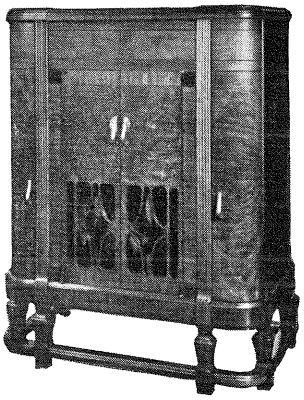
RCA Victor
Model 381 "DUO"

Twelve-Tube, Five-Band A. C. Automatic Radio-Phonograph

SERVICE NOTES



SERVICE DIVISION

RCA Victor Company, Inc.

Camden, N. J., U. S. A.

A RADIO CORPORATION OF AMERICA SUBSIDIARY

REPRESENTATIVES IN PRINCIPAL CITIES

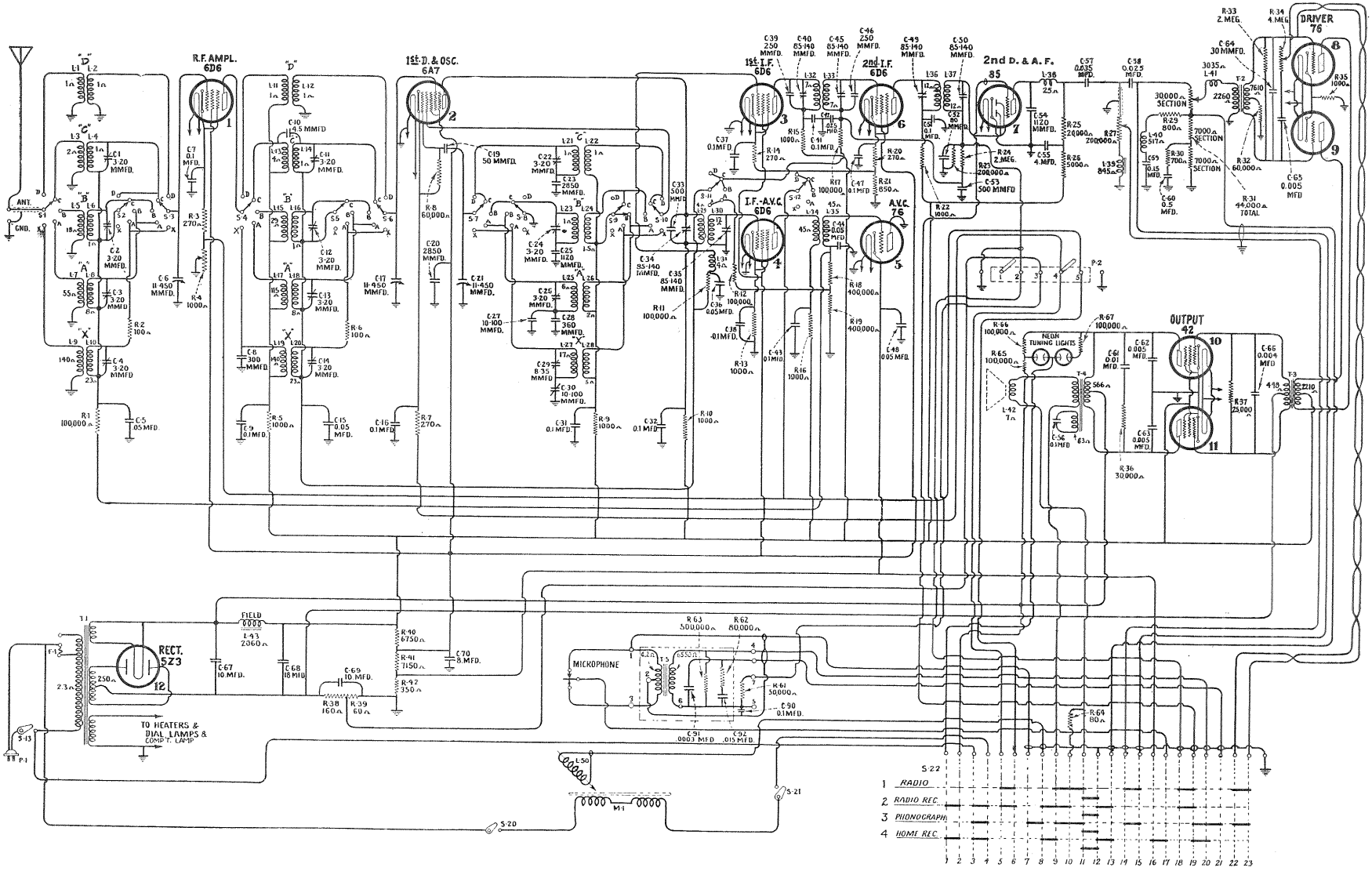


Figure 1—Schematic Circuit Diagram

RCA VICTOR MODEL 381

Twelve-Tube, Five-Band A. C. Automatic Radio-Phonograph

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

Voltage Rating	105–125 Volts
Frequency Rating	25, 30, 40, 50 and 60 Cycles
Power Consumption	170 Watts, 60 Cycles
Type and Number of Radiotrons	4 RCA-6D6, 1 RCA-6A7, 3 RCA-76, 1 RCA-85, 2 RCA-42, 1 RCA-5Z3 —Total 12
Tuning Frequency Range	Band X.....140 K. C.–410 K. C. Band A.....540 K. C.–1720 K. C. Band B.....1720 K. C.–5400 K. C. Band C....5400 K. C.–18,000 K. C. Band D..18,000 K. C.–36,000 K. C.
Line-up Frequencies	175 K. C., 410 K. C., 600 K. C., 1720 K. C., 5160 K. C., 18,000 K. C.
Maximum Undistorted Output	8 Watts
Maximum Output	16 Watts
Type of Magnetic Pickup	Low Impedance, Viscaloid
Type of Record Changer	Record Ejector Type
Capacity of Record Changer	Eight 10-Inch and Seven 12-Inch Records
Turntable Speed	33⅓ R.P.M. and 78 R.P.M.

PHYSICAL SPECIFICATIONS

Height	43 Inches
Width	34 9/16 Inches
Depth	19 Inches

This twelve-tube, five-band, all-wave radio-phonograph combination instrument incorporates the latest and most advanced developments known to the radio and phonograph art. Supplementing the radio and record reproducing facilities of the instrument, additional facilities include an arrangement whereby records may be made, either of a favorite radio program or of voice or other sounds originating in the home.

The radio facilities consist of a twelve-tube, five-band, all-wave superheterodyne radio receiver having a tuning range of from 140 K. C. to 36,000 K. C. except for one break between 410 K. C. and 540 K. C. Such an extreme range permits the listener to receive stations from all over the world in a manner not approached by other instruments. The tuning range covers every broadcasting band used throughout the world today.

A high degree of tonal fidelity is obtained through the use of a high-power, high-gain, low-distortion audio amplifier and a large-field, 10-inch electro-dynamic loudspeaker. A diode second detector further improves this characteristic. An aurally compensated volume control ensures to the listener the maintenance of this tone quality at all degrees of volume. High and low frequency tone controls provide a means whereby either the high or low frequency response may be reduced as required by adverse operating conditions (station hum, static, etc.).

Other features include a sensitivity control, two distinct automatic volume control systems, a special R. F. unit of high efficiency which greatly improves the noise to signal ratio for short-wave reception, and an automatic sensitivity change for the short-wave bands. The tuning dial is of the full vision "Airplane" type and is provided with a double-ratio vernier drive. Such a drive permits the user to tune either rapidly or slowly through stations, the slow speed being especially useful when receiving short-wave stations. A "second" or "band spread" indicator enables the operator to successfully log short-wave stations.

The phonograph facilities of this instrument consist of the perfected automatic record changer in conjunction with the new viscoloid magnetic pickup and the amplifying and reproducing facilities of the radio receiver. The instrument will play manually or automatically either 78 R.P.M. or 33⅓ R.P.M. records of ten or twelve inch diameter.

The recording facilities permit the user to make either six-inch or ten-inch home-recording records of either radio programs or of sounds such as voice, music, etc., originating in the home which are picked up by the microphone.

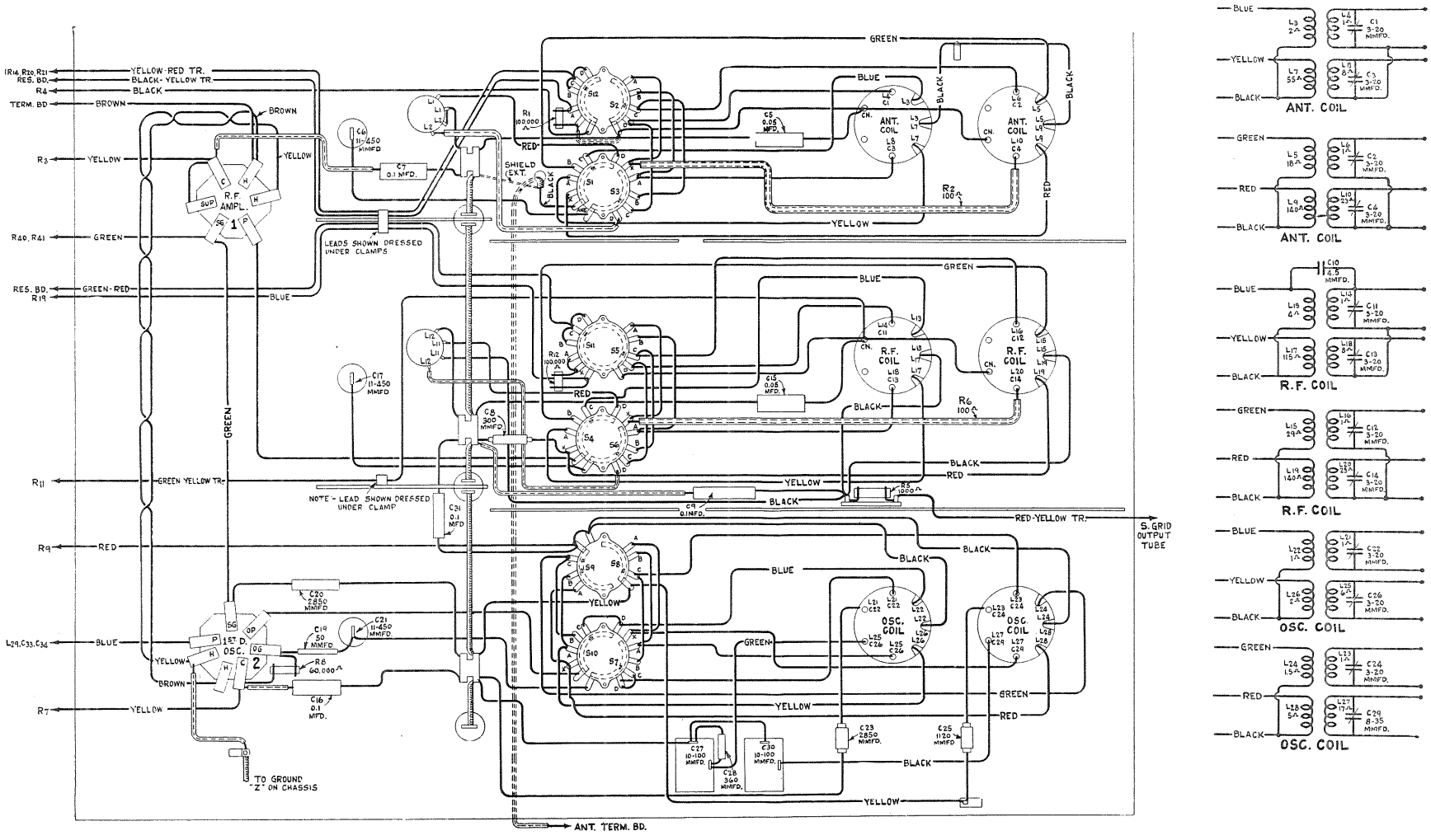


Figure 2—R. F. Assembly Wiring Diagram

DESCRIPTION OF ELECTRICAL CIRCUIT

RADIO

The general circuit arrangement consists of an R. F. stage, a combined oscillator and first detector stage, two I. F. stages, a combined second detector, automatic volume control and 1st A. F. amplifier, a push-pull audio driver stage and a push-pull Class A output stage. Plate and grid voltages are supplied by the RCA-5Z3 heavy duty rectifier combined with a suitable filtering system. In addition, a double channel A.V. C. stage is provided which uses two additional tubes. Figure 1 shows the over-all schematic circuit diagram while Figure 2 shows the R. F. assembly wiring.

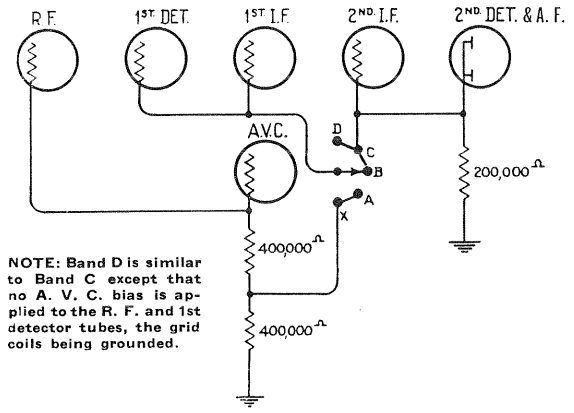


Figure 3—Switching Arrangement of Automatic Volume Control Systems

The signal enters the receiver through a shielded antenna lead and is applied to the grid of the R. F. tube through the antenna coupling transformer. The secondary of this transformer is tuned to the signal frequency by means of one unit of the gang-capacitor. The output of this stage is transformer coupled to the grid circuit of the first detector, which is also tuned to the signal frequency by a unit of the gang-capacitor.

Combined with the signal in the first detector is the local oscillator signal, which is always at a 460 K. C. frequency difference (higher) from the signal frequency. A separate coil system and the third unit of the gang-capacitor are used in the oscillator circuit.

In conjunction with these three tuned circuits it is well to point out that five different groups of tuned circuits are used, one group for each tuning band. A five-position selector switch is provided for selecting the band in which the desired signal is located. In addition to selecting the desired coil system, additional groups of contacts are provided for short-circuiting the preceding lower frequency R. F. and detector coils and the two preceding oscillator coils. This is to prevent "dead" spots due to absorption effects caused by the coils, the natural period of which without the gang-capacitor connected falls in the next higher frequency band. This gang switch also has additional contacts for performing other functions which will be discussed.

The output of the first detector, which is the I. F. signal (460 K. C.), is fed directly through two tuned circuits to the grid of the automatic volume control I. F. amplifier stage. A coupling coil adjacent to the secondary of this transformer is connected directly to the signal I. F. stage, which is in effect parallel to the A. V. C., I. F. stage. Examining the signal amplifier further we find that the output of the first signal I. F. stage is applied through a transformer to the second I. F. stage and thence through a second transformer to the second detector. Both circuits of each transformer are accurately tuned to the I. F. signal, which is 460 K. C.

Further examining the A. V. C., I. F. stage it will be seen that the output of this stage is applied to the A. V. C. tube through an untuned I. F. transformer. The A. V. C. stage, which is an RCA-76, is operated as a straight rectifier, its plate being grounded and only the grid being used. This tube is shielded in the usual manner. A small grid voltage, approximately 5.0 volts, is maintained so that rectification does not occur until the signal level exceeds this grid voltage. When this occurs, a portion of the rectified signal produces a voltage drop across resistors R-18 and R-19. The drop across both of these resistors constitutes the automatic bias voltage for the R. F. stage. The drop across R-19 alone gives the automatic bias voltage for the first detector and first I. F. stage on bands X and A.

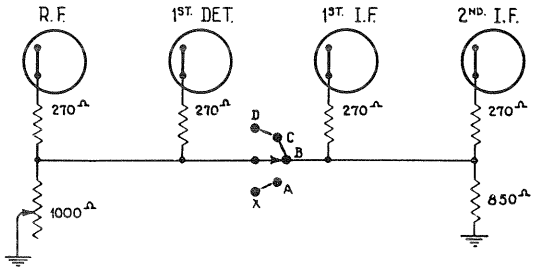
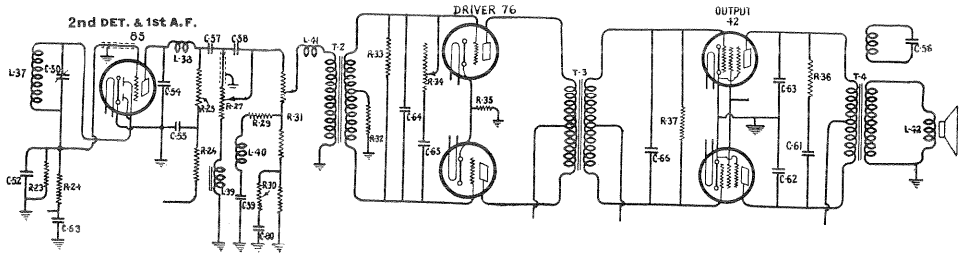


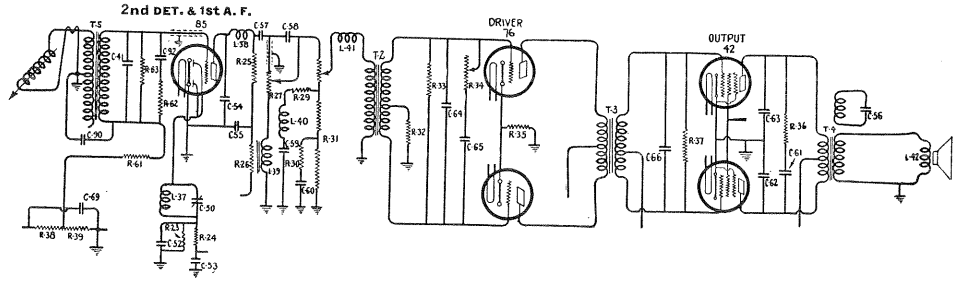
Figure 4—Sensitivity Control Switching Arrangement

Examining the second detector, the diode electrodes provide the detector action while the grid and plate give audio amplification. A portion of the rectified signal also gives a voltage drop across R-23, which is a second automatic volume control system for the receiver. The voltage drop is applied to the second I. F. stage in all bands and to the first detector and first I. F. stage in bands B and C. The change in automatic volume control systems is made by an additional group of contacts on the band selector switch. Figure 3 shows the switching arrangements for changing the A. V. C. system in the various bands.

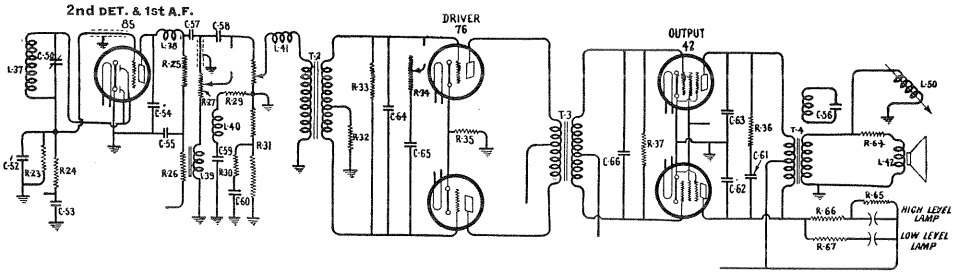
At this point, an explanation as to why two automatic volume control systems are used and why the sensitivity control is changed in different bands may be in order.



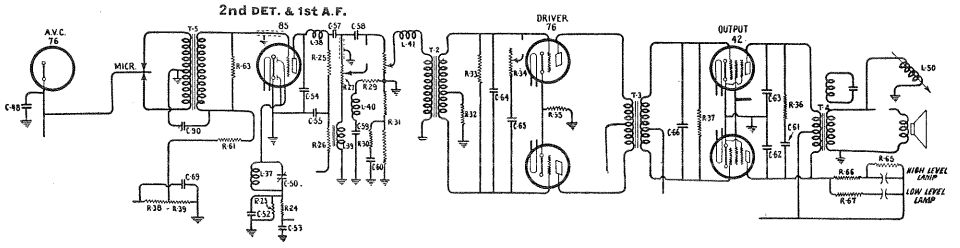
Radio Receiving



Record Reproduction



Radio Recording



Home Recording

Figure 5—Schematic Circuits of Audio Amplifier at each Selector Switch Position

Two automatic volume control systems are used because of the different receiving conditions in the various bands. For example, in the broadcast and long-wave band (X and A) signal levels are very high. Also due to the use of an aurally compensated volume control, a constant input to the second detector must be maintained. From this it is evident that the double channel I. F. automatic volume control is ideal. It maintains a constant input to the second detector and yet does not function on an extremely weak signal. In the short-wave bands, however, conditions are different. Signal strengths are always very low and fluctuate widely. For this reason it is important to have some automatic volume control action below the level at which the double channel system works. This is provided by the tube marked 2nd detector and 1st A. F. which functions on the first detector and two I. F. stages on the short-wave bands. It should be noted that this action is present on the second I. F. stage on all bands. This further flattens the action of the double-channel system in bands X and A.

At this point it is well to examine the sensitivity control, which also changes on different bands. The sensitivity control adjusts the residual bias on the R. F. and first detector stages in bands X and A while it controls the R. F., 1st detector and both I. F. stages on bands B, C, and D. Figure 4 shows the switching arrangement used.

The sensitivity control is changed so that in bands X and A it controls the R. F. and 1st detector while in bands B, C, and D it controls the R. F., 1st detector, 1st I. F. and 2nd I. F. stages. The reason for this is that for a given degree of sensitivity in bands X and A the residual bias will be considerably higher in the R. F. and 1st detector stages than in the bands B, C, and D used. This is to prevent possible overloading of these stages due to the high-signal strengths encountered in bands X and A. Also, in bands B, C, and D, for a given degree of sensitivity the R. F. stage operates at a higher gain, which gives an improved signal to noise ratio. This is caused by the paralleling of the sensitivity control with an 850-ohm resistor in these bands.

Returning to the second detector, we find its output circuit is coupled to the grid circuit of the driver stage through a compensated volume control system, tone control system and transformer. The volume control uses two stages of compensation, which serves to increase the high and low frequencies as the volume is reduced. This compensates for the natural loss in sensitivity of the human ear to the high and low frequencies at low sound levels. A low and a high frequency tone control enables the listener to alter the fidelity of the receiver to his individual taste.

The driver stage, which is a pair of RCA-76 Radiotrons connected in push-pull, is transformer coupled to a pair of RCA-42's which are the output stage. A feature of the output stage is the use of fixed bias, which reduces distortion and increases the available output. This is accomplished by the use of the drop across R-38 and R-39, which carries the entire D. C. output from the rectifier. Naturally the output stage uses but a portion of the total rectified current and current variations in it will have but little effect on the drop across the resistor.

The output of the power stage is coupled through a step-down transformer to the voice coil of the loudspeaker. A separate winding, which is shunted by a capacitor, has been provided in this transformer which gives a very sharp, high-frequency cut-off for the entire

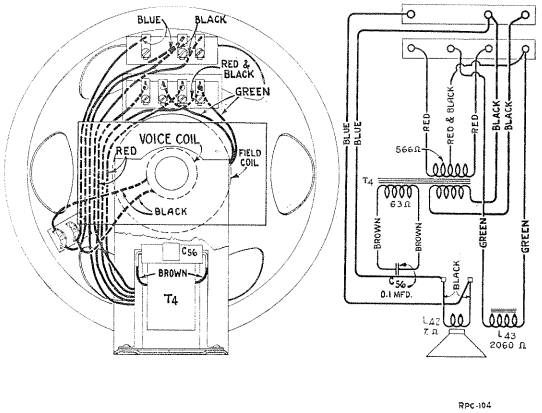


Figure 6—Loudspeaker Wiring

audio system. This greatly reduces the reproduction of any high-frequency interchannel interference or other disturbance of a high-frequency character which is outside of the useful musical range.

The loudspeaker used is of the large-field ten-inch type. It is fully capable of handling the high-power, high-quality output of the receiver and converting it into faithful sound reproduction.

Figure 6 shows the loudspeaker wiring while Figure 7 shows the chassis wiring diagram. Figure 9 shows the assembly wiring diagram.

PHONOGRAPH AND RECORDING

The record reproducing facilities consist of a low impedance magnetic pickup with its associated inertia type tone arm, a compensated volume control, the audio amplifier of the receiver and the loudspeaker of the receiver. The radio receiver is made inoperative by the switch used for changing to record reproduction.

The recording facilities use the audio amplifier of the radio receiver, the output of which is connected to the magnetic pickup instead of the voice coil of the loudspeaker. The input to the amplifier may be either from the microphone or from the radio receiver, depending on whether radio recording or home recording is desired. It should be noted that when radio recording is being used, the loudspeaker is connected across the output through a resistor so that the program being recorded may be monitored at the same time.

Figure 5 shows schematic circuit diagram of the audio circuits at each of the four selection switch positions.

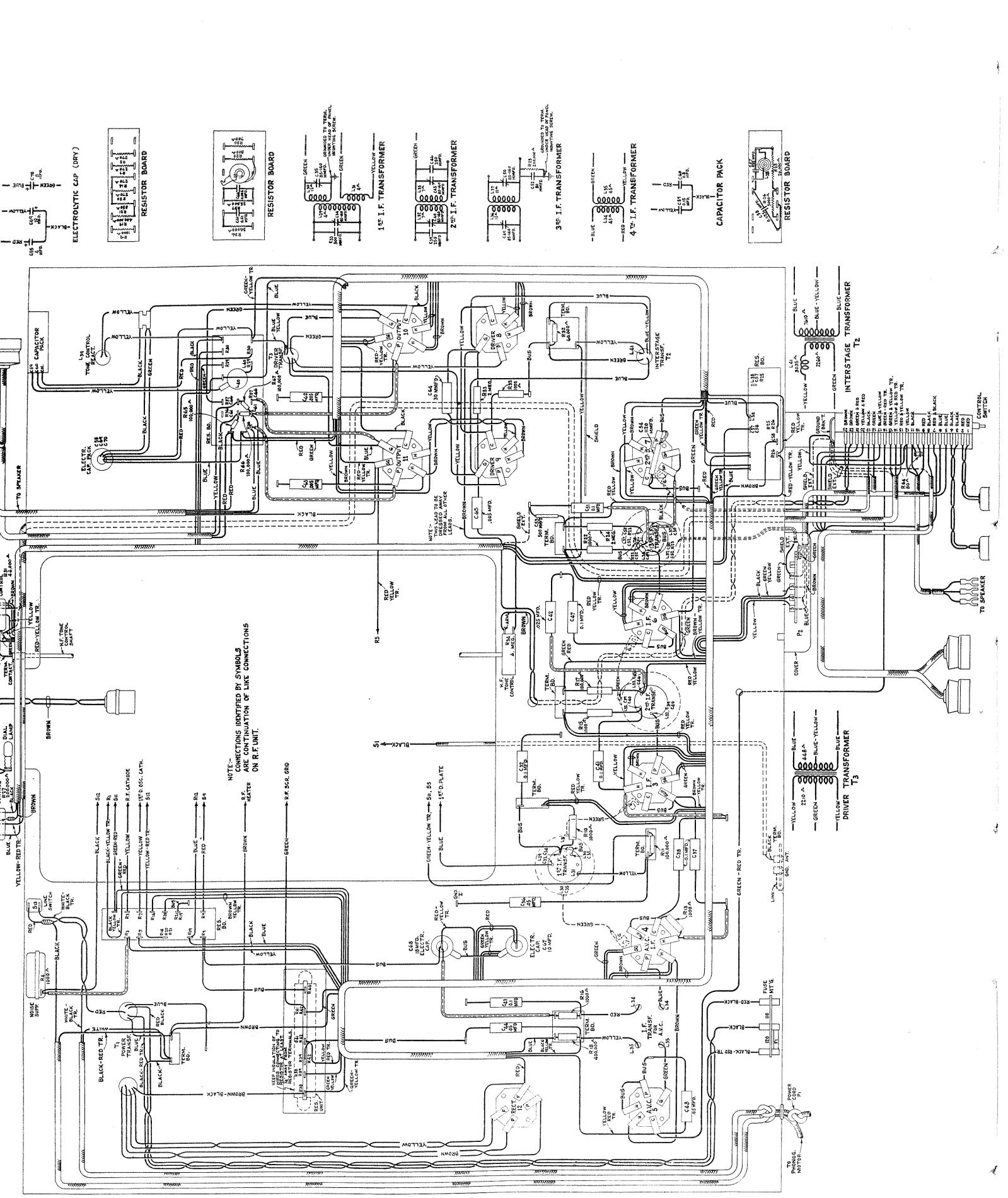


Figure 7—Chassis Wiring Diagram

SERVICE DATA

(1) LINE-UP PROCEDURE

The line-up procedure of this receiver is somewhat involved and it is important that these instructions be carefully followed when making adjustments. Properly aligned, this receiver has outstanding performance; improperly aligned, it may be impossible to receive signals on all bands.

Equipment

To properly align this receiver, the following equipment must be used. This is a modulated R. F. oscillator having proper frequency range, an output indicator, an alignment tool, a tuning wand, and a "dummy" Radiotron RCA-76. These parts have been developed by the manufacturer of this receiver

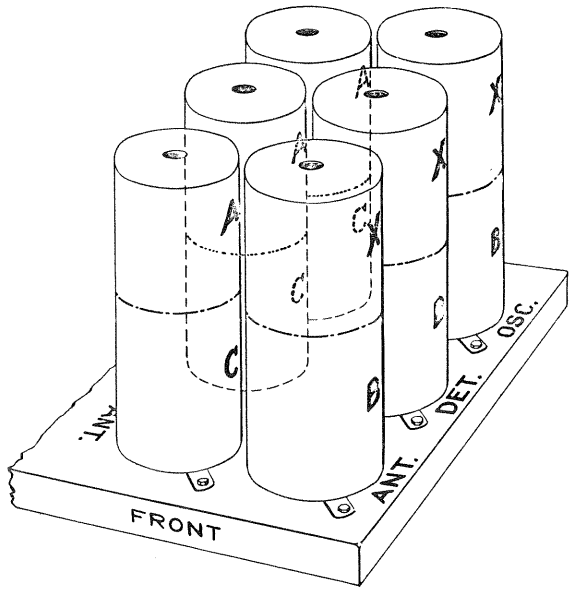


Figure 8—Location of Various Coils in Shields

for use by service men to duplicate the original factory adjustments. The "dummy" Radiotron, RCA-76, is obtained by removing one heater prong from an otherwise perfect tube.

Checking with Tuning Wand

Before making any R. F., oscillator or first detector adjustments, the accuracy of the present adjustments may be checked by means of the tuning wand (Stock No. 6679). The tuning wand consists of a bakelite rod having a brass cylinder at one end and a special finely divided iron insert at the other end. Inserting the cylinder into the center of a coil lowers its inductance, while inserting the iron end increases its inductance. From this it is seen that unless the trimmer adjustment for a particular coil is perfect at alignment frequencies, inserting one end of the wand may increase the output of a particular signal. A perfect adjustment is evidenced by a lowering of output when either end of the wand is inserted into a coil.

The shields over the R. F. coil assembly have a hole at their top for entrance of the tuning wand. The location of the various coils inside of the shield is shown in Figure 8. An example of the proper manner of using the tuning wand would be to assume the external oscillator were set at 1720 and the signal tuned in. The A. V. C. tube would be replaced by the "dummy" RCA-76 and the output indicator connected across the voice coil of the loudspeaker. Then the tuning wand should be inserted, first one end and then the other end, into the top of the three transformers at the left of the R. F. assembly, facing the front of the chassis. A perfect adjustment of the trimmer would be evidenced by a reduction in output when each end of the wand is inserted in each of the three transformers. If one end—for example, the iron end—when inserted in one coil caused an increase in output, then that circuit is low. An increase in the trimmer capacitance would be the proper remedy.

(2) I. F. TUNING CAPACITOR ADJUSTMENTS

Although this receiver has three I. F. stages, two for the signal and one for the A. V. C., only three transformers having six adjustable capacitors require adjustment. The fourth transformer is in the A. V. C. circuit and is broadly tuned, not requiring adjustments. The transformers are all peaked, being tuned to 460 K. C.

A detailed procedure for making this adjustment follows:

(a) Connect the output of an external oscillator tuned to 460 K. C. between the first detector grid and ground. Connect the output indicator across the voice coil of the loudspeaker. Replace the A. V. C. tube in the receiver with the "dummy" RCA-76.

(b) Place the oscillator in operation at 460 K. C.; place the receiver in operation and adjust the station selector until a point is reached (Band A) where no signals are heard and turn both the volume and sensitivity controls to their maximum position. Reduce the oscillator input until a slight indication is obtained in the output indicator.

(c) Refer to Figure 10. Adjust each trimmer of the I. F. transformers until a maximum output is obtained. Go over the adjustments a second time.

This completes the I. F. adjustments. However, it is good practice to follow the I. F. adjustments with the R. F. and Oscillator adjustments due to interlocking which always occurs.

(3) R. F. OSCILLATOR AND FIRST DETECTOR ADJUSTMENTS

Four R. F., oscillator and first detector adjustments are required in bands "X" and "A." Three are required in bands "B" and "C" while none are required in band "D." Band "D" uses the second harmonic of the oscillator while the detector and R. F. coils do not have trimmers.

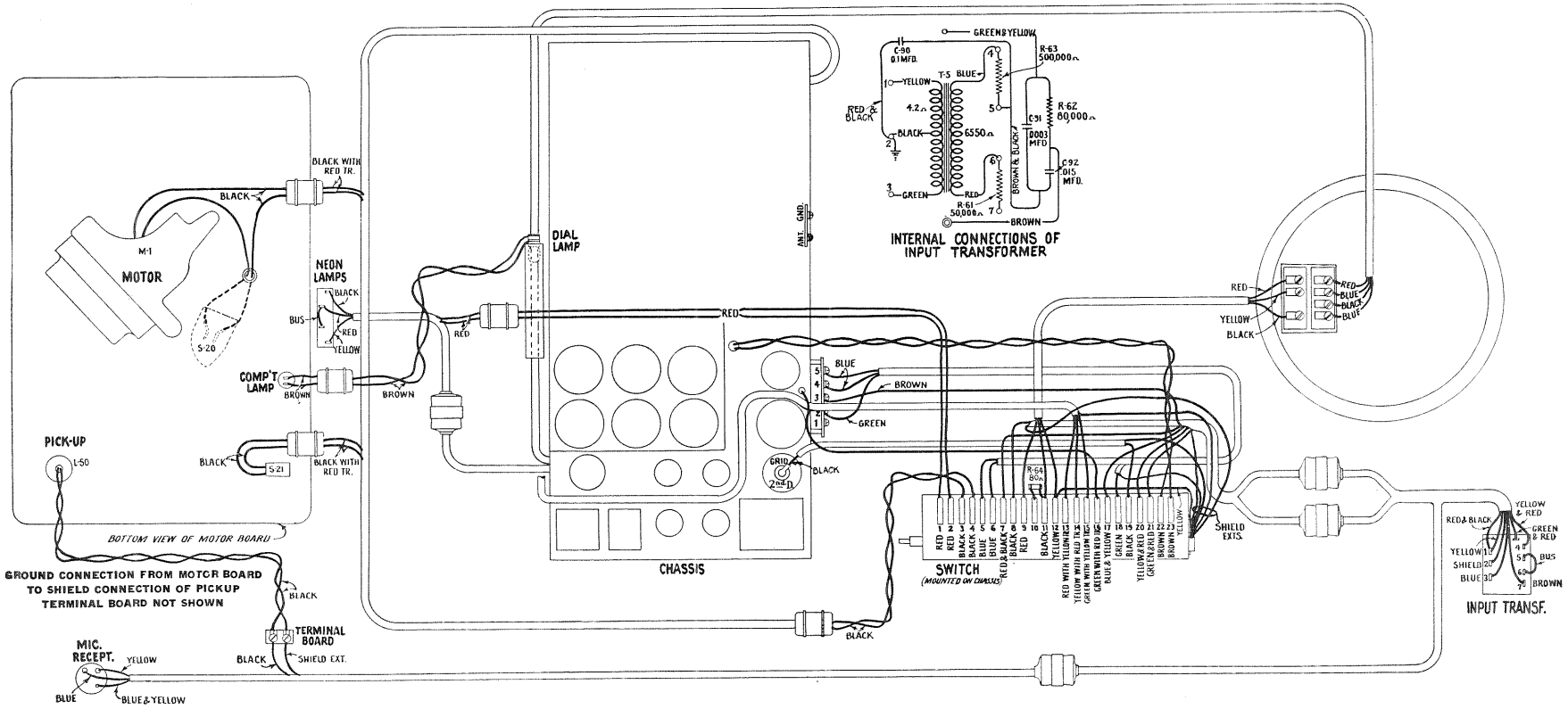


Figure 9—Assembly Wiring Diagram

To properly align the various bands, each band must be aligned individually. The preliminary set-up requires the external oscillator to be connected between the antenna and ground terminals of the receiver. The output indicator must be connected across the voice coil of the loudspeaker while the "dummy" RCA-76 must be placed in the A. V. C. socket. The sensitivity and volume controls must be at their maximum position and the input from the oscillator must be at the minimum value possible to get an output indication under these conditions. In the high-frequency bands, it may be necessary to disconnect the oscillator from the receiver and place it at a distance in order to get a sufficiently low input to the receiver.

The Dial Pointer must be properly set before starting any actual adjustments. This is done by turning the variable capacitor until it is at its maximum capacity position. One end should point exactly at the horizontal line at the lowest frequency end of band "A," while the other end should point to within 1/64" of the horizontal line at the highest frequency end of band "A."

Figure 10 shows the location of the trimmers for each band. Care must be exercised to only adjust the trimmers in the band under test.

Band "X"

(a) Tune the external oscillator to 410 K. C., set the pointer at 410 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(b) Shift the external oscillator to 175 K. C. Tune in the 175 K. C. signal irrespective of scale calibration and adjust the series trimmer marked 175 K. C. on Figure 10, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 410 K. C. as described in (a).

Band "A"

(a) Tune the external oscillator to 1720 K. C., set the pointer at 1720 K. C. and adjust the oscillator, detector and R. F. trimmers for maximum output.

(b) Shift the external oscillator to 600 K. C. Tune in the 600 K. C. signal irrespective of scale calibration and adjust the series trimmer, marked 600 K. C. on Figure 10, for maximum output, at the same time rocking the variable tuning capacitor. Then readjust at 1720 K. C. as described in (a).

Band "B"

(a) Tune the external oscillator to 5160 K. C., and set the pointer at 5160 K. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacitor from minimum to maximum.

(b) Check for the image signal, which should be received at approximately 4240 on the dial. It will be necessary to increase the external oscillator output for this check.

(c) The antenna and detector trimmers should now be peaked for maximum output.

Band "C"

(a) Tune the external oscillator to 18,000 K. C., and set the pointer at 18 M. C. Adjust the oscillator trimmer for maximum output. The trimmer should be set at the first peak obtained when increasing the trimmer capacity from minimum to maximum.

(b) Check for the image signal, which should be received at approximately 17,080 on the dial. It may be necessary to increase the external oscillator output for this check.

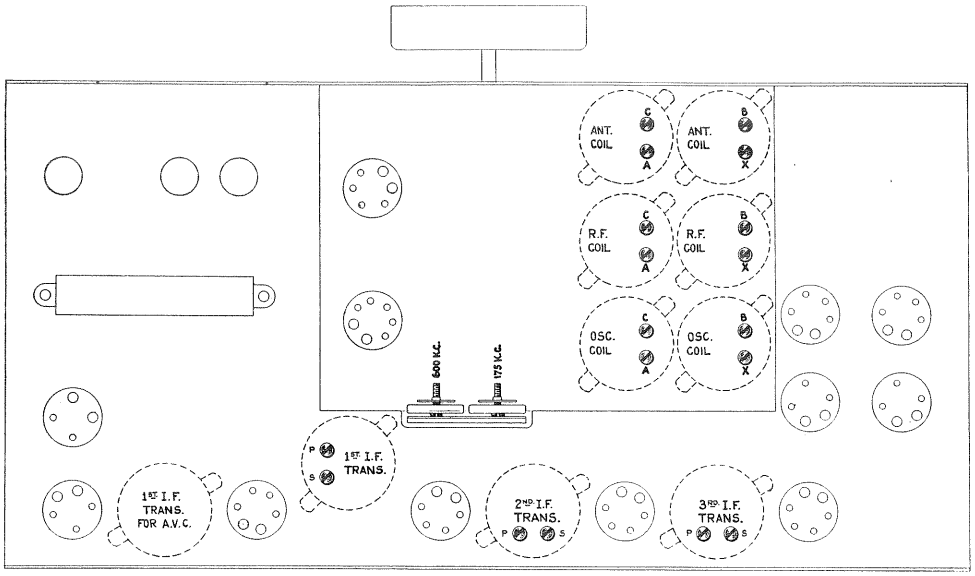


Figure 10—Location of Various Trimmer Capacitors

(c) Reduce the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal disappears. The first detector circuit is then at the oscillator frequency and the RCA-6A7 tube is blocked. Then increase the capacity of the detector trimmer, while rocking the tuning capacitor, until the signal is peaked for maximum output.

(d) The antenna trimmer should now be peaked for maximum output. It is not necessary to rock the main tuning capacitor while making this adjustment.

Band "D"

No adjustments are required for Band D.

(5) VOLTAGE READINGS

The following voltages are those at the various tube sockets while the receiver is in operating condition. No allowance has been made for currents drawn by the meter, and if low-resistance meters are used, such allowances must be made. Figure 13 shows the location and voltage at each socket contact.

(6) TESTING NEON LEVEL INDICATING LAMPS

Two Neon Level Indicating Lamps are provided so that a visual indication of the recording level may be obtained at all times. These lamps normally give long service without attention. However, if failure occurs, and all circuits have been checked and eliminated as possible source of failure, the lamps may be

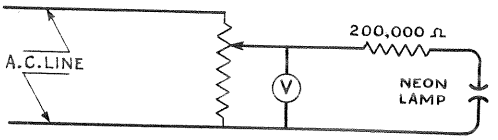


Figure 11—Testing Circuit

easily checked as indicated in the circuit shown in Figure 11. The method for checking involves testing for lighting between certain voltages. The lamps must not light before 52 volts have been applied and must not require a voltage greater than 64 volts to cause them to light. Lamps requiring different voltages from these are defective and must not be used.

RADIOTRON SOCKET VOLTAGES

Maximum Sensitivity—No Signal—120-Volt A. C. Input

Radiotron No.		Cathode to Ground, Volts	Screen Grid to Ground, Volts	Plate to Ground, Volts	Cathode Current, M. A.	Heater Volts, A. C.
RCA-6D6—R. F.		2.3	100	231	8.8	6.3
RCA-6A7	Osc.	3.0	—	232	10.9	6.3
	Det.		100	238		
RCA-6D6—1st I. F.		7.0	100	236	3.5	6.3
RCA-6D6—2nd I. F.		7.0	100	236	3.5	6.3
RCA-6D6—A. V. C.–I. F.		6.0	100	236	4.0	6.3
RCA-76—A. V. C.		4.7	—	0	0	6.3
RCA-85—2nd Det.		0	—	60	7.2	6.3
RCA-76—A. F.		11.0	—	235	5.5	6.3
RCA-76—A. F.		11.0	—	235	5.5	6.3
RCA-42—Power		0	240	365	23.0	6.3
RCA-42—Power		0	240	365	23.0	6.3
RCA-5Z3—Rectifier		—	—	768–384 RMS	104.0	5.0

Power Transformer connected to 120-volt Tap

(7) SERVICE DATA ON MAGNETIC PICKUP

The Magnetic Pickup used in this combination instrument is of a new design with an improved frequency range. While in physical appearance it is similar to that of the older type, details of construction are considerably different. It consists essentially of a

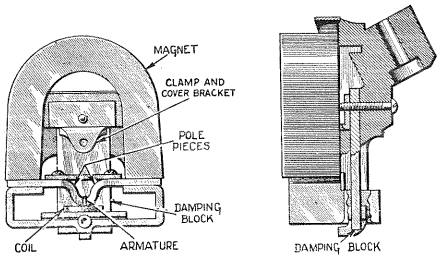


Figure 12—Details of Magnetic Pickup

chromium steel magnet, two thin pole pieces, a mechanism support and bracket, a coil, and an armature that is damped by means of an anchored damping block.

The use of the anchored damping block eliminates any bad peaks in the frequency range. The frequency-response characteristic is substantially flat from 50 to 5,000 cycles.

(8) REPLACING MAGNET COIL, PIVOT RUBBERS, ARMATURE OR DAMPING BLOCK

In order to replace a defective coil or the hardened pivot rubbers (see Figure 15), it is necessary to proceed as follows:

(a) Remove the pickup cover by removing the center holding screw and needle screw.

(b) Remove the pickup magnet and the magnet clamp by pulling them forward.

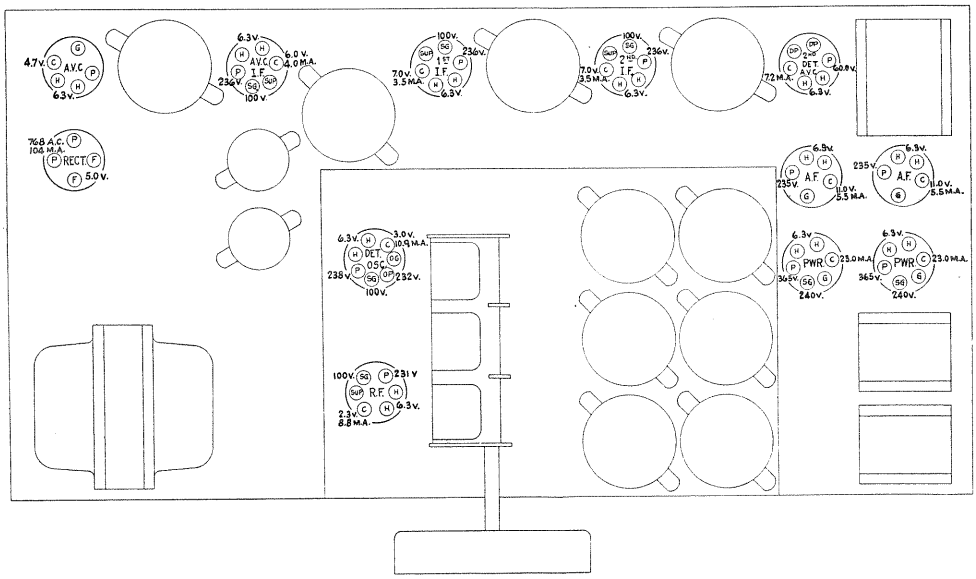
(c) Unsolder the coil leads and remove the mechanism assembly from the back plate by releasing the two mounting screws and the damping block clamping screw.

(d) Remove screws A and B, Figure 15, and then remove the mechanism assembly from the pole pieces.

(e) The coil or the front pivot rubber may now be removed and replaced. If it is desired to replace the rear pivot rubber, then the end of the armature soldered to the mechanism support must be unsoldered and the damping block removed. The rear pivot rubber now may be replaced. After putting the pivot rubbers in place a new damping block should be fastened to the armature as outlined in instructions on replacing the damping block.

(f) The mechanism should now be reassembled, except for the magnet, which must be magnetized. After being magnetized, the mechanism—with the pole pieces upward—should be placed so that the magnet may be slid from the magnetizer onto the pole pieces without breaking physical contact. After placing the pole pieces on the magnet, the entire assembly should be remagnetized thoroughly, being careful not to change the polarity obtained by the initial magnetization.

(g) After assembling to the mechanism, the entire assembly should be fastened to the back plate by means of the screws provided, making sure the damping block is securely clamped. At



ALL D. C. VOLTAGES ARE TO GROUND

Figure 13—Radiotron Socket Voltages

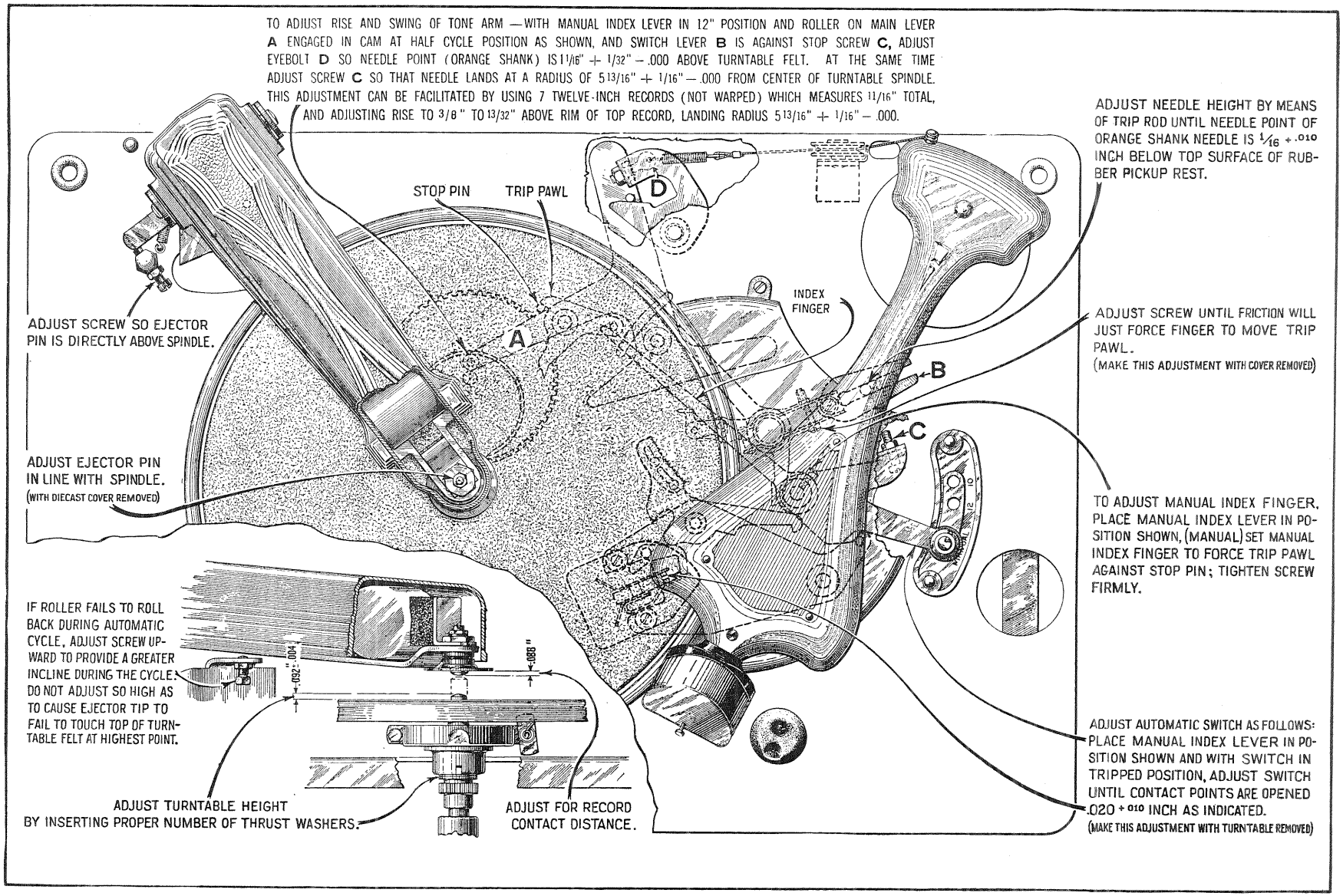


Figure 14—Automatic Record Changer Adjustments

the same time, the metal dust cover must be placed in position.

(h) After remagnetizing, it is necessary to correctly center the armature. This may be done quite accurately by feeling its play after the needle is inserted. A little practice will quickly show which way an adjustment is necessary to have

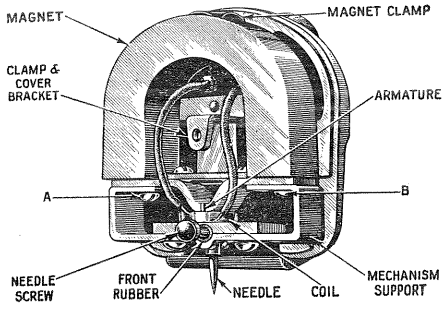


Figure 15—Pickup Nomenclature

the armature centered properly. The adjustment is made by loosening screws A and B (Figure 15), and sliding the mechanism slightly in relation to the pole pieces.

(i) The cover may be now replaced over the entire assembly, and the pickup returned to the tone arm.

In assembling, it may be desirable to check the armature air gap by means of a small Feeler Gauge. This air gap should be .009" on each side of the armature. However, a little practice with the needle in place will quickly disclose whether or not the armature is centered.

(9) REPLACING THE DAMPING BLOCK

If it is desired to replace the damping block, it may be done in the following manner:

(a) Disassemble the pickup as described under the preceding section.

(b) Remove the armature entirely by unsoldering it at its joint with the mechanism support.

(c) Remove the damping block from the armature and clean the bushing for holding the damping block with emery paper.

(d) Insert the armature through the new block so that it occupies the same position as that of the old. Also ascertain that the block is in correct vertical alignment with the armature. It will be noted that the hole in the damping block is somewhat smaller than the diameter of the armature. This is done so that a snug fit will be obtained.

(e) After properly locating the damping block, a soldering iron should be applied to the armature so that the block will melt slightly at its point of contact with the armature. A special tip, constructed as shown in Figure 16, will prove desirable for fusing the block in place. The iron should be applied long enough to slightly melt the block and cause a small bulge on both sides, but should not be applied long enough to cause any bubbling. The pickup should then be reassembled as described in the preceding section.

Only rosin core solder should be used for soldering the coil leads in the pickup. Also rosin core solder should be satisfactory for resoldering the end of the spring in the hole in the mechanism, since both these parts have been previously tinned. In case the parts are not well tinned, it will be necessary to scrape the end of the spring and the hole in the mechanism until bright. These parts may now be tinned by using as a flux a water solution of zinc chloride (commonly called acid flux). After tinning, dip the parts in water to wash off the acid flux and thereby prevent serious subsequent corrosion. After making sure that the pivot rubbers and damping block are properly in place,

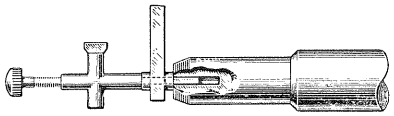


Figure 16—Special Soldering-Iron Tip

as described under (e) above, the armature may now be soldered in place in the mechanism by using rosin core solder, since the parts are now tinned. Care must be exercised to get the needle hole perfectly square with respect to the mechanism, or otherwise it will be difficult if not impossible to center the armature in the air gap as explained under (h), section (8).

(10) AUTOMATIC RECORD CHANGING MECHANISM

The automatic record changer used in this instrument is of simple design and fool-proof construction. Under normal operating conditions service difficulties should be negligible. However, in event adjustments are required, a reference to Figure 14 will disclose the proper method of making all adjustments.

REPLACEMENT PARTS

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
	RECEIVER ASSEMBLIES	
4372	Bracket—Low frequency tone or volume control mounting bracket	$0.20
4406	Bracket—High frequency tone control mounting bracket	.25
2747	Cap—Contact cap—Package of 5	.50
4407	Capacitor—30 mmfd. (C64)	.25
4405	Capacitor—80 mmfd. (C52)—Package of 5	.85
4376	Capacitor—250 mmfd.—Located on second intermediate frequency transformer (C39, C46)—Package of 5	.80
4404	Capacitor—500 mmfd. (C33, C53)—Package of 5	.85
4409	Capacitor—1120 mmfd. (C54)	.35
4070	Capacitor—.004 mfd. (C66)	.42
3643	Capacitor—.005 mfd. (C62, C63)	.25
3512	Capacitor—.005 mfd. (C65)	.28
3787	Capacitor—.01 mfd. (C61)	.30
3888	Capacitor—.05 mfd. (C36, C44, C48)	.25
3765	Capacitor—.025 mfd. (C42, C58)	.34
4645	Capacitor—.1 mfd. (C32, C41, C43, C51)	.25
3877	Capacitor—.1 mfd. (C37, C38, C47)	.32
4720	Capacitor—.035 mfd. (C57)	.42
7790	Capacitor—10 mfd. (C67)	1.05
7788	Capacitor—18 mfd. (C68)	1.10
7787	Capacitor pack—Comprising one .15 mfd. and one .5 mfd. capacitors (C59, C60)	1.10
7789	Capacitor pack—Comprising one 4., one 8. and one 10. mfd. capacitors (C55, C69, C70)	2.68
4358	Clamp—Electrolytic capacitor clamp	.15
7806	Coil—Second detector plate choke coil (L38)	.30
4371	Cover—Fuse mount cover	.15
4359	Cover—Terminal board cover	.15
10907	Fuse—3-ampere—Package of 5	.40
3376	Mount—Fuse mount 105–125-volt instrument	.40
7784	Reactor—Tone control reactor (L39)	1.30
7483	Reactor—Volume control compensating reactor (L40)	.68
6135	Resistor—270 ohms—Carbon type—¼ watt (R3, R7, R14, R20)—Package of 5	1.00
4240	Resistor—700 ohms—Carbon type—¼ watt (R30)—Package of 5	1.00
4375	Resistor—800 ohms—Carbon type—¼ watt (R29)—Package of 10	2.00
6247	Resistor—850 ohms—Carbon type—¼ watt (R21)—Package of 5	1.00
4687	Resistor—1,000 ohms—Carbon type—¼ watt (R9, R10, R13, R15, R16, R22, R35)—Package of 10	2.00
3110	Resistor—25,000 ohms—Carbon type—¼ watt (R37)—Package of 5	1.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R32)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R11, R17)—Package of 5	1.00
3116	Resistor—200,000 ohms—Carbon type—¼ watt—Located on third I. F. transformer (R23)—Package of 5	1.00
4368	Resistor—400,000 ohms—Carbon type—¼ watt (R18, R19)—Package of 10	2.00
6242	Resistor—2 megohms—Carbon type—¼ watt (R24, R33)—Package of 5	$1.00
3413	Resistor—5,000 ohms—Carbon type—½ watt (R26)—Package of 5	1.00
2240	Resistor—30,000 ohms—Carbon type—1 watt (R36)	.22
5817	Resistor—20,000 ohms—Carbon type—3 watt (R25)	.25
6997	Resistor—Total resistance 14,470 ohms with 160–60–350–7150 and 6750 ohm sections (R38, R39, R40, R41, R42)	.95
7804	Rheostat—Noise suppressor rheostat (R4)	1.30
4453	Shield—First I. F., AVC—I. F. or second I. F. Radiotron shield	.32
3683	Shield—Radiotron shield top	.20
4452	Shield—Second detector or AVC Radiotron shield	.35
7800	Shield—Shield for intermediate frequency coils	.45
3859	Socket—4-contact rectifier Radiotron socket	.30
7484	Socket—5-contact AVC Radiotron socket	.35
6676	Socket—6-contact output Radiotron socket	.40
7485	Socket—6-contact driver Radiotron socket	.40
7796	Switch—Operating switch (S13)	.62
7795	Tone control—Low frequency (R27)	1.30
7797	Tone control—High frequency (R34)	1.35
7794	Transformer—AVC intermediate frequency transformer (L34, L35)	.82
7785	Transformer—Driver transformer (T3)	2.40
7791	Transformer—First intermediate frequency transformer (L29, L30, L31, C33, C34, C35)	2.35
9505	Transformer—Power transformer 105–125-volt, 50–60 cycle (T1)	6.35
9506	Transformer — Power transformer 105–125 volts, 25–40 cycles	8.90
7792	Transformer—Second intermediate frequency transformer (L32, L33, C39, C40, C45, C46)	2.22
7793	Transformer—Third intermediate frequency transformer (L36, L37, C49, C50, C52, R23)	2.50
7786	Transformer pack—Comprising one reactor and interstage transformer (L41, T2)	4.25
7798	Volume control—Radio and Phonograph (R31)	2.05
	R. F. UNIT ASSEMBLIES	
4646	Capacitor—4.5 mmfd. (C10)	.20
4416	Capacitor—50 mmfd. (C19)—Package of 5	1.25
3981	Capacitor—300 mmfd. (C8)	.30
4413	Capacitor—360 mmfd. (C28)	.22
4412	Capacitor—1120 mmfd. (C25)	.25
4524	Capacitor—2850 mmfd. (C23)	.35
4615	Capacitor—2850 mmfd. (C20)	.34
4417	Capacitor—0.05 mfd. (C5, C15)	.25
4415	Capacitor—0.1 mfd. (C7, C16)	.30
4645	Capacitor—0.1 mfd. (C9, C31)	.25
3861	Capacitor—Adjustable capacitor (C27, C30)	.78
4420	Clamp—Antenna lead clamp and screw—Package of 10	.40
4410	Coil—Antenna coil—Band "D" (L1, L2)	.70
7803	Coil—Antenna coil—"B"—"SW" (L3, L4, L7, L8, C1, C3)	1.82

REPLACEMENT PARTS—(Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
7810	Coil—Antenna coil—"PB"—"LW" (L5, L6, L9, L10, C2, C4)	$2.10
7805	Coil—Detector coil—"B-SW" (L13, L14, L17, L18, C11, C13)	2.15
7808	Coil—Detector coil—"PB-LW" (L15, L16, L19, L20, C12, C14)	2.05
4421	Coil—Detector coil—Band "D" (L11, L12)	.70
7807	Coil—Oscillator coil—"B-SW" (L21, L22, L25, L26, C22, C26)	1.62
7809	Coil—Oscillator coil—"PB-LW" (L23, L24, L27, L28, C24, C29)	1.70
7801	Condenser—3-gang variable tuning condenser (C6, C17, C21)	4.42
4419	Lead—Shield single-conductor antenna lead	.45
4687	Resistor—1,000 ohms—Carbon type—¼ watt (R5)—Package of 10	2.00
3602	Resistor—60,000 ohms—Carbon type—¼ watt (R8)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—¼ watt (R1, R12)—Package of 5	1.00
4418	Resistor—100 ohms—Flexible type (R2, R6)—Package of 10	1.50
7800	Shield—Antenna, detector or oscillator coil shield	.45
4452	Shield—First detector oscillator coil shield	.35
3683	Shield—Radiotron shield top	.20
4454	Shield—R. F. amplifier Radiotron shield	.44
3529	Socket—Dial lamp socket	.32
7485	Socket—6-contact Radiotron socket	.40
3572	Socket—7-contact Radiotron socket	.38
4686	Strip—Terminal strip engraved "ANT-GND"	.20
7802	Switch—Range switch (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12)	4.05
	CABLE AND PLUG ASSEMBLIES	
4547	Cable — 3-conductor — Recording indicator cable—With female section of connector plug—Stock No. 4153—One end connected to resistor board	.85
4548	Cable—3-conductor with spade terminals—Phonograph chassis cable—One end connected to selector switch, other end to terminal board	.50
4553	Cable—3-conductor—Reproducer cable with spade terminals	.45
4549	Cable—Input transformer cable—3 branches—With 2 male and one female section of connector plugs—Stock Nos. 4571, 4574 and 6123	2.30
4576	Cable—Input transformer—One end connected to selector switch—With two female sections of connector plugs—Stock Nos. 4153 and 4571	1.84
4550	Cable—Microphone cable—One end connected to microphone receptacle—3-conductor with male section of connector plug—Stock No. 4574	1.00
4551	Cable—Recording indicator cable—One end connected to indicator with one male and one female section of connector plug—Stock Nos. 4573 and 6123	1.88
4552	Cable—2-conductor—Motor power cable—With three female sections of connector—Stock No. 4573	$3.36
4554	Cable—Volume control cable—One end connected to selector switch, other end to volume control and low frequency tone control	.50
4153	Plug—Female section of 4-contact connector plug—Used with following cables—Stock No. 4547 and 4576	.48
4573	Plug—Female section of 2-contact connector plug—Used with dial lamp cord and following cables—Stock Nos. 4551 and 4552	.30
4571	Plug—Female section of 6-contact connector plug—Used with cables—Stock Nos. 4549 and 4576	.65
6123	Plug—Male section of 4-prong connector plug—Used with the following cables—Stock Nos. 4549 and 4551	.30
4577	Plug—Male section of 2-prong connector plug—Connected to terminals Nos. 1, 2, 3 and 4 of selector switch	.30
4574	Plug—Male section of 6-prong connector plug—Used with cables Stock Nos. 4550 and 4549	.48
	DRIVE ASSEMBLIES	
4362	Arm—Band indicator operating arm	.28
10194	Ball—Steel ball for variable condenser drive assembly—Package of 20	.25
4422	Clutch—Tuning condenser drive clutch assembly—Comprising drive shaft, balls, ring, spring and washers assembled	.88
4455	Dial—Station selector dial	.60
7799	Drive—Variable tuning condenser drive assembly complete	2.45
4364	Gear—Spring gear assembly complete with hub pinion, gear cover and spring	.96
4361	Indicator—Band indicator—Celluloid-lettered D-C-B-A-X	.12
4363	Pointer—Station selector main pointer—Large	.18
4367	Pointer—Station selector vernier pointer—Small	.15
3993	Screw—No. 6-32-5/32" square head set screw for variable condenser drive assembly—Package of 10	.25
4377	Spring—Band indicator and arm tension spring—Package of 5	.25
4360	Stem—Pointer stem assembly	.35
4378	Stud—Band indicator operating arm stud—Package of 5	.25
	EJECT ARM ASSEMBLIES	
4713	Arm—Eject arm complete	7.74
3658	Ball—Steel ball bearing—Package of 20	.30
3656	Bearing—Ejector tip bearing	.48
4054	Bracket—Eject arm bracket assembly	1.35
4058	Collar—Eject arm shaft collar and set screw	.18
4714	Cover—Eject arm cover	1.38

REPLACEMENT PARTS—(Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

Stock No.	Description	List Price
3930	Cushion—Counter balance cushion and bracket—Located inside of eject arm	$0.18
3662	Plate—Ejector plate—Package of 5	.95
4055	Post—Vertical adjustment post—Located on eject arm bracket	.30
3655	Retainer—Ball retainer with three balls	.45
3729	Roller—Counterbalance roller — Located inside of eject arm	.45
3665	Screw—Eject arm horizontal adjustment screw and nut—Package of 5	.25
4057	Shaft and collar—For eject arm	.24
4067	Spring—Eject arm bracket spring—Package of 10	.30
4125	Spring—Eject arm horizontal action tension spring—60 cycle operation—Package of 10.	.42
4126	Spring—Eject arm—Horizontal action tension spring—For 25 cycle operation—Package of 10	.60
3657	Tip—Ejector tip	.30
4056	Yoke—Eject arm yoke assembly	1.04
	MICROPHONE ASSEMBLIES	
7534	Cord—Microphone cord	.70
6883	Cover—Microphone cover—Two sides	1.96
3216	Cushion—Microphone rubber cushions—Pkg. of 6	.24
6884	Frame—Microphone frame	1.19
7533	Mechanism—Microphone mechanism	6.80
6882	Microphone complete	7.50
4171	Plug—3-contact microphone plug	.30
4158	Socket—Microphone socket	.40
	MOTOR ASSEMBLIES	
9477	Motor—105–125 volts—60 cycles	25.88
9478	Motor—105–125 volts—50 cycles	25.88
9479	Motor—105–125 volts—25 cycles	36.48
4562	Motor mounting spring, washer and stud assembly—Comprising six springs, six cup washers, three spring washers and three studs	.58
	MOTOR BOARD ASSEMBLIES	
4060	Escutcheon — Index escutcheon engraved "Manual 12-10"	.28
3764	Nut—Cap nut for motor board—Package of 4.	.40
3672	Pin—Manual index pin	.42
4066	Rest—Pickup rest	.14
3654	Roller—Pickup arm guide roller assembly—Comprising bracket and guide pin	.34
3763	Suspension spring, washer and bolt assembly for motor board—Comprising one bolt, two cup washers, two springs, one "C" washer and one cap nut	.42
	OPERATING MECHANISM ASSEMBLIES	
6502	Cam—Cam and gear assembly	1.18
6808	Clutch—Trip lever friction clutch	.30
4719	Cover—Metal cover for trip lever and friction finger assembly	$0.28
3670	Finger—Friction finger assembly	.32
6809	Finger—Manual index lever finger assembly	.25
6846	Lever—Main lever and link assembly	1.45
6810	Lever—Main spring lever	.44
6806	Lever—Manual control index lever—Less pin.	.55
3677	Lever—Pickup arm cable lever assembly complete—Comprising lever with cable screw spring and nut	.40
6807	Lever—Trip lever and friction clutch assembly.	1.16
6503	Pawl—Trip pawl assembly	.40
4124	Plate—Eject arm actuating plate assembly	.50
4563	Screw—Cable lever cable screw and nut—Package of 10	.60
4564	Screw—Manual index lever finger set screw—Package of 10	.20
4567	Screw—Manual index lever assembly—Adjustment screw and nut—Package of 10.	.32
4566	Screw—Special screw used to fasten main lever and link assembly bushing—Package of 10	.30
4059	Screw—Trip lever clutch tension adjustment screw—Package of 10	.22
4127	Spring—Actuating plate tension spring—Package of 10	.24
3666	Spring—Cable lever tension spring—Package of 10	.44
3676	Spring—Cam and gear, pawl carrier tension spring—Package of 10	.52
4061	Spring—Main spring	.38
4565	Spring—Manual index lever finger tension spring—Package of 10	.30
2893	Spring—Trip lever latch plate tension spring—Package of 10	.30
2917	Washer—Spring washer "U" type—Package of 10	.25
	PICKUP AND ARM ASSEMBLIES	
4581	Arm—Pickup arm complete less escutcheon and pickup unit	5.72
4128	Armature—Pickup armature	.96
6813	Back—Pickup housing back	.68
4064	Cable—Pickup arm cable—Package of 5	1.00
4583	Coil—Pickup coil (L50)	.80
4711	Cover—Pickup cover	.34
4709	Cover—Pickup back cover with two mounting screws	.34
3737	Damper—Pickup damper—Package of 5	.65
6815	Escutcheon—Pickup arm escutcheon	.64
4561	Pad—Cork pad—Used when making home recordings	.45
4582	Pickup unit complete	4.30
4062	Rod—Automatic brake trip rod	.20

REPLACEMENT PARTS—(Continued)

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers

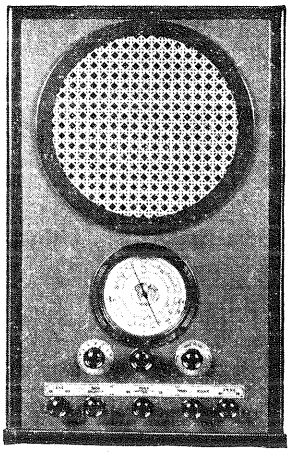
Stock No.	Description	List Price
4063	Screw assembly—Pickup mounting screw assembly—Comprising one screw, one washer and one nut—Package of 10	$0.54
3388	Screw—Needle holding screw—Package of 10	.60
3419	Screw—Pickup cover holding screw—Package of 10	.40
4157	Weight—Home recording weight	1.72
	RECORDING INDICATOR ASSEMBLIES	
4162	Escutcheon—Recording indicator escutcheon	.34
4161	Lamp—Neon lamp	.56
4164	Screen—Indicator lamp screen	.18
4163	Screw—Screen, escutcheon and terminal board mounting screw assembly—Comprising two screws, two spacers, two nuts and two lockwashers	.20
	REPRODUCER ASSEMBLIES	
4706	Board—Terminal board—Three terminals	.30
4568	Bolt assembly—Reproducer mounting bolt assembly—Comprising one bolt, one lockwasher, one washer and one nut—Package of 10	.55
9542	Coil—Field coil, magnet and cone support (L43)	11.16
7000	Cone—Reproducer cone (L42)—Package of 5	9.45
9541	Reproducer complete	17.32
6999	Screen—Dust screen—Package of 6	.12
7826	Transformer—Output transformer and capacitor (T4, C56)	2.80
	SWITCH ASSEMBLIES	
3994	Cover—Motor switch cover	.26
10184	Plate—Automatic brake latch plate—Package of 5	.40
10174	Springs—Automatic brake springs—Package of 4	.50
6805	Switch assembly—Automatic switch complete	1.90
3322	Switch—Motor switch (S20)	.75
	TURNTABLE ASSEMBLIES	
4065	Bushing—Speed shifter lever bushing—Package of 4	.82
3344	Cover—Grease retainer cover—Package of 2	.70
6818	Lever—Speed shifter lever	.38
3341	Pin—Groov pin—Package of 2	.56
6816	Ring—Clamp ring assembly—Comprising spring, latch lever and stud	.42
4708	Turntable complete	5.10
6817	Sleeve—Sleeve complete with ball race	2.25
3342	Spring—Latch spring—Located on clamping ring—Package of 2	.56
3347	Spring—Speed shifter lever spring—Package of 2	.30
3340	Washer—Thrust washer—Package of 2	.56

Stock No.	Description	List Price
	MISCELLANEOUS PARTS	
4556	Base—Phonograph compartment lamp base and socket	$0.55
4546	Bearing—Selector flexible shaft bearing and nut and set screw—Fastened to motor board	.50
4677	Bezel—Metal bezel (escutcheon) for station selector dial	.56
4555	Box—Needle box complete with lid	.40
4559	Bracket and bushing—Selector switch flexible shaft bracket and bushing—Fastened to selector switch	.52
4572	Escutcheon—Selector switch escutcheon	.46
6614	Glass—Station selector dial glass	.30
4425	Knob—Station selector or Radio-phonograph—Recording switch knob—Package of 5	.75
3829	Knob—Volume control, tone control, noise suppressor or range switch knob—Package of 5	1.10
4340	Lamp—Dial lamp—Package of 5	.60
4190	Pointer—Selector switch pointer—Package of 5	.72
4710	Receptacle—Needle receptacle	.35
4091	Resistor—80 ohms—Carbon type—1/4 watt—Located on selector switch (R64)—Package of 5	1.00
3118	Resistor—100,000 ohms—Carbon type—1/4 watt (R65, R66, R67)—Package of 5	1.00
4678	Ring—Station selector dial glass retaining ring—Package of 5	.34
4119	Screw—8-32-1/4" headless set screw for knob—Stock Number 4425—Package of 20	.38
4393	Screw—8-32-5/16" headless set screw for knob—Stock Number 3829—Package of 10	.25
4191	Screw—10-32-7/16" dog point fillister head set screw—Used with flexible shaft bearing—Package of 10	.50
3651	Screw—10-32-3/16" self-locking headless set screw—Used with flexible shaft bearing—Package of 10	.32
3652	Screw—10-32-1/4" self-locking set screw for selector switch, flexible shaft bracket and bushing—Package of 10	.32
4580	Screw—6-32-3/16 square head set screw for selector switch flexible shaft—Package of 10	.25
4560	Screw assembly—Receiver chassis mounting screw and washer assembly—Package of 10	.30
4557	Shade—Phonograph compartment lamp shade	.35
4558	Shaft—Selector switch flexible shaft	1.10
4544	Switch—Radio-phonograph, or home recording selector switch (S22)	7.10
4579	Switch—Toggle type—Motor starting switch (S21)	1.55
4545	Transformer — Input transformer pack — Comprising one input transformer, one 50,000 ohm, one 500,000 ohm and one 80,000 ohm resistor, one .0003 mfd. and one 0.1 mfd. and one .015 mfd. capacitors (T5, C90, C91, C92, R61, R62, R63)	5.40

Instructions 23273

Nine-Tube General Purpose "All-Wave" Receiver

(With CW Oscillator)



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INTRODUCTION

This all-wave radio receiver utilizes the widely-recognized superheterodyne circuit and the broad range covered makes it an ideal general purpose receiver. The receiver is capable of operation through a continuous tuning range of from 540 to 18,000 kilocycles (555 to 16.7 meters) and also in the aviation long-wave services of 150 to 410 kilocycles (2,000 to 732 meters). A separate heterodyne oscillator unit is included to provide a beat-note for CW reception. All facilities provided in this instrument for reception beyond the limits of the standardized broadcast band (540 to 1500 kilocycles) are built-in as integral parts of the radio chassis—not simply connected to an existing chassis as a short-wave adaptor—resulting in distinctly superior performance.

To facilitate tuning as much as possible, the complete main tuning range is divided into five bands, each spread over the full span of the dial. These steps, or frequency bands, are quickly interchangeable by means of a range-switch controlled by a knob on the front panel. Also contributing to tuning ease and accuracy are the clock-type "full-vision" illuminated dial which is calibrated throughout in frequency, and the associated vernier (double-reduction ball-bearing) tuning drive. For greater flexibility in operation, a separate heterodyne oscillator unit is included which provides an audio beat-note for reception of CW signals. A switch is provided for disconnecting the automatic volume control when desired and a radio sensitivity control is provided as an inter-channel noise suppressor or for adjustment of the r-f gain when the AVC is off. Pin-jacks are provided for connection of headphones and a switch is provided for connecting the output to either the loudspeaker or headphones.

The technically-informed user of this instrument naturally will be interested in its many advanced engineering features. Of chief importance is the use of tuned-radio-frequency amplification preceding the first heterodyne oscillator circuit to minimize extraneous signal interference (image-frequency response, etc.) and to improve the "signal-noise" ratio. Two t-r-f stages are included, one being common to all bands and the second used only in conjunction with the highest-frequency band to compensate for the inherently greater circuit losses obtained in that range. Additional features of note are: (1) Its automatic volume control operating uniformly at all carrier frequencies and (2) its high-powered (Class B) audio-output system utilizing the new "twin-amplifier" Radiotron RCA-53. In general, all of the best practices observed heretofore in modern high-grade receivers of the standard broadcast type are incorporated in this "all-wave" instrument, thus insuring excellent performance over the entire tuning range.

INSTALLATION

Location.—The instrument should be placed convenient to the antenna and ground connections and near an electrical outlet.

Tubes.—The instrument is equipped and tested at the factory with RCA Radiotrons and is shipped with these tubes installed. Before making the required external connections, however, it will be advisable to examine the tube installation, as one or more of the tubes, shields or dome terminal clips may have been jarred loose in shipment. Refer to the tube location diagram printed on the instrument label inside the cabinet and make certain:

(1) That all tubes are in the proper sockets and pressed down firmly.

(2) That all shields are rigidly in place over the tubes represented by double circles on the diagram.

(3) That the spring connectors of the short flexible (grid) leads, shown on the diagram, are securely attached to the dome terminals of the proper tubes.

NOTE—The grid lead for the RCA-2B7 Radiotron must be enclosed by the cylindrical tube shield. A slot is provided at the bottom of this shield for entrance of the lead.

Antenna and Ground.—The efficiency of any antenna varies greatly with the frequency of incoming radio waves, a given length being excellent at certain frequencies and comparatively poor at others. For uniform results throughout a wide tuning range such as found in this instrument, therefore, an antenna of adjustable length would be desirable theoretically. From a practical standpoint, however, very good results will be obtained using two antennas of different lengths, one 24–29 feet for short-wave reception, and the other 50–100 feet for reception in the long-wave, standard broadcast and police bands, the lead-in considered as part of the total length in each case.

The shorter antenna may be used alone if preferred, but probably will not be satisfactory for receiving distant or low-powered stations in the standard broadcast band. Further, no advantage will be gained by its use on the shorter wavelengths unless it can be installed so that the majority of its length is unshielded (not contained in a building of metallic construction) and sufficiently remote from sources of man-made interference (such as house wiring, power lines, street-railways and passing automobiles) to prevent excessive noise. If these conditions cannot be fulfilled, it will be preferable to erect a single antenna of compromise length (100–105 feet overall), which, in addition to providing excellent results in the standard broadcast band, will also favor reception in the short-wave broadcast bands located at 49, 31, 25 and 19 meters.

Best performance of this receiver on the shorter wavelengths can be insured by installation of the recently introduced "World-Wide" antenna system, available from your dealer as a convenient accessory kit. The advantages of this system are two-fold, its use providing: (1) A great improvement in efficiency, as evidenced by increased signal strength —often several times that obtainable with the conventional single-wire type and (2) a considerable decrease in local electrical interference (man-made static) which is apt to be objectionably severe at the higher frequencies. For densely-populated districts, therefore, this system is virtually a necessity.

Good reception in many installations will be obtained without connecting the instrument to an external ground, since the power-line characteristics often render a separate radio ground unnecessary. In any case, however, best results will be insured by grounding the set in the conventional manner to a water-pipe or radiator or to a metallic pipe or stake driven from five to eight feet into the soil. The ground lead when used should be short, preferably not more than 15 feet in length, and connected to a clean portion of the pipe or stake surface by means of an approved ground clamp.

A terminal board is provided at the rear of the receiver chassis for connection to the antenna and ground. Attach the antenna wire or lead-in to the left-hand terminal (marked "ANT") and the ground wire to the right-hand terminal (marked "GND"). Tighten both terminals with a screwdriver to insure permanent electrical connections.

Power Supply.—These equipments are furnished for operation from a 100–125/200–250 volts, 50–60 cycle supply. To insure correct tube operating voltages, internal connections may be changed to adapt the receiver for operation from 100–115, 115–125, 200–230 and 230–250 volt, 50–60 cycle supplies. (The receiver as shipped is connected for 115–125 volt operation.) Consult your local power company if you are in doubt as to the specific voltage of the supply. Reconnections when required should be made only by a competent technician; changes are as shown in Figure F.

After making certain that the instrument has been connected for the proper voltage, attach the power cord to the electrical outlet.