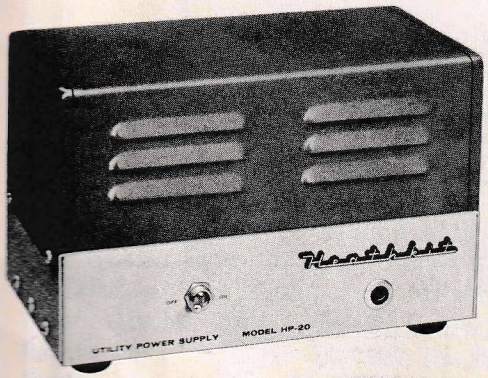
Assembly
and
Operation
of the

HEATHKIT® by DAYSTROM

UTILITY POWER SUPPLY

MODEL HP-20



HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

a subsidiary of DAYSTROM, INCORPORATED

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12/7/62

SPECIFICATIONS

Power Requirements:.	117 volts AC, 50/60 cycles, 200 watts.
Chassis Dimensions:.	9" long, 4-3/4" wide, 2-1/4" high.
Overall Height:.	6" (with cover and four rubber feet).
Total Continuous DC Output Power:.	1. 120 watts - 600 volts at 200 milliamperes —or— 120 watts - 600 volts at 150 milliamperes and 300 volts at 100 milliamperes. 2. Bias - 130 volts at 30 milliamperes. (Available in addition to above.)
Filament Power:.	6.3 volts at 11 amperes, or 12.6 volts at 5.5 amperes.
Regulation (50% load to 100% load, from high voltage tap):.	Approximately 10%.
Net Weight:.	12 lbs.
Shipping Weight:.	15 lbs.

INTRODUCTION

The HEATHKIT Model HP-20 Utility Power Supply was designed primarily to furnish all the necessary power for HEATHKIT Mobile Transmitters and Receivers, when they are used as fixed station units.

Being a utility power supply allows it to be used to supply power to many other makes and types of amateur equipment as well.

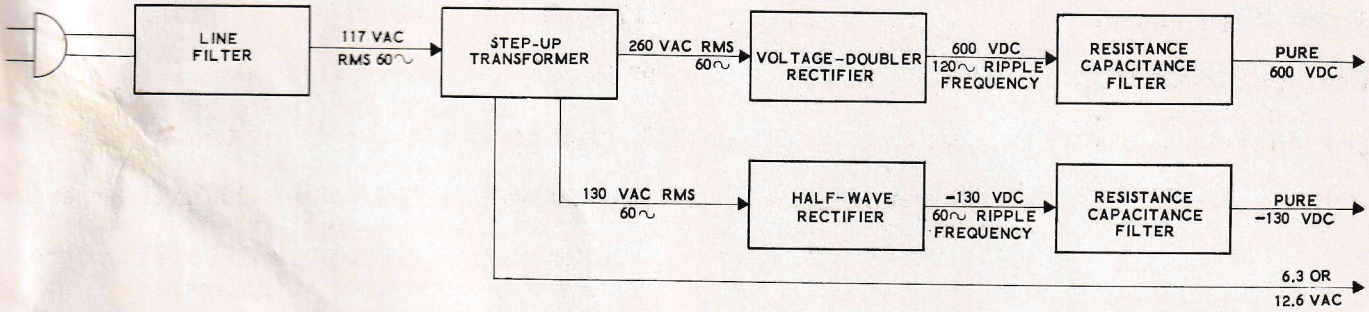
The Model HP-20 will supply a full 120 watts of power, 600 volts at 200 milliamperes. A half voltage tap (300 volts) is available for supplying the receiver, or low level stages of the transmitter. In addition, 130 volts of negative bias is available at a current rating (30 ma) consistent with voltage regulator service. This feature allows use of the HP-20 with SSB equipment requiring regulated bias voltage.

The loads on the high and low voltage terminals of the supply should be adjusted so that the total power drain will not exceed 120 watts. A typical example would be a drain of 600 volts at 150 milliamperes from the high voltage tap, which equals 90 watts. This would leave 30 watts available at the low voltage tap, or 300 volts at 100 milliamperes. The total of the two will equal the 120 watt rating of the supply.

In event of a complete short circuit in any of the secondary circuits of the supply, two fuses of the proper current rating afford adequate protection.

The supply features excellent static regulation, combined with the advantages of good dynamic regulation, achieved through the use of high value filter capacitors.

A full-wave voltage doubler circuit affords good efficiency along with circuit economy. The resultant ripple frequency is twice the source frequency and, therefore, is easier to filter. A further advantage is that each capacitor in the doubler circuit requires a DC rating of only half the output voltage, since the capacitors are in series.



THEORY OF OPERATION

The conventional voltage-doubler circuit used in this power supply has been chosen because of its efficiency, economy and circuit simplicity.

A voltage-doubler circuit will deliver a DC output voltage approximately twice the rms value of the secondary winding of the transformer. Under very high current drains, the output voltage may be slightly under twice the secondary voltage.

In operation, the filter capacitors C5 and C6 are each charged to the peak voltage of the transformer secondary on alternate half cycles, but with polarities such that the DC voltages developed across the capacitors add, in so far as the output voltage is concerned.

Due to the low ripple content existing in the waveform immediately after rectification (the ripple frequency being doubled, as well as the voltage), a minimum of filtering is required. This is accomplished with a simple resistance and capacity network, consisting of R1, R2, C7, and C8. A half-wave rectifier is used in the bias supply. The bias supply filter network consists of C9, R6, and C10 with R7 serving as the bleeder resistor.

In order to provide good dynamic regulation, high value output filter capacitors are used.

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 a stable instrument, operating at a high degree of dependability. We suggest that you retain the manual in your files for future reference, both in the use of the instrument 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 charts and other 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 REPLACEMENT section and supply the information called for therein. Include all inspection slips in your letter to us.

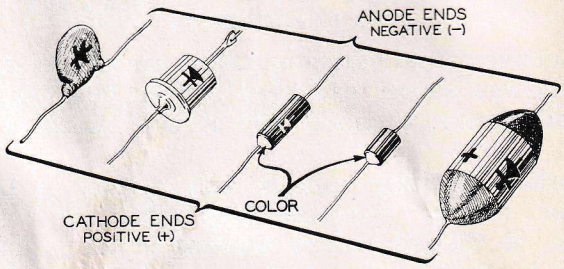
Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

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.

IMPORTANT NOTE: The #57-20 silicon diodes supplied in this kit will meet all circuit requirements, but may appear different than shown in the parts pictorial and other sections of the manual. The accompanying illustration shows some of the silicon diode types that may be supplied.



PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors-Capacitors		
1A-19	1	220 Ω 1 watt resistor (red-red-brown)
1A-28	1	100 KΩ 1 watt resistor (brown-black-yellow)
3G-9	2	100 Ω 7 watt wire-wound 10% resistor
3Y-3	1	30 KΩ 25 watt wire-wound center tapped resistor
21-71	4	.001 μfd GMV 1400 V disc ceramic capacitor
25-34	2	125 μfd 450 V twist prong electrolytic capacitor
25-36	2	40 μfd 450 V electrolytic tubular capacitor
25-80	1	20+20 μfd 150 volt capacitor
Choke-Switch-Transformer		
45-17	2	Line choke
54-109	1	Power transformer
61-1	1	SPST toggle switch
Plug-Socket-Terminal Strips		
431-1	1	1-lug terminal strip
431-2	1	2-lug terminal strip
431-5	3	4-lug terminal strip
431-11	2	5-lug terminal strip
431-27	1	3-lug terminal strip
431-33	1	3-lug terminal strip, #8 foot
434-39	1	Octal socket

PART No.	PARTS Per Kit	DESCRIPTION
Plug-Socket-Terminal Strips (Cont'd.)		
438-11	1	Plug, AC fused
438-22	1	Octal plug
Wire-Cord-Sleeving		
89-4	1	Line cord
344-1	4	Length hookup wire (1 each-black, orange, yellow, red)
346-1	1	Length insulated sleeving
346-10	2	Length 3/8" fiber glass sleeving
347-18	1	Length 8-conductor cable
Metal Parts		
200-M279F396	1	Chassis
204-M198	1	Mounting bracket
205-M168F	1	Bottom plate
Hardware		
250-8	8	#6 x 3/8" BH sheet metal screw
250-18	7	8-32 x 3/8" RHMS
250-56	6	6-32 x 1/4" BHMS
250-89	4	6-32 x 3/8" BHMS
250-123	1	10-24 x 2-1/4" slotted hex head screw
252-3	10	6-32 x 1/4" nut
252-4	11	8-32 x 3/8" nut
252-30	1	10-24 hex nut

PART No.	PARTS Per Kit	DESCRIPTION
Hardware (Cont'd.)		
253-7	1	#10 fiber shoulder washer
253-42	3	1/2" x 3/16" flat washer
254-1	10	#6 lockwasher
254-2	11	#8 lockwasher
255-41	4	1/4" spacer
Miscellaneous		
57-20	5	Silicon rectifier (500 ma)
73-1	1	3/8" rubber grommet
73-4	1	5/16" rubber grommet

PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (Cont'd.)		
90-101	1	Cabinet cover
261-6	4	Rubber feet
391-7	1	Nameplate
412-10	1	Neon pilot light
421-2	2	3 amp fuse
440-1	1	Octal plug cap
481-3	2	Capacitor mounting wafer (fiber)
336-1		Solder
595-363	1	Manual


6-32 x 1/4" BHMS
#250-56


#6 LOCKWASHER
#254-1


6-32 NUT
#252-3


8-32 NUT
#252-4


10-24 NUT
#252-30

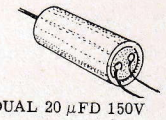

1/4" SPACER
#255-41


6-32 x 3/8" BHMS
#250-89

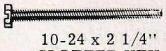

8-32 x 3/8" RHMS
#250-18


#8 LOCKWASHER
#254-2

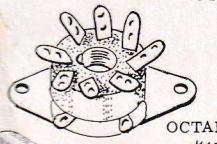

#10 FIBER
(SHOULDER) WASHER
#253-7


DUAL 20 μFD 150V
ELECTROLYTIC CAPACITOR
#25-80

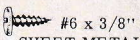

3/16" x 5/16"
RUBBER GROMMET
#73-4


10-24 x 2 1/4"
SLOTTED HEX
HEAD SCREW
#250-123

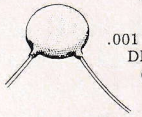

1/2" x 3/16" WASHER
#253-42

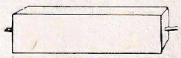

OCTAL SOCKET
#434-39


3/8" x 9/32"
RUBBER GROMMET
#73-1

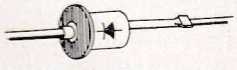

#6 x 3/8" BH
SHEET METAL SCREW
#250-8

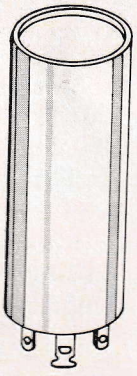

40 μfd 450 VOLT
ELECTROLYTIC
CAPACITOR
#25-36

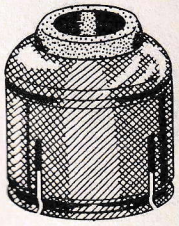

.001 μfd 1400 VOLT
DISC CERAMIC
CAPACITOR
21-71

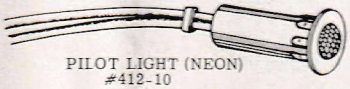

100 Ω 7 WATT RESISTOR
#3G-9


LINE CHOKE
#45-17

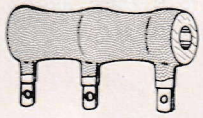

SILICON RECTIFIER
500 ma.
#57-20

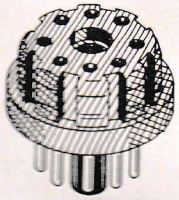

125 μfd 450 VOLT
ELECTROLYTIC CAPACITOR
#25-34


OCTAL PLUG CAP
#440-1


PILOT LIGHT (NEON)
#412-10

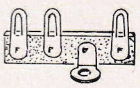

RUBBER FOOT
#261-6

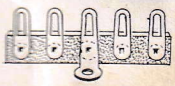

30 KΩ 25 WATT
BLEEDER RESISTOR
#3Y-3

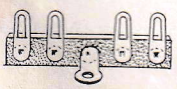

OCTAL PLUG
#438-22

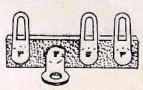

3/8" FIBER
GLASS SLEEVING
#346-10

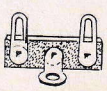

1-LUG
TERMINAL STRIP
#431-1


3-LUG
TERMINAL STRIP
#431-27


5-LUG
TERMINAL STRIP
#431-11


4-LUG
TERMINAL STRIP
#431-5


3-LUG
TERMINAL STRIP
#8 Foot #431-33


2-LUG
TERMINAL STRIP
#431-2

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 30 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.

6. Position the work, if possible, so that gravity will help to keep the solder where you want it.

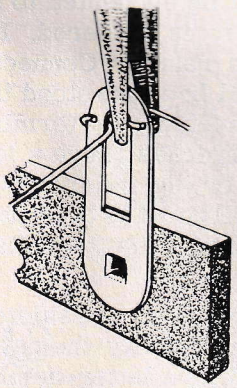
7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.

8. Then place the solder against the heated terminal and it will immediately flow over

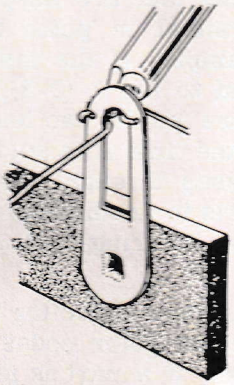
the joint; use only enough solder to thoroughly wet the junction. It is usually not necessary to fill the entire hole in the terminal with solder.

9. Remove the solder and then the iron from the completed junction. Use care not to move the leads until the solder is solidified.

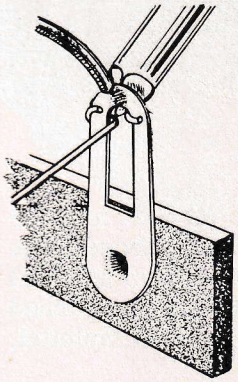
A poor or cold solder joint will usually look crystalline and have a grainy texture, or the solder will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly over the entire junction. In some cases, it may be necessary to add a little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



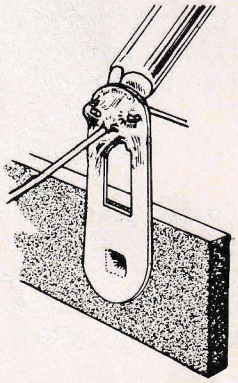
CRIMP WIRES



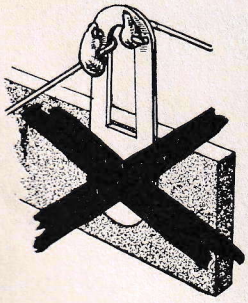
HEAT CONNECTION



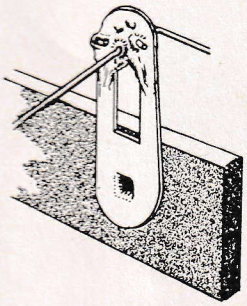
APPLY SOLDER



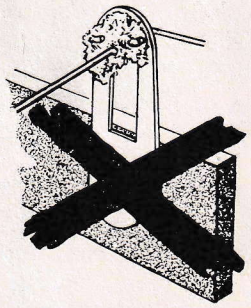
ALLOW SOLDER TO FLOW



COLD SOLDER JOINT CONNECTION INSUFFICIENTLY HEATED



PROPER SOLDER CONNECTION



COLD 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

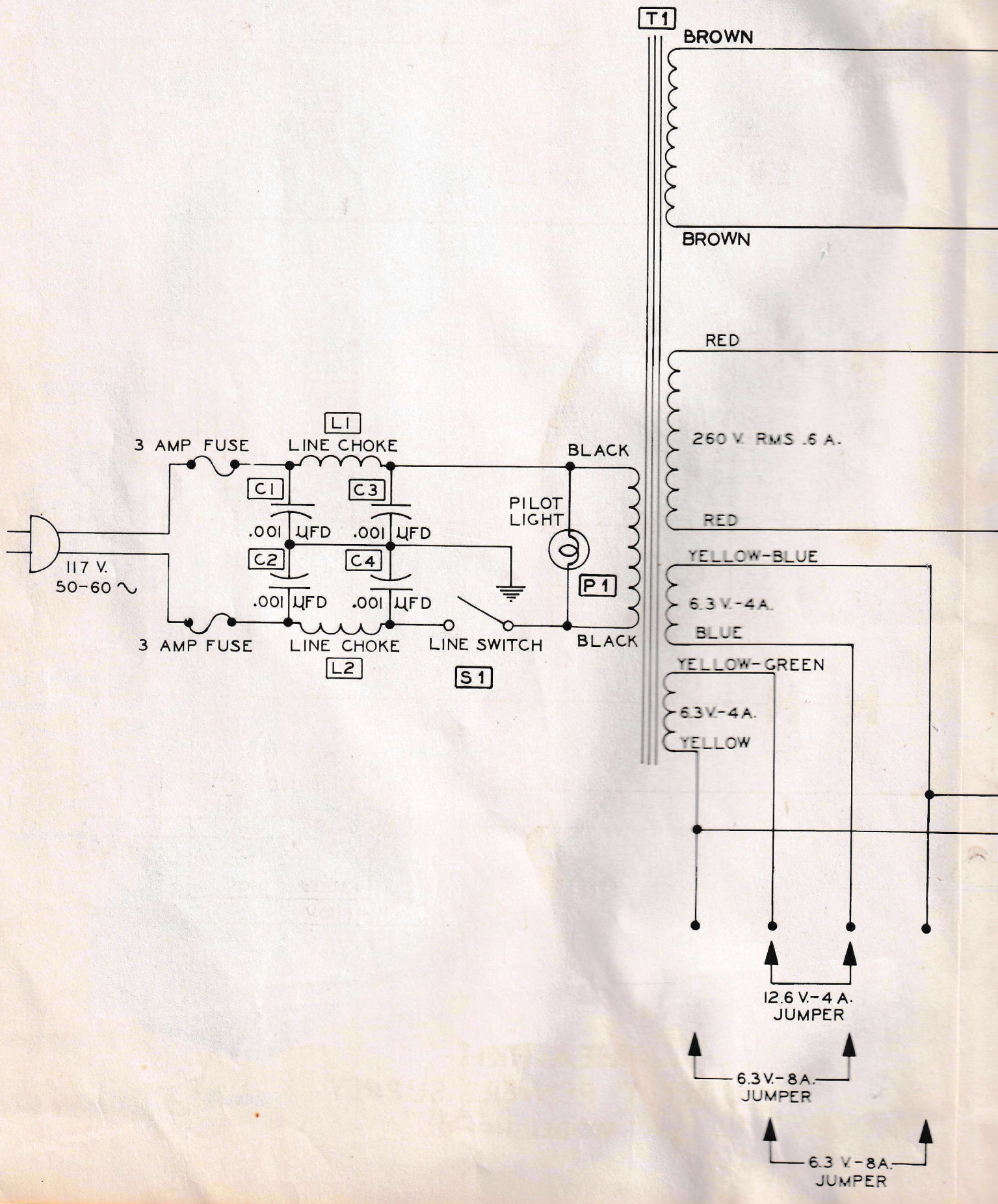
The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This 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.

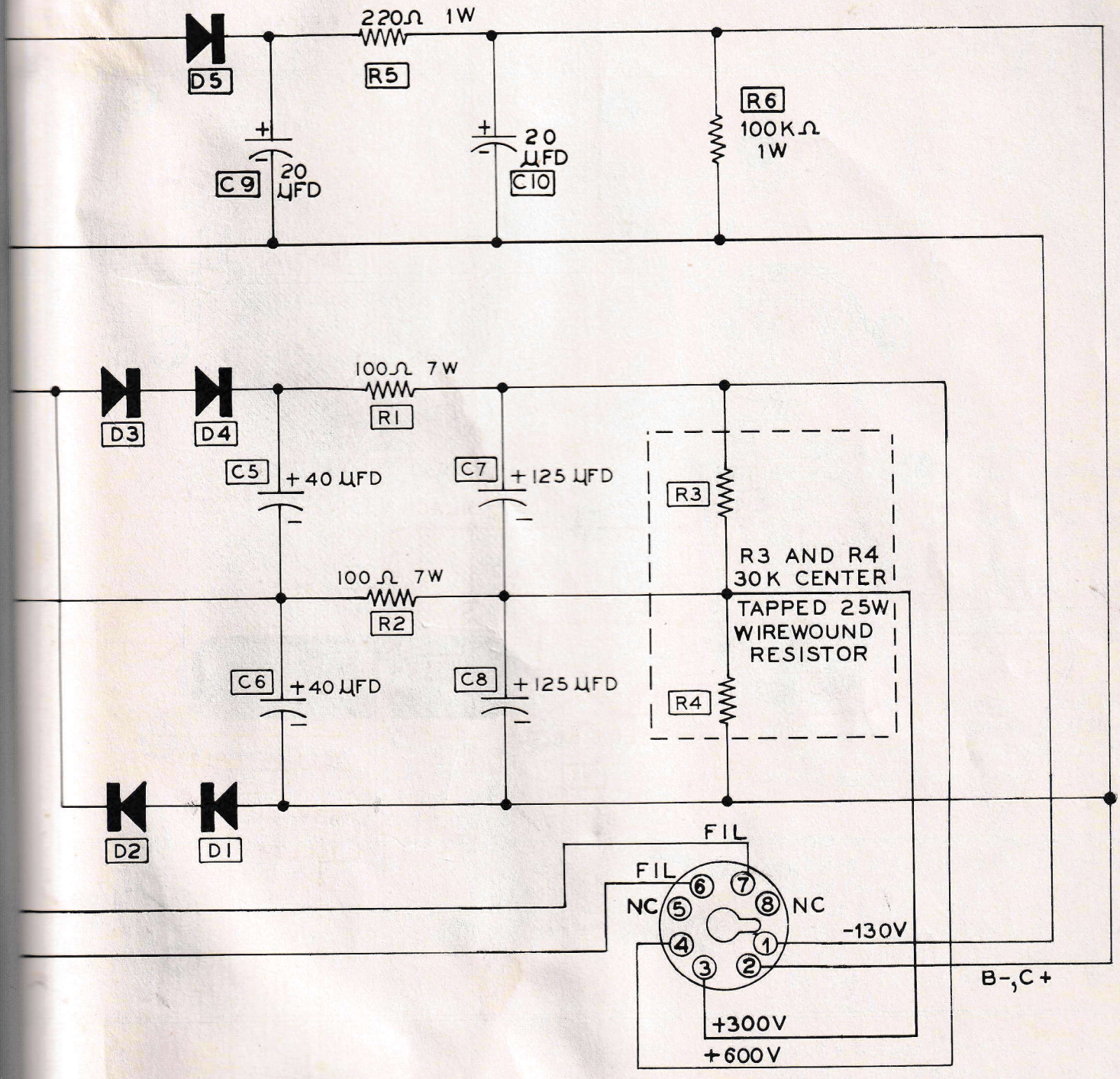
The fold-out diagrams in this manual may be removed and attached to the wall above your working area; but, because they are an integral part of the instructions, they should be returned to the manual after the kit is completed.

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.

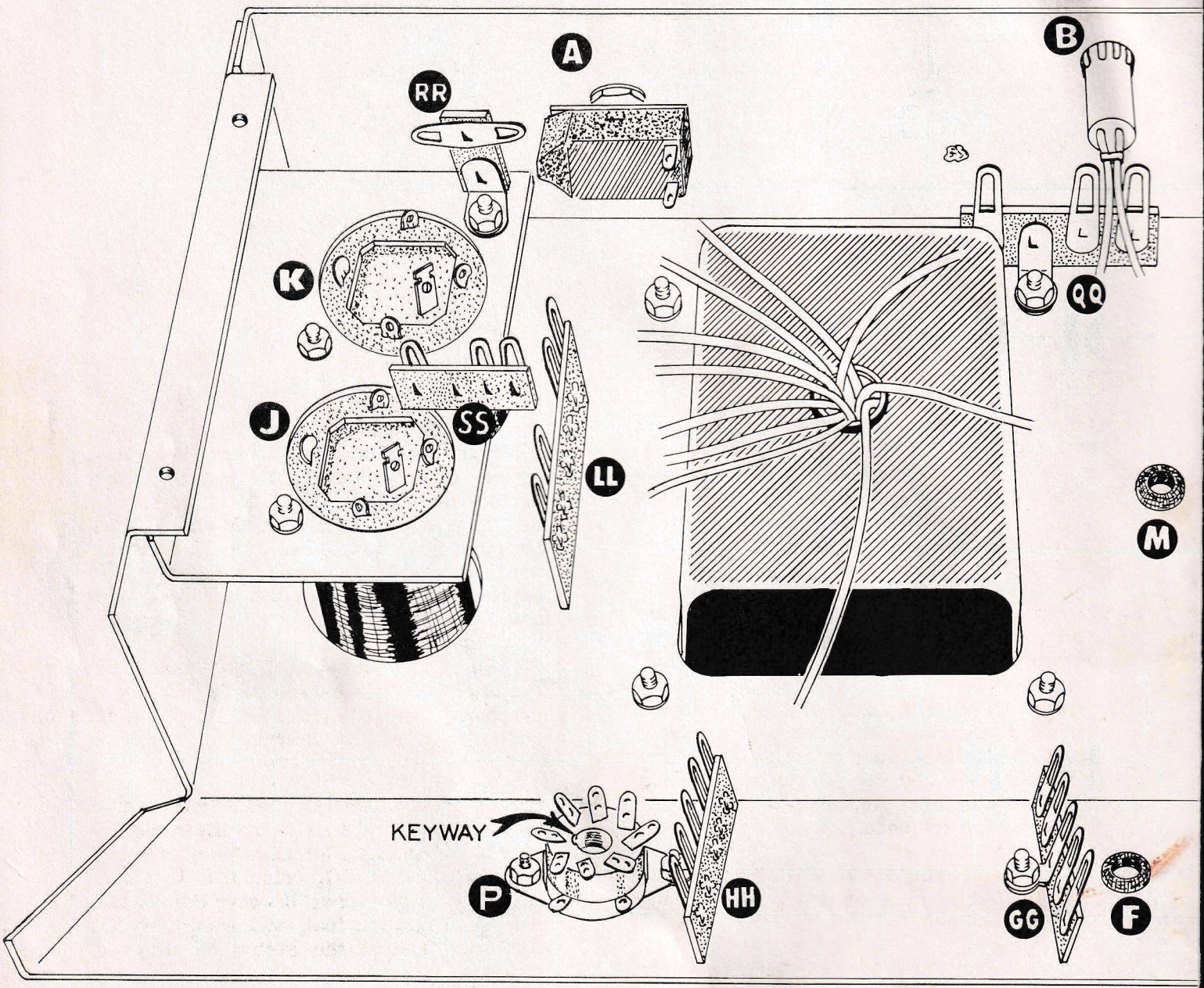
The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates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

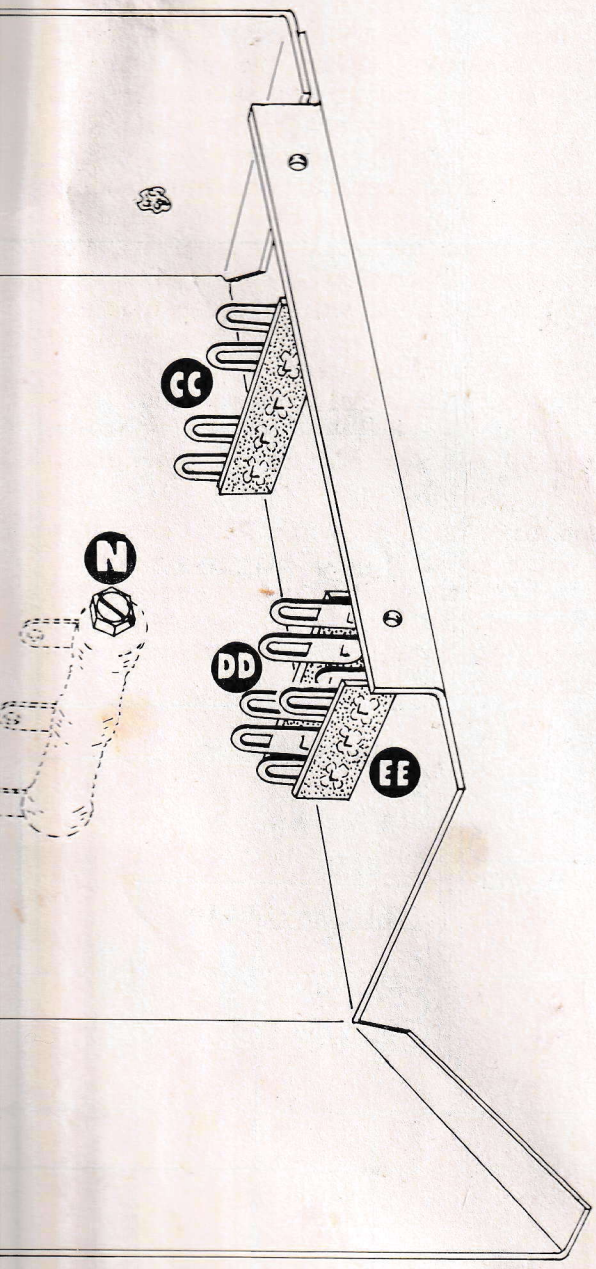

T1
BROWN
BROWN
RED
260 V. RMS .6 A.
RED
YELLOW-BLUE
6.3 V.-4A.
BLUE
YELLOW-GREEN
6.3V.-4A.
YELLOW
L1
3 AMP FUSE
LINE CHOKE
BLACK
C1
C3
.001 MFD
.001 MFD
PILOT LIGHT
C2
C4
117 V.
50-60 ~
P1
.001 MFD
.001 MFD
3 AMP FUSE
LINE CHOKE
LINE SWITCH
BLACK
L2
S1
12.6 V.-4 A.
JUMPER
6.3 V.-8A.
JUMPER
6.3 V.-8A.
JUMPER



HEATHKIT
UTILITY POWER SUPPLY
MODEL HP-20



Pictorial 1



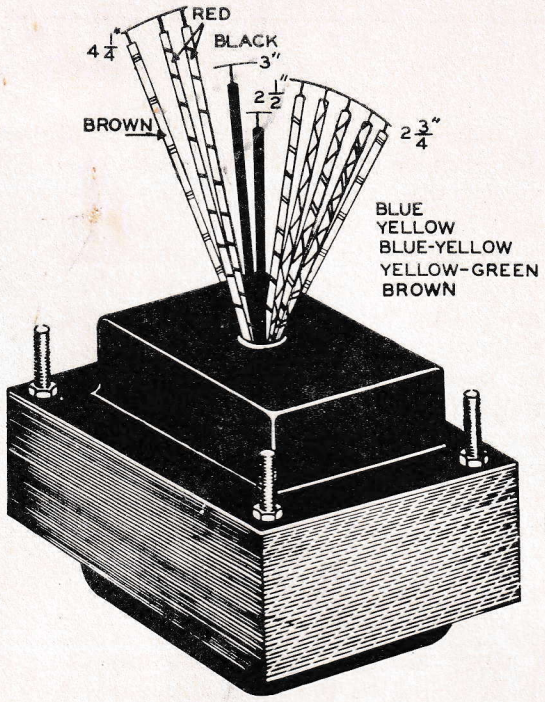


Figure 2

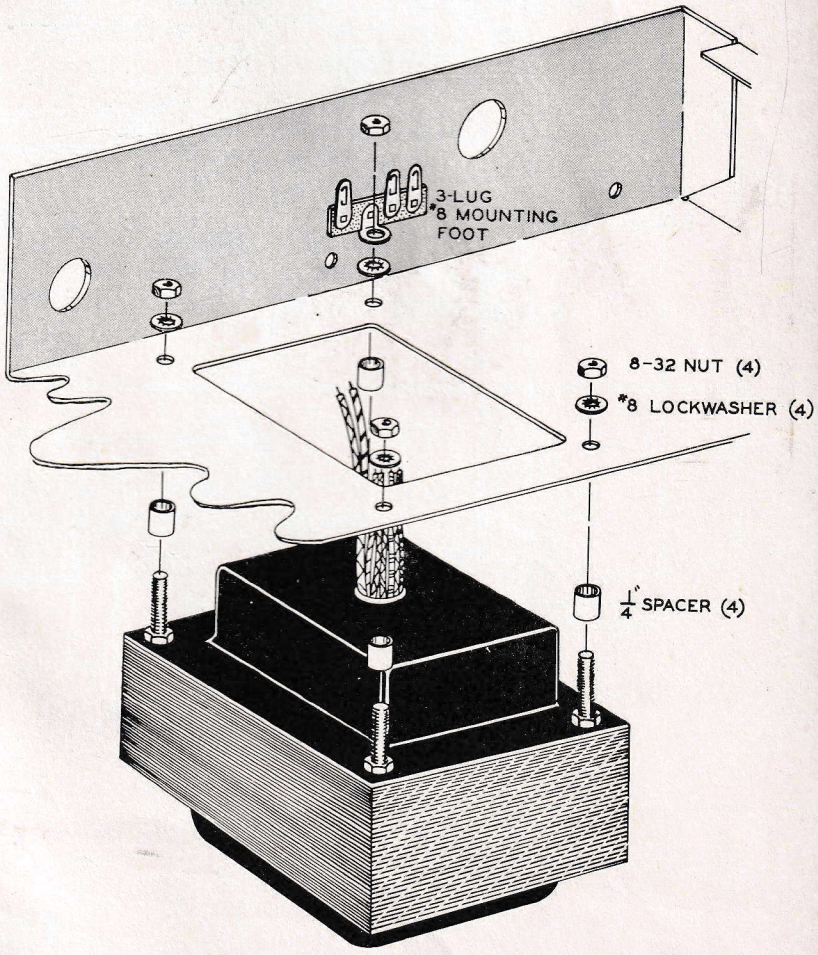


Figure 3

STEP-BY-STEP ASSEMBLY

Refer to Figure 1 for the following step.

( ) Insert the two studs of the nameplate in the two holes in the chassis face side, orienting as shown. While holding the nameplate tight to the chassis, melt the studs down with a hot soldering iron until a small flat retaining bead is formed.

Refer to Pictorial 1 for the following steps.

( ) Mount a 4-lug terminal strip at location CC. Orient the terminal strip as shown. Use a 6-32 x 1/4" Binder Head Machine Screw (BHMS) through the chassis, the mounting foot of the terminal strip, a #6 lockwasher and secure with a 6-32 nut.

NOTE: The plastic nut holder will be found convenient in the mounting of these components.

( ) Mount a 4-lug terminal strip at location DD and a 2-lug terminal strip at location EE (on the same screw). Face the terminal strips as shown in Pictorial 1 and Figure 6. Use a 6-32 x 1/4" BHMS through the chassis, the two mounting feet, a #6 lockwasher, and secure with a 6-32 nut.

( ) Mount a third 4-lug terminal strip at location LL, as shown. Use a 6-32 x 1/4" BHMS, #6 lockwasher and 6-32 nut.

( ) Locate the power transformer (#54-109) and refer to Figure 2. Measuring straight out from the transformer bottom shell, cut the two red leads and one of the brown leads to 4-1/4". Trim approximately 5/16" of the insulation off the ends.

NOTE: In the following steps, when instructions are given to strip the ends, strip 5/16" of insulation in each case.

( ) Cut one black lead to 3" in length and the other to 2-1/2" in length. Strip the ends. Save the two pieces of excess wire as they will be used later.

( ) Cut each of the remaining five colored leads (blue, brown, yellow, blue-yellow, and yellow-green) to 2-3/4" in length. Strip the ends. Save these pieces of wire for use later.

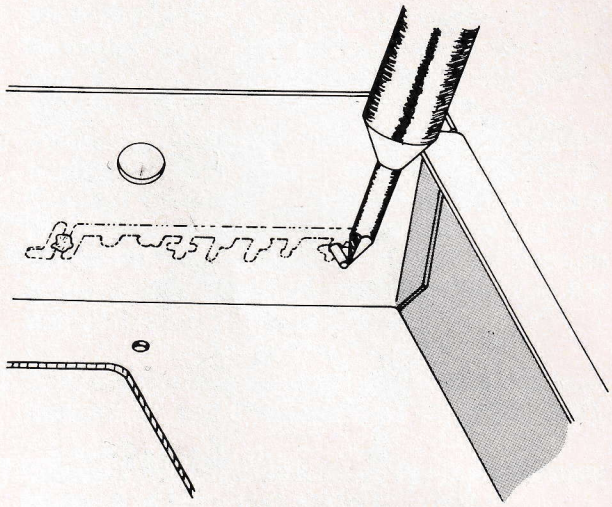


Figure 1

( ) T1. Slip a 1/4" spacer onto each 8-32 stud and seat the transformer into its mounting position. See Figure 3. Secure the transformer on the chassis bottom side with a #8 lockwasher and an 8-32 nut on each of the three studs, as shown. Mount a 3-lug terminal strip at QQ (has an 8-32 mounting foot) on the transformer stud. Use a #8 lockwasher first, then the mounting foot, and the 8-32 nut last.

( ) S1. Refer to Pictorial 1 and mount the single-pole single-throw (SPST) switch at location A, with the lockwasher and one nut on the inside of the chassis.

( ) Scrape or sandpaper any paint from around the holes at locations GG and HH on the inside of the chassis. Mount a 5-lug terminal strip at location GG, using a 6-32 x 1/4" BHMS, #6 lockwasher between the chassis and the mounting foot, and secure with a 6-32 nut. Orient the strips as shown in Pictorial 1.

( ) Mount a second 5-lug terminal strip at location HH. At the same time, mount the octal power socket at location P, using 6-32 x 1/4" BHMS, #6 lockwashers and 6-32 nuts. The #6 lockwasher is used between the octal socket and the mounting foot of terminal strip HH. Orient the socket with the keyway as shown in Pictorial 1.

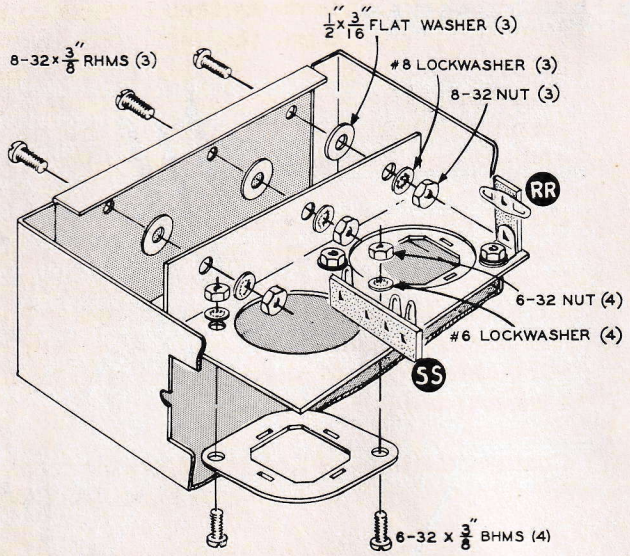


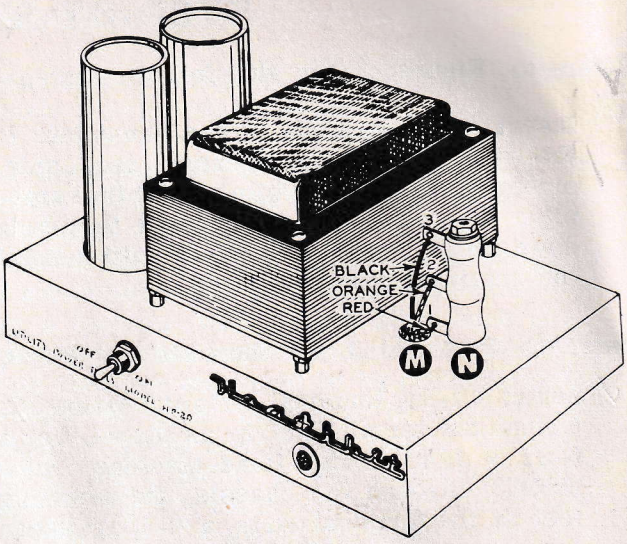
Figure 4

( ) Mount the two fiber capacitor mounting wafers with 1-lug terminal strip RR and 3-lug terminal strip SS on the electrolytic capacitor bracket, using 6-32 x 3/8" BHMS, #6 lockwashers and 6-32 nuts, as shown in Figure 4.

( ) Secure this bracket to the end of the chassis at the 3-hole location, after scraping away any paint around the holes on the inside of the chassis. Use an 8-32 x 3/8" screw through the chassis, a #8 flat washer, the bracket, a #8 lockwasher and secure with an 8-32 nut. See Pictorial 3 (fold-out from Page 15) and Figure 4.

( ) P1. Mount the pilot light at location B. Be sure all the metal points are entering the hole before applying pressure to seat the socket into place. If the socket fits loosely, the metal tabs can be bent outward after inserting the socket in the chassis, to provide a snug fit.

( ) Mount a 3/8" rubber grommet at location F.



Pictorial 2

Refer to Pictorial 2 for the following steps.

( ) Mount a 5/16" rubber grommet at location M on the top side of the chassis.

( ) R3, R4. Adjacent to this grommet, at location N, mount the 30 KΩ 25 watt wirewound resistor. Use the 10-24 x 2-1/4" hex head screw through the hole from the chassis bottom, through the resistor, a #10 fiber shoulder washer (the shoulder fits inside the resistor), and secure with the 10-24 nut.

( ) C7, C8. Refer to Pictorials 1 and 2 and, from the top side of the chassis, insert the two 125 μfd 450 volt electrolytic capacitors through the two large holes J and K. Orient the capacitors as shown and secure them in the fiber wafers by twisting the four mounting tabs 1/4 turn.

NOTE: Refer to Pictorial 3 (fold-out from Page 15) for the following steps unless otherwise noted.

( ) Connect the longer black lead from the transformer to lug 2 of the SPST switch at location A (NS).

( ) Connect one pilot light lead to the same lug 2 of the SPST switch (S-2).

( ) Strip both ends of the longer piece of black wire which was trimmed off the transformer. Connect one end to lug 1 of the SPST switch (S-1). Route the other end down along the chassis and connect it to lug 4 of terminal strip HH (NS).

( ) C4. Cut both leads of a .001 µfd 1400 volt disc ceramic capacitor to 3/8" in length. Connect one end to lug 4 of terminal strip HH (NS). Connect the other end to lug 3 of terminal strip HH (NS).

( ) L2. Cut both leads of a line choke to 1/2" in length. While retaining the end turns of the coil by holding them with narrow-nose pliers, bend both leads axially to facilitate mounting, as shown in Pictorial 3. Slip a piece of the large 3/8" sleeving over the choke coil. Connect one end to lug 4 of terminal strip GG (NS). Connect the other end to lug 4 of terminal strip HH (S-3). Trim off excess lead length.

( ) Connect the remaining black lead from the transformer to lug 2 of terminal strip HH (NS).

( ) Route the remaining pilot light lead under the line choke, as shown, and connect to the same lug 2 of terminal strip HH (NS).

( ) C3. Cut the leads on another .001 µfd 1400 volt disc ceramic capacitor to 3/8" in length. Connect one end to lug 2 of terminal strip HH (NS). Connect the other end to lug 3 of terminal strip HH (S-2).

( ) L1. Cut both leads on another line choke to 1/2" in length, form the leads axially as before, and slip a piece of 3/8" sleeving over the choke. Connect one end to lug 2 of terminal strip GG (NS). Connect the other end to lug 2 of terminal strip HH (S-4).

( ) Cut a piece of the remaining blue-yellow wire to 2" in length and strip the ends. Connect one end to lug 1 of terminal strip LL (NS). Connect the other end to lug 7 of the power output socket (S-1). Use care in soldering to avoid shorting this lead to the socket frame.

( ) Connect the blue-yellow lead from the transformer to lug 1 of terminal strip LL (NS).

( ) Connect the blue lead from the transformer to lug 2 of terminal strip LL (NS).

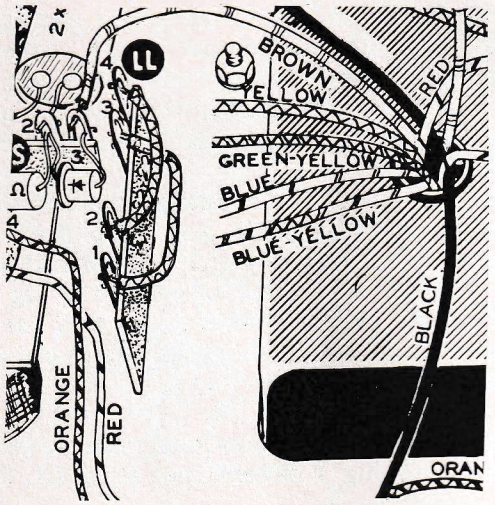
( ) Connect the green-yellow lead to lug 3 of terminal strip LL (NS).

( ) Connect the yellow lead to lug 4 of terminal strip LL (NS).

( ) Cut a piece of the leftover yellow transformer lead to 3-1/2" in length. Strip the ends. Tin one end lightly with solder and route this lead down under the other filament leads and connect to lug 4 of terminal strip LL (NS). Connect the remaining lead to lug 6 on the power output socket (S-1).

NOTE: Now decide whether this supply is to deliver 6.3 volts AC at 11 amperes or 12.6 volts AC at 5.5 amperes for the filament circuit. If the supply is to be used with the HEATHKIT Models MR-1 and MT-1, select the filament voltage for which the transmitter and receiver have been wired.

SELECT AND PERFORM THE STEPS FOR ONLY ONE, NOT BOTH, VALUES OF FILAMENT VOLTAGE.



Detail 3A

FOR 6.3 VOLTS AT 8 AMPERES (See Detail 3A):

( ) Cut pieces of the leftover blue and green-yellow leads to 2-1/2" in length. Strip the ends and tin lightly. Connect the green-yellow lead as a jumper from lug 1 (S-3) to lug 3 (S-2) of terminal strip LL.

( ) Connect the blue lead as a jumper from lug 2 (S-2) to lug 4 (S-3) of terminal strip LL.

This completes the wiring for 6.3 volt filament operation.

FOR 12.6 VOLTS AT 4 AMPERES (See Pictorial 3):

(✓) Cut one piece of the remaining blue lead to 2-1/2" in length. Strip the ends and tin lightly. Connect this lead from lug 2 (S-2) to lug 3 (S-2) on terminal strip LL.

(✓) Solder lug 1 (S-2) and lug 4 (S-2) of terminal strip LL.

This completes the wiring for 12.6 volt filament operation.

(✓) Strip a short length of hookup wire and connect this bare wire from lug 2 of the power output socket (NS) to the adjacent socket ground lug (S-1).

(✓) Cut a piece of black hookup wire 6" in length. Strip the ends. Connect one end to lug 2 of the power output socket (S-2). Connect the other end to lug 1 on the 125 μfd capacitor at location K (NS). Route wire as shown.

(✓) Cut a piece of orange wire to 2-1/2" in length. Strip the ends. Connect one end to lug 3 on the power output socket (S-1). Connect the other end to lug 4 of the 125 μfd capacitor at location J (NS).

(✓) R2. Cut one lead of a 100 Ω 7 watt resistor (#3G-9) to 5/8" in length. Cover the other lead with a piece of insulated sleeving 1-1/4" in length. Connect the short lead to lug 1 of terminal strip HH (NS). If the resistor supplied is the square body type, face the "filled" side of the resistor upward, or away from the power output socket, otherwise rest the resistor body against the socket. Connect the insulated lead to lug 4 of the 125 μfd capacitor at location J (S-2).

(✓) Cut a piece of black hookup wire 9" in length. Strip the ends. Connect one end to lug 5 of terminal strip GG (NS). Connect the other end to lug 1 of the 125 μfd capacitor at location K (NS). Route wire as shown.

(✓) Cut another piece of black wire 6-1/2" in length. Strip the ends. Connect one end to lug 5 of terminal strip GG (NS), routing close to the chassis. Connect the other end to lug 1 of terminal strip DD (NS).

(✓) Cut another piece of black wire 6-1/2" in length. Strip the ends. Connect one end to lug 3 of the 30 KΩ 25 watt bleeder resistor (S-1). Route the other end through grommet M close to the chassis and connect to lug 1 of terminal strip DD (NS).

(✓) Cut a piece of orange wire 1-1/2" in length. Strip the ends. Connect one end to lug 3 of the 125 μfd filter capacitor J (S-1). Connect the other end to lug 5 of the 125 μfd filter capacitor K (S-1).

( ) Cut a piece of orange hookup wire 10" in length. Strip the ends. From the bottom side of the chassis, insert one end up through the 5/16" rubber grommet M adjacent to the 30 KΩ bleeder resistor, and connect to lug 2 of the bleeder resistor (S-1). Route the other lead end close to the chassis, under terminal strips GG and HH, and connect to lug 1 of the 125 μfd filter capacitor at location J (S-1).

( ) Cut a piece of orange hookup wire 8-1/2" in length. Strip the ends. Route one end down under the line chokes, close to the chassis, and connect to lug 3 of terminal strip QQ (NS) (lugs 1 and 2 are not used). Connect the other end to lug 1 of terminal strip HH (S-2).

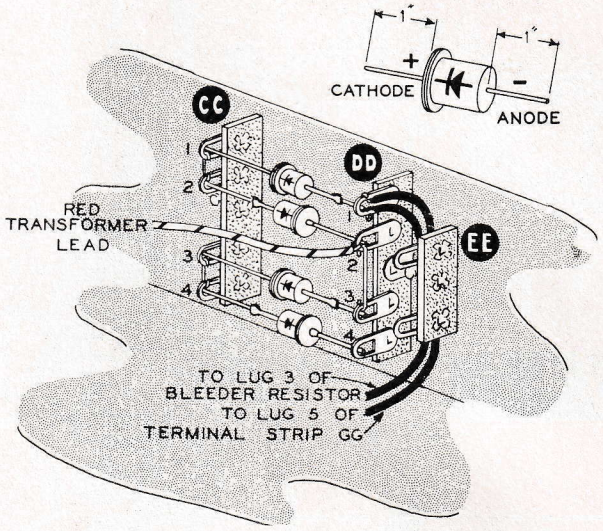
( ) Cut a piece of red hookup wire 2-1/2" in length. Strip the ends. Connect one end to lug 4 of the power output socket (S-1). Connect the other end to lug 5 of the 125 μfd filter capacitor J (NS).

( ) Cut another piece of red hookup wire 11" in length. Strip the ends. Route one end down close to the chassis, under the power output socket, under terminal strips HH and GG and up to lug 1 on terminal strip EE (NS). Connect the other end to lug 5 of the 125 μfd filter capacitor J (S-2).

( ) Cut another piece of red hookup wire 5" in length. Strip the ends. From the chassis bottom side, insert one end up through the 5/16" rubber grommet M and connect to lug 1 of the bleeder resistor (S-1). Route the other end close to the chassis and up to lug 1 on terminal strip EE (NS). Lug 2 is not used.

NOTE: Maintain the diode bodies at the mid-point between terminal strips CC and DD. Do not allow the diodes to touch the chassis or each other.

( ) D4. Refer to Detail 4A for diode polarity indication. Cut the leads on four of the diodes to 1" in length, measuring from the diode body as shown. Mount the first diode with the positive (+) lead connected to lug 4 of terminal strip DD (NS). Connect the negative (-) lead to lug 4 of terminal strip CC (NS).



Detail 4A

( ) D3. In a similar manner, mount a second diode with the negative (-) end connected to lug 3 of terminal strip DD (NS) and the positive (+) end connected to lug 3 of terminal strip CC (NS).

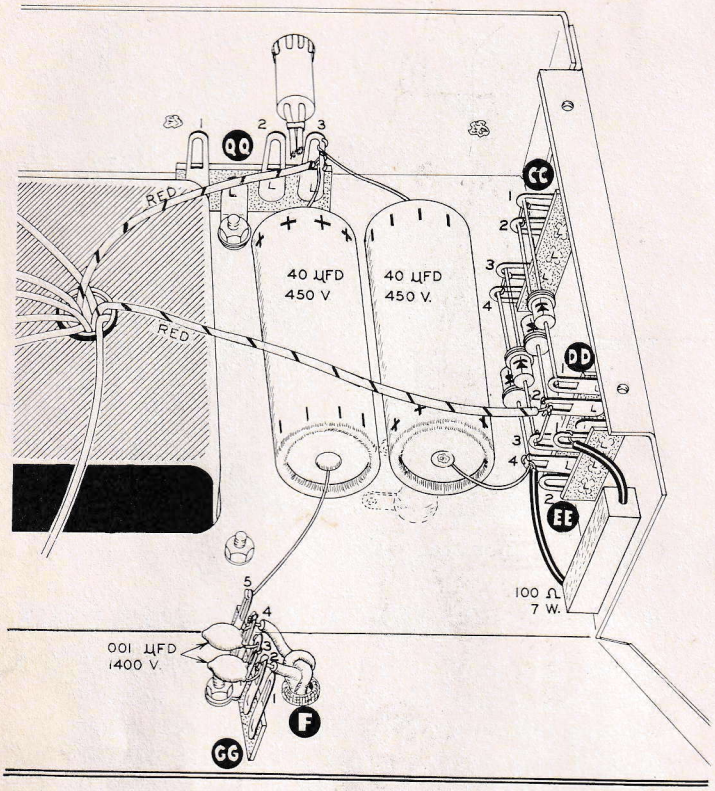
( ) Connect a 1" length of bare wire (a clipping from one of the components) between lug 3 (S-2) and lug 4 (S-2) of terminal strip CC, as shown in Figure 4A.

( ) D2. Connect the positive (+) end of a third diode to lug 2 of terminal strip DD (NS). Connect the negative (-) lead of this same diode to lug 2 on terminal strip CC (NS).

( ) D1. Install the fourth diode with its negative (-) lead connected to lug 1 on terminal strip DD (S-3). Connect the positive (+) lead of this same diode to lug 1 on terminal strip CC (NS).

( ) Connect a 1" length of bare wire between lug 1 (S-2) and lug 2 (S-2) of terminal strip CC, as shown in Detail 4A.

( ) Connect a 1-1/4" length of bare wire between lug 2 (NS) and lug 3 (S-2) on terminal strip DD.



Pictorial 4

( ) R1. Cut one lead of a 100 Ω 7 watt resistor (#3G-9) to 1-1/4" in length. Cover this lead with a piece of insulated sleeving 1" in length. Cover the longer lead with a piece of sleeving 1-1/4" in length.

( ) Place this resistor in the corner of the chassis, as shown in Pictorial 4. Connect the longer lead to lug 4 on terminal strip DD (NS). Connect the other lead to lug 1 on terminal strip EE (S-3).

( ) C5. Cut both leads on a 40 μfd 450 volt filter capacitor to 1-1/4" in length. Position the capacitor as shown in Pictorial 4, allowing 1/8" to 1/4" of space between the capacitor and the transformer shell. Connect the positive (+) lead to lug 3 on terminal strip QQ (NS). Connect the negative (-) lead to lug 5 on terminal strip GG (S-3). Avoid burning the insulation on other adjacent wiring.

( ) C6. Cut both leads on another 40 μfd filter capacitor to 1-1/2" in length. Connect the negative (-) lead to lug 3 on terminal strip QQ (NS). Connect the positive (+) lead to lug 4 on terminal strip DD (S-3).

( ) Connect the nearest red lead from the transformer to lug 2 on terminal strip DD (S-3).

( ) Connect the remaining red lead from the transformer to lug 3 of terminal strip QQ (S-4).

Refer to Pictorial 3 for the following steps.

( ) Connect the shorter brown lead from the transformer to lug 3 of terminal strip SS (NS).

( ) Connect the remaining brown lead to lug 2 of terminal strip RR (NS).

( ) Cut all three leads of the dual 20 μfd electrolytic capacitor to 3/4" in length.

( ) Connect the negative (-) capacitor lead to lug 2 of terminal strip RR (S-2).

( ) C9, C10. Connect the nearest positive (+) capacitor lead to lug 1 of terminal strip SS (NS) and the other positive (+) lead to lug 2 of the same terminal strip (NS).

( ) R6. Cut both leads of a 100 KΩ 1 watt (brown-black-yellow) resistor to 1/2" in length. Connect one lead to lug 1 of terminal strip RR (NS). Connect the other lead to lug 3 of the 125 μfd capacitor at location K (S-1).

( ) R5. Cut both leads of a 220 ohm 1 watt (red-red-brown) resistor to 3/4" in length. Connect one lead to lug 1 of terminal strip SS (NS). Connect the other lead to lug 2 of the same terminal strip (NS).

( ) D5. Cut both leads of the remaining silicon diode to 3/4" and connect the positive (+) lead to lug 2 of terminal strip SS (S-3). Connect the negative (-) lead to lug 3 of terminal strip SS (S-2).

( ) Cut a piece of black hookup wire to 1-1/2" in length and strip both ends. Connect one end to lug 1 of terminal strip SS (S-3). Connect the other end to lug 1 of the 125 μfd capacitor K (S-3).

( ) Cut a piece of yellow hookup wire to 8" in length. Strip both ends. Connect one end to lug 1 of terminal strip RR (S-2). Connect the other end to lug 1 of the power socket P (S-1).

Refer to Pictorial 4 for the following steps.

( ) Separate the leads at one end of the line cord for a distance of 2". Strip the ends 1/4" and tin lightly with solder. Insert the prepared ends through the 3/8" rubber grommet F and tie a simple knot, as shown in Pictorial 4.

( ) Connect one lead of the line cord to lug 4 of terminal strip GG (NS). Connect the other lead to lug 2 on terminal strip GG (NS).

( ) C2. Cut the leads on the two remaining .001 μfd 1400 volt disc ceramic capacitors to 3/8" in length. Connect one lead of one of these capacitors to lug 3 on terminal strip GG (NS). Connect the other lead to lug 4 on the same terminal strip (S-3).

( ) C1. Connect one lead of the remaining .001 μfd disc capacitor to lug 2 of terminal strip GG (S-3). Connect the other lead to lug 3 on the same terminal strip (S-2).

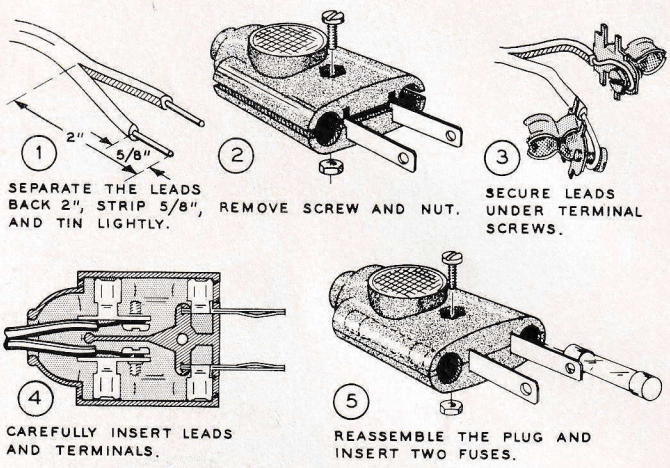


Figure 5

( ) Refer to Figure 5 and mount the fused power plug on the free end of the line cord. Separate the two leads for 2". Strip the ends 5/8" and tin lightly with solder. Secure the two leads under the screw terminals of the plug. Insert the two 3 ampere fuses.

NOTE: The top and bottom chassis covers are mounted after testing the Supply.

TESTING THE HP-20 POWER SUPPLY

If an ohmmeter is available, make the following resistance checks before applying power. With the negative (-) lead on output socket terminal 2, a resistance of more than 20,000 ohms should be read at terminal 4. With the negative (-) lead on terminal 1, a resistance of more than 75,000 ohms should be read at terminal 2. If either of these readings are zero, or very low, a short circuit exists. Refer to the IN CASE OF DIFFICULTY section (Page 17). If the readings are normal, proceed as follows.

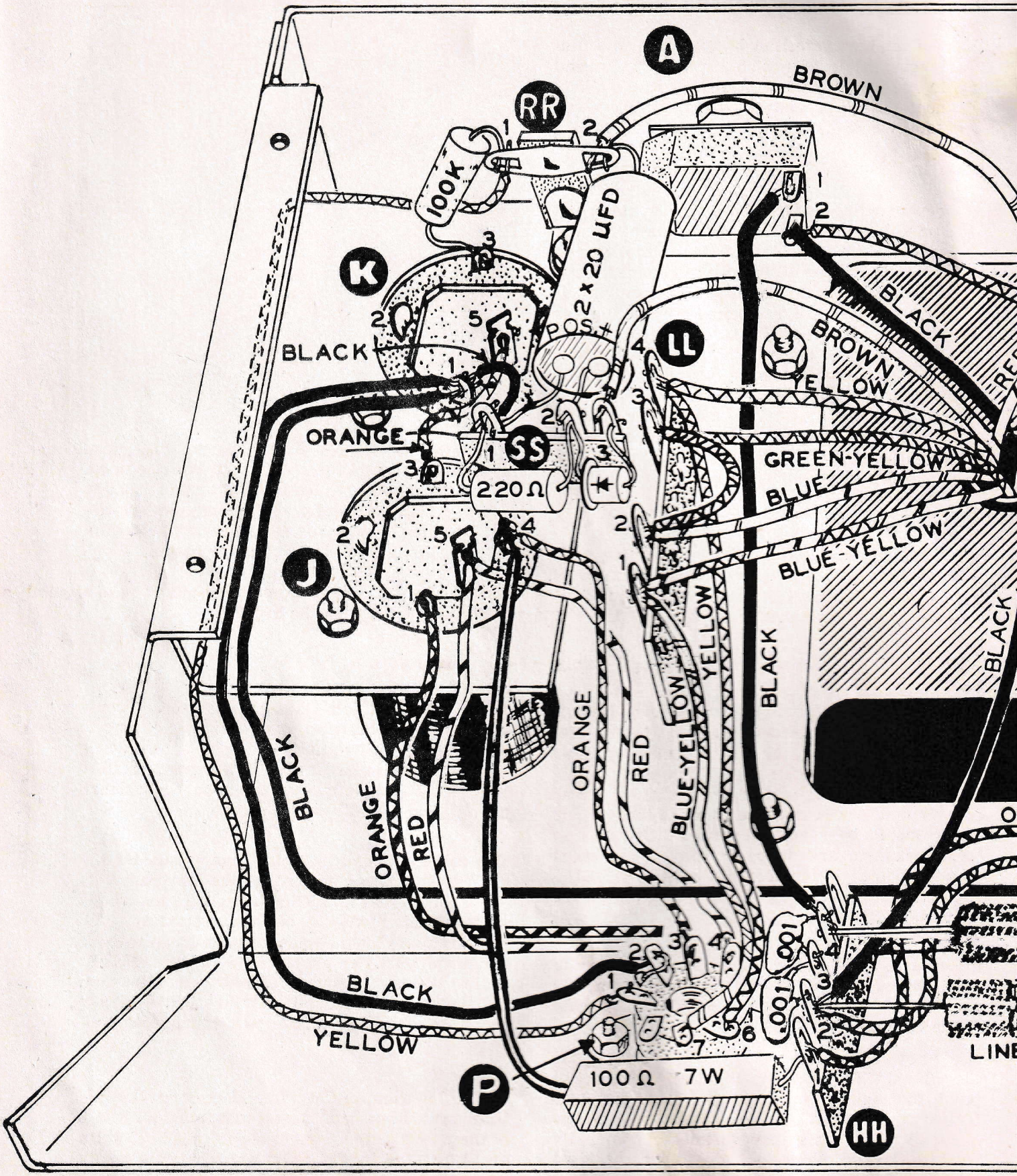
Be certain that the two 3 ampere fuses are in the power plug and insert the plug into a wall receptacle. Turn the power supply line switch to the ON position.

The pilot light should glow. (If it does not, see the IN CASE OF DIFFICULTY section.) A point to point voltage check should be done before the supply is used with any equipment. A high resistance voltmeter (generally 2000 to 20,000 ohms per volt) with at least 0-750 volt scale is used for voltage checking.

A HEATHKIT Volt-Ohm-Milliammeter would be ideal. Connect the common (ground) lead to terminal 2 of the power output socket. The voltage at terminal 3 should be approximately +365 volts with no load on the supply other than the self-contained bleeder resistor.

The voltage measured at the high voltage terminal 4 on the power plug should be approximately +730 volts, with no load. The voltage measured at terminal 1 should be approximately -150 volts, with no load. These voltages drop to their rated values under proper load current. NOTE: A line voltage variation of more or less than 117 volts will reflect itself in slightly higher or lower readings of the power supply's output voltages.

On the low range AC scale of the test meter, the filament voltage measured from terminal 5 to 6 of the power output socket should read 6.3 volts or 12.6 volts, depending on which way the supply was wired.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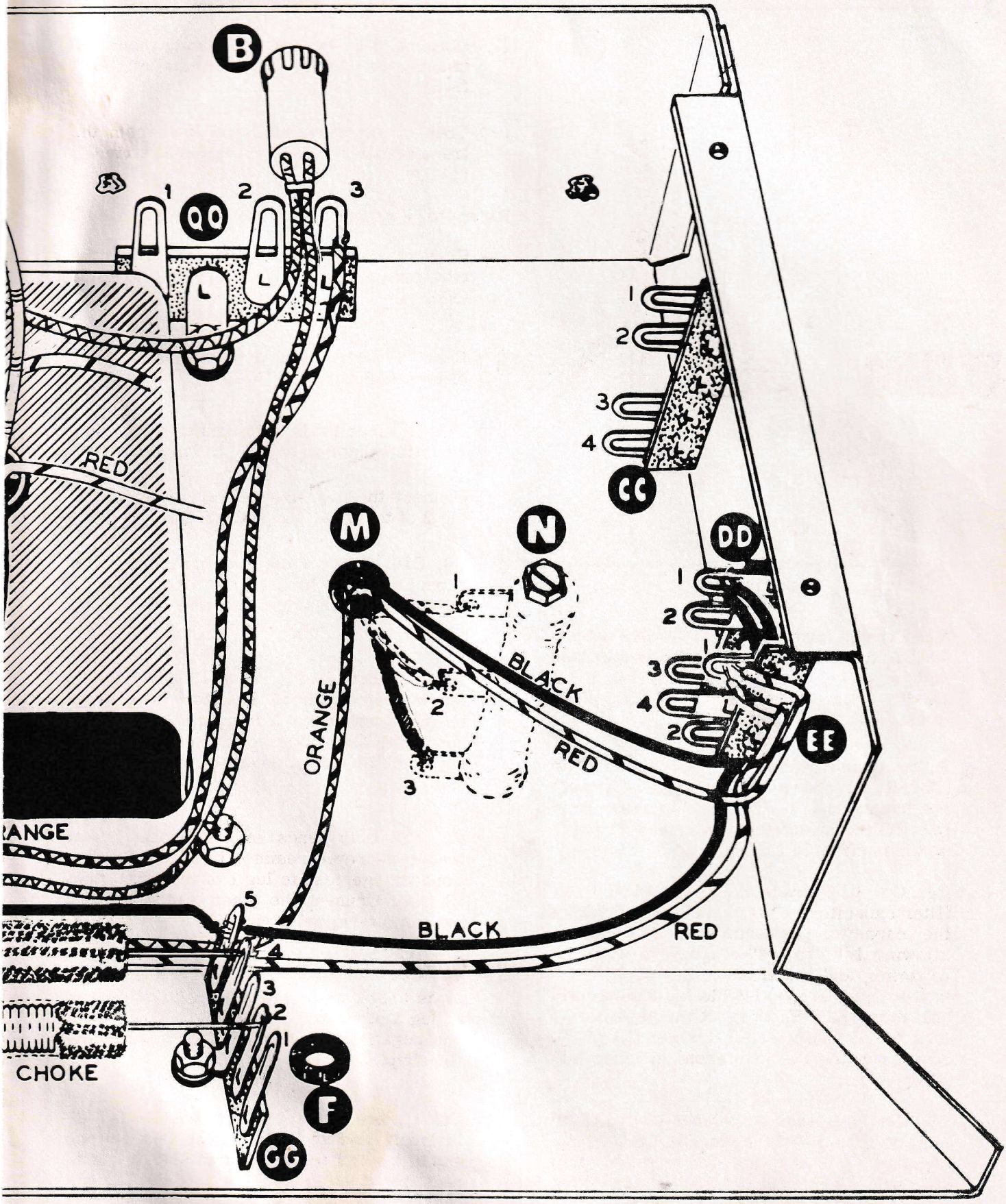
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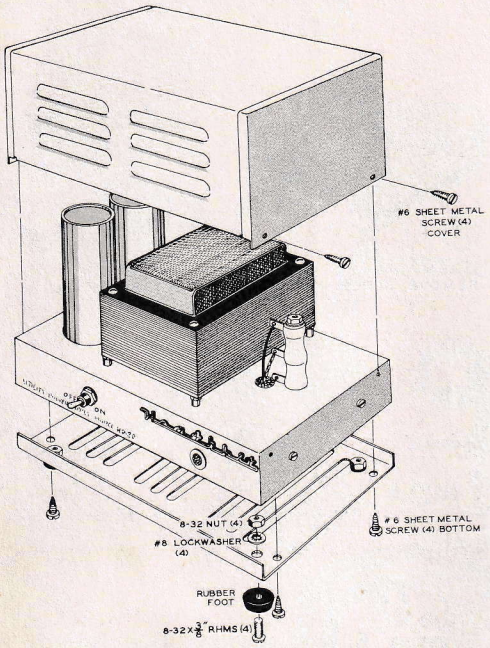
Pictorial 3



Pictorial 5

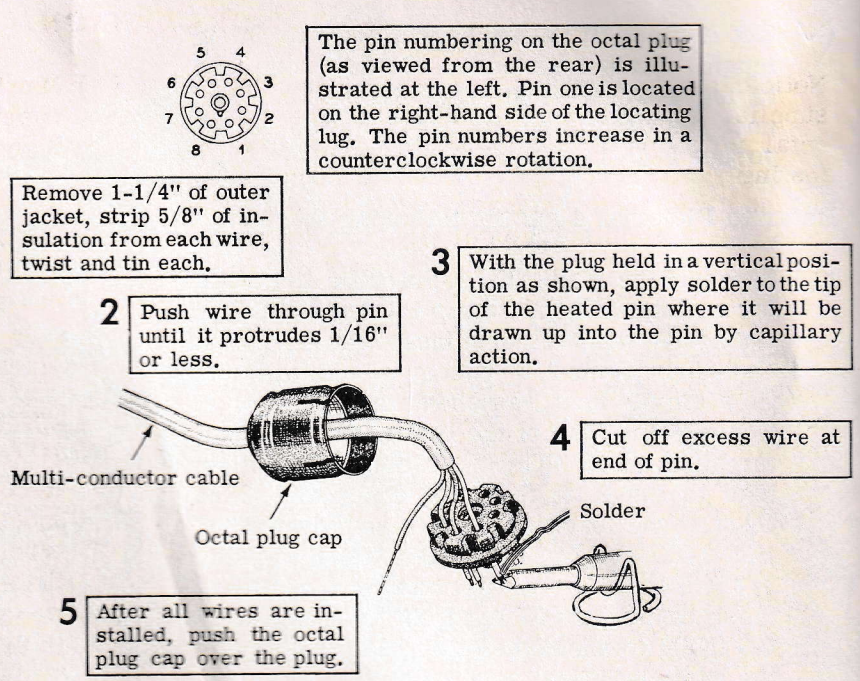


Figure 6

( ) Referring to Pictorial 5, mount the four rubber feet on the chassis bottom plate, as shown. Now mount both the bottom plate and top cover on the chassis, as shown.

CAUTION:

The unloaded voltage of this supply can reach a very dangerous 700 volts with an instantaneous current value of well over the rating of 250 milliamperes. One must be mindful of not only the inherent regulation of the supply itself, but also the potential stored in the high value capacitors.

In a situation where electric shock is a possibility, the common practice of standing on some dry insulating material and working with one hand behind the back is recommended.

CABLE TO PLUG CONNECTIONS

( ) Insert the end of the 8-conductor cable through the grommet in the octal plug shell.

( ) Remove 1-1/4" of the outer jacket of the cable and strip 5/8" of insulation from each of the colored wires. Twist the strands of each wire into a tight group and tin to prevent fraying during insertion of the wires into the plug pins.

NOTE: Soldering of the individual wires to the plug pins is most easily and neatly accomplished by using the tip of the iron (resting on its stand) as a form of "solder pot." The solder will pull up inside the pins through capillary action. See Figure 6.

Connect and solder: HP-20 Octal Plug	Function	*MR-1/MT-1 Jones Plug Connections
( ) Brown wire to pin 8	(unused)	4
( ) Black wire to pin 7	(Fil)	3
( ) Red wire to pin 6	(Fil)	5
( ) Blue wire to pin 5	(unused)	cut off blue wire
( ) Yellow wire to pin 4	(+600 volts)	2
( ) Orange wire to pin 3	(+300 volts)	1
( ) White wire to pin 2	(common B-, C+)	6
( ) Green wire to pin 1	(-130 volts)	cut off green wire

( ) Snap the plug shell over the back of the plug.

*See following paragraph under OPERATION.

OPERATION

Notice that only one output cable connector is supplied with the HP-20, that being the mating octal plug for the output socket. Any suitable mating connector can be used to connect the output cable to the associated equipment. The HEATHKIT Mobile Transmitters and Receivers are supplied with appropriate connectors. However, in all cases, be sure to connect the wire with the proper voltage, as indicated by its color and the chart shown on the preceding page, to the correct terminal on the connector used. The chart gives special information for installation of the Jones Plug supplied with the HEATHKIT MT-1 Mobile Transmitter since the color coding differs from that given for the octal plug. The same information applies to the installation of the HEATHKIT MR-1 Mobile Receiver Jones Plug when operated alone with the HP-20. With the above exceptions, all other HEATHKIT Mobile Equipment employ octal power plugs compatible with the HP-20 and each other.

If desired, the bias supply may be modified to deliver +130 volts at 30 ma, instead of its normal negative voltage, in order to supply plate power to an external VFO, certain low level transmitter or receiver stages, or some similar circuit. To accomplish this modification, proceed as follows:

( ) Remove the 100 KΩ 1 watt resistor between lug 1 of terminal strip RR and lug 3 on capacitor K.

( ) Remove the yellow lead from lug 1 of terminal strip RR and leave this wire free temporarily.

( ) Connect a bare wire between lug 1 of terminal strip RR (S-1) and lug 3 of capacitor K (S-1).

( ) Remove the black wire between lug 1 of terminal strip SS and lug 1 of capacitor K.

( ) Reconnect the 100 KΩ, 1 watt resistor removed previously from between lug 1 of terminal strip SS (NS) and lug 1 of capacitor K (S-3).

( ) Reconnect the free end of the yellow wire to lug 1 of terminal strip SS (S-3).

After the above steps have been accomplished, a positive (+) 130 volts will appear at output socket terminal 1.

Once the HP-20 has been connected properly to the associated equipment, complete power control over the system can be accomplished by use of the power switch on the HP-20 alone. With the controls of the associated equipment left in their normal operating position, both filament and plate power can be turned on or off simultaneously with the HP-20 power switch.

IN CASE OF DIFFICULTY

Upon completing your HP-20 Power Supply and plugging it into the line voltage source with the switch to the ON position, the neon pilot light should glow.

If it does not, use an alternating current voltmeter of proper voltage range (generally 0-150 volts AC) and check for line voltage at the pilot light terminals. (A test light could also be used.) If the line voltage does exist across the pilot light and it does not light, then the pilot light assembly is defective. If no line voltage is evident, remove the plug from the power source and use a VOM to check the fuses in the plug for continuity.

If the preceding checks fail to reveal the difficulty, a complete primary circuit check (including all solder connections) would be in order.

NOTE: Sometimes having a friend check your wiring may disclose an error consistently overlooked.

If the line fuses blow, a short circuit in either the primary or secondary circuit may exist. With the line plug removed, repeat the resistance check outlined under TESTING THE HP-20 POWER SUPPLY. A reading of near zero ohms would indicate a short in the secondary circuit.

Little or no voltage at either the low or the high voltage terminals of the supply may indicate an open 100 Ω 7 watt resistor, a shorted electrolytic capacitor or one or more of the diodes having become shorted. The possibility of transformer failure should not be overlooked. The primary and secondary should be checked for continuity.

Too heavy a load, or a direct short at either the high or low output of the supply (if it did not blow a fuse) could cause one or both 100 Ω 7 watt resistors to overheat and smoke. This could also be caused by a leaky or shorted 125 μfd output filter capacitor.

SERVICE INFORMATION

SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under "IN CASE OF DIFFICULTY." Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under "IN CASE OF DIFFICULTY." Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)
5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed instrument to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer 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.

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 for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. 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.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY