KG-650 RF SIGNAL GENERATOR

SPECIFICATIONS

FREQUENCY RANGE
CALIBRATED FUNDAMENTALS

BAND A	160 KC to 550 KC
BAND B	550 KC to 1850 KC
BAND C	1850 KC to 7 MC
BAND D	7 MC to 27 MC
BAND E	27 MC to 112 MC
USEABLE 2ND HARMONICS	to 224 MC

RADIO FREQUENCY OUTPUT ..... IN EXCESS OF 400,000 MICROVOLTS

MODULATION..... 400 CYCLES

AUDIO OUTPUT..... IN EXCESS OF 10 VOLTS

TUBES..... 6C4 AUDIO OSCILLATOR
12AT7 RF OSCILLATOR & MIXER

POWER SOURCE..... 110 to 130 VOLTS
60 CYCLES AC

HOW TO BUILD THE KNIGHT RF SIGNAL GENERATOR

INTRODUCTION

A signal generator is an instrument that generates a signal which can be used for measuring, testing, or servicing. The generator's output signal is usually representative of the signal normally present in the circuit being tested or serviced. Your KNIGHT RF Signal Generator generates an RF signal, in excess of 400,000 microvolts, which can be used modulated or unmodulated for alignment of a receiver's RF & IF stages or for a TV marker signal. In addition to the RF signal a 400 cycle audio signal is also generated. This signal can be used internally to modulate the RF signal or externally to troubleshoot radio and television audio circuits, public address amplifiers or HI-FI amplifiers. You can see that this RF Signal Generator has many applications and that to a serviceman, experimenter, or amateur radio operator it can be a valuable instrument.

The oscillator circuits of this generator are of the highly stable Colpitts type. This assures you of a high degree of accuracy and frequency stability. The large, easily read, calibrated dial scale and vernier dial mechanism permits easy selection of the desired frequency.

Building the KNIGHT RF Signal Generator kit will be easier if you study the diagrams and instructions before any assembly is started.

Check all of the parts against the Parts List on page 27 , as you unpack the KNIGHT RF Signal Generator kit. If you are unable to identify some of the parts by sight, locate them on the pictorial diagrams. Resistor and capacitor values, if not printed on the part, may be found with the aid of the color code chart.

Hardware is listed in the last part of the Parts List. To keep our kits at the lowest possible price, we frequently weigh hardware rather than count it one by one. Therefore, do

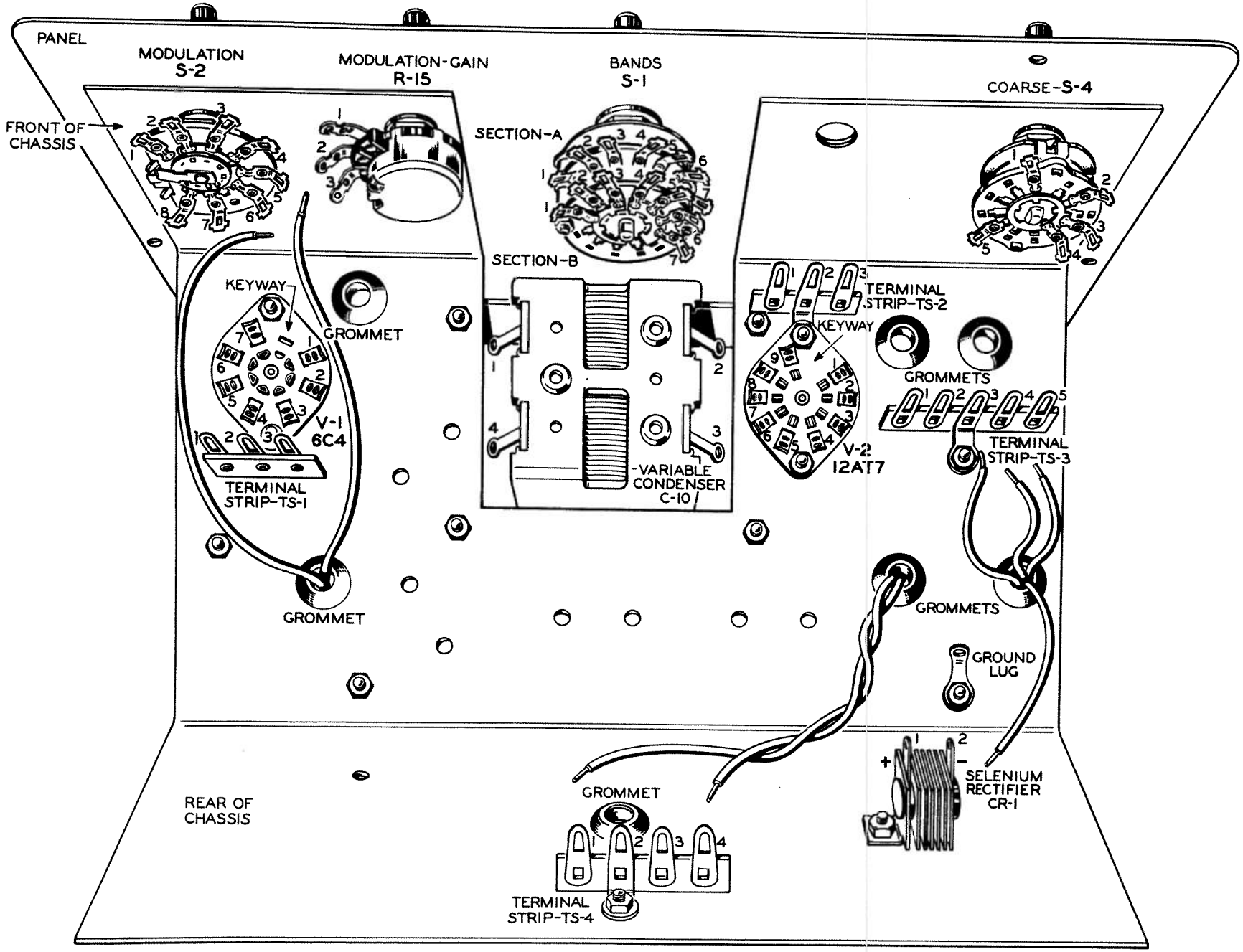


FIGURE 1. HOW TO MOUNT THE PARTS INSIDE THE CHASSIS

not be concerned if more nuts and machine screws, for example, are supplied than are specified in the Parts List.

The only tools you will need are: long-nose pliers, diagonal cutters, a screwdriver, a small set-screw driver, and a soldering iron.

The pictorial diagrams show the actual location of all parts and wiring. The KNIGHT RF Signal Generator will work best when all parts are placed as shown in the diagrams. The schematic diagram shows how the parts are connected electrically and is useful in understanding how the Generator works.

The step-by-step instructions were prepared while actually building the KNIGHT Signal Generator. They are the best and quickest way of assembling this unit. May we suggest that you check off each step after you have completed it. Some builders also put a pencil mark on the wiring views along the leads and parts that they have just installed. Both of these methods are good and will assure speedy and correct wiring.

SEE FIGURE 1.

Begin building your kit by mounting the major parts on the chassis.

( ) Place the chassis in the position shown in Figure 1, with the large cutout facing away from you.

( ) Mount socket V-1, the 7-pin miniature socket, from inside the chassis. The keyway, or wide space between two of the pins, must be toward the front of the chassis. Mount a 3-terminal terminal strip (TS-1) on the socket's rear mounting screw, between the socket and the chassis. Use two of the longer machine screws and two of the small nuts to mount the socket and the terminal strip.

( ) Mount socket V-2, the 9-pin miniature socket, from inside the chassis. The keyway, or wide space between two of the pins, should be toward the front of the chassis. Mount a 3-terminal terminal strip (TS-2) on the socket's front mounting screw, between the socket and the chassis. Use two of the longer machine screws and two of the small nuts to mount the socket and the terminal strip.

( ) There are six 3/8" holes in the chassis and one on the back of the chassis; insert the seven rubber grommets into these holes.

( ) Mount the 4-terminal terminal strip (TS-4) on back of the chassis with one of the longer machine screws and a nut.

( ) Mount CR-1, the selenium rectifier, on the back of the chassis with one of the longer machine screws and a nut.

SEE FIGURE 2.

( ) Position the leads of T-1, the power transformer, as shown. Mount the transformer using 2 of the longer screws. On the underside of the chassis place a 5-terminal strip on the screw nearest the front panel. Place a solder lug on the other screw. Secure each screw with a small nut.

( ) Insert the leads of L-1, the choke, through the grommet as shown. Mount the choke with 2 long screws and small nuts.

( ) Use 4 of the short machine screws to attach the 2 capacitor mounting brackets to C-10, the variable capacitor, as shown.

( ) Bend the 4 terminals of the capacitor slightly, so they face the bottom of the capacitor. Mount the capacitor to the chassis using 4 machine screws and nuts.

SEE FIGURE 1.

Notice that the row of holes across the bottom of the panel matches the holes across the front of the chassis.

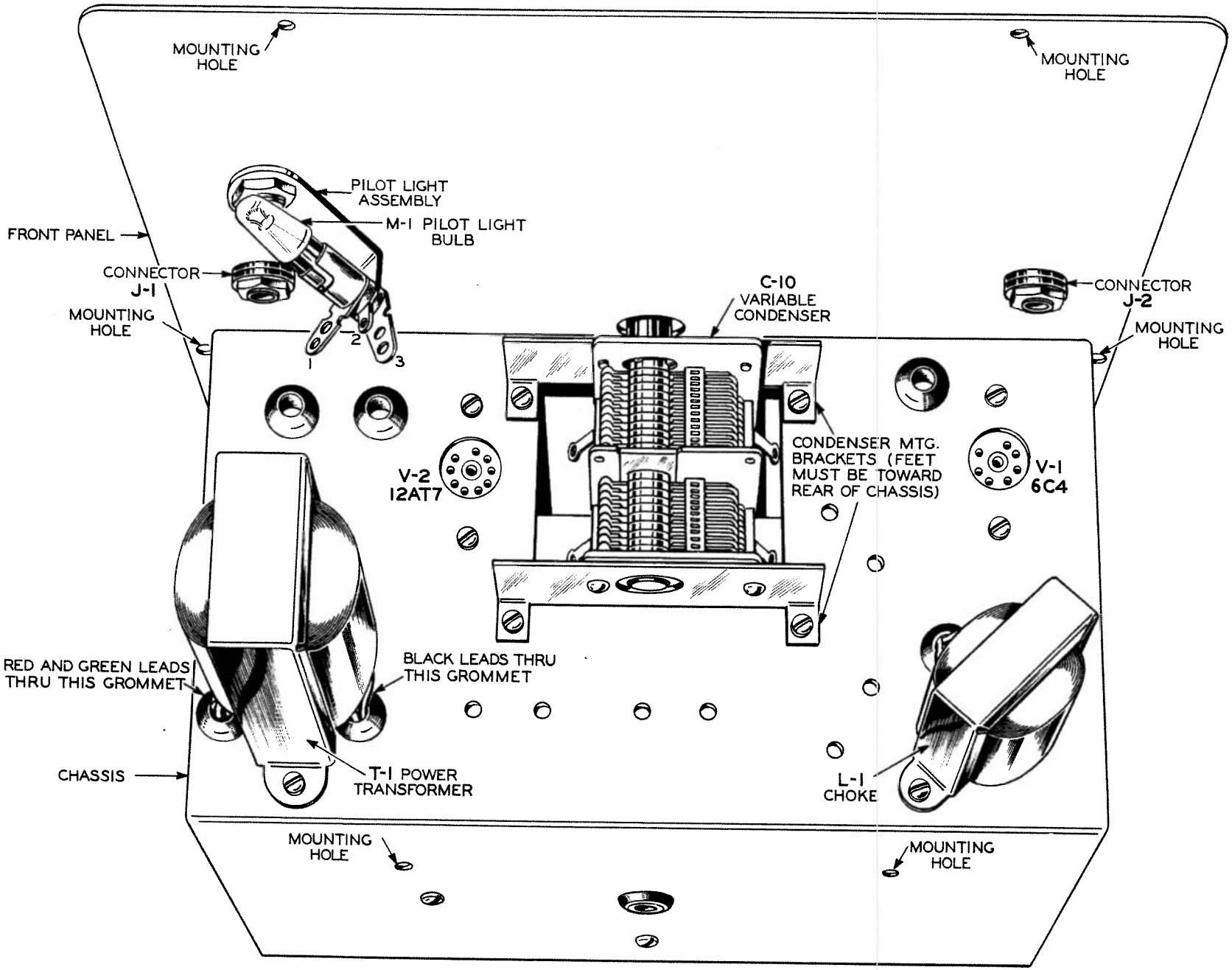


FIGURE 2. HOW TO MOUNT THE PARTS ON TOP OF THE CHASSIS

(X) Mount S-4, the Coarse RF Attenuator switch to the chassis and panel, following the assembly details shown in Figure 3A. Position the terminals as shown in Figure 1. To check the knob calibration, temporarily place a knob on the shaft of S-4. Check to see that the line on the knob points to the proper markings on the panel as it is rotated. If necessary, rotate S-4 until the knob indicates correctly. Remove the knob and tighten the switch mounting nut.

(X) Mount S-2, the Modulation switch, following the assembly details shown in Figure 3A. Position the terminals as shown in Figure 1. Check the knob calibration.

(X) Mount R-15, the Modulation Gain control, positioning the terminals as shown in Figure 1. Follow the assembly details shown in Figure 3A.

(X) Mount S-1, the Bands switch, positioning the terminals as shown in Figure 1. Follow the assembly details shown in Figure 3A. Check the knob calibration.

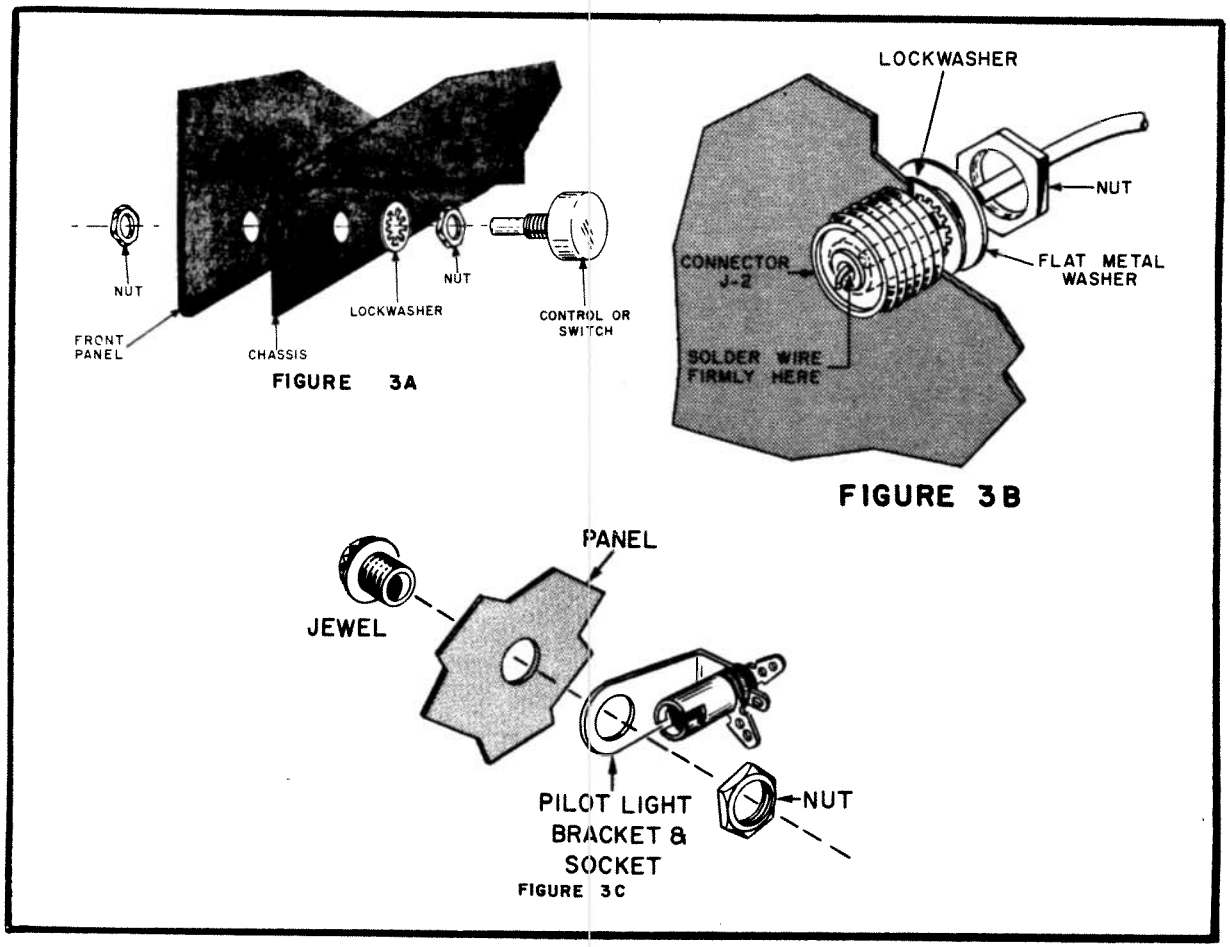


FIGURE 3. CONSTRUCTION DETAILS

SEE FIGURE# 2

(X) Mount J-2, the Audio In-Out cable connector, following the assembly details shown in Figure 3B.

(X) Mount J-1, the RF Output connector, following the assembly details shown in Figure 3B.

(X) Mount the pilot light assembly following the assembly details shown in Figure 3C. Position the terminals as shown in Figure 2.

THIS KIT MUST BE PROPERLY SOLDERED!

USE ENOUGH HEAT

This is the main idea of good soldering. Apply enough heat to the metal surfaces you are joining to make the solder spread freely, until the contour (shape) of the connection shows under the solder.

AN ELECTRONIC UNIT WILL NOT WORK . . . unless it is properly soldered. Read these instructions carefully to understand the basic ideas of good soldering.

Enough heat must be used so the solder can actually penetrate the metal surfaces, making an unbroken path over which electricity can travel. You are not using enough heat if the solder barely melts and forms a rounded ball of rough, flaky solder.

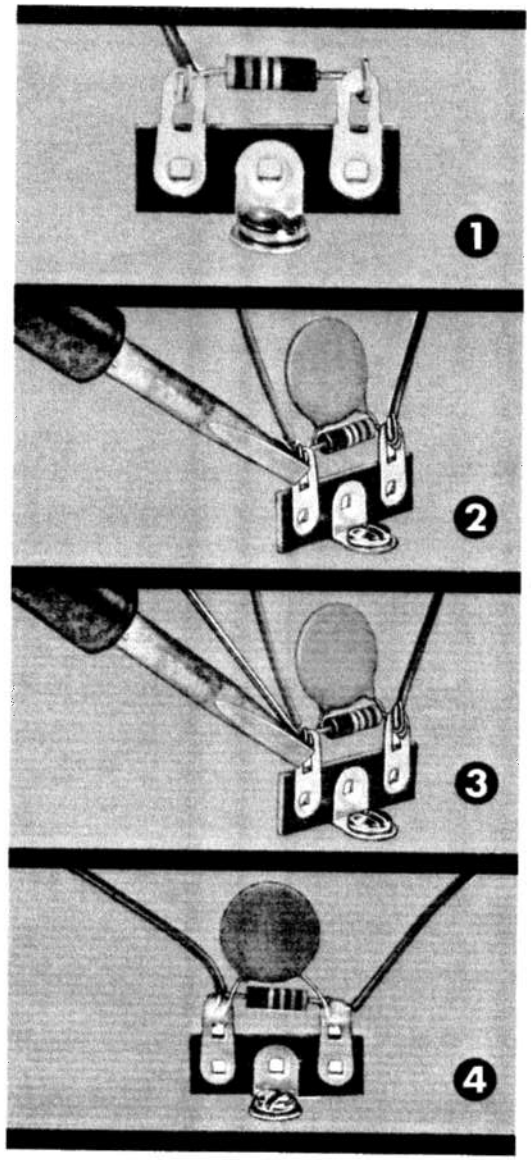
Use the Right Soldering Tool

A soldering iron in the 27-40 watt range is recommended. Any iron in this range with a clean, chisel-shaped tip will supply the correct amount of heat to make a good solder connection. You may also use a solder gun but make sure the tip reaches full heat before you solder.

Keep the iron or gun tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth. If you are using an old tip, clean it before you start soldering.

Use Only Rosin Core Solder

We supply the right kind of solder (*rosin core solder*). Do not use any other kind of solder! **Use of Acid Core Solder, Paste, or Irons Cleaned on a Sal Ammoniac Block will ruin any Electronic Unit and will Void the Guarantee.**



HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal; insulation must be removed. Make good mechanical connections and keep resistor and capacitor leads as short as possible, unless otherwise specified.

2. Coat the tip of a hot iron with solder. Then **Firmly Press the Flat Side of the Tip** against the parts to be soldered together. Keep the iron there while you . . .

3. Apply the solder between the metal to be soldered and the iron tip. Use only enough solder to flow over all surfaces of the connection, and all wires in the connection. Remove the iron.

Do Not Move Parts Until the Solder Hardens. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

4. Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright and all wires in the connection should be well-soldered.

You Have Not Used Enough Heat: If your connection is rough and flaky-looking, or if the solder has formed a round ball instead of spreading.

The difference between good soldering (enough heat) and poor soldering (not enough heat) is just a few extra seconds with a hot iron **firmly** applied. **REMEMBER, LARGER METAL SURFACES TAKE A LONGER TIME TO HEAT.**

HOW TO CARE FOR YOUR SOLDERING IRON

Your soldering iron is the key to good soldering since it supplies the essential ingredient - HEAT. If the tip is covered by a dirt (oxide) film, the iron will not be able to transfer its full heat. A new tip can be protected from film by coating it with solder the first time it is heated. An old tip should first be cleaned with a file until bare copper is exposed. Then coat it with solder like a new tip.

Never use the iron like a brush -- soldering is not a paste-spreading operation. To get the most heat out of the iron, always press the iron firmly to the connection. Hold it so the greatest tip surface is directly in contact with the connection.

WIRING THE KIT

SEE FIGURE 6.

Note: Position the wire leads and parts as shown in the pictorial diagrams.

( ) Connect but do not solder one end of a 3 inch orange wire to terminal 5 of TS-3. Connect but do not solder the other end to pin 4 of tube socket V-2.

( ) Connect but do not solder one end of a 5 inch green wire to terminal 5 of TS-3. Push the other end through the grommet located on the right side of V-2. This end will be connected later.

( ) Connect but do not solder either one of the red leads and either one of the green leads from T-1, the power transformer, to terminal 3 of TS-3.

( ) Solder one end of a 2 inch red wire to terminal 3 of TS-3. Connect but do not solder the other end to terminal 5 of S-4.

( ) Solder the remaining green lead from T-1, the power transformer, to terminal 5 of TS-3.

( ) Solder the remaining red lead from T-1 to terminal 2 of CR-1, the selenium rectifier.

( ) Twist the two black leads from T-1, the power transformer, together tightly. Connect but do not solder one lead to terminal 1 of TS-4. Connect but do not solder the other lead to terminal 4 of TS-4.

( ) Solder one end of a 4 inch yellow wire to terminal 1 of CR-1. Connect, but do not solder the other end to terminal 4 of TS-3.

( ) Connect but do not solder one end of R-7, a 100,000 ohm resistor (brown, black, yellow), to terminal 2 of TS-2. Connect but do not solder the other end to terminal 3 of TS-2.

( ) Connect but do not solder one end of R-6, a 1000 ohm resistor (brown, black, red), to pin 3 of V-2. Pass the other lead through terminal 2 of TS-2, and through pin 9 of V-2, then connect to pin 8 of V-2. Only solder the connection to pin 9.

( ) Solder one end of R-9, a 22,000 ohm resistor (red, red, orange) to terminal 2 of TS-2. Connect but do not solder the other end to pin 7 of V-2.

( ) Solder one end of C-11, a 33 MMFD capacitor, to pin 7 of V-2. Solder the other end to terminal 2 of C-10, the variable capacitor.

( ) Connect but do not solder one end of C-7, a .001 MFD capacitor, to pin 1 of V-2. Solder the other end to pin 8 of V-2.

( ) Connect but do not solder one end of R-8, a 470,000 ohm resistor (yellow, violet, yellow) to terminal 3 of TS-2. Connect but do not solder the other end to pin 2 of V-2.

( ) Connect but do not solder one end of C-9, a 150 MMFD capacitor, to terminal 3 of TS-2. Connect but do not solder the other end to pin 2 of V-2.

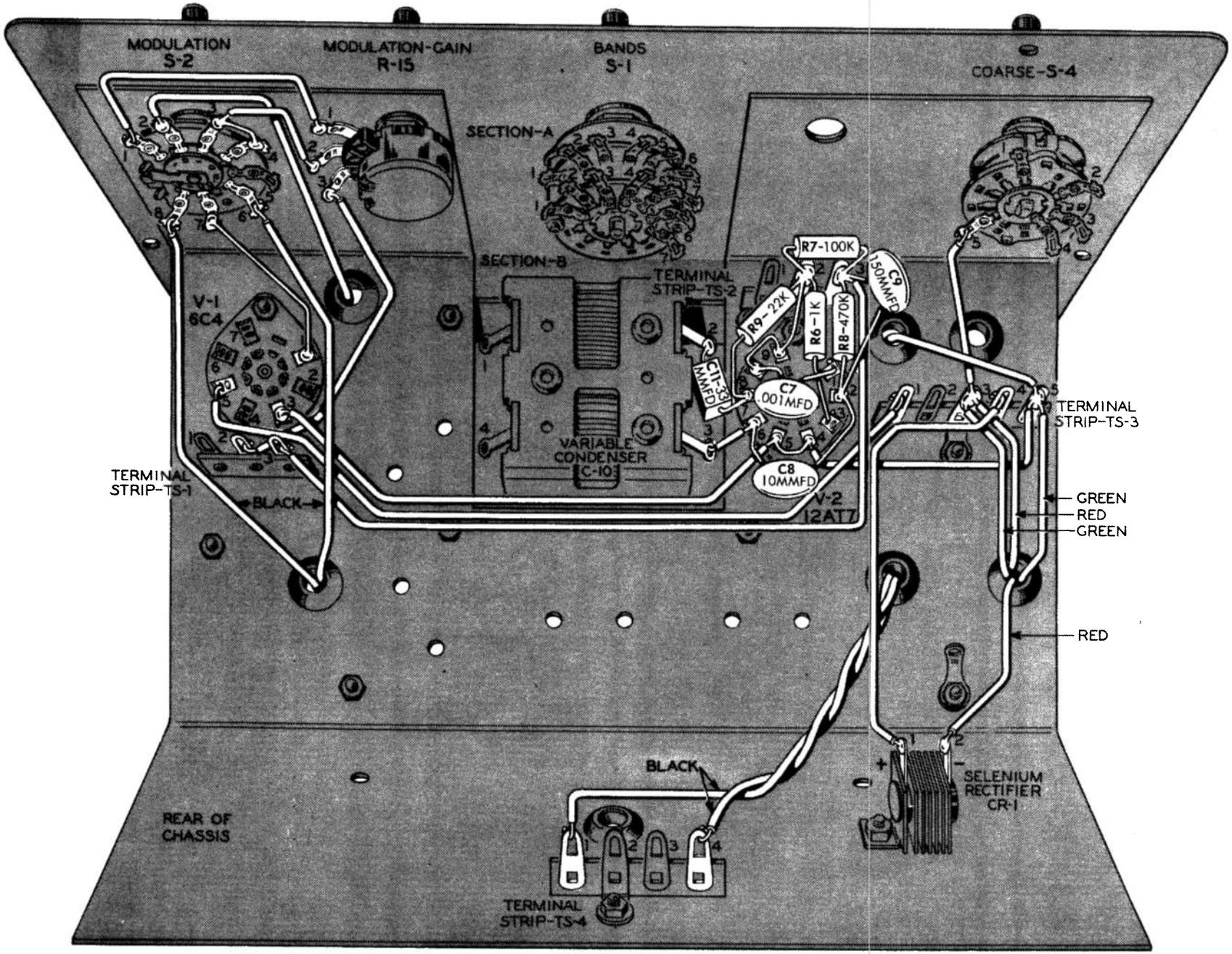


FIGURE 6. FIRST WIRING VIEW INSIDE THE CHASSIS

(X) Solder one end of C-8, a 10 MMFD capacitor, to pin 2 of V-2. Pass the other lead through pin 6 of V-2 and slide a 1/2 inch piece of spaghetti over this lead. Then connect it to terminal 3 of C-10, the variable capacitor. Only solder the connection to pin 6.

(X) Pass one end of a 7 inch violet wire, through pin 5 and connect to pin 4 of V-2. Solder both connections. Solder the other end of this lead to pin 3 of V-1.

(X) Connect but do not solder one end of a 9 inch white wire to terminal 1 of TS-3. Connect but do not solder the other end to pin 5 of V-1.

(X) Solder one end of an 8 inch gray wire to terminal 3 of TS-2. Connect but do not solder the other end to terminal 3 of TS-1.

(X) Cut a 1 inch length from the bare wire supplied. Solder one end to pin 1 of V-1 and solder the other end to terminal 7 of S-2, the modulation switch.

(X) Connect but do not solder one black lead of L-1, the audio choke, to terminal 8 of S-2, the modulation switch. Connect but do not solder the other black lead to terminal 6 of S-2, the modulation switch.

(X) Solder one end of a 4 inch yellow wire to terminal 3 of R-15, the modulation gain control. Connect but do not solder the other end to terminal 2 of TS-1.

(X) Solder one end of a 3 inch orange wire to terminal 1 of R-15, the Modulation Gain control. Connect but do not solder the other end to terminal 1 of S-2, the Modulation Switch.

(X) Solder one end of a 2 inch red wire to terminal 2 of R-15, the Modulation Gain control. Remove 3/4 inch of the insulation from the other end. Pass this end through terminal 3 and connect it to terminal 4 of S-2, the Modulation Switch. Solder both connections.

(X) Solder one end of a 6 inch blue wire to terminal 2 of S-2, the Modulation Switch. Push the other end through the chassis grommet located to the right of and below S-2. This end will be connected later.

SEE FIGURE 7.

(X) Mount R-14, the Fine Attenuator control. Screw one of the two remaining large nuts onto the threaded bushing of the control then place a lockwasher over the bushing. Insert the shaft through the hole in the panel between the Coarse Attenuator (S-4) and the Band Switch (S-1). The terminals on the RF output control must be positioned as shown in Figure 7.

(X) Connect but do not solder one end of a 2 inch red wire to terminal 1 of S-4, the Coarse Attenuator. Solder the other end to terminal 2 of R-14, the Fine Attenuator control.

(X) Solder one end of R-11, a 680 ohm resistor (blue, gray, brown) to terminal 1 of S-4, the Coarse Attenuator. Connect but do not solder the other lead to terminal 2 of S-4.

(X) Connect but do not solder one end of R-10, a 680 ohm resistor (blue, gray, brown) to terminal 2 of S-4, the Coarse Attenuator. Connect but do not solder the other lead to terminal 3 of S-4.

(X) Solder one end of R-12, a 220 ohm resistor (red, red, brown) to terminal 3 of S-4. Connect but do not solder the other lead to terminal 5 of S-4. Be sure that the resistor does not lay against the switch parts.

(X) Solder one end of R-13, a 220 ohm resistor (red, red, brown) to terminal 2 of S 4. Pass the other lead through terminal 5 of S-4 and connect it to terminal 1 of R-14, the Fine Attenuator control. Solder both connections.

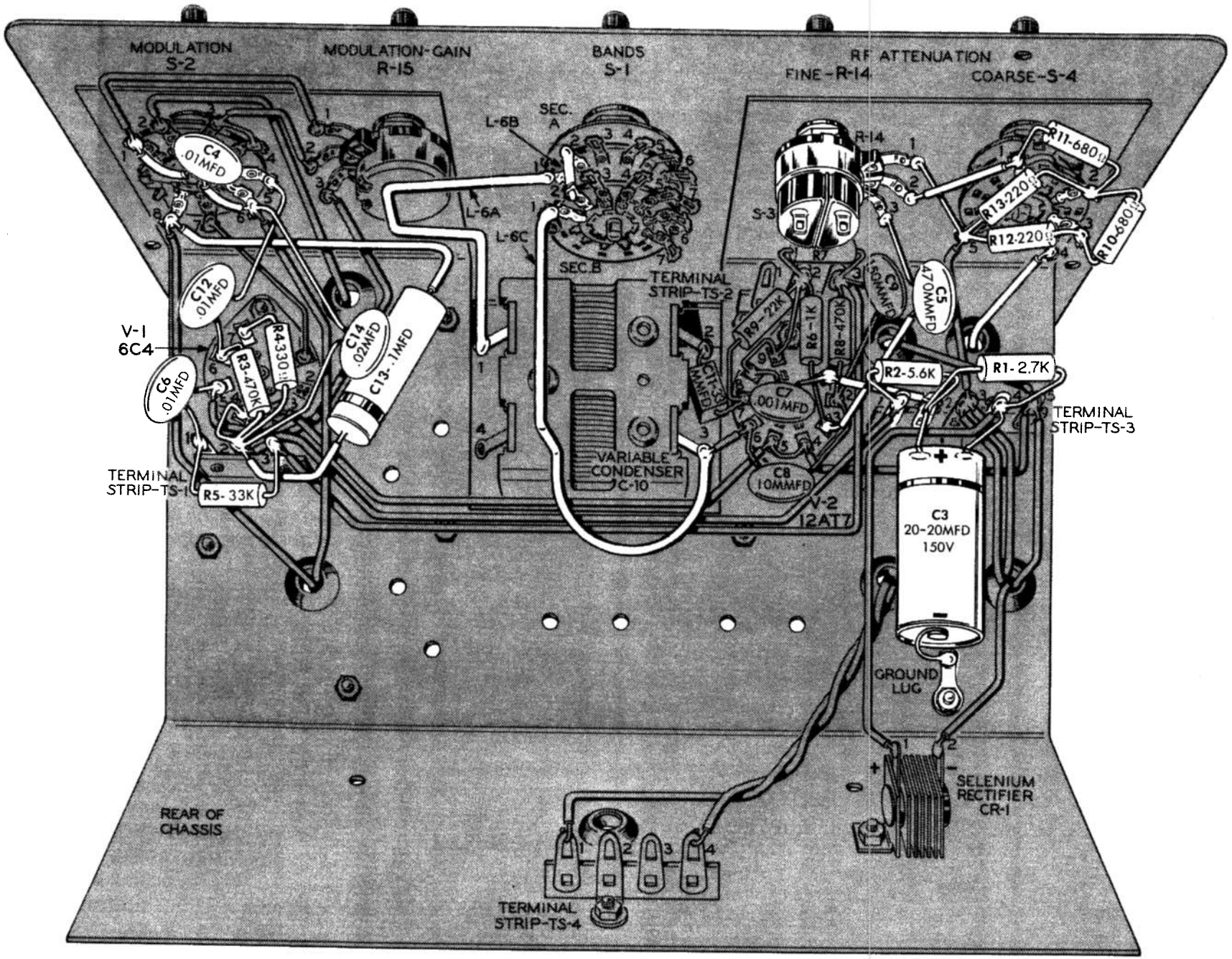


FIGURE 7. SECOND WIRING VIEW INSIDE THE CHASSIS

(X) Solder one end of a 3 inch orange wire to terminal 4 of S-4. Push the other end through the grommet located directly below S-4. This end will be connected later.

(X) Solder one end of R-2, a 5600 ohm resistor (green, blue, red) to terminal 1 of terminal strip TS-3. Connect but do not solder the other lead to terminal 2 of TS-3.

(X) Connect but do not solder one end lead of R-1, a 2700 ohm, 1 watt resistor (red, violet, red) to terminal 4 of TS-3. Connect but do not solder the other lead to terminal 2 of TS-3.

(X) Place C-3, the 20-20 MFD capacitor, on the chassis so that the two leads from the end marked "+" face TS-3. Solder the lead nearest terminal 4 of TS-3 from the end marked "+" to terminal 4 of TS-3.

(X) Pass but do not solder the other lead from the end marked "+" through terminal 2 of TS-3 and place a 3/4 inch length of spaghetti over the lead. Solder the end of this lead to pin 1 of V-2.

(X) Solder the lead from the end marked "-" to the ground lug.

(X) Solder one end of C-5, a 470 MMFD Capacitor, to terminal 3 of R-14, the Fine Attenuator control. Place a 1" length of spaghetti on the other lead. Solder this lead to pin 3 of V-2.

(X) Place a 3/4 inch length of spaghetti over the black banded end of C-13, a .1 MFD capacitor. Connect but do not solder this end to terminal 2 of TS-1.

(X) Place a 2 inch length of spaghetti over the other lead of C-13. Solder this lead to terminal 8 of S-2, the Modulation Switch.

(X) Solder one end of C-12, a .01 MFD capacitor, to terminal 5 of S-2. Connect but do not solder the other lead to pin 6 of V-1.

(X) Place a 3/4 inch length of spaghetti on both leads of C-4, a .01 MFD capacitor. Solder one end of C-4 to terminal 1 of S-2, the Modulation Switch. Connect but do not solder the other end to terminal 6 of S-2.

(X) Solder one end of C-14, a .02 MFD capacitor, to terminal 6 of S-2. Connect but do not solder the other lead to terminal 2 of TS-1.

(X) Solder one end of R-4, a 330 ohm resistor (orange, orange, brown) to pin 7 of V-1. Connect but do not solder the other lead to terminal 2 of TS-1.

(X) Solder one end of R-3, a 470,000 ohm resistor (yellow, violet, yellow) to pin 6 of V-1. Pass the other lead through terminal 2 of TS-1 and connect it to pin 4 of socket V-1. Solder both connections.

(X) Solder one end of C-6, a .01 MFD capacitor, to pin 5 of V-1. Connect but do not solder the other lead to terminal 1 of TS-1.

(X) Solder one end of R-5, a 33,000 ohm resistor (orange, orange, orange) to terminal 1 of TS-1. Solder the other end to terminal 3 of TS-1.

(X) There are three coils made of heavy bare copper wire. They are designated L-6A, L-6B, and L-6C. To identify these coils see Fig. 7. When connecting the coils, insert the pointed ends carefully into the connection terminals. Do not bend the coil wire over the terminals. After soldering, make sure the connection is mechanically strong.

S-1, the Band Switch has two sections. Each section has 7 terminals. The section closer to the front panel is designated section A. The section closer to the rear of the chassis is designated section B.

(X) Solder one end of Coil L-6A to terminal 1 of C-10, the variable capacitor. See Fig. 7 for the proper positioning of the coil. Solder the other end of the coil to terminal 1, section A, of S-1, the Band Switch. Do not bend the ends of the coils around the terminals.

( ) Solder one end of coil L-6C to terminal 1, section B, of S-1. See Fig. 7 for proper positioning of the coil. Solder the other end to terminal 3 of C-10, the variable capacitor.

( ) Solder one end of coil L-6B to terminal 2, section A, of S-1. Connect, but do not solder, the other end to terminal 2, section B, of S-1.

SEE FIGURE 8.

( ) There are four band coils wound on fibre forms. Identify these coils so that you can mount them in the proper position. L-2 is the coil with the two large windings. L-3 is the coil with the two small windings. L-4 is the coil with the large single winding. L-5 is the coil with the small single winding.

( ) Mount the band coils L-2, L-3, L-4, and L-5 with the terminals positioned as shown in Fig. 8. Insert the coil mounting studs from the inside of the chassis and attach the small nuts to the studs, on the top of the chassis.

( ) Cut a 9-inch length from the bare wire supplied. Connect one end of the lead to terminal 2 of TS-3. Pass the other end through terminal 2 of coil L-2, terminal 2 of coil L-3, terminal 2 of coil L-4 and terminal 2 of L-5; then, connect it to terminal 2, section B, of S-1. Solder all of these connections.

( ) Connect, but do not solder one lead of C-15, a 3.3 MMFD ceramic tubular capacitor, to terminal 1 of L-2. Connect, but do not solder the other lead to terminal 3 of L-2.

( ) Cut a 1 inch length from the bare wire supplied. Solder one end to terminal 7, section A, of S-1. Solder the other end to terminal 7, section B, of S-1.

NOTE: When connecting wires from the band coils to S-1, make all wires as short and direct as possible.

( ) Solder one end of a 4 inch yellow wire to terminal 3, section A, of S-1. Solder the other end to terminal 3 of coil L-5.

( ) Solder one end of a 2 inch red wire, to terminal 3, section B, of S-1. Solder the other end to terminal 1 of coil L-5.

( ) Solder one end of a 4 inch yellow wire to terminal 1 of coil L-4. Solder the other end to terminal 4, section B, of S-1.

( ) Solder one end of a 5 inch green wire to terminal 3 of coil L-4. Solder the other end to terminal 4, section A, of S-1. Trim this end so that the wire is as short as possible.

( ) Solder one end of a 4 inch yellow wire to terminal 1 of coil L-3. Solder the other end to terminal 5, section B, of S-1.

( ) Solder one end of a 4 inch yellow wire to terminal 3 of coil L-3. Solder the other end to terminal 5, section A, of S-1.

( ) Solder one end of a 3 inch orange wire to terminal 1 of coil L-2. Solder the other end to terminal 6, section B, of S-1.

( ) Solder one end of a 4 inch yellow lead to terminal 3 of coil L-2. Solder the other end to terminal 6, section A, of S-1.

( ) Twist two 9 inch white wires together tightly.

( ) Connect one end of either wire to each of the two lugs on the rear of S-3, the AC power switch. The AC power switch is attached to the rear of R-14, the Fine Attenuator control. Solder both connections.

( ) Solder the other end of one of the twisted leads to terminal 1 of TS-4. Connect but do not solder the other end of the remaining lead to terminal 3 of TS-4.

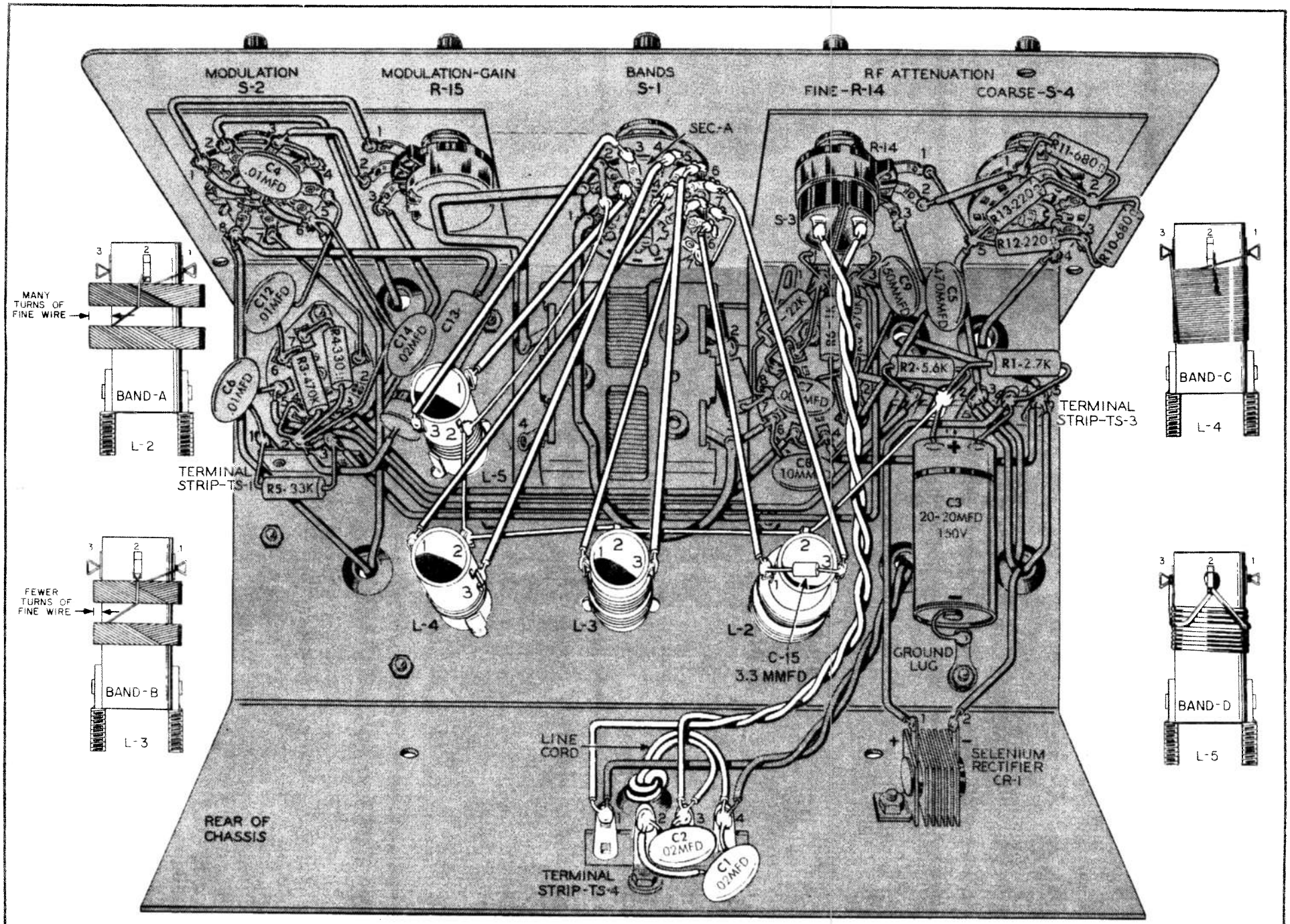


FIGURE 8. THIRD WIRING VIEW INSIDE THE CHASSIS

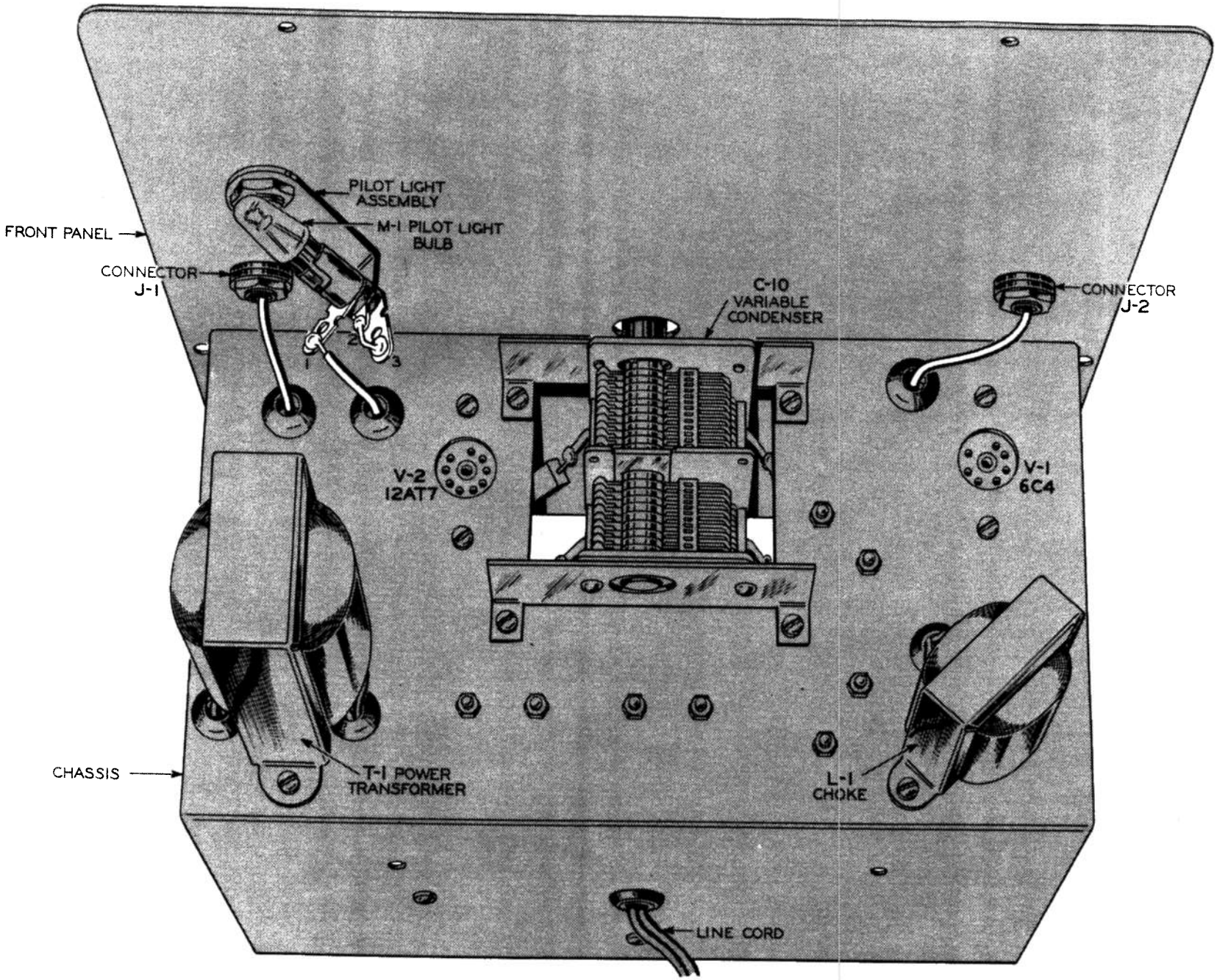


FIGURE 9. WIRING VIEW OF CHASSIS TOP SIDE

NOTE: Position the twisted white wires down along the chassis and away from the Band coil L-2.

(X) Connect but do not solder one end of C-2, a .02 MFD capacitor, to terminal 2 of TS-4. Connect but do not solder the other lead to terminal 3 of TS-4.

(X) Place a 3/4 inch length of spaghetti on one lead of C-1, a .02 MFD capacitor. Solder this lead to terminal 2 of TS-4. Connect but do not solder the other lead to terminal 4 of TS-4.

> NEVER touch any part of the under-chassis wiring while the line cord plug is connected to the wall power outlet. Always remove the plug from the power outlet when working on the set.
>
> Never use or test the instrument on or near a GROUNDED METAL bench, radiator, sink or other grounded metal object.

(X) Pull the AC power cord through the grommet on the chassis rear. This grommet is located just below terminal strip TS-4. Knot the cord 2-1/2 inches from the end and split the two leads back an inch.

(X) Solder one lead of the AC cord to terminal 3 of TS-4. Solder the other lead to terminal 4 of TS-4.

SEE FIGURE 9.

(X) You are now ready to do the above-chassis wiring. There is a blue wire coming out of the grommet located near the right edge of the chassis. Solder this lead to the AF connector (J-2).

(X) There is a green wire coming out of the grommet located near the pilot light assembly. Solder this wire to terminal 1 of the pilot light assembly.

(X) There is an orange wire coming out of the other grommet. Solder this lead to the RF connector (J-1).

(X) Cut a 1 inch length from the bare wire supplied. Connect the wire from terminal 2 to terminal 3 of the pilot light bracket assembly. Solder both connections.

( ) You have now completed the wiring of your KNIGHT RF Signal Generator. Insert the 6C4 and the 12AT7 tubes into their sockets. Insert the pilot light into its socket. See Fig. 9.

( ) Before proceeding to the next step in the assembly of your Knight RF Signal Generator, check all wiring and solder connections.

CABLE ASSEMBLY

SEE FIGURE 11A.

( ) You are now ready to assemble the output cable. Slip the 1 inch long rubber insulator up over one end of the cable, until about 7 inches of the cable comes through the insulator. Carefully remove 5-1/2 inches of the outer insulation from this end of the cable. Unravel the braid and twist it together, cut off the excess braid leaving a 1/2 inch long lead. Coat the 1/2 inch long twisted braid lead with solder. Twist one end of the 5 inch rubber insulated stranded wire supplied with this kit, to the soldered braid lead. Solder this connection. Pass the free end of this wire through the small hole of the BLACK clip insulator and connect under the screw of one of the alligator clips. The two small lugs on the end of the alligator clip are clamped down over the wire's insulation. Pass the end of the inner conductor through the small hole of the RED clip insulator. Remove 1/2 inch of insulation from the inner conductor and connect it to the remaining alligator clip, in the same manner that the first clip was connected. Slide the RED and BLACK insulators down over the alligator clips. Slide

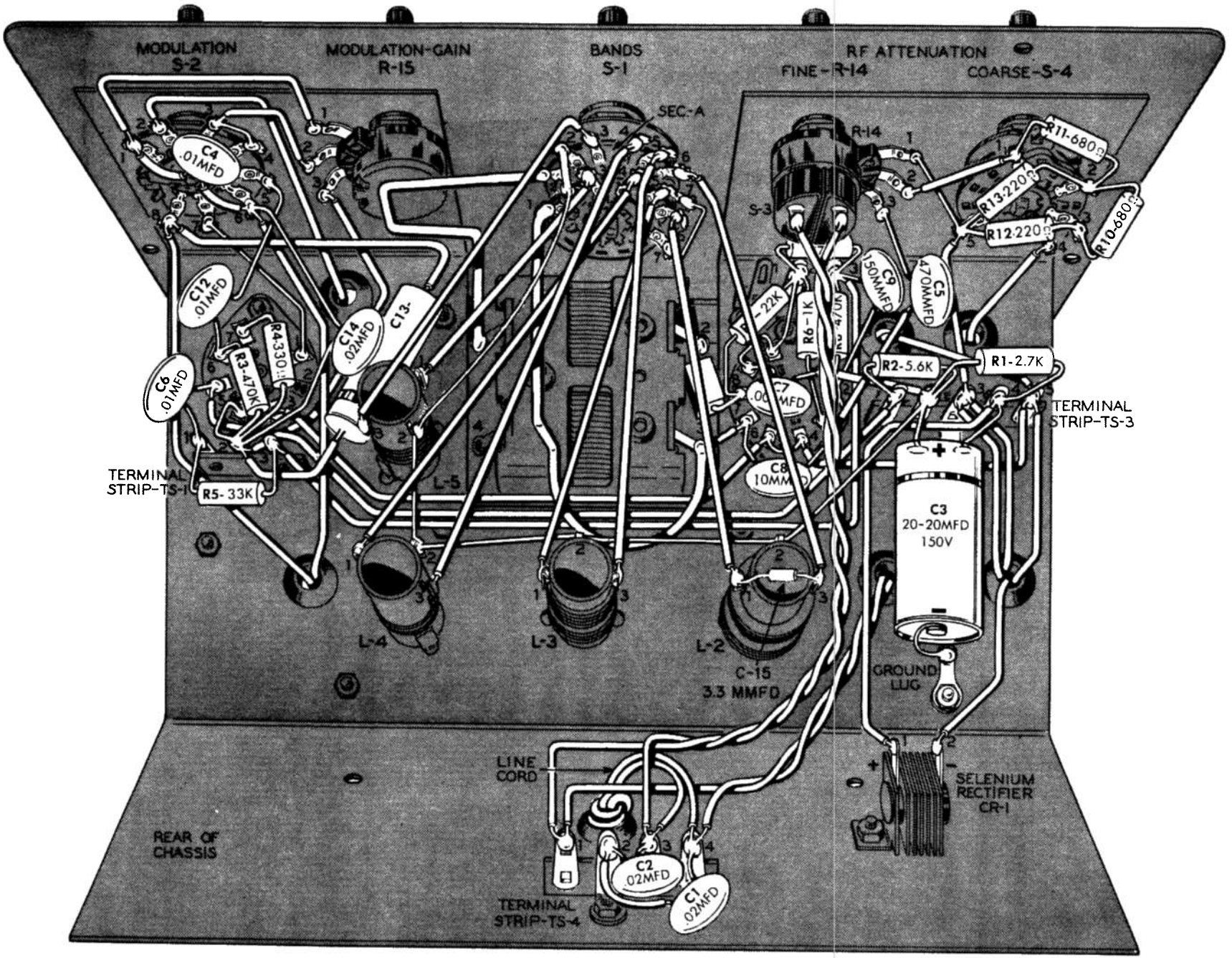


FIGURE 10. COMPLETED WIRING VIEW INSIDE THE CHASSIS

the rubber insulator down over the soldered braid connection.

SEE FIGURE 11B.

( ) Remove the small set-screw from the cable plug and remove the spring from the plug. Slide the spring, large hole first, over the other end of the cable. Remove 1/2 inch of the outer insulation from the cable. Unravel the braid and bend it back over the spring. Remove 1/8 inch of the insulation from the inner conductor. Twist the stranded leads together and coat them with solder. Insert the cable and spring into the open end of the plug. The inner conductor must fit into the small hole of the plug. The braid and spring should fit into the plug so that the set screw will tighten on the spring. Tighten the set-screw. Solder the inner conductor to the eyelet.

SEE FIGURE 12.

( ) You are now ready to attach the knobs and pointers. Fully close the plates of the variable condenser (C-10). Slide the pointer on the condenser shaft. The line on the pointer should point to the extreme left end of the band scales. Tighten the pointer set-screw. Slide the large knob over the condenser shaft as far as it will go. Tighten the set-screw. If the large knob is not evenly spaced between the two sides of the dial scale, loosen the four capacitor mounting bracket screws. Move the capacitor either to the right or the left until the knob is centered. Hold the capacitor in place and tighten the four screws.

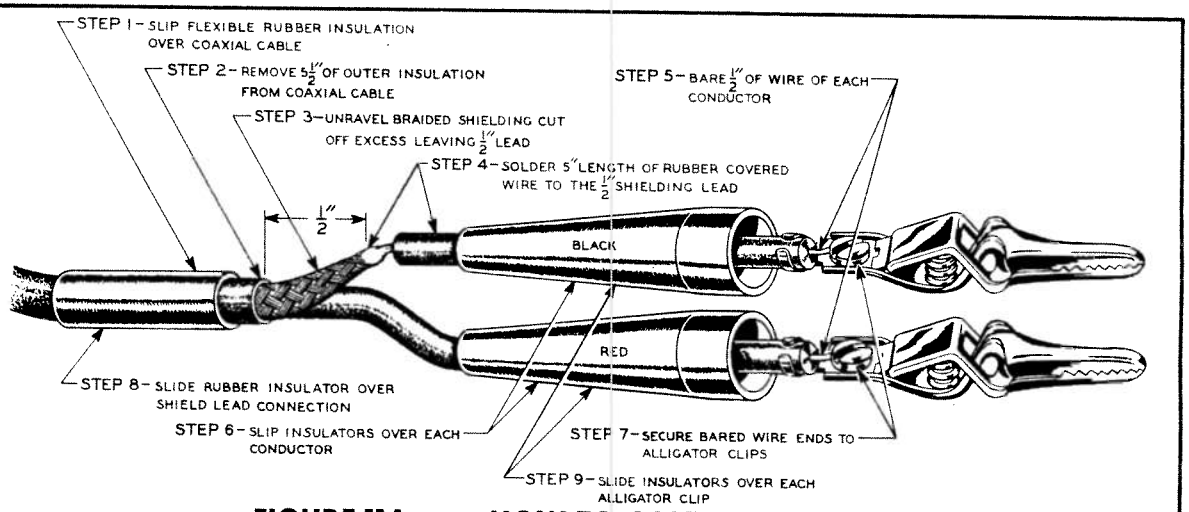


FIGURE 11A. HOW TO ASSEMBLE THE CABLE

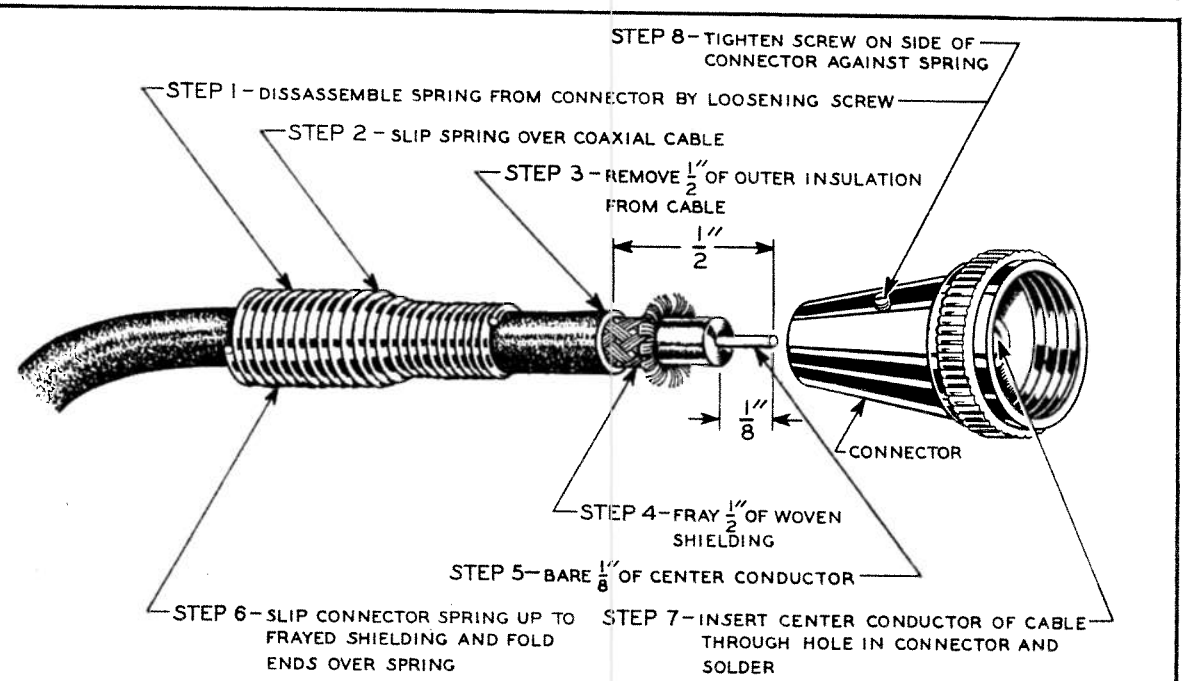


FIGURE 11B. HOW TO ASSEMBLE THE CABLE

( ) Place a knob over the shaft of the Modulation Switch so that the set-screw will tighten against the flat portion of the shaft. Tighten the set-screw. Turn the knob fully to the left (counterclockwise). The white line on the knob must point to the INT position.

( ) Turn the Modulation Gain control shaft fully to the left (counterclockwise). Place a knob on the shaft so that the white line on the knob points to the extreme left calibration mark. Tighten the set-screw.

( ) Place a knob over the shaft of the Bands Switch so that the set-screw will tighten against the flat portion of the shaft. Tighten the set-screw. Turn the knob fully to the left (counterclockwise). The white line on the knob must point to Band A.

( ) Turn the Fine RF Attenuator control shaft fully to the left (counterclockwise) so that the AC power switch is in the OFF position. Place a knob on the shaft so that the white line on the knob points to the AC OFF calibration mark. Tighten the set-screw.

( ) Place a knob over the shaft of the Coarse RF Attenuator so that the set-screw will tighten against the flat portion of the shaft. Tighten the set-screw. Turn the knob fully counterclockwise. The white line on the knob must point to the HI position.

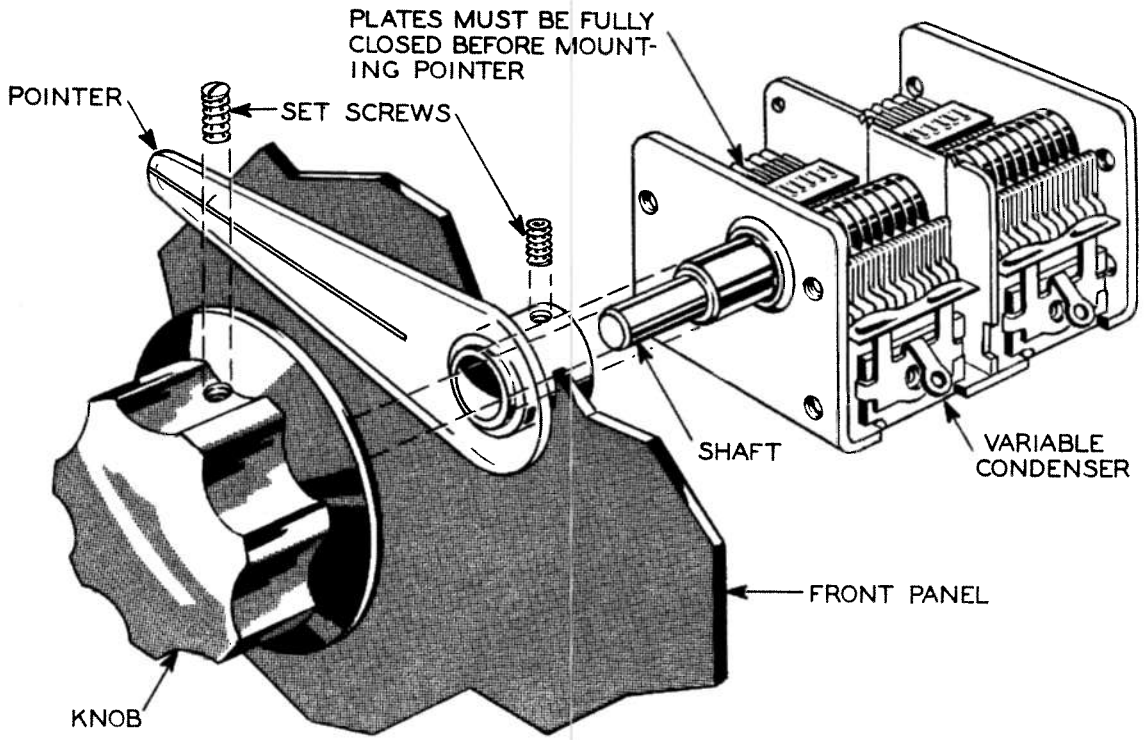


FIGURE 12. HOW TO ASSEMBLE POINTER AND KNOB TO THE TUNING SHAFT

FINAL ASSEMBLY

SEE FIGURE 13.

( ) Lay the handle in the handle well on the top of the case. Turn the case on edge.

( ) Place a flat washer, a coil spring, and another flat washer over each leg of the handle.

( ) Insert one of the cotter pins through the hole in one leg of the handle. Spread the two sections of the cotter pin so that it cannot fall out.

( ) Insert the other cotter pin through the hole in the other leg of the handle. Spread the two sections of this cotter pin also.

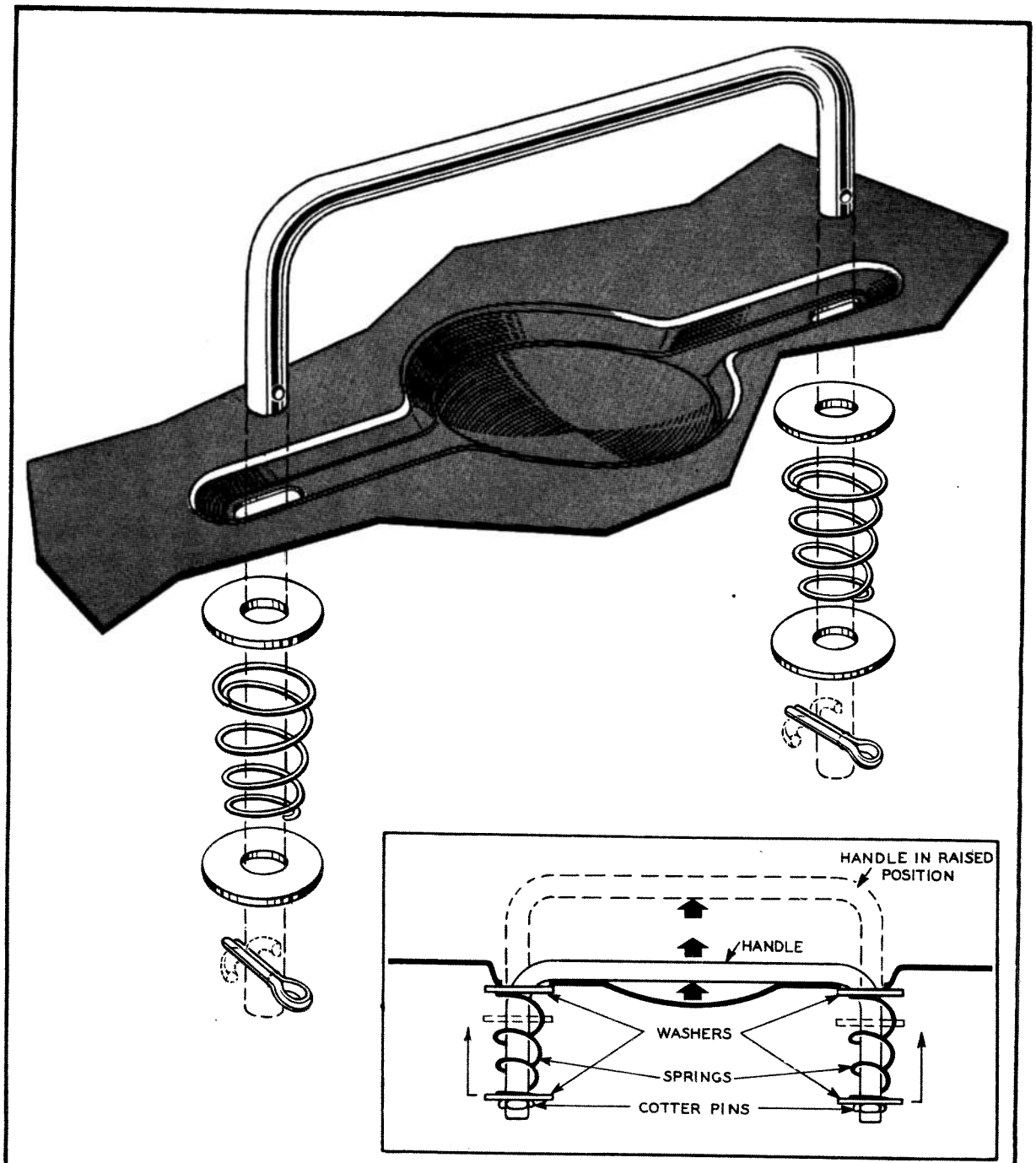


FIGURE 13. HOW TO ASSEMBLE THE HANDLE

( ) Push the line cord through the hole in the rear of the cabinet. Set the completed Signal Generator into the case. Match the 6 holes in the front panel and the 2 holes on the rear of the chassis with the small holes in the case. Fasten the completed Signal Generator in the case securely with the 8 self-tapping screw supplied. Use the 2 longer screws for fastening the rear of the chassis.

HOW TO USE YOUR KNIGHT RF SIGNAL GENERATOR

CIRCUIT DESCRIPTION

A block diagram of your Knight RF Signal Generator is shown in Figure 14.

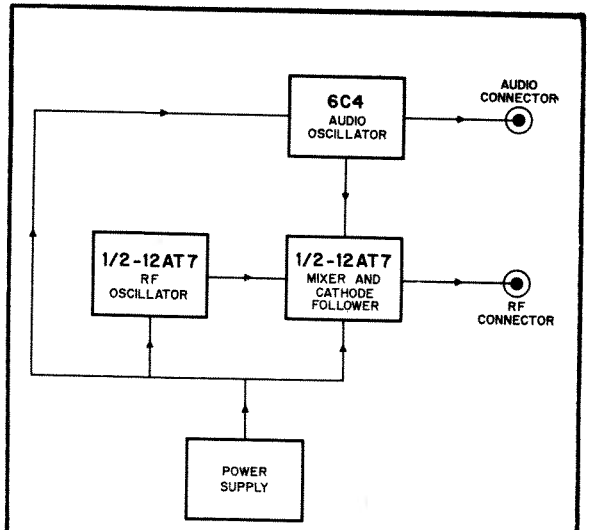


FIGURE 14. BLOCK DIAGRAM OF THE KNIGHT RF SIGNAL GENERATOR

Incorporated in the design are the following features: RF coils are precision wound and adjusted to calibration before shipment; Colpitts type oscillator circuits; Coaxial type output connectors; Buffer Cathode Follower type output circuit.

The audio oscillator makes use of a 6C4 tube in a Colpitts type oscillator circuit to generate approximately a 400 cycle audio note. The resonant circuit of the audio oscillator consists of L-1, the AF choke and two capacitors C-13 (.1 MFD) and C-14 (.02 MFD). When the Modulation Switch is in the INT position the audio signal is fed to the mixer section of the 12AT7 tube to modulate the RF signal. The signal is also fed through the Modulation Gain control to the AF connector. When the Modulation Switch is in the EXT position the grid of the 6C4 tube is connected through C-4 a .01 MFD capacitor to the AF connector. The 6C4 tube functions as an audio amplifier for the external modulation signal. The RF oscillator makes use of 1/2 of a 12AT7 tube, in a highly stable Colpitts type circuit. The Bands Switch selects the desired band by selecting any one of five coils to be used with C-1, the variable condenser to form a resonant circuit. The Bands Switch is of the self shorting type, which means that all coils in the ranges below the one being used are shorted out. This type of switching eliminates undesired signals from being generated by the lower band coils.

The signal from the RF oscillator is fed to the grid of the second section of the 12AT7 tube, which functions as a mixer and buffer cathode follower output. The mixer action of the tube combines the audio signal from the AF oscillator with the RF signal, when the modulation switch is in INT position, to produce the modulated RF signal. This same section of the 12AT7 tube also functions as a buffer cathode follower output circuit, which decouples the oscillator from the output, thereby preventing any frequency changes with load variations. The cathode follower method of coupling maintains a constant low impedance output. Before the RF signal gets to the RF connector it goes through an attenuation network, which consists of a "vernier" continuous control (Fine) and a steps attenuator (Coarse). By adjusting the two attenuator controls the RF output to the RF connector can be varied from zero to maximum (maximum is in excess of 400,000 microvolts.)

The power supply consists of a selenium rectifier (CR-1) and a power transformer (T-1) in a half-wave rectifier circuit. Filtering is accomplished by an RC network, which consists of capacitor (C-3) and resistor (R-1). The AC line cord is bypassed to prevent any signal from feeding back into the power lines.

OPERATING CONTROLS

NOTE: This RF signal generator is designed to work from 105 to 125 volts 50 to 60 cycles alternating current only. Do not use any other source of power to operate this generator.

AC-FINE RF ATTENUATOR: This control turns the AC ON or OFF and is a "Vernier" RF OUTPUT CONTROL; which means that it controls small increases or decreases of the RF signal to the RF output connector. A clockwise rotation of this control increases the output or amplitude of the RF signal. The Fine Attenuator is used in conjunction with the Coarse Attenuator.

COARSE RF ATTENUATOR: This control produces a larger change in the output of the RF signal. It is marked HI-MED-LO corresponding to high, medium, and low attenuation. When used with the Fine Attenuation control the RF signal output can be adjusted to the desired level.

BANDS: This switch selects the RF frequency range of the generator. The frequency range of the generator is divided into five bands as follows:

Band A	160 KC to 550 KC
Band B	550 KC to 1850 KC
Band C	1850 KC to 7 MC
Band D	7 MC to 27 MC
Band E	27 MC to 112 MC
Harmonics	to 224 MC

To use the second harmonics to 224 MC set Band Switch to Band E and multiply the frequency reading indicated on the scale by 2.

TUNING KNOB: The exact frequency is chosen by turning the TUNING KNOB until the pointer hairline is pointing to the desired frequency.

MODULATION: This control is marked INT-EXT; which means that the MODULATION control selects either internal modulation from the built-in audio source or external modulation from some other source. If audio modulation is not desired this control is set to the EXT position. To use an audio signal from another source set the MODULATION control to EXT and connect the external signal to the AF connector. Set the Modulation control to INT position when 400 cycle audio is desired at the AF connector.

MODULATION GAIN: This control varies the amplitude or strength of the audio signal available at the AF connector.

RF CONNECTOR: The threaded end of the coaxial cable supplied with this generator is connected to the RF CONNECTOR. The other end of the cable is connected to the equipment to be tested or aligned. The clip with the RED insulator is the "HOT" signal lead, and the clip with the BLACK insulator is the ground or B minus lead.

AUDIO CONNECTOR: The coaxial cable can be attached to the AUDIO CONNECTOR to obtain a 400 cycle audio signal for testing audio circuits. Again the clip with the RED insulator is the "HOT" or signal lead, and the clip with the BLACK insulator is the ground or B minus lead. The amplitude or volume of the audio signal is controlled by the MODULATION GAIN control.

GENERATOR APPLICATIONS

ALIGNMENT OF STANDARD BROADCAST RECEIVERS

Whenever possible the manufacturers alignment procedure should be used. If the manufacturer's literature is not available the following procedure will suffice in most instances.

In recent years 455 KC has been the most popular IF frequency used in broadcast receivers although 262 KC and 175 KC have been used. Because 455 KC is the most popular IF frequency it has been chosen for use in our sample alignment procedure.

IF ALIGNMENT: Connect the HOT lead of Your KNIGHT Signal Generator to the signal input grid socket terminal of the receiver's mixer tube. Connect the signal generator ground lead to the receiver's chassis or B minus lead. If the receiver is of the AC/DC type connect the ground lead through a .05 MFD 400 volt capacitor.

If an output meter is available connect it across the secondary winding of the receiver's output transformer. If an output meter is not available maximum reading can be determined by ear. Set the receiver volume control to maximum and the tuning gang to the extreme high frequency end of the dial. The signal generator is set to 455 KC modulated RF. Adjust the Signal Generator output for a minimum readable indication on the low range scale of the meter or until the signal is just audible if alignment is done by ear. Adjust the second IF transformer secondary and primary (top and bottom) for maximum reading. Then adjust the first IF transformer in the same manner. If the signal becomes too loud reduce the Signal Generator's output.

OSCILLATOR ALIGNMENT: The generator is connected to the same point as above. Set the signal generator frequency to 1620 KC and tune the receiver to 1620 KC on the dial scale. Adjust the oscillator trimmer condenser for maximum reading.

RF ALIGNMENT: Construct a 5 inch diameter loop of several turns of wire and connect the generator to this loop. Bring the loop to within about 6 to 10 inches of the receiver's

loop. Set the signal generator frequency to 1400 KC, tune the receiver until the signal is heard and then adjust the RF trimmer for maximum reading.

APPLICATION TO FM AND TELEVISION RECEIVERS

By referring to the set manufacturer's alignment instructions most FM receivers can be aligned with your KNIGHT Signal Generator. Also your KNIGHT Signal Generator is an ideal marker generator for use with any good sweep generator for alignment of television receivers.

SIGNAL GENERATOR USED FOR TROUBLESHOOTING

If you are servicing a receiver that is dead your KNIGHT Signal Generator will come in handy to help you localize the stage in which the trouble occurs.

To troubleshoot a receiver with your signal generator first connect the coaxial output cable to the AF CONNECTOR and set the MODULATION control to the INT position. Turn up the Modulation Gain control to about the midway position. Connect the signal generator's ground lead to the receiver's chassis or "B" minus lead. If the receiver is of the AC/DC type connect the ground lead through a .05 400 V capacitor. Connect the signal generator's "HOT" signal lead to the grid socket terminal of the receiver's audio output tube. A loud 400 cycle note should be heard from the speaker. If the 400 cycle note is not heard this stage is at fault and the tube and its associated circuits should be checked. If the 400 cycle note is heard we can proceed to check in a similar manner all of the stages back toward the antenna by connecting the Signal Generator to the grid of each stage.

Once we pass the second detector stage the coaxial output cable must be connected to the RF CONNECTOR and the Signal Generator frequency set to the IF frequency of the receiver being checked. If RF stages or the mixer are being checked the Signal Generator and the receiver must be tuned to the same frequency.

To check the receiver oscillator, clip the Signal Generator "HOT" lead to the mixer's oscillator grid and set the Signal Generator's frequency to 455 KC higher than the frequency the receiver is tuned to. If the receiver is tuned to 1000 KC and the RF generator is tuned to 1455 KC, a station located at 1000 KC should be received. For this check the MODULATION control should be set to EXT so that the RF signal is unmodulated.

SERVICE HINTS

If you have followed all the previous instructions carefully your KNIGHT RF Signal Generator should operate properly.

If it does not, recheck all wiring carefully, because most causes of difficulty result from incorrect wiring. It is often helpful to have the wiring checked by someone else, preferably someone with radio experience.

If the tubes do not light up check the wiring to the tube filaments, this includes wiring to pins 4, 5, and 9, of the 12AT7 tube (V-2) and pins 3 and 4 of the 6C4 tube (V-1). If the wiring is correct and a tube does not light up the filament is burned out and this tube should be replaced.

Make sure the output cable is not shorted at the connector.

If a VTVM or a VOM is available make voltage and resistance measurements. Refer to the Voltage and Resistance charts.

NOTES: MEASUREMENT MADE WITH A VTVM FROM POINT INDICATED TO CHASSIS.
BAND A - GANG FULLY CLOSED-
RF OUTPUT CONTROL FULLY CLOCKWISE-
AF GAIN CONTROL FULLY CLOCKWISE-MODULATION SWITCH IN "INT" POSITION

VOLTAGE CHART

	PIN								
TUBE	1	2	3	4	5	6	7	8	9
6C4 AF-OSC	110V		6.3VAC	0	110V	-16V	1.1		
12AT7 RF OSC MIXER	132V	-7V	1.6V	6.3VAC	6.3VAC	132V	-11.2	0	0

RESISTANCE CHART

	PIN								
TUBE	1	2	3	4	5	6	7	8	9
6C4 AF OSC	5.6K*		.4 ohm	0	5.6K*	470K	330 ohm		
12AT7 RF OSC MIXER	0*	570K	1K	.4 ohm	.4 ohm	28 ohm*	22K	0	0

* MEASURED FROM POINT INDICATED TO POSITIVE LEAD OF C-3B

KNIGHT-KIT SERVICE FACILITIES

TECHNICAL CONSULTING SERVICE

If, after following the instructions and suggestions given in this manual you are still unable to obtain proper performance from your kit, we invite you to contact our Technical Consulting Service for further assistance. Please be as accurate and thorough as possible because the effectiveness of our advice depends entirely on the information you supply.

Use the following as a guide for your correspondence:

1. Have you checked all the suggestions under Service Hints? Careful consideration of these points may solve your problem without writing.
2. Be sure to give the kit model number, the date of purchase and the serial numbers on the label pasted on the chassis and the back cover of the manual.
3. Have you made a thorough check of all wiring and soldering? Each solder connection should have a shiny metallic finish. Reheat any connection that appears doubtful and add a little solder if needed. Be sure there are no parts accidentally touching each other, the chassis or nearby terminals.
4. If the kit is of the type that requires calibration or alignment, double check these procedures. Be as specific as possible in your report. Outline adjustments made and the alignment procedure employed.
5. When you write be sure to describe all associated equipment. Specifically note the switch positions. Define as clearly as possible the symptoms as noted and mention any particular circumstance under which the problem occurs (after unit has been on for some time, only when jarred or moved, only when used for a particular purpose, etc.).
6. If you have completed the recommended service hints, be sure to outline the results and note any measurements taken which are out of tolerance.

KNIGHT-KIT PARTS WARRANTY

Knight Electronics guarantees that only premium-quality parts are selected for use in Knight-Kits. Every Knight-Kit part is fully warranted for a period of one year from date of purchase against defects in material and workmanship. Prompt No-Charge replacements of defective parts will be made.

INSPECTION SERVICE

You may return your completed Knight-Kit for inspection and repair within **one year from purchase** for a service charge of $5.00. for this particular kit. An additional charge will be made for parts damaged in construction.

Kits not completely wired or which require extensive re-work will incur an additional labor charge. You will be notified of these charges prior to our repairing your kit.

No service charge will be made for a **period of 90 days from date of purchase,** if malfunctioning of the completed kit is due to a defective part. Service charges for kits returned **after the one year period** will be on a time and materials basis.

Should you find it necessary to return your Knight-Kit, be sure to pack it carefully. The original carton should be used, if available. If not, a sound carton of similar size may be used. Remove the knobs before packing. **TO PREVENT COSTLY DAMAGE IN TRANSIT,** cushion your Knight-Kit tightly using plenty of packing material. Mark: FRAGILE — DELICATE ELECTRONIC EQUIPMENT.

SHIPPING INSTRUCTIONS

Ship your unit by Parcel Post **Insured.** Please include remittance to cover repair costs plus return postage and insurance. Postage and insurance may be estimated by referring to the "how to order page" in our catalog. This will save you costly COD fees; any excess remittance will be refunded.

When you return a kit please enclose your order papers and a letter explaining why you are returning the unit. On the front of the package print "**FIRST CLASS LETTER ENCLOSED**" and apply postage on the package for the enclosed letter.

ADDRESS CORRESPONDENCE AND RETURN KITS TO:

KNIGHT ELECTRONICS CORP.
Knight-Kit Service Department
2100 Maywood Drive • Maywood, Illinois

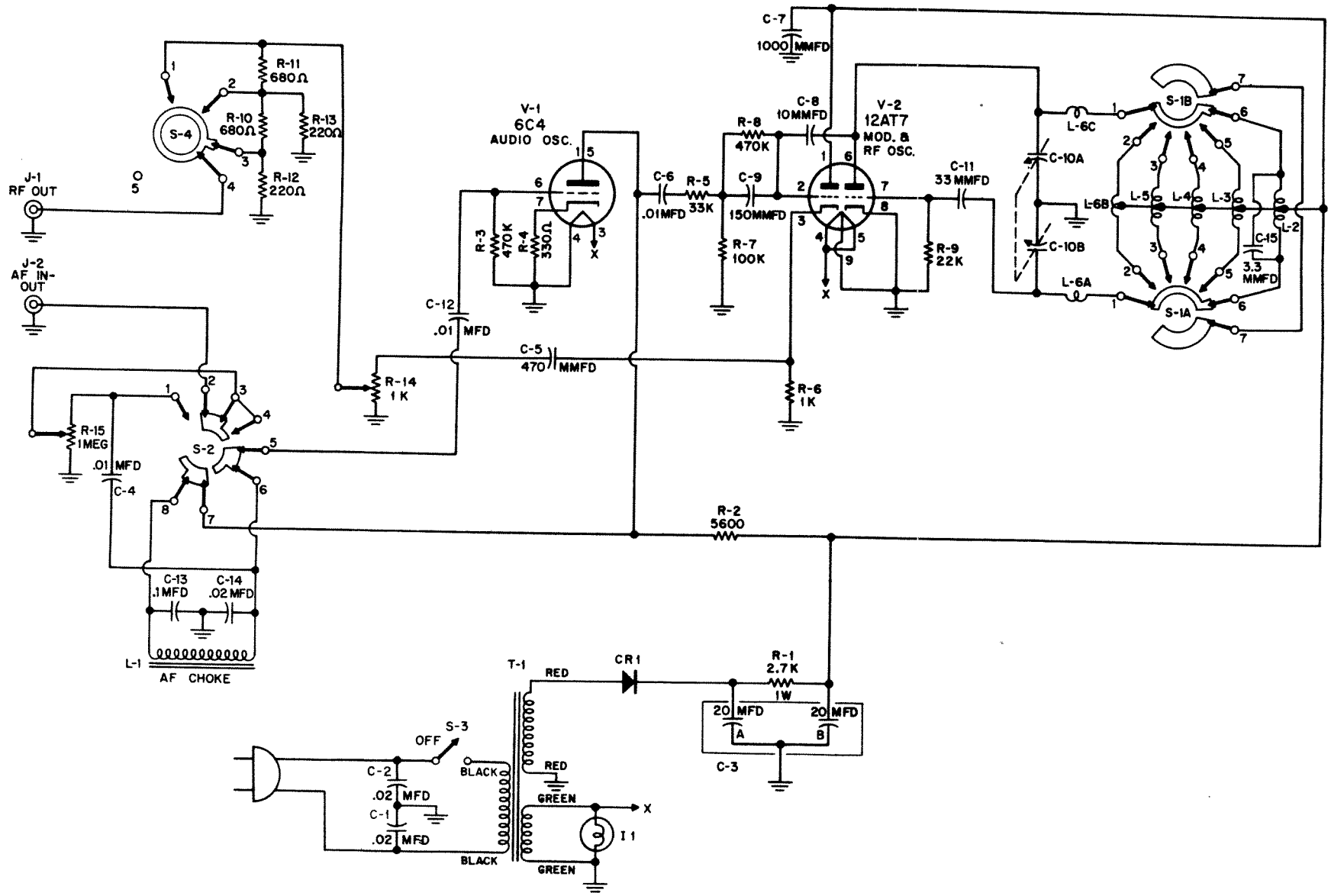


FIGURE 15. SCHEMATIC DIAGRAM OF THE KNIGHT RF SIGNAL GENERATOR

PARTS LIST

LEGEND NO.	DESCRIPTION	PART NO.
C-1	.02 MFD cer. disc capacitor	296009
C-2	.02 MFD cer. disc capacitor	296009
C-3	20-20 MFD/150 v electrolytic filter capacitor	213201
C-4	.01 MFD cer. disc capacitor	276015
C-5	470 MMFD cer. disc capacitor	276478
C-6	.01 MFD cer. disc capacitor	276015
C-7	.001 MFD cer. disc capacitor	276016
C-8	10 MMFD cer. disc capacitor	276018
C-9	150 MMFD cer. disc capacitor	276158
C-10	2-gang variable tuning capacitor	282002
C-11	33 MMFD mica capacitor	266339
C-12	.01 MFD cer. disc capacitor	276015
C-13	.1 MFD 400 V capacitor	245014
C-14	.02 MFD cer. disc capacitor	296009
C-15	3.3 MMFD cer. tubular capacitor	276039
CR-1	Rectifier, selenium 50 MA	620007
L-1	Audio choke 5.5 henrys	140003
L-2	Coil, osc. band "A"	151002
L-3	Coil, band "B"	151003
L-4	Coil, band "C"	152009
L-5	Coil, band "D"	152010
L-6A	Coil, band "E"	152011
L-6B	Coil, band "E"	152020
L-6C	Coil, band "E"	152013
M-1	#44 pilot light clear	640003

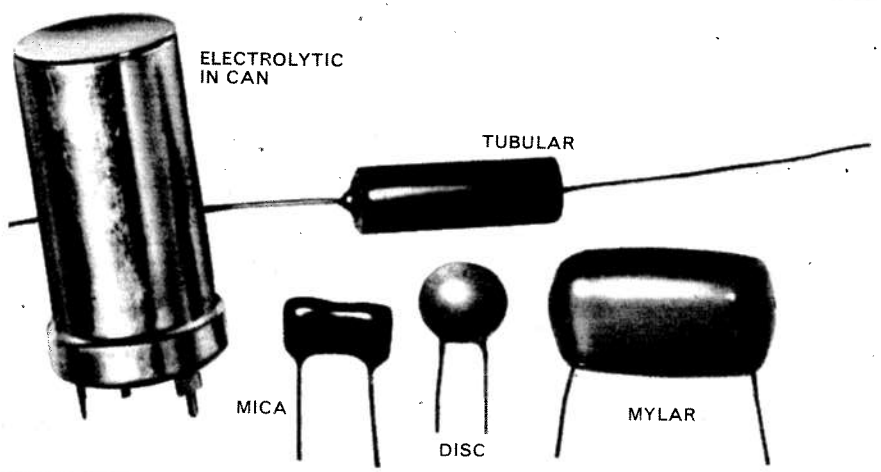
LEGEND NO.	DESCRIPTION	PART NO.
R-1	2,700 ohm, 1 watt resistor	304272
R-2	5,600 ohm, 1/2 watt resistor	301562
R-3	470,000 ohm, 1/2 watt resistor	301474
R-4	330 ohm, 1/2 watt resistor	301331
R-5	33,000 ohm, 1/2 watt resistor	301333
R-6	1,000 ohm, 1/2 watt resistor	301102
R-7	100,000 ohm, 1/2 watt resistor	301104
R-8	470,000 ohm, 1/2 watt resistor	301474
R-9	22,000 ohm, 1/2 watt resistor	301223
R-10	680 ohm, 1/2 watt resistor	301681
R-11	680 ohm, 1/2 watt resistor	301681
R-12	220 ohm, 1/2 watt resistor	301221
R-13	220 ohm, 1/2 watt resistor	301221
R-14	1,000 ohm, pot. fine attenuator control incl. ON-OFF switch S-3	390114
R-15	1 megohm, pot., AF output control	390007
S-1	2-section 5-position rotary switch	432206
S-2	Modulation switch 2-position 3-pole	432105
S-3	ON-OFF Switch part of R-14 the RF output control	
S-4	Coarse attenuator switch, 3-position, 1-pole	432106

LEGEND NO.	DESCRIPTION	PART NO.
T-1	Power transformer	101301
TS-1	3-lug terminal strip	440301
TS-2	3-lug terminal strip	440301
TS-3	5-lug terminal strip	440501
TS-4	4-lug terminal strip	440401
V-1	6C4 tube	610020
V-2	12AT7 tube	611013

DESCRIPTION	QUAN.	PART NO.
Bracket, variable condenser mtg.	2	470037
Cabinet, metal	1	702082
Cable, shielded, 48"	1	803001
Clip, alligator	2	532005
Connector, chassis type	2	040178
Cord, AC power	1	802001
Chassis	1	461402
Cotterpin, handle	2	552000
Handle, carrying	1	470169
Insulator, clip black	1	880004
Insulator, clip red	1	880003
Knob, large	1	765052
Knob, small	5	765074
Panel, front	1	463550
Lug, ground	1	553002
Plug, cable	1	502224
Pilot light assem.	1	501720
Pointer & set screw assem.	1	870018
Socket, tube 7 prong	1	501070
Socket, tube 9 prong	1	501090
Spring, handle mtg.	2	470040
Washer, handle mtg.	4	580901
Grommet, rubber 3/8"	7	830004
Nut, Hex: 3/8"	10	570840
Nut, hex: 6-32	22	570340

DESCRIPTION	QUAN.	PART NO.
Screw 6/32 x 1/4"	14	560342
Screw, sheet metal #6 x 5/16"	6	562393
Screw, machine, 6-32 x 1/8"	4	560340
Screw, sheet metal: #6 x 1/2"	2	562396
Washer, shakeproof 3/8"	7	582700
#20 solid, hookup wire, ends stripped:		
2" red	4	801002
3" orange	4	801003
4" yellow	7	801004
5" green	2	801005
6" blue	1	801006
7" violet	1	801007
8" gray	1	801008
9" white	3	801009
16" bare	1	806016
5" stranded rubber covered: black	1	804026
6" spaghetti	1	812005
48" rosin core solder	1	930004
1" rubber tubing	1	840003

CAPACITORS and RESISTORS



CAPACITOR IDENTIFICATION

The capacitors in your kit (named for their *capacity* for storing electrical energy) may be of several different types. You must choose the correct capacitor for each step, or the kit will not work as designed.

TYPE OR SHAPE. Select by type or shape such as disc, tubular, mylar, mica or electrolytic in a can.

CAPACITY VALUE. Select by capacity value, given in microfarads (μf or mf) or micro-microfarads ($\mu\mu$f, mmf or pf). Most small values are stated in micro-microfarads such as 10 $\mu\mu$f and 270 $\mu\mu$f. Larger values are given in microfarads as .02 μf and .015 μf.

On some disc capacitors, values may be stated either in μf or $\mu\mu$f. To change from μf to $\mu\mu$f, simply move the decimal point to the right 6 places. Here are a few examples of alternate markings:

.0022 μf equals 2200 $\mu\mu$f
.01 μf equals 10,000 $\mu\mu$f
.0033 μf equals 3300 $\mu\mu$f

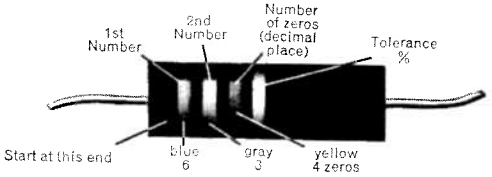
VOLTAGE RATINGS. The capacitor may be marked with the maximum operating voltage, such as 600 v, 500 v, 350 wvdc. Where these are important they will be stated.

TOLERANCE ratings are given in percentages (%). Where these are important they will be stated. Manufacturer's type number such as: SK, BIT, SPRAGUE, CRL, Z5F etc. are not used for identification purposes.

RESISTORS

Resistors are used to *resist* the flow of electricity. For your convenience, the resistors in your kit are supplied carded and labeled by R numbers for ready identification. Variable resistors (controls) and resistors too large to fit on the resistor card are clearly marked with the resistance value, either in ohms (Ω), thousand ohms (K) or million ohms (meg). The electronics color code used for the color bands on the resistors is easy to learn. Numbers 0 through 9 are shown by these colors:

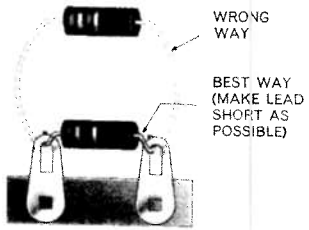
0 . . . black	5 . . . green
1 . . . brown	6 . . . blue
2 . . . red	7 . . . violet
3 . . . orange	8 . . . gray
4 . . . yellow	9 . . . white



To read the value of a resistor, start at the end closest to the color bands. Write down the number for the *first band*, 6 (blue) in the example shown on this page, To the right of 6, write the number for the *second band*, 8 (gray) in our example. *The third band* gives the number of zeros. Since the third band in our example is yellow, write 4 zeros (0000) next to the 68, making the number 680,000 ohms. This is usually given in a short form, 680K, with K standing for a thousand ohms.

The fourth color band shows the tolerance rating, or how closely the resistance value is controlled in manufacture. Silver indicates a tolerance of ±10%, gold, ±5%.

SPECIAL CASE. For resistors under 10 ohms, the third color band will be silver or gold. If the third band is gold, the resistor is between 1 and 10 ohms so the decimal point goes between the first and second digit. For example, blue, gray, gold is 6.8 ohms. But if the third band is silver, the value is less than 1 ohm, with the decimal point before the first digit. For example, blue, gray, silver is .68 ohms.



MOUNTING RESISTORS AND CAPACITORS

Keep resistor and capacitor leads SHORT. Mount the part as shown in the wiring illustrations . . . then pull the leads all the way through. Cut off excess lead length. Proper soldering techniques are shown on the other side.

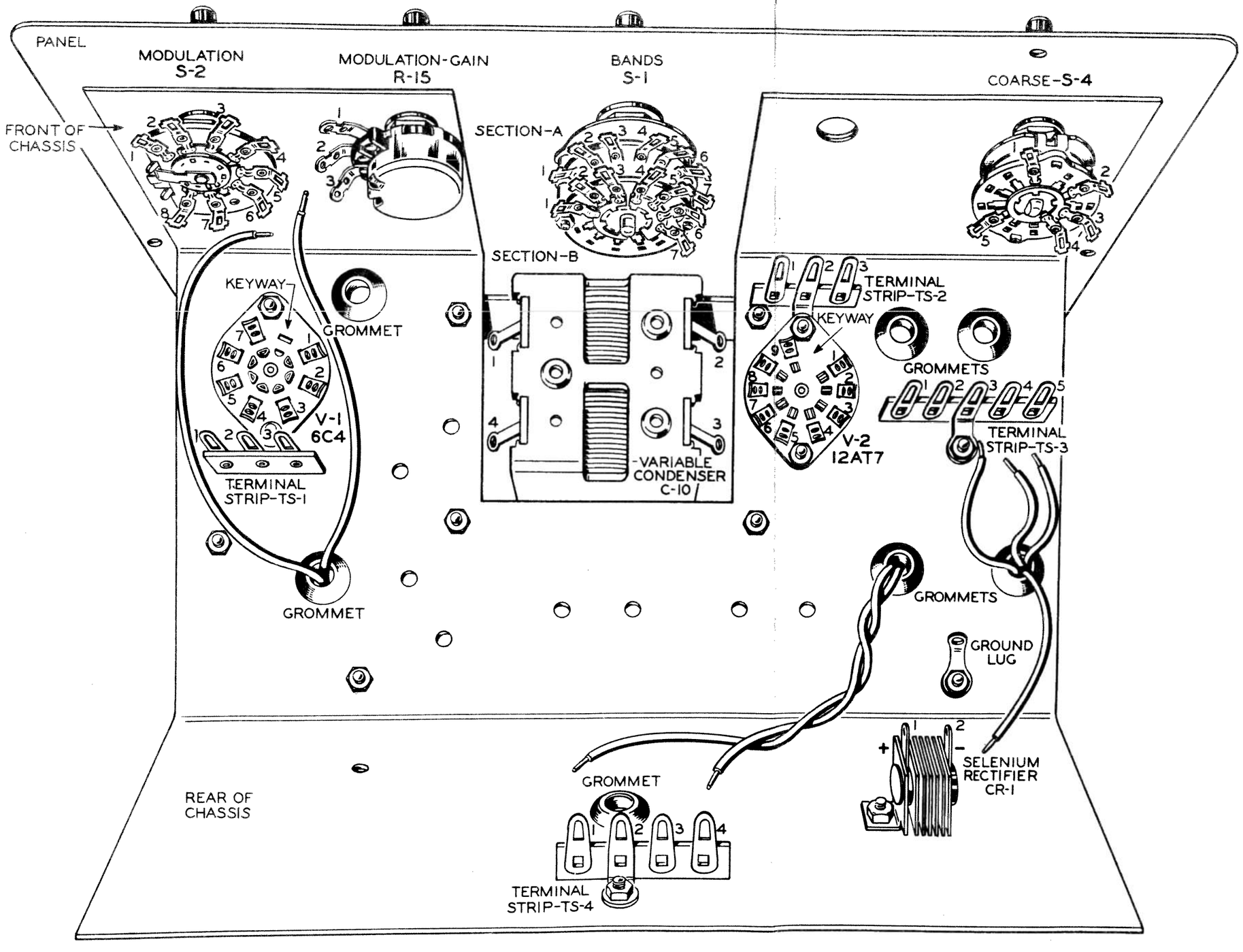


FIGURE 1. HOW TO MOUNT THE PARTS INSIDE THE CHASSIS.

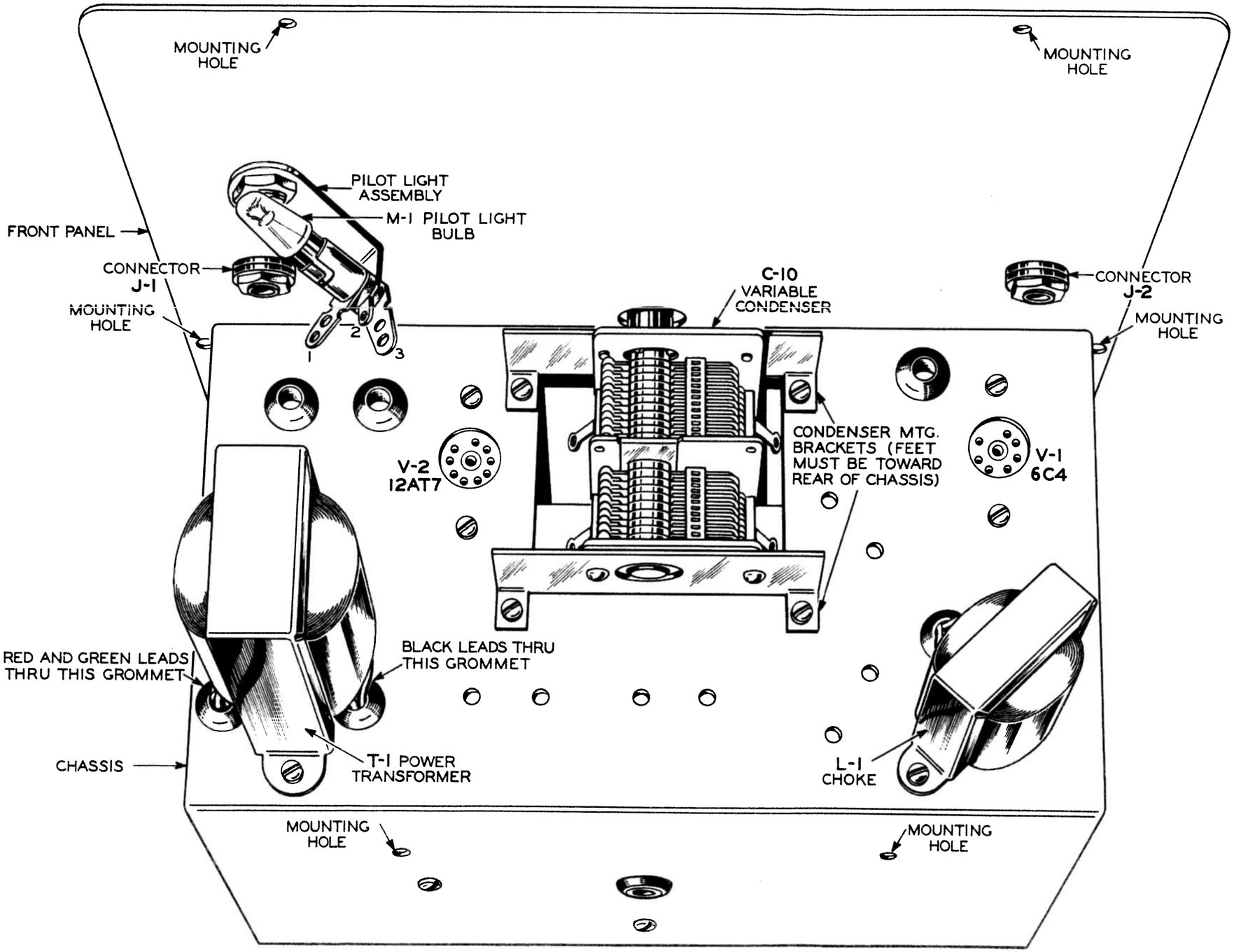


FIGURE 2. HOW TO MOUNT THE PARTS ON TOP OF THE CHASSIS.

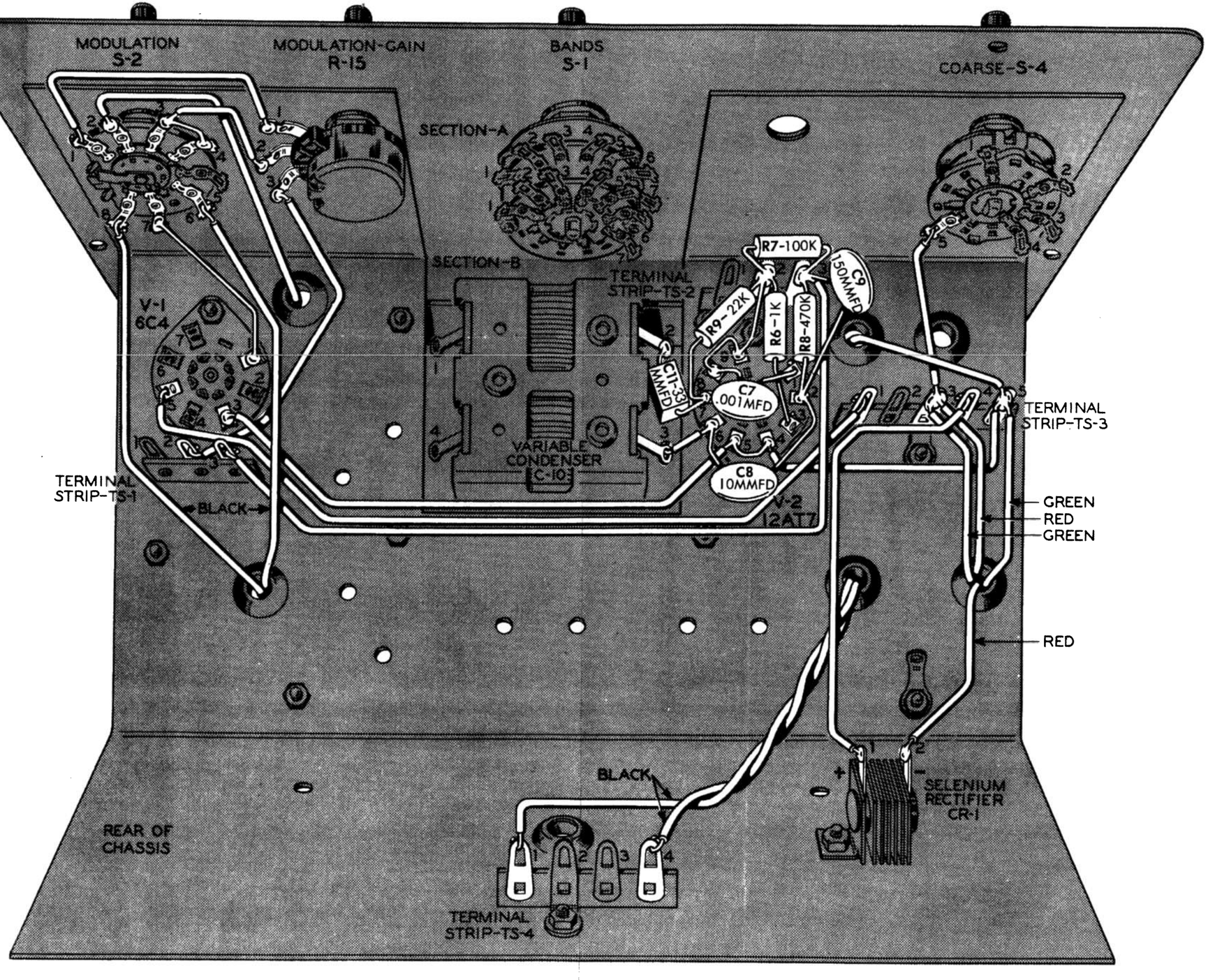


FIGURE 6. FIRST WIRING VIEW INSIDE THE CHASSIS.

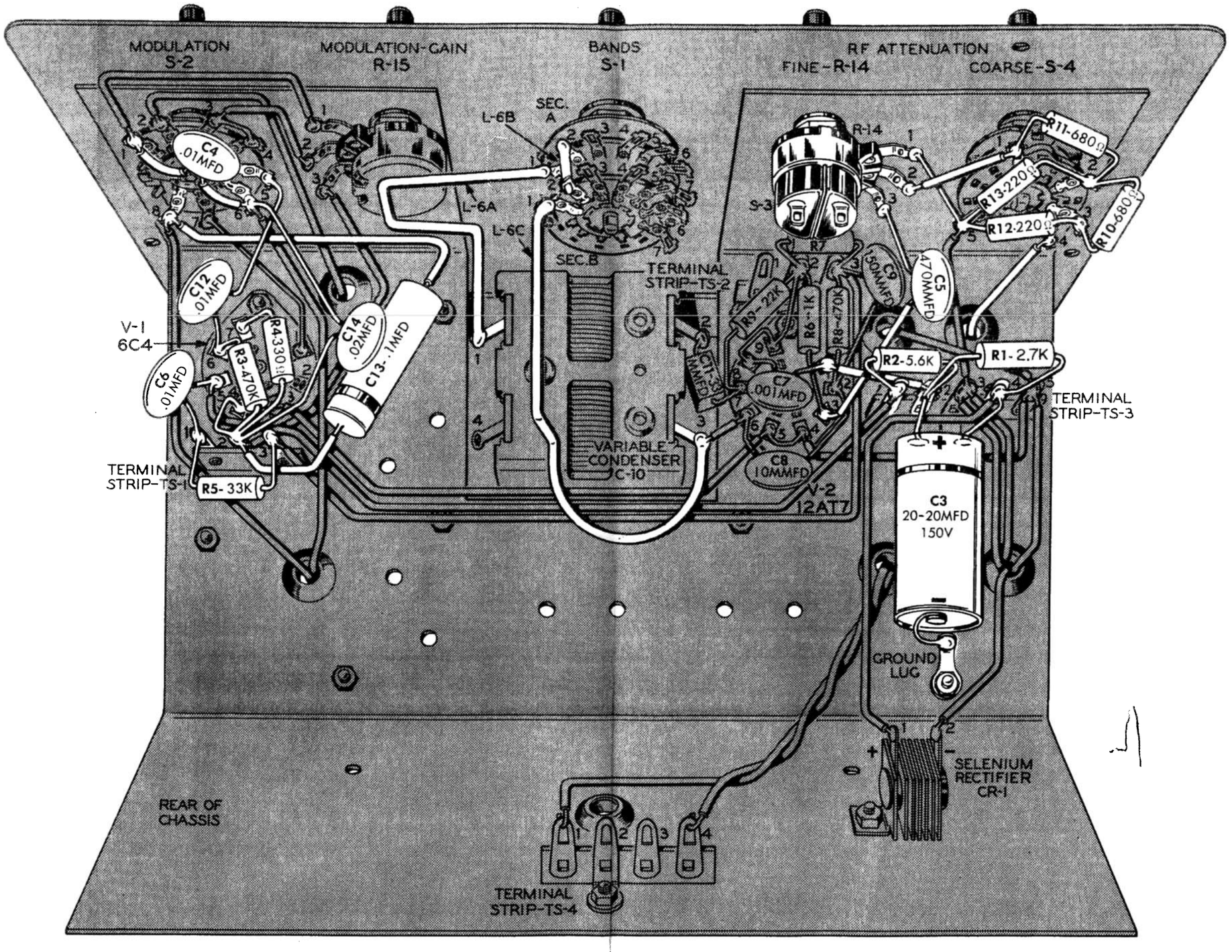


FIGURE 7. SECOND WIRING VIEW INSIDE THE CHASSIS.

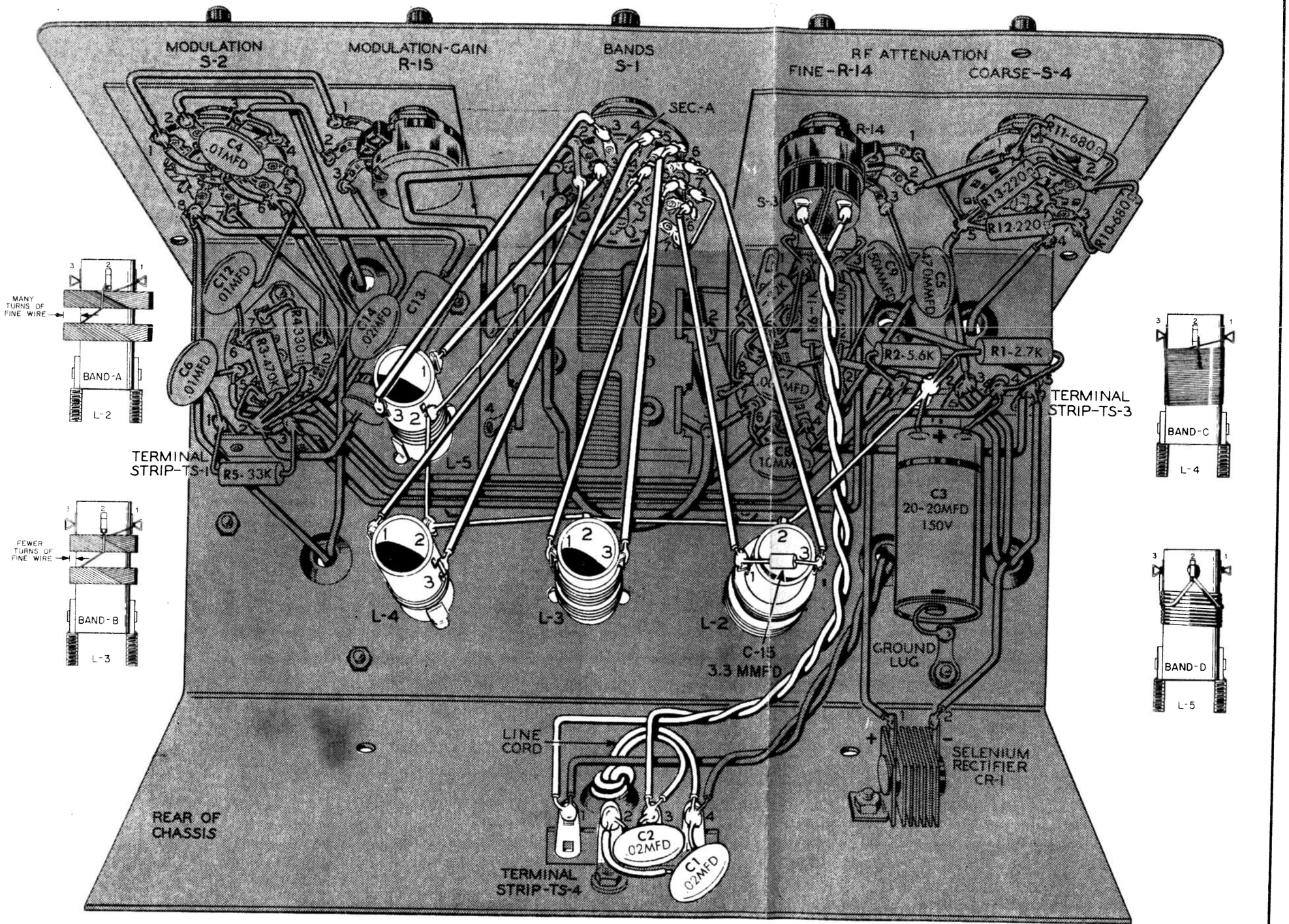


FIGURE 8. THIRD WIRING VIEW INSIDE THE CHASSIS.

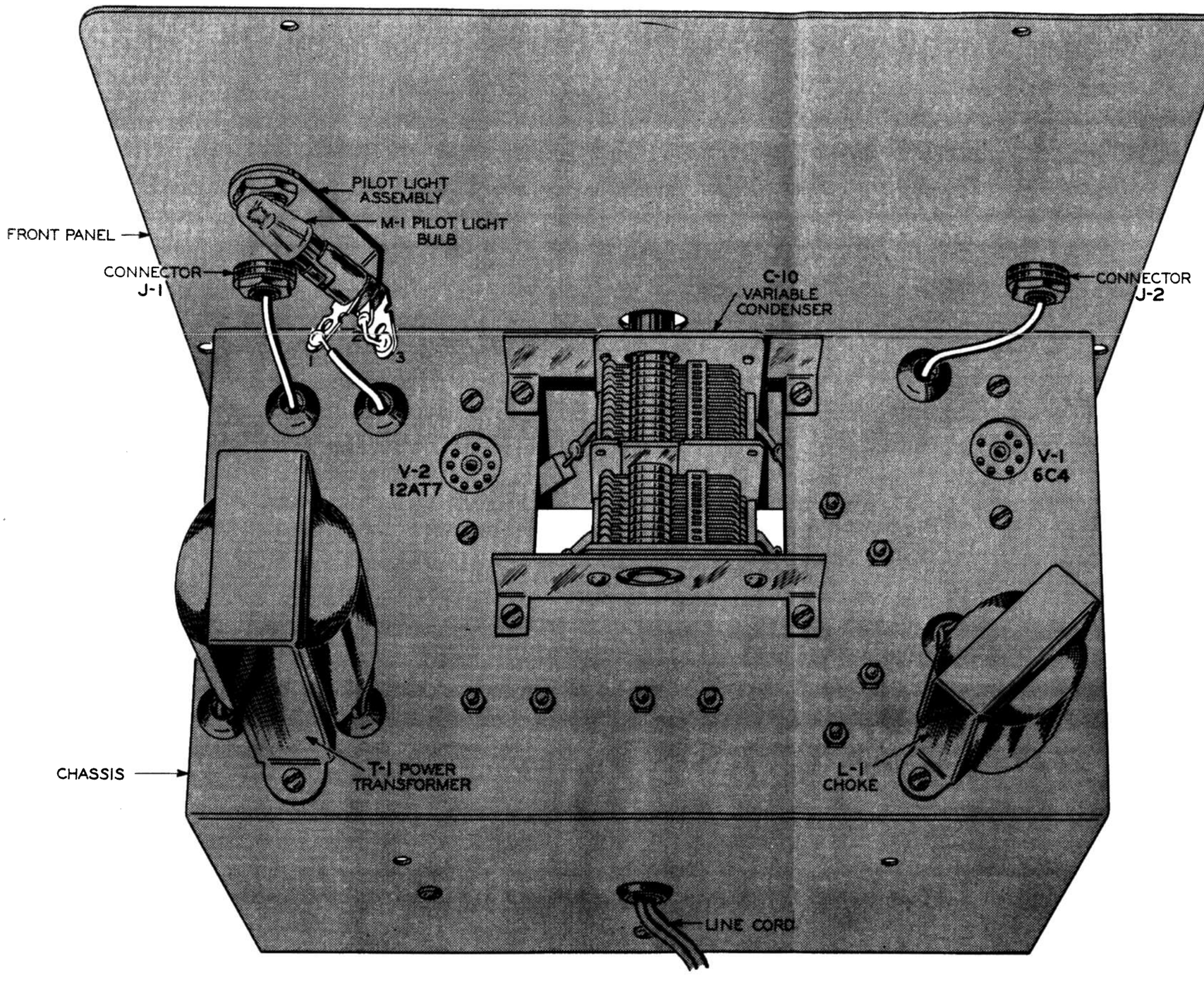


FIGURE 9. WIRING VIEW OF CHASSIS TOP SIDE.

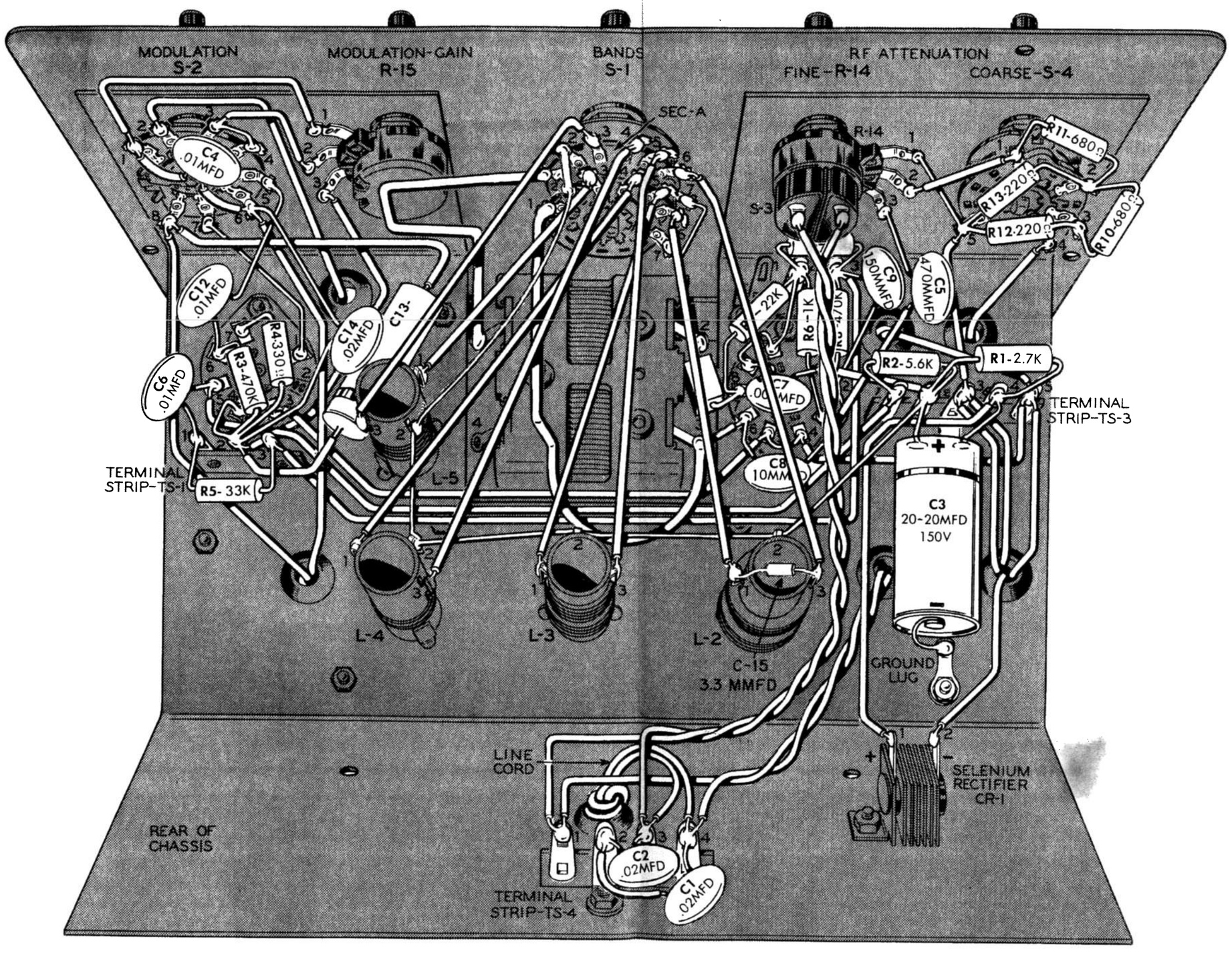


FIGURE 10. COMPLETED WIRING VIEW INSIDE THE CHASSIS.

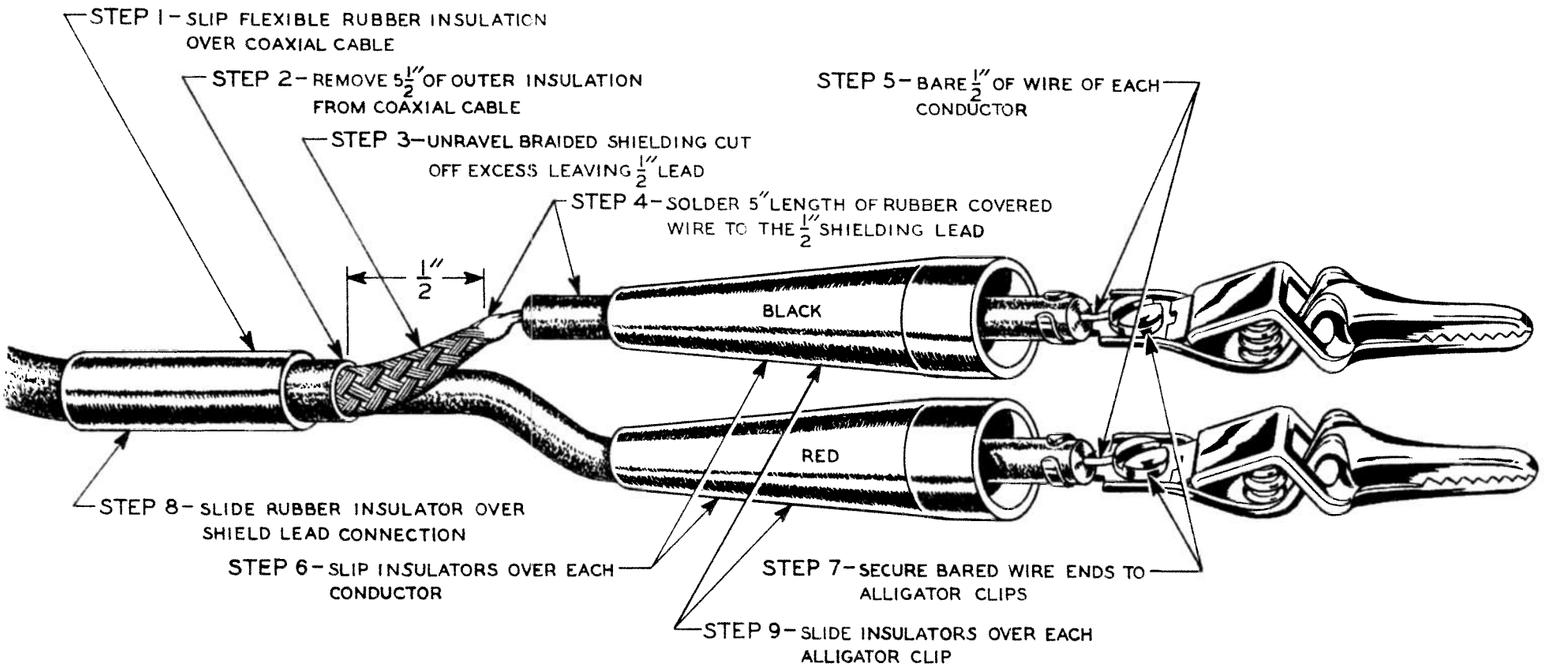


FIGURE 11A, B HOW TO ASSEMBLE THE CABLE.