

# NATIONAL RADIO INSTITUTE

*Washington D. C.*

# Radio-Trician Service Manual

Compiled solely for  Students & Graduates

ON

## KOLSTER SIX AND SEVEN TUBE RECEIVERS

Kolster Electric Receiving Sets are divided into two main sections, the chassis which contains the detector and tuning stages, and the power pack which contains the power supply and the audio frequency amplifying stages.

### Description of the 4-tube Chassis

The 4-tube model consists of three stages of tuned Radio frequency amplification and a detector stage. The same chassis and power pack is used in Models K20, K22, K25 and K27.

The lower left-hand tuning unit marked "Sensitivity" consists of a switch which controls the antenna inductance, and a knob controlling the combination variometer and vario-coupler. The later device tunes the first R.F. stage depending upon the main control knob, and with the same motion varies the coupling of the secondary of the first tuning stage with respect to the antenna inductance. This allows the set to be installed with any antenna or used without affecting the position of logging on the selector scale. The R.F. coils are solenoidal in type and are wound on composition tuning. They are so placed and shielded that a minimum amount of interstage coupling results. Grid resistances are placed in each Radio frequency grid circuit to prevent oscillation.

Signal rectification is accomplished by the grid condenser and grid leak method. The grid leak is not shunted across the condenser, but is returned to the ground circuit.

Volume is controlled by a variable resistance shunted across the last R.F. primary winding. This variable resistance

is used to vary the gain of that particular stage and in consequence the volume will increase or decrease as selected.

There is a voltage regulator switch incorporated in the power pack so that the power transformer primary winding may be changed to conform with the existing A.C. line supply voltages.

The A.C. current is properly filtered but to insure a minimum of ripple passing the circuits, two hum adjusters are incorporated, one being in the Radio frequency filament circuit and by-passed with two .6 microfarad condensers from the ground and plate circuits. The other is in the detector heater circuit and in this position, when properly biased, reduces the possibility of a detector ripple pick-up.

The pilot light which illuminates the logging scale is supplied with 2.2 volts and a 2.5 volt miniature base bulb is used.

The friction belt on the condenser drive control is made of specially woven cord. A spring arrangement is supplied which automatically takes up all slack in the cord due to stretching.

### Description of the 5-tube Chassis

The general appearance of the five-tube chassis differs little from the four-tube chassis. With exception of the longer tube panel, an extra tube socket, the extra twin .6 microfarad by-pass condenser and the lack of an antenna switch, the outward appearances are exactly the same. Models K21, K23, K24 and K28 use the same 5-tube chassis.

When the five-tube chassis is removed from the cabinet and turned up-side-down, the mechanical differences will be

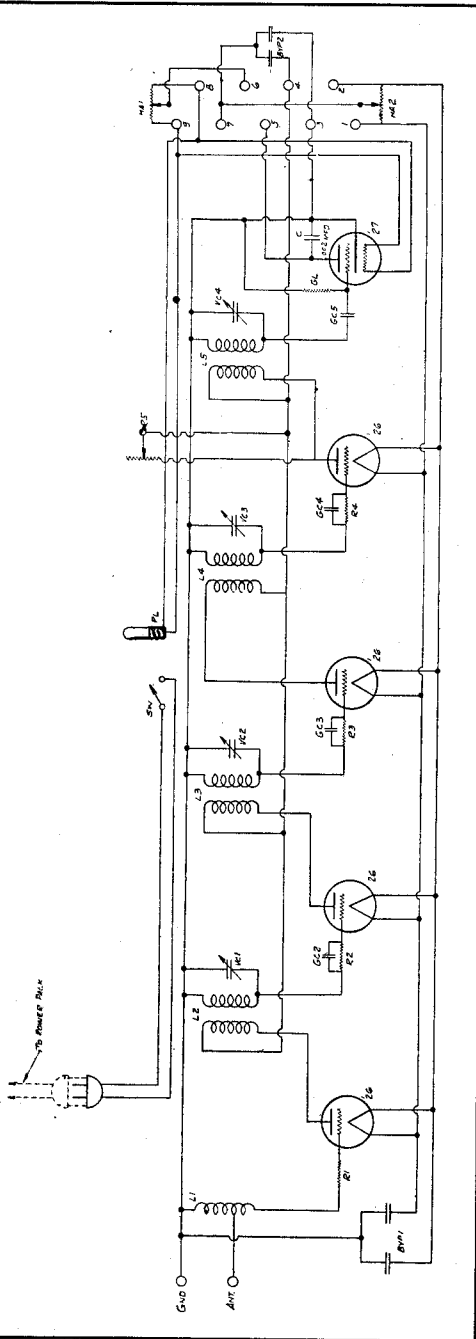


Fig. 1—Schematic diagram of five-tube chassis used with Kolster seven-tube receivers.

### TABLE NO. 1

#### Terminal Cord Binding Posts for Set Voltage Input

- |                                       |  |
|---------------------------------------|--|
| 1 } 1 1/2 volt A. C. filament supply. | 5 45-volt D. C. detector plate supply. |
| 2 } 3 Ground.                         | 6 3 1/4-volt heater bias.              |
| 4 90-volt D. C. R. F. plate supply.   | 7 B minus.                             |
|                                       | 8 } 2.2 volt A. C. detector heater.    |
|                                       | 9 }                                    |

instantly noticed. There are four shielded, balanced coils, mounted parallel to each other on an aluminum bracket. The coils are so placed because the shielding prevents any possibility of inter-stage coupling and compactness is the result. The four shielded coils are the tuned inductances.

Mounted on the left of the underside of the chassis is a coil inductance which is in the antenna circuit. This inductance is untuned and is a part of the first R.F. stage. By adding the extra tube and an inductance of this type the variometer method of varying the incoming signal can be dispensed with and the result is a strictly one dial control receiving set.

By-pass condensers of a .6 microfarad isolate the A.C. filament circuits from the grid circuits. Two hum adjusters are placed in the same position in the circuit as in the four-tube chassis.

#### Testing

In testing any of these receivers, a good high resistance voltmeter and a battery is essential. Under no circumstances, should a lamp be used to test for continuity in the R.F. grid circuit of any Kolster receiver; it would probably result in the instant burning out of the grid resistors.

A high frequency oscillator is also an essential part of the equipment of an up-to-date Service Department.

When servicing a receiver, proceed along well defined lines rather than in a series of hard-hearted tests with nothing particular in mind. Certain symptoms are positive indications of certain ills. Learn the symptoms by carefully questioning the operator of the receiver or by attempting to operate the set before trying to make repairs.

Assuming that the set fails to operate, that all the tubes have been tested and the antenna inspected and line voltage checked, the following continuity test procedure and voltage check may be used: To check the voltages employing an A.C. three-scale meter, equipped with two test points and referring to Figures 1 and 2, Nos. 1 to 2 should read 1.5 volts, Nos. 8 to 9 should read 2.2 volts. With a 0-200 volt high resistance D.C. meter, the plate and bias voltages can be ascertained.

Nos. 3 to 5 should read 45 volts, Nos. 4 to 7 should read 90 volts.

Reverse leads. Nos. 4 to 6 should read —3 volts. Nos. 3 to 7 should read —6 volts.

Finding that the voltage check coincides with the above, further tests are necessary.

Remove the terminal card from the binding posts, and with test points check symbol Ant. to Gnd. This should show "closed" on all positions of switch. This tests the antenna circuit L1, primary winding.

Other continuity tests can be made without any difficulty, but it is advisable to often refer to the schematic lay-out while checking the various circuits. Examine all soldered connections for excess resin or flux and loose connections, and carefully examine all fibre insulated washers for possible grounding through same. Examine all leads to be sure that only the relative connections and contacts are made.

The schematic diagram shown in Figure 2 shows the 4-tube chassis as used with all 6-tube Kolster sets. The schematic diagram of the power pack and the audio amplifier used in the Kolster 6-tube sets is shown in Figure 2.

Assuming that it is necessary to test the power pack and that the audio and rectifying tubes are perfect, proceed as follows: With the set hooked up and the tubes in position and with an A.C. meter with test lead connections on 0 and 3-volt binding posts, check the voltages at the terminal cord lugs. Voltages may vary from those specified below due to the A. C. line variations. If the line voltage is below 110, be sure that the regulator switch at the base of the rectifier tube is snapped over to the left, or the 100 to 110-volt side. Of course, it is necessary to check the line voltage at the base plug to determine the above, using the 0 to 150 scale of the meter.

Using zero to 3-volt scale, check the approximate filament voltages by placing the test points on lugs 1A, 2A, etc.

Next, remove the tube from the right-hand socket, Figure 2, of the power pack and with the A. C. meter, zero to 3-volt scale, place the test points to T3 and T3. This should read 1.5 volts. To test the power tube filament, second socket from the right, with the A. C. meter, zero to 15-volt scale, place the test points to T2 and T2 of the socket. This should read 5 volts.

Assuming that no voltage discrepancy has been discovered, remove the tubes, disconnect the A.C. supply cord, disconnect the terminal cord, and remove the power pack from the cabinet, then turn the power pack upside down and remove

the bottom plate. Then, with the aid of the schematic diagram, shown in Figure 2, proceeded to test the various circuits and apparatus with the proper instruments.

#### Oscillation and Microphonic

These receivers should not oscillate on any wavelength. In case a receiver should oscillate, one of the following defects may be the cause:

1. Particularly bad tube or tubes in the R.F. stages.
2. Short circuited grid resistor.
3. Voltage too high on R.F. tubes.
4. 6-mfd. by-pass condenser may be open, shorted, or lead off.
5. In some cases, the antenna may be too long.
6. Poor or high resistance ground or no ground at all.
7. Primary coil possibly reversed.
8. Shorted grid condenser.
9. Shorted detector plate condenser.
10. Open detector plate condenser.

When a microphonic reaction occurs, any of the above defects may contribute to the disturbance.

Although we recognize that the cabinet itself enters somewhat into the problem, we have as yet to find a combination where it is necessary to replace the cabinet. We have generally found that a severe microphonic case is due primarily to the chassis which, either from its own mechanical construction or the B voltage supply, is super-sensitive. In other words, with this particular chassis, the R.F. gain of the set was so high as to be abnormal, with the signal very near the peak and verge of oscillation. Therefore, in this critical condition, very little additional signal impulse was necessary to start an acoustical feedback between chassis and speaker, resulting in the microphonic howl and a seemingly insurmountable problem.

From the above, it is obvious that the fundamental method of cure is in some way to reduce the overall gain of the

set. Sometimes this is possible by merely substituting tubes which tend to be less microphonic and probably less sensitive than others. The substitution of a 5-megohm leak for the standard 2 megohms is also of some help.

A definite procedure can be followed to correct this condition by changes in the chassis assembly. The small condensers GC1, GC2 and GC3 in the six-tube receiver and GC2, GC3, GC4 in the seven-tube receiver have exposed corner plates, some of which may be turned up and others turned down. Change the position of these corners and then tune the set and note the reaction. Should the set still be microphonic, pro-

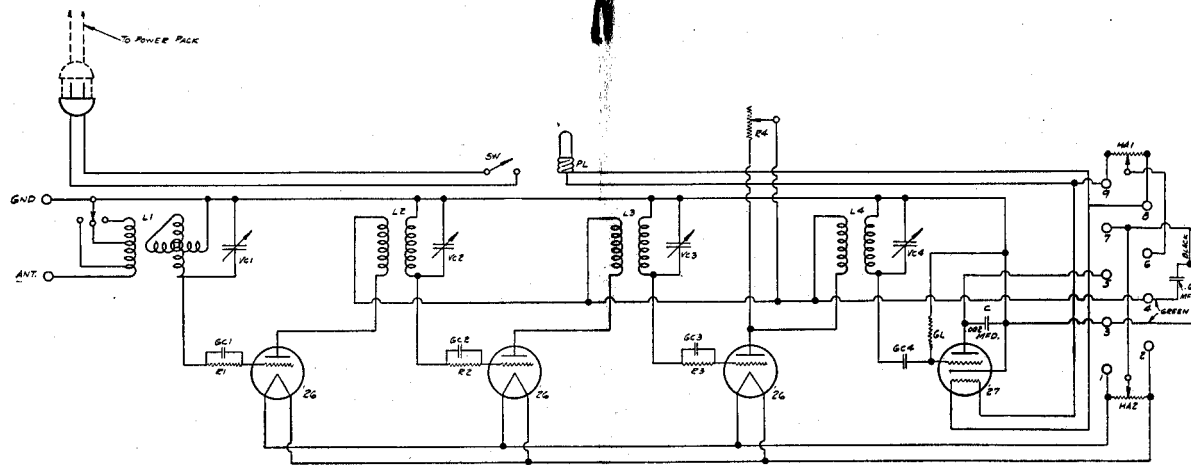


Fig. 2—Schematic diagram of the four-tube chassis as used with Kolster six-tube sets.

ceed further by removing the synchronizing condenser from the gang condenser assembly. Remove the nut securing same and just bend the buss bar so that the instrument is away from the condenser gang shield.

Should this make no difference in the output, try removing one grid condenser, preferably from the 2nd R.F. stage. The set may be in such a sensitive condition that the microphonics will not be entirely eliminated by the above means. Should this be so, the sensitivity must be reduced.

The grid resistances used are of fixed

values, but their values differ in the different sets. By increasing this resistance to the grid return, the gain will be reduced, and vice versa. If the existing grid resistances are replaced with others of a lower value, the sensitivity will be increased.

If it is necessary to make these changes, and reduction of sensitivity is the objective, the replacement resistance should involve an increase of no more than 400 ohms on all tuned stages. Do not use various values of resistances or add to one stage and not the others, as the circuits will be unbalanced and the set inefficient.

Examine the cabinet for looseness and

factorer (which is usually 110 volts), add a resistor of the correct value to reduce it to a safe figure.

Table No. 2 lists the current in amperes drawn by the receiver, several line voltages in excess of 110, and the value of resistors which will reduce the abnormal line voltage to 110 across the receiver. It should be borne in mind that the current is the primary current rating, which will be found on the name plate inside the cover of the cabinet of the table models and on the side panel of console models. This rating can also be found on the name plates of the receiver chassis and voltage supply units.

The six and seven-tube models, K-20, K-21, K-22, K-25, K-27, have a drain of ½ amperes or 50 watts per hour.

The seven-tube K-23 drain is 1 ampere or 100 watts per hour.

The seven-tube K-24 drain is 1.25 amperes or 125 watts per hour.

Figure 1 shows a schematic diagram of the 5-tube chassis used with the Kolster 7-tube receivers. Figure 2 shows the diagram of the 4-tube chassis used in the 6-tube sets. Figure 3 shows the diagram of the power pack in the 6-tube receivers while Figure 4 shows the schematic diagram of the 7-tube receiver power pack and audio amplifier. These diagrams will enable the Radio-Trician to successfully test each separate circuit for continuity.

#### Removing the Component Parts of the Six or Seven Tube Set Power Packs

To remove the power pack from a K-20 or K-21 cabinet, unscrew the nuts from the terminal binding posts to release the terminal card and cable. Be sure that the speaker tips have been removed, unscrew the three cap bolts from bottom of cabinet and lift the unit out.

To gain access to the connections and components of the power pack audio assembly, it is necessary to remove the plate enclosing the base. There are two ears on this plate which are bent around

TABLE NO. 2 Resistors to Use at Various Line Voltages for Various Loads  
These Resistors Will Reduce the Voltage Across the Receiver From the Voltages Shown to 110 Volts

Current in Amperes Drawn by Receiver	2.5 Ohms Line Voltage	3.5 Ohms Line Voltage	5 Ohms Line Voltage	7 Ohms Line Voltage	10 Ohms Line Voltage	12.5 Ohms Line Voltage	15 Ohms Line Voltage	22 Ohms Line Voltage	31 Ohms Line Voltage	45 Ohms Line Voltage	62 Ohms Line Voltage
0.50											
1.00											
1.25	112.5	112.7	114.0	114.0	114.0	115.1	116.1	119.0	122.7	128.7	136.0
		113.5	114.0	115.6	118.2	120.2	122.2	128.2	136.0	128.7	136.0
			115.0	117.1	120.2	122.7	125.2	133.1			



the flange of the base. Straighten these ears and slide the plate off.

To remove the audio transformer assembly, unsolder the leads and straighten ears which secure the housing. The assembly should lift right out.

To remove the vitreous resistor unsolder all leads, being careful to note the relative leads and their position on the resistor. Remove the mounting bracket and slip the resistor carefully to the side so that the ground lug does not jam the vitreous resistor soldering lug. In the K-21, K-23 and K-28 power pack the vitreous resistor is in two sections mounted on a wood plug and separated by an insulating washer. To remove either of these sections the bracket must be loosened and the above procedure followed.

To remove the chokes back off the screws which secure the center housing to the base, unsolder all condenser leads and lift the housing off the base. The chokes will be in view for tracing leads and unscrewing the mounting bolts.

To remove the condenser bank unsolder all the leads and remove the housing as instructed above. You will find that the condenser bank is secured in the housing by clamps. Straighten out the ears of these clamps and the bank will come out. When replacing the bank and to reclamp it in the housing, a block of wood 2"x4"x6" can be used to great advantage. Assemble the condenser bank and place the clamps in position. Set this on the wooden block and hammer over the clamp ears.

To remove the power transformer unsolder all connections, straighten out the ears and the housing will come off. Unscrew the mounting bolts. The brackets supporting the power transformer will now come off and the power transformer will be released. Within the frame of the supporting brackets are bushings for mounting the power pack base to a baseboard. When remounting the brackets these bushings should be placed in their relative positions and extreme care should be taken to place the power transformers in the correct position.

### How to Change Drive Cords in Kolster Receivers

Tools necessary: Needle nose pliers, screwdriver, No. 7 Spintite socket wrench.

Remove the terminal card from the terminal board of the receiver chassis.

Remove the three tuning knobs from the control panel and unscrew the large shaft assembly nuts.

Remove the cap screws from the baseboard of the cabinet and lift the power pack out.

Back the receiver chassis into the cabinet so that the shafts come free of the front panel and lift out.

Remove the old cord from the dial drum. Stretch the new cord as much as possible. It should measure thirteen inches from bead to bead or knot to knot.

Turn chassis upside down. Put both ends of cord through the opening in the chassis and then loop around the main drive pulley. Turn the chassis over again.

Rotate the drum so that the socket is in front and hold it firmly in this position.

Viewing from the top of the chassis, the cord end, on the right side of the main drive pulley should be looped over the idler pulley and under the dial drum to the forward part of the set. Place the beaded or knotted end of the cord in the socket.

The other end of the cord should be looped OVER the other idler pulley and placed under the dial drum to the front of the set.

Grasp the end of the cord firmly in the pliers, not forgetting to keep a full strain on the cord and with the other hand press down the tension spring as far as necessary. Force the knot or bead over and the cord into the spring slot.

Rotate the drum several times by turning the tuning knob and make sure that the condenser rotor plates turn easily and that the cord does not slip in the pulley assembly.