.E. Stock No. 4317 Neon Glow Indicator.** The two procedures are outlined as follows·

Cathode-Ray Alignment

Make alignment apparatus connections shown on figure 4. Remove the plug of the frequency modulator cable from the test oscillator jack. Connect the receiver chassis to a good external ground. Connect oscillograph "Vertical" input terminals as indicated on figure 2. Set oscillograph power switch to "On" and adjust "Intensity" and "Focus" controls to give a clearly defined spot, or line, on the screen. Set oscillograph "Ampl. A" switch to "On," "Vertical gain" control full-clockwise, "Ampl. B" switch to "Timing," "Range" switch to No. 2 position, and "Timing" switch to "Int." Place the "Sync." control, "Freq." control, and "Horizontal gain" control to about their mid-positions. For each of the following adjustments, the test oscillator output must be regulated so that the image obtained on the oscillograph screen will be of the minimum size for accurate observation. The receiver volume control setting is optional.

I-F Adjustments

(a) Connect the "Ant." output of the test oscillator to the grid cap of Type-6K7 (with grid lead in place) through a **.001-mfd.** capacitor, with "Gnd." to receiver chassis. Tune the test oscillator to **460 kc,** place its modulation switch to "On" and its output switch to "Hi."

(b) Turn on the receiver and test oscillator. Increase the output of the test oscillator until a deflection is noticeable on the oscillograph screen. The figures obtained represent several waves of the detected signal, the amplitude of which may be observed as an indication of output. Cause the wave image formed (400-cycle waves) to be spread completely across the screen by adjusting the "Horizontal gain" control. The image should be synchronized and made to remain motionless by adjusting the "Sync." and "Freq." controls.

(c) Adjust the two magnetite core screws (see figures 3 and 7) of the second i-f transformer (one on top and one on bottom) to produce maximum vertical deflection of the oscillographic image. This adjustment places the transformer in exact resonance with the **460-kc** signal.

(d) The sweeping operation should follow using the frequency modulator. Shift the oscillograph "Timing" switch to "Ext." Insert plug of frequency modulator cable in test oscillator jack. Turn the test oscillator modulation switch to "Off." Turn on the frequency modulator and place its sweep-range switch to "Hi."

(e) Increase the frequency of the test oscillator by slowly turning its tuning control until two sep-

arate, distinct, and similar waves appear on the screen. If only one wave appears, increase the "Freq." control on the oscillograph to obtain two waves. These waves will be identical in shape, totally disconnected, and appear in reversed positions. They will have a common base line, which is discontinuous. Adjust the "Freq." and "Sync." controls of the oscillograph to make them remain motionless on the screen. Continue increasing the test oscillator frequency until these forward and reverse curves move together and overlap, with their highest points exactly coincident. This condition will be obtained at a test oscillator setting of **approximately 575 kc.**

(f) With the images established as in (e), re-adjust the two magnetite core screws on the second i-f transformer so that they cause the curves on the oscillograph screen to become exactly coincident throughout their lengths and have maximum amplitude.

(g) Without altering the adjustments of the apparatus, shift the "Ant." output of the test oscillator to the input of the i-f system, i.e., to the RCA-6L7 first-detector grid cap through a **.001-mfd.** capacitor (with grid lead in place). Regulate the test oscillator output so that the amplitude of the oscillographic image is approximately the same as used above for adjustment (f).

(h) The two first i-f transformer magnetite core screws (one on top and one on bottom) should then be adjusted so that they cause the forward and reverse curves to become coincident throughout their lengths and have maximum amplitude. The composite wave obtained in this manner represents the resonance characteristic of the total i-f system. Lack of symmetry or irregularity of the resultant image will indicate the presence of a defect in the i-f system.

R-F Adjustments

Calibrate the pointer of the tuning dial by adjusting it to the extreme low-frequency end of dial scale (beyond 55 on dial) with the plates of the gang tuning condenser in full mesh. Alignment must be made in the sequence of "Short wave" band, "Medium wave" band, "Wave-trap," and "Standard broadcast" band.

"Short Wave" Band

(i) Connect the "Ant." output of the test oscillator to the antenna terminal "A1" through a **300-ohm** resistor. Remove the plug of the frequency modulator cable from the test oscillator. Turn test oscillator modulation switch to "On." Shift the oscillograph "Timing" switch to "Int."

(j) Set receiver range selector to its "Short wave" position and dial pointer to **20,000 kc.** Adjust the test oscillator to **20,000 kc.** Set oscillator air trimmer **C13** to minimum capacity (plunger full out), and antenna air trimmer **C5** to maximum capacity (plunger full in). Slowly push in oscillator trimmer **C13** until maximum (peak) amplitude of output is reached. Two peaks may be found. Adjust **C13** to the peak with minimum capacity (plunger near out) for maximum indication. Tighten lock nut. Slowly pull out plunger of antenna air trimmer **C5** until maximum (peak) amplitude of output is reached while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacity (plunger near in) should be used. Tighten lock nut.

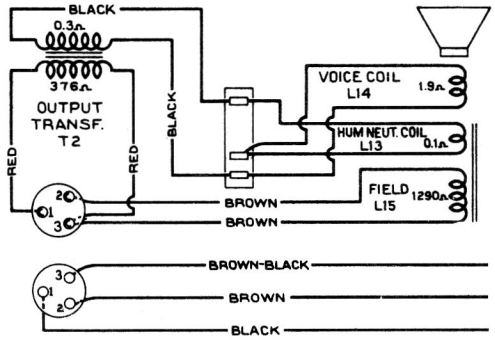

Figure 5—Loudspeaker Wiring

"Medium Wave" Band

(k) Place receiver range selector to its "Medium wave" position with the receiver dial pointer set to **6,000 kc.** Tune the test oscillator to **6,000 kc.** Carefully adjust the oscillator and antenna air trimmers **C14** and **C6** respectively, so that each brings about maximum (peak) amplitude of output as shown by the wave on the oscillograph. When adjusting the oscillator trimmer **C14,** two peaks may be found. The one of minimum capacitance (plunger near out) should be used. Tighten lock nuts.

"Wave-Trap" Adjustment

(l) Connect the output of the test oscillator to the antenna terminal "A1" through a **200 mmfd. (important)** capacitor. Place receiver range selector in "Standard broadcast" position. Set the receiver dial to a position of no extraneous signals **near 600 kc.** Tune the test oscillator to **460 kc.** Adjust the wave-trap magnetite core screw to the point which causes minimum amplitude of output (maximum suppression of signal) as shown by the wave on the oscillograph. An increase of the test-oscillator output may be necessary before this point of minimum amplitude, obtained by correct adjustment of wave-trap screw, becomes apparent on oscillograph screen.

"Standard Broadcast" Band

(m) Reduce output of test oscillator to minimum. Set receiver dial pointer to **600 kc.** Tune the test oscillator to **600 kc** and increase its output until a deflection is noticeable on the oscillograph screen.

(n) Adjust oscillator magnetite core screw (top of oscillator coil) so that maximum (peak) amplitude of output is shown on the oscillograph screen.

(o) Set receiver dial pointer to **1,500 kc.** Set the test oscillator to **1,500 kc** (1,500-3,100-kc range) and increase its output to produce a registration on the oscillograph. Carefully adjust the oscillator and antenna air trimmers **C16** and **C7** respectively so that each brings about maximum (peak) amplitude of output as shown by the waves on the oscillograph. Shift the oscillograph "Timing" switch to "Ext." Place the frequency modulator sweep-range switch to "Lo" position and insert plug of the frequency modulator cable in test oscillator jack. Turn test oscillator modulation switch to "Off." Retune the test oscillator (increase frequency) until the forward and reverse waves show on the oscillograph screen and become coincident at their highest points. This will occur at a test oscillator setting of **approximately 1,680 kc.** Adjust the trimmers **C16** and **C7** again, setting each to the point which produces the best coincidence and maximum amplitude of the images.

(p) Remove the plug of the frequency modulator cable from test oscillator jack. Turn test oscillator modulation switch to "On." Set oscillograph "Timing" switch to "Int." Tune test oscillator to **200 kc.** (200-400-kc range). Tune receiver for maximum response to this signal at a dial reading of **approximately 600 kc.** Third harmonic of **200 kc** is used for this adjustment. Shift oscillograph "Timing" switch to "Ext." Insert the plug of the frequency modulator cable in test oscillator jack. Turn test oscillator modulation switch to "Off." Retune the test oscillator (increase frequency) until the forward and reverse waves show on the oscillograph screen. This will occur at a test oscillator setting of **approximately 230 kc.** Disregarding the fact that the two images may come together, adjust the oscillator magnetite core screw (top of oscillator coil) to produce maximum amplitude of images. Shift oscillograph "Timing" switch to "Int." Remove the plug of the frequency modulator cable from the test oscillator. Turn test oscillator modulation switch to "On." Repeat adjustment (o), and then lock **C16** and **C7.**

Output Indicator Alignment

Attach the output indicator across the loudspeaker voice-coil circuit. Advance the receiver volume control to its maximum position, letting it remain in such position for all adjustments. For each adjusting operation, regulate the test oscillator output so that the signal level is as low as possible and still be observable at the receiver output. Use of such small signal will obviate broadness of tuning which would otherwise result from a.v.c. action on a stronger one.

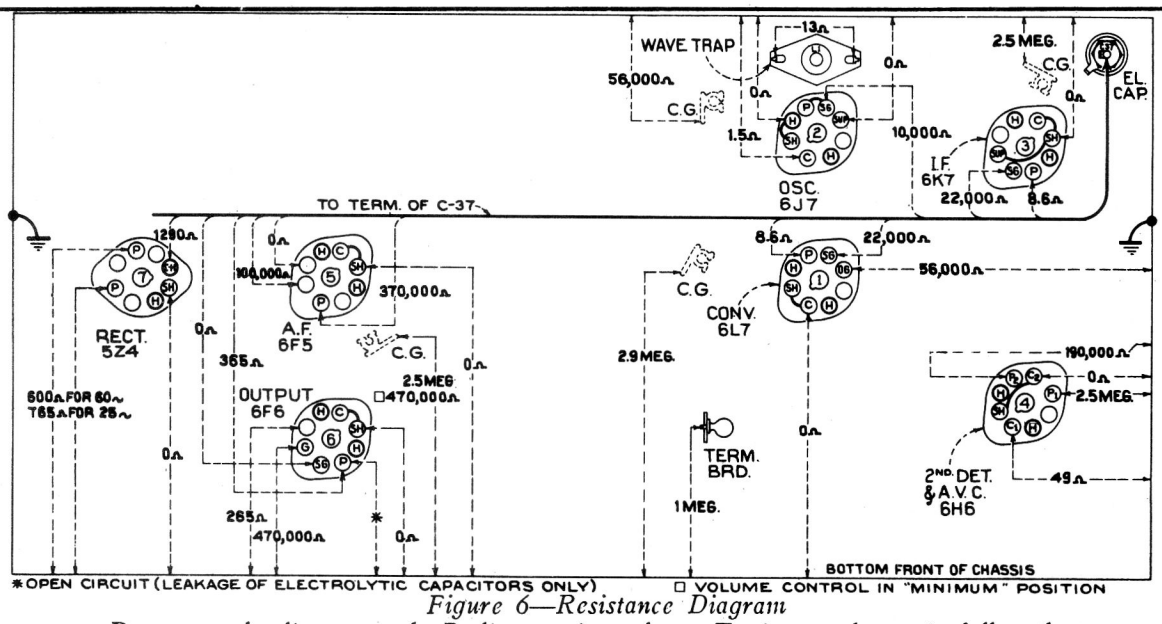

Figure 6—Resistance Diagram

Power supply disconnected—Radiotrons in sockets—Tuning condenser in full-mesh—Range selector in "Standard broadcast" position—Volume control maximum

Resistance Measurements

The resistance values shown between Radiotron socket contacts, grid caps, resistors, and terminals to receiver chassis ground or other pertinent point on figure 6, permit a rapid continuity check of the circuits. The use of this diagram in conjunction with the Schematic Circuit Diagram, figure 1, and Chassis Wiring Diagram, figure 2, will permit the location of certain troubles which might otherwise be difficult to ascertain. Each value as specified should hold within ±20%. Variations in excess of this limit will usually be indicative of trouble in circuit under test. Resistance values were measured with the Radiotrons in sockets, range selector in "Standard broadcast" position, tuning condenser in full mesh, and volume control set at maximum unless otherwise noted. In all cases of measuring the resistance between points of the circuit and ground, it will be necessary to connect the negative terminal of the resistance meter to chassis-ground. If the polarity of the resistance meter is not known, it may be readily ascertained by connecting a d-c voltmeter of indicated polarity across the terminals of the device.

I-F Adjustments

(a) Connect the "Ant." output of the test oscillator to the grid cap of the Type 6L7 (with grid lead in place) through a **.001-mfd.** capacitor, with "Gnd." to receiver chassis. Tune the test oscillator to **460 kc,** place its modulation switch to "On" and its output switch to "Hi."

(b) Adjust the two magnetite core screws of the second i-f transformer (one on top and one on bottom), to produce maximum (peak) output.

(c) The two first i-f transformer magnetite core screws (one on top and one on bottom) should be adjusted to produce maximum (peak) output. It is advisable to repeat the adjustment of all i-f magnetite core screws to assure that the interaction between them has not disturbed the original adjustments.

R-F Adjustments

Calibrate the pointer of the tuning dial by adjusting it to the extreme low-frequency end of dial scale (beyond 55 on dial) with the plates of the gang tuning condenser in full mesh. Alignment must be made in sequence of "Short wave" band, "Medium wave" band, "Wave-trap", and "Standard broadcast" band.

"Short Wave" Band

(d) Connect the "Ant." output of the test oscillator to the antenna terminal "A1" through a **300-ohm** resistor, leaving the "Gnd." of the oscillator connected to the receiver chassis.

(e) Place range selector to its "Short wave" position. Set receiver dial pointer to **20,000 kc.** Adjust test oscillator to **20,000 kc.** Set oscillator air trimmer **C13** to minimum capacity (plunger full out), and antenna air trimmer **C5** to maximum capacity (plunger full in). Slowly push in oscillator trimmer **C13** until maximum (peak) output is reached. Two peaks may be found. Adjust **C13** to the peak with minimum capacity (plunger near out) for maximum indication. Tighten lock nut. Slowly pull out plunger of antenna air trimmer **C5** until maximum (peak) output is reached while slightly rocking the gang tuning condenser back and forth through the signal. Two peaks may be found with this circuit. The peak with maximum capacity (plunger near in) should be used. Tighten lock nut.

"Medium Wave" Band

(f) Place the receiver range selector to its "Medium

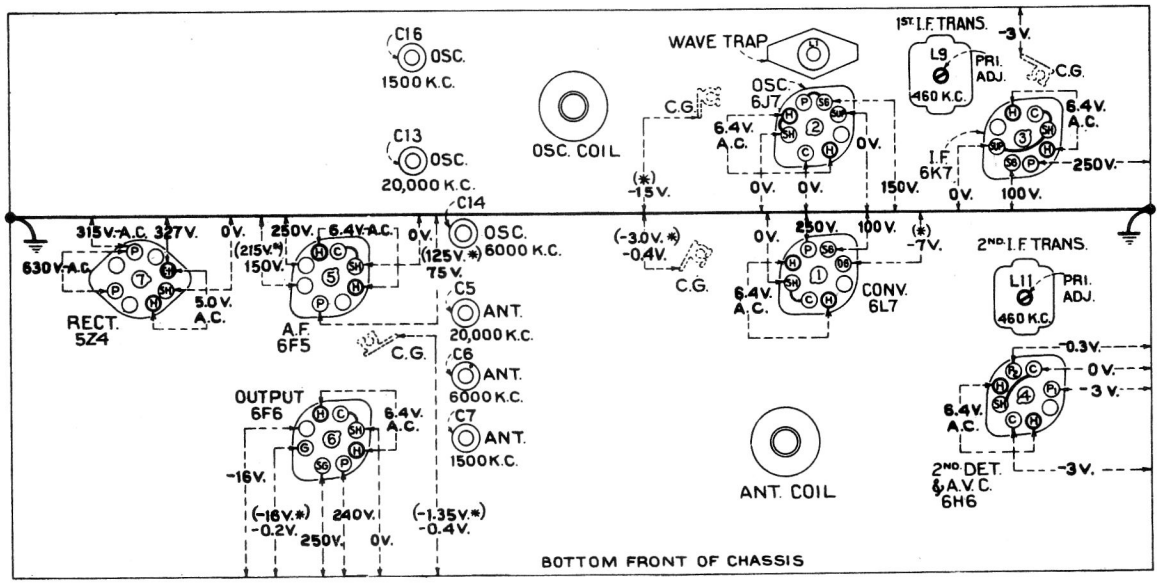

Figure 7—Radiotron Socket Voltages, Coil, and Trimmer Locations

Measured at 115 volts, 60-cycle supply—Tuned to approximately 1,000 kc—No signal being received—Volume control minimum

Radiotron Socket Voltages

Note: *Two voltage values are shown for some readings. The higher value shown in parenthesis with asterisk (*) indicates operating conditions without voltmeter loading. The lower value is the actual measured voltage and differs from the higher value because of the additional loading of the voltmeter through the high series circuit resistance.*

The voltage values indicated from the Radiotron socket contacts, grid caps, resistors, and terminals to receiver chassis ground on figure 7 will assist in locating cause for faulty operation. Each value as specified should hold within ±20% when the receiver is normally operative at its rated line voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. These voltages were measured with receiver tuned to approximately 1,000 kc, no signal being received and volume control set at maximum. To duplicate the conditions under which the voltages were measured requires a 1,000-ohm-per-volt d-c meter, having ranges of 10, 50, 250, 500, and 1,000 volts. Use the nearest range above the voltage to be measured. A-c voltages were measured with a corresponding a-c meter.

wave" position, with the receiver dial pointer set to **6,000 kc.** Tune test oscillator to **6,000 kc.** Carefully adjust the oscillator and antenna air trimmers **C14** and **C6** respectively, so that each brings about maximum (peak) output. When adjusting the oscillator trimmer **C14,** two peaks may be found. The one of minimum capacitance (plunger near out) should be used.

"Wave-Trap" Adjustment

(g) Connect the "Ant." output of the test oscillator to the antenna terminal "A1" through a **200 mmfd. (important)** capacitor. Place the range selector to its "Standard broadcast" position and set the receiver dial pointer to a position of no extraneous signals **near 600 kc.** Tune the test oscillator to **460 kc.** Adjust the wave-trap magnetite core screw to the point which causes minimum output (maximum suppression of signal). An increase of the test-oscillator output may be necessary before the point of minimum output, obtained by adjustment of wave-trap screw, becomes apparent on the output indicator.

"Standard Broadcast" Band

(h) Reduce output of test oscillator to a minimum. Tune the test oscillator to **600 kc** and set receiver dial pointer to **600 kc.** Adjust output of test oscillator until a slight indication of output is visible.

(i) Adjust the oscillator magnetite core screw (top of oscillator coil) so that maximum (peak) output results.

(j) Set receiver dial pointer to **1,500 kc.** Tune the test oscillator to **1,500 kc.** Carefully adjust the oscillator and antenna air trimmers **C16** and **C7** respectively so that each brings about maximum (peak) output.

(k) Tune the test oscillator to **600 kc.** Tune the receiver to pick up this signal disregarding the dial reading at which it is best received. Adjust oscillator magnetite core screw (top of oscillator coil) for maximum (peak) output while rocking gang tuning condenser. After completing this adjustment, the trimmers **C16** and **C7** should be re-adjusted as in (j) to correct for any change in the oscillator high-frequency tuning which has been caused by the preceding adjustment.

Antenna and Ground Terminals

These receivers are equipped with an antenna-ground terminal board having three terminals. These terminals are marked "A2," "A1", and "G", the latter being the ground terminal and should always be connected to a good external ground.

The transmission line leads of antenna systems, having no receiver coupling units, should be connected to terminals "A2" and "A1". When receiver coupling units are supplied with antenna kits, they should be connected to terminals "A1" and "G". Connect a single wire antenna to terminal "A1".

Phonograph Mechanism

The phonograph motor is of the synchronous type and designed to be simple and foolproof. Under normal operating conditions, service difficulties should be negligible. Occasionally, however, certain adjustments may be required. These adjustments are illustrated and explained in Figure 8.

Magnetic Pickup

The pickup used in the phonograph unit is of an improved design. The horseshoe magnet is rigidly welded to the pole pieces and is irremovable. There is a centering spring attached to the armature to maintain proper adjustment and to provide a limiting effect on the movement of the armature. The frequency response is substantially uniform over a wide range. Service operations which may be necessary on the pickup are as follows:

Centering Armature

Refer to Figure 9 showing the pickup inner structure. The armature is shown in its proper relation to the magnet pole pieces, i. e., exactly centered. Whenever this centering adjustment has been disturbed it will be necessary to remove the pickup mechanism from the tone arm by removing the needle holding screw and the two mounting screws from the front of the tone arm, holding the pickup assembly to keep it from dropping. Unsolder the two leads from the lugs on the terminal board at the rear of the pickup. Insert a small rod or nail into the armature needle hole and replace the needle holding screw, tightening it to hold the rod securely. If the armature clamping screws A and B have not been disturbed, screw C should be loosened which will permit the armature

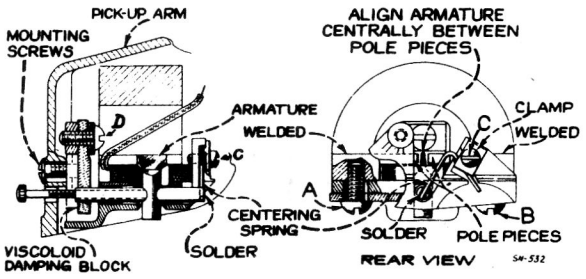

Figure 9—Details of Pickup

to be moved from side to side, the rod acting as a lever to perform this operation. The proper adjustment is obtained when the armature is moved to the extreme position on each side (the movement being limited by the armature striking the pole pieces) and then brought to the mid position between these two

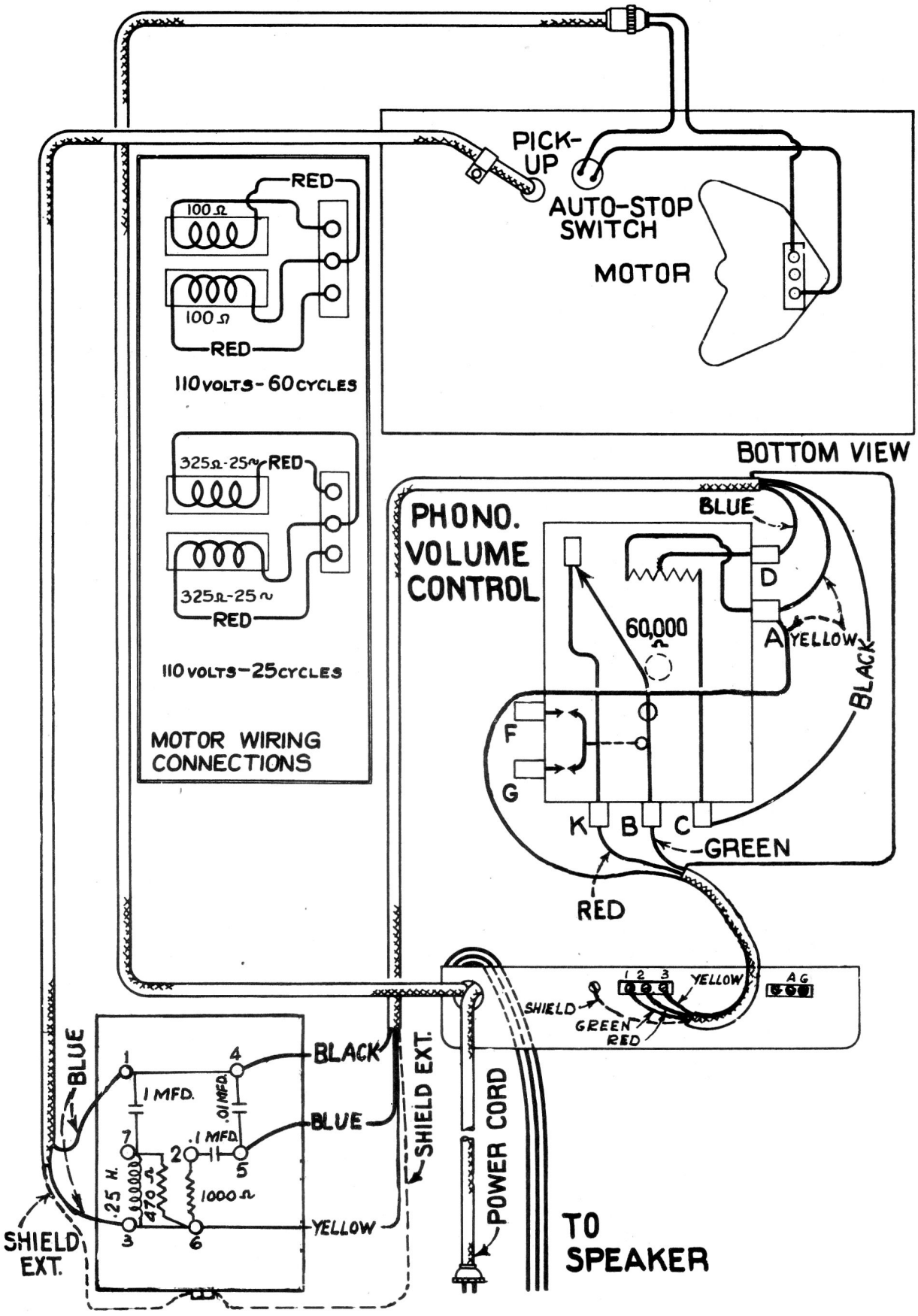

Figure 8—Assembly Wiring

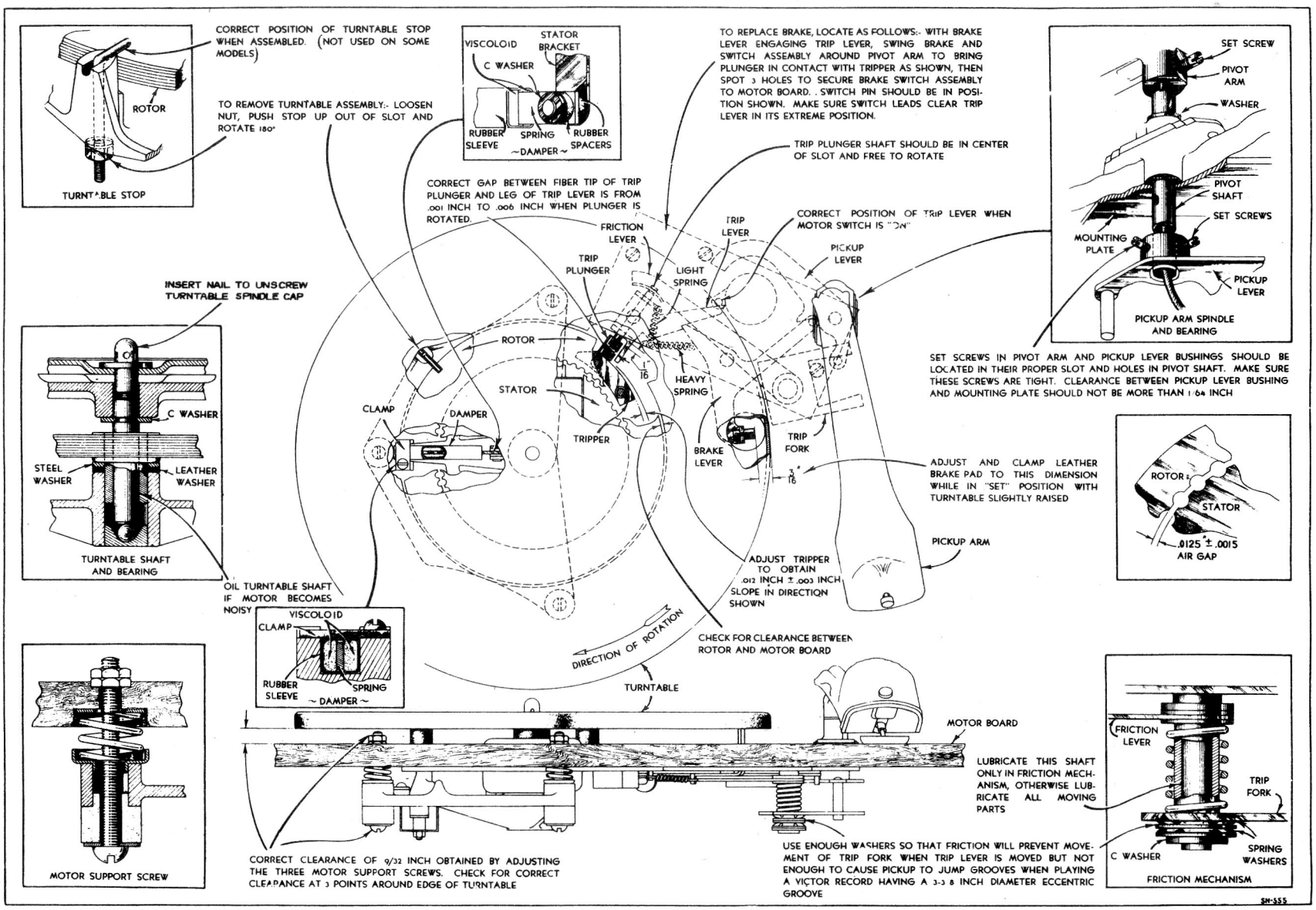

Figure 9—Motor Board Adjustments

extremes. Screw C should then be tightened. The armature position should then be central between the pole pieces and at right angles to them. With a little practice, the correct adjustment of the armature will be obtained. The air gap between the pole pieces and the armature should be kept free from dust, filings, and other foreign material which would obstruct the movement of the pickup armature.

Damping Block

The viscoloid damping block which is attached to the front end of the armature shank serves as a mechanical filter to eliminate undesirable resonances and to cause the frequency response to be uniform. Should it be necessary to replace this damping block, the pickup mechanism should be removed from the tone arm as explained above. Then unsolder the pickup coil leads from the two lugs on the pickup terminal board and remove the terminal board mounting screw and the terminal board. Then remove screw D and the damping block from the pickup assembly. Make sure that the shaft of the armature which contacts the viscoloid is clean. Then insert the new damping block so that it occupies the same position as that of the original block, and is in correct vertical alignment with the armature. The hole in the block is somewhat smaller than the diameter of the armature in order to permit a snug fit. With the damping block properly aligned on the armature, screw D with its washer should then be replaced. Heat should be applied to the armature (viscoloid side) so that the damping block will fuse at the point of contact and become rigidly attached to the armature. A special-tip soldering iron, constructed as shown in Figure 10, will be found very useful in performing this operation. The iron should be applied only long enough to slightly melt the block, causing a small bulge on both sides.

Replacing Coil

Whenever there is defective operation due to an open or shorted pickup coil, this coil should be replaced. Remove the pickup mechanism and terminal board as described above. Remove screws A and B and the magnet assembly. Remove the bakelite coil support (with coil attached) and insert the new coil support assembly in its place, after which replace the magnet assembly and center the armature as described above, then reassemble the remainder of the unit. Only rosin core solder should be used for soldering the coil leads and pickup leads to the pickup terminal board. This same type of solder should be used when necessary for soldering the centering spring to the armature.

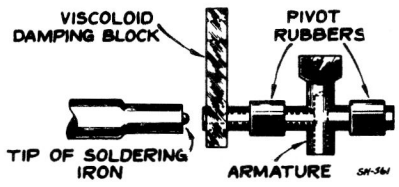

Figure 10—Special Soldering-Iron Tip

Magnetizing

Loss of magnetization will not usually occur when the pickup has received normal care due to the fact that the magnet and pole pieces are one unit and the magnetic circuit remains closed at all times. When the pickup has been mishandled, subjected to a strong a-c field, jolted, or dropped, there may be an appreciable loss of magnetic strength, in which case it will be necessary to remagnetize the entire structure. To do this, it will be necessary to first remove the pickup mechanism from the tone arm, and then remove the magnet assembly. Place the magnet assembly on the poles of a standard pickup magnetizer such as the **G.E. *Stock No. 9549 Pickup Magnetizer*** and charging the magnet in accordance with the instructions accompanying the magnetizer. It is preferable to check the polarity of the pickup magnet and to remagnetize it so that the same polarity is maintained.

REPLACEMENT PARTS

STOCK No.	DESCRIPTION		STOCK No.	DESCRIPTION	
	RECEIVER ASSEMBLIES		12511	Cap-Grid contact cap-Package of 5	
			12714	Capacitor-Adjustable capacitor (C5,C6,C7,C13,C14,C16).....	
12706	Arm-Hub and arm complete for operating shutter (located on range switch shaft).....		12722	Capacitor-18 Mmfd. (C15).....	
			12723	Capacitor-56 Mmfd. (C9).....	
			12726	Capacitor-56 Mmfd. (C2).....	
12716	Board-Antenna and ground terminal board.....		12724	Capacitor-120 Mmfd.(C18,C32).....	
			12404	Capacitor-120 Mmfd.(C20,C22,C23, C24).....	
12717	Board-Phonograph terminal board....				
5237	Bushing-Variable capacitor mounting bushing assembly-Package of 3.....		12725	Capacitor-150 Mmfd.(C1).....	
			12406	Capacitor-180 Mmfd.(C25).....	
			12727	Capacitor-555 Mmfd.(C12).....	
12730	Cable-Shielded cable approximately 14⅝ in.long,-volume control to phono terminal board.....		12537	Capacitor-560 Mmfd.(C3).....	
			12729	Capacitor-1,550 Mmfd.(C11).....	
			12728	Capacitor-4,500 Mmfd.(C10).....	
11625	Cable-Tuning tube cable and socket complete.....		4868	Capacitor-.005 Mfd.(C19,C35).....	

REPLACEMENT PARTS—E-89

STOCK No.	DESCRIPTION
4858	Capacitor-.01 Mfd.(C26,C27,C31)....
4792	Capacitor-.015 Mfd.(C33).....
12670	Capacitor-.035 Mfd.(C34).....
4836	Capacitor-.05 Mfd.(C40).....
4883	Capacitor-0.1 Mfd.(C29).....
11414	Capacitor-0.1 Mfd.(C30).....
S-1592	Capacitor-0.25 Mfd.(C28).....
5170	Capacitor-0.25 Mfd.(C8,C21).....
11240	Capacitor-10 Mfd. (C36).....
5212	Capacitor-18 Mfd. C37).....
12708	Coil-Antenna coil and shield (L2, L3,L4,L5).....
12709	Coil-Oscillator coil and shield (L6,L7,L8).....
12701	Condenser-2-gang variable tuning condenser,(C4,C17).....
5119	Connector-3-contact female connector for speaker cable.....
12711	Core-Adjustable core and stud for Stock No.12709.....
12006	Core-Adjustable core and stud for Stock No.12652 and 12653.....
12664	Core-Adjustable core and stud for Stock No.12654.....
12703	Dial-Station selector dial scale...
12702	Drive-Vernier drive for tuning capacitor.....
12712	Indicator-S t a t i o n selector indicator pointer.....
5226	Lamp-Indicator dial lamp 6.3 volt, Package of 2.....
12718	Mask-Dial light diffuser complete with red, orange and green colored screen.....
12738	Resistor-27,000 ohms, insulated, 1/4 watt,(R10).....
11282	Resistor-56,000 ohm,carbon type, 1/10 watt (R8,R4).....
12286	Resistor-56,000 ohm, carbon type, 1/4 watt, (R2).....
11281	Resistor-100,000 ohm, carbon type, 1/10 watt (R13).....
11398	Resistor-220,000 ohm, carbon type, 1/10 watt (R9).....
11453	Resistor-270,000 ohm, carbon type, 1/10 watt (R14).....
11452	Resistor-470,000 ohm, carbon type, 1/10 watt (R1,R15).....
12285	Resistor-470,000 ohm, insulated, 1/4 watt, (R12).....
11382	Resistor-1 meg.,carbon type, 1/10 watt, (R22).....
11626	Resistor-2.2 meg.,carbon type, 1/4 watt, (R7,R20,R21).....
12004	Resistor-Voltage divider comprising one 216 ohm, one 27 ohm and one 22 ohm sections (R17,R18,R19).....
12715	Resistor-Wire wound comprising one 22,000 ohm and one 10,000 ohm sections (R3,R6).....
4669	Screw-No.8-32 set screw for arm Stock No.12706-Package of 10.....
12651	Shield-Coil shield for Stock No. 12708.....
12710	Shield-Coil shield for Stock No. 12709.....
12735	Shield-Dial lamp shield-Package of 5.....
12008	Shield-I.F.transformer shield for Stock No.12652 and 12653.....
12581	Shield-Shield top for I.F.transformer,Stock No.12653.....
12607	Shield-Shield top for I.F.transformer,Stock No.12652.....
12704	Shutter-Dial scale holder and shutter assembly for band indicator.....
11195	Socket-5-contact 5Z4 radiotron socket.....
11198	Socket-7-contact 6J7,6K7,or 6L7 radiotron socket.....
11196	Socket-8-contact 6F5,6F6,6H6, radiotron socket.....
11222	Socket-Dial lamp socket.....
11381	Socket-Tuning tube socket and cover.....
12007	Spring-Retaining spring for core Stock No.12006,12664 and 12711-Package of 10.....
12849	Spring-Tension spring for band indicator shutter link - Package of 5.....
12707	Switch-Range switch (S1,S2).....
12668	Tone Control-Control and Operating Switch, (R16,S3).....
12652	Transformer-First I.F. transformer complete,(L9,L10,C20,C22).....
11999	Transformer-Power transformer 105-125 volts,60 cycle (T1).....
12132	Transformer-Power transformer 105-125 volts, 25 cycle (T1).....
12653	Transformer-Second I.F. transformer complete (L11,L12,C23, C24,C25,R8,R9).....
12654	Trap-Wave trap complete (L1).....
13144	Volume Control-Control and operating switch, (R11).....
	REPRODUCER ASSEMBLIES
12641	Board-Reproducer terminal board...
12640	Bracket-Output transformer mounting bracket.....
12012	Coil-Field coil (L15).....
11469	Coil-Neutralizing coil (L13).....
12667	Cone-Reproducer cone and dust cap (L14).....
5118	Connector-3-contact male connector for speaker cable.....
9696	Reproducer Complete.....
11253	Transformer-Output transformer(T2)
11886	Washer-Spring washer to hold field coil securely-Package of 5.
	MISCELLANEOUS ASSEMBLIES
11996	Bracket-Tuning tube mounting bracket.....
12698	Crystal-Station selector crystal and escutcheon.....
12742	Escutcheon-Tuning tube escutcheon..
12699	Knob-Large tuning knob.....
S-1662	Knob-Range switch knob .....
12700	Knob-Vernier tuning knob (small)..
11347	Knob-volume control,tone control knob.....
11210	Screw-Chassis mounting screw assembly Package of 4.....
4982	Spring-Retaining spring for knob stock No. 12699-Package of 10....
11349	Spring-Retaining spring for knob stock No.11347 and 12700 - Package of 5.....
	PICK-UP AND ARM ASSEMBLIES
11731	Armature-Pickup Armature.....
S-1667	Cable-Pickup cable.....

REPLACEMENT PARTS—E-89

STOCK No.	DESCRIPTION	
11732	Coil-Pickup coil.....	
4543	Damper-Pickup damper block complete with damper plate.....	
S-1668	Pickup and arm assembly complete.....	
3811	Screw - Needle holding screw - Package of 4.....	
	MOTOR ASSEMBLIES	
S-1669	Ball-Steel ball bearing - Package of 10.....	
S-1613	Base-Motor base and bearing assembly.....	
S-1745	Cap-Turntable spindle cap - Package of 5.....	
S-1614	Coil-Stator assembly comprising coil and laminations 105-125 volt, 60 cycle operation.....	
S-1615	Coil-Stator assembly comprising coil and laminations 105-125 volt, 25-cycle operation.....	
11748	Damper-motor assembly comprising one damper, one damper plate, one screw, two rubber washers and one "C" washer.....	
S-1629	Motor, 105-125 volts 60-cycle motor complete.....	
S-1630	Motor, 105-125 volts 25-cycle motor complete.....	
11746	Tripper-Automatic brake tripper located on rotor laminations.....	
S-1631	Turntable - Turntable assembly complete with rotor laminations 60-cycle operation.....	
S-1632	Turntable - Turntable assembly complete with rotor laminations 25-cycle operation.....	
4083	Washer - Leather washer - Package of 10.....	
4084	Washer-Metal washer - Package of 10.....	

STOCK No.	DESCRIPTION	
	MOTOR-BOARD ASSEMBLIES	
11752	Brake-Automatic brake and switch complete.....	
11751	Bushing-Motor mounting bushing and spring assembly-comprising one bushing, one large washer, one cup washer, one spring, one small washer and two nuts.....	
4577	Connector-Two-contact male connector for power supply cable.....	
4573	Connector-Two-contact female connector for motor cable-receiver section.....	
2947	Leather-Automatic brake friction leather-Package of 2.....	
11749	Lever-Brake mechanism actuating lever-fastens to pivot shaft under base of pickup arm.....	
11754	Lever-Friction lever assembly complete.....	
11753	Plunger-Automatic brake trip plunger	
11750	Screw-No.4-40 x9/32 in.cone pointed headless set screw for brake mechanism actuating lever Stock #11749 Package of 10.....	
11756	Spring-Automatic stop mechanism trip lever spring-Package of 10.....	
11757	Spring-Automatic stop mechanism brake lever spring-Package of 10..	
11755	Switch-Automatic brake switch.....	
11762	Box-Used needle box.....	
11763	Receptacle-needle receptacle.....	
S-1672	Cable-Three conductor shielded cable approximately 21 in.long-connects phonograph volume control to chassis phonograph terminal board.....	
S-1673	Cable-three conductor shielded cable approximately 15 in. long-connects phonograph volume control to the phonograph compensator.....	
S-1670	Compensator-Phonograph compensator pack comprising one 470-ohm and one 1000 ohm resistors, one .01 mfd., one 0.1 mfd.and one 1.0 mfd.capacitors, and one 0.25H reactor.....	
S-1671	Volume control-Phonograph volume control.....	