RCA VICTOR MODEL C 15-3

Fifteen-Tube, Five-Band, A-C, Superheterodyne Receiver

SERVICE NOTES

ELECTRICAL SPECIFICATIONS

FREQUENCY RANGES

Band X	140— 410 kc.
Band A	540— 1,800 kc.
Band B	1,800— 6,000 kc.
Band C	6,000—18,000 kc.
Band D	18,000—60,000 kc.

ALIGNMENT FREQUENCIES

Band X	150 kc. and 400 kc.
Band A	600 kc. and 1720 kc.
Band B	6132 kc.
Band C	18000 kc.
Band D	*none required*

VOLTAGE AND FREQUENCY

Rating A	105—125 volts, 50—60 cycles
Rating B	105—125 volts, 25—60 cycles
Rating C	100—130/140—160/195—250 volts, 40—60 cycles

RADIOTRON COMPLEMENT

(1) RCA-6K7	Radio-Frequency Amplifier
(2) RCA-6L7	First Detector
(3) RCA-6J7	Heterodyne Oscillator
(4) RCA-6K7	First Intermediate Amplifier
(5) RCA-6K7	Second Intermediate Amplifier
(6) RCA-6K7	Automatic Volume Control Amplifier
(7) RCA-6H6	Automatic Volume Control
(8) RCA-6H6	Second Detector
(9) RCA-6C5	First Audio Amplifier
(10) RCA-6C5	Audio Driver Amplifier
(11) RCA-6C5	Audio Driver Amplifier
(12) RCA-6F6	Power Output Amplifier
(13) RCA-6F6	Power Output Amplifier
(14) RCA-5Z3	Full Wave Rectifier
(15) RCA-6E5	Tuning Indicator

MISCELLANEOUS

Power Consumption	145 watts
Undistorted Output	10 watts
Maximum Output	15 watts
Loudspeaker	12 inch, Electrodynamic
Voice Coil Impedance	7.5 ohms at 400 cycles
Intermediate Frequency	460 kc.

MECHANICAL SPECIFICATIONS

CABINET DIMENSIONS

Height	42 inches
Width	29 3/8 inches
Depth	15 5/8 inches

Weight (Net)	113 pounds
Weight (Shipping)	165 pounds
Chassis Base Size	20 3/4 inches x 10 1/2 inches x 3 1/2 inches

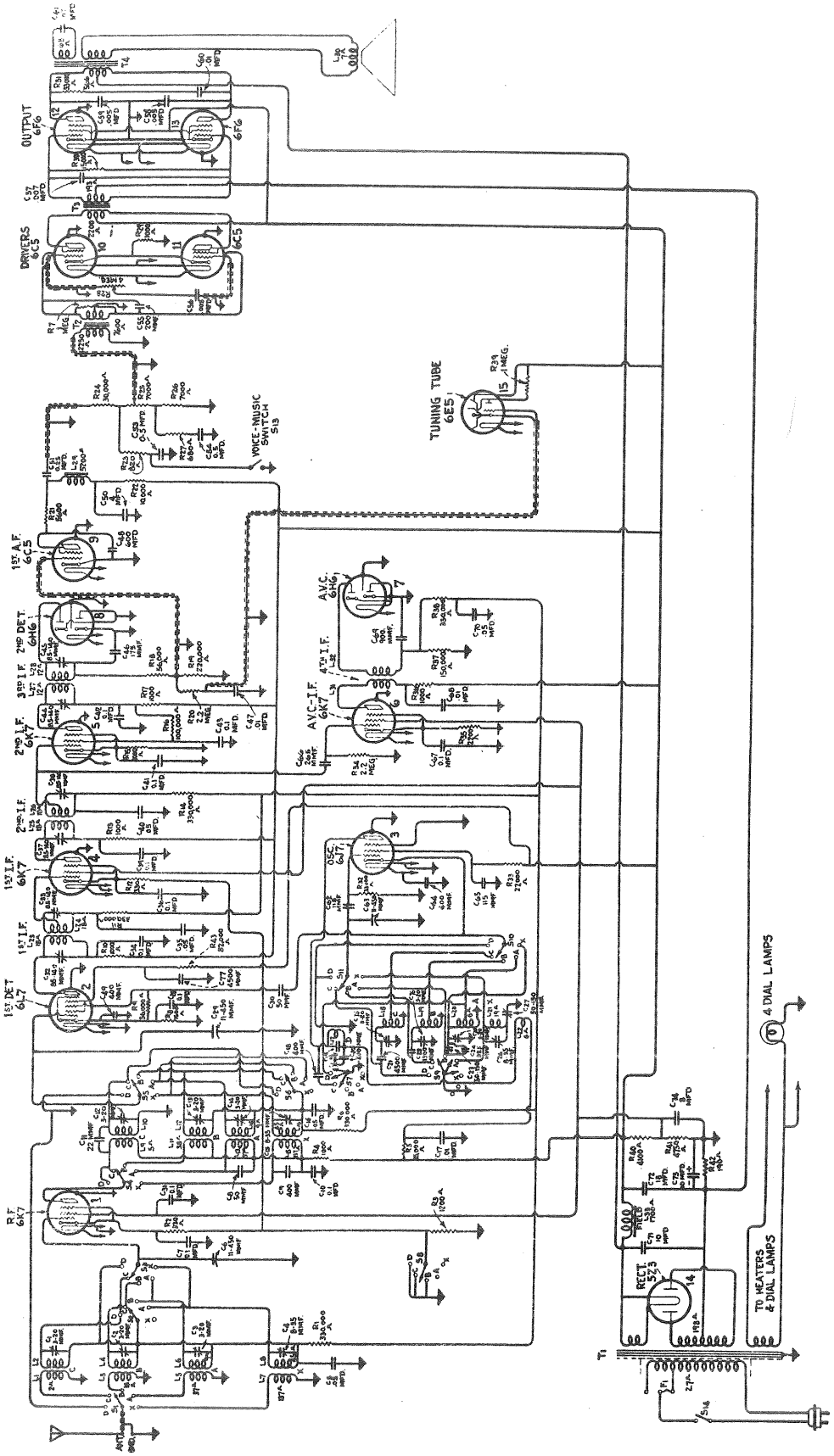
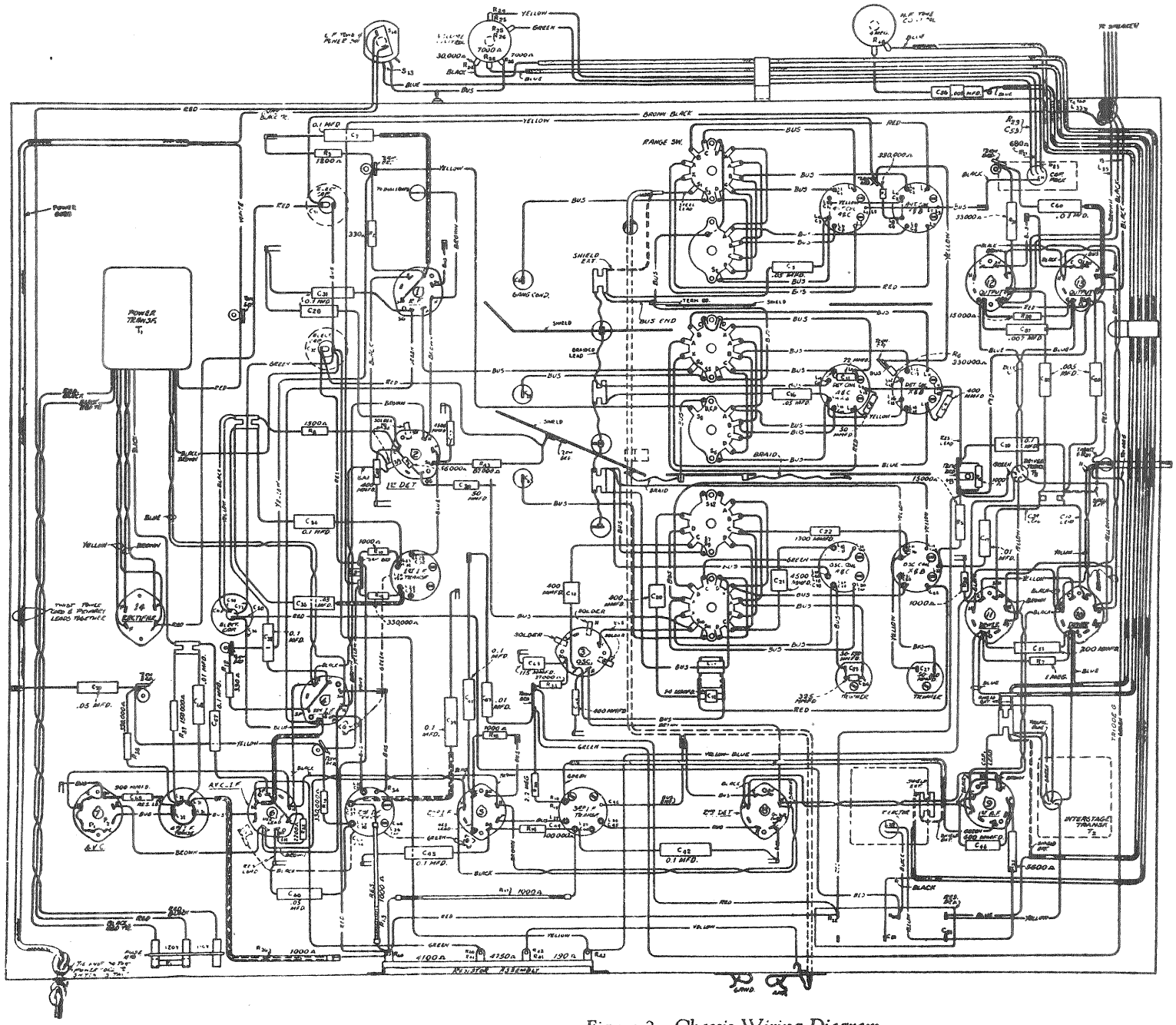
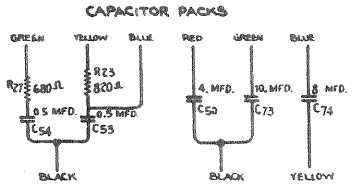
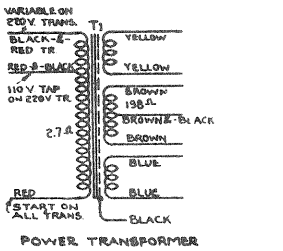
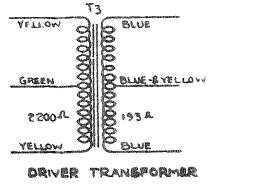


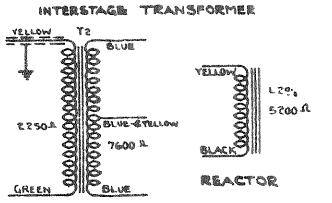
Figure 1—Schematic Circuit Diagram











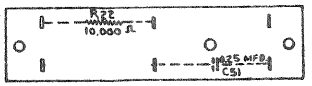


Figure 2—Chassis Wiring Diagram

GENERAL FEATURES

Metal Tubes

This receiver uses the new metal tubes which are much smaller in size than the corresponding glass types. The high frequency efficiency of these metal tubes is greater because of the shorter lengths of leads, lesser interelectrode capacitance and the more complete shielding of the metallic envelopes. Their rugged construction prevents breakage and reduces microphonic tendencies. The bases and sockets of all types have a standardized arrangement of connecting prongs.

Receiver Chassis

Service convenience has been a controlling factor in the layout of the chassis parts and wiring. The assembly of these various elements is such that the number of conductors is minimized with all important connections being readily accessible. Further accessibility to all parts of the chassis is due to the open construction of the base and mounting supports. Trimmer adjustments are easily reached from the underside of the chassis. The r-f, detector and oscillator coils are identified by markings on their bases, which for example read "AAO" to indicate the Band A, "antenna" and "oscillator" coils.

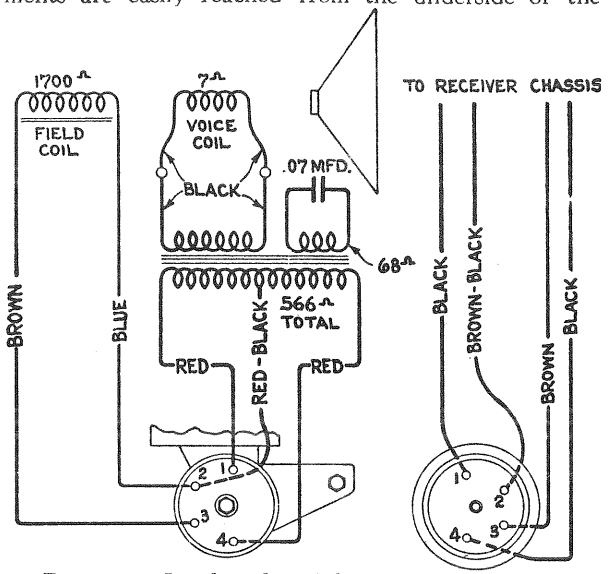


Figure 3—Loudspeaker Schematic and Wiring

Dial Drive

The dial drive and station indicator system are of new and unique design. Five individual dial scales, each with full 180 degree band spread, are provided, one for use on each band. The scales are eccentrically arranged on a rotary disc and adapted to operate in connection with the band change switch so that as the switch is shifted to a certain band, the corresponding dial scale rotates into position. For other positions of the band switch, a similar scale selection takes place, there being only one scale visible at a time. The driving mechanism for the dial and condenser has tuning ratios of 10 to 1 and 50 to 1. Control may be interchanged between these two ratios by push-in operation of a positive action clutch which is actuated by the tuning knob. From the clutch and ratio controlling mechanism, the drive system interlinks with the tuning condenser, main dial pointer and vernier dial pointer through means of fibre and brass gears. The ratio of vernier rotation to the main pointer is 20 to 1. An intermediate gear is used in the system to reduce gear back-lash. This gear is suspended in position with two tension springs which maintain the proper mesh at all times. A flexible coupling disc is used between the drive and the condenser shaft.

Tuning Condenser

The variable tuning condenser is supported by a new design of shock-proof mount which has been developed by our engineers to prevent chassis vibration from producing audio frequency "howl."

Power Transformer

The heat incident to the operation of the transformer is efficiently radiated by the fin effect of the chassis base to which it is mounted. Life of the transformer and its efficiency of performance are thereby appreciably increased. An improved static shield is used between the windings to eliminate line disturbances.

Loudspeaker

A super-sensitive 12 inch electrodynamic speaker is employed. It is correctly adapted to the cabinet design to assure the best possible acoustic performance. Electrical connection is made from the speaker to the chassis through a plug and connector attachment, permitting easy removal for servicing.

ELECTRICAL CIRCUIT

The Superheterodyne method of operation is the basis of the design. The amount of radio frequency as well as audio frequency amplification is balanced in such manner that the maximum of performance is obtained. The following general items cover the circuit arrangement and notable features involved:—

Tuned Circuits

Six adjustable tuned circuits are used in the i-f system, each resonating at 460 kc. A three section variable condenser tunes the secondary of the antenna transformer, the secondary of the detector input transformer and the oscillator coil on all bands with the exception of D, which has only its detector and oscillator tuned. Each tuning range has its own group of r-f and oscillator coils, they being selected as desired by operation of the band-change switch. Trimmer condensers are provided on all of the tuned circuits for use in obtaining precise alignment.

Band D Tuning

Special notice should be taken of the manner of tuning this band. The r-f stage is unused when the range switch is turned to its Band D position and the signal is fed from the antenna directly to the first detector input circuit. The inductance of this circuit consists of a short length of bus wire to which the antenna lead is tapped at a definite predetermined point. The

total length of this inductive wire from the stator of the tuning capacitor to ground represents the secondary of a high frequency autotransformer, while the inductive section included between the antenna lead tap and ground forms the primary. Alteration of the dimensions and position of this wiring will change the tuning and alignment of the circuit, resulting in total

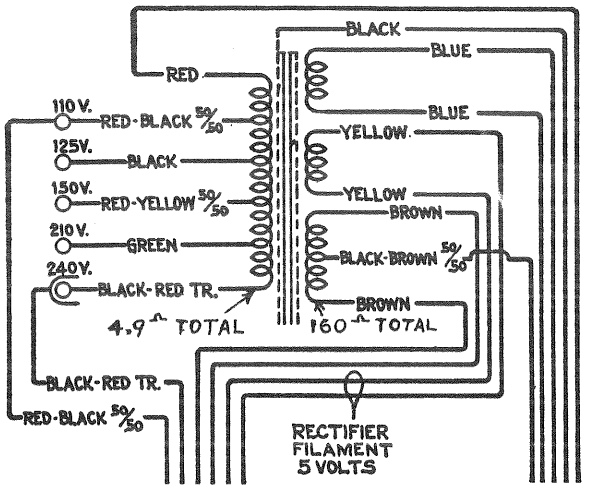


Figure 4—Universal Transformer Schematic and Wiring

lack of operation or seriously poor operation. *It is therefore necessary when servicing to avoid changes in the wiring which includes Band D detector and oscillator r-f circuits unless the arrangement is restored to its exact original condition.* Similar caution should be observed when exchanging by-pass condensers in these same circuits, since their values, physical positions, length of leads, quality of dielectric etc. are critical and variations will definitely affect operation of the receiver. The small heater by-pass condensers and ground terminals installed at the tube sockets are very important in this respect.

Oscillator Stage

The heterodyne oscillator circuit used in this receiver is an improved type, having exceptional frequency stability and uniformity of output over its various tuning ranges. It operates on fundamental frequencies which are fed to the first detector hexode tube (RCA-6L7) on an auxiliary mixing grid. The oscillator generates a signal which is at all times above the frequency of the incoming signal by 460 kc. As shown by the schematic diagram, the cathode of the oscillator tube is above ground potential for r.f., while the plate is effectively at ground potential. This particular arrangement, together with the plate and screen series resistors, makes the circuit independent of supply voltage variations in regard to stability and uniformity of output. Separate coils are used for each of the tuning ranges. The switching of the different bands is such as to short circuit certain unused coils which would absorb energy from the circuits used.

Intermediate Amplifier

Two stages of i-f amplification comprising three tuned transformers and two RCA-6K7 tubes are arranged in cascade to operate at 460 kc. The transformers have their primaries as well as secondaries tuned by adjustable trimmer capacitors. These trimmers are designed to resist moisture, temperature and other detrimental factors which may affect their adjustments. Litz wire is used for the windings of the third transformer in order to provide the proper efficiency in driving the diode second detector.

Second Detector

Signal detection is brought about by the rectifying action of the RCA-6H6 double diode tube. Audio signal obtained from the voltage drop across resistor R-19 in the diode circuit, is transmitted to the first audio stage by direct coupling. The direct signal component across resistor R-19 is used for bias for the RCA-6C5 first audio tube.

Automatic Volume Control

The a.v.c. operates as a parallel system, being fed from the first i-f output through an auxiliary amplifier tube, an RCA-6K7. This stage has an untuned input and broadly resonated output, as accomplished in the natural period fourth i-f transformer. A double diode RCA-6H6 receives the signal at i-f frequency from the No. 6 stage and rectifies it in order to obtain the d-c component required for a.v.c. This component, which develops across resistor R-37, is applied to the control grids of the r-f, first detector and i-f tubes through resistor-condenser filter systems. The value of the bias obtained by this process varies with the intensity of the received signal and in turn governs the amplification of the receiver, thereby automatically regulating the output to the same level when there are fading tendencies and similarly when tuning from station to station.

Audio System

Several stages of audio amplification provide excellent fidelity and wide range of volume both for short wave as well as on the standard and long wave bands. The high gain of the system has necessitated thorough shielding and careful manufacture. All wiring, transformers, etc., should always be placed as originally installed if it has been necessary to remove such for service purposes. Hum difficulties are likely to occur if this caution is not observed. Manual volume control is by means of an acoustically tapered potentiometer which conveys the audio output of the first a-f stage to the interstage coupling transformer. This control has tone compensation produced by filters connected to two points thereon. This gives the correct aural balance at different volume settings. A music-speech switch is provided in one of the volume control filter circuits for use in obtaining good speech intelligibility. On the speech position, the low frequency tones are reduced. A push-pull driver stage is used between the first a.f. and the Class AB output amplifier. A continuously variable high frequency tone control is shunted across the grids of the driver tubes. A sharp, high audio frequency cut-off is obtained by a tertiary winding on the audio output transformer and by the correct design of the driver and interstage transformers. This cut-off feature results in quieter operation by the reduction of high frequency noise, especially on weaker stations.

Rectifier and Filter

An RCA-5Z3 full-wave rectifier tube is employed in the high voltage supply system. The loudspeaker field

coil serves as a filter reactor in conjunction with high capacity, electrolytic condensers. Fixed bias voltages are made available at the filter output on a divider system, which is likewise well filtered with large capacitors.

Tuning Indicator

A cathode-ray tube is used as a means of visually indicating when the receiver is accurately tuned to the incoming signal. This tube is of new design and comprises an amplifier section and a cathode-ray section built in the same glass envelope. The cathode-ray section consists of a conically shaped luminescent screen, upon which a pattern is formed by an effect of the detected signal after said effect has been amplified by the amplifier section which is fed from the detector diode circuit. The size of the pattern is determined by the strength of the signal voltage, so that any change of tuning may be readily observed in order to facilitate tuning to exact resonance.

SERVICE DATA

The various diagrams of this booklet contain such information as will be needed to isolate causes for defective operation. In general, the ratings of the resistors, capacitors, coils, etc. are indicated adjacent to the symbols signifying these parts. Identification titles such as R-3, L-2, C-1, etc., are provided for reference between the illustrations and Replacement Parts List. The coils, reactors and transformer windings are rated in terms of their d-c resistances. Where the value is not given, the resistance is less than one ohm.

Alignment Procedure

The extensive frequency range of this receiver necessitates a more or less involved method of alignment. However, if the following directions are carefully applied, the normal performance of the instrument will be obtained.

Circuits aligned by use of Cathode-Ray equipment will be as near to perfection as possible, hence this method is to be preferred in all cases. Alignment by other methods is oftentimes an approximation unless extreme care is taken and a good deal of time expended. The oscillographic method is particularly advantageous for trimming the i-f tuned circuits to obtain the utmost in tone quality and at the same time the maximum of selectivity. Procedure to be followed when using a Cathode-Ray Oscillograph is therefore given in detail. Should this type of equipment be unavailable, a substitute indicator may be used, the procedure being the same but without the sweeping operations.

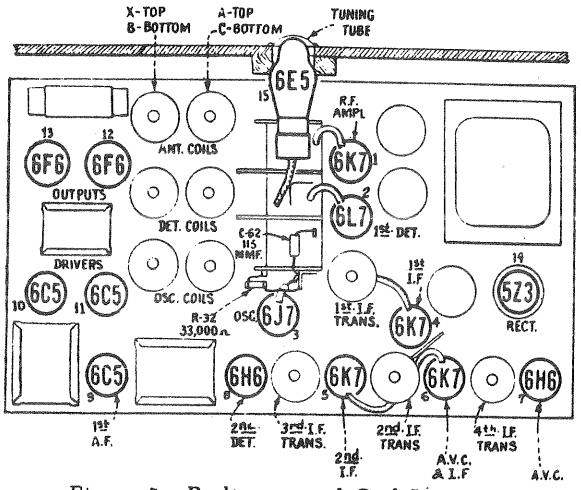


Figure 5—Radiotron and Coil Locations

Equipment

The instruments required for placing this receiver in proper alignment should consist of an RCA Cathode-Ray Oscillograph, an RCA Full Range Oscillator, an RCA Frequency Modulator, a Tuning Wand and an Alignment Tool. All of these devices are illustrated and described on a separate page of this booklet. The Cathode-Ray Oscillograph is to be used as an output indicator to precisely show when the circuits are correctly aligned. The Full Range Oscillator is required as the source of standard alignment signals at the various frequencies. Visual alignment is made possible through use of the Frequency Modulator, which in conjunction with the Oscillograph and Oscillator, causes the characteristic wave shape of the circuit under test to be formed on the Oscillograph screen. Adjustments must be made with an insulated screw driver, the Alignment Tool fitting such a requirement. The necessity for alignment and direction of required change may be tested with the Tuning Wand. Its use is as follows:—

The Tuning Wand, which consists of a bakelite rod having a small brass cylinder installed at one end and a core of finely divided iron at the other, may be inserted into a tuned coil to obtain an indication of the tuning. With a signal being supplied to the receiver at the particular frequency of the circuit concerned, each end of the Wand should be placed through the center of the coil. Holes are provided in the coil shields for this test. A change in tuning will be produced by the presence of the brass cylinder or iron core and consequent change of receiver output occurs. If there is a decrease of output when either of the two ends are inserted, the tuning is correct and will require no adjustment. However, should there be an increase of output due to the iron core and decrease with the brass cylinder, an increase in inductance or capacitance is indicated as necessary to bring the circuit into line. The trimmer involved should therefore be increased accordingly. If the brass cylinder end causes an increase in output, while the iron end causes a decrease, reduction of inductance will be necessary to bring the circuit into alignment. This will be equivalent to decreasing the trimmer concerned.

Changes Indicated by Tuning Wand

WAND	SIGNAL	TRIMMER
Brass	Decrease	None
Iron	Decrease	
Brass	Increase	Decrease
Iron	Decrease	
Brass	Decrease	Increase
Iron	Increase	

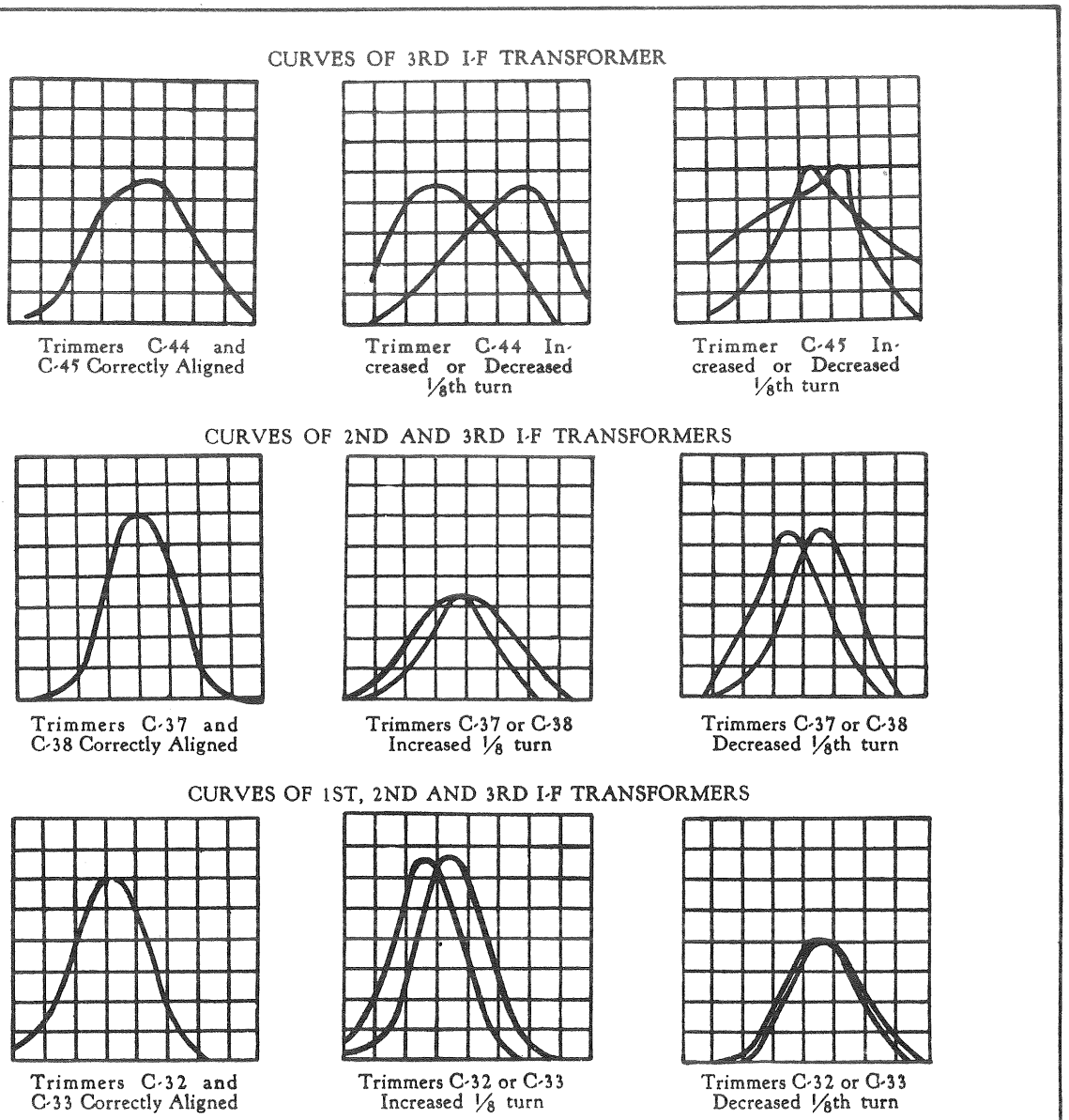


Figure 6—Cathode-Ray Images for I-F System

I-F TRIMMER ADJUSTMENT

Six trimmers are associated with the three i-f transformers. Their locations on the chassis are shown by Figure 8. Each must be aligned to a basic frequency of **460 kc.** The last i-f transformer should be adjusted first, the one preceding it second and the operation carried through successive stages until the first transformer has been aligned. For such a process, it is necessary to feed the output of the Full Range Oscillator to the stages in their order of alignment, adjusting the trimmers of each and observing the effect at the second detector output on the Cathode-Ray Oscillograph. The most convenient point for connection of the Oscillograph is at the control grid of the RCA-6C5 first audio tube, with the vertical "Hi" input terminal attached to the grid connection and the "Gnd" to the chassis. The "Ext. Sync." terminals of the Oscillograph should be connected to the Frequency Modulator as illustrated in Figure 7. A .001 mfd. capacitor installed in series with the Oscillator "Ant." output lead will prevent the voltage constants of the stage being aligned from becoming upset. Proceed further as follows:—

(a) Place the receiver, Oscillograph and test Oscillator in operation. Set the receiver volume control to maximum and the range switch to Band "A". Tune the station selector to a point where no interference is caused by local stations or the local oscillator, removing the 6J7 tube if necessary. Turn the Oscillograph vertical "A" amplifier to "On" and advance the vertical gain control to its maximum position. Set the

horizontal "B" amplifier to "Timing" and control its gain so that the luminescent spot sweeps a trace completely across the screen. Have the timing control adjusted to "Int."

(b) Attach the output of the test Oscillator to the control grid cap of the second i-f tube (RCA-6K7) and chassis ground. Tune the Oscillator

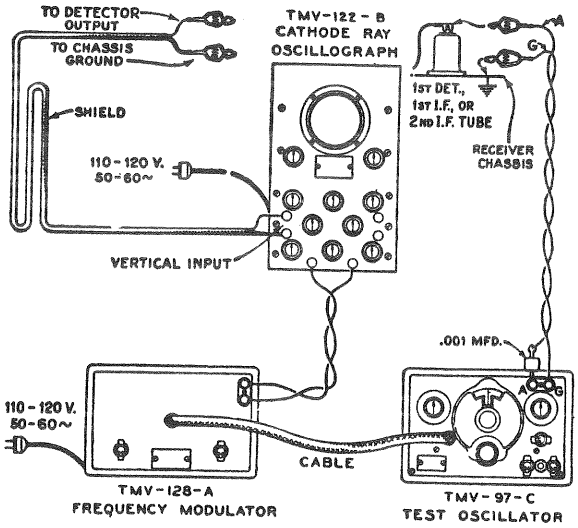


Figure 7—Alignment Apparatus Connections

to **460 kc.** having its modulation switch turned to "On". Regulate the output control until the signal produces a wave pattern on the Oscillograph screen, adjusting the Oscillograph frequency and range controls to give the desired number of cycles. Cause the image formed to stand still on the screen by manipulation of the "Sync." control. Use as low a signal output from the Oscillator as can be accurately observed at the Oscillograph. Then tune the two trimmers C-44 and C-45 of the third i-f transformer to produce maximum amplitude (vertical deflection) of the oscillographic image. Under this condition, the transformer will be sharply resonated to 460 kc.

(c) The Frequency Modulator should then be placed in operation and interconnected with the Full Range Oscillator by means of the shielded patch cord provided. Figure 7 shows the proper arrangement. Set the Frequency Modulator sweep range switch to its "Lo" position and turn the Oscillator modulation switch to "Off". Change the timing (Sync.) control of the Oscillograph to "Ext." and place the range switch to its No. 2 position. Then shift the tuning of the Oscillator so as to increase its frequency, until two distinct and similar waves appear on the Oscillograph screen and become coincident at their highest points. These curves will be found to occur at an Oscillator setting of *approximately* 540 kc. They will be identical in shape but appearing in reversed positions. Adjust the frequency control of the Oscillograph in order to cause the waves to conform with these requirements and to make them remain motionless on the screen. This will require a setting of approximately ½ clockwise rotation of the frequency control. The trimmers C-44 and C-45 should then be re-adjusted so that the two curves move together and become exactly coincident throughout their lengths, maintaining the maximum amplitude at which this condition can be brought about.

(d) Leaving the equipment connected and adjusted as above, change the Oscillator output to the control grid cap of the first i-f tube (RCA-6K7). Adjust the two trimmers C-37 and C-38 of the second i-f transformer until the forward and reverse waves appearing on the Oscillograph coincide throughout their lengths and have maximum amplitude.

(e) Change the test Oscillator output to the control grid of the first detector tube (RCA-6L7) without disturbing the connections and adjustments of the other apparatus. Then align the trimmers C-32 and C33 of the first i-f transformer to produce waves of maximum coincidence and maximum amplitude. The shape of the composite wave obtained from this operation is a true representation of the over-all tuning characteristic of the i-f system.

ANTENNA, DETECTOR AND OSCILLATOR

For Bands A and X, adjustments must be made at the high and low frequency ends of the range. On Bands B and C, alignment is required only at the high frequency end. Band D is permanently adjusted during manufacture, hence no alignment will be necessary in this range. Locations of the various antenna, detector and oscillator trimmers are shown on Figure 8. The test Oscillator should be removed from connection with the i-f system and its output attached to the antenna-ground terminals of the receiver. No changes are to be made in the attachment of the Oscillograph at the second detector. During the adjustments, the Oscillator output should be regulated as often as is necessary to keep the oscillographic image as low as is practically observable. Such procedure will obviate apparent broadness of tuning which would result from a.v.c. action on a stronger signal. The sequence of alignment should be Band A, Band X, Band B and Band C. Proceed with the adjustments as follows:—

Calibration

Set the receiver range switch to Band A and rotate the station selector until the tuning capacitor plates are in full mesh (maximum capacity). Then move the main dial pointer until it points exactly to the horizontal line at the low frequency end of the and A scale. Correct the setting of the vernier second hand pointer to read zero.

Band A

(a) With the receiver range switch on its Band A position, tune the station selector until the dial pointer is at a reading of **1720 kc.** Adjust the Oscillator to **1720 kc.** (modulation "On" and Frequency Modulator disconnected) and increase its output to produce a registration on the Oscillograph. Carefully align the oscil-

lator, detector and antenna trimmers, C-25, C-14 and C-3 respectively, so that each brings about maximum amplitude of output as shown by the wave on the Oscillograph. It will be necessary to have the timing control of the Oscillograph on "Int." for this operation. Then shift the timing control to "Ext." and place the Frequency Modulator into operation with its connections to the Oscillator and Oscillograph as shown on Figure 7. Retune the test Oscillator (increase frequency) until the forward and reverse waves show on the Oscillograph and become coincident at their highest points. Adjust the trimmers C-25, C-14 and C-3 again, setting each to the point which produces the best coincidence and maximum amplitude of the images.

(b) Remove the Frequency Modulator cable from the Oscillator and shift the signal frequency to **600 kc.** Tune the receiver to pick up this signal, disregarding the dial reading at which it is best received. Then insert the Frequency Modulator plug and retune the Oscillator until the two similar forward and reverse waves appear on the screen. It is advisable to shift the Oscillator to its 200—400 kc. range and use the third harmonic of the generated signal in order to obtain the desired range of sweep for this adjustment. The trimmer C-23 should then be adjusted until a point is reached where the waves have the greatest amplitude. It will be unnecessary to rock the tuning condenser for this operation inasmuch as the Frequency Modulator is automatically producing the same effect. After completing this adjustment, the trimmer C-25 should be realigned as in (a) to correct for any change in the oscillator high frequency tuning which has been caused by the adjustment of C-23.

Band X

(a) Disconnect the Frequency Modulator and tune the test Oscillator to a frequency of **400 kc.** (Modulation "On"). Place the receiver range switch in its Band X position and turn the station selector until the dial pointer reads **400 kc.** Adjust the Oscillograph timing control to "Int." Then align each of the trimmers C-26, C-15 and C-4 to the point producing maximum output at the Oscillograph. Place the Frequency Modulator in operation and attach it to the Oscillator in the normal manner. Change the Oscillograph timing to "Ext." Increase the frequency of the Oscillator (modulation "Off") until the two waves appear and become coincident at their highest points, *ap-*

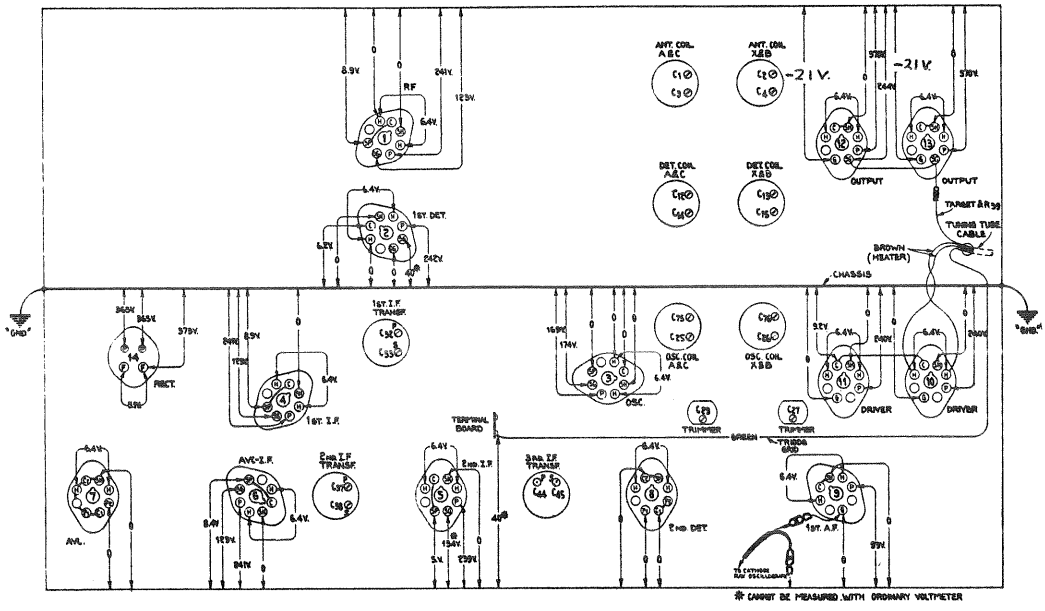


Figure 8—Trimmer Locations and Radiotron Socket Voltages

Measured at 120 volts A.C.—No Signal—All Tubes Intact—Band Switch on "A"

proximately at 462 kc.. They may be made to remain stationary on the screen by manipulation of the Oscillograph range switch and frequency control. Readjust the three trimmers C-26, C-15 and C-4 to give maximum amplitude and complete coincidence of the waves.

(b) Change the test Oscillator so that it delivers a signal of **150 kc.** with the Frequency Modulator disconnected. Tune this signal on the receiver which has previously been set to Band X, disregarding the dial reading at which the signal is best received. Then interconnect the Frequency Modulator with the Oscillator and retune the latter to the point at which the two similar waves appear on the screen. Adjust the trimmer C-27, for maximum amplitude of the wave images. Rocking of the tuning condenser will not be necessary as the Frequency Modulator duplicates such an operation. Repeat the alignment of C-26 as outlined in (a) to correct for any reflective error brought about by the adjustment of C-27.

Band B

(a) Advance the receiver range switch to its Band B position and tune the station selector to a dial reading of **6132 kc.** Set the test Oscillator to this same frequency (Modulation "ON" and Frequency Modulator disconnected) and increase its output until a suitable indication is apparent on the Oscillograph. Then adjust the trimmer C-76 to the point producing the maximum amplitude of the image. Two positions will be found on this trimmer which causes maximum amplitude. The one of least capacitance is correct and should be used. Check for the "image" signal, which will be received at **5212 kc.** on the dial if the adjustment of C-76 has been properly made. An increase in Oscillator output may be necessary for this test, however its frequency should not be changed nor any trimmer adjustments made on the receiver.

(b) Return the station selector to the **6132 kc.** reading and align the detector and antenna trimmers C-13 and C-2 respectively, for maximum (peak) output as shown by the Oscillograph. No further adjustments are to be made on Band B.

Band C

(a) Turn the range switch of the receiver to its Band C position and tune the station selector until the dial pointer reads **18,000 kc.** Set the test Oscillator to this same frequency (Modulation "On" and Frequency Modulator disconnected), regulating its output to the level required for convenient observation. Adjust the trimmer C-75 to the point producing maximum output as indicated on the Oscillograph. Check for the presence of "image" signal by tuning the receiver to **17,080 kc.** The **18,000 kc.** signal of the Oscillator will be received at this point if the adjustment of C-75 has been properly made, using the position of minimum capacitance giving maximum receiver output. It may be necessary to increase the output of the Oscillator in order to get an indication of the "image". *No adjustments should be made during this check.*

(b) Return the receiver tuning to **18,000 kc.**, realign C-75 if necessary, and then adjust the detector and antenna trimmers C-12 and C-1 for maximum signal output as evidenced by the oscillographic image. No further adjustments are to be made on Band C.

Band D

No adjustments are required on this band.

To align the receiver by other means than those explained in the above procedure will require the use of an output indicator and a suitable test oscillator. The output device should be connected at the receiver output, either to the voice coil circuit or to the output transformer primary. Successive points of connection of the test Oscillator will be identical to those specified for Cathode-Ray alignment, the same test frequencies being used in each case. The process of sweeping the frequency of the test Oscillator with the Frequency Modulator will of course be omitted, instead, the trimmers throughout the system should be adjusted to produce maximum indication at the output. It will be essential to rock the tuning condenser for the low frequency adjustments of Bands X and A, but to cause maximum output rather than the type of indication afforded by the Oscillograph. The receiver volume control must be kept at its maximum setting and for each test, the Oscillator output regulated to maintain an indication which will be as small as possible. Under this condition, the receiver will be operating at maximum gain, but receiving only a weak signal of insufficient strength to cause appreciable a.v.c. action. This requirement is of importance in either method of procedure, since the a.v.c. will have a definite effect on the indication if a more intense input is used.

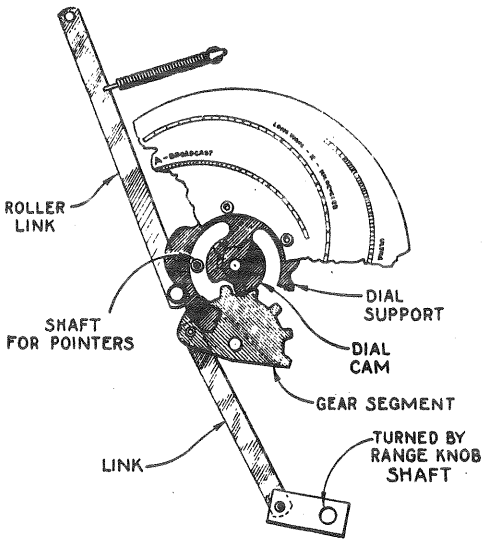


Figure 9—Selector Dial Change Mechanism

Dial Adjustment

Figure 9 illustrates the relations of the various parts of the dial mechanism when it is in its A—Broadcast position and the range switch is likewise turned to its

Band A setting. In re-assembling the dial after repair, see that the gears are meshed in accordance with the diagram, at the same time noting that the lever which is attached to the range switch shaft is in the position as shown.

Phonograph Attachment

The audio system of this receiver may be adapted for use in the reproduction of phonograph records by proper connection and arrangement of an external turntable and its associated accessories. The relatively

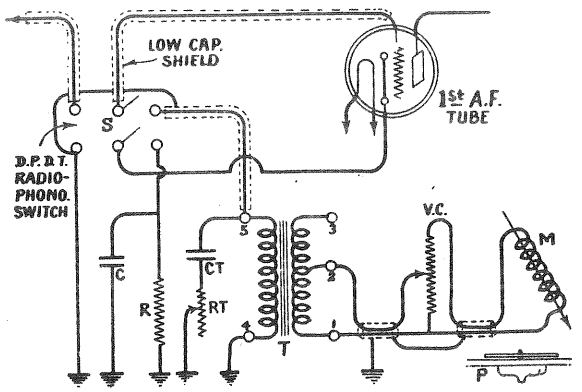


Figure 10—General Phonograph Connections

INSTALLATION

Change the receiver circuits and add phonograph connections to conform with the above schematic. Resistor R and capacitor C must be used to provide the proper bias. Thoroughly shield leads where indicated, keeping them clear of a-c circuits and transformers. Place transformer T so as to obtain minimum lengths of secondary leads and mount it in the position which does not cause hum.

PARTS REQUIRED

M—Magnetic Pickup —Low Impedance
VC—Volume Control —100 ohms
R—Biasing Resistor— 2500 ohms
C—By-pass Condenser —10 mfd.
T—Phono Input Transformer—Stock No. 7445
P—Phono Turntable Mechanism
C_t—Condenser—.05 mfd.
R_t—Variable Resistor —0 to 10,000 ohms

high amplification due to the number of a-f stages employed, necessitates that great care be taken when the circuits are changed for phonograph input. It is recommended that the pickup used be fed directly to the grid circuit of the first audio stage, with suitable switching installed for changing between radio and phonograph operation. Bias of the stage must be maintained by addition of a resistor, to be shorted out for the radio position of the switch. This resistor should be by-passed by a condenser of appropriate rating. Diagrams covering suggested methods of phonograph attachment are given in Figures 10 and 11 with installation details. Hum may possibly be encountered from lack of shielding and improper placement and shielding of the input transformer if these items are not taken care of during re-arrangement of the circuits. All wiring should be installed in a substantial and permanent manner.

Radiotron Socket Voltages

The voltage values indicated from the Radiotron socket contacts to ground on Figure 8 will serve to assist in locating causes for faulty operation when existent. Each value as specified should hold within ± 20% when the receiver is normally operative at the rated supply voltage. Variations in excess of this limit will usually be indicative of trouble in the basic circuits. The voltages given on the diagram are actual operating values and do not allow for inaccuracies which may be caused by the loading effect of a voltmeter's internal resistance. This resistance should be duly considered for all readings. The amount of circuit resistance shunting the meter during measurement will determine the accuracy to be obtained, the error increasing as the meter resistance is comparable to or less than the circuit resistance. For the majority of readings, a meter having an internal resistance of 1000 ohms per volt will be satisfactory when the range used for each check is chosen as high as possible consistent with good readability.

Universal Transformer

The wiring of the special transformer used in some models of this receiver is given by Figure 4. This transformer is adaptable to several ranges of voltage, hence, in cases of receiver inoperation, the connections should be checked to assure that they are correct for the voltage being used.

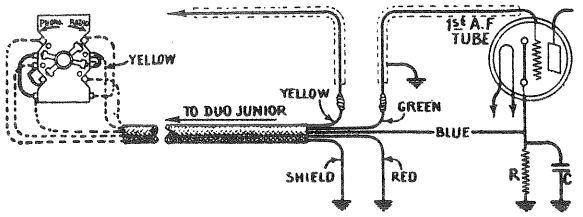


Figure 11—Duo Junior Connections

INSTALLATION

Arrange connections from Duo Junior output cable to receiver so that completed wiring is in accordance with schematic above. Add two jumpers shown by heavy full lines to Duo Junior Radio-Phono switch. Resistor R and capacitor C must be added to receiver circuit to maintain bias. Keep all leads as short as possible and well shielded where indicated.

PARTS REQUIRED

Model R-93—Duo Junior Phonograph
R—Biasing Resistor— 2500 ohms
C—By-pass Condenser —10 mfd.

MODEL C15-3
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	
4427	Bracket—Low frequency tone control switch, volume control or high frequency tone control mounting bracket	$0.18
5237	Bushing—Variable capacitor mounting bushing assembly—Package of 3	.43
11255	Cable—Radiotron tuning lamp cable complete with socket	1.20
5241	Capacitor—Adjustable capacitor—C23, C27	.40
11286	Capacitor—14 Mmfd. capacitor—C19	.24
11292	Capacitor—22 Mmfd. capacitor—C11	.24
11289	Capacitor—50 Mmfd. capacitor—C8, C30	.26
11291	Capacitor—115 Mmfd. capacitor—C62, C65	.24
11295	Capacitor—200 Mmfd. capacitor—C55	.30
11294	Capacitor—325 Mmfd. capacitor—C24	.32
11290	Capacitor—400 Mmfd. capacitor—C9, C18, C20, C49, C64	.25
11299	Capacitor—600 Mmfd. capacitor—C48	.26
3784	Capacitor—900 Mmfd. capacitor—C69	.30
11335	Capacitor—1300 Mmfd. capacitor—C22	.30
11287	Capacitor—4500 Mmfd. capacitor—C21, C77	.30
4838	Capacitor—.005 Mfd. capacitor—C58, C59	.20
5242	Capacitor—.005 Mfd. High frequency tone control capacitor—C56	.52
5148	Capacitor—.007 Mfd. capacitor—C57	.20
4937	Capacitor—.01 Mfd. capacitor—C60	.25
4858	Capacitor—.01 Mfd. capacitor—C17, C68.	.25
4870	Capacitor—.025 Mfd.—C47	.20
4836	Capacitor—.05 Mfd. capacitor—C5, C16, C35, C40, C70	.30
4835	Capacitor—.1 Mfd. capacitor—C31	.28
4841	Capacitor—.1 Mfd. capacitor—C7, C28, C36, C41, C67	.22
4885	Capacitor—.1 Mfd. capacitor—C10, C34, C39, C42, C43	.28
3597	Capacitor—.25 Mfd. capacitor—C51	.40
11203	Capacitor—10 Mfd. capacitor—C71	1.18
5212	Capacitor—18 Mfd. capacitor—C72	1.16
5213	Capacitor Pack—Comprising one 4. Mfd., one 10 Mfd. and one 8. Mfd. capacitors—C50, C73, C74	2.94
5236	Capacitor Pack—Comprising two .5 Mfd., capacitors, one 680 ohm resistor and one 820 ohm resistor—C53, C54, R23, R27.	1.36
4693	Clamp—Electrolytic capacitor mounting clamp (For stock No. 5213)	.15
5215	Coil—Antenna coil—A and C Bands—L1, L2, L5, L6 ,C1, C3	2.32
5218	Coil—Antenna coil—X and B Bands—L3, L4, L7, L8, C2, C4	2.58
5216	Coil—Detector coil—A and C Bands—L9, L10, L13, L14, C12, C14	2.34
5219	Coil—Detector coil—X and B Bands—L11, L12, L15, L16, C13, C15	2.58
5217	Coil—Oscillator coil—A and C Bands—L18, L20, C25, C75	2.20
5220	Coil—Oscillator coil—X and B Bands—L19, L22, C26, C76	$2.24
5221	Coil—Oscillator coil—D Band—L17	.64
5214	Condenser—3 gang variable tuning condenser—C6, C29, C63	4.42
5240	Cover—Fuse cover plate	.24
11202	Foot—Chassis mounting foot and bracket assembly—Package of 2	.78
10907	Fuse—3 ampere fuse—F1—Package of 5	.40
5226	Lamp—Dial lamp—Package of 5	.70
11710	Lead—Shielded lead for antenna	.40
5239	Mounting—Fuse mounting for 110 volt instrument	.36
5244	Mounting—Fuse mounting for 220 volt instrument	.32
8041	Plate—I.F. or R.F. coil shield locking plate—Package of 2	.12
5233	Reactor—Coupling reactor—L29	2.32
11296	Resistor—330 ohms—Carbon type—1/4 watt (R2, R12)—Package of 5	1.00
11285	Resistor—1000 ohms—Flexible type resistor (R13, R17, R36)—Package of 5	1.00
5112	Resistor—1000 ohms—Carbon type—1/4 watt (R4, R10, R15, R29)—Package of 5	1.00
11283	Resistor—1200 ohms—Carbon type—1/4 watt (R3)—Package of 5	1.00
4408	Resistor—1500 ohms—Carbon type—1/4 watt (R8)—Package of 10	2.00
5159	Resistor—2200 ohms—Carbon type—1/4 watt (R35)—Package of 5	1.00
11298	Resistor—5600 ohms—Carbon type—1 watt (R21)	.22
8043	Resistor—10,000 ohms—Carbon type—2 watts (R22)	.25
3998	Resistor—15,000 ohms—Carbon type—1/4 watt (R30)—Package of 5	1.00
5114	Resistor—15,000 ohms—Carbon type—1 watt (R5)	.22
8065	Resistor—27,000 ohms—Carbon type—1/2 watt (R33)—Package of 5	1.00
11300	Resistor—33,000 ohms—Carbon type—1/10 watt (R32)—Package of 5	.75
5033	Resistor—33,000 ohms—Carbon type—1 watt (R31)—Package of 5	1.10
11282	Resistor—56,000 ohms—Carbon type—1/10 watt (R9)—Package of 5	.75
8064	Resistor—82,000 ohms—Carbon type—1/2 watt (R43)—Package of 5	1.00
5145	Resistor—100,000 ohms—Carbon type—1/4 watt (R16)—Package of 5	1.00
5027	Resistor—150,000 ohms—Carbon type—1/4 watt (R37)—Package of 5	1.00
11297	Resistor—330,000 ohms—Carbon type—1/10 watt (R1, R6)—Package of 5	.75
5108	Resistor—330,000 ohms—Carbon type—1/4 watt (R11, R14, R38)—Package of 5	1.00
3033	Resistor—1 Megohm—Carbon type—1/4 watt (R7)—Package of 5	1.00
11151	Resistor—2.2 Megohm—Carbon type—1/4 watt (R20)—Package of 5	1.00

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
5235	Resistor—Voltage divider resistor—3 sections—4100 ohms, 4750 ohms and 190 ohms (R40, R41, R42)	$1.15
5249	Shield—Antenna, detector or oscillator coil shield	.20
5250	Shield—Intermediate frequency transformer shield	.22
11273	Shield—Radiotron shield	.25
4794	Socket—4 contact Radiotron socket—For Radiotron 5Z3	.15
11197	Socket—6 contact Radiotron socket—For Radiotron 6C5	.14
11198	Socket—7 contact Radiotron socket—For Radiotron 6K7, 6H6 or 6F6	.15
11278	Socket—7 contact Radiotron socket—For Radiotron 6J7 (oscillator)	.20
11280	Socket—7 contact Radiotron socket—For Radiotron 6L7 (First detector)	.14
11199	Socket—Dial lamp socket	.14
5224	Switch—Low frequency tone control and power switch—S13, S14	1.00
5225	Switch—Range switch—S1, S2, S3, S4, S5, S6, S7, S8 ,S9, S10, S11	3.75
5238	Terminal—Antenna terminal board with clip, insulating strip and rivets	.14
5222	Tone Control—High frequency tone control (R28)	1.04
5232	Transformer—Audio driver transformer—(T3)	2.50
5228	Transformer—First intermediate frequency transformer (L23, L24, C32, C33)	1.80
5231	Transformer—Fourth intermediate frequency transformer (L31, L32)	1.50
5234	Transformer—Interstage transformer (T2)	3.40
8061	Transformer—Power transformer 105-125 volts 50/60 cycles (T1)	6.75
8062	Transformer—Power transformer 105-125 volts 25-50 cycles	9.84
11194	Transformer—Power transformer 105/125/150/210/250 volts—40-60 cycles	7.08
5229	Transformer—Second intermediate frequency transformer (L25, L26, C37, C38, C66, R34)	2.42
5230	Transformer—Third intermediate frequency transformer (L27, L28, C44, C45, C46, R18, R19)	2.76
5223	Volume Control—(R24, R25, R26)	1.22
	DRIVE ASSEMBLIES	
5243	Arm—Band indicator operating arm	.42
10194	Ball—Steel ball for drive assembly—Package of 20	.25
8054	Cam—Five position cam for station selector drive assembly	.28
4422	Clutch—Tuning condenser drive clutch assembly comprising shaft, balls, ring, spring and washers assembled	1.00
8048	Coupling—Flexible coupling for variable capacitor (includes indicator shaft)	.70
11336	Dial—Dial scale with mounting rivets	.60
8045	Disc—Drive disc and micarta gear assembly	.46
11380	Drive—Tuning condenser drive assembly complete	$6.35
8044	Escutcheon—Dial escutcheon with vernier scale	1.08
8046	Gear—Indicator shaft micarta drive gear and vernier idler brass gear with one spring	.72
8050	Gear—Gear sector and band indicator operating link (link connects to arm on band switch)	.15
8053	Indicator—Station selector vernier indicator pointer	.12
11793	Indicator—Station selector indicator pointer	.15
8051	Link—Complete with roller and spring	.30
8049	Pinion—Vernier pointer drive pinion and shaft	.55
4669	Screw—Square head No. 8-32x5/32 set screw—Package of 10	.25
8047	Spring—Coil spring for indicator shaft drive gear and vernier idler (Stock No. 8046)	.12
8052	Spring—Coil spring for link—Package of 5	.32
8042	Stud—Band indicator operating arm stud—Package of 5	.25
	LOUDSPEAKER ASSEMBLY	
8059	Board—Reproducer terminal board (2 terminals)	.14
8060	Bracket—Output transformer mounting bracket	.14
11200	Cable—Reproducer cable—Complete with connector	.50
8058	Clamp—Cone rim clamp—Package of 4	.44
11189	Coil—Field coil, magnet and cone housing (L33)	10.60
8056	Cone—Reproducer cone (L30)	1.58
5039	Connector—4 prong male connector plug for reproducer	.25
5040	Connector—4 contact female connector socket for reproducer cable	.25
9620	Reproducer—Complete	16.32
8057	Transformer—Output transformer (T4, C61)	3.22
	MISCELLANEOUS ASSEMBLY	
5211	Bolt—Speaker mounting bolt assembly—Package of 2	.24
11191	Bracket—Radiotron tuning lamp mounting bracket—less clamp (Stock No. 11192)	.12
11192	Clamp—Radiotron tuning lamp mounting clamp—less bracket (Stock No. 11191)	.12
11193	Cover—Reproducer cover	.82
11276	Escutcheon—Tuning lamp escutcheon	.40
11379	Escutcheon—Station selector escutcheon and crystal	1.08
11346	Knob—Station selector knob—Package of 5	.75
11347	Knob—Volume control, tone control, power switch or range switch knob—Package of 5	.75
11382	Resistor—1 Megohm—Carbon type—1/10 watt (R39)—Package of 5	.75
11348	Screw—8-32-7/16" headless set screw for knob (Stock No. 11346)—Package of 10	.32
5210	Screw—Chassis mounting screw assembly—Package of 4	.16
11381	Socket—Tuning tube socket and cover	.45
11349	Spring—Retaining spring for knob (Stock No. 11347)—Package of 5	.15