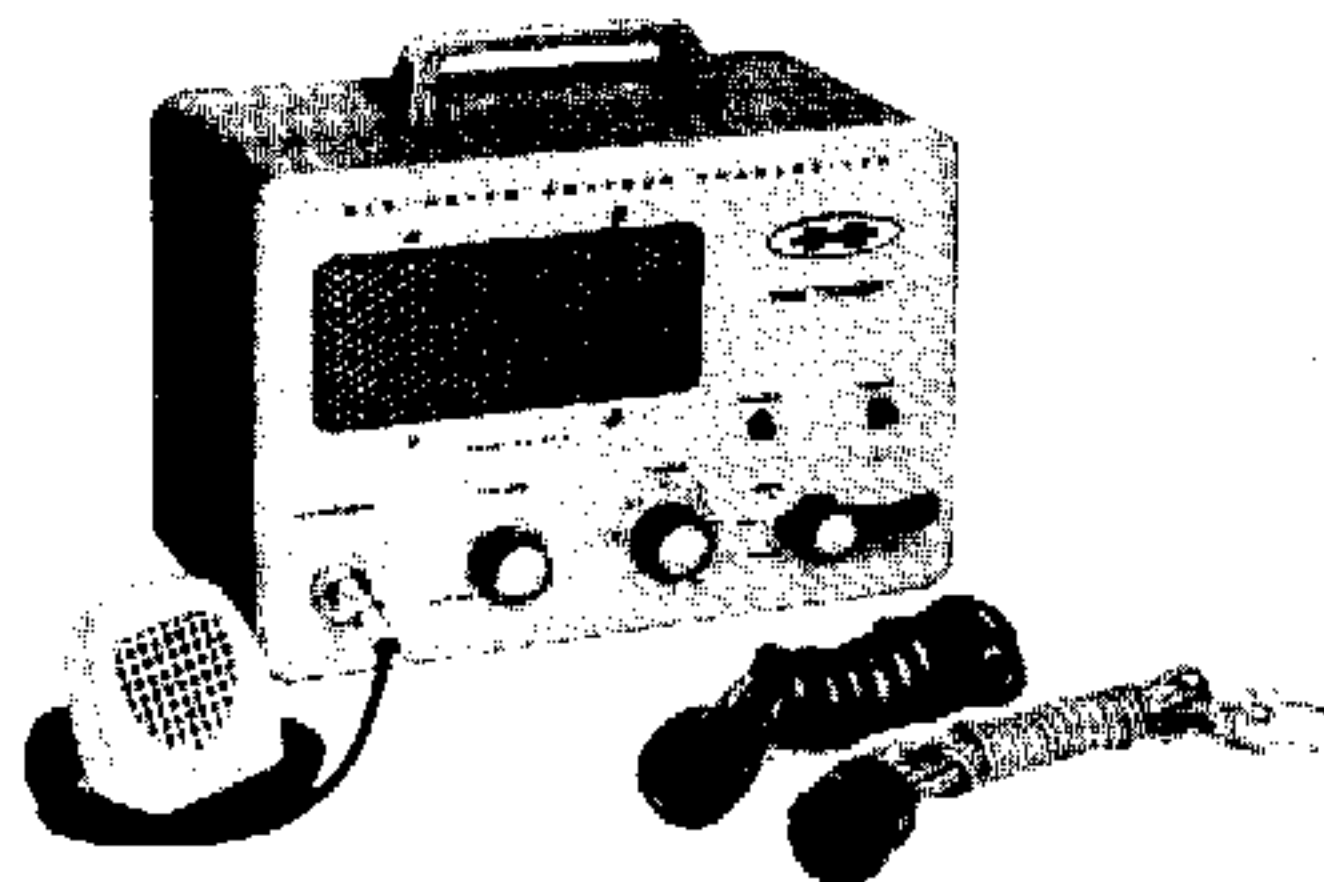


Assembly and Operation of the



6-METER AMATEUR TRANSCEIVER MODEL HW-29A



HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

D a subsidiary of
DAYSTROM, INCORPORATED

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All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

SPECIFICATIONS

TRANSMITTER SECTION

Power Input To Final RF Amplifier:	Approximately 5 watts.
Frequency Control:	8.333 mc to 9.000 mc quartz crystal. Pin spacing .500". Pin diameter .093". FT-241 or FT-243 crystal holder.
Modulation:	AM plate modulation, automatically limited to not more than 100%.
Output Impedance:	50 or 72 Ω .

RECEIVER SECTION

Receiver Type:	Superregenerative detector preceded by RF pre-amplifier stage.
Sensitivity:	Usable with signals as low as 1 microvolt at the antenna terminals.
Speaker Size:	3-1/2" round.
Audio Power Output:	Approximately 1 watt (undistorted).
Tuning Range:	50 mc to 54 mc.

POWER SUPPLY

Power Rectifier:	Two silicon diodes in full-wave voltage doubler circuit.
Power Requirements:	With built-in supply: 105-125 volts 50/60 cycle AC 45 watts. With external supply: 6 volt operation - 6 volts at 2.35 amps, 260 volts DC at 90 ma. 12 volt operation - 12 volts at 1.2 amps, 260 volts DC at 90 ma.

ACCESSORIES

Microphone:	Ceramic element type, plastic case. Suitable for either hand or desk operation.
Connecting Cables:	Two supplied, one for 105-125 volt AC operation and one for 6 or 12 volt external DC power supply use. Power circuits are automatically switched for internal or external power supply use when cable is plugged in.

GENERAL

Tube Complement:	1 - 6BA8: Oscillator/Tripler (Pentode Section) Doubler (Triode Section)
	1 - 6CL6: Final RF Amplifier
	1 - 6AN8: Receiver Preamplifier and Detector
	1 - 12AX7: Speech Amplifier and First Audio Amplifier.
	1 - 6AQ5: Audio Output and Modulator
Cabinet Dimensions:	8" high (including handle). 6" deep (including knobs). 9-3/4" wide (including license holder).
Net Weight:	6-1/2 lbs.
Shipping Weight:	10 lbs.

Minor variations from these specifications may be encountered in kit-assembled equipment. Such factors as exact lead placement, component variations and normal variations in tube characteristics are possible sources of deviations. Such variables will ordinarily have no significant effect on overall performance.

INTRODUCTION

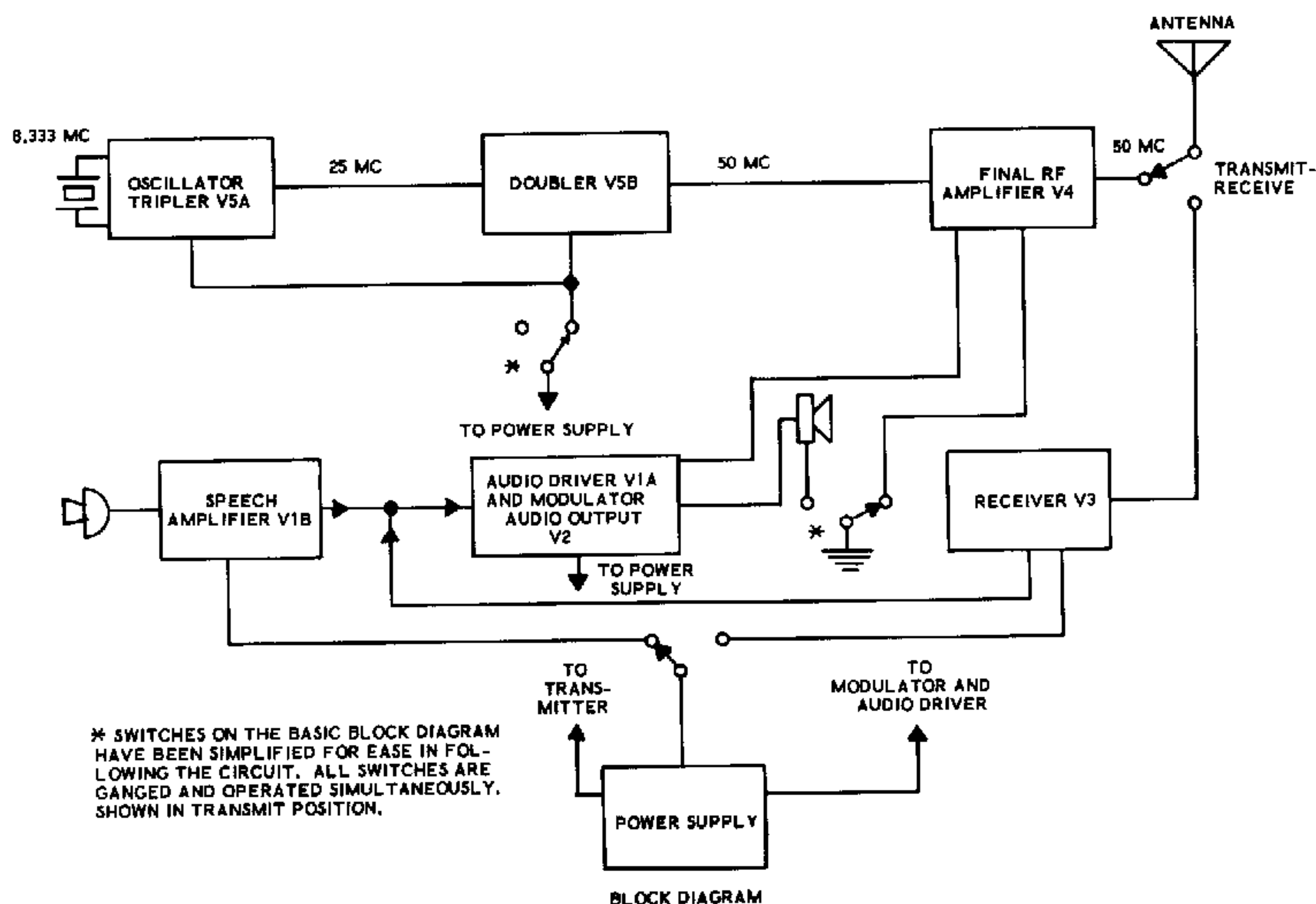
The HEATHKIT Model HW-29A Transceiver is a combination transmitter and receiver for use in the 6-meter amateur radiotelephone service.

Extensive proofbuilding and field testing over a period of several months have provided conclusive evidence that the HW-29A Transceiver will provide highly reliable service in its intended application, if assembled, wired and adjusted in accordance with the instructions outlined in this manual. It is, therefore, recommended that you follow the instructions carefully and make full use of the Circuit Description, Block Diagram, Schematic Diagram, Installation Information, etc., in the

interest of acquiring a good understanding of the transceiver and its capabilities.

The HW-29A Transceiver has a self-contained power supply for operation from a 117 volt 50/60 cycle AC power line, or can be operated from either a 6 volt or a 12 volt battery by using an external power supply having a rating of 260 volts B+ at 90 ma.

The HW-29A can be used with a wide variety of antenna types; an antenna should be selected for the transceiver on the basis of the application involved. See Page 34 for a discussion of suitable antenna types.



CIRCUIT DESCRIPTION

TRANSMITTER SECTION

The basic signal from which the final transmitter output is obtained (8.333 mc to 9,000 mc) is generated at 1/6 of the final output frequency in tube section V5A. This circuit is crystal controlled providing excellent frequency stability and is known as an "electron coupled" Pierce oscillator. "Three times" frequency multiplication is obtained in the plate circuit by tuning the output to three times the basic crystal frequency (25 to 27 mc). This signal is coupled to the following stage through C6.

Tube section V5B doubles the 25 to 27 mc signal, providing a 50 to 54 mc signal which drives the final amplifier stage, through C8.

V4 is the final amplifier and operates "straight through;" i.e., the input and output circuits are tuned to the same frequency. RF output is coupled to the antenna, through C12 and the transmit-receive switch contacts, from a tap approximately 1-1/2 turns from the "cold" end of the final tank coil L3. The actual tap point is not critical and can be adjusted for optimum coupling if deemed necessary. Since most antenna feed lines will be in the vicinity of 50-75 ohms, the suggested tap point will provide near optimum coupling for most typical situations.

At the antenna terminal, there is provided a rather unique power output detector circuit consisting of diode D1, resistor R13 and capacitors C26 and C27. This system, used in conjunction with an external voltmeter, supplies a convenient means of tuning the final tank circuit for maximum power into the antenna transmission line. Since the power consumed by this device is negligible, the meter may be left in the circuit at all times to indicate proper operation of the transmitter. The meter jack for this purpose is a three-circuit, standard phone jack and the reading is made with the plug inserted approximately halfway into the jack, such that the tip of the meter plug contacts only the first terminal in the jack.

If the metering plug is inserted all the way into the jack, the meter will read final amplifier cathode current, typically in the order of 20-25 ma. The meter plug must be withdrawn from this position for normal operation once proper tuneup has been accomplished. The meter plug in this fully inserted position overrides the normal functioning of the transmit-receive switch and allows final amplifier plate current to flow regardless of switch position.

With a key plug inserted all the way in the meter

jack, the transmitter may be used on CW if desired, although considerable "back wave" may result due to the fact that previous transmitter stages are running constantly.

Modulation is accomplished for phone operation by causing the plate and screen voltage source for V4 to vary at an audio frequency. This audio frequency is determined by the signal that is passed through T2, the combination modulation-output transformer.

RECEIVER SECTION

The incoming signal picked up by the antenna is applied to the grid of V3A through the coil tap of L4. Tapped coil L4 forms a broadly tuned circuit which reduces the level of frequencies other than those desired (between 50.0 and 54.0 mc).

The incoming signal, after amplification in V3A, is applied to the tuned circuit consisting of C18, C19, and L5. C18 is the variable tuning capacitor. The signal tuned by this circuit is then applied to the grid of the superregenerative detector V3B, through C20.

The superregenerative detector actually goes into and out of oscillation at approximately a 20 kc rate (referred to as "quench" frequency), and signal detection takes place during the time just before actual oscillation occurs. At this time, the gain of V3B is very high, and for this reason, overall sensitivity is quite good. R11 and C20 control the quench frequency rate. L7, in the plate circuit of V3B, presents a high impedance to the quench frequency and a low impedance to audio signal frequencies. C22 bypasses the RF present in the detected audio to ground. R26, the regeneration control, is used to set the circuit at the maximum sensitivity point by varying the plate voltage.

AUDIO SECTION

The detected audio signal passes through C23 to the 1 megohm volume control R12. Signal flow proceeds through the audio mixing resistor R17 to the grid of the audio driver V1A. V1A is coupled to the power output stage V2 by capacitor C34. The combination modulation-output

transformer, T2, provides proper impedance matching to the speaker when the unit operates as a receiver. With the transmit-receive switch in the receive position, no loading of the audio output occurs at the primary modulation tap because the cathode circuit of the transmitter final amplifier is open. During receive, tubes V5, V4 and section V1B are inoperative.

During transmit conditions, only tube V3 is switched out of the circuit, with all other circuits operating. B+ is supplied to V5, V4 and V1B while the cathode of the final amplifier V4 is returned to ground. With B+ removed from the receiver section V3, no audio voltage appears across the volume control R12 and only the signal which is amplified by the microphone pre-amplifier V1B reaches the grid of the audio driver stage V1A.

External radio frequency energy is prevented from re-entering the audio circuitry via the microphone cable through the use of capacitor C29 in the microphone input circuit. In transmit, the volume control will have negligible effect on the amount of audio impressed on the RF carrier, the volume control being isolated by resistor R17. It will be found that fixed gain in the microphone audio circuit is adequate for all normal transmit conditions.

POWER SUPPLY SECTION

The internal power supply provides the voltages necessary for proper operation from any 105-125 volt 50/60 cycle source. The B+ voltage is produced in a full-wave voltage doubler circuit consisting of D2, D3, C36, and C37. This DC voltage is then filtered by C32C and C32D, and distributed to the proper circuit points. Approximate B+ requirements are 260 volts at 45 ma during receive and 90 ma during transmit.

The power connector on the chassis rear apron permits operation from any external source offering the proper voltages. The filament wiring is so arranged that the tubes are connected for either 6 or 12 volt operation, depending upon which power cable is in use. For 117 V AC operation, the power transformer provides 6.3 V AC for parallel wired filaments.

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be highly stable and dependable performance. We suggest that you retain the manual in your files for future reference, both in the use of the equipment and for its maintenance.

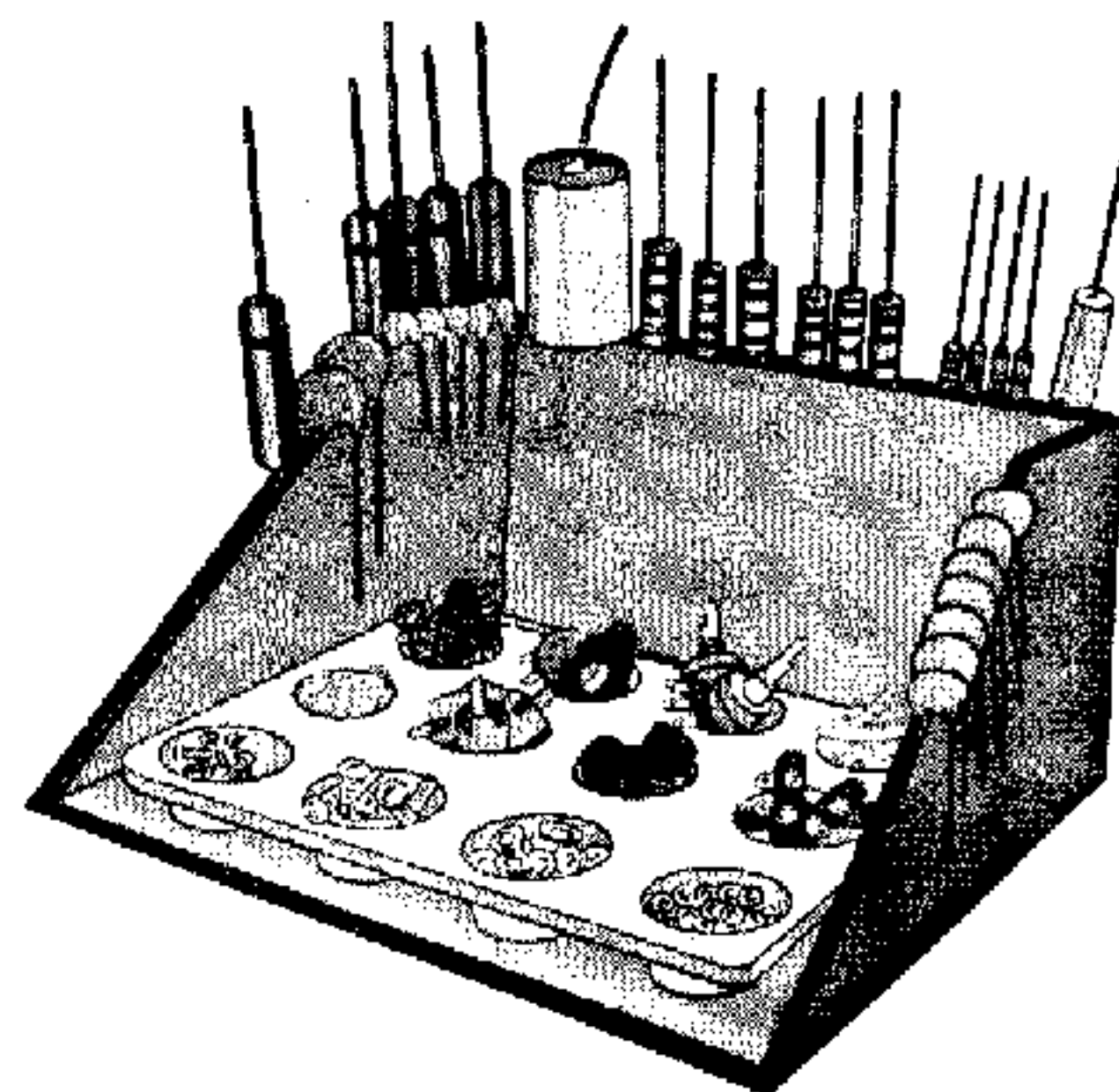
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacements section and supply the information called for therein. Include all inspection slips in your letter to us.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a penknife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



PARTS LIST

Refer to the Parts Pictorial which is a fold-out from Page 9.

PART No.	PARTS Per Kit	DESCRIPTION
<u>Resistors</u>		
1-66	1	150 Ω 1/2 watt (brown-green-brown)
1-6	1	470 Ω 1/2 watt (yellow-violet-brown)
1-14	2	3300 Ω 1/2 watt (orange-orange-red)
1-16	1	4700 Ω 1/2 watt (yellow-violet-red)
1-25	1	47 K Ω 1/2 watt (yellow-violet-orange)
1-60	1	68 K Ω 1/2 watt (blue-gray-orange)
1-26	2	100 K Ω 1/2 watt (brown-black-yellow)
1-27	3	150 K Ω 1/2 watt (brown-green-yellow)
1-29	2	220 K Ω 1/2 watt (red-red-yellow)
1-30	2	270 K Ω 1/2 watt (red-violet-yellow)
1-33	2	470 K Ω 1/2 watt (yellow-violet-yellow)
1-40	2	10 megohm 1/2 watt (brown-black-blue)
1A-4	1	8200 Ω 1 watt (gray-red-red)
1A-5	1	22 K Ω 1 watt (red-red-orange)
1B-12	1	470 Ω 2 watt (yellow-violet-brown)
1B-14	1	1500 Ω 2 watt (brown-green-red)
3E-19	1	330 Ω 5 watt wire-wound
<u>Capacitors</u>		
28-2	1	1.0 $\mu\mu\text{f}$ tubular phenolic
28-1	1	2.2 $\mu\mu\text{f}$ tubular phenolic
21-28	3	10 $\mu\mu\text{f}$ tubular ceramic
20-118	1	15 $\mu\mu\text{f}$ silver mica
20-97	2	50 $\mu\mu\text{f}$ silver mica
21-14	25	.001 μf disc ceramic
21-59	1	.001 μf ceramic feed-through with nut, 1000 V
21-16	1	.01 μf disc ceramic
21-70	1	.01 μf disc ceramic, 1400 V
25-57	2	100 μf tubular electrolytic, 200 V

PART No.	PARTS Per Kit	DESCRIPTION
<u>Capacitors (Cont'd.)</u>		
25-86	1	40-40-25-25 μf twist-prong electrolytic at 450 V - 350 V - 25 V - 25 V
26-65	1	2.5 $\mu\mu\text{f}$ variable tuning capacitor
31-10	1	4.5 - 25 $\mu\mu\text{f}$ ceramic trimmer
<u>Controls-Switches</u>		
10-60	1	500 K Ω linear, tab-mounting (REGENERATION)
19-27	1	1 megohm audio taper control with SPST switch (VOLUME, OFF-ON)
63-210	1	3-position switch (TRANSMIT-RECEIVE)
<u>Transformer-Coils</u>		
141-18	1	Coil set
Consisting of		
40-186	1	Coil, tripler stage
40-306	1	Coil, antenna
40-307	2	Coil, doubler, detector
45-36	2	7 μh RF choke
45-48	1	75 mh RF choke
40-355	1	Coil, final tank
51-94	1	Modulation-output-transformer
54-87	1	Power transformer
<u>Metal Parts</u>		
90-111	1	Cabinet
200-M280F398	1	Chassis
203-181F328	1	Front panel
205-M167F	1	Speaker baffle plate
209-25	1	Speaker grille
<u>Hardware</u>		
250-3	3	4-40 x 3/16" screw
250-10	4	6-32 x 1/2" screw
250-26	1	6-32 x 5/8" screw
250-49	8	3-48 x 1/4" screw
250-51	2	#10 sheet metal screw
250-56	7	6-32 x 1/4" screw
250-89	12	6-32 x 3/8" screw

PART No.	PARTS Per Kit	DESCRIPTION
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Hardware (Cont'd.)

250-136	1	3-48 x 1/2" fillister head screw
250-172	2	3-48 x 3/8" screw
252-1	11	3-48 nut
252-3	20	6-32 nut
252-7	3	Control nut
252-22	4	#6 speednut
252-23	1	Knurled thumbnut
252-32	2	Large speednut
253-10	4	Flat control washer
253-21	6	Flat washer, 9/16"
254-1	25	#6 lockwasher
254-4	4	Control lockwasher
254-7	12	#3 lockwasher
259-1	3	#6 solder lug
259-11	3	#6 spade lug

Wire

340-3	1	Length bare wire
344-1	1	Length #22 hookup wire, solid conductor
344-2	1	Length #18 black wire, stranded
344-3	1	Length #18 red wire, stranded
346-1	1	Length sleeving
347-9	1	Length 3-conductor shielded cable

Diodes-Tubes-Lamps

56-4	1	Crystal diode
57-27	2	Silicon diode
411-26	1	12AX7 tube
411-60	1	6AQ5 tube
411-63	1	6CL6 tube
411-68	1	6AN8 tube
411-98	1	6BA8 tube
412-1	1	#47 pilot lamp
412-12	1	Neon pilot lamp (clear)
412-13	1	Neon pilot lamp (red)

PART No.	PARTS Per Kit	DESCRIPTION
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Terminal Strips-Sockets-Plugs

431-1	1	1-lug terminal strip
431-5	1	4-lug terminal strip
431-10	2	3-lug terminal strip (large)
431-14	1	2-lug terminal strip
431-38	2	3-lug terminal strip (small)
431-40	1	4-lug terminal strip
432-1	1	Microphone connector (female)
432-3	1	Microphone connector (male)
434-4	2	Octal socket
434-15	1	7-pin wafer socket
434-38	1	Crystal socket
434-42	1	Phono socket
434-75	3	9-pin ceramic socket
434-77	1	9-pin wafer socket
435-1	1	Octal socket ring
436-6	1	3-circuit phone jack
438-3	1	Phone plug
438-4	2	Phono plug
438-22	1	Octal plug
440-1	2	Octal plug cap

Miscellaneous

73-1	2	3/8" grommet
73-4	1	5/16" grommet
89-1	1	Line cord
211-16	1	Plastic handle
261-9	4	Rubber feet
391-5	1	Nameplate
401-21	1	Speaker
421-1	1	1-1/2 ampere fuse
421-4	1	8 ampere fuse
423-1	1	Fuse holder
462-85	2	Round knob
462-86	1	Lever type knob
480-8	1	Microphone
481-1	1	Capacitor mounting wafer
331-6		Solder
595-406	1	Manual

PROPER SOLDERING TECHNIQUES

Only a small percentage of HEATHKIT equipment purchasers find it necessary to return an instrument for factory service. Of these instruments, by far the largest portion of malfunctions are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

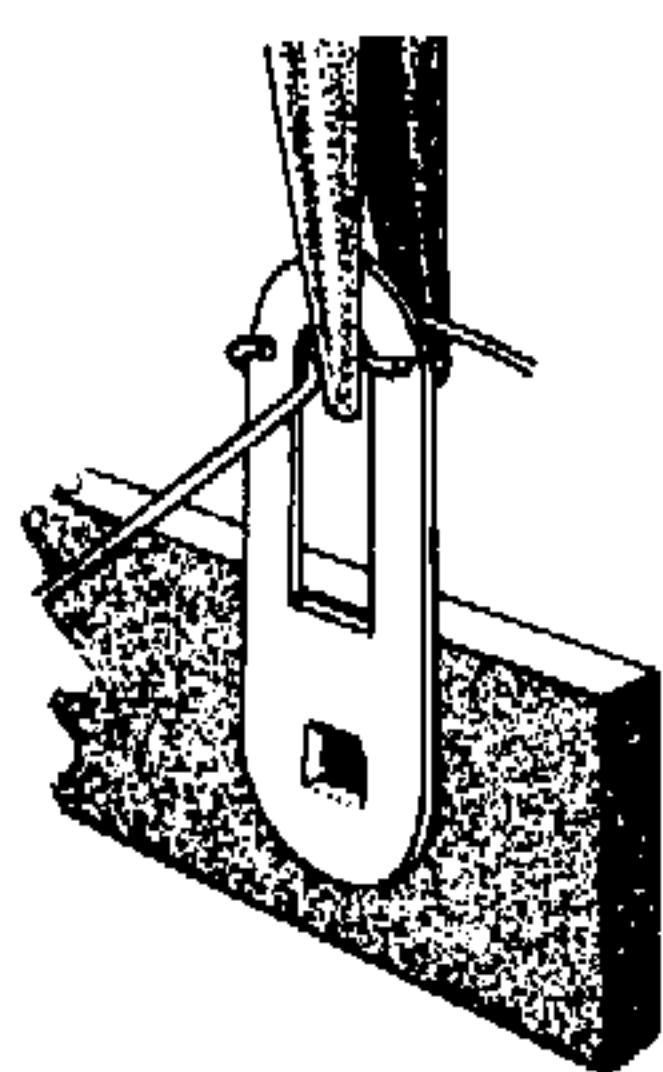
For most wiring, a 25 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly over the joint. Keep the iron tip clean and bright by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

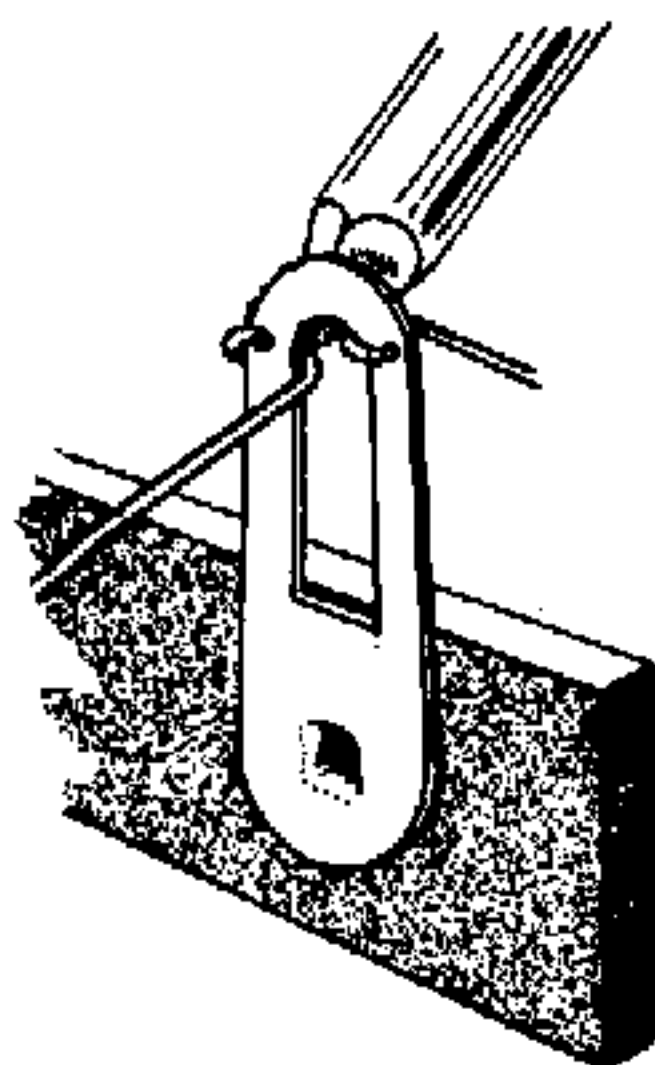
1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire); the size of the conductor is the same for all colors of hookup wires furnished with this kit. In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the construction step.
2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.
3. Leads on resistors, capacitors and similar components are generally much longer than they need to be to make the required connections. In these cases, the leads should be cut to proper length before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points.
4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated construction step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.
5. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the wire is too large to allow bending or if the step states that the wire is not to be crimped, position the wire so that a good solder connection can still be made.

Position the work, if possible, so that gravity will help to keep the solder where you want it.
7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.
8. Then place the solder against the heated terminal and it will immediately flow over the joint; use only enough solder to thoroughly wet the junction. It is usually not necessary to fill the entire hole in the terminal with solder.
9. Remove the solder and then the iron from the completed junction. Use care not to move the leads until the solder is solidified.

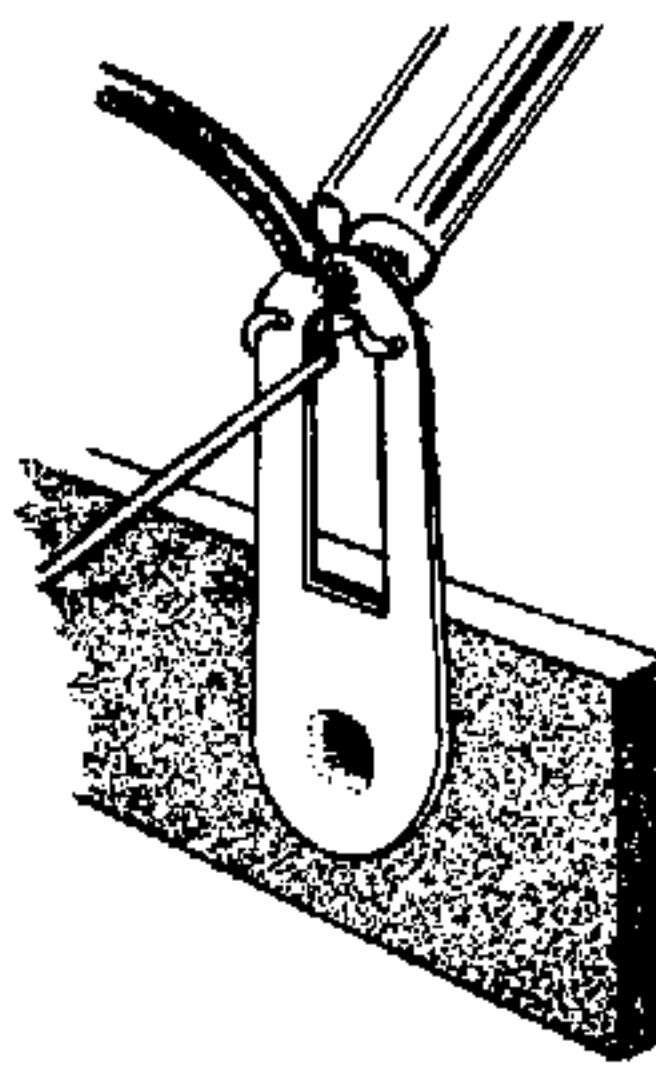
A poor or cold solder joint will usually look crystalline and have a grainy texture, or the solder will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly over the entire junction. In some cases, it may be necessary to add a little more solder to achieve a smooth bright appearance.



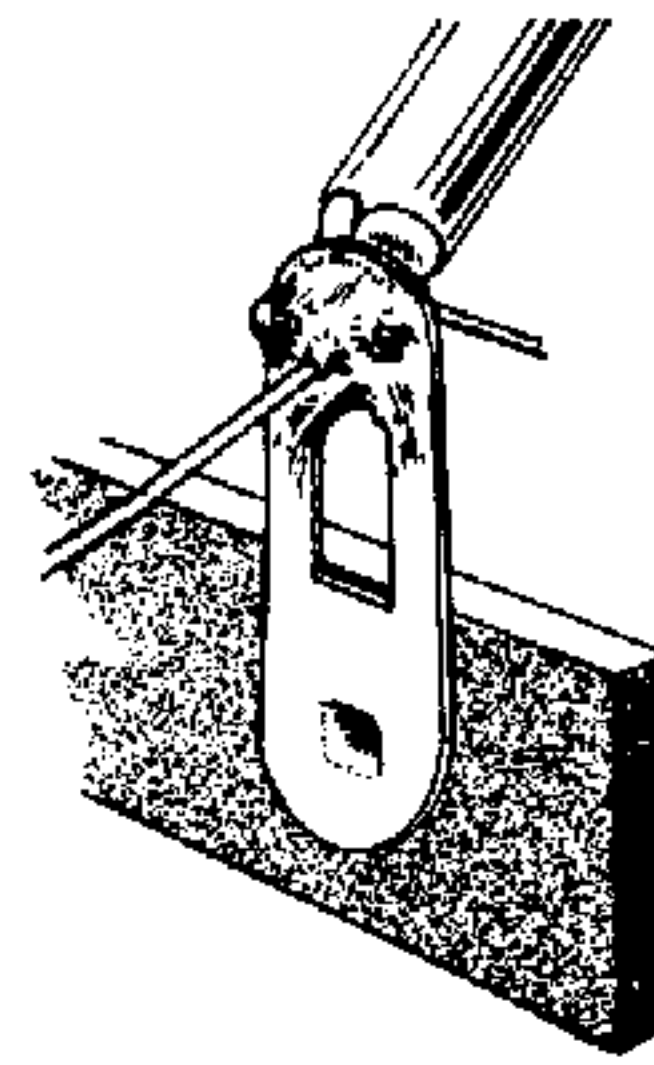
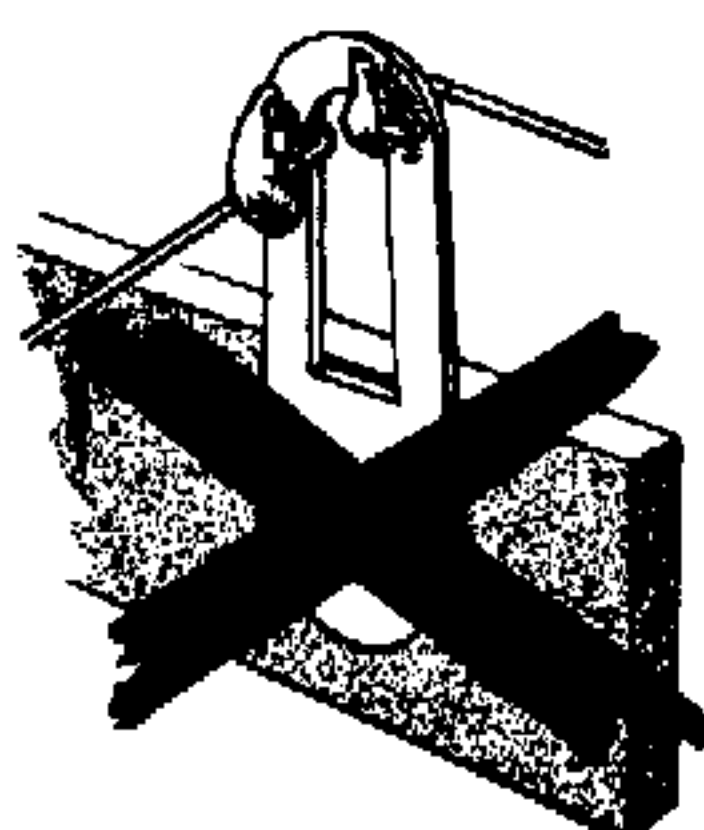
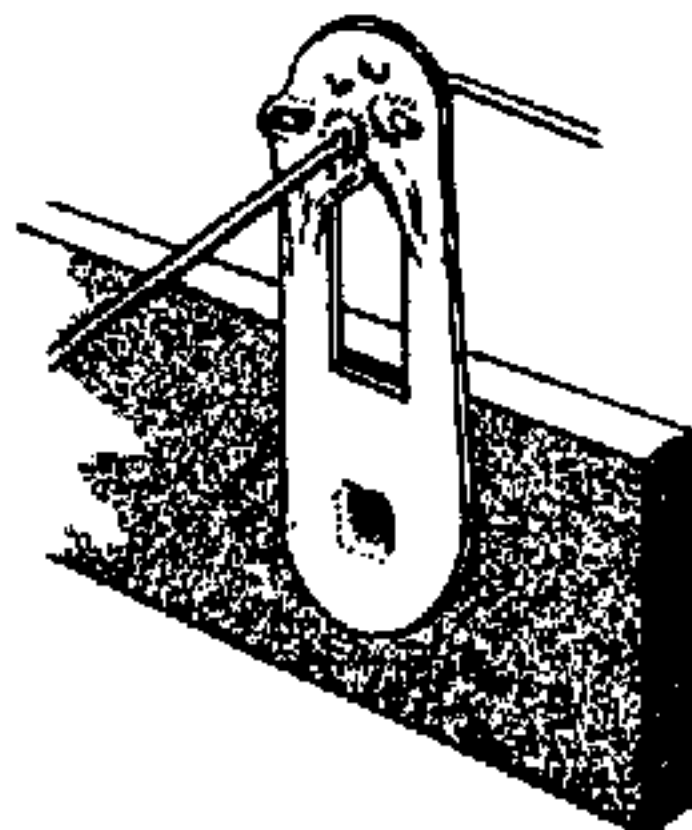
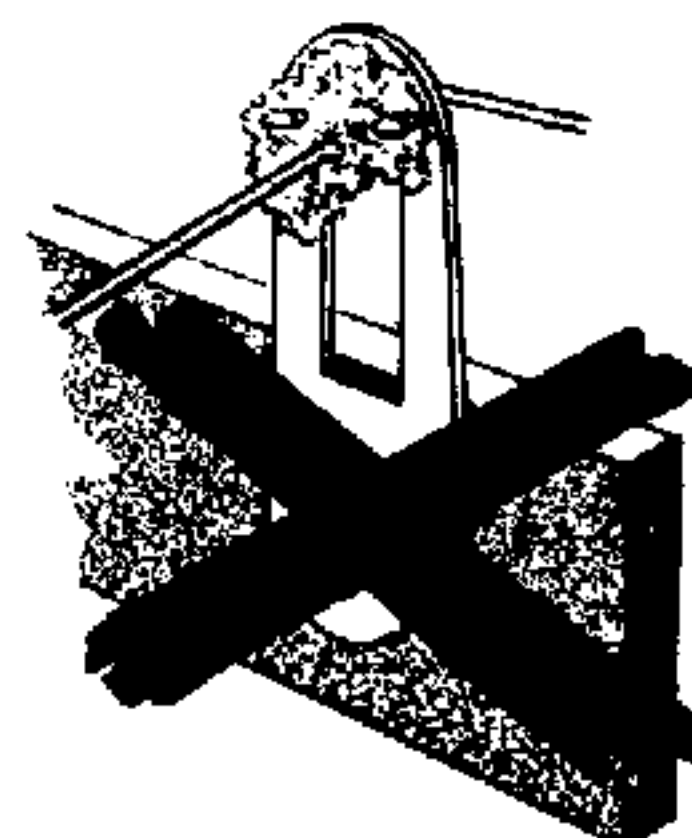
CRIMP WIRES



HEAT CONNECTION



APPLY SOLDER

ALLOW SOLDER
TO FLOWCOLD SOLDER JOINT
CONNECTION INSUFFICIENTLY
HEATEDPROPER SOLDER
CONNECTIONCOLD SOLDER JOINT
CONNECTION MOVED
WHILE COOLING

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each lead in colored pencil on the Pictorial as it is added.

The fold-out diagrams in this manual may be

removed and attached to the wall above your working area; but, because they are an integral part of the instructions, they should be returned to the manual after the kit is completed.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder

instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. (In cases where a lead passes through a terminal or lug and then connects to another point, it will count as two leads,

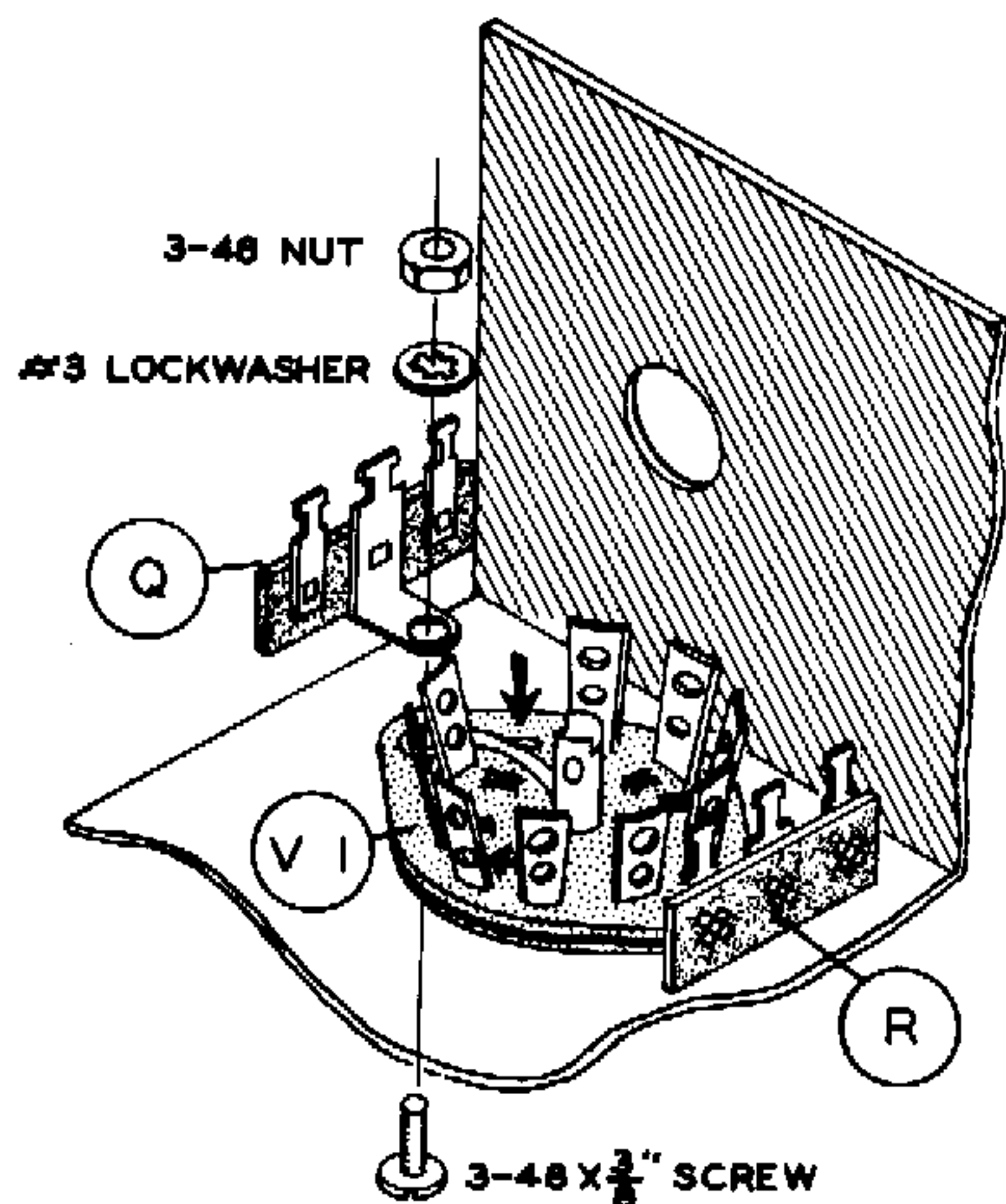
one entering and one leaving the terminal.)

The steps directing the installation of resistors include color codes to help identify the parts. Also, if a part is identified by a letter-number designation on the Schematic, its designation will appear in the construction step which directs its installation.

STEP-BY-STEP ASSEMBLY

MECHANICAL ASSEMBLY

Refer to Pictorial 1 for the following steps.



Detail 1A

NOTE: When mounting wafer tube sockets, be sure to mount each socket from the bottom of the chassis. If, by mistake, the sockets are mounted so the lugs pass through the chassis, they will short to the chassis where they pass through the mounting hole.

(✓) Referring to Detail 1A, mount a 9-pin wafer tube socket at V1. Secure small 3-lug terminal strips Q and R with the mounting screws. Use the 3-48 x 3/8" screws, #3 lockwashers, and 3-48 nuts. Be sure to orient the blank spaces of the tube sockets according to the arrows in Pictorial 1.

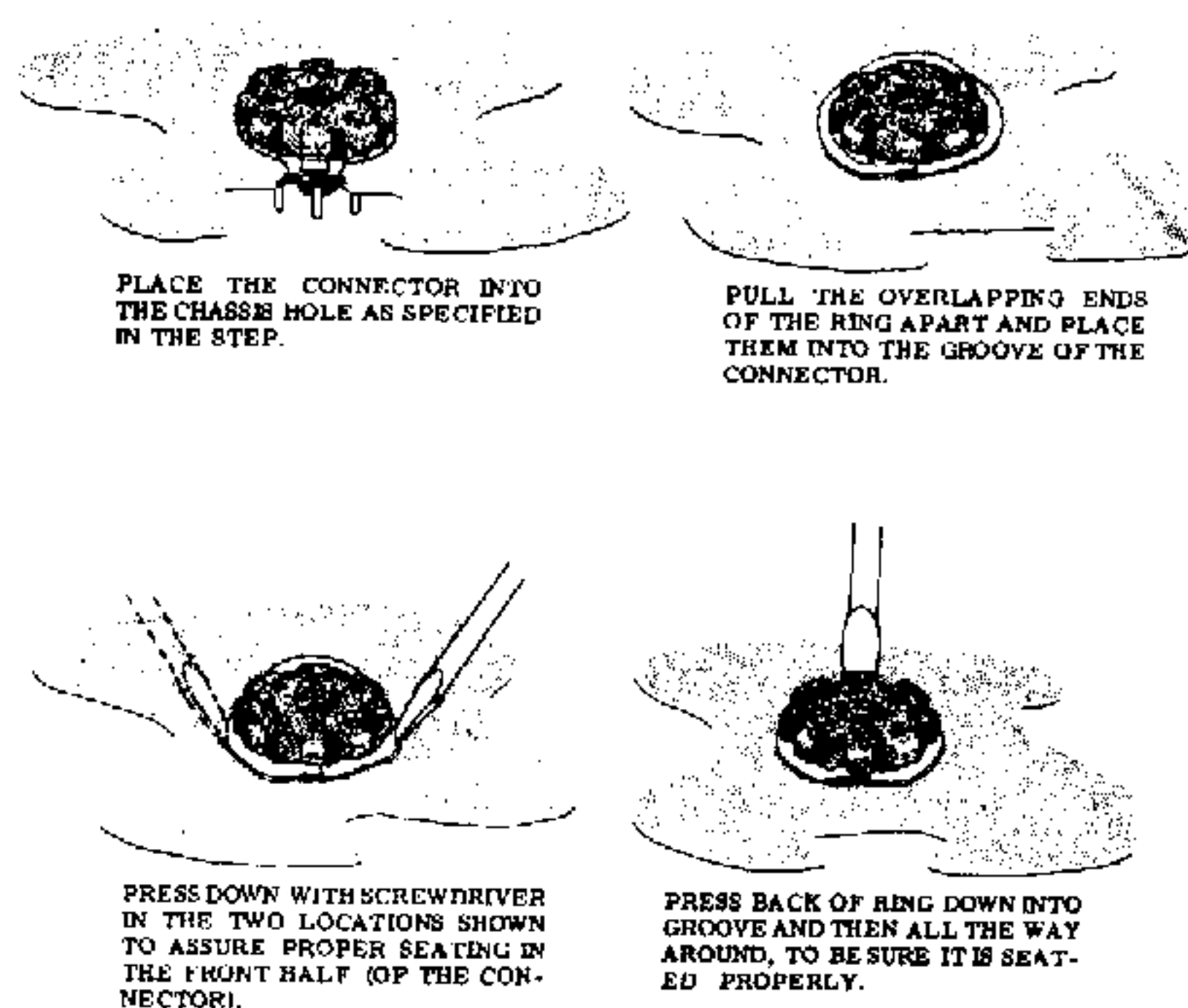
(✓) Mount the 7-pin wafer socket V2. Use 3-48 x 1/4" screws, #3 lockwashers and 3-48 nuts.

(✓) Similarly mount the 9-pin ceramic tube sockets at V3, V4, and V5. Make sure the blank spaces are as shown in Pictorial 1.

(✓) Mount the crystal socket at location M. Use the 3-48 x 1/2" fillister head screw with a #3 lockwasher under the screwhead. Secure with a 3-48 nut. Do not overtighten the mounting screw or you may crack the socket.

(✓) Install 3/8" rubber grommets at locations H and J.

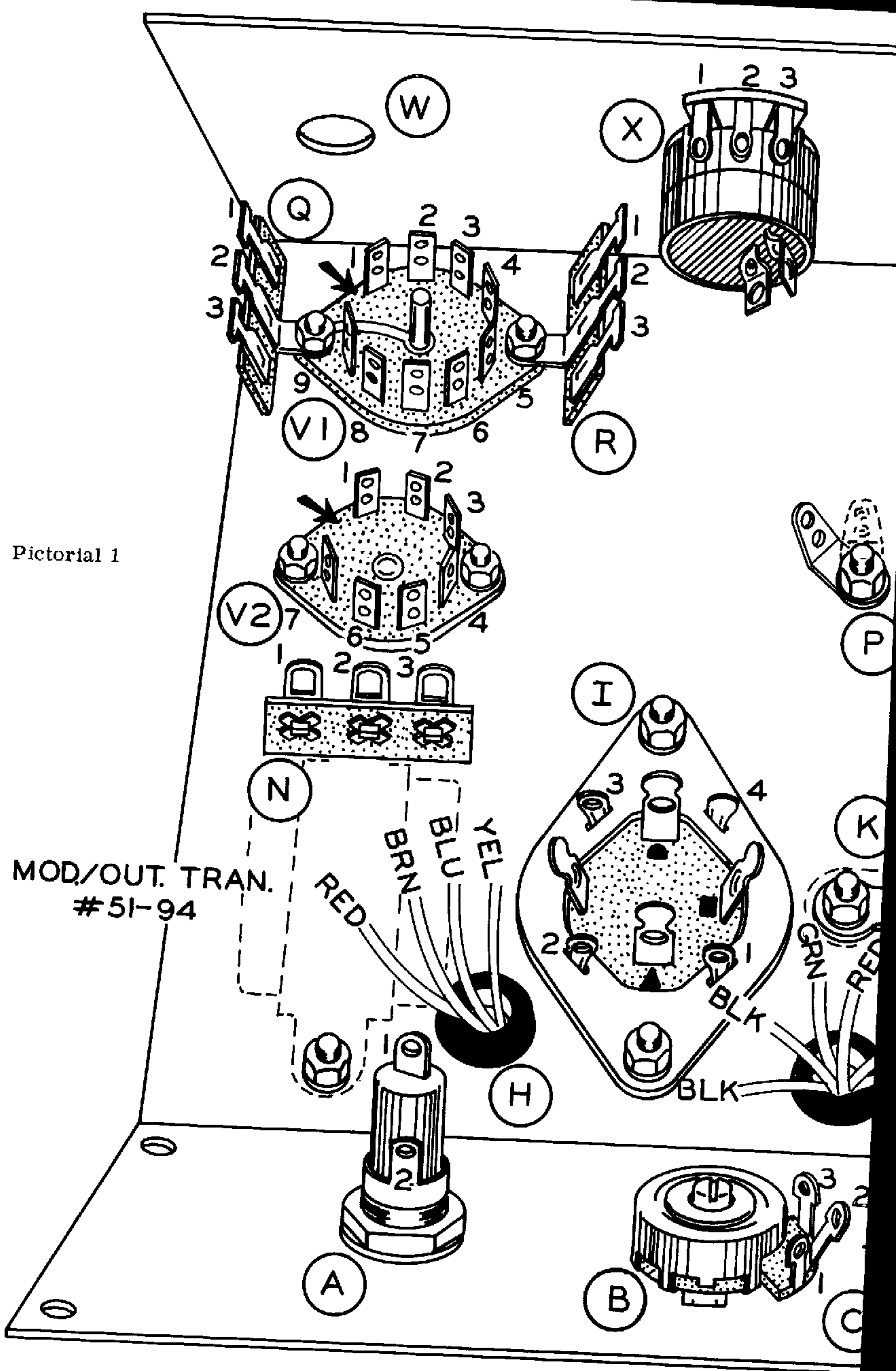
(✓) Similarly install a 5/16" rubber grommet in hole U.

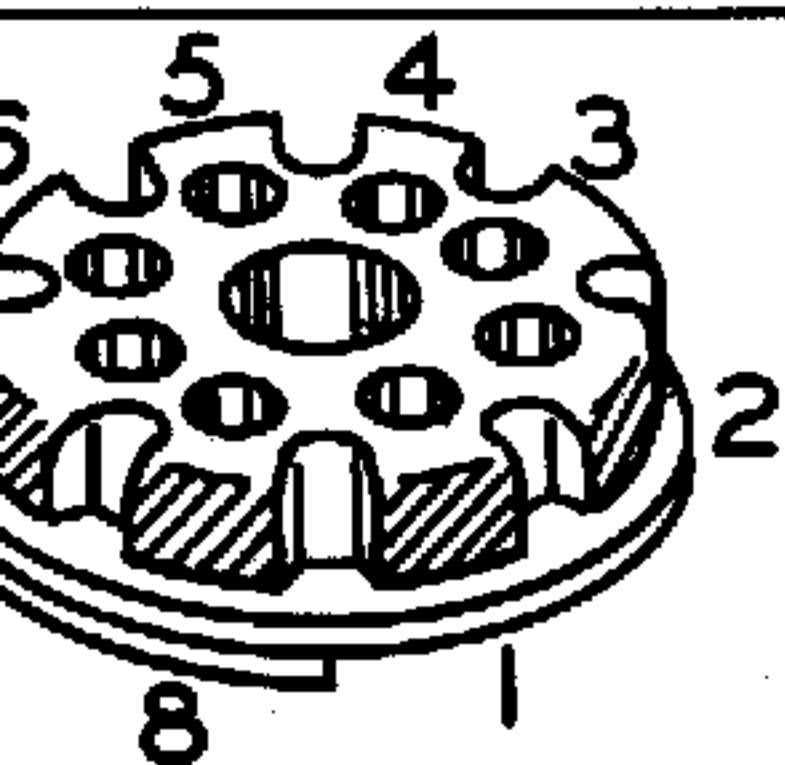
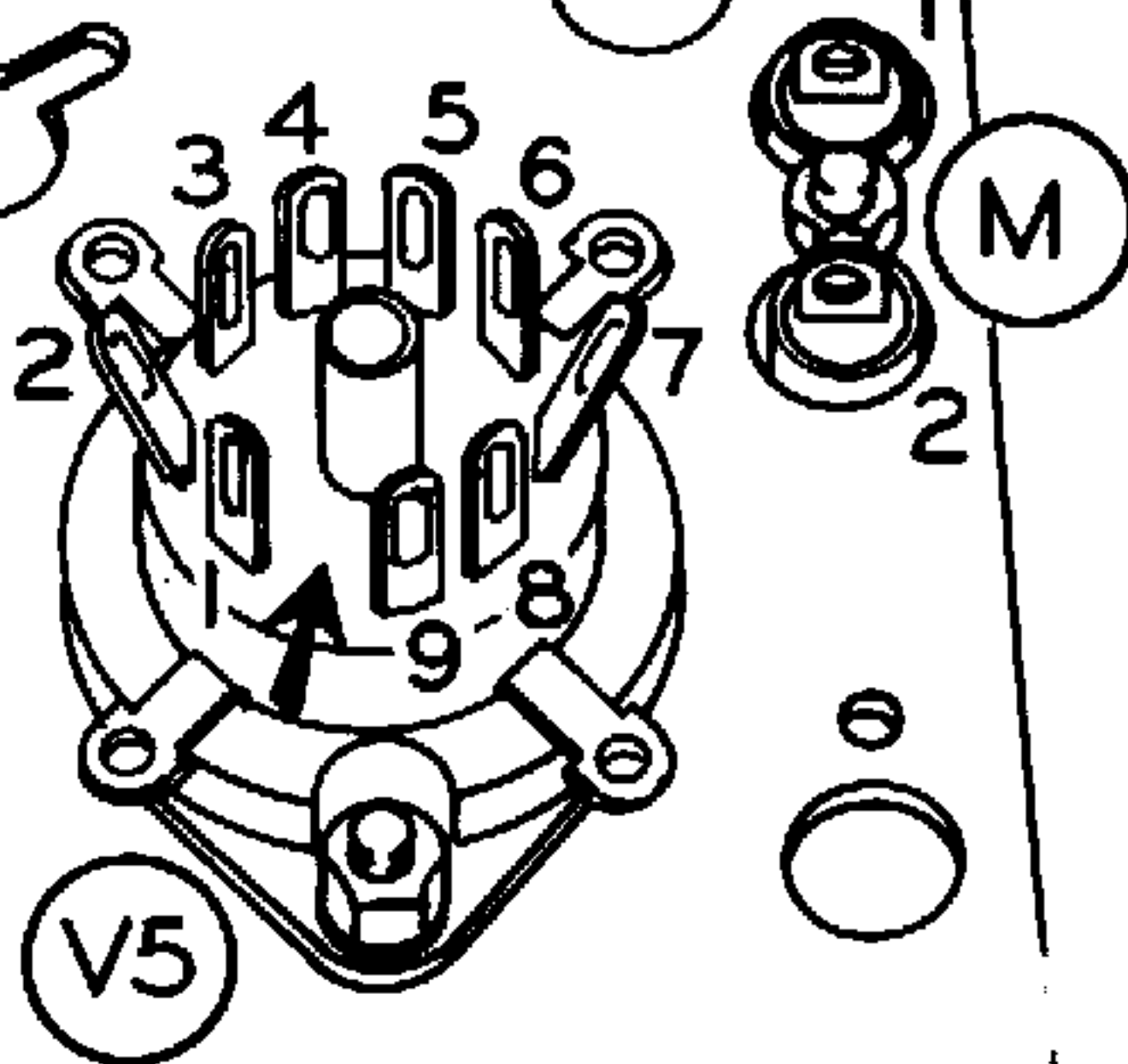
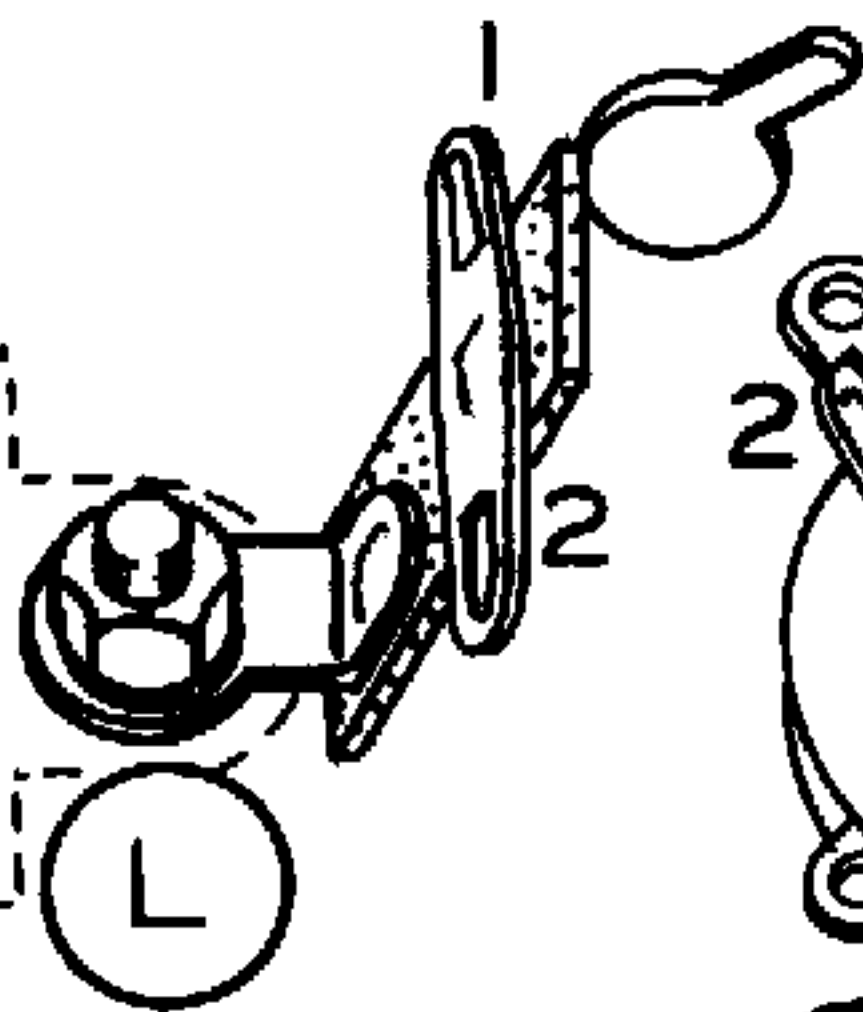
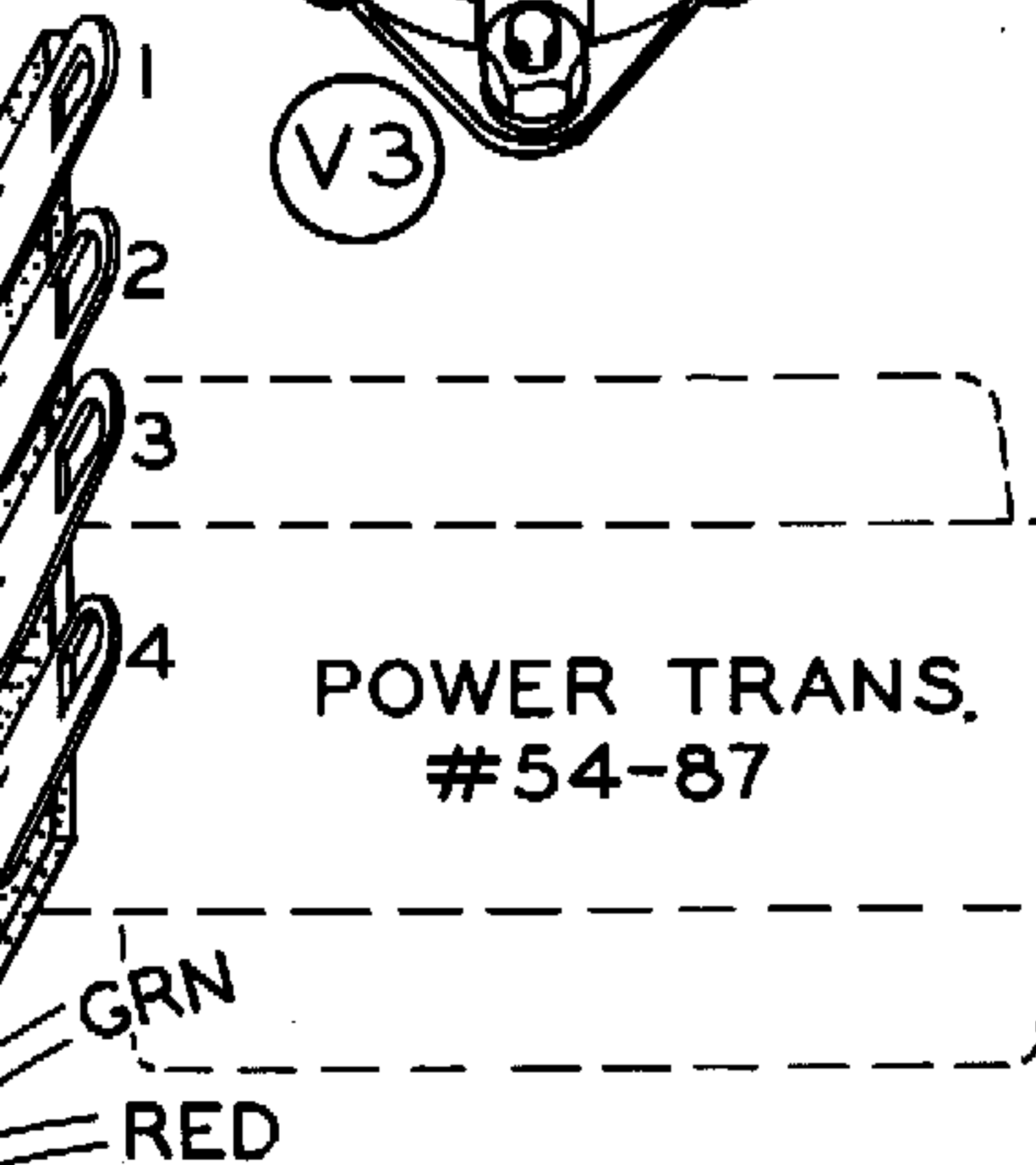
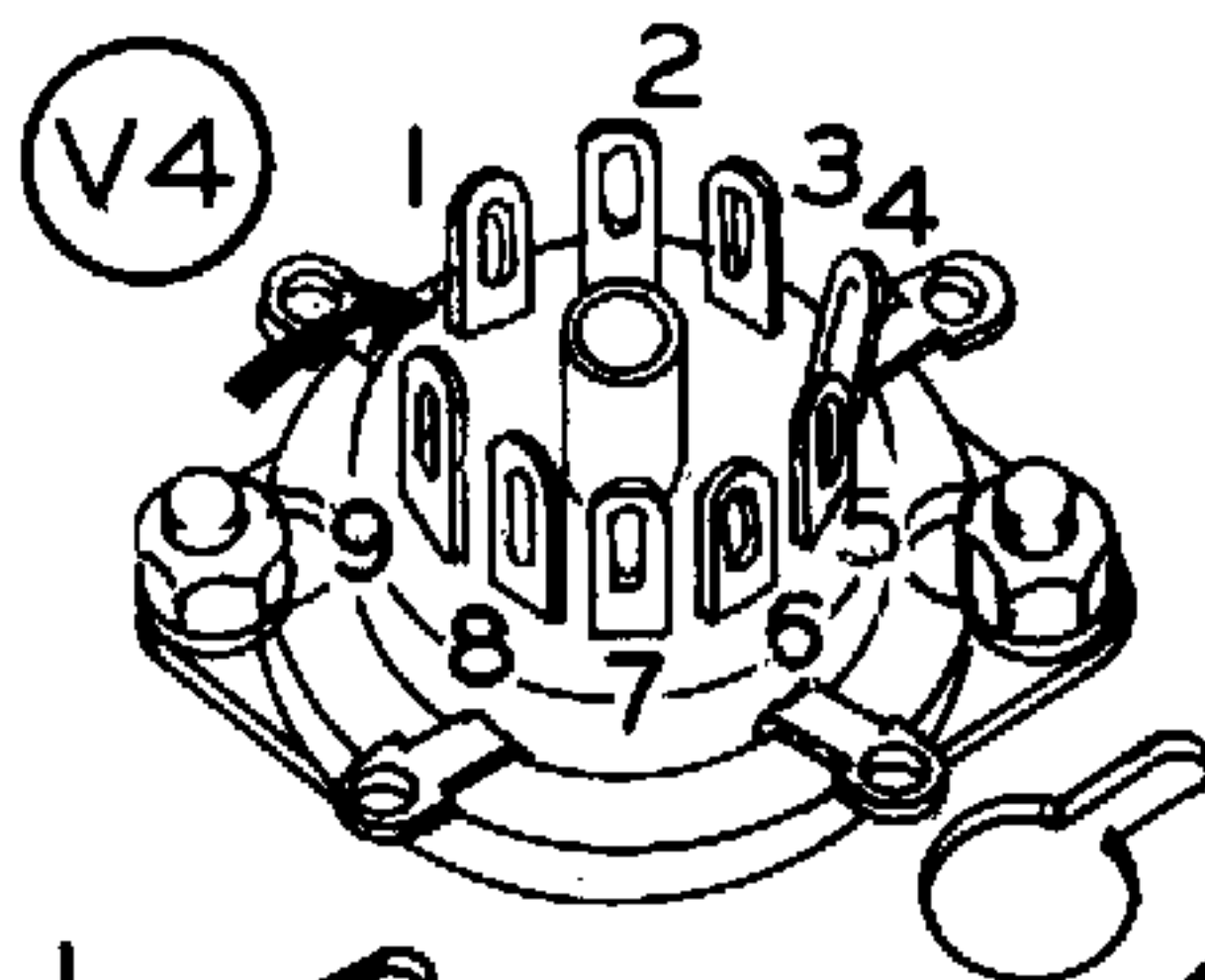
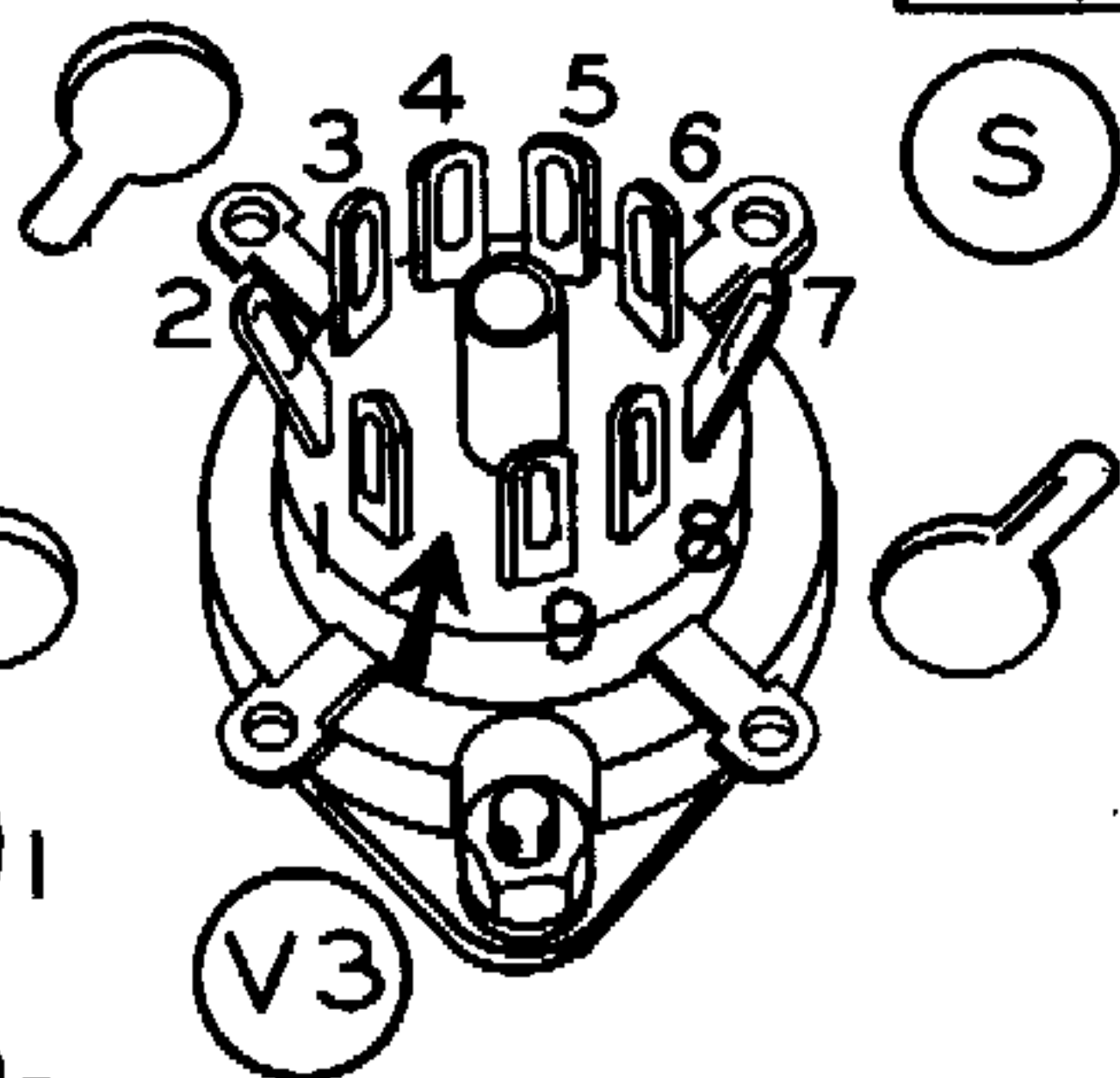
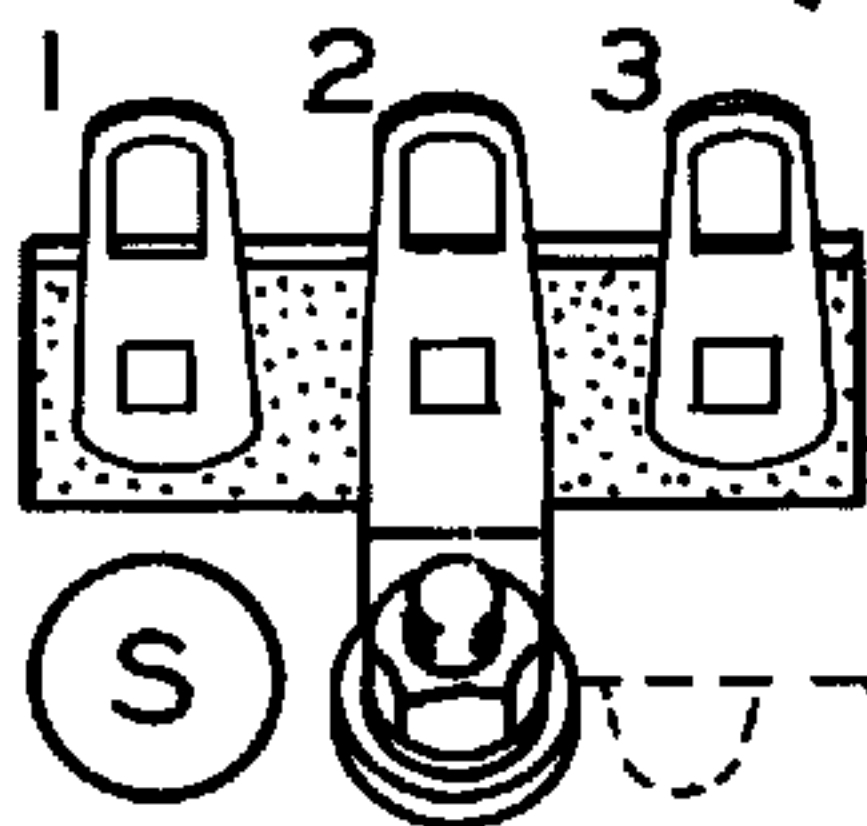
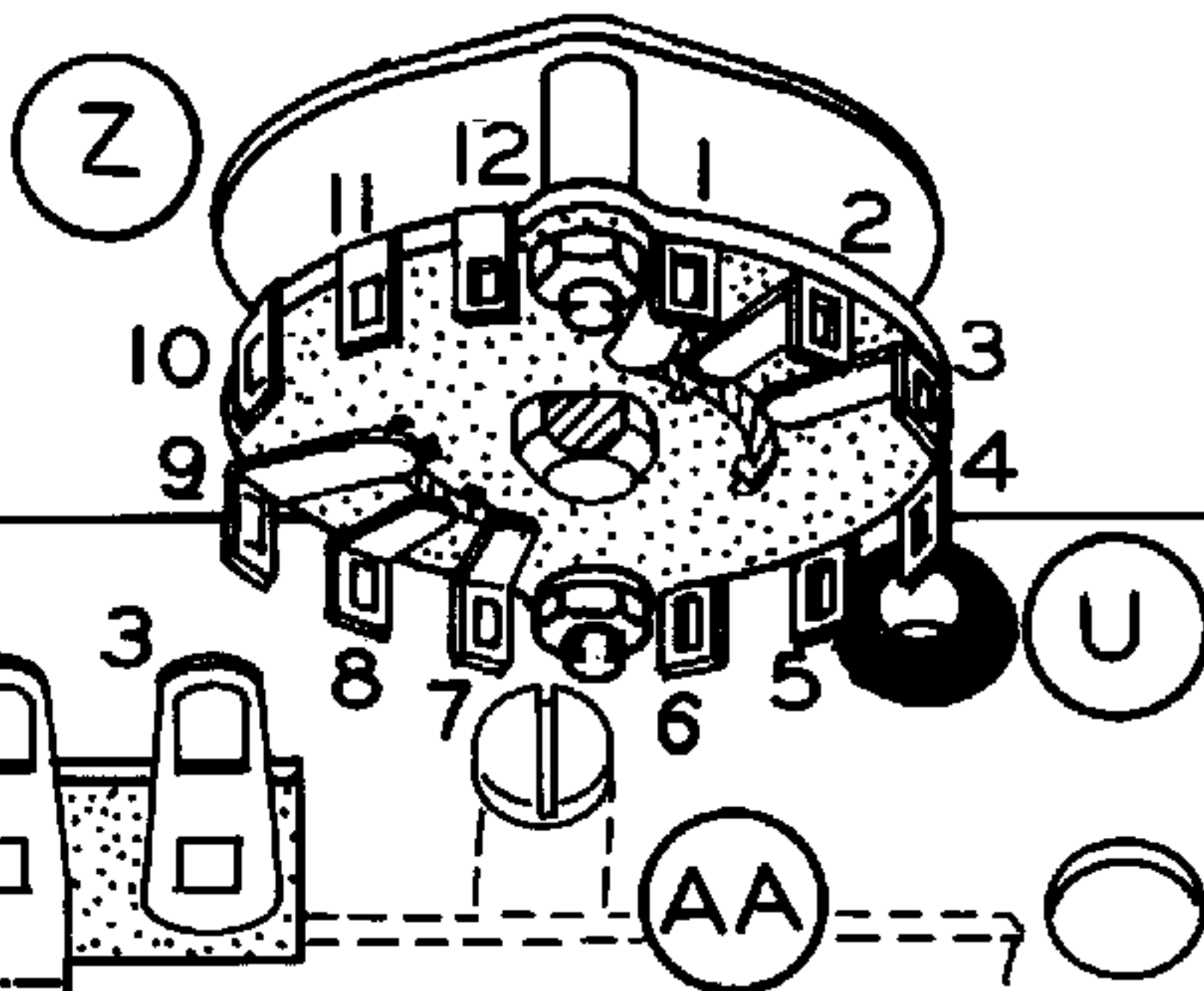


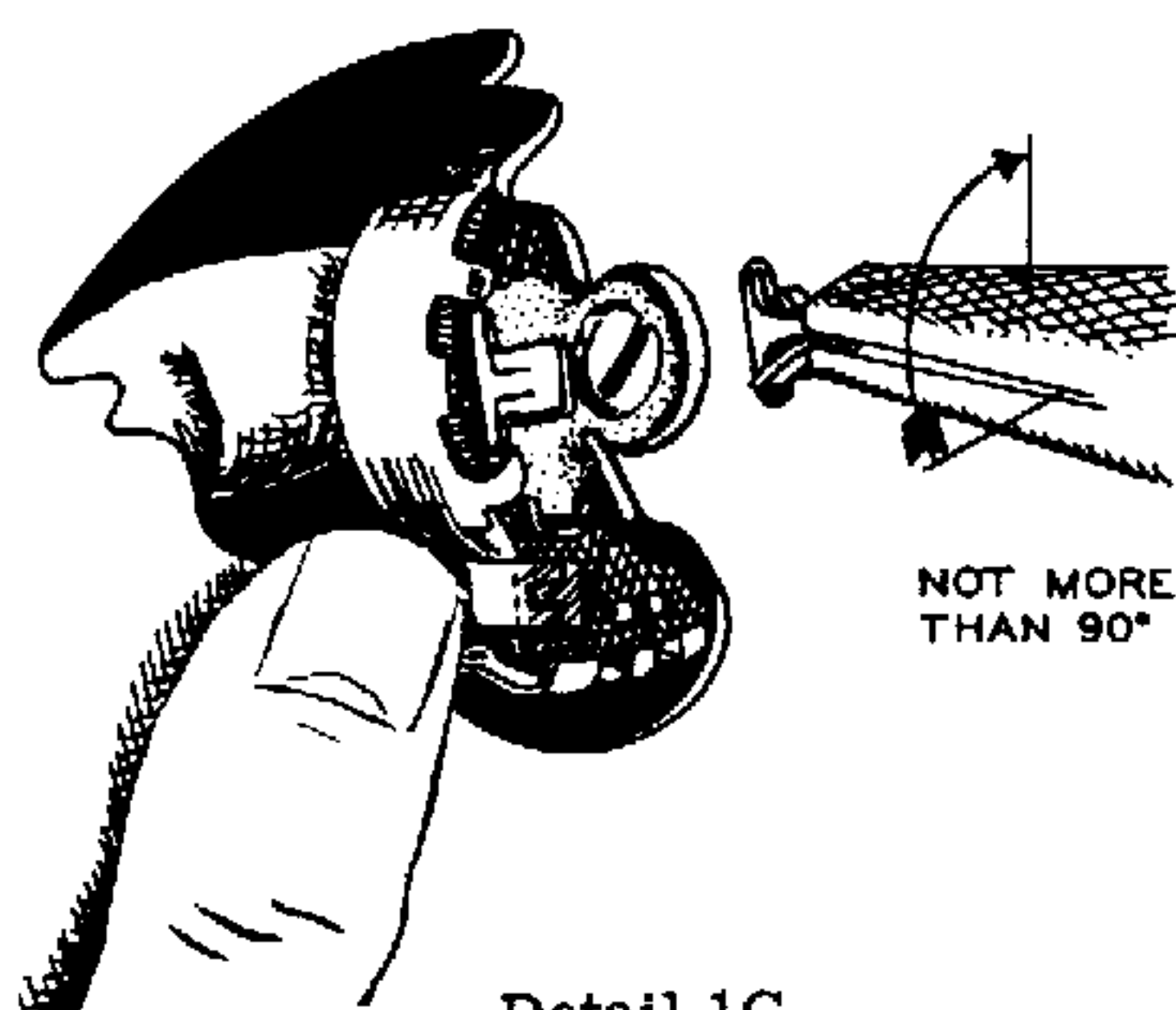
Detail 1B

(✓) Locate the octal power plug (#438-22) and the retaining ring (#435-1). Referring to Detail 1B, mount the octal plug at C. Position the key on the power plug so that it is pointing toward the bottom edge of the chassis flange. Secure the plug with the retaining ring.

Pictorial 1

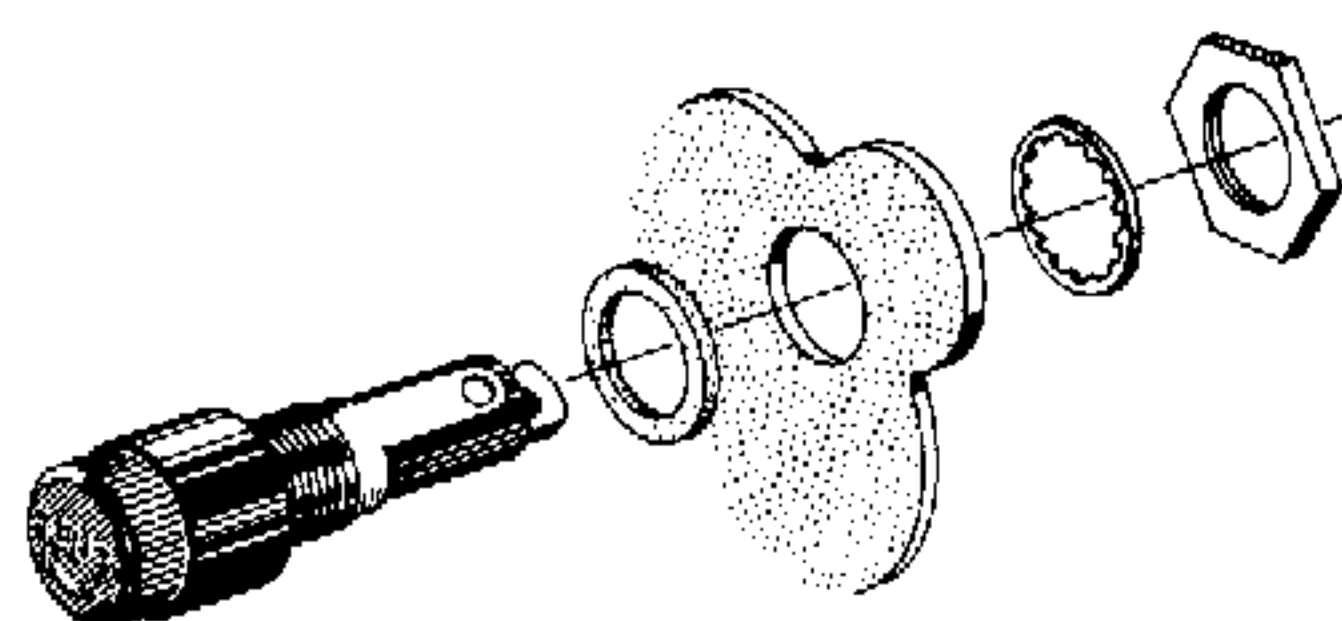






Detail 1C

- (✓) Mount the 500 K Ω control B. Referring to Detail 1C, secure the control by twisting each mounting tab approximately 1/8 turn with long-nose pliers.



Detail 1D

- (✓) Referring to Detail 1D, mount fuse holder A. Use the hardware that is furnished with the fuse holder. Bend lug 2 of the fuse holder up slightly so that a wire can be connected to it later.

Cut the power transformer (#54-87) leads to the following lengths. Strip 1/4" of insulation from the end of each wire (unless directed otherwise) and tin the wire. (Tin means to melt a small amount of solder on the bare end of the wire.)

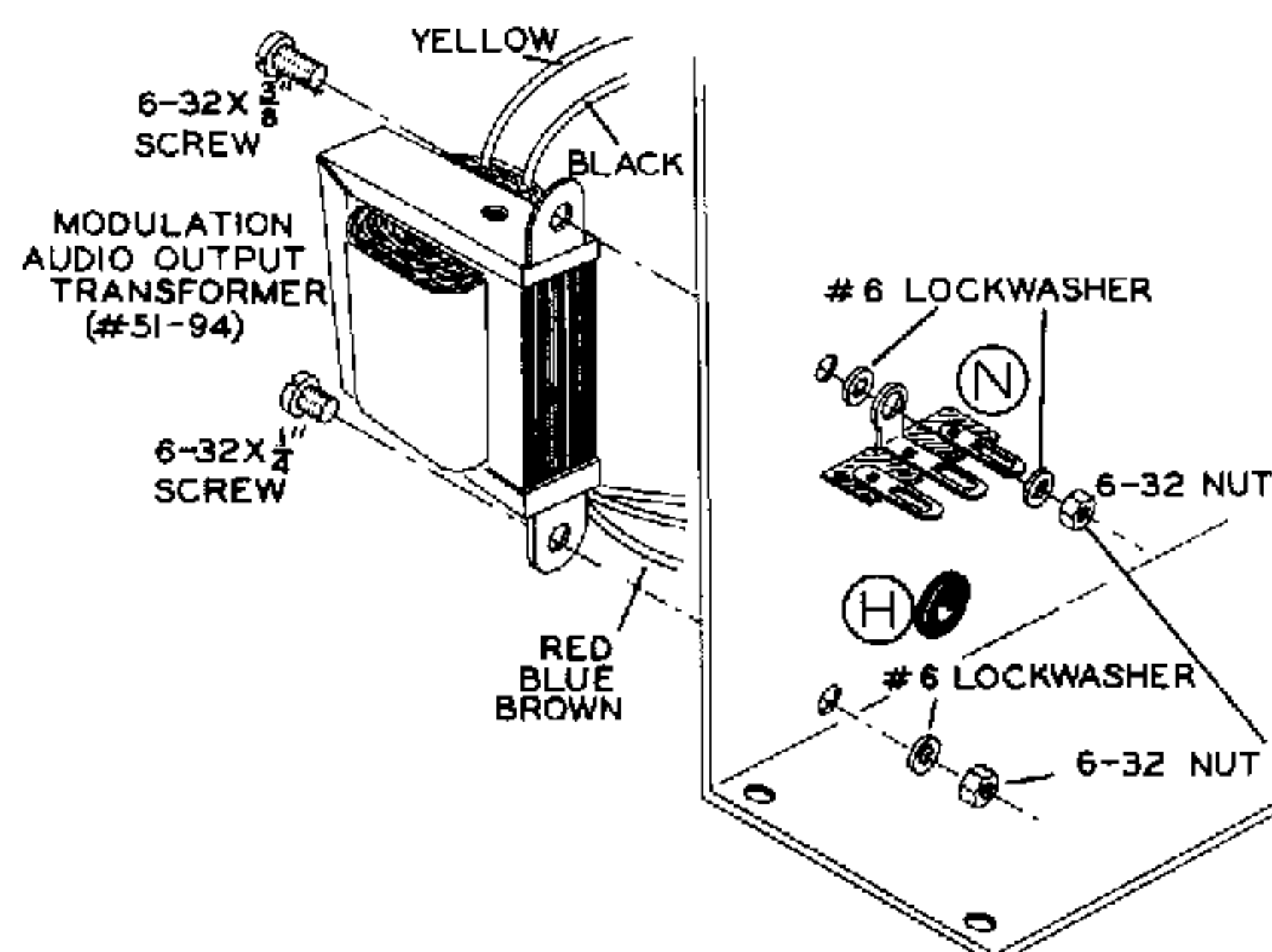
COLOR	LENGTH
() Either black	5-3/4"
() Other black	5-3/4"*
() Either green	4-1/2"*
() Other green	3-1/4"

The red wires are of proper length and need not be cut.

*Remove 5/8" of insulation.

Similarly, prepare the combination modulation-audio transformer (#51-94) leads to the following lengths:

COLOR	LENGTH
() Brown	3-1/2"
() Red	4-3/4"
() Blue	3-3/4"
() Black	3"
() Yellow	3-1/2"

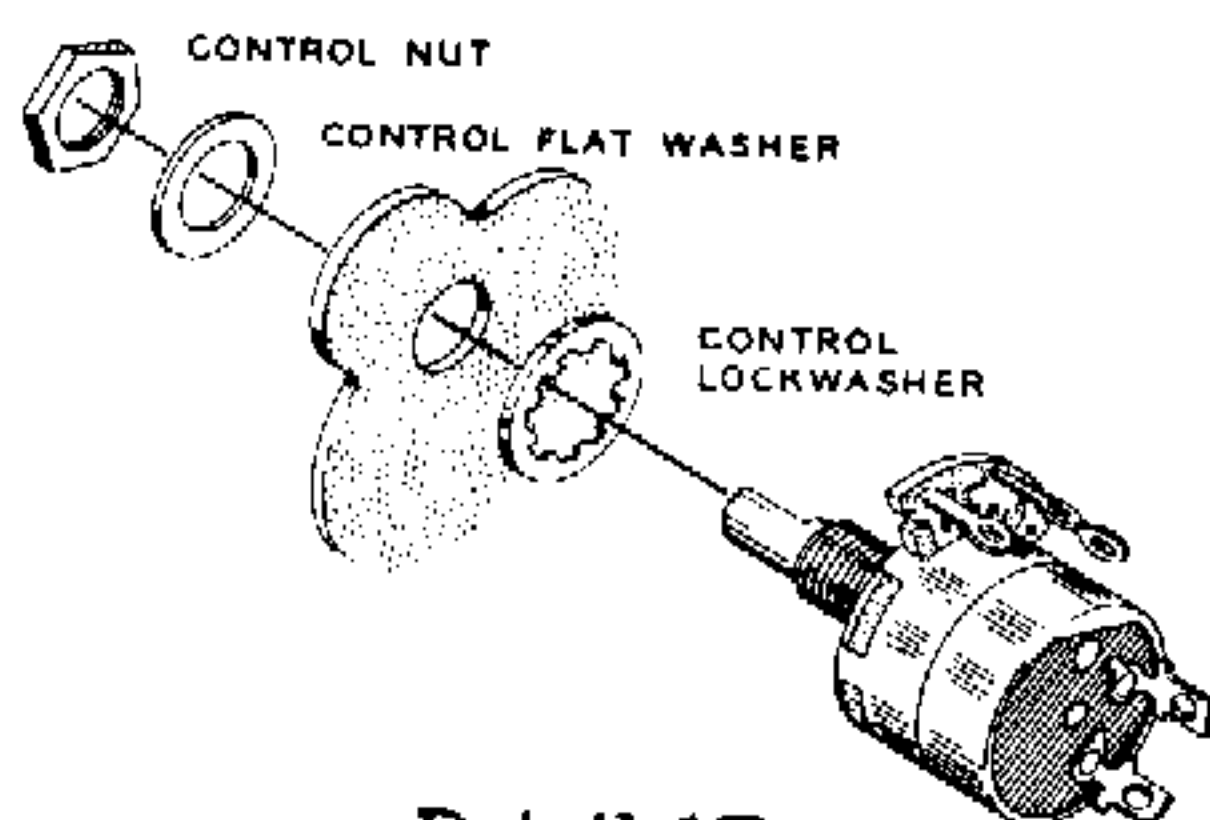


Detail 1E

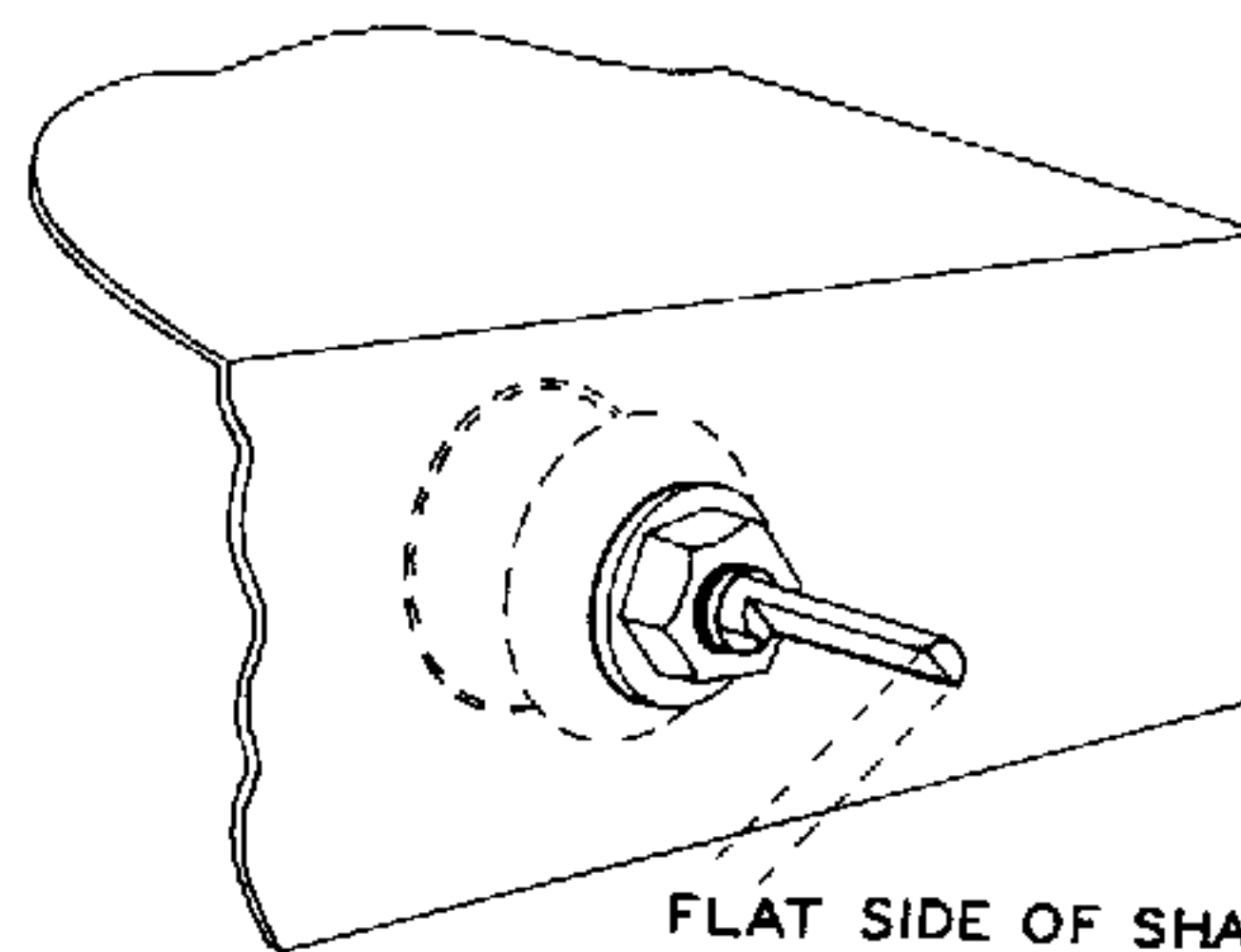
- (✓) Referring to Detail 1E, mount the combination modulation-audio (#51-94) transformer and 3-lug terminal strip N. Orient the transformer so that the red, blue and brown leads are next to grommet H. Place a 6-32 x 3/8" screw through the transformer mounting foot, then through the chassis. Slip a #6 lockwasher and 3-lug terminal strip N over the screw. Secure the screw with another #6 lockwasher and 6-32 nut.
- (✓) Now, secure the other mounting foot with a 6-32 x 1/4" screw, #6 lockwasher and 6-32 nut.
- (✓) Similarly, mount the power transformer (#54-87), 4-lug terminal strip K and 1-lug terminal strip L. Orient the power transformer so that the red and green wires are located close to grommet J. Use 6-32 x 3/8" screws. See Pictorial 1 (fold-out from Page 10) and Pictorial 11 (fold-out from Page 16).

NOTE: In the following steps, unless otherwise specified, #6 hardware will be used. In all steps calling for #6 hardware, use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

- (✓) Install the capacitor mounting wafer, using #6 hardware. Note that the wafer mounts on the bottom of the chassis.
- (✓) Mount the 4-section electrolytic capacitor I. Orient the lugs as shown in Pictorial 1. Secure the capacitor by twisting each tab approximately $1/8$ turn with long-nose pliers.
- (✓) Mount two #6 solder lugs at location P, one on top of the chassis and one below. Position each as shown in Pictorial 1 and secure with a 6-32 x $1/4$ " screw and 6-32 nut.
- (✓) Mount 3-lug terminal strip S. Use #6 hardware with a lockwasher on each side of the mounting foot.
- (✓) Mount 4-lug terminal strip AA on top of the chassis. Use #6 hardware. Orient as shown in Pictorial 1, using a lockwasher on each side of the mounting foot.



Detail 1F



Detail 1G

FLAT SIDE OF SHAFT
SHOULD FACE AS
SHOWN WITH SWITCH
IN FULL COUNTER-
CLOCKWISE POSITION

- (✓) Similarly, mount the TRANSMIT-RECEIVE switch Z, noting Pictorial 1 and Detail 1G. Momentarily place the lever knob (#462-86) on the shaft, and check for proper orientation of the switch against the switch lever positions indicated on the control function drawing on Page 33.

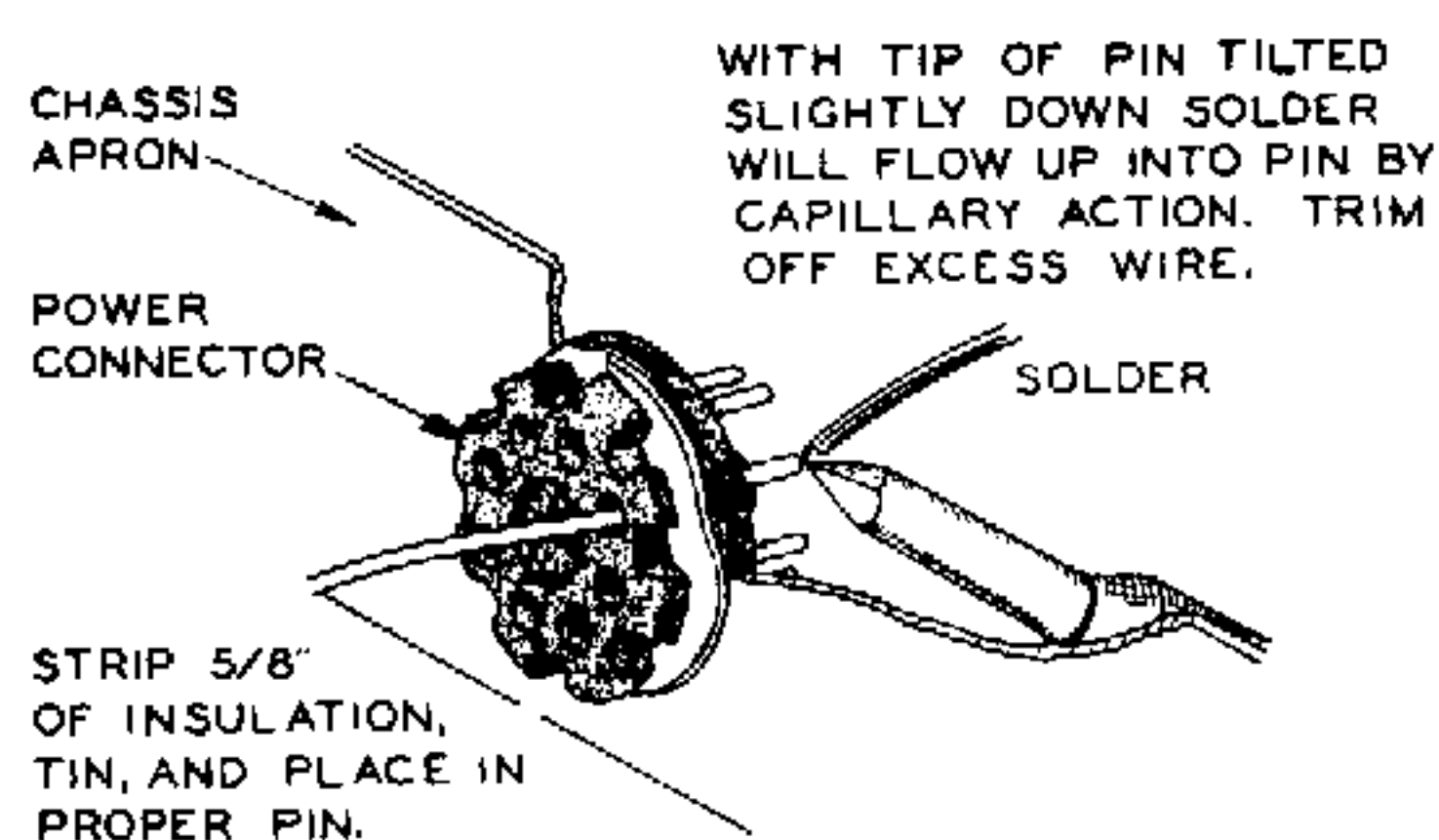
PRELIMINARY WIRING

Refer to Pictorial 2 (fold-out from Page 15) for the following steps.

- (✓) Solder twist-mounting lug 4 of electrolytic capacitor I to the capacitor mounting wafer to establish a good electrical ground.
- (✓) Now, place the power transformer leads through grommet J.
- (✓) Connect the short red power transformer lead to lug 4 of terminal strip K (NS).
- (✓) Connect the other red lead to lug 2 of terminal strip L (NS).

- (✓) Referring to Detail 1F, temporarily mount the 1 megohm control with switch at X. Use a control lockwasher, flat control washer and nut.

- () Connect the short green lead of the power transformer to lug 1 of filter capacitor I (NS).



Detail 2A

- (✓) Connect the other green lead to pin 4 of power plug C (S-1). See Detail 2A.
- (✓) Connect the black lead of the power transformer from which 5/8" of insulation has been removed, to pin 8 of power plug C (S-1).
- (✓) Connect the other black lead from the power transformer to lug 1 of fuse holder A (NS).
- (✓) Place all of the modulation-output transformer leads, except the black lead, through grommet H.
- (✓) Connect the yellow lead to lug 3 of terminal strip N (NS).
- () Connect the blue lead to lug 1 of terminal strip N (NS).
- () Connect the brown lead to lug 5 of tube socket V2 (NS).
- () Connect the red lead to lug 6 of tube socket V2 (NS).

NOTE: In wiring the HW-29A, use hookup wire unless otherwise directed in the step.

- () Connect a 2" wire from lug 5 of tube socket V1 (NS) to lug 4 of tube socket V2 (NS).
- () Connect a 4-3/4" wire from lug 3 of tube socket V2 (NS) to lug 5 of tube socket V3 (NS).

- (✓) Strip 5/8" of insulation from one end of a 7-1/2" wire. Connect this end to pin 2 of power plug C (S-1). Connect the other end to lug 4 of tube socket V2 (S-2).
- (✓) Strip 5/8" of insulation from one end of a 2-1/2" wire. Connect this end to pin 1 of power plug C (S-1). Connect the other end to lug 3 of control B (NS).
- (✓) Connect a 2" wire from lug 3 of control B (S-2) to lug 2 of electrolytic capacitor I (S-1).
- (✓) Connect a 2" wire from lug 3 of tube socket V2 (NS) to lug 9 of tube socket V1 (NS).
- (✓) Strip 5/8" of insulation from one end of a 7-3/4" wire. Connect this end to pin 3 of power plug C (S-1). Connect the other end of this wire to lug 3 of tube socket V2 (S-3).
- () Connect a 5" wire from lug 5 of tube socket V3 (NS) to lug 4 of tube socket V4 (NS).
- (✓) Connect a 2" wire from lug 4 of tube socket V4 (NS) to lug 5 of tube socket V5 (NS).
- (✓) Connect an 8" wire from lug 1 of terminal strip Q (NS) to lug 8 of switch Z (S-1).
- (✓) Connect a 3-3/4" wire from lug 8 of tube socket V1 (NS) to the unmarked lug of electrolytic capacitor I (S-1).
- (✓) Connect a 4-1/2" wire from lug 2 of the socket V2 (S-1) to lug ■ of electrolytic capacitor I (NS).
- (✓) Connect a 3" wire from lug 6 of tube socket V2 (NS) to lug ■ of electrolytic capacitor I (NS).
- (✓) Connect an 8-1/2" wire from lug ■ of electrolytic capacitor I (NS) to lug 3 of switch Z (NS).
- (✓) Connect an 8" wire from lug 1 of terminal strip N (NS) to lug 3 of terminal strip S (NS).
- () Connect a 9-1/4" wire from lug 3 of terminal strip N (S-2) to lug 4 of switch Z (S-1).
- (✓) Connect a 4-1/4" wire from lug 3 of terminal strip R (NS) to lug ■ of electrolytic capacitor I (NS).

HEATHKIT

(✓) Connect a 8-1/2" wire from lug 3 of terminal strip R (NS) to lug 9 of switch Z (S-1).

(✓) Connect a 2" wire from lug 2 of terminal strip R (NS) to lug 1 of control X (S-1).

() Twist two 7" wires together. Strip 5/8" of insulation from one end of one wire and 1/4" from each of the three other wire ends.

(✓) Connect the end of the wire stripped 5/8" to pin 6 of power plug C (S-1). Connect the other wire at this end of the twisted pair to lug 2 of fuse holder A (S-1).

NOTE: Lugs 4 and 5 of control X may or may not be positioned as shown in the pictorial. Since these two lugs represent the switch connections, either may be used as lug 4, and the other as lug 5.

(✓) Connect the other end of either of the twisted wires to lug 4 of control X (S-1).

(✓) Connect the other twisted wire to lug 5 of control X (S-1).

(✓) Strip 5/8" of insulation from one end of a 3-1/2" wire. Connect this wire from pin 5 of power plug C (S-1) to lug 2 of terminal strip K (NS).

(✓) Connect a 7" wire from lug 1 of control B (S-1) to lug 1 of terminal strip S (NS).

(✓) Connect a 3-1/4" wire from lug 2 of control B (S-1) to lug 1 of terminal strip K (NS).

(✓) Connect a 1-1/2" wire from lug 2 of terminal strip S (NS) to lug 6 of switch Z (S-1). Place the wire close to the chassis to avoid lug 3 of terminal strip S and switch lug 7.

(✓) Connect a 3" wire to lug 2 of switch Z (NS). Insert the free end of this wire through grommet U. It will be connected later.

(✓) Connect a 3-1/4" wire to lug 3 of switch Z (S-2). Insert the free end of this wire through grommet U. It will be connected later.

() Connect a 3-1/2" wire from lug 1 of terminal strip S (NS) to lug 1 of switch Z (S-1).

() Connect a 10" wire from lug 5 of tube socket V1 (NS) to lug 5 of tube socket V4 (NS).

NOTE: For the following steps, use the heavy bare wire or use completely stripped hookup wire, whichever is indicated. When using ordinary hookup wire, it is usually best to wrap the leads around the lugs. However, it is suggested that you do not attempt to wrap the heavy bare wire, since you may damage the component.

(✓) Connect a length of stripped hookup wire between lug 3 (NS) and the center post (NS) of tube socket V1.

(✓) Connect a length of stripped hookup wire from the center post of tube socket V1 (NS), through lug 4 of V1 (NS) to the hole in the bottom of lug 2 of terminal strip R (NS).

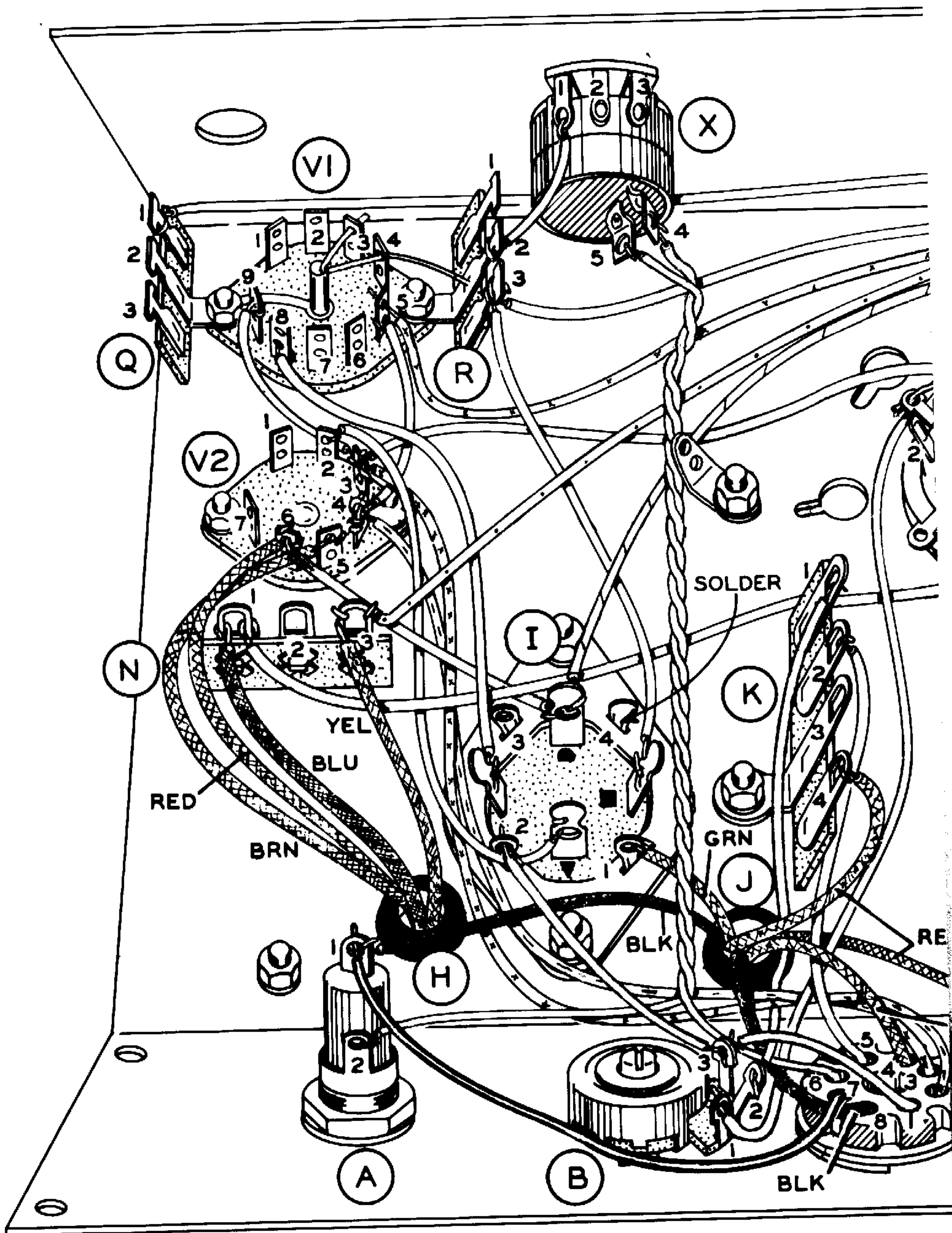
(✓) Connect a length of stripped hookup wire from the center post of tube socket V3 (NS), through lug 4 (NS) to the nearest ground lug on V3 (NS).

(✓) Connect a length of stripped hookup wire from the ground lug nearest lug 6 of tube socket V4 (S-1), through lug 7 (NS) to the center post of V4 (NS). Now solder lug 7 (S-2).

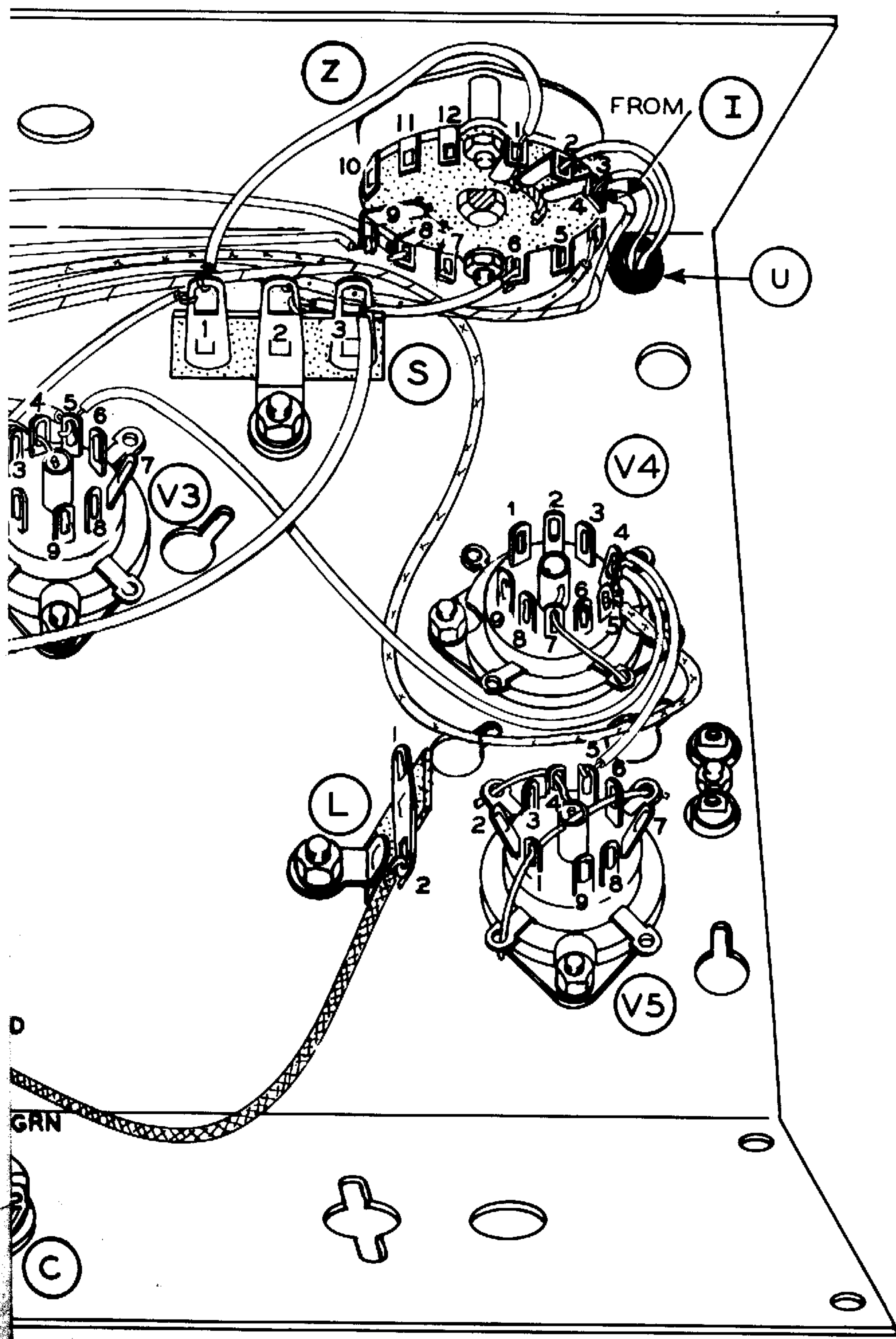
(✓) Connect a length of stripped hookup wire from the ground lug nearest lug 1 of tube socket V5 (NS), through lug 1 (NS), through the center post (NS), through lug 6 (NS), and to the ground lug nearest lug 6 of V5 (NS). Now solder lugs 1 and 6 of V5.

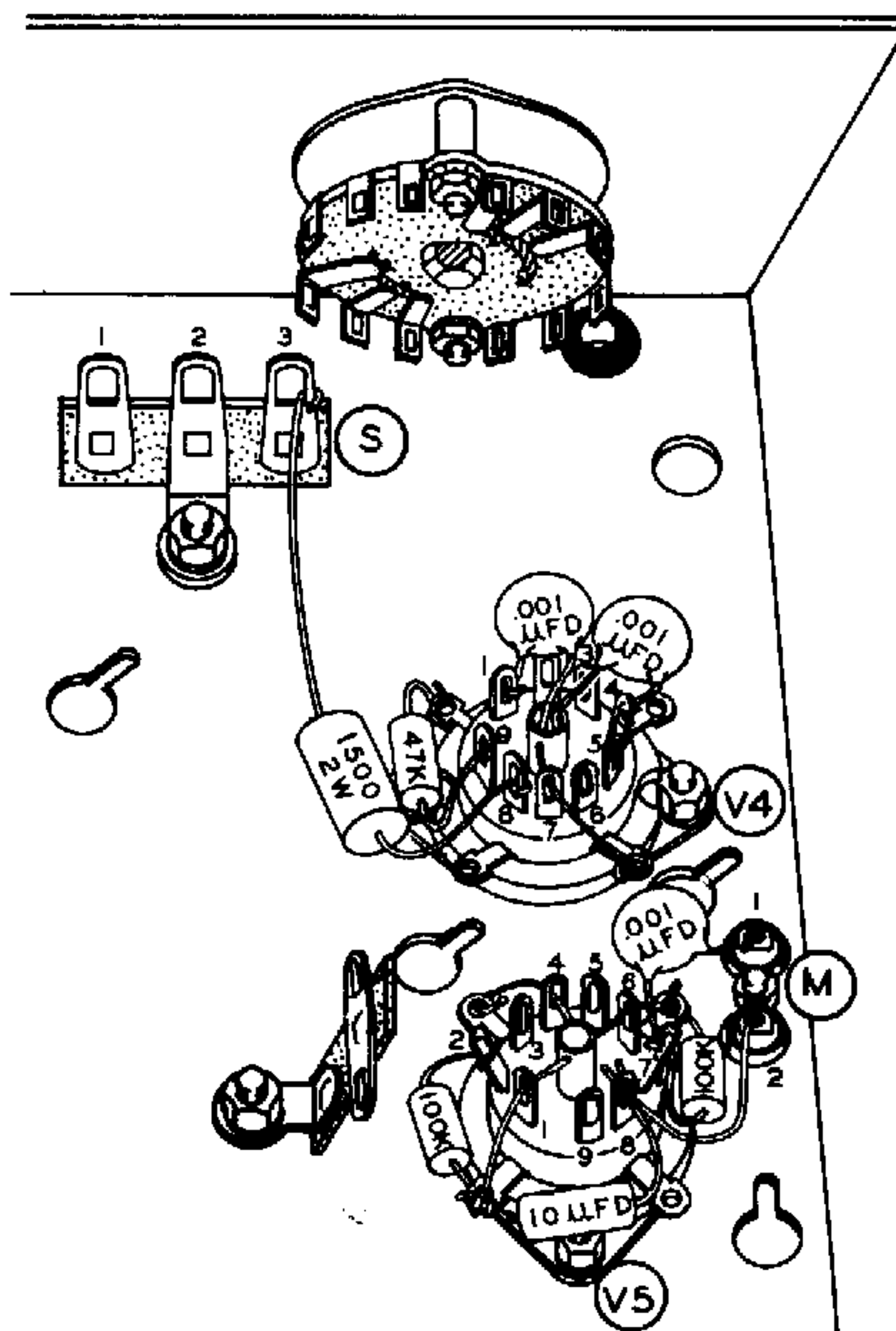
(✓) Connect a length of stripped hookup wire from the ground lug nearest lug 4 of tube socket V5 (NS), up through lug 4 (NS) to the center post (NS). Now solder lug 4 (S-2).

(✓) Connect a length of heavy bare wire from pin 7 of power plug C (S-1) to lug 1 of fuse holder A (S-2). Use sleeving.



Pictorial 2





Pictorial 3

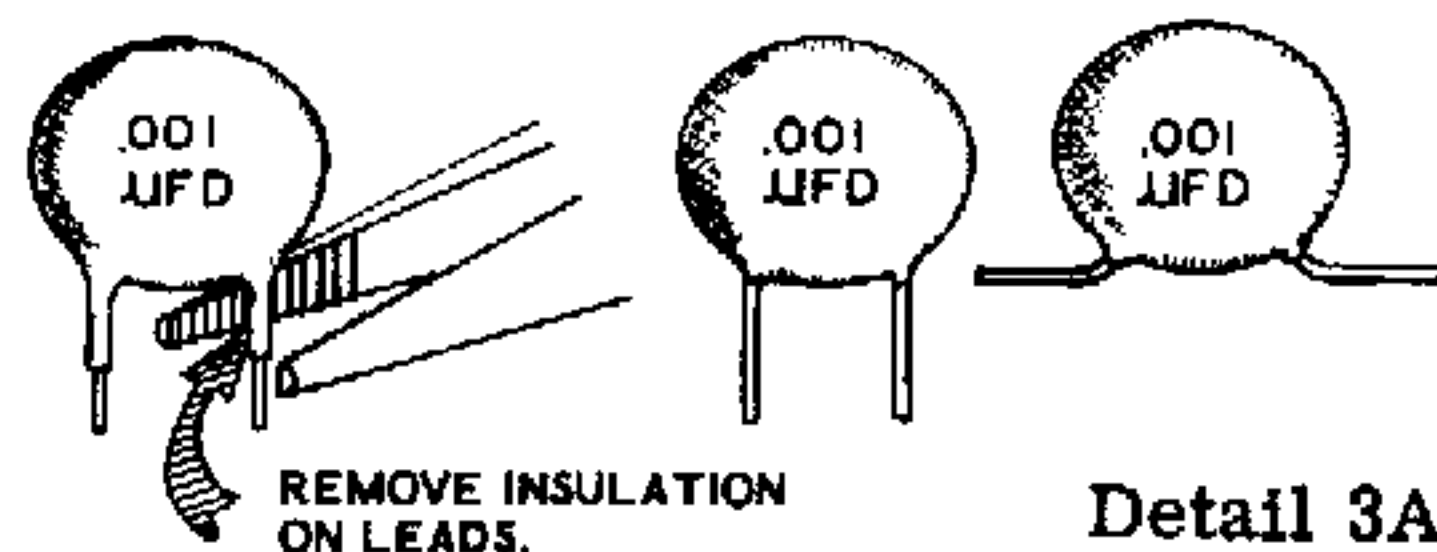
RF SECTION WIRING

NOTE: Due to the characteristic of very high radio frequencies, all component leads should be kept to their shortest possible physical length.

Refer to Pictorial 3 for the following steps.

- (✓) R4. Connect a 47 K Ω (yellow-violet-orange) resistor from lug 9 of tube socket V4 (NS) to the ground lug nearest lug 1 of V4 (S-1).
- (✓) R3. Connect a 100 K Ω (brown-black-yellow) resistor from lug 2 of tube socket V5 (NS) to the ground lug nearest lug 1 of tube socket V5 (NS).
- (✓) R1. Connect a 100 K Ω (brown-black-yellow) resistor from lug 7 of tube socket V5 (NS) to the ground lug nearest lug 6 of V5 (S-2).
- (✓) R6. Connect a 1500 Ω (brown-green-red) 2-watt resistor from lug 8 of tube socket V4 (NS) to lug 3 of terminal strip S (NS).
- (✓) Connect a length of stripped hookup wire from lug 8 of tube socket V5 (NS) to lug 2 of crystal socket M (NS).

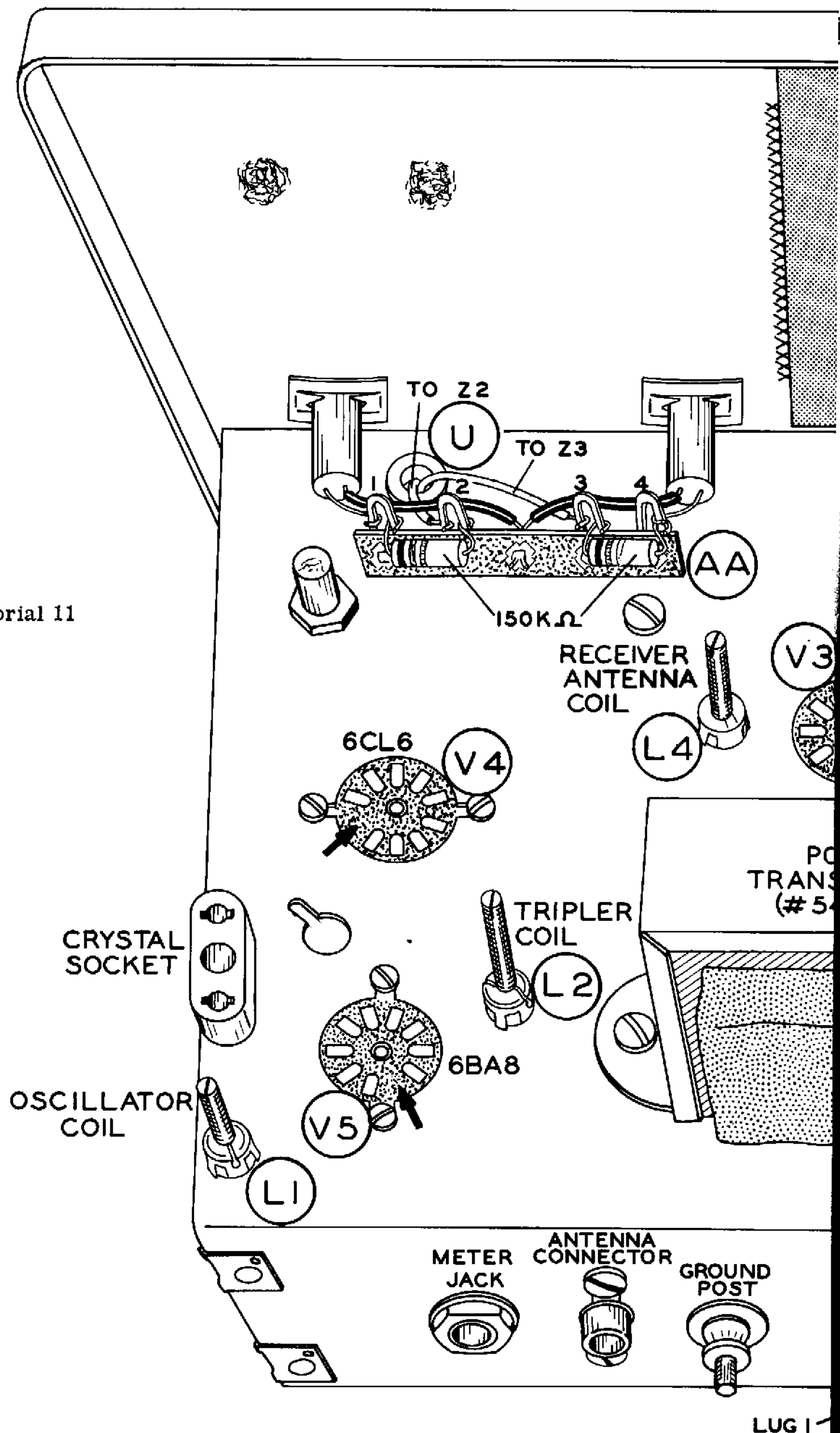
- () C3. Connect a 10 μfd tubular ceramic capacitor from lug 8 (S-2) to the ground lug nearest lug 1 (S-3) of tube socket V4 (NS).

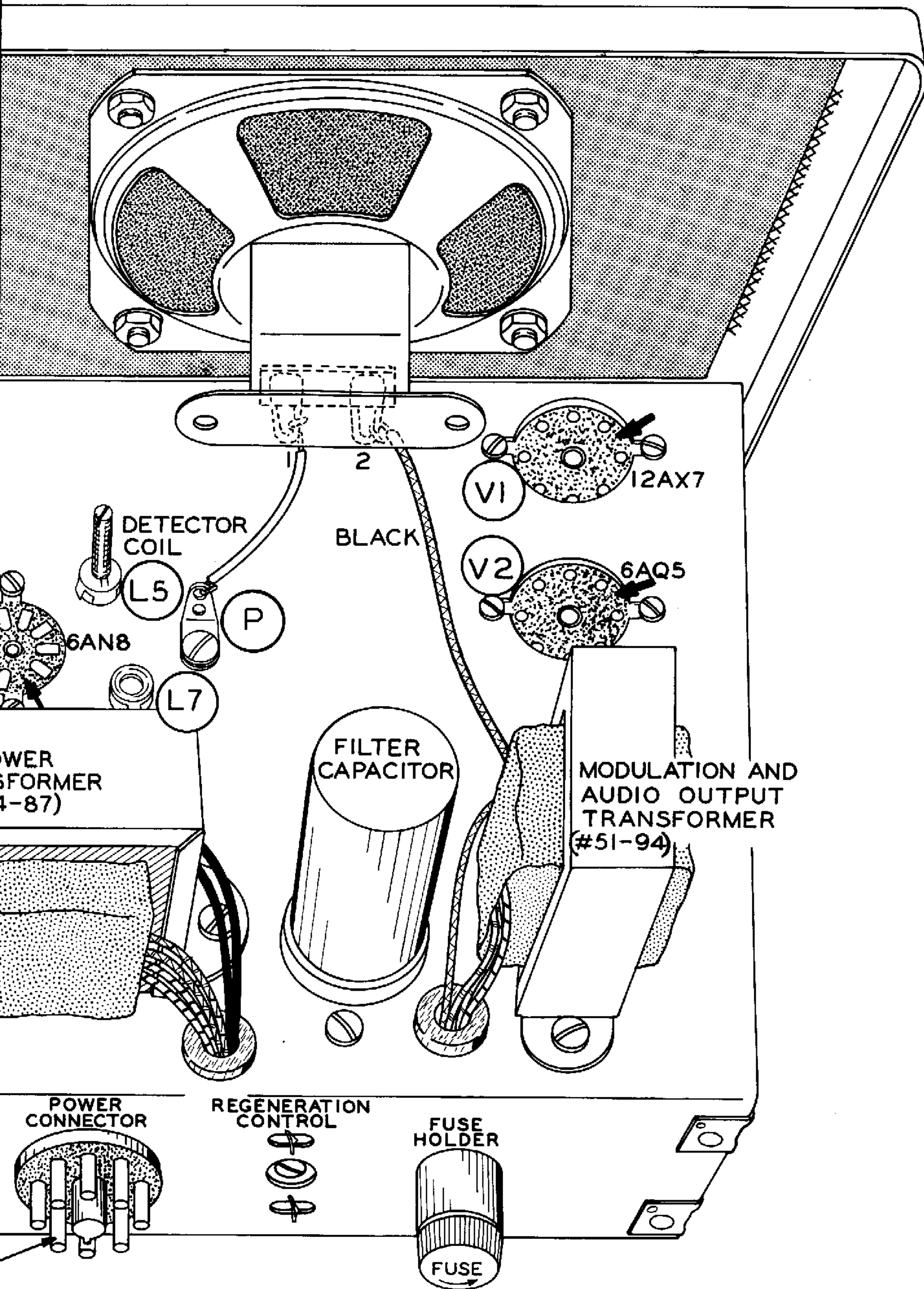


NOTE: The .001 μfd capacitor leads should be kept as short as possible. Refer to Detail 3A for preparation of the capacitors.

- () C1. Connect a .001 μfd disc ceramic capacitor from lug 1 of crystal socket M (NS) to lug 7 of tube socket V5 (S-2).
- () C7. Connect a .001 μfd disc ceramic capacitor from lug 4 of tube socket V4 (NS) to the center post of V4 (NS).
- () C10. Connect a .001 μfd disc ceramic capacitor from lug 1 (NS) to the center post (NS) of tube socket V4.

Pictorial 11

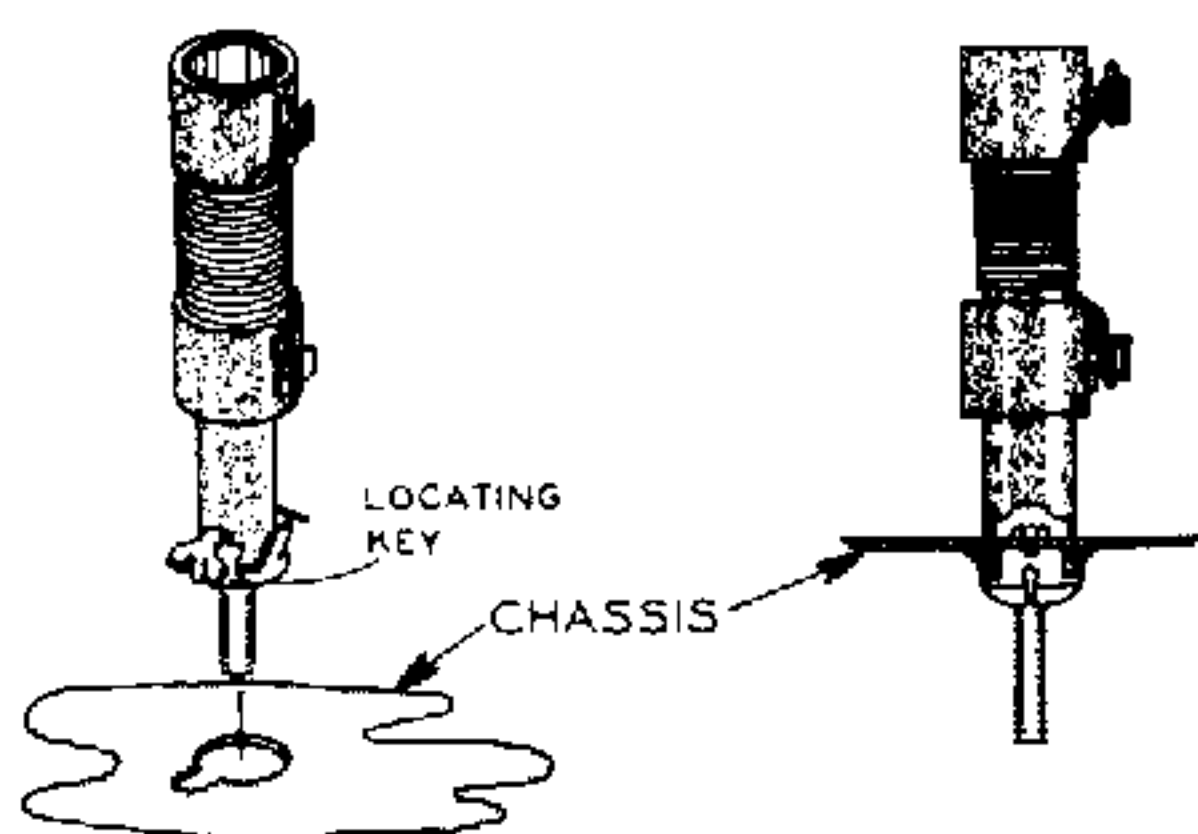




Refer to Pictorial 4 for the following steps.

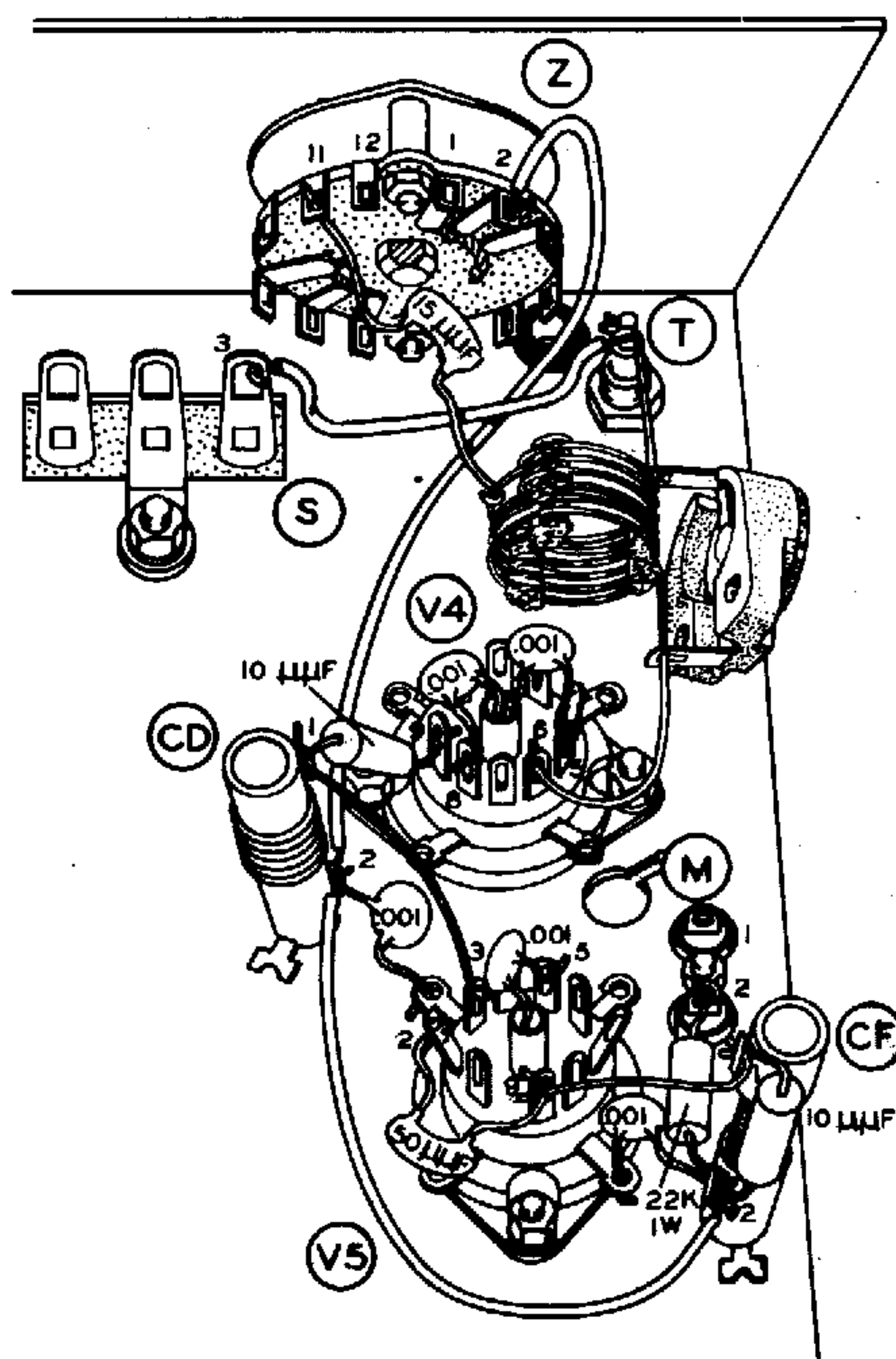
- (✓) C39. Connect a .001 μ fd disc ceramic capacitor from lug 5 of tube socket V4 (S-2) to the center post of V4 (NS).

NOTE: To mount a coil, position the coil so that the locating key is in line with the keyway in the coil mounting hole. Press the coil into hole until it snaps into place. See Detail 4A.



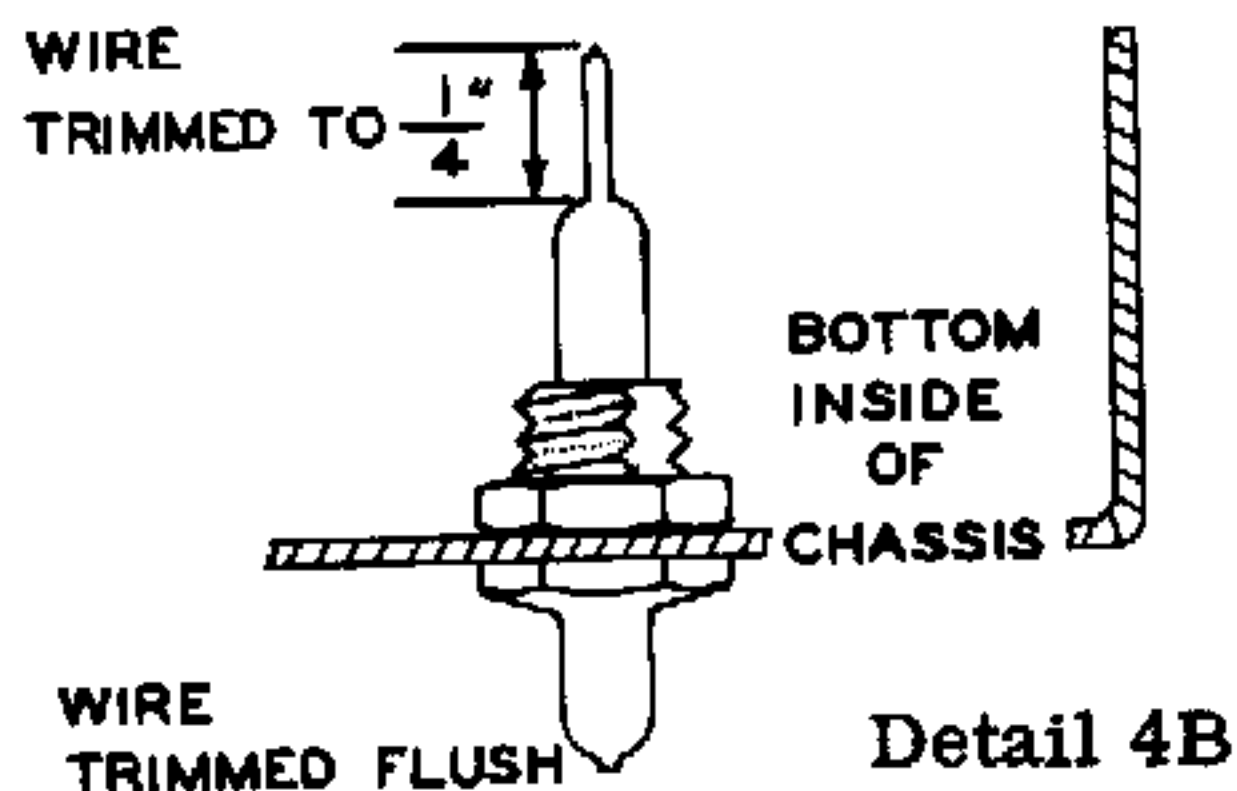
Detail 4A

- (✓) Mount the tripler plate coil CD (#40-307).
- (✓) C9. Connect a .001 μ fd disc ceramic capacitor from lug 2 of coil CD (NS) to the ground lug nearest lug 3 of tube socket V5 (S-2).
- (✓) C40. Connect a .001 μ fd disc ceramic capacitor from lug 8 of tube socket V4 (S-2) to the center post of V4 (S-5).
- (✓) C8. Connect a 10 μ fd tubular ceramic capacitor from lug 1 of coil CD (NS) to lug 9 of tube socket V4 (S-2).
- (✓) Mount the oscillator coil CF (#40-186).
- (✓) Connect a 3" length of hookup wire from lug 2 of coil CD (NS) to lug 2 of coil CF (NS).
- (✓) R2. Connect a 22 K Ω (red-red-orange) 1 watt resistor from lug 2 of crystal socket M (S-2) to lug 2 of coil CF (NS).
- (✓) Connect a 4-3/4" length of hookup wire from lug 2 of coil CD (S-3) to lug 2 of switch Z (S-2).
- (✓) C4. Connect a .001 μ fd disc ceramic capacitor from lug 2 of coil CF (NS) to the ground lug nearest lug 8 of tube socket V5 (S-1).

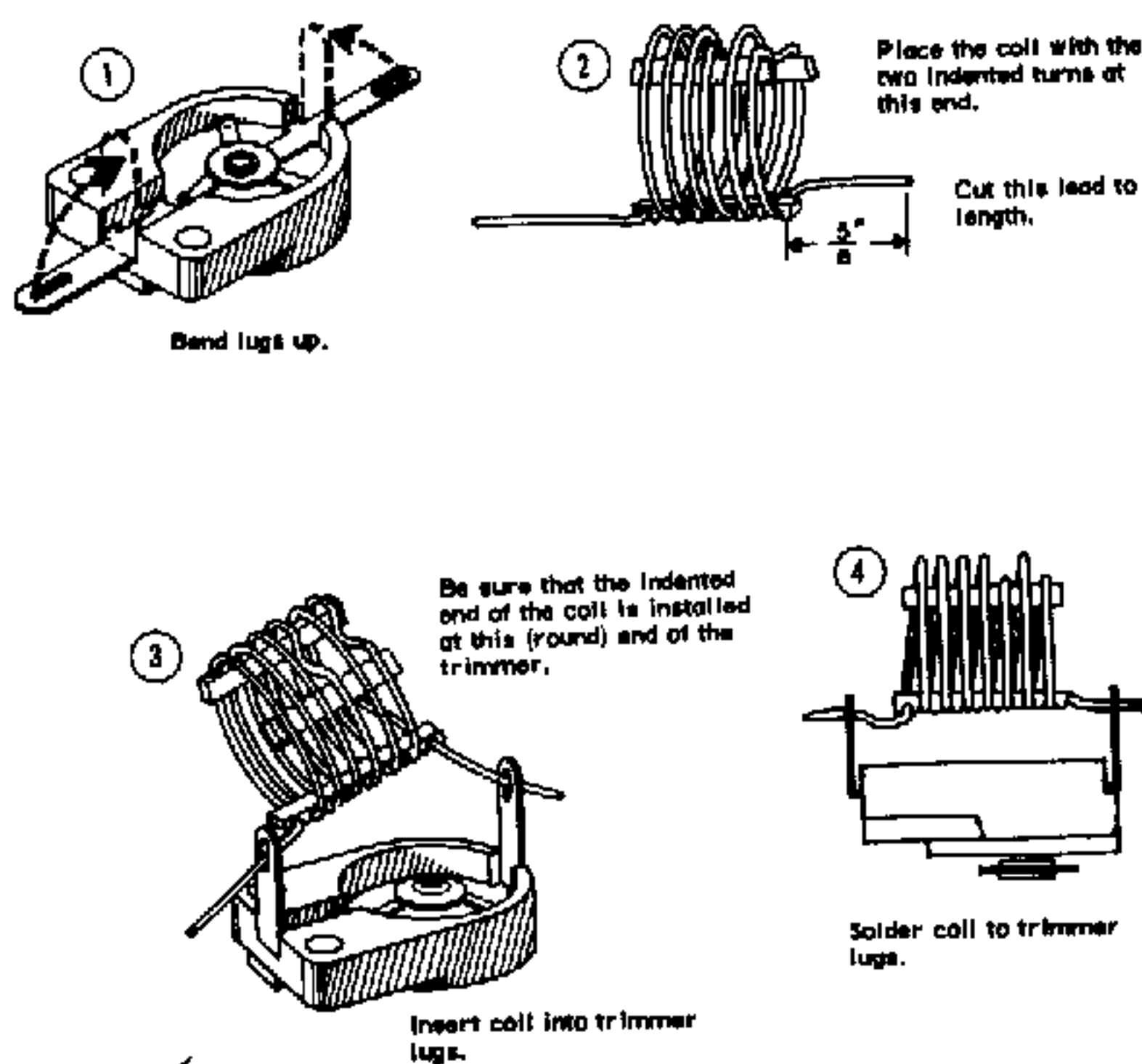


Pictorial 4

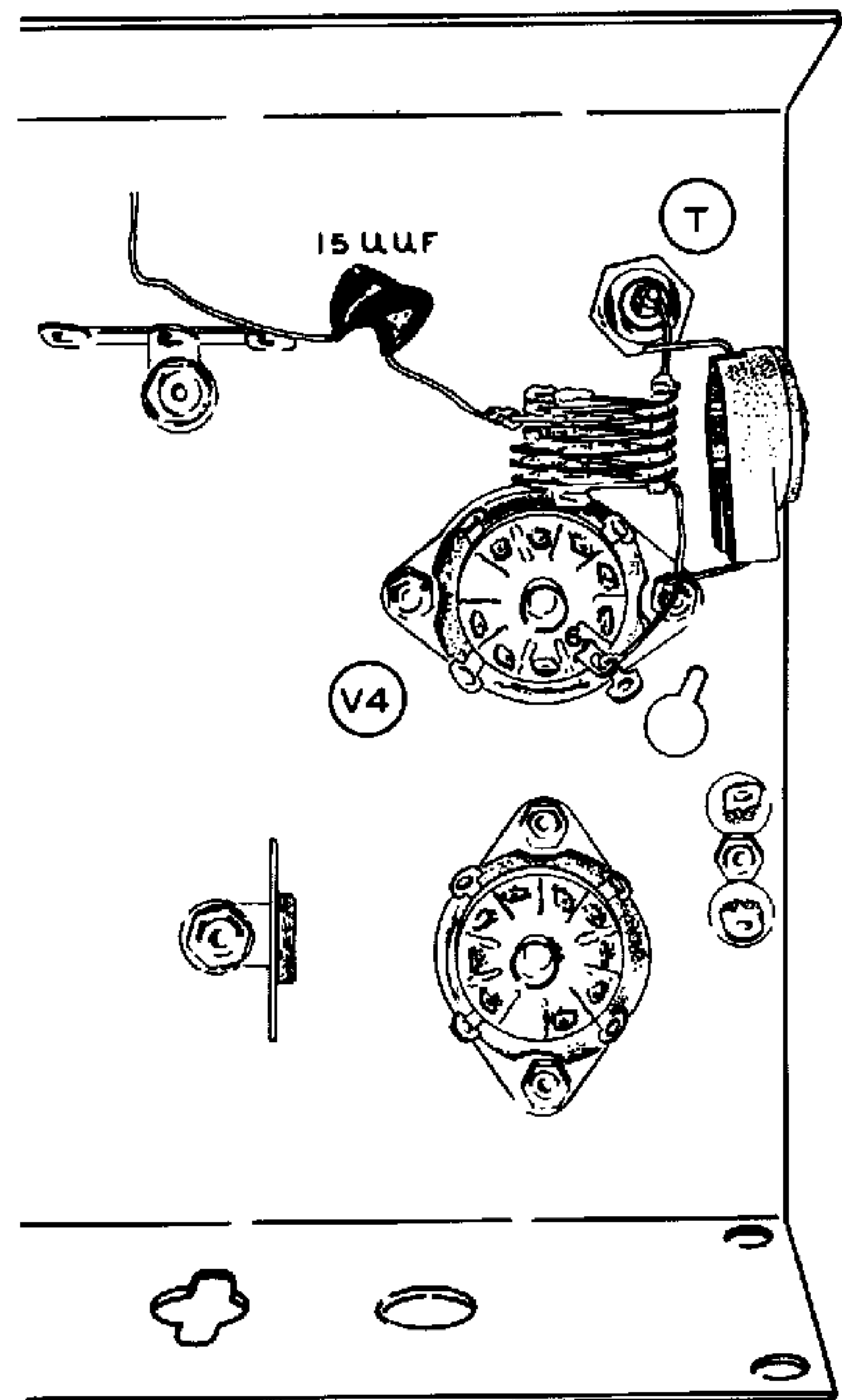
- (✓) C5. Connect a 10 μ fd tubular ceramic capacitor between lugs 1 (NS) and 2 (S-4) of coil CF.
- (✓) Connect a length of stripped hookup wire from lug 1 of coil CF (S-2) to lug 9 of tube socket V5 (NS).
- (✓) C6. Connect a 50 μ fd silver mica capacitor between lugs 2 (S-2) and 9 (S-2) of tube socket V5.
- (✓) Connect a length of stripped hookup wire from lug 1 of coil CD (S-2) to lug 3 of tube socket V5 (S-1).
- (✓) C2. Connect a .001 μ fd disc ceramic capacitor from lug 5 (S-2) to the center post (S-4) of V5.



- (✓) Install the .001 μ fd feed-through capacitor T. Use the nut furnished with the capacitor. Do not overtighten this capacitor since you may crack the insulating material. See Detail 4B.
- (✓) Now, cut the lead extending from the top of the feed-through capacitor flush with the top of the insulating material. See Detail 4B.
- (✓) Cut the lead extending from the bottom of the feed-through capacitor to $\frac{1}{4}$ " as shown in Detail 4B.
- (✓) Connect a 2- $\frac{1}{2}$ " wire from lug 3 of terminal strip S (S-3) to feed-through capacitor T (NS).



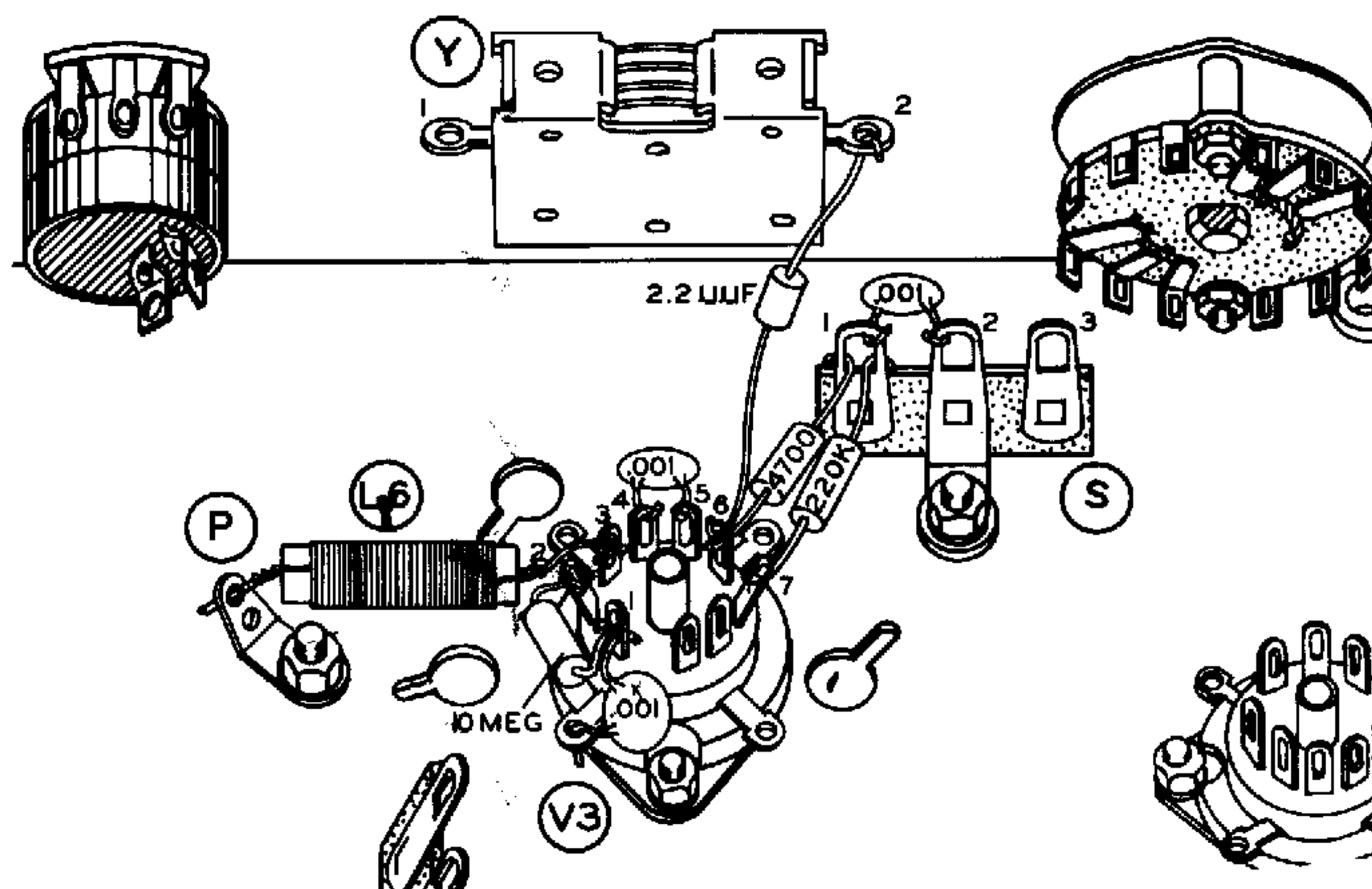
- (✓) Prepare the final tank coil (#40-355) and trimmer capacitor C11 as shown in Detail 4C.
- (1) C11, L3. Connect the long lead of this final tank coil trimmer assembly to lug 6 of tube socket V4 (S-1). Connect a short lead to the feed-through capacitor (S-2). See Detail 4D.



Make sure that the tank coil does not touch any other tube lug on part.

- (✓) C12. Cut one lead of the 15 μ fd silver mica capacitor to $\frac{5}{8}$ ". Connect this lead to the turn that is between the two indented turns on the tank coil (S-1).
- (✓) Connect the other lead of this capacitor to lug 11 of switch Z (S-1).

This completes the wiring of the oscillator and final amplifier section of the HW-29A. Check all connections to be sure that they are securely soldered and see that all components have been properly installed. The only connections in this area that should not be soldered are the lugs of terminal strip L and lug 1 of tube socket V4. The remaining coil mounting hole near V4 is not used.



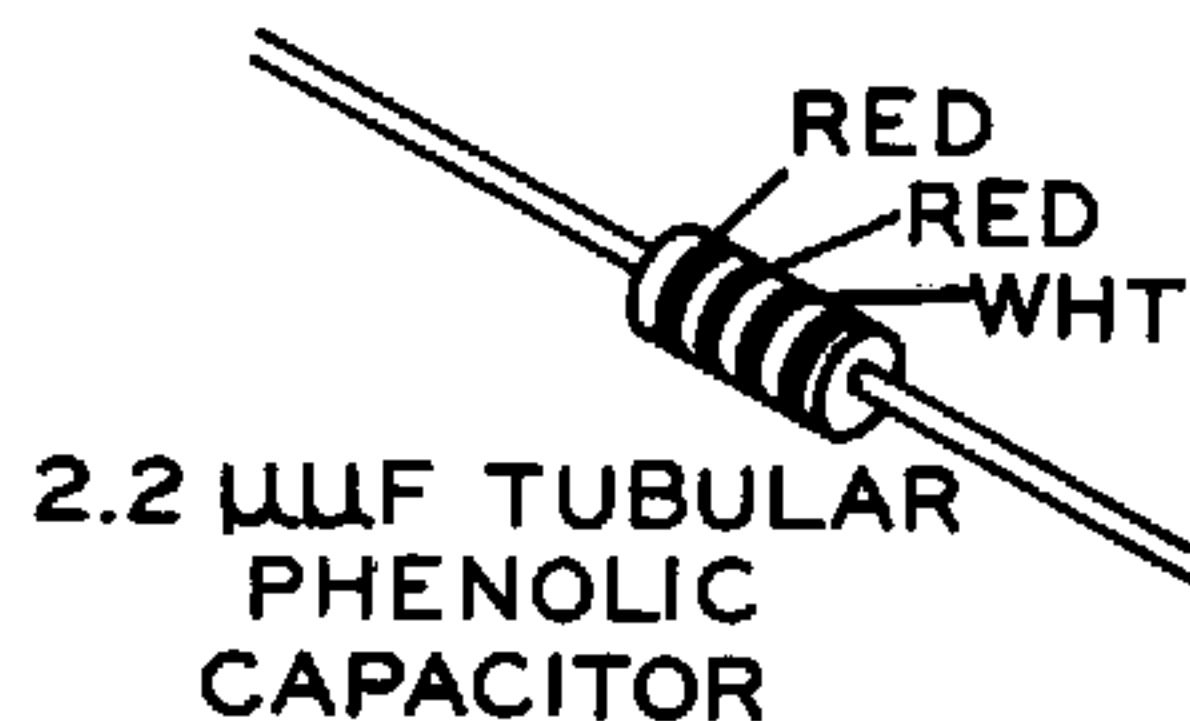
Pictorial 5

RECEIVER SECTION WIRING

Refer to Pictorial 5 for the following steps.

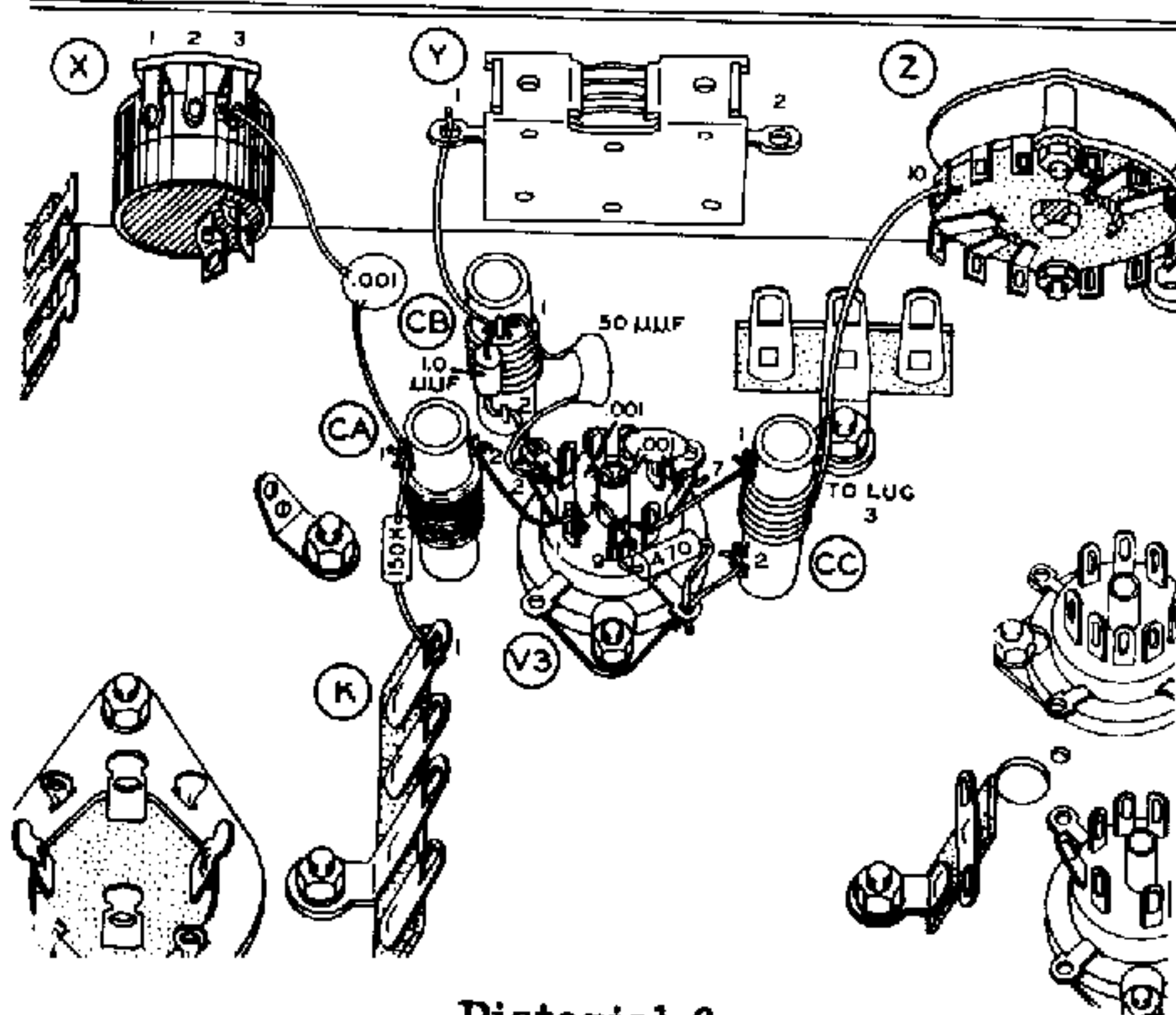
- (✓) C22. Connect a .001 μ fd disc ceramic capacitor from lug 1 (NS) to the nearest ground lug (S-1) of tube socket V3.
- (✓) L6. Connect a 7 μ h RF choke (#45-36) from lug 3 of tube socket V3 (S-1) to ground lug P (S-1).
- (✓) R11. Connect a 10 megohm (brown-black-blue) resistor from lug 1 (NS) to lug 2 (NS) of tube socket V3.
- (✓) R9. Connect a 4700 Ω (yellow-violet-red) resistor from lug 6 of tube socket V3 (NS) to lug 1 of terminal strip S (NS).
- (✓) R8. Connect a 220 K Ω (red-red-yellow) resistor from lug 7 of tube socket V3 (NS) to lug 1 of terminal strip S (NS).
- (✓) C16. Connect a .001 μ fd disc ceramic capacitor from lug 1 (S-5) to lug 2 (S-2) of terminal strip S.

- (✓) Install tuning capacitor Y on the front flange of the chassis. Insert the three 4-40 x 3/16" screws through the holes in the flange and into the tapped holes in the tuning capacitor frame.
- (✓) Connect the 2.2 μ fd tubular phenolic capacitor (see Detail 5A) from lug 6 of tube socket V3 (S-2) to lug 2 of tuning capacitor Y (S-1).



Detail 5A

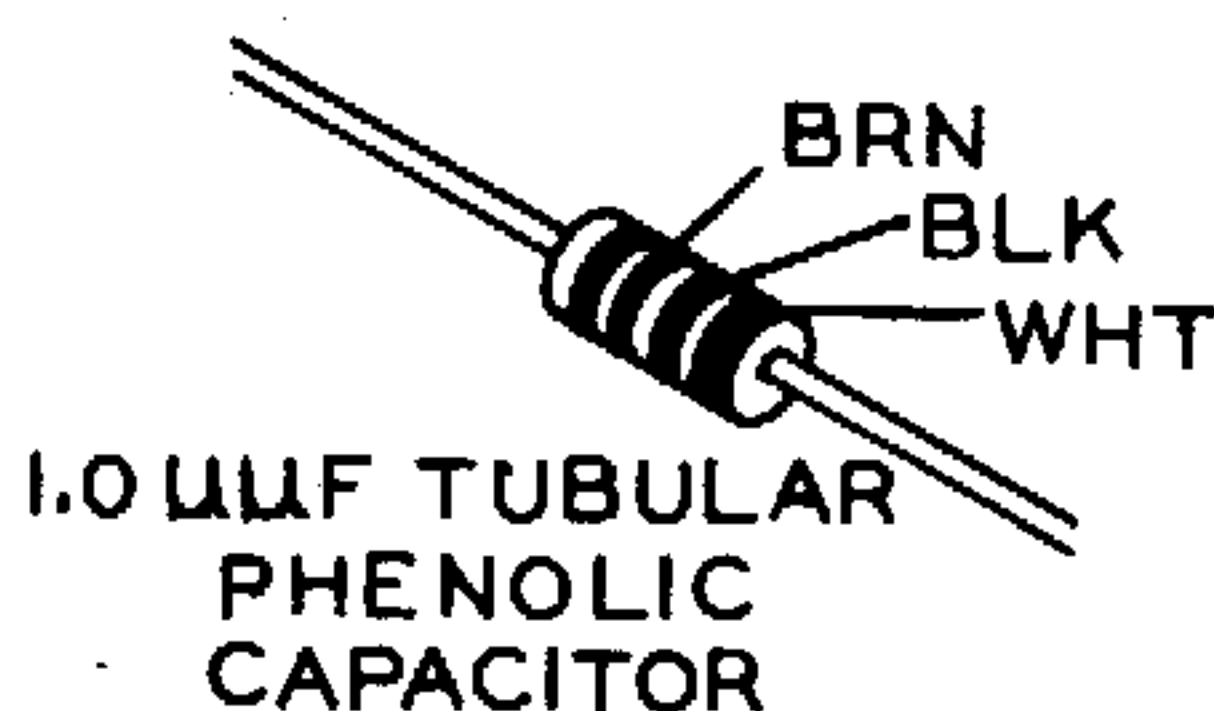
- (✓) C14. Connect a .001 μ fd disc ceramic capacitor from lug 5 (S-3) to lug 4 (S-3) of tube socket V3.



Pictorial 6

Refer to Pictorial 6 for the following steps.

- (✓) L7. Install 75 mh RF choke CA (#45-48)
- (✓) L4, L5. In the same manner, install antenna coil CC (#40-306) and detector coil CB (#40-307).
- (✓) Connect a 1-1/2" length of stripped hookup wire from lug 3 of coil CC (S-1) to lug 10 of switch Z (S-1).
- (✓) Connect a 7/8" length of stripped hookup wire from lug 2 of coil CC (S-1) to the ground lug nearest lug 8 of tube socket V3 (NS).
- (✓) C19. Insert one lead of a 1.0 μmf tubular phenolic capacitor (see Detail 6A) through lug 2 of coil CB (NS) to the ground lug near lug 4 of tube socket V3 (S-2). Now solder lug 2 of coil CB (S-2).



Detail 6A

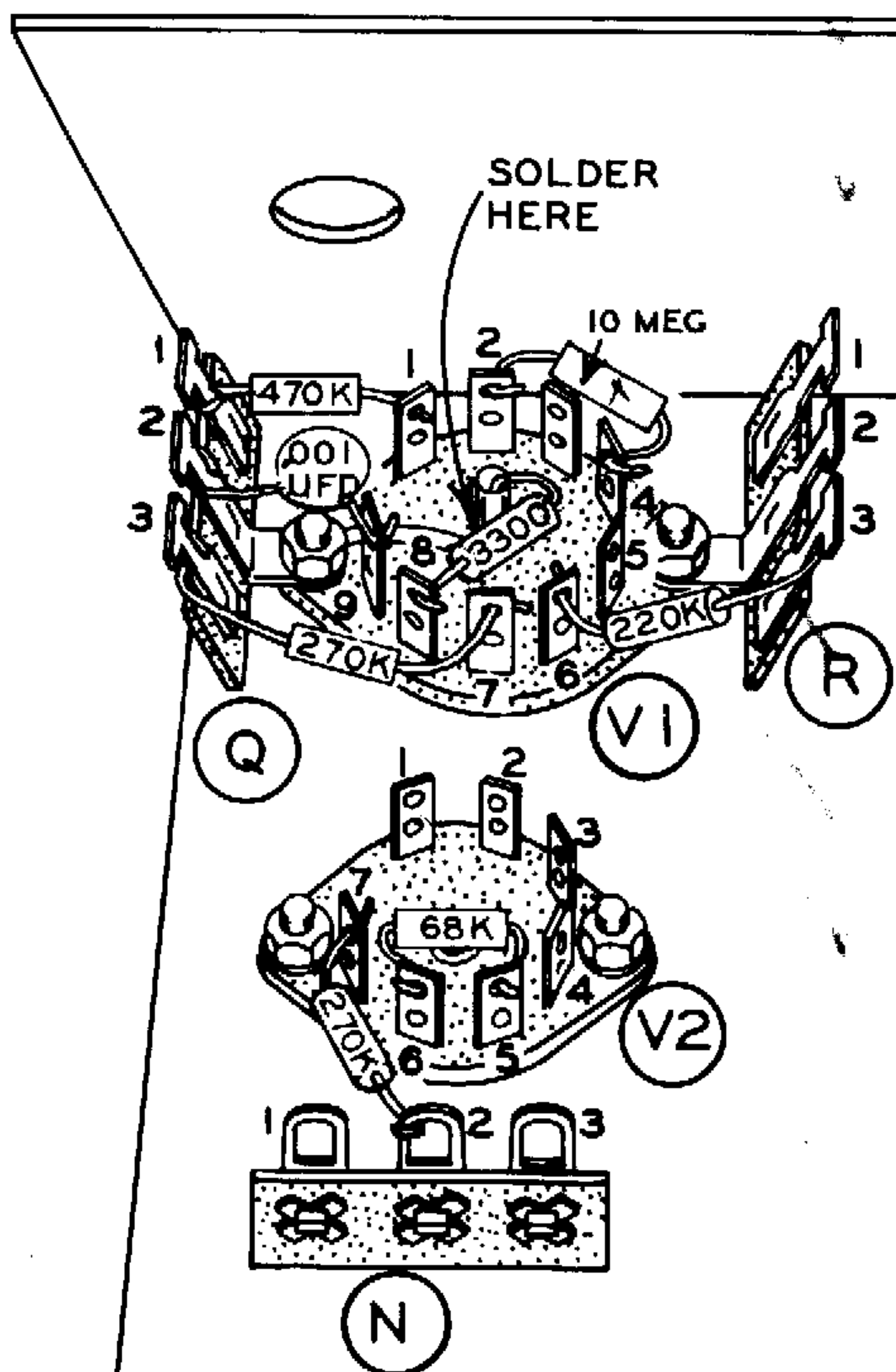
- (✓) Connect the other lead of this 1.0 μmf capacitor to lug 1 of coil CB (NS).

- (✓) C20. Connect a 50 μmf silver mica capacitor from lug 1 of coil CB (NS) to lug 2 of tube socket V3 (S-2).
- (✓) Connect a 1-1/4" length of stripped hookup wire from lug 1 of tuning capacitor Y (S-1) to lug 1 of coil CB (S-3).
- (✓) C15. Connect a .001 disc ceramic capacitor from lug 7 (S-2) to the center post (NS) of tube socket V3.
- (✓) Connect a 1-1/8" length of stripped hookup wire from lug 2 of coil CA (S-1) to lug 1 of tube socket V3 (S-3).
- (✓) R7. Connect a 470 Ω (yellow-violet-brown) resistor from lug 9 (NS) to the ground lug near lug 8 of tube socket V3 (S-2).
- (✓) C13. Connect a .001 μfd disc ceramic capacitor from lug 9 (S-2) to the center post (S-3) of tube socket V3.
- (✓) C23. Connect a .001 μfd disc ceramic capacitor from lug 1 of coil CA (NS) to lug 3 of control X (S-1).
- (✓) R10. Connect a 150 K Ω (brown-green-yellow) resistor from lug 1 of coil CA (S-2) to lug 1 of terminal strip K (S-2).
- (✓) Connect a 1-1/8" length of stripped hookup wire from lug 1 of coil CC (S-1) to lug 8 of tube socket V3 (S-1).

AUDIO SECTION WIRING

Refer to Pictorial 7 for the following steps.

- (✓) On tube socket V1, solder the center post to the center post grounding strap at the point indicated on Pictorial 7.
- (✓) R14. Connect a 10 megohm (brown-black-blue) resistor between lugs 2 (NS) and 4 (NS) of tube socket V1.
- (✓) R18. Connect a 3300 Ω (orange-orange-red) resistor between lug 8 (S-2) and the center post (S-3) of tube socket V1.
- (✓) R19. Connect a 220 K Ω (red-red-yellow) resistor from lug 6 of tube socket V1 (NS) to lug 3 of terminal strip R (NS).

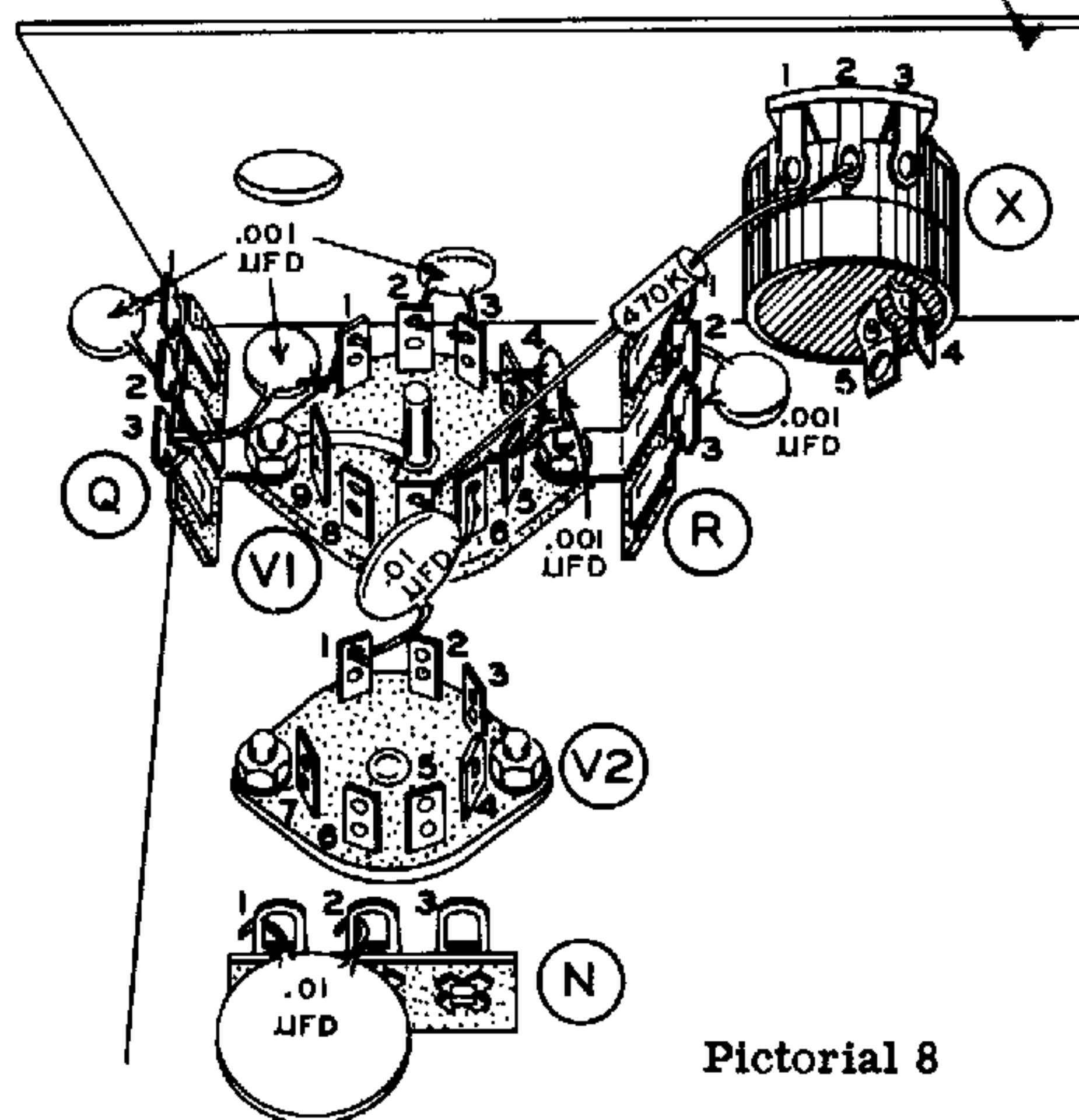


Pictorial 7

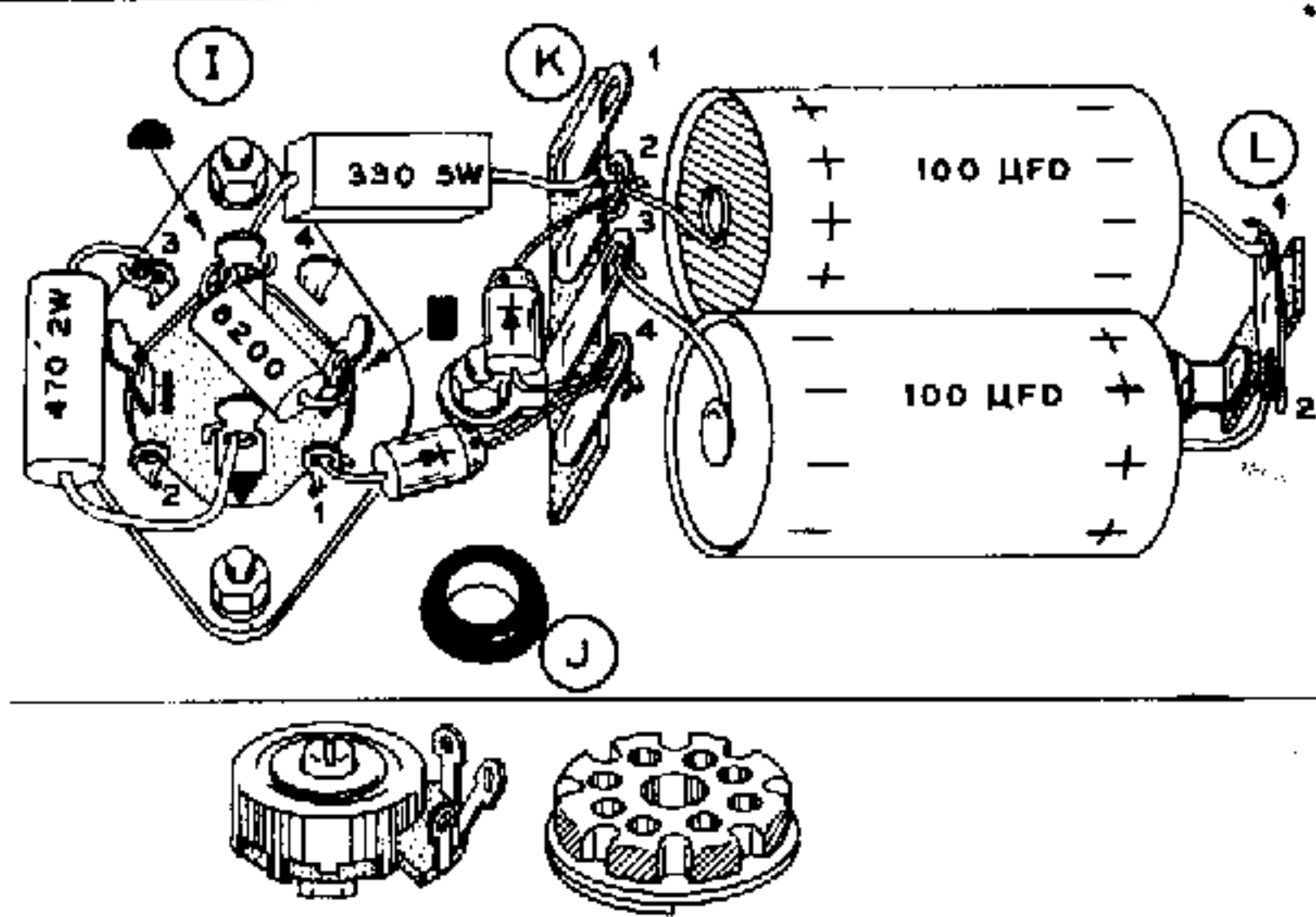
- (✓) R15. Connect a 470 K Ω (yellow-violet-yellow) resistor from lug 1 of tube socket V1 (NS) to lug 1 of terminal strip Q (NS).
- (✓) R22. Connect a 68 K Ω (blue-gray-orange) resistor between lugs 6 (S-3) and 5 (S-2) of tube socket V2.
- (✓) C30. Connect a .001 μ fd disc ceramic capacitor from lug 9 of tube socket V1 (S-2) to lug 2 of terminal strip Q (NS).
- (✓) R16. Connect a 270 K Ω (red-violet-yellow) resistor from lug 7 of tube socket V1 (NS) to lug 3 of terminal strip Q (NS).
- (✓) R20. Connect a 270 K Ω (red-violet-yellow) resistor from lug 7 of tube socket V2 (S-1) to lug 2 of terminal strip N (NS).

Refer to Pictorial 8 for the following steps.

- (✓) C35. Connect a .01 μ fd 1400 V disc ceramic capacitor between lugs 1 (S-3) and 2 (S-2) of terminal strip N.
- (✓) C39. Connect a .001 μ fd disc ceramic capacitor between lugs 1 (S-3) and 2 (S-2) of terminal strip Q.
- (✓) C31. Connect a .001 μ fd disc ceramic capacitor from lug 1 of tube socket V1 (S-2) to lug 3 of terminal strip Q (S-2).
- (✓) C29. Connect a .001 μ fd disc ceramic capacitor between lugs 2 (NS) and 3 (S-2) of tube socket V1.
- (✓) C33. Connect a .001 μ fd disc ceramic capacitor from lug 5 (S-3) to lug 4 (S-4) of tube socket V1.
- (✓) C38. Connect a .001 μ fd disc ceramic capacitor between lugs 2 (S-3) and 3 (S-4) of terminal strip R.
- (✓) C34. Connect a .01 μ fd disc ceramic capacitor from lug 6 of tube socket V1 (S-2) to lug 1 of tube socket V2 (S-1).
- (✓) R17. Connect a 470 K Ω (yellow-violet-yellow) resistor from lug 7 of tube socket V1 (S-2) to lug 2 of control X (S-1).



Pictorial 8



Pictorial 9

POWER SECTION WIRING

Refer to Pictorial 9 for the following steps.

- (✓) R21. Connect a 470 Ω (yellow-violet-brown) 2 watt resistor from lug $\blacktriangle$ (S-2) to lug 3 (S-1) of electrolytic capacitor I.
- (✓) R24. Connect an 8200 Ω (gray-red-red) 1 watt resistor between lugs $\blacksquare$ (S-2) and $\blacktriangle$ (NS) of electrolytic capacitor I.
- (✓) R23. Connect a 330 Ω (orange-orange-brown) 5 watt resistor from lug $\blacktriangle$ of electrolytic capacitor I (S-4) to lug 2 of terminal strip K (NS).
- (✓) C36. Connect a 100 μ f 200 volt electrolytic capacitor from lug 2 of terminal strip L (S-2) to lug 3 of terminal strip K (S-1). Make sure that the plus (+) end of this capacitor is connected as shown in Pictorial 9.
- (✓) C37. Connect the other 100 μ f 200 volt electrolytic capacitor from lug 2 of terminal strip K (NS) to lug 1 of terminal strip L (S-1). Be sure the plus (+) end is as shown.

NOTE: Refer to Detail 9A in the following steps to determine the polarity of the silicon diodes. Be sure the diodes are installed as specified to prevent damage to them and related components.

NOTE: WHEN INSTALLING SILICON DIODES, THE CATHODE END SHOULD BE PLACED AS DIRECTED. THE CATHODE END IS MARKED WITH EITHER A COLOR END, COLOR DOT OR COLOR BAND. IN THE ILLUSTRATION, THE SYMBOL K INDICATES THE CATHODE END.



Detail 9A

- (✓) Connect the cathode (K) lead of a silicon diode to lug 4 of terminal strip K (NS) and the other lead to lug 1 of filter capacitor I (S-2).
- (✓) Connect the cathode (K) lead of a silicon diode to lug 2 of terminal strip K (S-4) and the other lead to lug 4 of K (S-3).

FRONT PANEL ASSEMBLY AND INSTALLATION

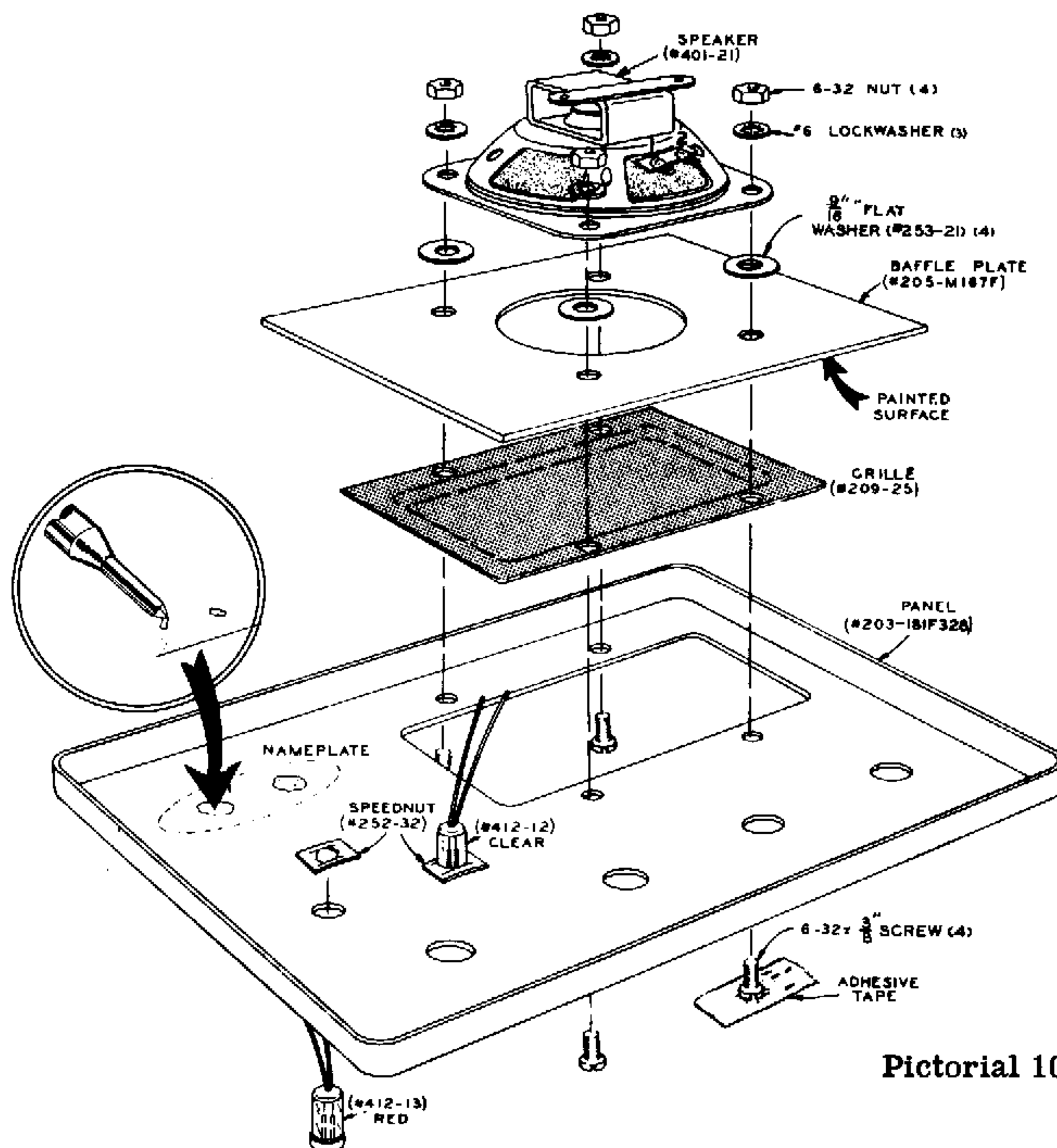
Refer to Pictorial 10 for the following steps.

NOTE: It is recommended that you cover the work area with a soft cloth to prevent scratching the front panel during the following steps.

- (✓) Mount the clear neon pilot lamp at the hole marked POWER, using one of the large speednuts.
- (✓) Similarly, mount the red neon pilot lamp at the hole marked TRANS.
- (✓) Mount the nameplate at the two holes above the words "THE SIXER." Melt the pins of the nameplate with a soldering iron and press them against the back of the panel.
- (✓) Locate four 6-32 x 3/8" screws. Place each through a speaker mounting hole and temporarily fasten them there with adhesive tape over the heads.

Place the panel face down on the work area and assemble the speaker to the panel as follows:

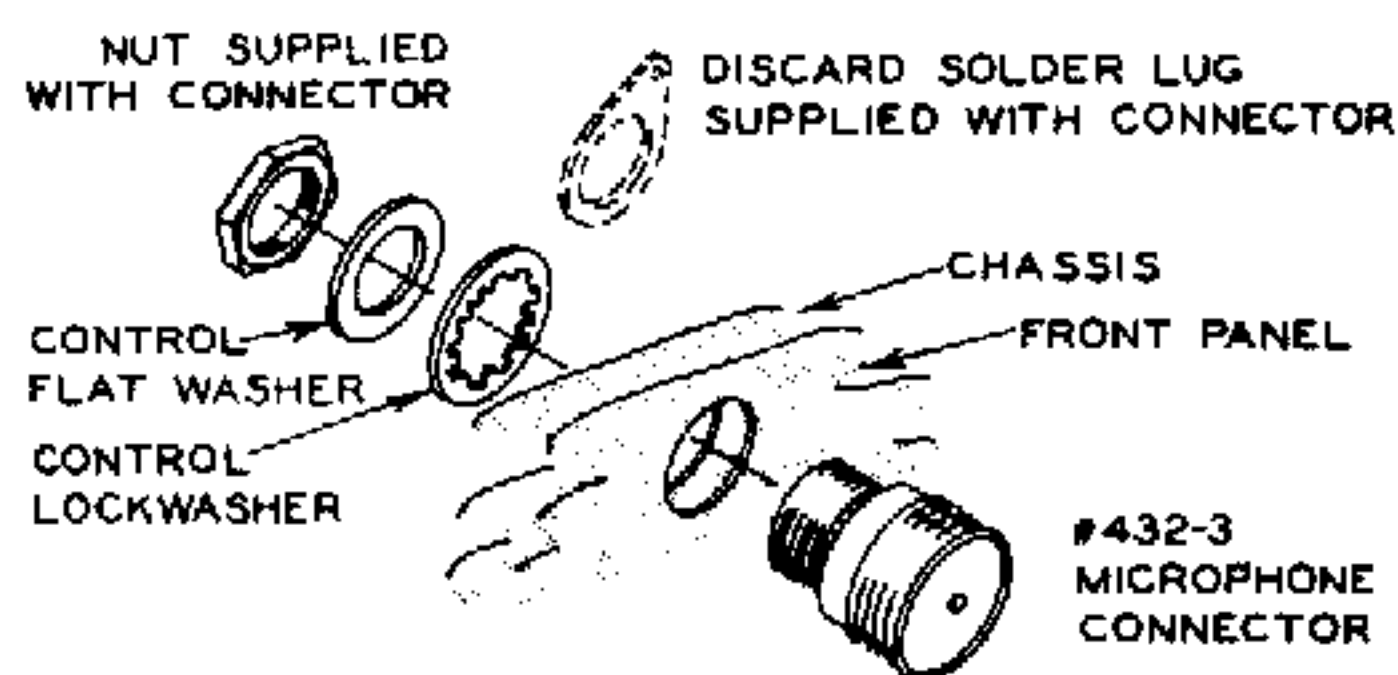
- (✓) Place the grille over the screws so that it protrudes through the front panel, with the openings in the mesh facing toward the bottom edge of the panel.
- (✓) Place the baffle plate over the screws with the black surface toward the grille.
- (✓) Place a 9/16" flat washer over each screw.
- (✓) Now, install the speaker. Position it as shown in Pictorial 10. Place a #6 lock-washer and 6-32 nut on each of the screws. Carefully center the speaker grille in the opening and tighten all nuts.
- () Now, place the chassis so that it rests on the rear apron, power transformer, and filter capacitor.
- () Remove the nuts and flat washers from switch Z and control X.



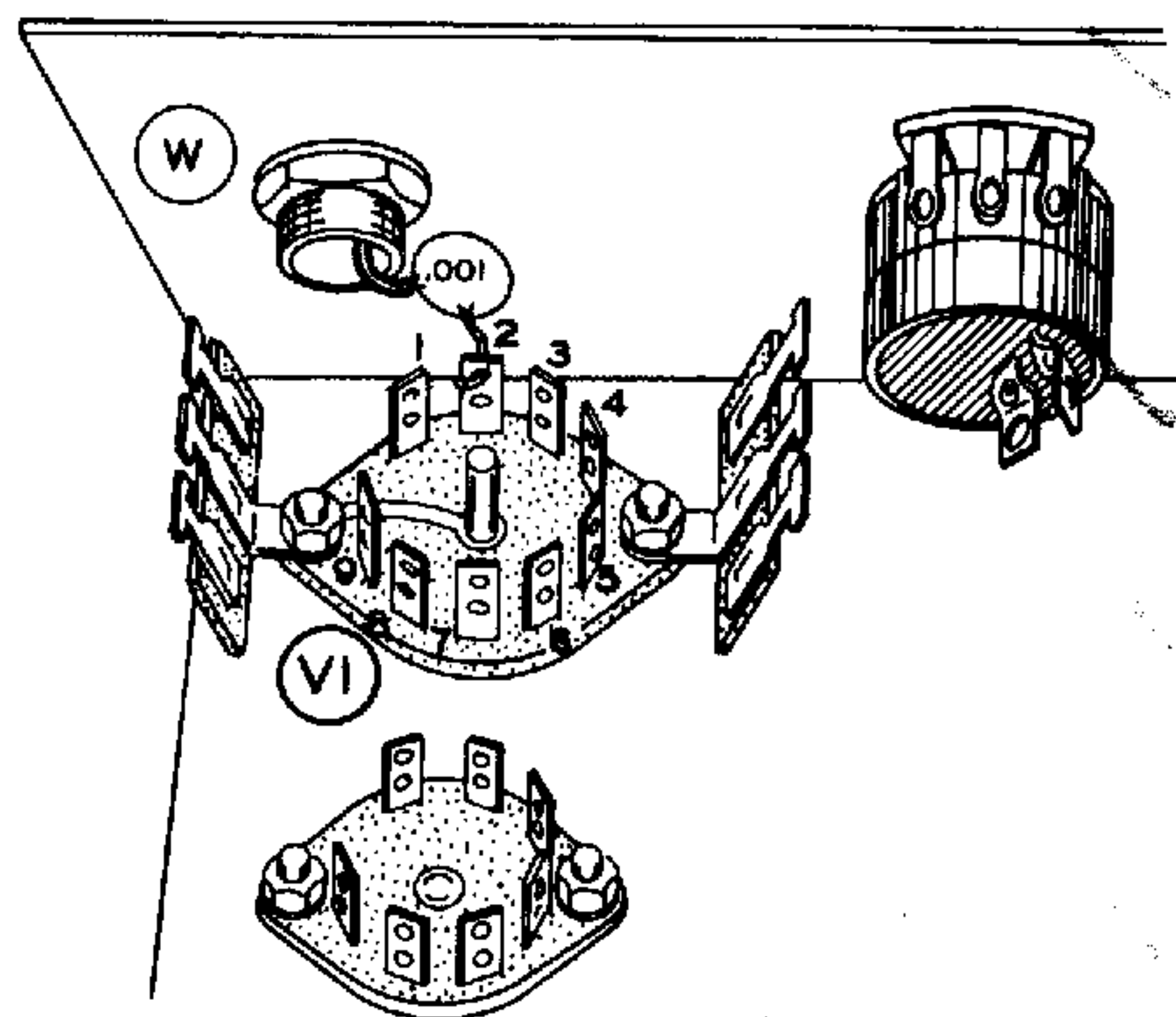
Pictorial 10

- () Place the front panel in position over the two bushings and install a flat washer and nut on each bushing. Do not tighten yet. Make sure that the leads from the neon pilot lamps are not caught between the panel and chassis.

- () Now, tighten the mounting nuts for the control and switch at Z and X, while holding them so they do not turn.



Detail 10A



Detail 11A

- () Install the microphone connector at W. Place the connector through the front of the panel. Install a control lockwasher, a flat control washer and nut on the connector inside the chassis, and tighten securely. See Details 10A and 11A.

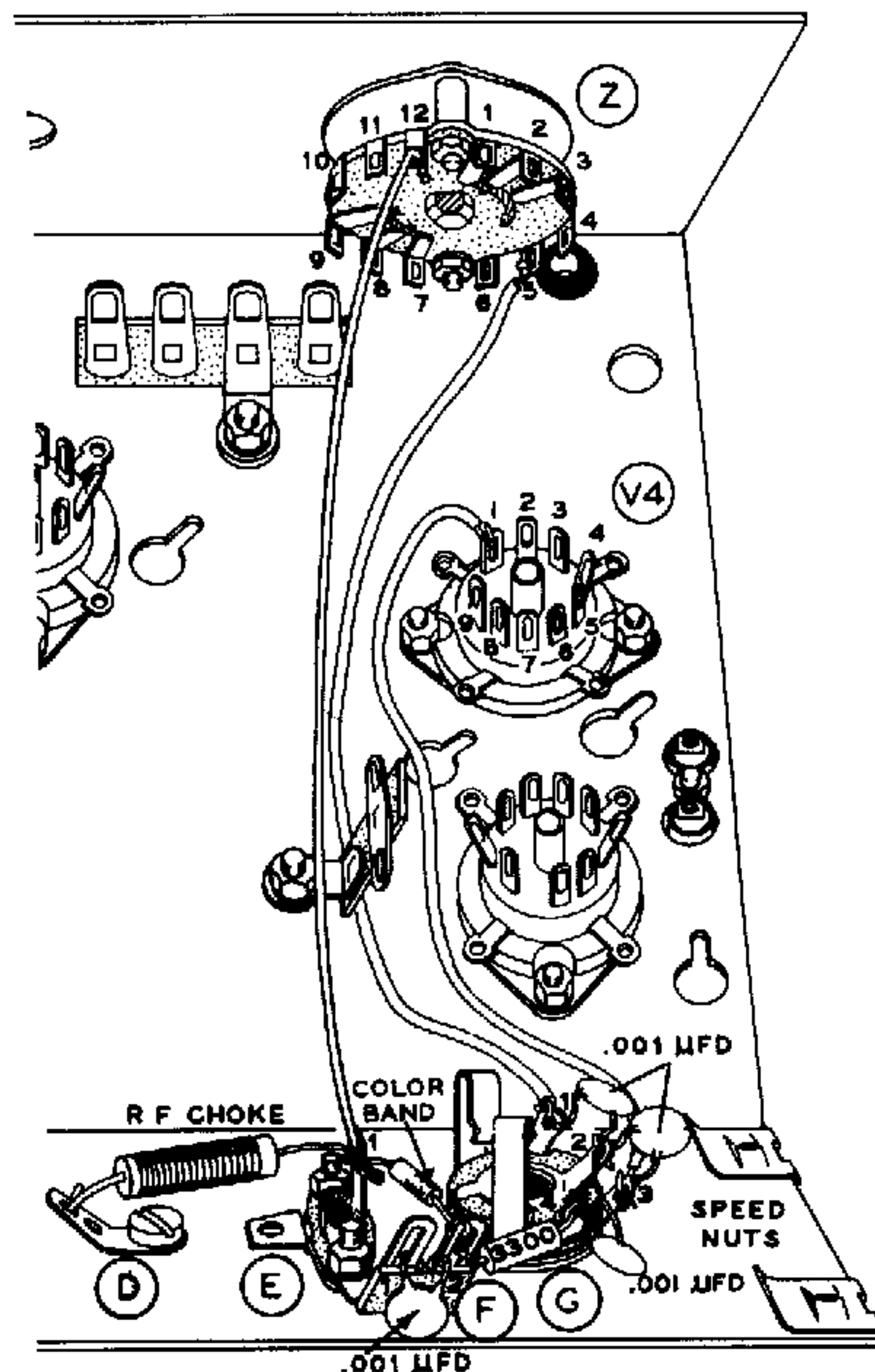
FINAL WIRING ABOVE CHASSIS

Refer to Pictorial 11 (fold-out from Page 16) for the following steps.

- (✓) Connect a 1-1/4" length of hookup wire from lug 1 of the speaker (S-1) to the solder lug at location P (S-1).
- (✓) Connect the lead coming through grommet U, from lug 3 of switch Z to lug 3 of terminal strip AA (NS).
- (✓) Connect the lead coming through grommet U, from lug 2 of switch Z to lug 2 of terminal strip AA (NS).
- (✓) Connect one lead of the red neon pilot lamp to lug 1 of terminal strip AA (NS).
- (✓) Connect the other lead to the hole in the mounting foot of terminal strip AA (NS). Use sleeving on this lead.
- (✓) Connect one lead of the clear neon pilot lamp to lug 4 of terminal strip AA (NS).
- (✓) Connect the other lead to the hole in the mounting lug of terminal strip AA (S-2). Use sleeving on this lead.
- (✓) R5. Connect a 150 K Ω (brown-green-yellow) resistor between lugs 1 (S-2) and 2 (S-2) of terminal strip AA.
- (✓) R25. Connect another 150 K Ω (brown-green-yellow) resistor between lugs 3 (S-2) and 4 (S-2) of terminal strip AA.
- (✓) Connect the black lead from the audio output transformer to lug 2 of the speaker (S-1).

FINAL WIRING BELOW CHASSIS

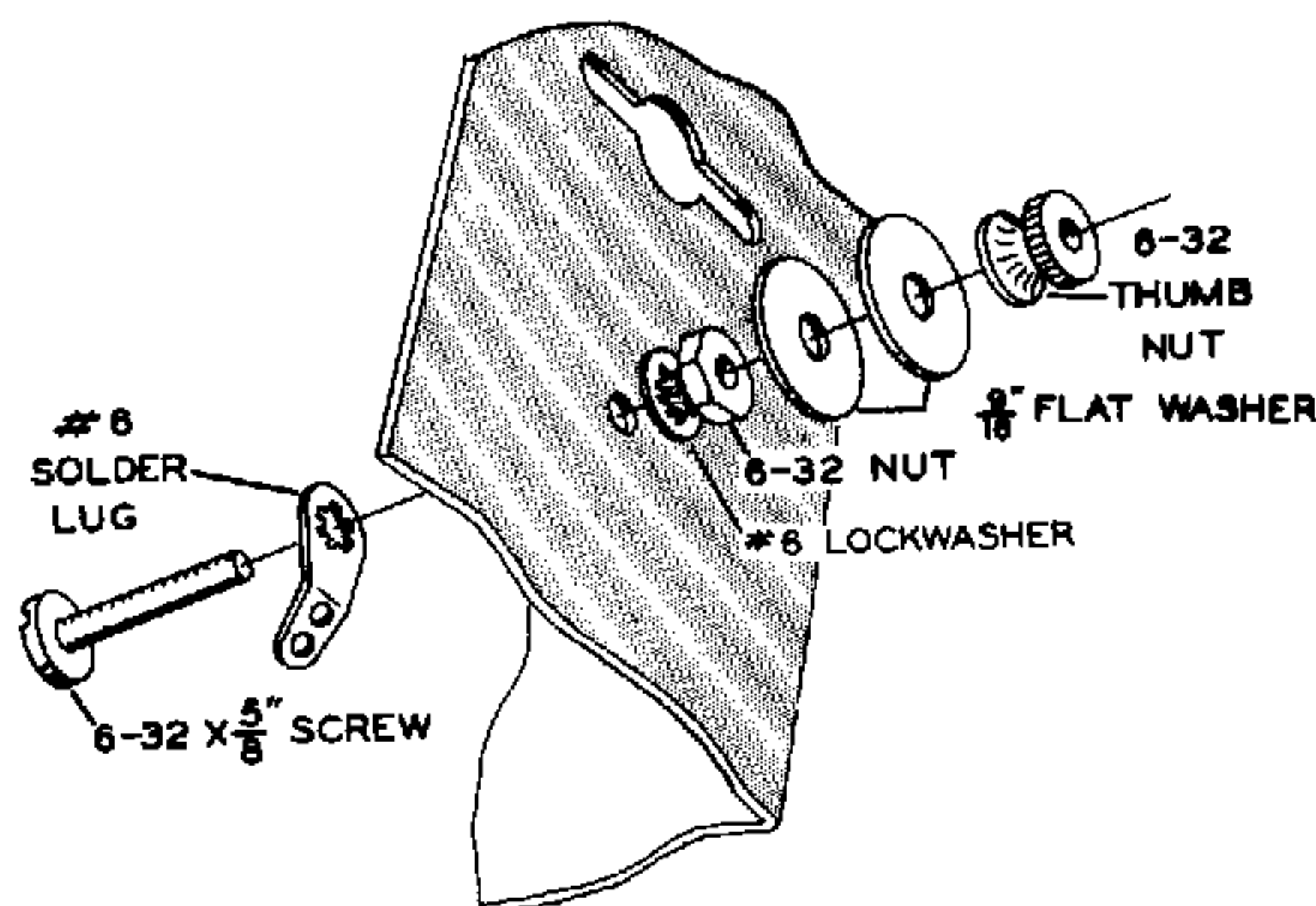
- (✓) C28. Cut one lead of a .001 μ fd capacitor to 1/2", and cut the other lead to 1". Place 3/4" of sleeving over the 1" lead.
- (✓) Insert the 1" lead through the center of the microphone connector and solder (S-1). Clip off any excess lead protruding from the front of the connector.
- (✓) Connect the 1/2" lead of this capacitor to lug 2 of tube socket V1 (S-3).



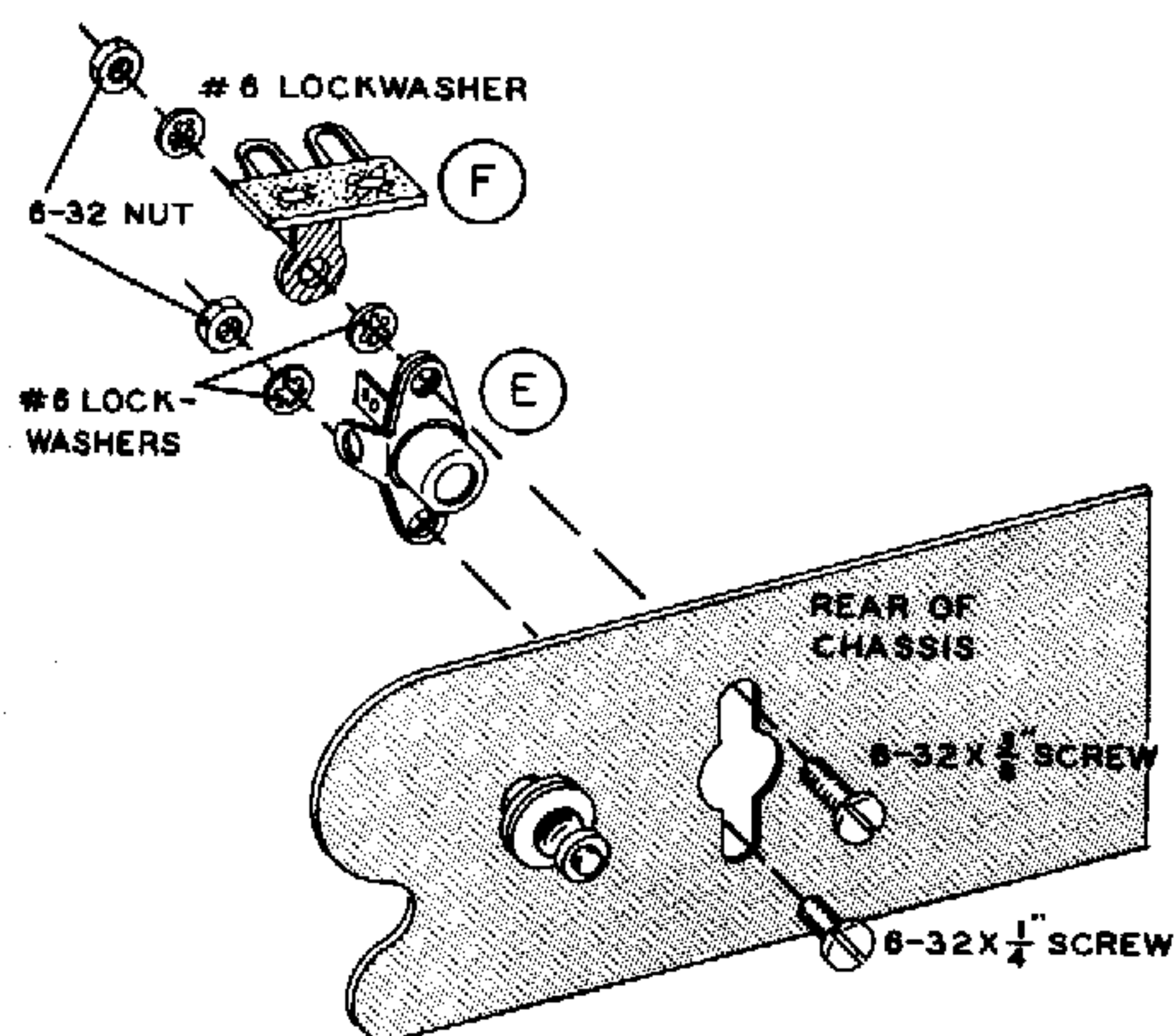
Pictorial 12

Refer to Pictorial 12 for the following steps.

- (✓) Mount a #6 solder lug at location D with the associated components, as shown in Detail 12A. Use a 6-32 x 5/8" screw. Place a #6 lockwasher, a 6-32 nut, and two flat washers on the screw. Secure with the 6-32 thumb-nut.



Detail 12A



Detail 12B

- (✓) Mount phono socket E with 2-lug terminal strip F as shown in Detail 12B. Use a 6-32 x 3/8" screw, #6 lockwasher and 6-32 nut for the double mounting.
- (✓) Mount the phone jack at location G. Use a control lockwasher, flat control washer and nut.
- (✓) L8. Connect an RF choke (#45-36) from lug 1 of phono socket E (NS) to solder lug D (S-1). See Pictorial 12.
- (✓) Connect a 5" wire from lug 1 of phone jack G (NS) to lug 5 of switch Z (S-1).
- (✓) Connect a 5" wire from lug 3 of phone jack G (NS) to lug 1 of tube socket V4 (S-2).
- (✓) C26. Connect a .001 μ fd disc ceramic capacitor between lugs 2 (NS) and 4 (NS) of phone jack G.

- (✓) C24. Connect a .001 μ fd disc ceramic capacitor between lugs 1 (S-2) and 2 (NS) of phone jack G.
- (✓) C25. Connect a .001 μ fd disc ceramic capacitor between lugs 2 (S-3) and 3 (S-2) of phone jack G.
- (✓) C27. Connect another .001 μ fd disc ceramic capacitor between lugs 1 (S-1) and 2 (NS) of terminal strip F.
- (✓) R13. Connect a 3300 Ω (orange-orange-red) resistor from lug 2 of terminal strip F (NS) to lug 4 of phone jack G (S-2).
- (✓) Connect a 4" length of heavy bare wire from lug 1 of phono socket E (NS) to lug 12 of switch Z (S-1). Provide a slight amount of slack in this wire to prevent damage to switch Z when the rear chassis apron is pulled back against the inside rear of the cabinet.

NOTE: Use care when soldering crystal diode connections, since the diode can be damaged by excessive heat. A heat sink can be made by gripping the lead between the diode body and the solder connection with long-nose pliers.

- (✓) Connect lead of the crystal diode with the color bands to lug 2 of terminal strip F (S-3). Connect the other lead of the crystal diode to lug 1 of phono socket E (S-3).
- (✓) Install a speednut at each corner of the chassis back apron. Be sure that the flat side is facing outward. See Pictorial 12.
- (✓) Install the lever knob on the TRANSMIT-RECEIVE switch.
- (✓) Install the other knobs on the TUNING shaft and the VOLUME control shaft.

Set this assembly aside for the moment and proceed with the assembly of the cabinet and cables.

FINAL ASSEMBLY

CABINET

- (✓) Fasten the handle to the cabinet with the two #10 self-tapping screws.
- (✓) Mount the four rubber feet in the four holes in the cabinet bottom. Use 6-32 x 1/2" screws, #6 lockwashers, and 6-32 nuts. The cabinet will be installed later.

MICROPHONE CABLE

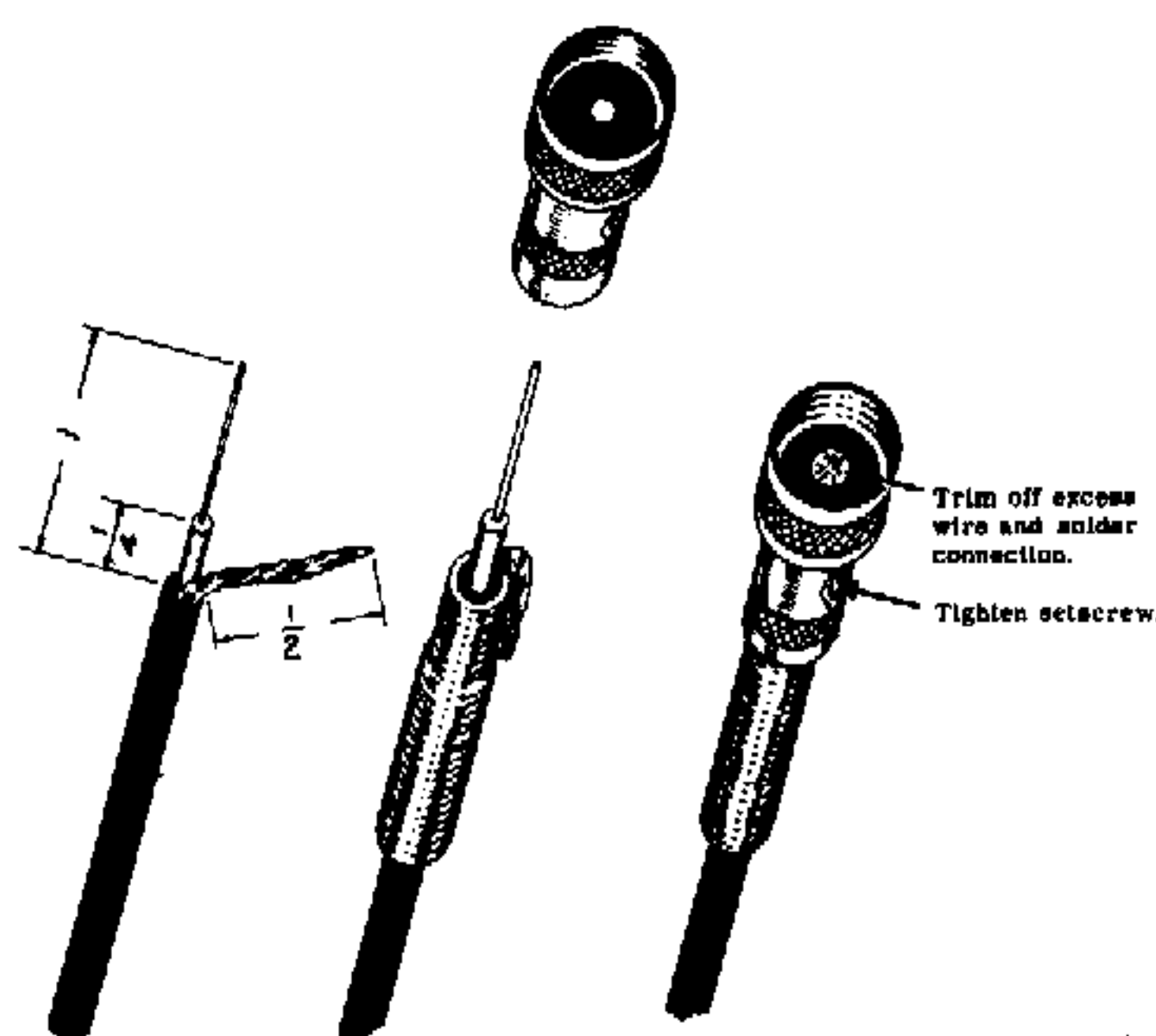


Figure 1

- (✓) Using Figure 1, install the microphone connector (#432-1) on the microphone cable.

AC POWER CORD

Refer to Figure 2 for the following steps.

- (✓) Slide an octal plug cap (#440-1) over the line cord, grommet end first.

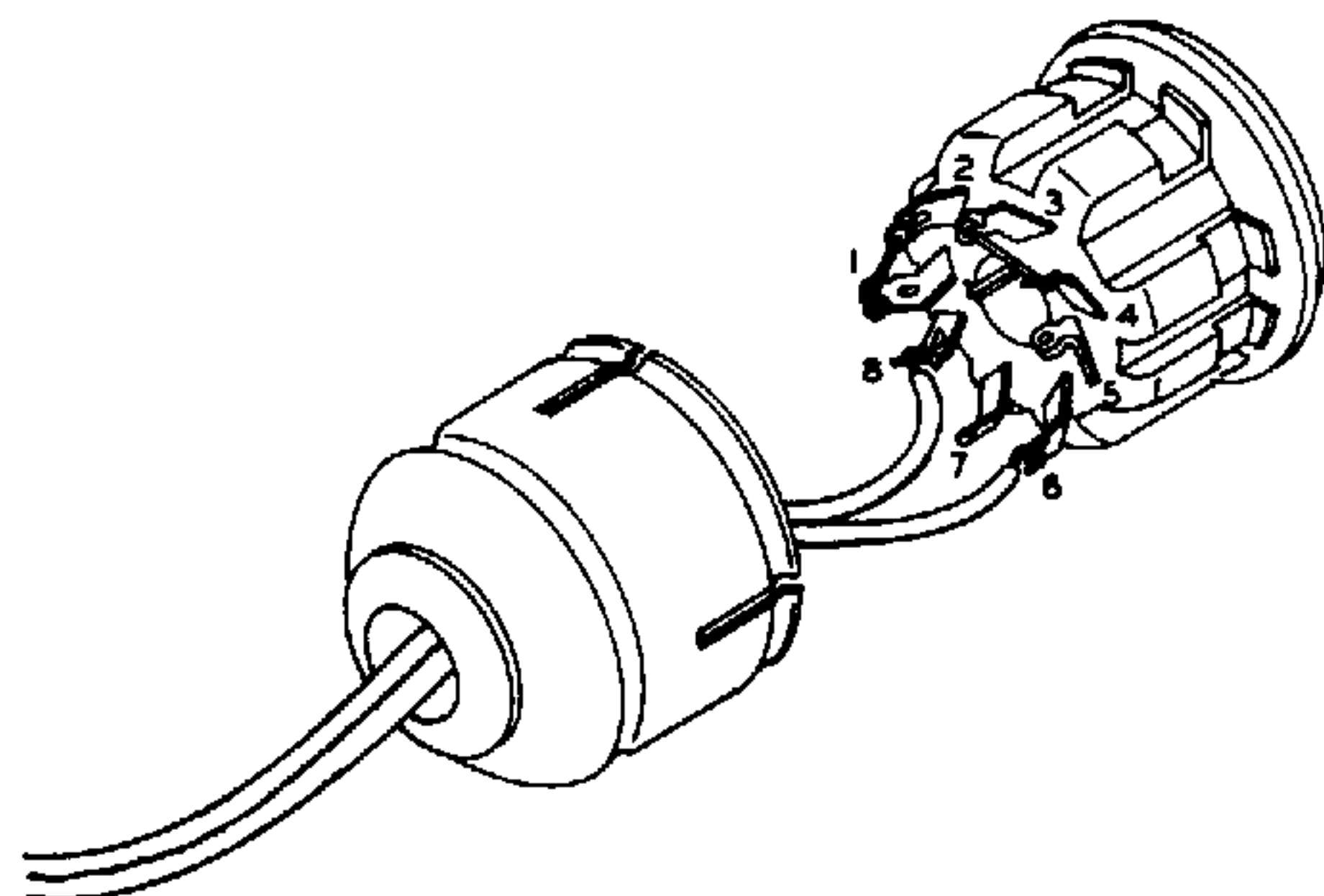


Figure 2

- (✓) Tie a large double knot in the cord to act as a strain relief.
- (✓) Connect a bare wire from lug 4 (S-1) to lug 3 (S-1) of an octal socket (#434-4).
- (✓) Connect another bare wire from lug 2 (S-1) to lug 1 (S-1).
- (✓) Connect one lead of the line cord to lug 8 (S-1). Connect the other lead to lug 6 (S-1).
- (✓) Snap the cap over the socket.
- (✓) Check the line cord and socket pins with an ohmmeter to be sure no connections exist between socket pins other than those shown in Figure 2.

CONNECTING CABLES

EXTERNAL POWER SUPPLY CABLE

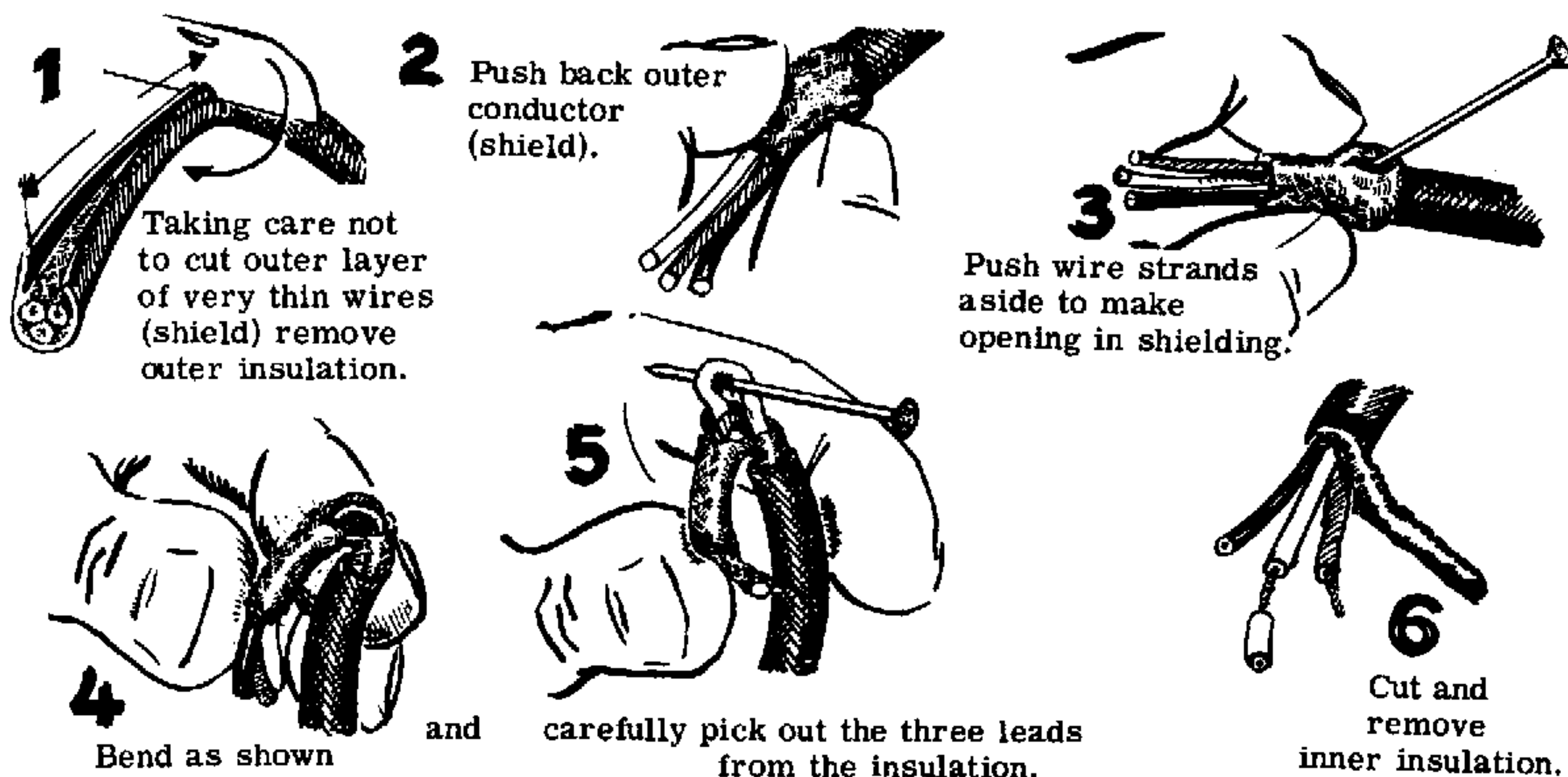


Figure 3

Refer to Figure 3.

- () Using care to not cut the shield wires, remove 3" of the outer jacket from the 3-conductor shielded cable. Strip 3/4" of the jacket from the other end.
- () On both ends of the cable, break the wires out of the side of the shield braid, as shown in Figure 3.

() Strip all the leads 1/4".

- () Pull the slack out of the shield braid pig-tails and cut them to the same lengths as the black wires at both ends of the cable.

NOTE: Determine the voltage on which this cable is to operate. If the source is 12 volts, use the first group of steps; if the source is 6 volts, use the second group of steps following this note.

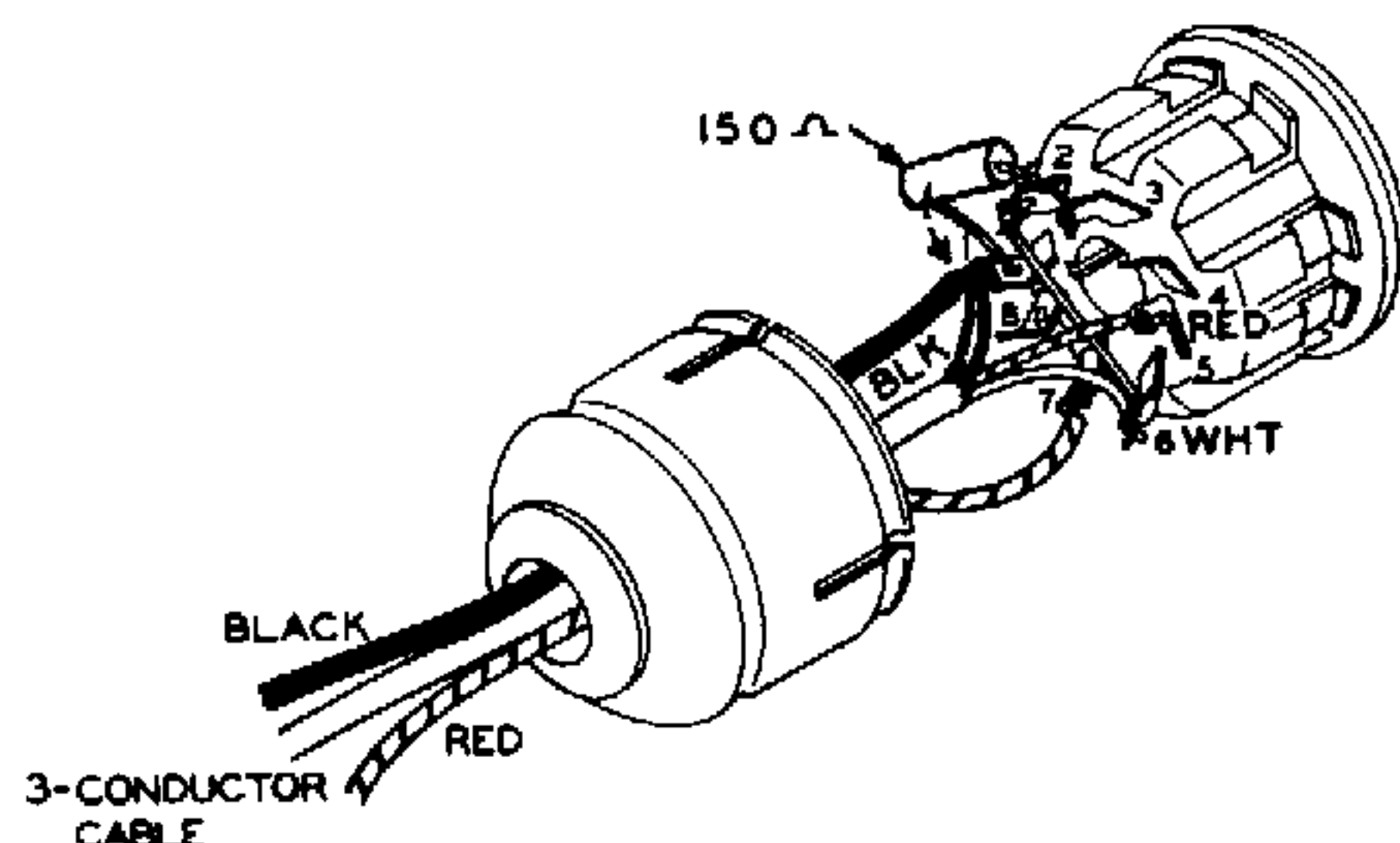


Figure 4

CONNECTIONS FOR 12 VOLT OPERATION

Refer to Figure 4.

- () Feed the 3/4" end of the cable through the octal plug cap from the grommet side.
- () Strip the heavy red and black wires 5/8" on one end and 1/4" on the other. Tin the ends. Pass the ends stripped 1/4" through the octal plug cap where they will be used in the following steps. The ends stripped 5/8" are for connection to the power source.
- () Connect the heavy red wire to lug 7 of the octal socket (#434-4) (S-1).
- () Connect the small red wire from the shielded cable to lug 5 of the socket (S-1).
- () Connect both black wires and the shield pigtail to lug 1 (NS).
- () Connect a 150 Ω (brown-green-brown) resistor between lugs 1 (S-4) and 3 (S-1).
- () Connect the white wire to lug 6 (NS).
- () Connect a bare wire from lug 6 (S-2) directly across the socket to lug 2 (S-1). Use sleeving.

CONNECTIONS FOR 6 VOLT OPERATION

Refer to Figure 5.

- () Feed the 3/4" end of the cable through the octal plug cap from the grommet side.
- () Strip the heavy red and black wires 5/8" on one end and 1/4" on the other. Tin the ends. Pass the ends stripped 1/4" through the octal plug cap where they will be used in the following steps. The ends stripped 5/8" are for connection to the power source.
- () Connect the heavy red wire to lug 7 of the octal socket (#434-4) (S-1).
- () Connect the small red wire from the shielded cable to lug 5 of the socket (S-1).
- () Connect both black wires and the shield pigtail to lug 1 (NS).
- () Connect a bare wire from lug 1 (S-4) to lug 2 (S-1).
- () Connect the white wire to lug 6 (NS).
- () Connect a bare wire from lug 6 (S-2) directly across the socket to lug 3 (S-1). Use sleeving.

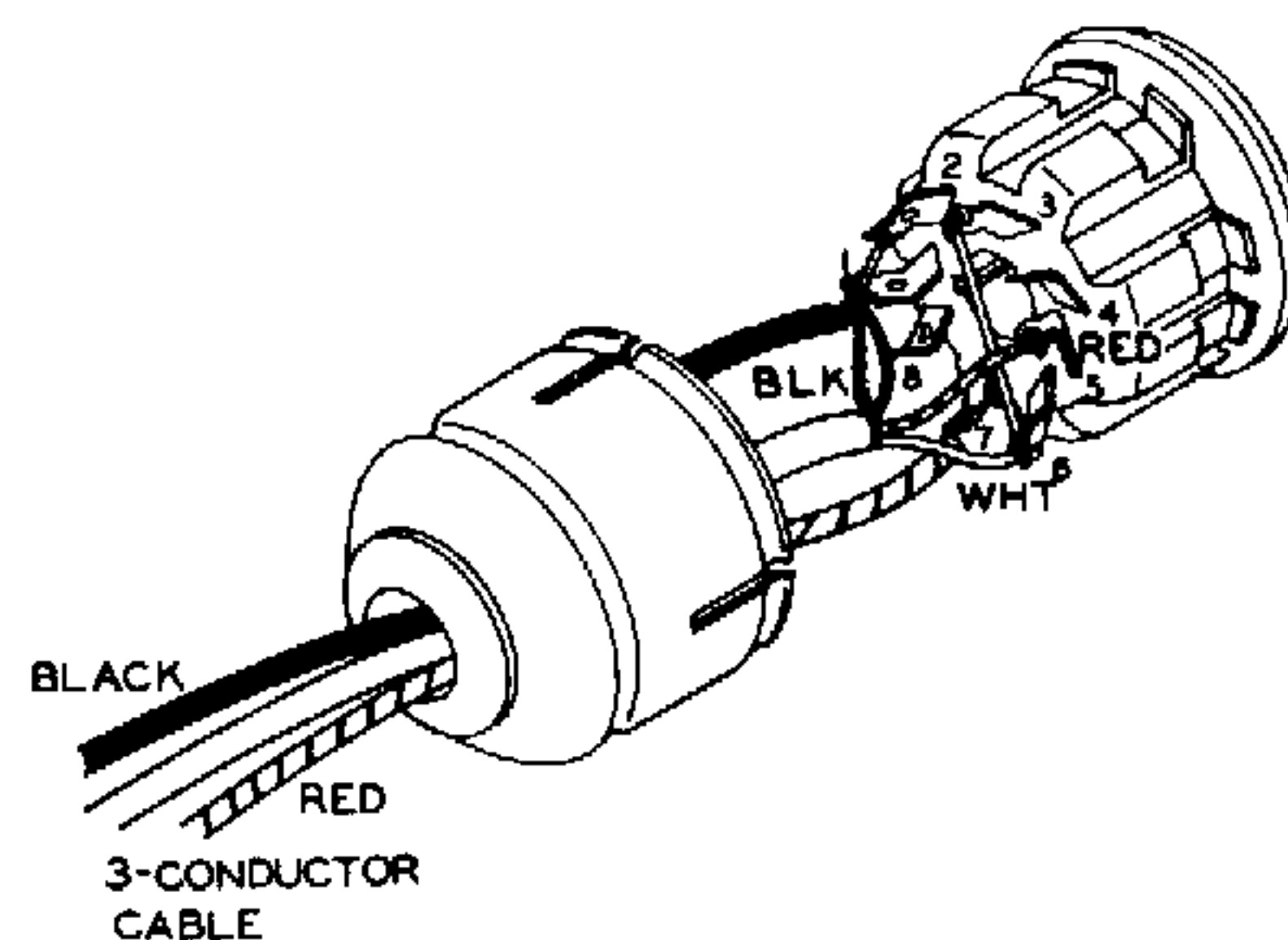


Figure 5

NOTE: The 150 Ω (brown-green-brown) resistor is used for 12 volt operation only, and will otherwise not be used.

Check the connections just completed on the socket and when you are sure no shorts exist, snap the cap over the socket (if in doubt, tape connections). It might be wise to put a piece of tape on the outside of the shell with the operating voltage of the cable plainly marked for future reference.

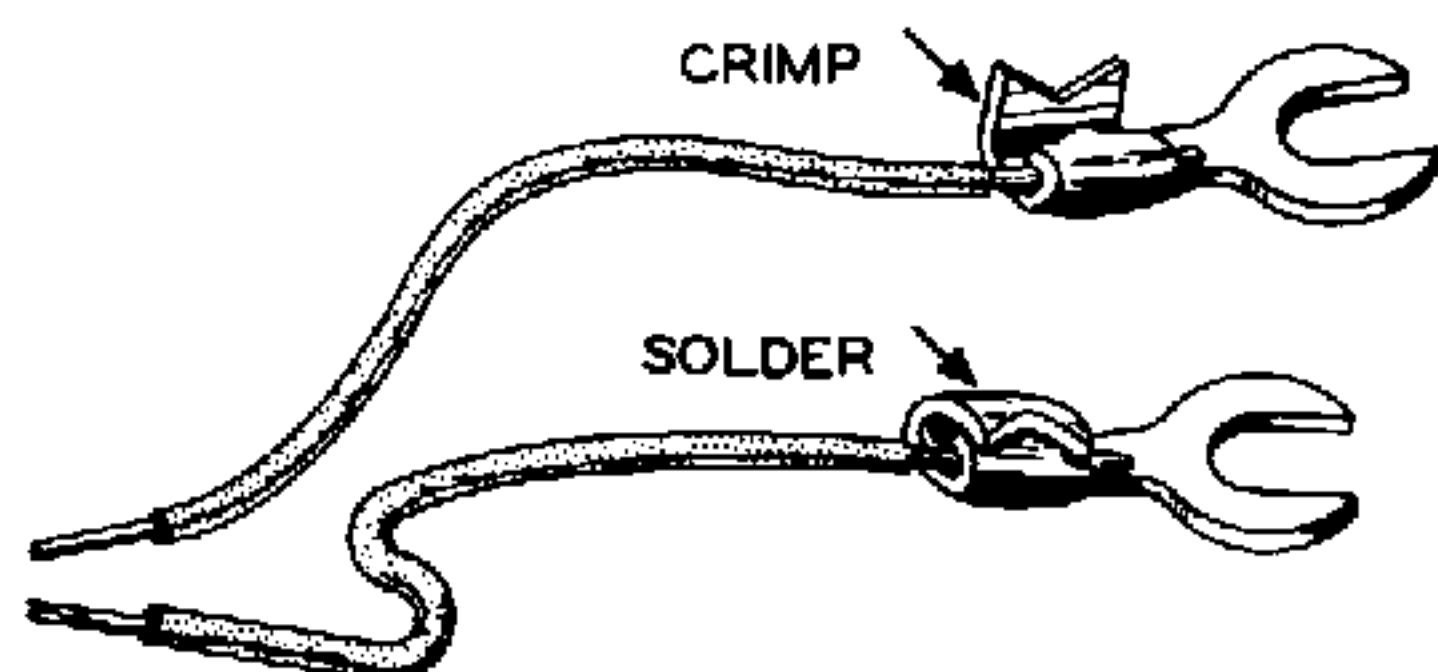


Figure 6

- () Refer to Figure 6 and at the 3" stripped end of the cable install spade lugs on the red and white wires. Connect both black wires and the shield pigtail to the remaining spade lug, in a similar manner.

DUMMY LOAD

- () Construct the dummy load by carefully following Figure 7.

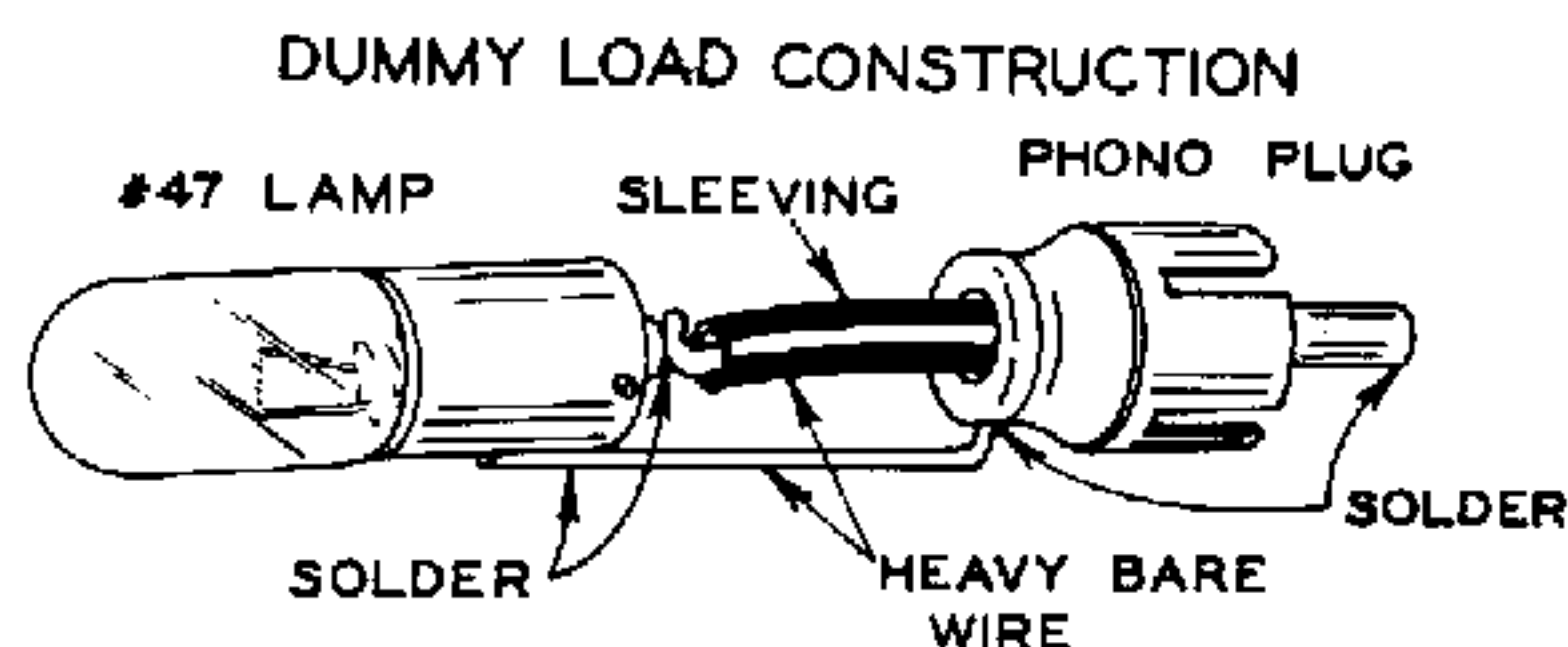


Figure 7

NOTE: Use care in soldering to the solder blob at the tip of the #47 lamp to avoid damaging the lamp.

It might be wise to now recheck the HW-29A wiring once more against the Pictorials to be sure that everything is correct. Shake out any wire clippings or solder splashes which might be in the wiring. Now proceed with testing and calibration of the unit as directed in the following pages.

INITIAL TEST AND CALIBRATION

This and the following section are concerned with adjustments and tests which must be performed before your HW-29A is put into use.

THE TRANSMITTER ALIGNMENT PROCEDURE MUST BE STRICTLY FOLLOWED TO THE LETTER, OTHERWISE OUT-OF-BAND OPERATION CAN RESULT!!!!

IT SHOULD BE NOTED HERE THAT AN AMATEUR RADIO OPERATOR AND STATION LICENSE IS REQUIRED TO PLACE THIS TRANSCIVER ON THE AIR. Information regarding licensing and amateur frequency allocations may be obtained from publications of the Federal Communications Commission or the American Radio Relay League.

RECEIVER AND AUDIO SECTIONS

- () Install a fuse in the fuse holder. Use the 1-1/2 ampere fuse for AC operation, and for the initial testing and calibration. The 8 ampere fuse is for 6 volt or 12 volt operation.
- () Begin by checking the power supply for short circuits. An ohmmeter, with positive probe on pin 5 of the power connector and negative probe on the chassis, should read 150 K Ω or above within one minute, while allowing the filter capacitors to charge.
- () The power supply output voltage will be checked next. Connect the 117 volt power cord to the power connector. Plug the cord into a source of 105-125 V 50/60 cycle AC only, and turn the power switch ON. Measure the DC voltage developed between the blue lead of the audio output transformer and ground. This voltage should be between 250-300 V DC. After making this measurement, check to see that the clear neon "power" lamp is lighted. With the TRANSMIT-RECEIVE switch in either of the two TRANS. positions, the red neon TRANS. lamp should also light. Now turn the unit off.
- () Install all tubes V1 (12AX7), V2 (6AQ5), V3 (6AN8), V4 (6CL6), and V5 (6BA8). See Pictorial 11.
- () Set the TRANSMIT-RECEIVE switch to the RECEIVE position, and TUNING control to full counterclockwise end of rotation.
- () Rotate the REGENERATION control on the rear chassis apron fully counterclockwise.
- () Turn the unit on and advance the VOLUME control until the knob pointer is vertical.
- () Now, slowly advance the REGENERATION control clockwise until a "hissing" or "rushing" sound is heard in the speaker. The correct setting will be the minimum clockwise position at which the receiver will remain in regeneration over the entire tuning range. This setting will require re-adjustment later during receiver alignment and is not critical at this point.
- () If the above steps have all produced the desired effects, turn the transceiver OFF and go on to the following section. If any difficulty was encountered in the foregoing tests, refer to the In Case Of Difficulty section on Page 37.

TRANSMITTER SECTION

NOTE: Proper alignment of the transmitter section is extremely important, otherwise off-frequency operation can result. A brief review of the transmitter section circuit description starting on Page 4 will prove helpful at this time.

- () Install a crystal in the crystal socket. Use one whose fundamental frequency is from 8.333 mc to 9.000 mc. War surplus crystals (in FT-241 or FT-243 holders) are ideal.
- () Plug the dummy load into the ANTENNA jack.

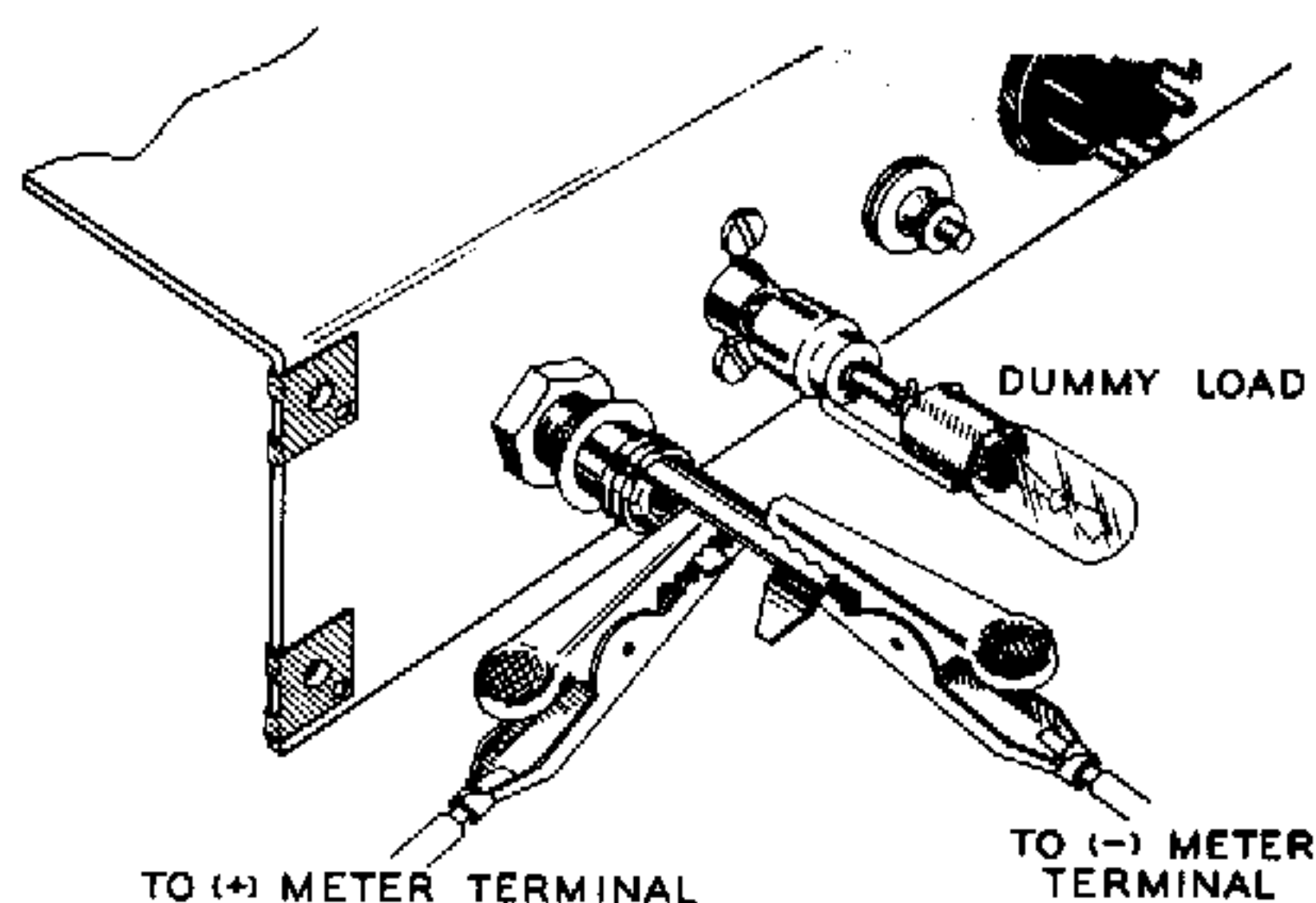


Figure 9

- () Connect a 0-50 V meter to the meter plug as shown in Figure 9. Place the meter plug in position B, as shown in Figure 10. For best results, a 20,000 ohms-per-volt-meter is recommended.

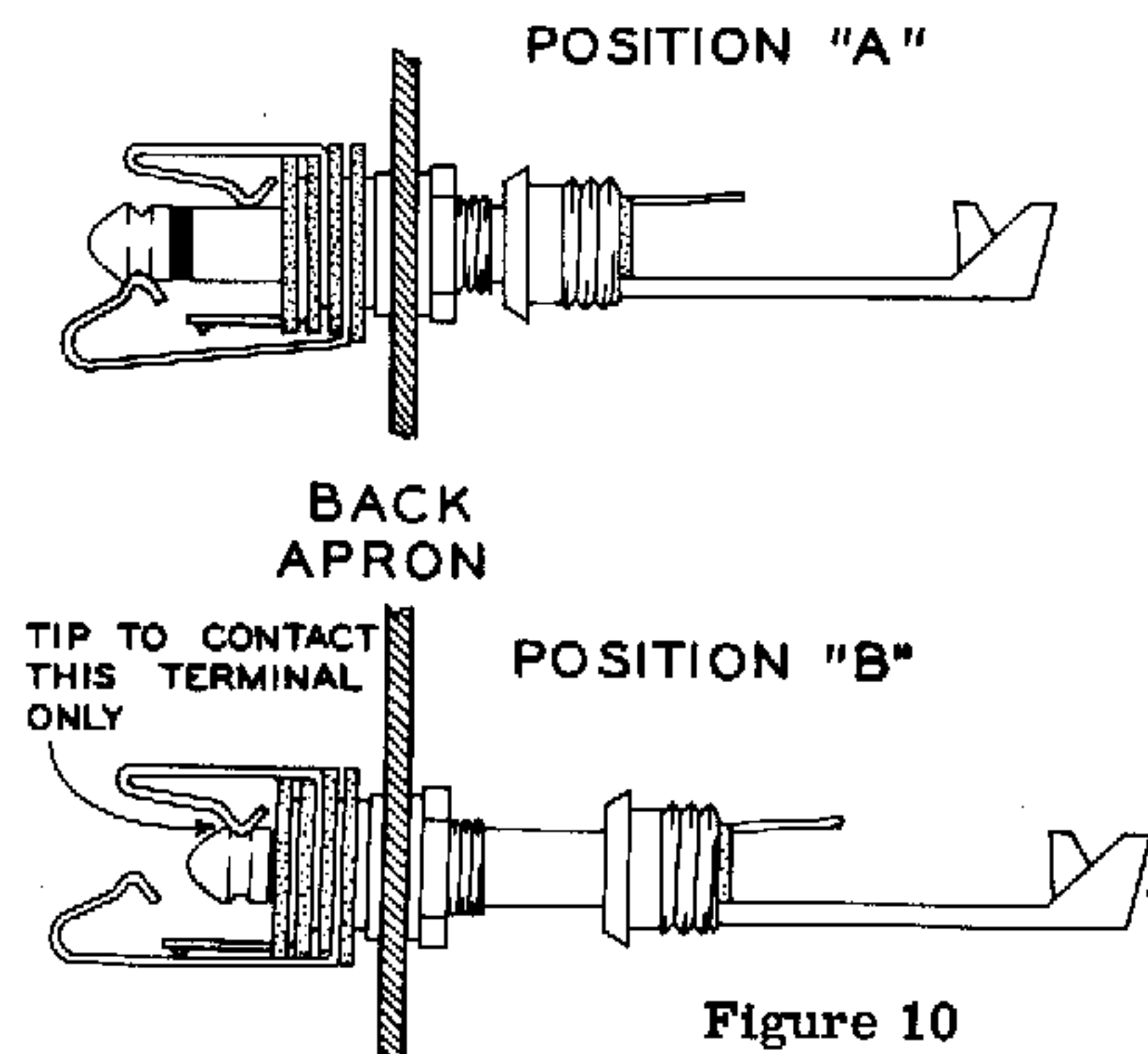


Figure 10

- () Turn the TRANSMIT-RECEIVE switch to TRANS. and rotate the final tank circuit trimmer capacitor. This should cause the dummy load lamp to glow. Tune the trimmer capacitor for a maximum reading on the voltmeter, and for the brightest glow of the lamp. (The lamp and meter should peak at the same place.) Turn the unit off.
- () Preset the adjusting screw of L1 (CF) to about 5/8" above the chassis. Set the screw of L2 (CD) about 9/16" above the chassis.

- () Connect the negative lead of the 0-50 V meter to lug 9 of tube socket V4. Connect the positive lead to ground, and turn the unit on again.
- () With the TRANSMIT-RECEIVE switch still in the TRANS. position, adjust both L1 (CF) and L2 (CD) for maximum negative voltage. This grid voltage for the final amplifier tube should be approximately -35 volts DC. Turn the unit off and disconnect the voltmeter leads.
- () Connect the 0-50 V meter to the meter plug with the plug in position B, as before. Once again, peak the final tank circuit trimmer capacitor for maximum meter reading. This should be between 15 V and 20 V.
- () Attach the microphone to the front panel connector. With the unit in the TRANS. position, talking in the microphone should cause the dummy load to glow brighter and the meter reading to increase by several volts. Slight readjustment of the doubler coil L2 may be necessary if this does not happen. It should be pointed out that the meter and plug can be left in this position during normal use of the unit as an indicator of RF output. The presence of the meter has negligible effect on performance, in either transmit or receive, and it provides an excellent means for tuning with the actual antenna system.
- () Turn the power off and push the meter plug into position A of the meter jack. Connect a 0-150 ma meter across the terminals of the meter plug. Turn the power on again and note the final amplifier current, it should be approximately 32 ma.

NOTE: The final tank circuit trimmer should be readjusted for maximum output voltage (meter jack, position B) when the unit is connected to the antenna.

RECEIVER SECTION ALIGNMENT

Alignment of the receiver is a very simple matter if you have an accurate signal generator or grid dipper. As kit builders frequently have only limited equipment, two methods will be suggested here, and you may take your choice depending upon the equipment you have at hand.

- () Regardless of method used, preset the two receiver coils to the following shaft-height-above-chassis settings:
 Antenna coil L4 9/16"
 Detector coil L5 5/8"
 See Pictorial 11.

METHOD 1

If an accurate signal generator or grid dipper that tunes to 52 mc is available it should be used. A generator that tunes to a fairly high sub-multiplier (1/2, 1/3, etc.) 52 mc is also sufficient for this method.

The harmonic content of an average signal generator used at a sub-harmonic will normally be sufficient to allow alignment of the receiver. A generator of lower frequency output than those indicated above would not be desirable since it would be difficult to determine which harmonic the receiver is tuned to.

- () The REGENERATION control on the rear chassis apron should be sufficiently advanced in the clockwise direction to cause the detector to go into regeneration. This is indicated by a distinct "hissing" or "rushing" sound. If the detector should drop out of oscillation and remain so during alignment, it will be necessary to advance the control further.
- () Connect the signal generator, set to 52 mc, to the antenna input. If the generator has clip leads, connect the generator shield or ground lead to the rear apron ground post. Connect the "hot" lead to the wire running between the TRANSMIT-RECEIVE switch and the antenna jack. If a grid dipper should be employed, set the frequency to 52 mc and position the dipper coil so that for initial alignment it is approximately 6" from the receiver. At this distance, radiation from a dipper used in the CW (carrier on) condition should be sufficient for calibration purposes.
- () With the receiver operating, set the tuning knob pointer vertical (52 mc) and adjust the detector coil L5 to receive the signal. This is indicated by maximum quieting in the receiver. This adjustment should be within several turns of its preset position.
- () Now, rotate the receiver tuning capacitor knob from one extreme to the other, making certain the detector remains in regeneration at both extremes. Also make sure that the received signal (from generator or grid dipper) is centered at the 52 mc point.
- () Leave the generator frequency set at 52 mc and decrease the generator output to the point where the signal is just barely receivable. This will be in the vicinity of 1 microvolt fundamental frequency on a calibrated generator. Now adjust the antenna coil L4 for maximum gain of the RF amplifier, as indicated by maximum quieting in the detector. This adjustment may change the frequency of the detector slightly, so it should be checked and retuned if necessary. The proper setting of this coil will be within several turns of the preset position. The peak will be rather broad in nature, although a definite increase in gain will be noted as the coil is tuned near 52 mc resonance.
- () Recheck the adjustments of the detector coil L5 for calibration, the antenna coil L4 for gain, and the REGENERATION control R26 for maximum sensitivity. With the two coils properly adjusted, set the REGENERATION control to the minimum clockwise position at which the receiver will remain in regeneration over the entire tuning range and will always start to regenerate each time the unit is turned on.

METHOD 2 - AN-ON-THE-AIR SIGNAL

- () With a suitable antenna connected (see antenna section, Page 34), have a friend, preferably at a distance of 10 miles or so, (depending upon his station equipment and your antenna) transmit a test signal for you.
- () Set the receive tuning knob to indicate his approximate known frequency. Now adjust the detector coil L5, to receive his signal. This adjustment should be within several turns of the preset position.
- () After the dial calibration has been established, adjust the antenna coil L4 and the

rear apron REGENERATION control R26 for maximum sensitivity of the receiver. This is best indicated by maximum quieting rather than loudest signal since the detector provides effective automatic volume control action above 3 microvolt input. If the on-the-air signal produces complete quieting, attempt to reduce the signal input to the receiver, by rotating either antenna system. Final adjustment of the receiver should be done with a very weak signal, one just barely audible. Simultaneously adjust L4 for calibration and L5 and R26 for sensitivity.

- () Install the cabinet, using four 6-32 x 3/8" screws. Place the screws through the holes in the rear of the cabinet and into the speed-nuts on the rear chassis apron.

Before placing your HW-29A into operation, a review of the control functions would be advisable. Refer to Figure 8 for a complete explanation of all controls.

CONTROL FUNCTIONS

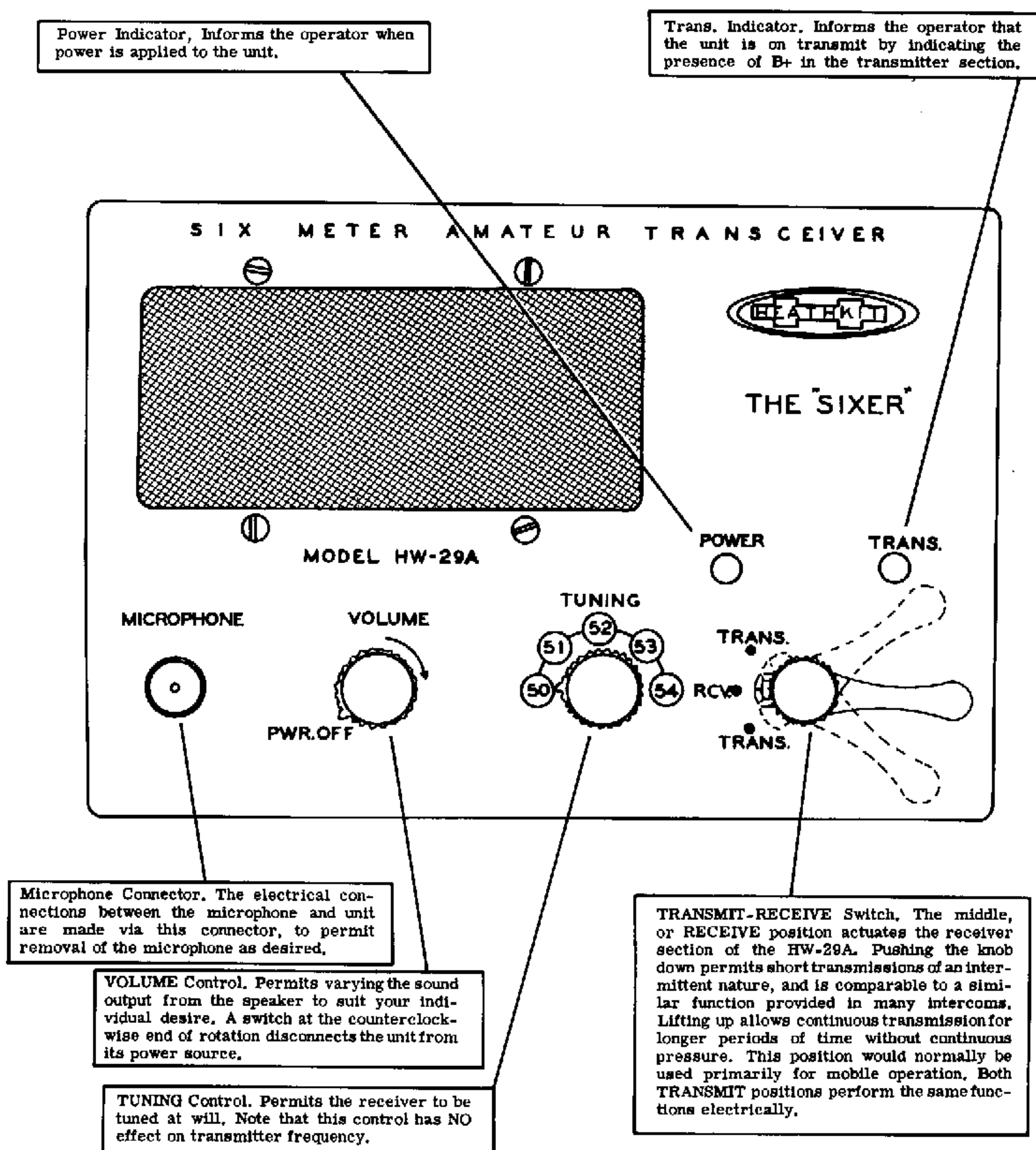


Figure 8

TYPES OF ANTENNAS

Various types of antenna designs exist which differ in complexity, directional characteristics, polarization and cost. The simplest of the horizontally polarized type is shown in Figure 11, and is generally referred to as a "dipole" or "doublet." Its directional characteristics are not very pronounced and represent an approximate "figure eight" pattern. The antenna as shown is properly fed with 75 Ω ribbon line (special twin lead), although doublets are frequently fed with 75 Ω coax with good results.

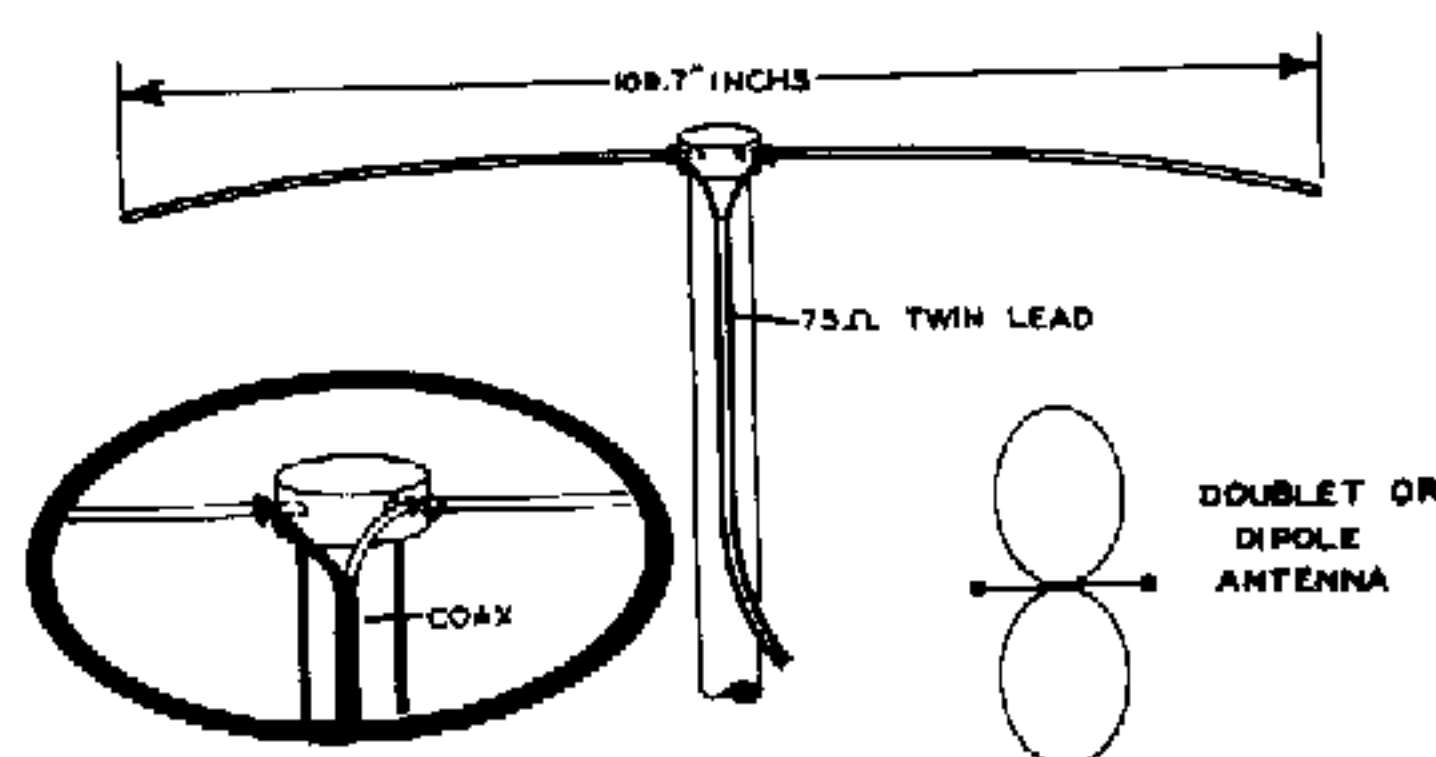


Figure 11

Simple, practical antennas for vertical polarization are the "ground plane" and "coaxial" types, either of which is essentially omni-directional, that is, they radiate equally well in all directions in the horizontal plane.

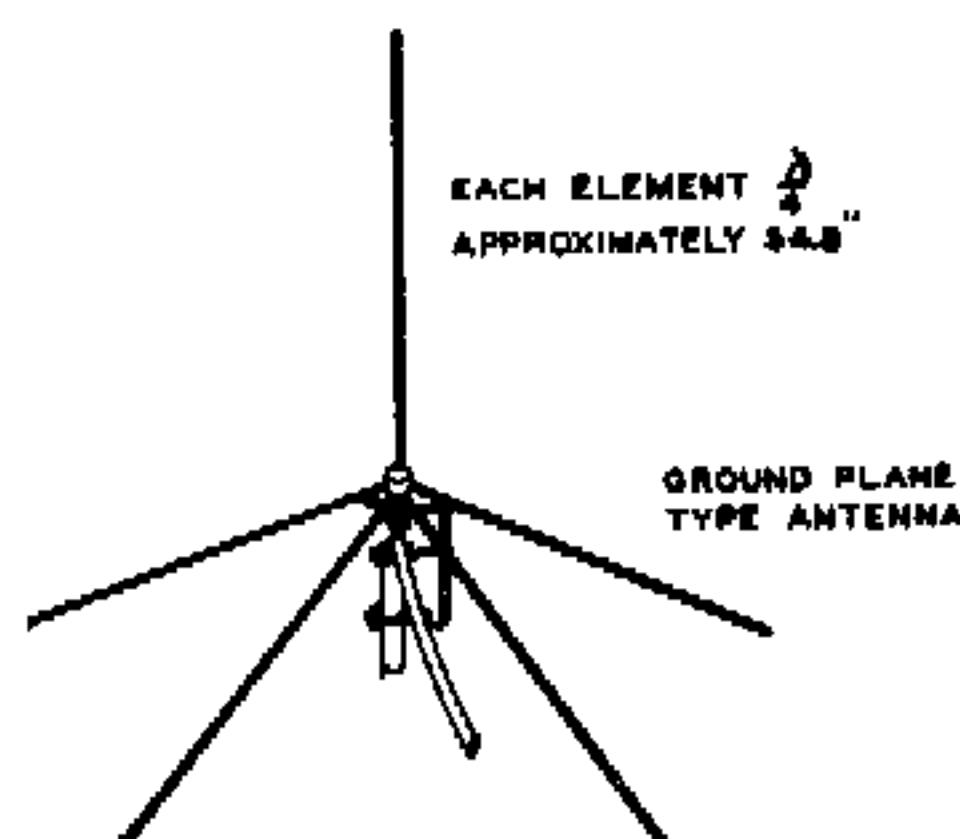


Figure 12

The choice of polarization is largely sectional. Some areas are predominately horizontal where others are vertical and it is suggested you use the polarization generally in use in your area. Beam antennas will provide typical effective radiated power gains up to 10 to 40, depending upon the number of parasitic elements used.

This means in effect that both transmitted and received signals will be up to 10 to 40 times stronger in signal strength (in the direction of maximum radiation) than when a simple doublet is used.

In viewing Figure 13, it is apparent that some means of turning the antenna is required unless point-to-point communication is the only requirement. Most any of the inexpensive television antenna rotors are adequate for a single bay beam of reasonable length on 6-meters.

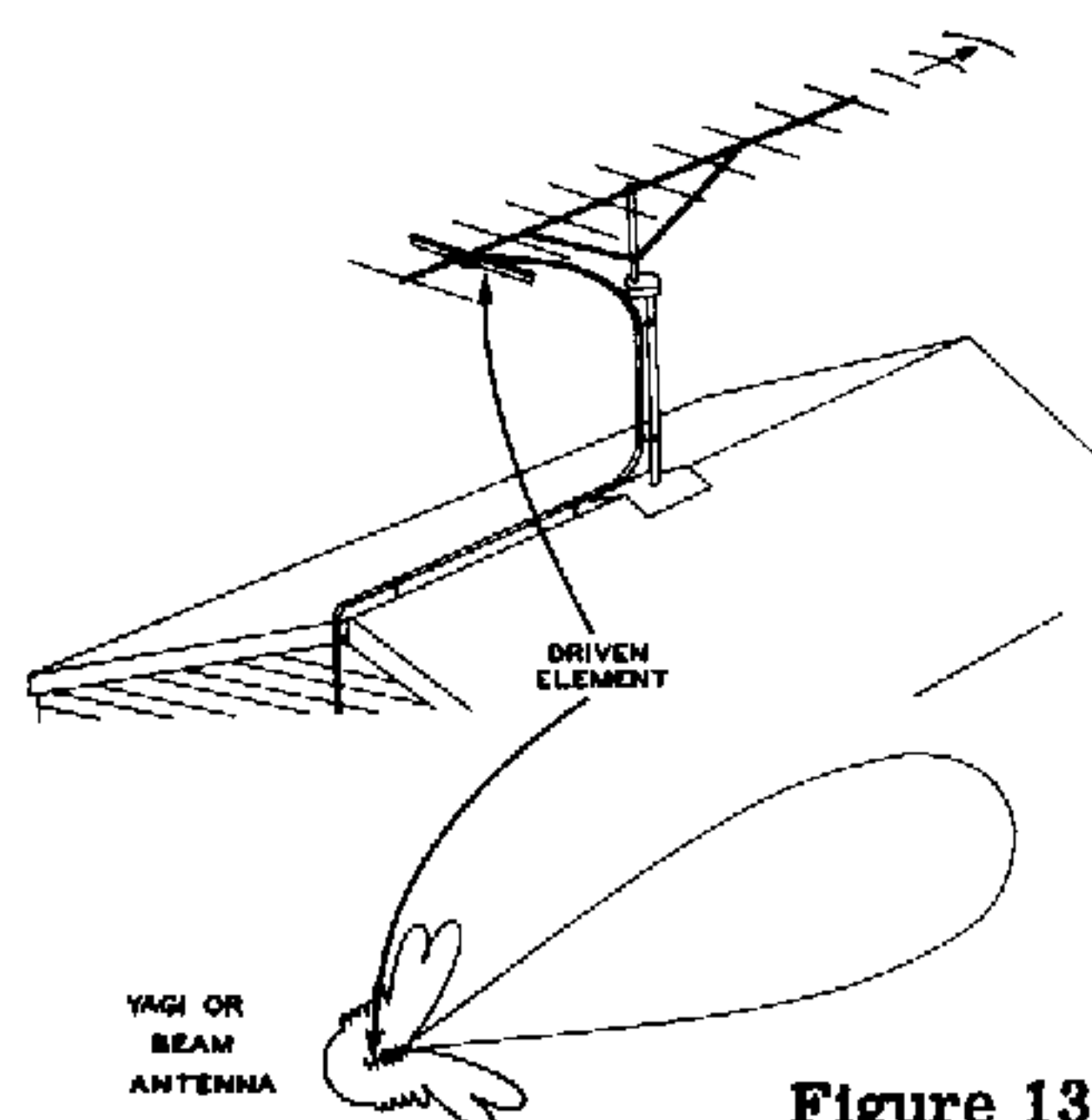


Figure 13

The choice of a directional antenna versus an omni-directional one is largely dependent upon application. Where strong signals are consistently present or where it is undesirable to have to rotate the antenna, the simpler types of antennas lend themselves readily. The highly directional arrays find good application in weak signal communications, point-to-point communications, or where it is desirable to reject signals from other interfering stations by rotating the antenna.

There are numerous other antenna systems available for these frequencies. Among many others, excellent references on the subject appear in VHF HANDBOOK by Orr and Johnson; THE RADIO AMATEUR'S HANDBOOK published by The American Radio Relay League and the more popular monthly periodicals.

ANTENNA FEED OR MATCHING SYSTEM

The antenna connector on your "Sixer" is designed for an unbalanced transmission line of 50-75 ohms (coaxial cable). Frequently, antenna systems are designed to be fed with 300 Ω twin lead or "ladder lines." A simple balun system shown in Figure 14 or Figure 14A, will provide the conversion from a 75 Ω unbalanced to 300 Ω balanced line, and may be used at either end of the transmission line.

For normally short runs of transmission line, either coax or twin lead may be used. For long runs, coax will have considerably more loss than twin lead or ladder line. If twin lead transmission line is used to the antenna, the coil type balun (Figure 14A) will work well. If the balun is used at the antenna (using coax as the transmission line), the coaxial balun (Figure 14) is preferred due to its exposure to outdoor conditions.

Figure 14B is a schematic view of a balun coil.

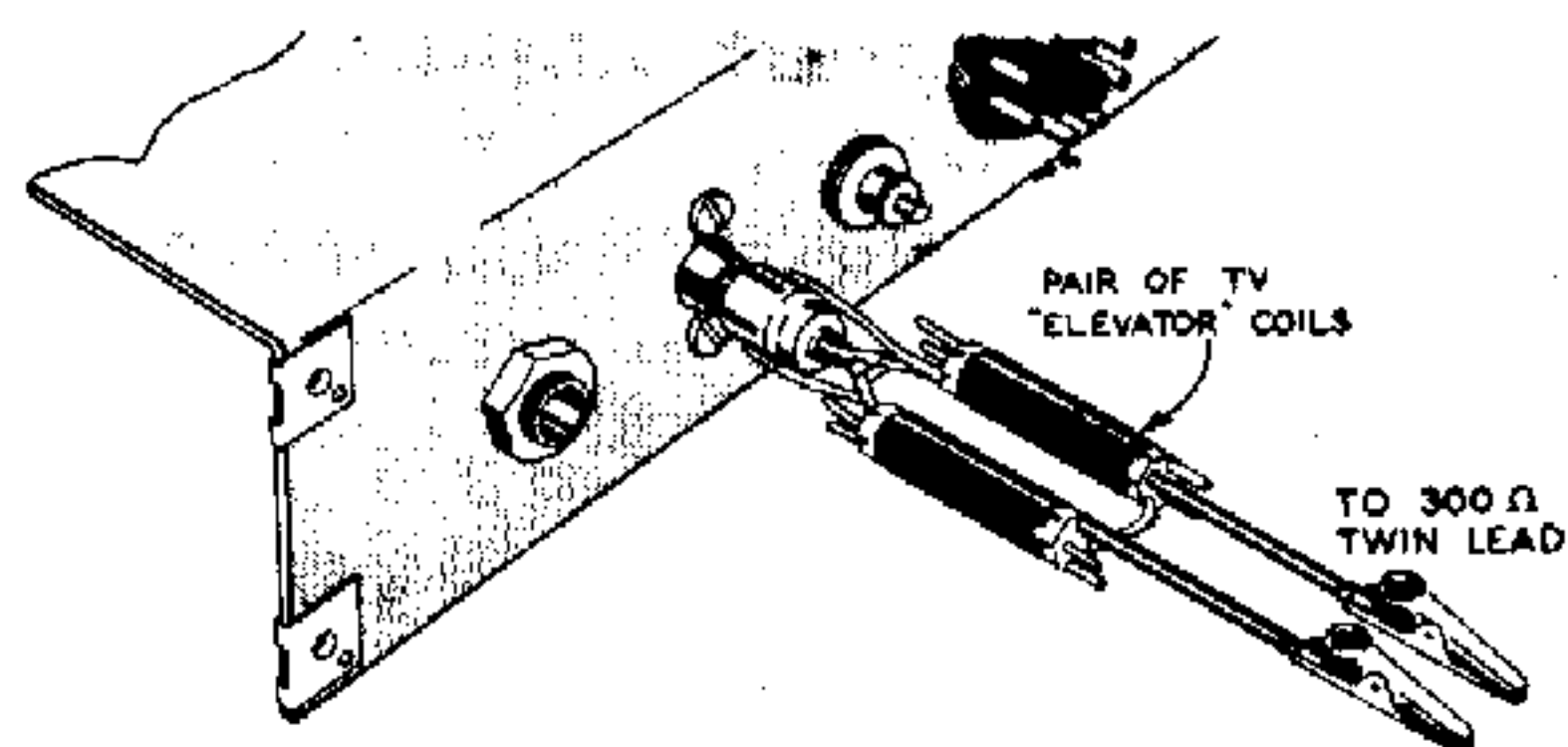


Figure 14

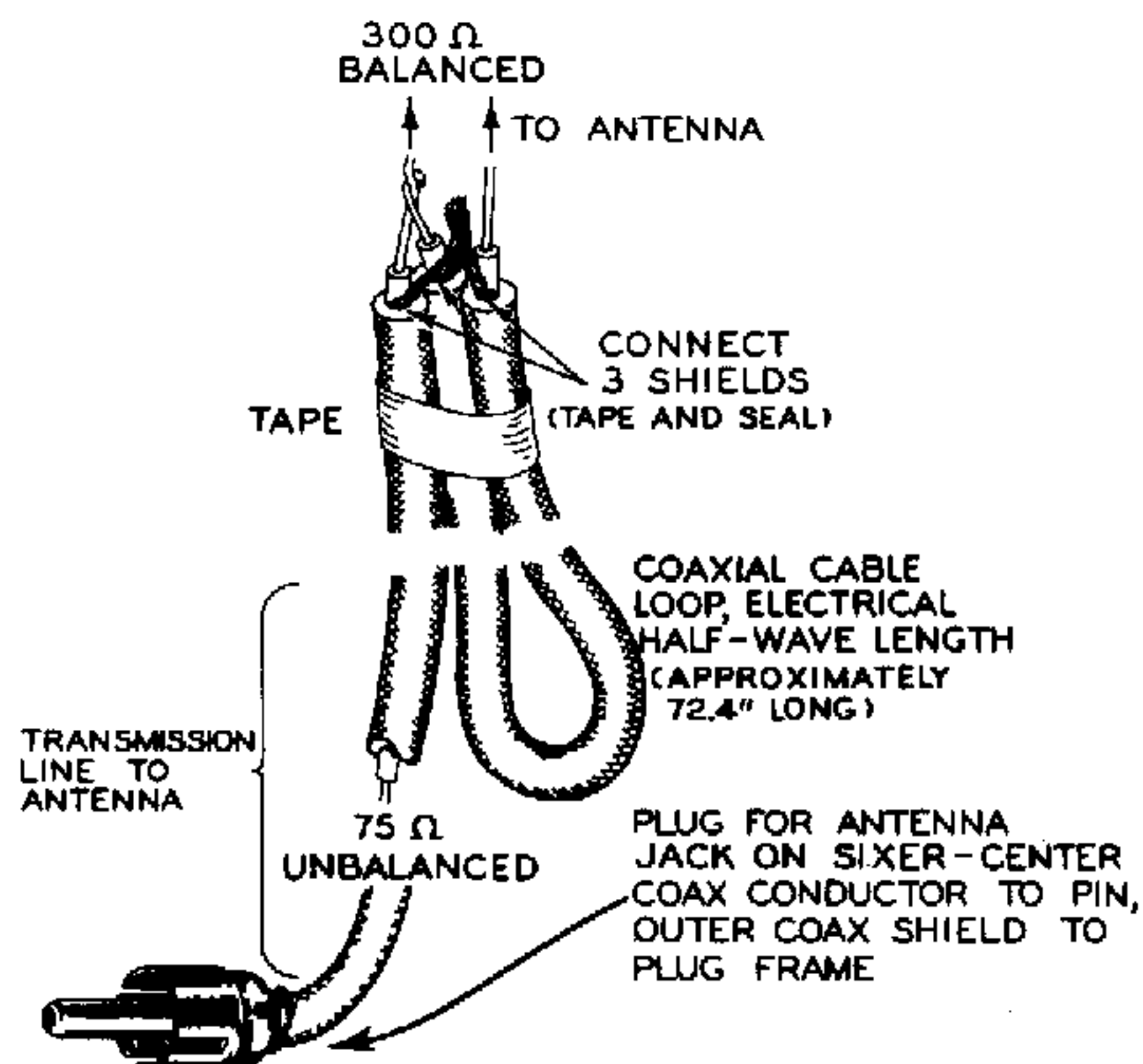


Figure 14 A

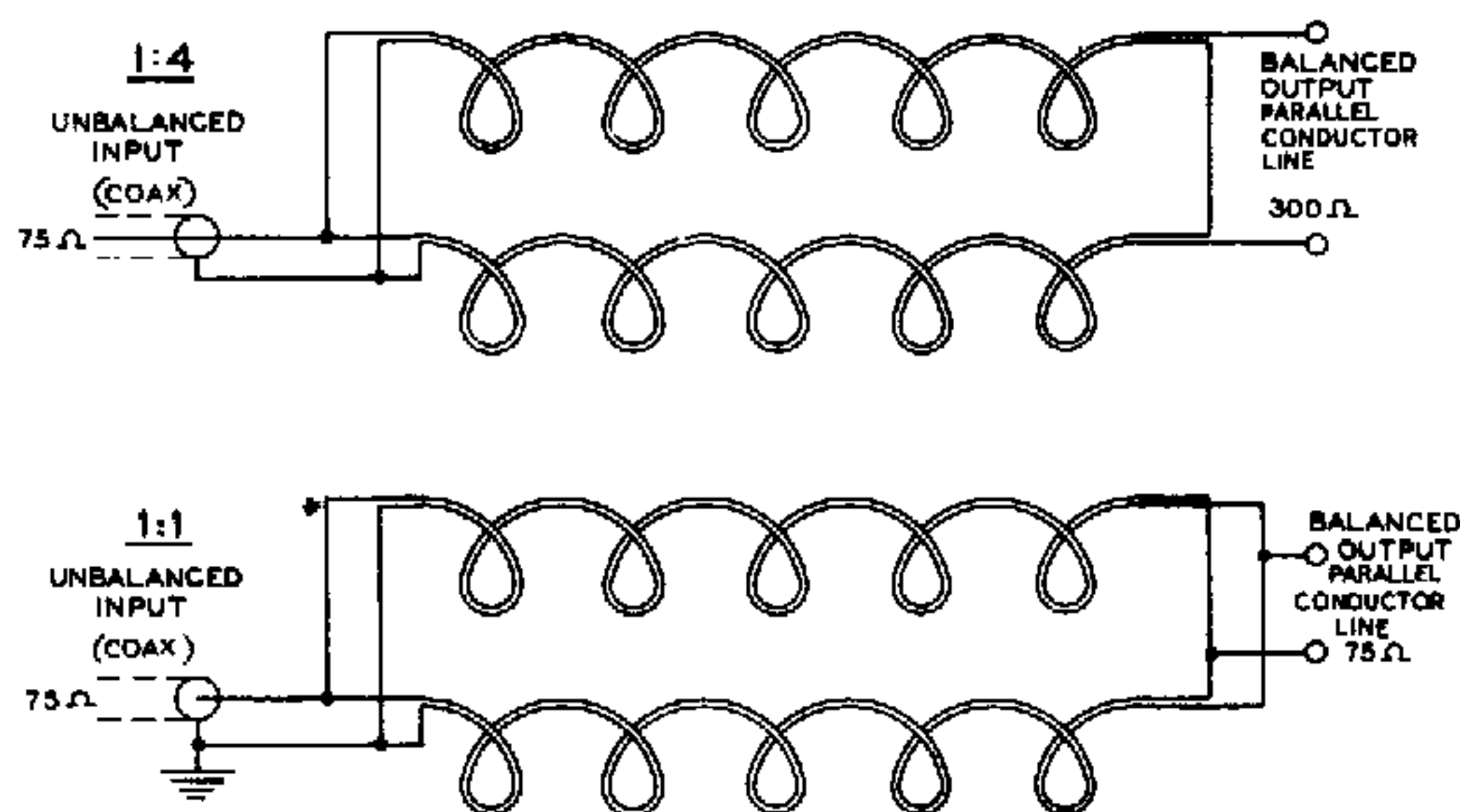


Figure 14B

INSTALLATION INFORMATION

Various factors should be considered before your HW-29A is installed at a fixed location. Several of these factors are listed below.

The polarization of the antenna system (the relative direction of the radiating elements) is quite important at the VHF frequencies. The majority of amateurs on 6-meters have horizontally polarized antennas; that is, the radiating element or elements are parallel to the surface of the earth. It should be pointed out that, even at short ranges, it is usually difficult to communicate between two stations, if one is horizontally polarized and the other is polarized vertically. Most horizontally polarized antennas show directional properties; that is, they will transmit and receive a stronger signal in one or more directions than in others. It is suggested that you use the polarization in general use in your area.

Non-directional, vertically polarized antennas frequently find application in fixed-to-mobile operation where the mobile units location is not predictable.

Try to locate your HW-29A near a good earth ground, such as a water pipe going directly underground. Although the use of an earth ground is not essential for proper operation of your HW-29A, in many instances greatly improved operation will result, and it is considered good practice to have the system grounded.

INSTALLATION AT A MOBILE LOCATION

The section to follow will deal specifically with installation in an automobile or light truck, but the majority of this information is also applicable to other mobile installation (boats, etc.). See Figures 15 and 16.

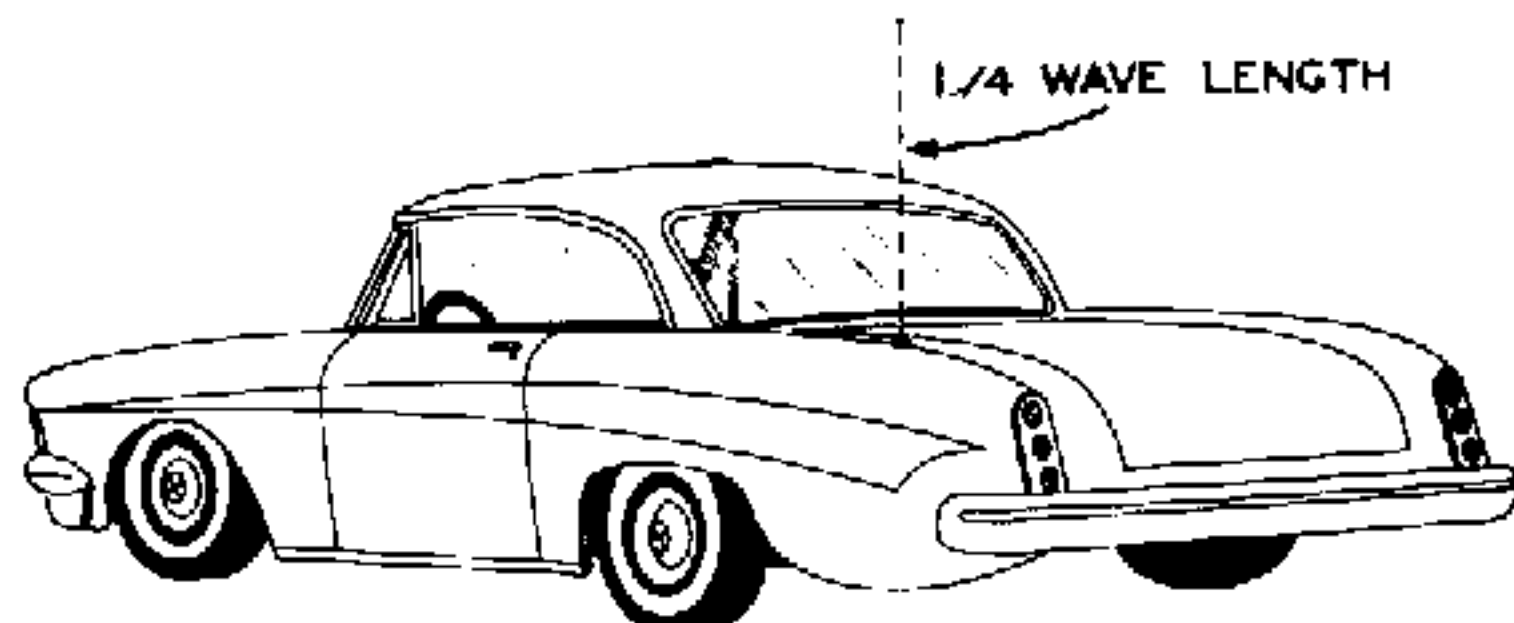


Figure 15

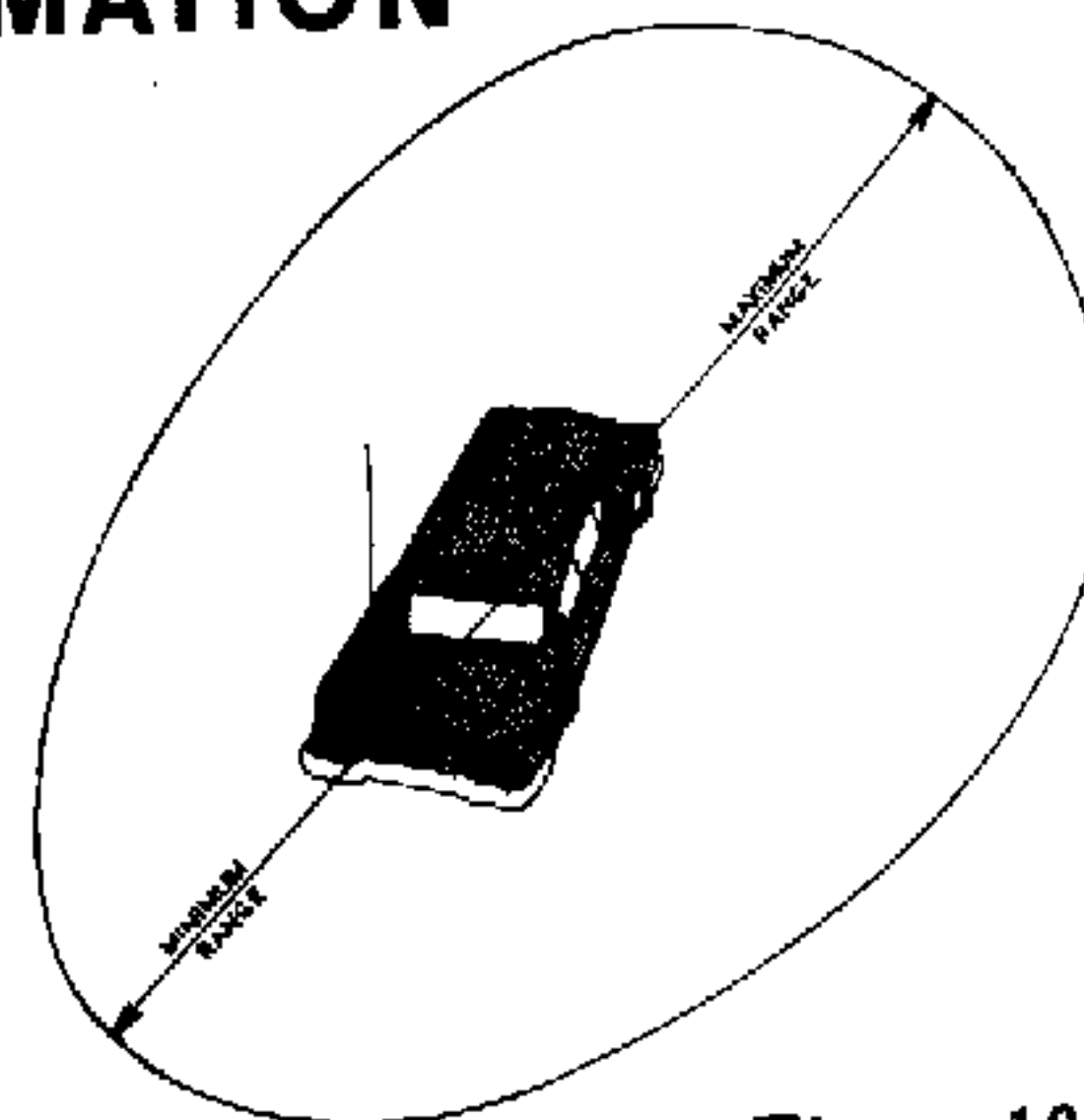


Figure 16

In a mobile installation, the antenna system is of great importance. Any mobile system is at a decided disadvantage, due to the lack of a good earth ground, the only ground being the capacitive coupling between the vehicle body and the earth below.

With few exceptions, the antenna best suited for mobile service will be either some sort of vertically polarized whip antenna (Figure 15) or the current "halo" antenna for horizontal polarization. It is suggested that you contact hams in your area to determine the type of polarization used in your locality, since some areas prefer one over the other, and it becomes very difficult to maintain communication under cross-polarization conditions at this frequency. For vertical polarization a $1/4$ wave (approximately 55") whip, suitably placed, as shown in Figure 15, is generally the most practical. These antennas use the metal vehicle body as their "ground plane" and for this reason are normally somewhat directional when installed at a more practical location, such as the rear of the vehicle. If installed in the roof center, radiation is usually better and very little directional properties will be noted. No specific information about the actual directional characteristics of any given installation can be given here due to variables in antenna location, but a typical installation might be expected to yield a radiation pattern similar to that shown in Figure 16.

This directional characteristic normally causes no serious difficulty, but you should be aware of its existence.

In nearly all mobile installations, the ambient noise level will be higher than at a fixed location. For this reason, serious consideration should be given to the physical position of the unit with

respect to the operator. Obviously, only those locations within easy reach of the operator should be considered, but usually in any given situation more than one such location exists. Try to pick the location which offers the best compromise of these requirements.

After this location has been chosen, the unit should be securely fastened to some solid surface. Simple sheet metal brackets, fashioned to fit your particular requirements, should suffice.

Engine ignition interference may be a problem. Actual field tests in a variety of vehicles have indicated no suppression is required (in the average vehicle) beyond that normally provided for a vehicle with a "factory equipped" standard broadcast band radio receiver. If an ignition interference problem is present, nearly any radio service shop, skilled in auto radio repair, should be able to help you locate and correct the difficulty. One possible cause of such interference can be the exhaust system. The muffler

and tail pipe are frequently mounted with rubber insulated mounting clamps to reduce vibration, and thus the muffler and tail pipe are electrically grounded at the engine end only. This problem can usually be solved by electrically grounding the tail pipe to the vehicle frame at one or more points. Many other possibilities could be mentioned here, but the many variables between vehicles and installations make this somewhat impractical.

Generator interference may also be a problem as evidenced by a generator "whine." It is recommended in these cases, that a coaxial capacitor of .5 μ fd value with a current rating exceeding the generator output (similar to Sprague 48P18 rated at 40 amperes) be used to replace the usual bypass capacitor. The insertion of a coaxial capacitor in the armature winding lead will require a short additional connecting lead of #10 gauge wire. The capacitor case is grounded using the same screw which held the old capacitor in place.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.
2. It is interesting to note that about 90% of the kits that are returned for repair, malfunction due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as illustrated in the Figures found in the Soldering Techniques section of this manual.
3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.
4. Check the tubes with a tube tester or by substitution of tubes of the same types and known to be good.
5. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.
6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring beneath the chassis.
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those found on the Schematic Diagram. NOTE: All voltage readings were taken with a HEATHKIT Vacuum Tube Voltmeter. Voltages may vary 10% due to line voltage variations.
8. Listed on the following page are some possible difficulties which might arise in the construction and operation of your HW-29A Transceiver. The suggested corrective measures given definitely DO NOT RULE OUT all other possibilities, but are given primarily to direct your attention to the areas most likely to be faulty.

TROUBLESHOOTING CHART	
1. Receiver section dead.	a. Faulty tubes - check V1, V2 and V3 voltages. b. Wiring error - recheck wiring. c. Faulty speaker or speaker ground - check speaker voice coil.
2. Receiver section weak.	a. Faulty tube - check V1, V2 and V3 voltages. b. Regeneration control not sufficiently advanced. c. RF or detector coils misaligned. d. Faulty antenna or connecting cable.
3. Transmitter appears dead.	a. Faulty tubes - check V4 and V5 voltages. b. Wiring error - recheck wiring. c. Transmitter section coils mistuned - recheck tuning. d. Dummy load shorted or open - recheck. e. Antenna mismatch - recheck antenna installation. f. Faulty crystal.
4. Power input to final amplifier too high (over 6 watts), or too low (less than 4 watts).	a. Faulty tube - check V4 and V5 voltages. b. Wiring error - recheck wiring. c. Transmitter section misaligned - recheck tuning procedure. d. Faulty meters - recheck meter readings. e. High or low activity crystal - substitute another crystal for comparison check. f. B+ voltage too high or low - check power supply voltages. Check for leaky capacitors, open or shorted resistors, at the power supply. Check transformer voltages.
5. Strong signal from transmitter but no modulation.	a. Faulty microphone or connections - recheck. b. Faulty tubes - check V1 and V2 voltages. c. Wiring error - recheck V2 and V2 wiring. d. Shorted lead to ground at mike connector - center lead in connector opening.
6. Weak transmitted signal.	a. Faulty antenna - check. b. Shorted or open connecting cable - check. c. Poor antenna location.
7. Low power supply voltages.	a. Low line voltage - check. b. Leaky filter capacitors - check. c. Error in dropping resistor values or wiring - check. d. Faulty transformer - check voltages.
8. Modulation hum.	a. Power supply filter capacitor ground connection ungrounded - resolder. b. Faulty tubes - check V1 and V2. c. Open grid circuit connection - check wiring and soldering of V1 and V2.
9. Cathode current of final amplifier higher than normal.	a. Check the tuning of all transmitter coils for proper resonance and alignment.

or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function

without difficulty. Occasionally improper instrument operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

- A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.
- B. Identify the type and model number of kit in which it is used.
- C. Mention date of purchase.
- D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. **PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO.** Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

The entire kit should be returned with all tubes and the cabinet properly installed. Be sure to include the microphone, all power cables, and the dummy load.

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Wrap the equipment in heavy paper, exercising care to

prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: **HEATH COMPANY**
Benton Harbor, Michigan

Include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

WARRANTY

Heath Company warrants that all Heathkit parts shall be free of all defects in materials and workmanship under normal use and service, and in fulfillment of such warranty Heath Company will, for a period of three months from the date of shipment, replace any part upon verification that it is defective.

The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

The foregoing warranty is completely void if corrosive solder or fluxes have been used in wiring the equipment. Heath Company will not replace or repair any equipment in which corrosive solder or fluxes have been used.

This warranty applies only to Heath equipment sold and shipped within the continental United States including APO and FPO shipments. Warranty replacements for Heathkit equipment outside the United States is on a f.o.b. factory basis. Contact the Heathkit authorized distributor in your country or write: Heath Company, International Division, Benton Harbor, Michigan, U.S.A.

HEATH COMPANY

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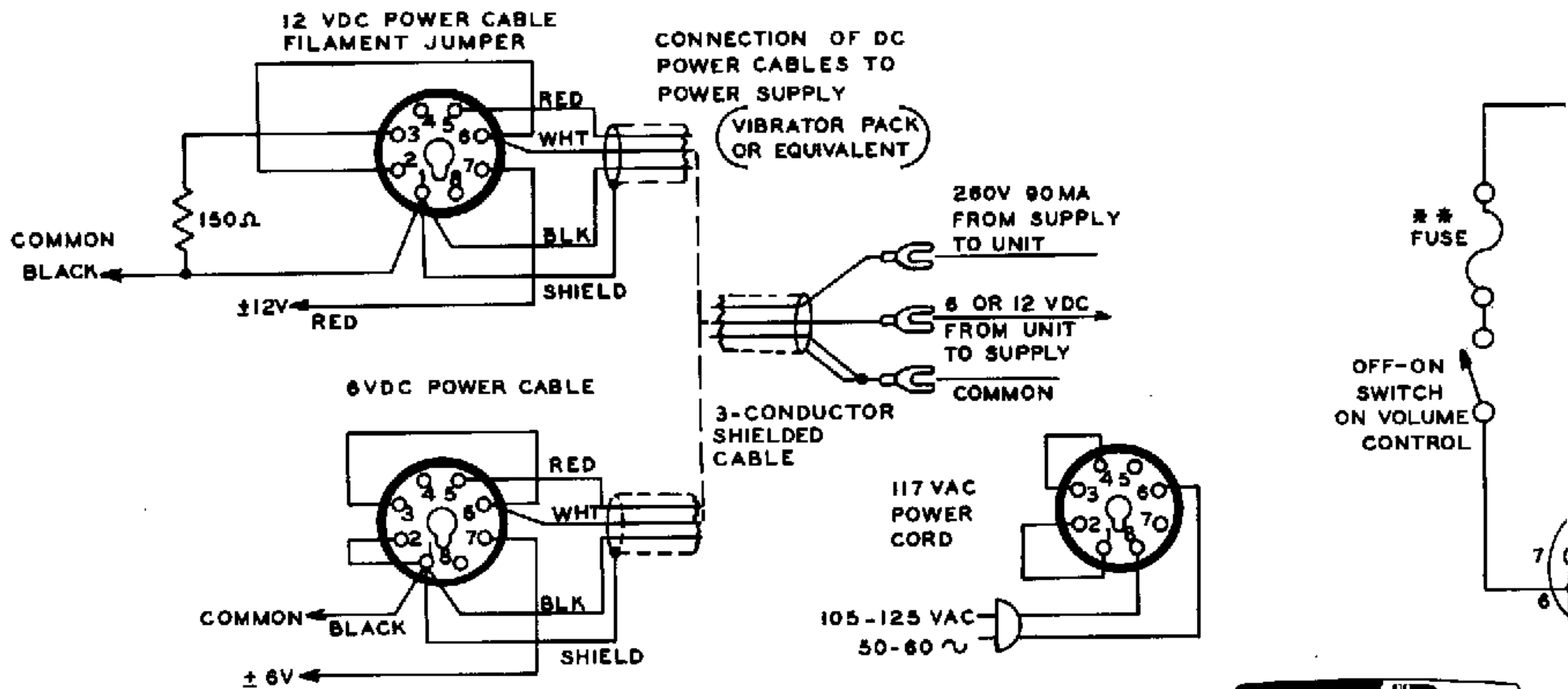
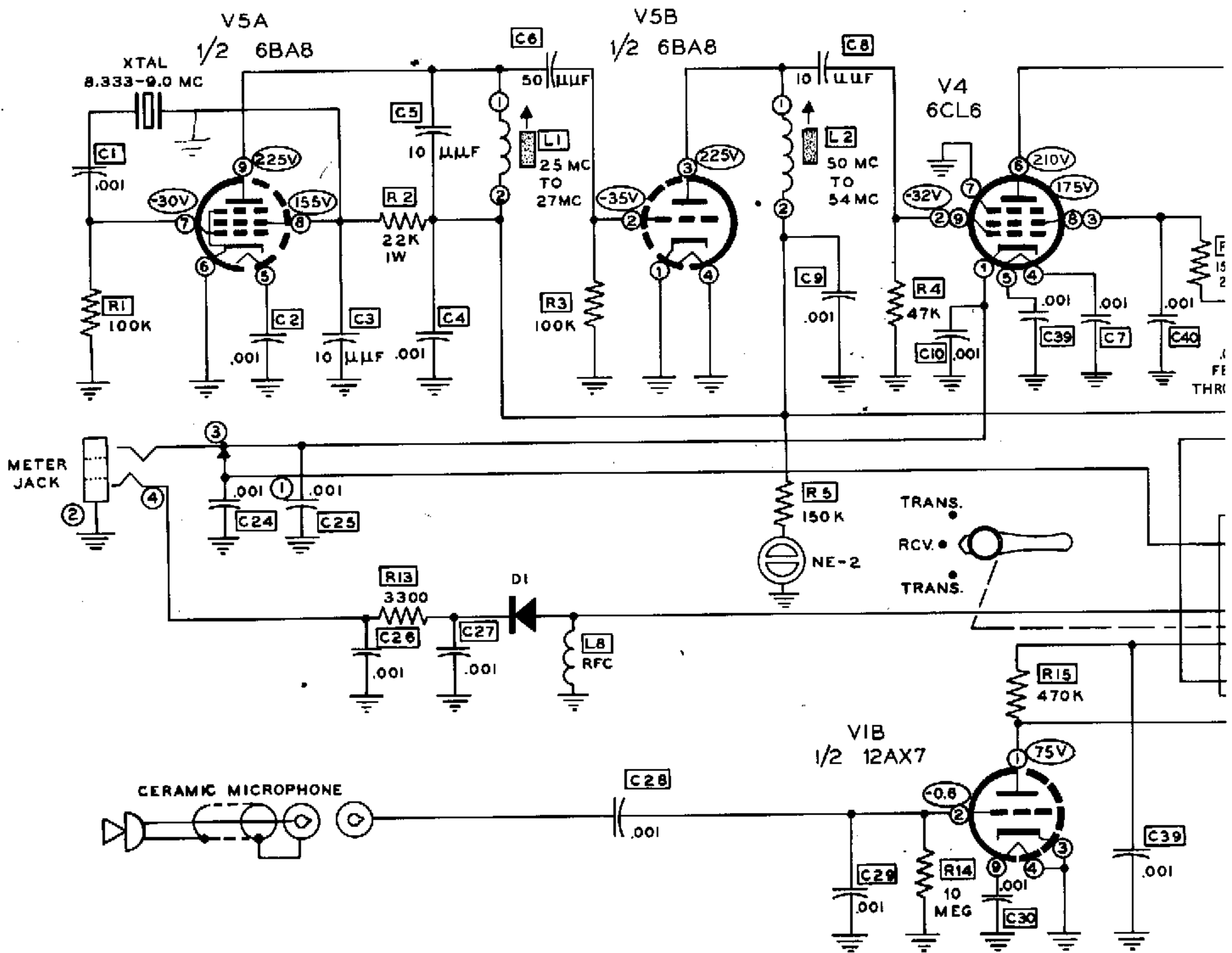
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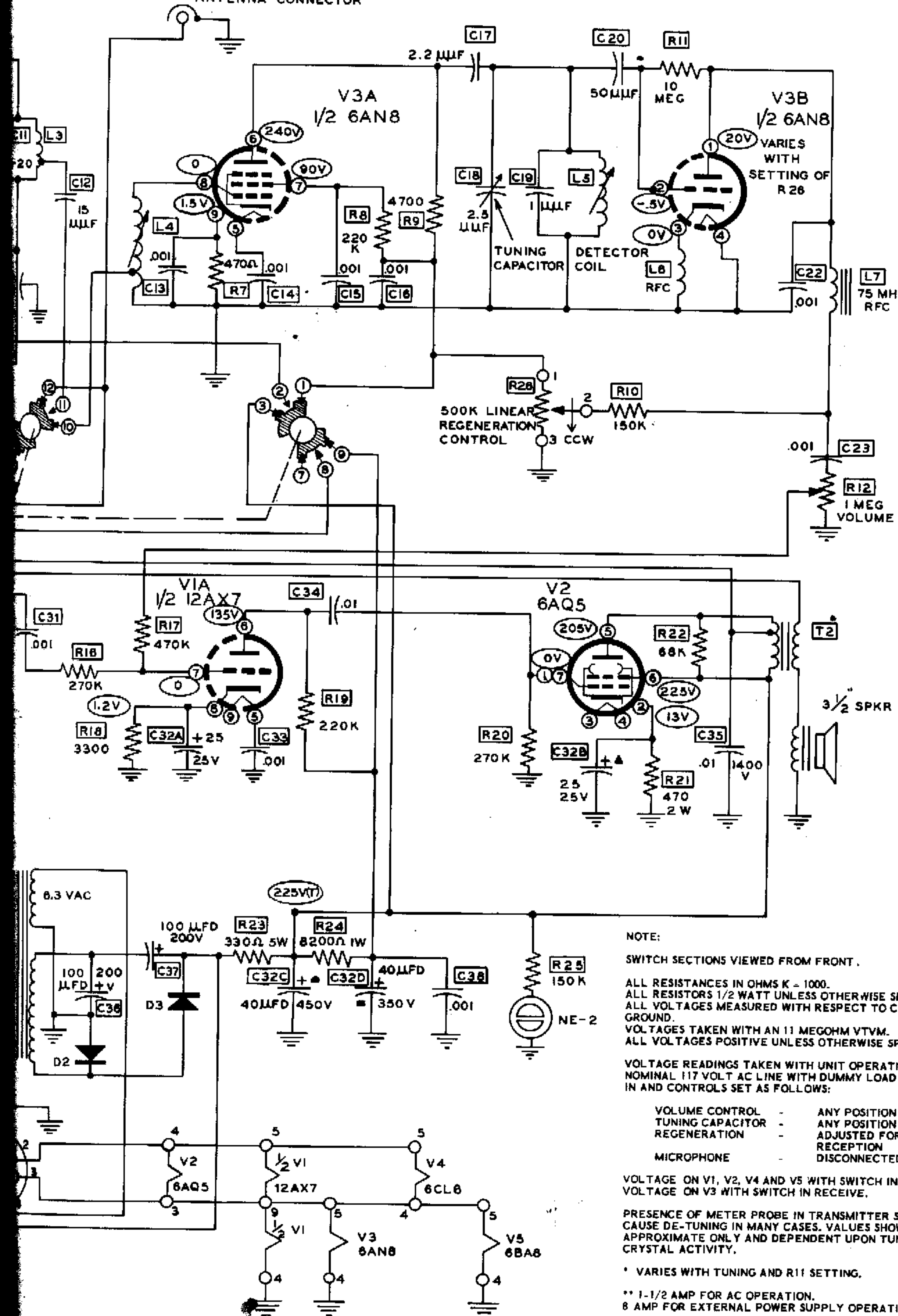
VHF HANDBOOK by Orr and Johnson.



HEATHKIT DAYSTROM

6 METER AMATEUR TRANSCEIVER
MODEL HW-29A

ANTENNA CONNECTOR



NOTE:

SWITCH SECTIONS VIEWED FROM FRONT.

ALL RESISTANCES IN OHMS K = 1000.
ALL RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED.
ALL VOLTAGES MEASURED WITH RESPECT TO CHASSIS GROUND.
VOLTAGES TAKEN WITH AN 11 MEGOHM VTVM.
ALL VOLTAGES POSITIVE UNLESS OTHERWISE SPECIFIED.

VOLTAGE READINGS TAKEN WITH UNIT OPERATING FROM NOMINAL 117 VOLT AC LINE WITH DUMMY LOAD PLUGGED IN AND CONTROLS SET AS FOLLOWS:

VOLUME CONTROL - ANY POSITION - ON
TUNING CAPACITOR - ANY POSITION
REGENERATION - ADJUSTED FOR NORMAL RECEPTION
MICROPHONE - DISCONNECTED

VOLTAGE ON V1, V2, V4 AND V5 WITH SWITCH IN TRANSMIT.
VOLTAGE ON V3 WITH SWITCH IN RECEIVE.

PRESENCE OF METER PROBE IN TRANSMITTER SECTION WILL CAUSE DE-TUNING IN MANY CASES. VALUES SHOWN ARE APPROXIMATE ONLY AND DEPENDENT UPON TUNING AND CRYSTAL ACTIVITY.

* VARIES WITH TUNING AND R11 SETTING.

** 1-1/2 AMP FOR AC OPERATION.
8 AMP FOR EXTERNAL POWER SUPPLY OPERATION.

L1 = #40-186
L2 = #40-307
L3 = #40-355
L4 = #40-306
L5 = #40-307