ASSEMBLY AND OPERATION OF THE HEATHKIT HIGH FIDELITY AMPLIFIER

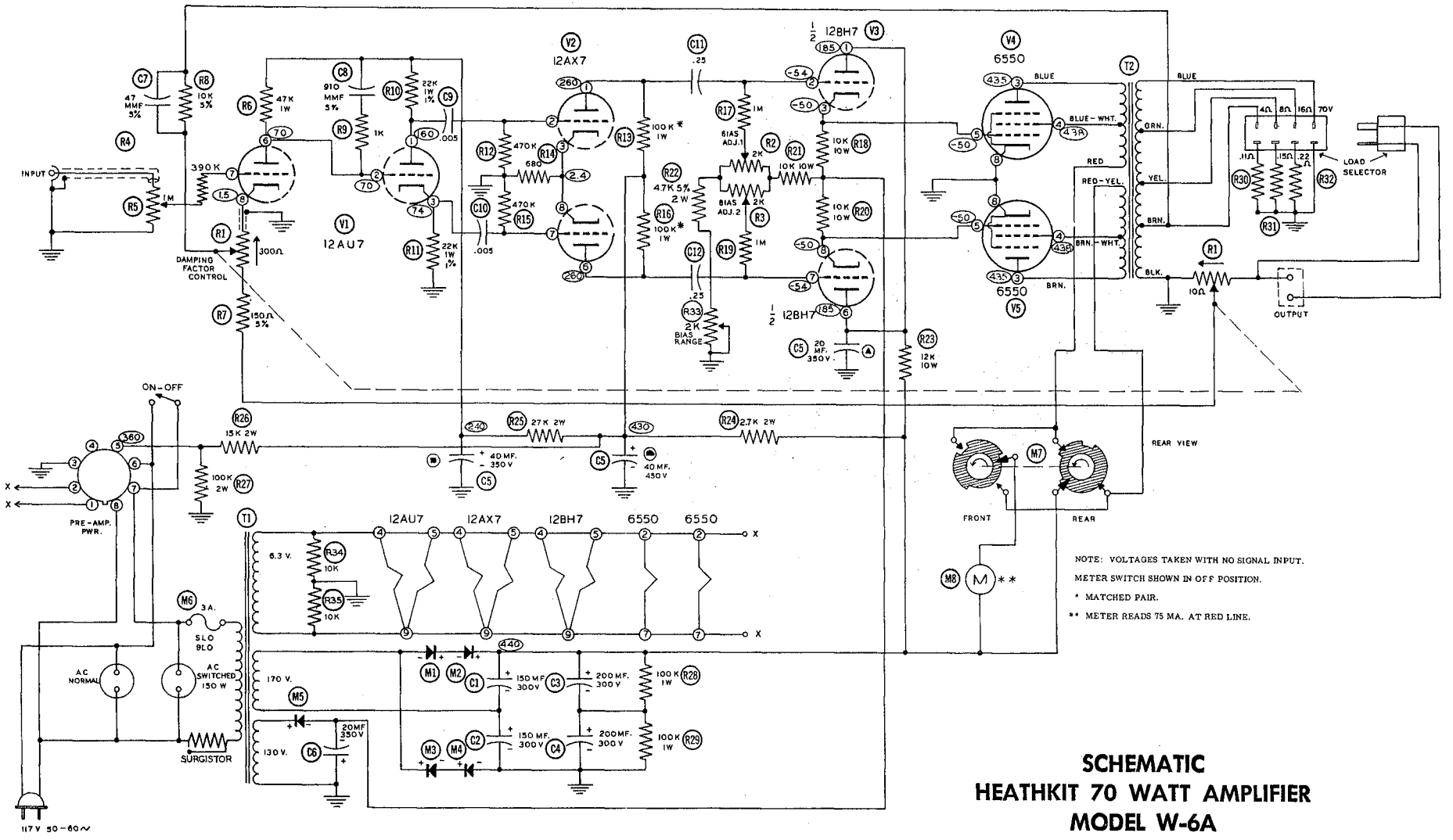
MODEL W-6A

SPECIFICATIONS

The following specifications on the Model W-6A Amplifier are presented in the belief that you are entitled to a factual and comprehensive technical report on the performance of the Amplifier.

These specifications are based on actual measurements taken on a typical W-6A Amplifier, using modern, accurate test equipment. Measurements were made under the most carefully controlled conditions; not to present the most favorable advertising information, but in strict accordance with the Heath Company published amplifier rating standards. These conditions are listed at the end of the specifications.

Minor variations from these specifications may be encountered in kit assembled amplifiers. Such factors as exact lead placement, component variations and tube characteristics are possible sources of deviations. In a highly stable amplifier such as the W-6A, these variables may be disregarded from a performance point of view.



NOTE: VOLTAGES TAKEN WITH NO SIGNAL INPUT.
METER SWITCH SHOWN IN OFF POSITION.
* MATCHED PAIR.
** METER READS 75 MA. AT RED LINE.

SCHEMATIC
HEATHKIT 70 WATT AMPLIFIER
MODEL W-6A

POWER OUTPUT:

Rated Power (rms)..... 70 watts (professional).

Peak Power..... 140 watts (peak power).

FREQUENCY RESPONSE:..... ± 0.5 db from 6 to 70,000 cycles at 0.5 watt level. Controlled high- and low-frequency roll-off, for maximum transient stability. The frequency response curve is shown in Figure 1.

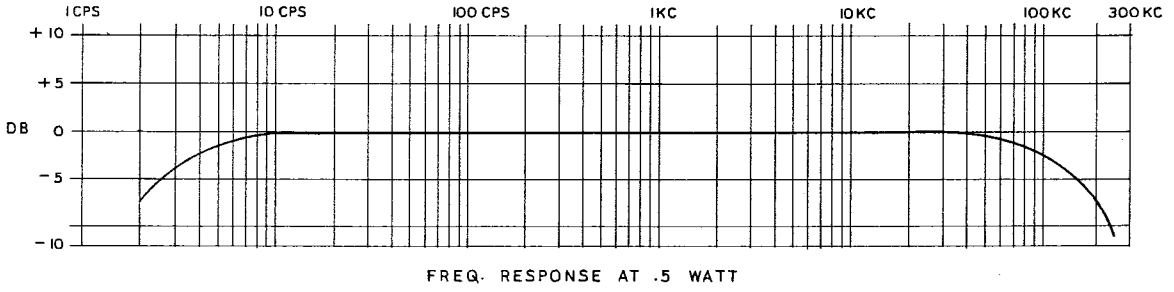


Figure 1

POWER RESPONSE:..... ± 0.25 db from 20 to 20,000 cycles. See Figure 2. In any amplifier, the output transformer places a limit on the undistorted power output available at very low frequencies. No equipment was available to measure harmonic distortion below 20 cycles; however, the graph of Figure 3, based on oscilloscope observations, shows power levels the W-6A Amplifier will deliver at low distortion (essentially a pure sine wave) at frequencies between 5 and 20 cycles.

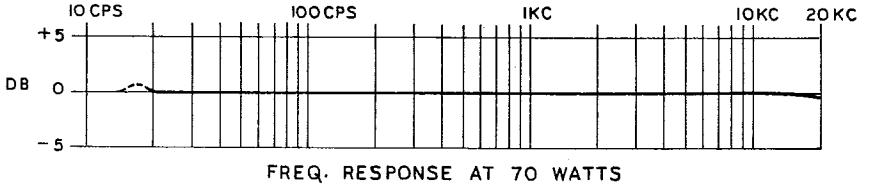


Figure 2

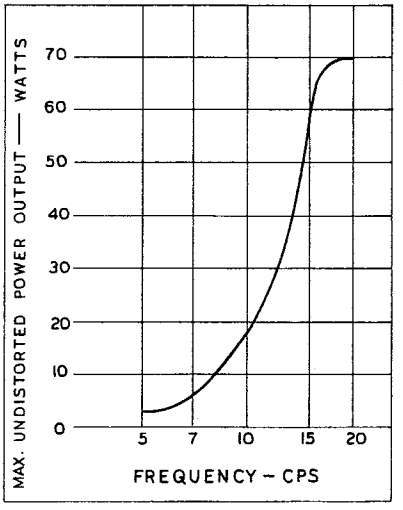


Figure 3

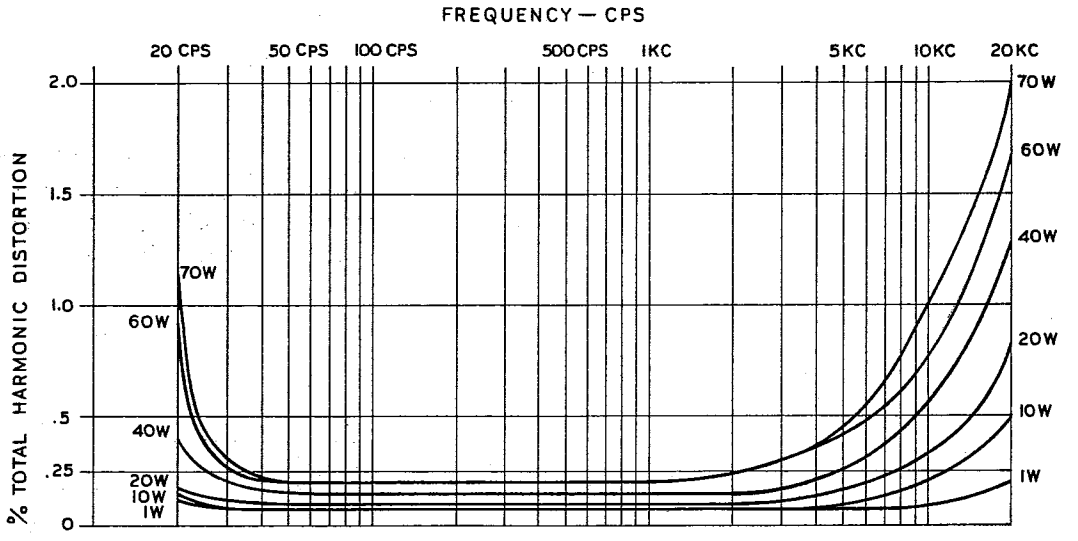


Figure 4

HARMONIC DISTORTION:..... Figure 4 shows total harmonic distortion versus frequency at several power levels. Competent authorities seem to agree that a total of 2% total harmonic distortion is tolerable for musical reproduction through wide-range audio equipment. Harmonic distortion below 0.7% is completely imperceptible, even to highly trained critical observers. Figure 5 shows the power output obtainable at these distortion levels.

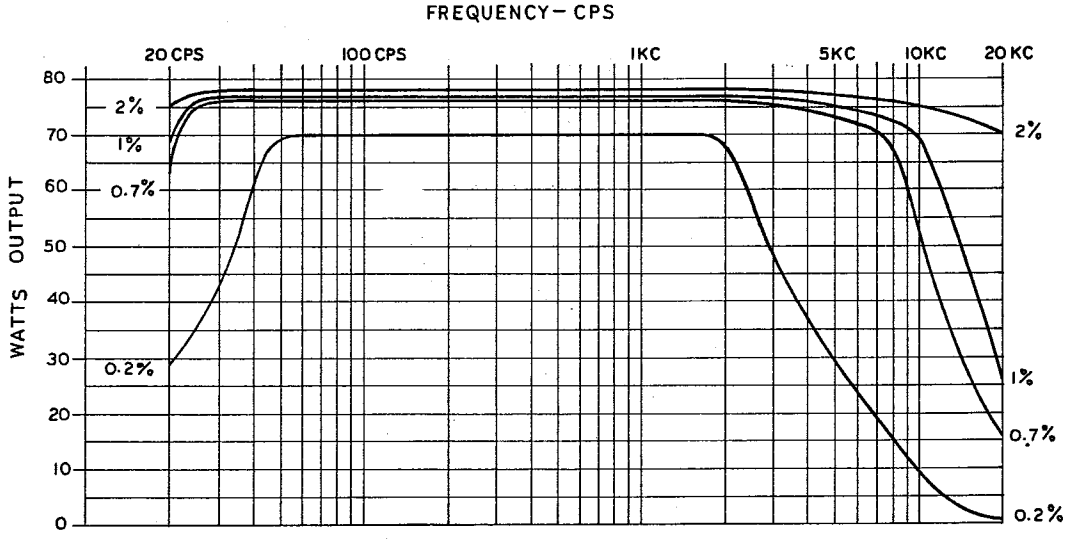


Figure 5

INTERMODULATION DISTORTION:..... Figure 6 shows intermodulation distortion versus power output under two separate test conditions. Note that the generally accepted limit for "extremely high fidelity" amplifiers (1% IM distortion) is not exceeded, even at full rated power.

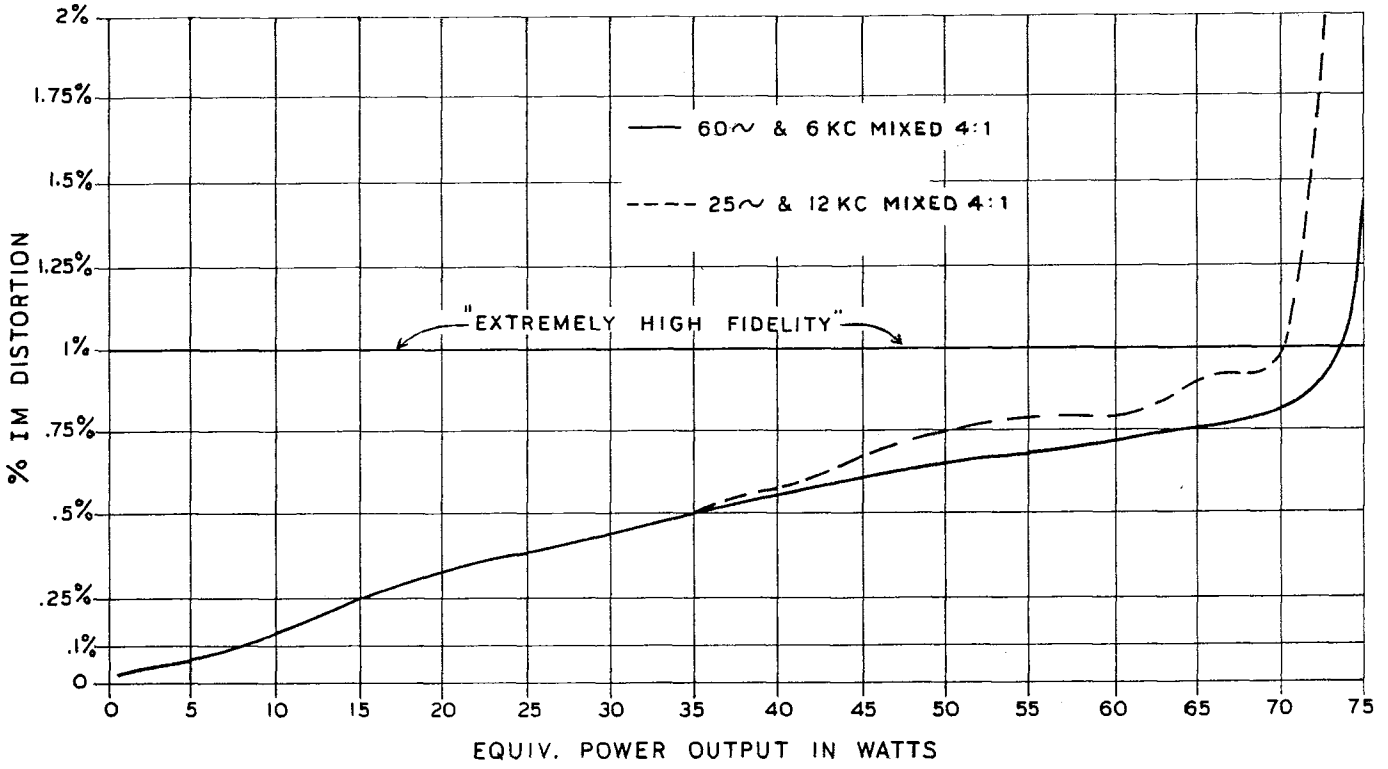


Figure 6

PHASE SHIFT:..... Figure 7 shows phase shift of the amplifier versus frequency, from 3 cps to 100 KC. Note that the phase shift characteristic is a smooth curve, without abrupt changes. This is a further indication of the stability of the amplifier.

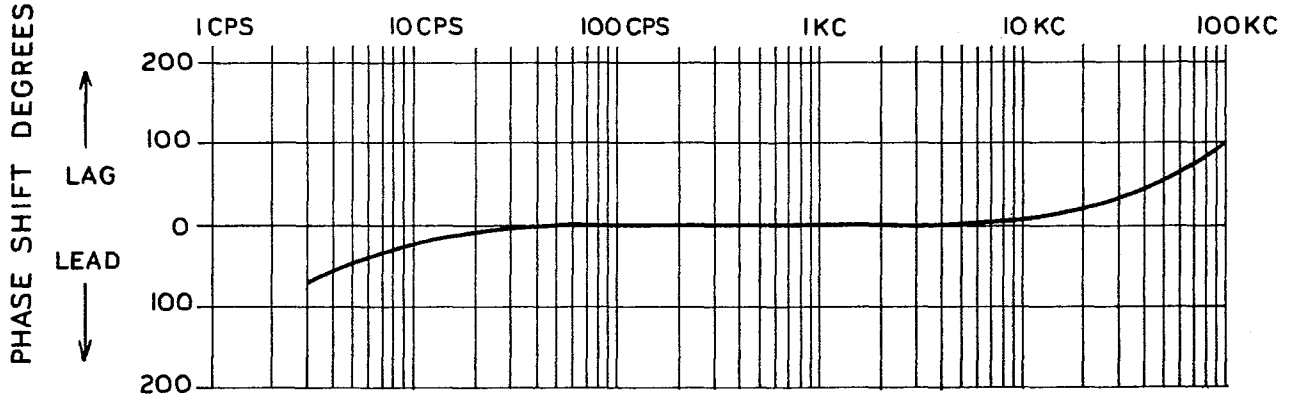


Figure 7

SENSITIVITY:..... Figure 8 indicates input voltage requirements for any power output level (solid curve). The dashed line shows linearity of output voltage versus input voltage.

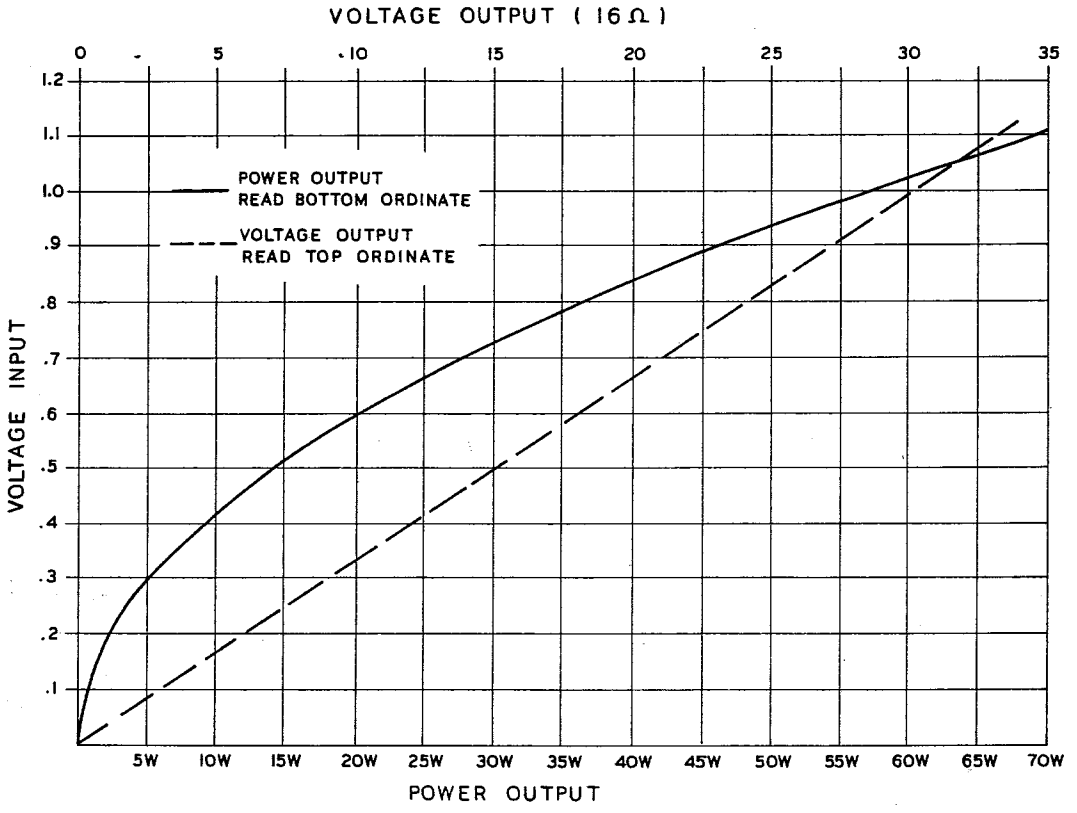


Figure 8

HUM AND NOISE:..... 90 db below 70 watts.

OUTPUT TUBE BALANCE:..... Meter, meter switch, and bias adjustments on front chassis apron for convenient and accurate adjustment of plate current and balance of output tubes.

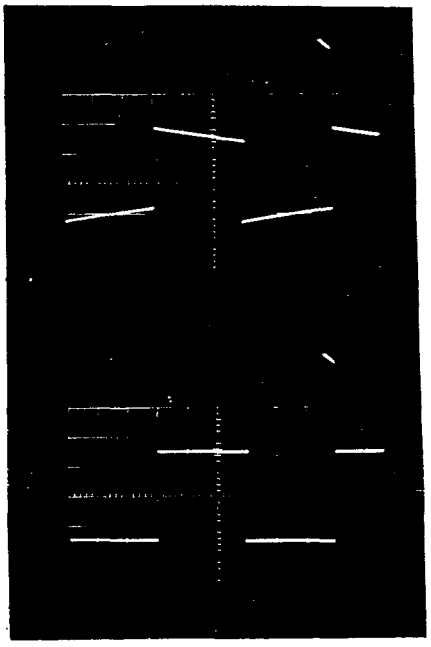
FEEDBACK:..... 20 db negative voltage/current feedback is applied around the entire amplifier and output transformer.

INPUT IMPEDANCE:..... 1.4 megohms.

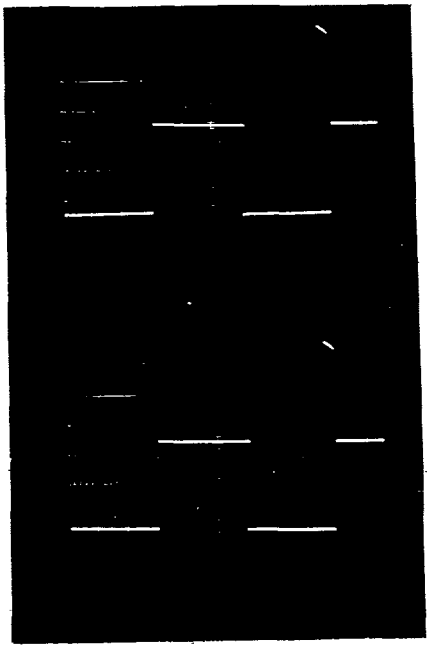
OUTPUT IMPEDANCES:..... 4, 8, and 16 ohms, and 70.7 volt line output.

DAMPING FACTOR:..... Variable, from 0.5 to 10 by means of calibrated control on front chassis apron.

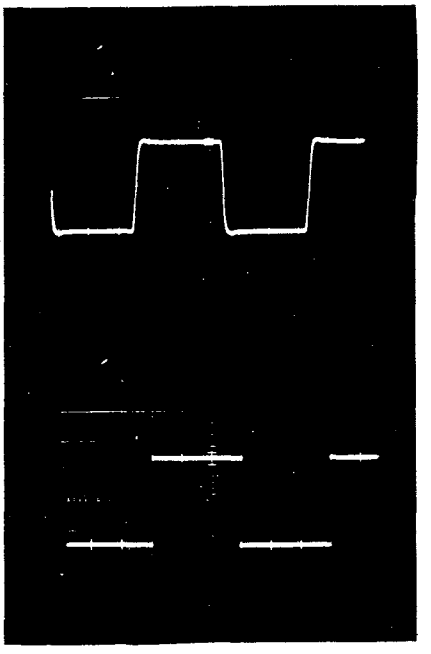
TRANSIENT RESPONSE:..... Square-wave response characteristics are shown in oscillograms A, B, and C, below.



50 Cycles A



500 Cycles B



10 KC C

In the above oscillograms, the lower trace shows the signal applied to the input of the amplifier; the upper trace is the output signal across a 16Ω load.

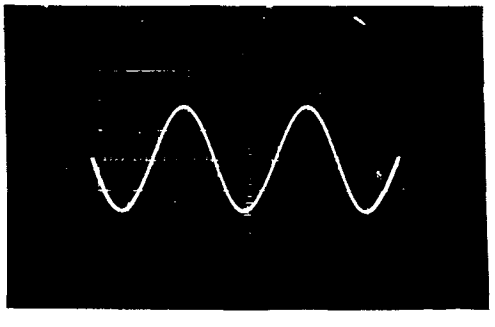
In A, B, and C, note the similarity between the input and output traces. The output wave shape in A is tilted slightly, owing to low-frequency phase shift (approximately 4^{o} at this frequency).

The output wave shape at C, which shows no ringing and negligible overshoot in the presence of a 10 KC square wave, is a rigorous test of high-frequency stability under transient conditions. It should be noted that a square wave of 10 KC will show response characteristics to at least 100 KC and that the transient represented by a 10 KC square wave is far steeper than that found in any known source of program material.

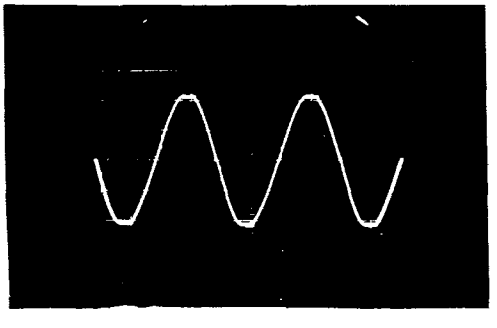
OVERLOAD RECOVERY:

Even a high-power amplifier such as the W-6A may occasionally be subjected to overload by heavy bass passages and transients. But regardless of the rated power output of an amplifier, it is extremely important that the overload be symmetrical, and that recovery after overload be smooth, without oscillation.

Oscillogram D shows the output waveform at 70 watts: note that this is still below the overload point. In oscillogram E, the amplifier is delivering approximately 77 watts, and has begun to overload; observe, however, that the clipping is perfectly symmetrical.

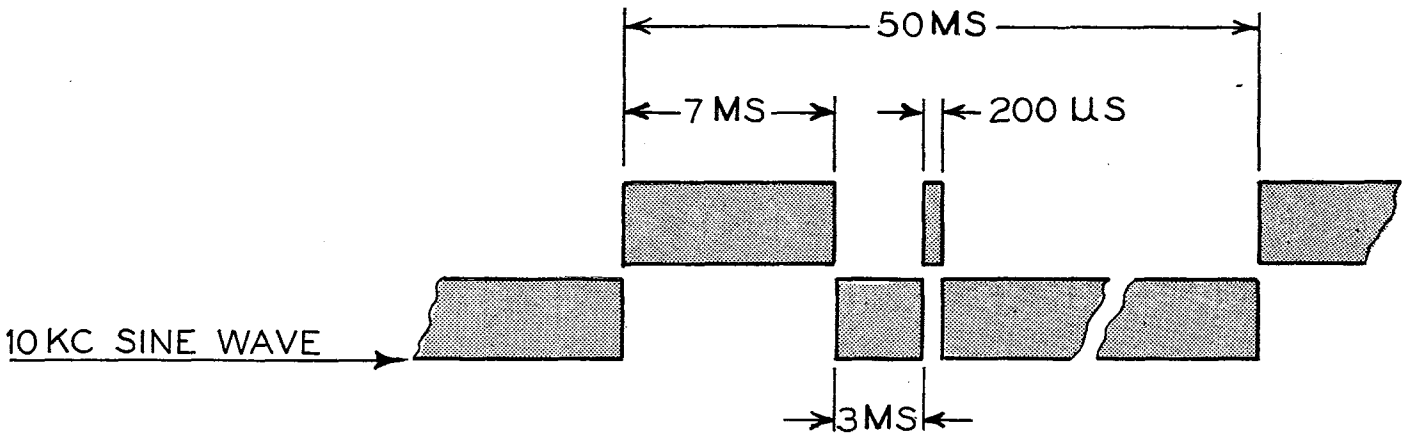


D



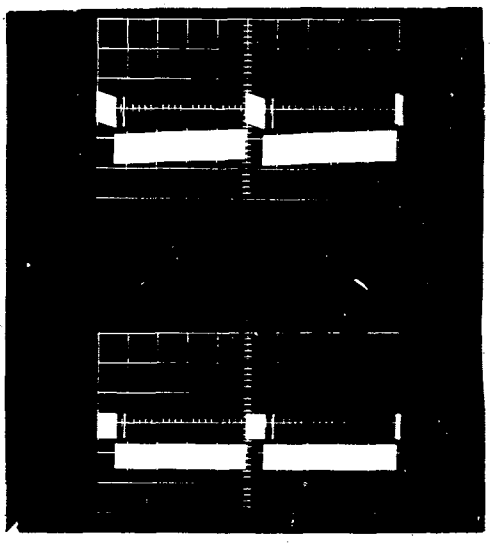
E

Tests for overload recovery were made by applying a special composite signal defined in the sketch below:

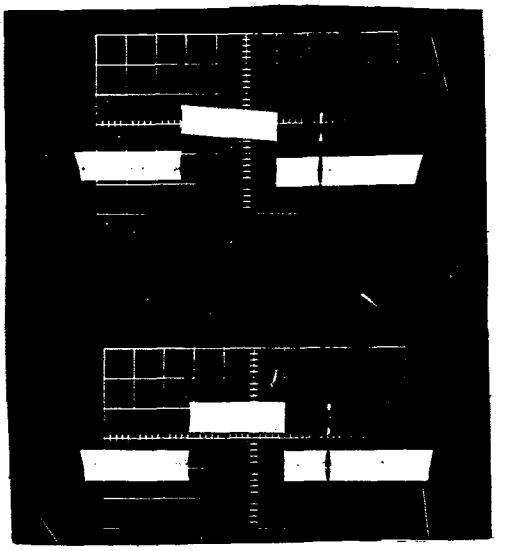


The 10 KC component represents normal mixed program material. The heavy 7 millisecond rectangular pulse simulates an overloading transient of sufficient length to show up any "ringing" or "hangover" effect following the sharp rise in signal level. The short 200 microsecond pulse follows this component after 3 milliseconds. This pulse could be placed at any point on the waveform. Its purpose was to determine if overload recovery was sufficient to faithfully reproduce a short transient immediately following overload.

The results are shown in oscillograms F, G, H, and J. In each case, the lower trace is the input signal to the amplifier; the upper trace is the output signal across a 16 ohm dummy load.



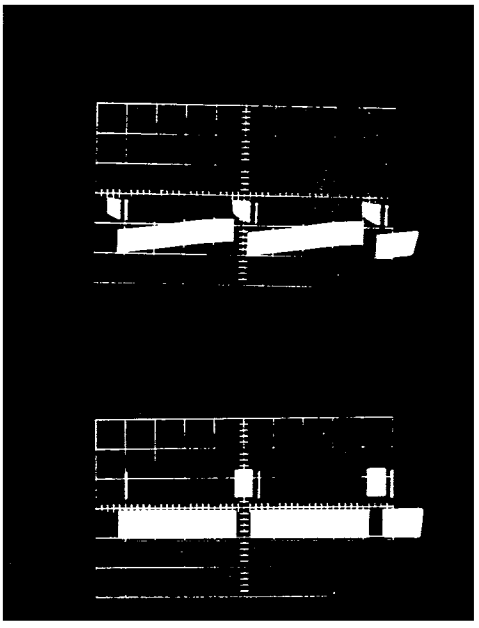
F



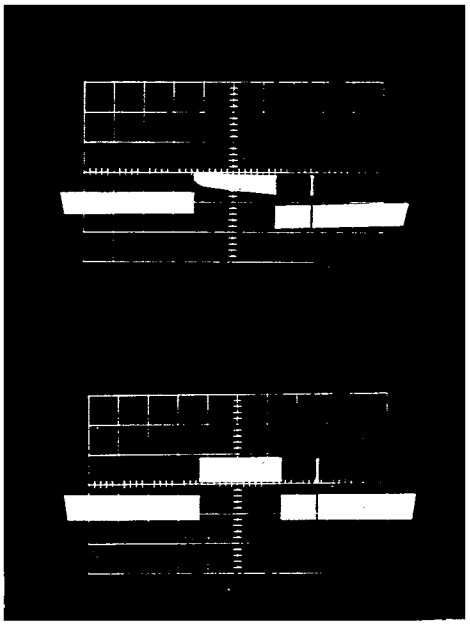
G

In oscillogram F, the amplifier is operating well below overload. Vertical sensitivity of the oscilloscope was 20 volts per centimeter; therefore the amplifier is delivering a signal of approximately 45 volts peak-to-peak.

Oscillogram G is a 5 times expansion of oscillogram F. (The tilt observed in the upper trace of F and G is due to phase shift in the amplifier.



H



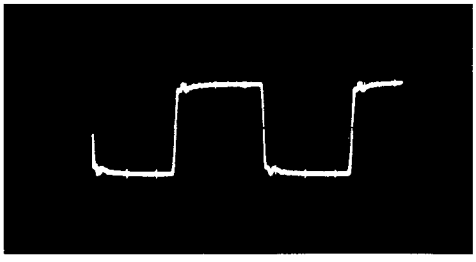
J

At H, the test signal has been increased in amplitude; the amplifier is now trying to deliver an output signal of 90 volts peak-to-peak. Again, J represents a 5 times expansion of this condition. Observe that the 7-millisecond pulse is severely distorted; it has driven the amplifier well into overload. However, the recovery of the amplifier is smooth and gradual, without hangover or ringing. The short pulse is reproduced faithfully, even during the gradual recovery, which is particularly important.

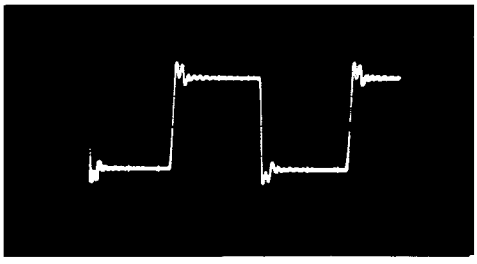
STABILITY

An important criterion of any feedback amplifier is the oscillation stability with no load, and with reactive loads.

K



L



Oscillogram K shows the 10 KC square-wave response of the W-6A Amplifier when driving the Heathkit SS-1 and SS-1B four-way speaker system, from the 16-ohm tap. Only a small degree of ringing is present.

A more stringent test is shown in oscillogram L; this is the 10 KC square-wave response with no load. The amplitude of the ringing is greater than in K, but nevertheless is well below the point of sustained oscillation. As a matter of fact, the W-6A will tolerate shunt capacities up to 1.0 μfd without oscillation, with no other load connected.

MECHANICAL PROTECTION

Decorative tube cover prevents accidental contact with hot tube envelopes. Cover is easily removed without tools. Meter and controls on front chassis apron; connectors and fuse on rear apron.

TUBE COMPLEMENT:..... 1-12AU7
1-12AX7
1-12BH7
2-6550

RECTIFIER:..... Four 500 ma. silicon rectifiers in full-wave voltage-doubler circuit.

INPUT AND OUTPUT TERMINATIONS:

Input..... Standard pin-jack.

Output..... Heavy-duty, 2-terminal "barrier strip".

A unique "quick-change" plug and receptacle permits instant selection of output impedance tap, without changing speaker lead connections.

FINISH:..... Chassis, satin gold enamel.
Cover, satin-black.

POWER REQUIREMENTS:..... 117 volts, 50-60 cycles, 140-225 watts.

ACCESSORIES:..... Octal socket on rear chassis apron for preamplifier power. Will supply 300 volts at 10 ma and 6.3 volts at 1.0 amperes.

DIMENSIONS:..... 11 7/8" deep x 9 1/16" high x 14 1/4" wide.

WEIGHT:..... 43 1/2 pounds

TEST CONDITIONS:

Load impedance..... Dummy load, 16.11 ohms, resistive.

Line voltage..... 117.0 volts, 60 cycles, regulated.

GENERATORS:..... For harmonic distortion measurements, Krohn-Hite model 440-A, inherent distortion less than 0.1%. Also used for very low frequency response measurements. For frequency response measurements, Hewlett-Packard model 650-A test oscillator. For square-wave tests, Tektronix type 105 square-wave generator.

DISTORTION:..... Total harmonic distortion measurements, Hewlett-Packard model 330-B distortion analyzer. Intermodulation distortion, Heathkit AA-1 audio analyzer.

POWER OUTPUT METERING:..... Ballantine model 310-A electronic voltmeter, across 16.11 ohm resistive load.

PHASE SHIFT:..... Advance type 405 precision phase meter.

OSCILLOGRAMS:..... Fairchild camera on Tektronix Model 515 oscilloscope.

INTRODUCTION

The question so often heard, "Why do I need 70 watts?" is a logical one since in many situations, 10 watts may be adequate. The answer is that the present upward trend in amplifier power is necessary to keep abreast with other recent advancements in the audio art. As loudspeaker systems have been improved in bass response, their efficiencies have, in general, been reduced; this means more amplifier power for the same acoustic output from the speaker. Another important factor is the ever-increasing dynamic range of LP records and pre-recorded tapes, approaching that found in the concert hall.

This all means that if amplifiers are to be compatible with present day speakers and source material, some increase in amplifier power is inevitable. Even though the full rated power output may be demanded only on the loudest musical passages and transients, it is extremely important that the amplifier be capable of supplying the reserve power with negligible harmonic and intermodulation distortion.

The design objectives behind the HEATHKIT Amplifier Model W-6A were to provide a high power amplifier of the highest quality, at a price well within reach of the average audiophile. The high degree of performance achieved, through the use of advanced, up-to-date design techniques, is more than sufficient to satisfy the most critical audio connoisseur.

CIRCUIT DESCRIPTION

The circuitry of the W-6A Amplifier is simple and straightforward. Signal from the input jack is fed through an isolation network to the grid of one triode section of the 12AU7 tube. Direct coupling is used to feed the amplified signal to the second section of the 12AU7, which operates as a phase-splitter. The push-pull signal from the phase-splitter is fed to the grids of the 12AX7 push-pull amplifier stage. This stage feeds the grids of the 12BH7 cathode follower driver stage. The cathodes of the 12BH7 are direct-coupled to the grids of the 6550 output tubes. Three potentiometers, in the grid return circuit of the driver stage, provide bias adjustment of each output tube. Fixed bias, obtained from a half-wave selenium rectifier, is applied to the output tube grids via the driver cathode resistors.

The output stage is operated in Class AB; the screen grids of the output tubes are connected to taps on the primary of the output transformer. As is well known, this results in greater power output than the triode connection and with much less distortion than the pentode connection.

Uniquely, the W-6A Amplifier uses the newly-developed silicon rectifiers in its power supply. These are connected in a full-wave, voltage-doubler configuration and supply 470 volts DC with low ripple content, and at better regulation than could be obtained from vacuum tube rectifiers.

Variable damping is provided, whereby the damping factor of the amplifier may be adjusted from 0.5 to 10, by means of a control calibrated directly in DF. This control is a dual potentiometer connected in a NEGATIVE voltage-current feedback path. As the control is rotated, the ratio of voltage feedback to current feedback changes, thereby changing the effective internal resistance of the amplifier and hence the damping factor, since

$$\text{DAMPING FACTOR} = \frac{\text{LOAD RESISTANCE}}{\text{AMPLIFIER INTERNAL RESISTANCE}}$$

At the same time, the total amount of feedback remains constant. This is important, for it means that the gain and distortion remain constant for any setting of the control. This desirable condition holds for all load impedance taps; likewise, the calibration of the damping factor control remains correct for all load impedance taps.

A "quick-change" plug and receptacle are provided, for selecting the desired impedance tap on the output transformer. At the same time, with this arrangement, the proper current-feedback resistor is automatically placed in the circuit, for the particular speaker impedance. This is a feature not found in all amplifiers incorporating variable-damping. It assures constant OVERALL feedback and damping control action at all impedance taps -- 4, 8, and 16 ohms.

The output transformer is a special Peerless design; among its features are excellence of core material and tightly coupled windings, for minimum distortion from 20 cycles to 20 kc, at full power; high efficiency (low power loss); and complete lack of high frequency resonances (good square-wave response) which contributes to the wide margin of stability of the W-6A Amplifier.

In addition, the circuitry of the W-6A Amplifier has been carefully engineered to assure freedom from ringing and oscillation. This high degree of stability, at both high and low frequencies may be verified by observing the .5 watt frequency response curve -- See Figure 1. The smooth roll-off below 10 cycles and above 100 kc are indications of unusually wide stability margins.

The excellent power supply regulation and the direct-coupled cathode-follower drivers, minimize grid current effects as the rated power output is approached and exceeded. This results in less than 1% intermodulation distortion at the rated 70 watts; the overload above 70 watts is gradual, and clipping is symmetrical.

A plate-current balance meter and associated switch on the front of the chassis permit the user to quickly and accurately adjust for proper balanced current in the output tubes, for maximum performance and tube life.

An octal socket is provided on the rear of the chassis for preamplifier power. Provision is made for the W-6A Amplifier to be turned on and off by a power switch located on the preamplifier-control unit. Although any HIGH QUALITY preamp-control unit may be used with the W-6A, the HEATHKIT Model WA-P2 is recommended as a compatible unit.

Only the highest quality components have been used in your HEATHKIT W-6A Amplifier. In specifying components, generous safety margins have been allowed so that all components are operating well below their maximum ratings. This is your assurance of years of dependable trouble-free operation.

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 REPLACEMENTS section and supply the information called for therein. Include all inspection slips in your letter to us. Hardware items are counted by weight and there may be a few more or less than the quantity specified. If a few are missing, please obtain them locally if at all possible.

In order to expedite delivery to you, we are occasionally forced to make minor substitution of parts. Such substitutions are carefully checked before they are approved and parts supplied will work satisfactorily. In checking the Parts List for resistors, for example, you may find that a resistor with a 5% tolerance has been substituted for a resistor with a 10% tolerance, as shown in the Parts List. These changes are self-evident and are mentioned here only to prevent confusion in checking the contents of your kit.

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 -50% are common for electrolytic capacitors.

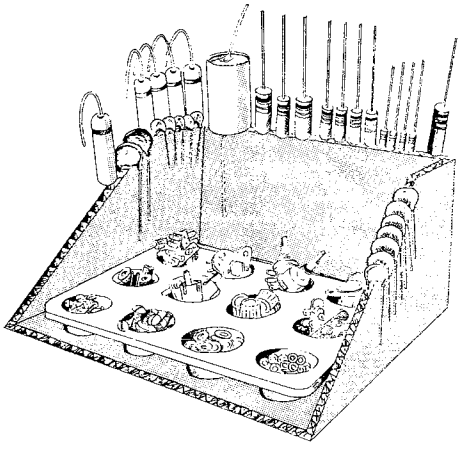
We suggest that you do the following before work is started:

1. Attach the large folded pictorials to the wall above your work bench.

2. Lay out all parts so that they are readily available.

3. 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 pen knife 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.



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 operation. 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.

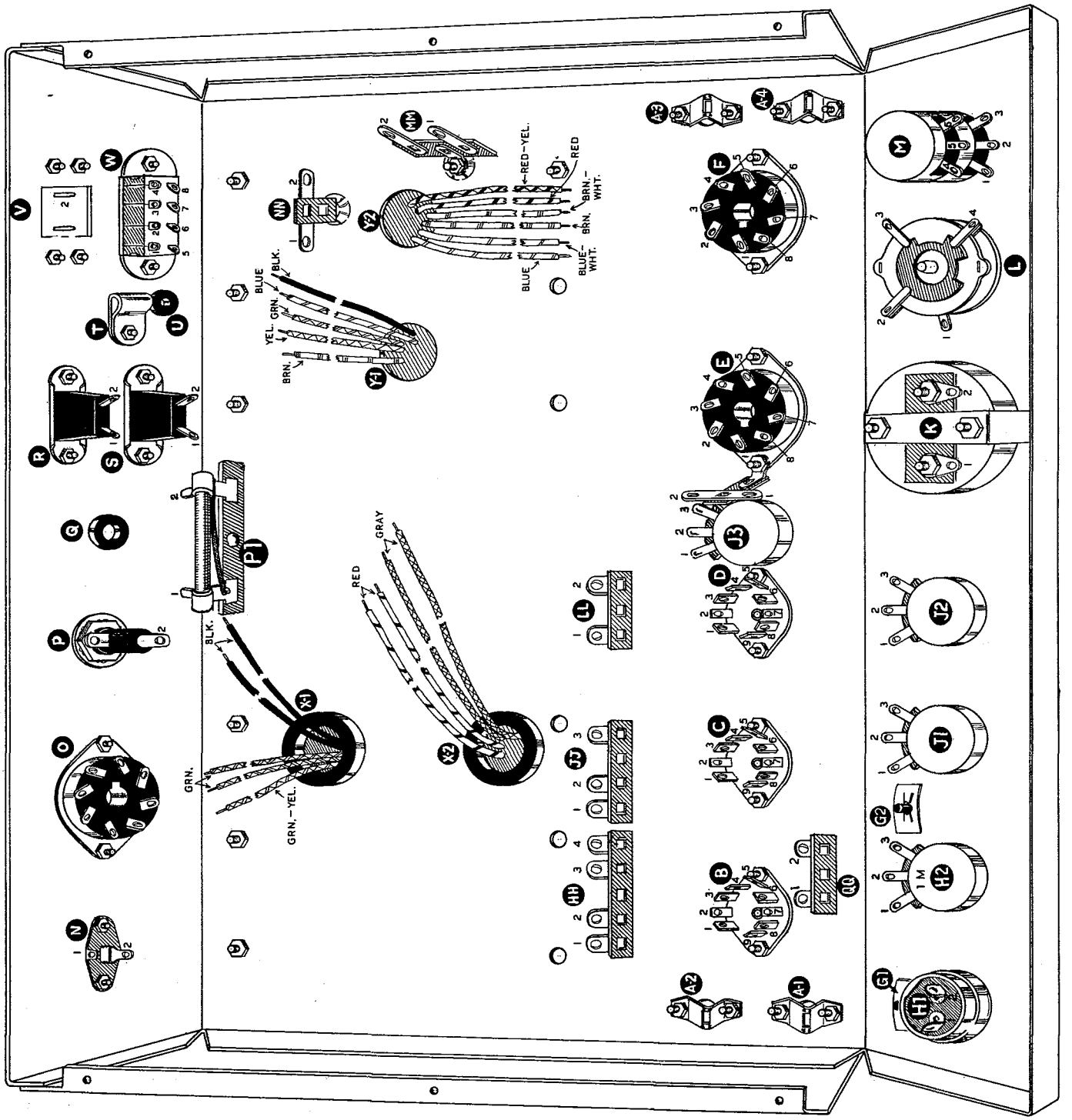

BLUE
BLK.
YEL.
GRN.
BRN.
RED-YEL.
RED
BRN.-WHT.
BLUE-WHT.
BLK.
GRAY
RED
GRN.
GRN.-YEL.

Figure 9

In assembling the kit, use lockwashers under all nuts, EXCEPT the 3-48 nuts used to mount the three 9-pin miniature tube sockets -- lockwashers are not required here. Other details of construction are included where pertinent in the instructions.

( ) Place the chassis with its open side up in front of you on your workbench. Place as shown in Figure 9, with the sloping front chassis apron toward you. A piece of cloth on the workbench would help to avoid scratches on the chassis.

( ) Identify the 8-contact connector, shown mounted on the rear chassis apron, at location W. Take care to mount as shown in the Figure, with the four horizontal lugs toward the open side of the chassis. Mount with two 3-48 pan head screws, #3 lockwashers, and 3-48 nuts. Use the drawings on Page 43 to identify the hardware sizes, if necessary.

( ) Mount the 2-contact terminal block on the outside of the chassis at location V, with the two lugs up and protruding through the square opening provided. Secure with four 6-32 x 1/2" screws, lockwashers, and nuts.

( ) Mount a spring catch clip at A1. Secure with two 4-40 pan head screws, #4 lockwashers, and 4-40 x 1/4" nuts.

( ) In the same manner, mount spring catch clips at A2, A3, and A4.

IMPORTANT: Refer to Figure 10, which shows the pin numbering system for 9-pin miniature tube sockets. Note that there is a blank space between pins 1 and 9. In mounting the sockets, be sure that this blank space is to the left, as shown in Figure 9.

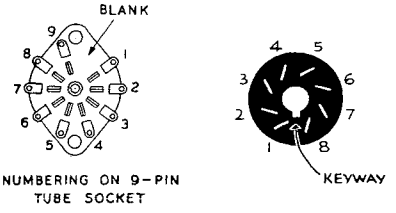


Figure 10

( ) Mount a 9-pin wafer tube socket at B, using 3-48 screws and nuts. No lockwashers are required.

( ) In the same way, mount a 9-pin socket at C, observing the same orientation as before.

( ) Mount a third 9-pin socket at D. Orient as before.

( ) Mount an octal socket at E, using 6-32 x 3/8" screws, lockwashers, and nuts. Note in Figure 10, the keyway between lugs 1 and 8. Mount with the keyway to the left, as shown in Figure 9. Mount a 1-lug terminal strip EE under one of the nuts, as in Figure 9.

( ) Install another octal socket at F, with the keyway oriented to the left, as before.

( ) Mount the 4-lug terminal strip HH, using 6-32 hardware. Position as shown in Figure 9.

( ) In the same manner, mount a 3-lug terminal strip JJ.

( ) Install 2-lug terminal strip LL.

( ) Install another 2-lug terminal strip MM.

( ) Mount 1-lug terminal strip NN.

( ) Mount 2-lug terminal strip QQ.

( ) On the rear chassis apron, install AC outlet S. Use 6-32 hardware.

( ) Install AC outlet R.

( ) Install fuse holder P. Refer to Figure 11 for mounting detail. Orient lugs as shown in Figure 9. Install fuse in holder. After installing, bend lug 1 up approximately 90°.

( ) Mount octal socket O, on the rear chassis apron. Position with keyway to the right, as shown.

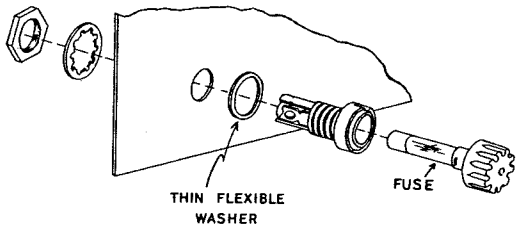


Figure 11

( ) Using 6-32 hardware, install input jack N. Position as shown, with terminal 1 toward the open side of the chassis.

( ) Using 6-32 hardware, install surgistor at P1 as shown in Figure 9. Be careful not to bend the contact strip which will upset its adjustment, however, the gap should be checked after installation and if readjustment is necessary, follow the instructions printed on the surgistor carton.

( ) Install the plastic HEATHKIT nameplate on the outside of the front chassis apron, with the plastic pins protruding through the holes provided. Push speednuts G1 and G2 on the pins, as far as they will go, or until the nameplate is firmly fastened.

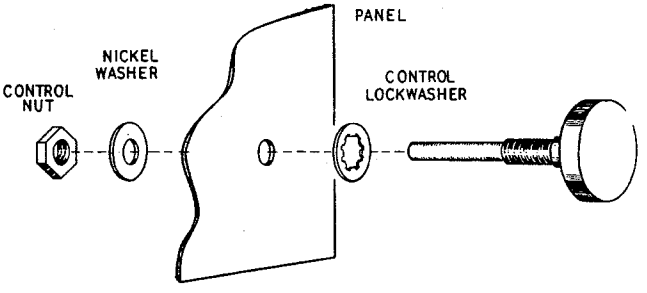
( ) Install AC switch H1 (#63-171) on the front chassis apron. Secure with a control lockwasher inside the chassis and a flat washer and control nut on the outside of the chassis. See Figure 12 for the switch mounting.

( ) Refer to Figure 12 and install 1 megohm control H2 (#10-67). Orient so that the lugs are positioned as shown in Figure 9. Secure with a control lockwasher inside the chassis and a flat washer and nut on the outside of the chassis.

( ) Install as before, a 2000 Ω control J1 (#10-56), on the front chassis apron. Orient so that the lugs are positioned as shown in Figure 9.

( ) In the same manner, install 2000 Ω control J2.

( ) In the same manner, install 2000 Ω control J3.



HOW TO MOUNT CONTROLS & SWITCHES.

Figure 12

( ) Again using a control lockwasher, flat washer and nut, install dual control M. Orient with lugs positioned as shown.

( ) Install meter switch L, with a control lockwasher, flat washer and nut. Carefully study the switch and orient so that the four lugs are positioned as shown in Figure 9 on Page 14.

It may be helpful to note that the switch lug designated number 1 is mounted under the switch wafer, when viewed as in Figure 9. Also, lugs 2 and 4 are double lugs, having lugs on both sides of the wafer.

( ) Mount meter K from the outside of the front chassis apron. Inside the chassis, plate the U-shaped meter mounting bracket on the meter as shown in Figure 9 and secure with two 6-32 nuts on the meter mounting studs. The bracket and nuts will be found in the meter box. Make sure the meter is right side up with the chassis in its upright position. Use care in tightening, to avoid meter damage.

( ) Install 3/16" rubber grommet U, on the rear chassis apron.

( ) Also on the rear chassis apron, install 3/8" rubber grommet Q.

( ) Install 3/4" rubber grommets X1 and X2.

PROPER SOLDERING TECHNIQUES

Only a small percentage of HEATHKIT purchasers find it necessary to return an instrument for factory service. Of these instruments, by far the largest proportion 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 the colored insulation (hookup wire); the size of the conductor is the same for all colors of hookup wires furnished with the kit.

2. Leads on resistors, capacitors and transformers are generally much longer than they need to be to make the indicated connections. In these cases, the excess leads should be cut off before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points.

3. Where the use of sleeving is specifically intended, the associated construction step will provide directions to this effect. In any case where there is a possibility of a component lead or bare wire coming in contact with terminals or other leads, or making unintentional contact with other metal parts, sleeving should be used. Extra sleeving is supplied for this purpose.

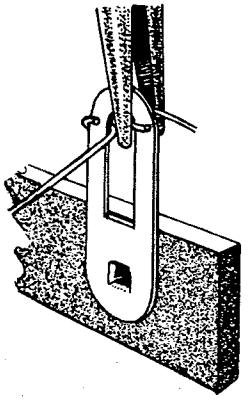
4. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the wire is too large to allow bending, or if the associated step states that the wire is not to be bent, position the wire so that a good solder connection can still be made.

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

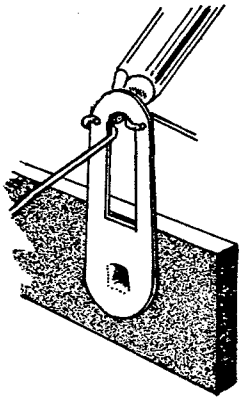
6. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.

7. 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.

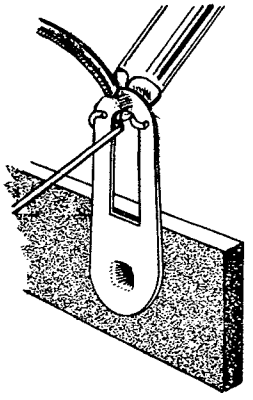
8. Remove the solder and then the iron from the completed junction. Use care not to move the leads until the solder has solidified.



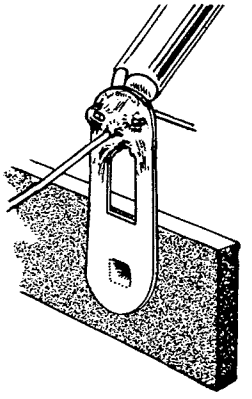
CRIMP WIRES



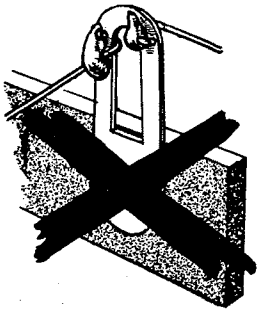
HEAT CONNECTION



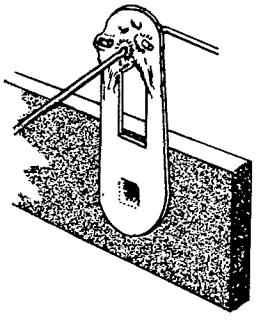
APPLY SOLDER



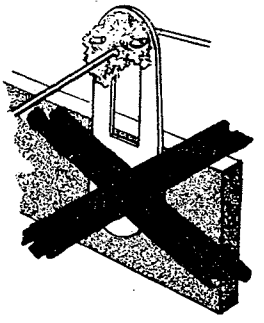
ALLOW SOLDER TO FLOW



COLD SOLDER JOINT CONNECTION INSUFFICIENTLY HEATED



PROPER SOLDER CONNECTION

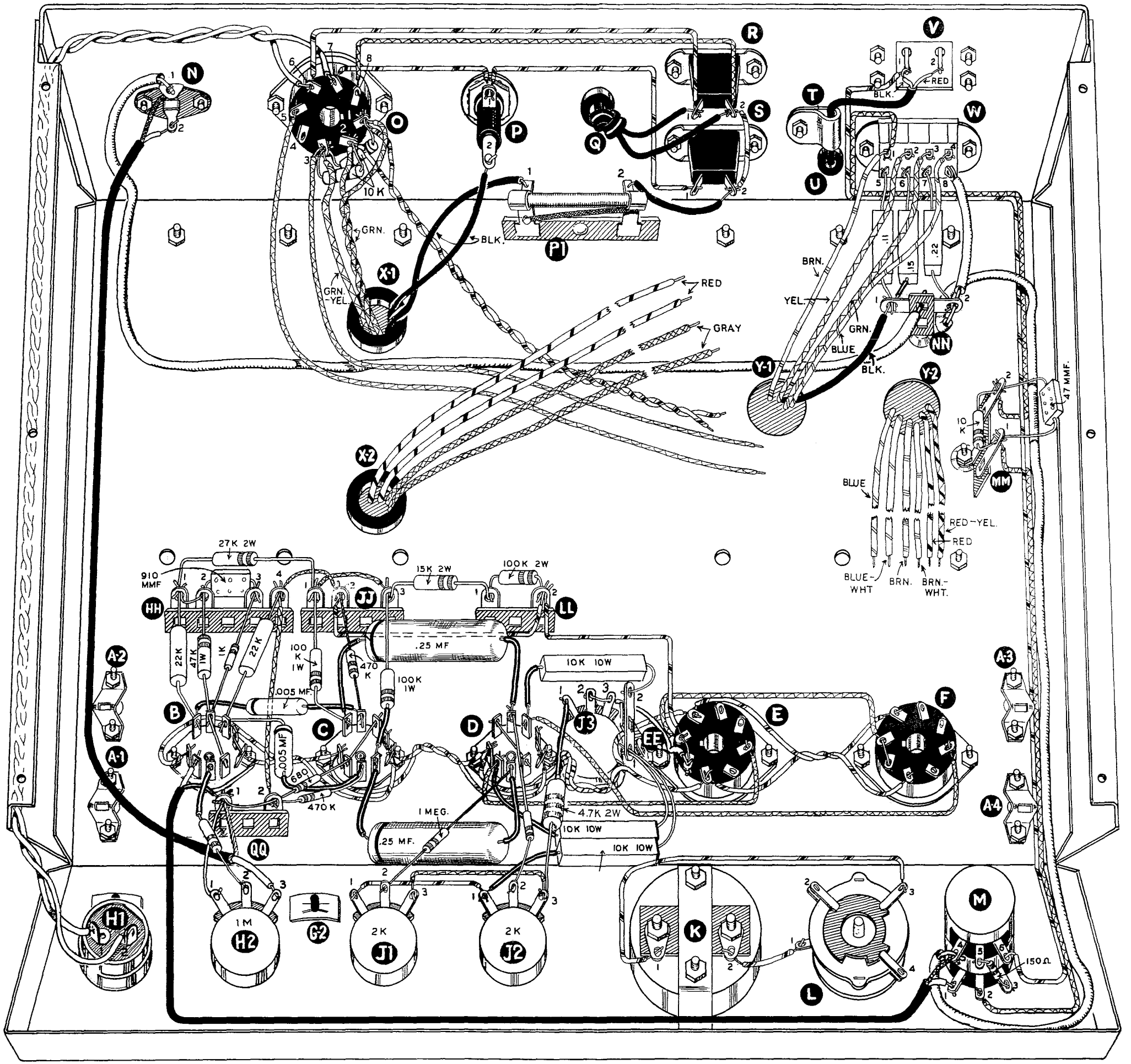


COLD SOLDER JOINT CONNECTION MOVED WHILE COOLING

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.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

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. This additional check will help avoid errors.


N
O
P
P1
Q
R
S
T
U
V
W
X-1
X-2
Y-1
Y-2
NN
MM
HH
JJ
LL
QQ
A-1
A-2
A-3
A-4
B
C
D
E
F
G-2
H1
H2
J1
J2
J3
K
L
M
EE
10 K
GRN.
BLK.
GRN.-YEL.
RED
GRAY
BRN.
YEL.
GRN.
BLUE
BLK.
RED
.11
.15
.22
47 MMF.
10 K
BLUE
RED-YEL.
RED
BLUE-WHT
BRN.
BRN.-WHT.
27K 2W
910 MMF
15K 2W
100K 2W
22K
47K 1W
1K
22K
100 K 1W
470 K
100K 1W
.25 MF
.005 MF.
10K 10W
680
470 K
1 MEG.
.25 MF.
4.7K 2W
10K 10W
10K 10W
1 M
2K
2K
150Ω

Pictorial 1

STEP-BY-STEP WIRING

Refer to Pictorial 1 in wiring the amplifier.

( ) Cut a length of wire 3 3/4" long. Strip 1/4" of insulation from each end. Connect one end to socket B9 (S-1). Leave the other end free temporarily.

( ) Cut another 3 3/4" length of wire. Strip 1/2" of insulation from each end. Pass one end through B5 (NS) to B4 (S-1). Now solder B5 (S-1).

( ) Run the wire previously soldered to B9 around the socket, on the side toward terminal strip HH. Dress this wire close to the chassis. Then twist this wire together with the one coming from B4 and B5.

( ) Connect the shorter end of this twisted pair to C9 (NS). Leave the longer end free temporarily.

( ) Cut another 3 3/4" length of wire. Strip for 1/4" at each end. Connect one end to C9 (S-2).

( ) Now twist this lead together with the free lead coming from the twisted pair previously installed. Twist for a length of about 1". Pass the shorter end through C5 (NS) to C4 (S-1).

( ) Cut another 3 3/4" length of wire and after stripping 1/4" at each end, connect one end to C5 (S-2). Twist together with the free end coming from the twisted pair previously installed. Twist for a length of about 1", and connect the shorter end to D9 (NS).

( ) Cut a wire to a length of 4 3/4" and after stripping 1/4" at each end, connect one end to D9 (S-2). Twist together with the free end from the twisted pair previously installed. Twist for a length of 1" then connect the shorter end to D5 (NS).

( ) Prepare a wire 3 3/4" long by stripping 1/2" of insulation at one end and 1/4" at the other end. Pass the 1/2" stripped end through D5 (NS) to D4 (S-1). Now solder D5 (S-2).

( ) Twist together the two remaining free leads. Twist for a length of 3/4", then connect one lead to octal socket E2 (NS).

( ) Connect the other lead to E7 (NS).

( ) Cut a lead 4 1/4" long, strip both ends 1/4", and connect one end to E7 (NS).

( ) Cut another lead 4 1/4" long, strip as before, and connect one end to E2 (NS).

( ) Dress each lead straight down from its lug to the chassis, then start twisting the pair just to the right of socket E. Connect either wire to octal socket F2 (S-1) and the other wire to F7 (S-1).

( ) Cut two 17" lengths of wire. Strip all four ends. Connect one of the wires to O6 (NS). Connect the other wire to O7 (NS). Now twist the two wires firmly together, dress as shown in Pictorial 1 and connect either wire to H1-1 (S-1), the other wire to H1-2 (S-1).

( ) Carefully check the dress of all wires installed thus far. In every case, the leads should be dressed close to the chassis, and away from all other socket lugs.

( ) Cut a wire 4" long and strip both ends. Connect one end to terminal strip HH4 (NS) and the other end to terminal strip QQ2 (NS). Dress close to chassis.

( ) Connect a short length of wire between HH4 (NS) and JJ2 (NS). (Dress toward chassis to avoid short-circuit with resistor leads to be connected to JJ1.)

( ) Prepare a wire 4" long, and connect between JJ2 (NS) and LL2 (NS). Dress close to chassis.

( ) Connect a 4" length of wire between LL2 (NS) and octal socket E1 (NS). Dress this lead as shown in Pictorial 1.

( ) Connect a 5" length of wire between E1 (NS) and F1 (NS). Dress close to chassis.

( ) Connect a short length of bare wire between E1 (S-3) and E8 (NS). Use hookup wire with insulation removed.

( ) Remove 3/4" insulation from a short length of wire. Run one end through J3-3 (NS) and connect to J3-2 (S-1). Now solder J3-3 (S-1).

( ) Connect the other end to E8 (S-2).

( ) In the same manner, connect a short length of bare wire between F1 (NS) and F8 (S-1).

( ) Connect a 5 1/4" length of wire between E5 (S-1) and D8 (NS).

( ) Connect a 7 1/2" length of wire between F5 (S-1) and D3 (NS). Dress this wire and the preceding one close to chassis.

( ) Connect a straight, bare jumper wire across tube socket D, from D6 (S-1) to D1 (NS).

( ) Run a short wire between switch lug L1 (S-1) and meter terminal K2 (S-1).

( ) Connect a wire between meter terminal K1 (S-1) and switch lug L3 (NS).

( ) Connect a wire from control J1-3 (S-1) to J2-3 (NS).

( ) Similarly, connect a wire from control J1-1 (S-1) to J2-1 (NS).

( ) Connect a bare wire from QQ1 (NS) to H2-1 (S-1).

( ) Connect a 7 1/2" length of wire between socket O8 (S-1) and AC socket R2 (NS). Dress close to rear chassis apron.

( ) Run a wire from AC socket R2 (NS) to S2 (NS).

( ) Connect a 7 3/4" length of wire between O6 (S-2) and R1 (NS). Dress close to rear apron.

( ) Connect a 3 1/2" length of wire between O7 (S-2) and fuse holder terminal P1 (NS). Dress close to rear apron.

( ) Connect a 6" length of wire between P1 (S-2) and S1 (S-1). Dress close to apron.

( ) Connect a 150 Ω resistor (brown-green-brown) between M3 (S-1) and M5 (S-1).

( ) Cut a 14 1/2" length of the #14 solid copper tinned wire. Cover with a 14" length of braided sleeving. Connect one end of the wire to control lug M4 (NS). Now refer to Pictorial 1 and dress against chassis as shown. Connect the other end to terminal strip NN2 (NS).

( ) Using #14 solid copper wire and braided sleeving, cut a 3" length and connect between terminal strip NN2 (NS) and connector terminal W8 (S-1).

( ) In the same manner, cut a 15 1/2" length of solid copper wire (again using braided sleeving). Connect one end to the lug center hole of terminal strip NN (S-1). Referring to Pictorial 1, dress as shown. Connect the other end to input jack N1 (NS).

( ) Connect an 11 1/4" length of wire between control lug M2 (S-1) and terminal strip MM1 (NS).

( ) Run a 19 1/2" length of wire from control lug M6 (S-1) to output terminal V1 (NS).

( ) Connect a 9 1/4" length of wire between MM2 (NS) and connector terminal W1 (NS).

( ) Install a .11 Ω 7 watt resistor between W5 (S-1) and NN1 (NS). Allow resistor body to lay flat against the chassis.

( ) In the same manner, install a .15 Ω 7 watt resistor between W6 (S-1) and NN1 (NS). Use sleeving on the lead to NN1.

( ) In similar manner, install a .22 Ω 5 watt resistor between W7 (S-1) and NN2 (S-3).

( ) Identify the 2-prong load selector plug which is a flat Bakelite plug with lead attached. Prepare the end of the lead coming from this plug by removing 1/2" of the outer plastic covering, exposing the red and black insulated leads within the covering. Now remove 1/4" of insulation from the red and black leads.

( ) From the outside of the chassis, pass the lead through grommet U. Insert the plug in the "70 V" position of connector W. Inside the chassis, slip plastic cable clamp T over the lead as shown in Pictorial 1. Secure the cable clamp with 6-32 hardware. Before tightening, allow a sufficient amount of slack in the lead outside the chassis for strain relief, when the plug is in the 70 volt position.

( ) Connect the red lead to V2 (S-1).

( ) Connect the black lead to V1 (S-2).

( ) Connect a 10 KΩ resistor (brown-black-orange) between lug 1 (NS) and lug 2 (NS) on terminal strip MM.

( ) Connect a 47 $\mu\mu$f mica capacitor (yellow-violet-black or marked 47 $\mu\mu$f) between lug 1 (S-3) and lug 2 (S-3) on terminal strip MM.

( ) Install a .005 μfd molded paper capacitor between socket B1 (NS) and C2 (NS). Use sleeving on both leads.

( ) Install a second .005 μfd capacitor between B3 (NS) and C7 (NS). Use sleeving on the lead going to C7. Position capacitor as shown in Pictorial 1.

( ) Connect a 22 KΩ precision resistor between B1 (S-2) and HH1 (NS).

( ) Pass one lead of a 47 KΩ 1 watt resistor (yellow-violet-orange) through B2 (NS) to B6 (S-1). Connect the other resistor lead to HH2 (NS).

( ) Connect a 1 KΩ 1/2 watt resistor (brown-black-red) from B2 (S-2) to HH3 (NS).

( ) Connect a 22 KΩ precision resistor between B3 (S-2) and HH4 (S-3).

( ) Connect one lead of a 910 μμf mica capacitor (white-brown-black or marked 910 μμf) to HH3 (S-2). Pass the other lead through HH2 (NS) to HH1 (NS). Now solder HH2 (S-2).

( ) Install a 27 KΩ 2 watt resistor (red-violet-orange) between HH1 (NS) and JJ1 (NS). Position body of resistor about 1/4" above the 910 μμf mica capacitor previously installed.

( ) Connect a wire between JJ1 (NS) and JJ3 (NS).

( ) Install a 470 KΩ resistor (yellow-violet-yellow) between C2 (S-2) and JJ2 (NS).

( ) Install a .25 μfd capacitor between C1 (NS) and D2 (NS). Use sleeving on both leads.

( ) Install a second .25 μfd capacitor between C6 (NS) and D7 (NS). Use sleeving on both leads.

( ) Install a 100 KΩ 1 watt resistor (brown-black-yellow, one of the matched pair) between JJ3 (NS) and C6 (S-2). Use sleeving on the lead to C6.

( ) Connect a 470 KΩ resistor (yellow-violet-yellow) from C7 (S-2) to QQ2 (NS).

( ) Pass one lead of a 680 Ω resistor (blue-gray-brown) through C8 (NS) to C3 (S-1). Now solder C8 (S-1). Pass the other lead through QQ2 (NS) to QQ1 (NS). Now solder QQ2 (S-3).

( ) Install a 100 KΩ 1 watt resistor (brown-black-yellow, one of the matched pair) between C1 (S-2) and JJ1 (NS).

( ) Install a 10 KΩ 10 watt resistor between D3 (S-2) and EE2 (NS). Use sleeving on the lead to D3, and allow resistor body to rest on chassis.

( ) Install a second 10 KΩ 10 watt resistor between EE1 (NS) and J2-1 (S-2). Use sleeving on the lead to J2-1. Position resistor flat against chassis.

( ) Install a third 10 KΩ 10 watt resistor between EE1 (S-2) and D8 (S-2). Use sleeving on the lead to D8. Position resistor against the one previously installed.

( ) Install a 4.7 KΩ 2 watt resistor (yellow-violet-red) between J2-3 (S-2) and J3-1 (S-1). Use sleeving on the lead to J3-1.

( ) Install a 1 megohm resistor (brown-black-green) between D7 (S-2) and J1-2 (S-1).

( ) Install another 1 megohm resistor between D2 (S-2) and J2-2 (S-1).

( ) Install a 15 KΩ 2 watt resistor (brown-green-orange) between J3 (NS) and LL1 (NS).

( ) Install a 100 KΩ 2 watt resistor (brown-black-yellow) between LL1 (NS) and LL2 (NS).

( ) Connect a 390 KΩ resistor (orange-white-yellow) from B7 (S-1) to H2-2 (S-1).

( ) Connect a 10 KΩ resistor (black-brown-orange) from O1 (NS) to O3 (NS).

( ) Connect another 10 KΩ resistor from O2 (NS) to O3 (NS).

( ) Cut a length of shielded cable 13" long. At one end cut away 3/4" of the outside insulation. Take care not to cut into the shield which is wrapped around the insulation of the inner conductor. Refer to Figure 13. Unwind the shield and twist into a pigtail. Now strip 1/4" of insulation from the inner conductor. Tin both leads.

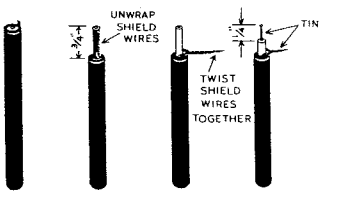


Figure 13

( ) Prepare the other end of the cable in the same manner.

( ) Connect the inner conductor to N2 of the input jack (S-1).

( ) Connect the shield to N1 (S-2).

( ) Run the cable along the left hand end of the chassis, and connect the shield to QQ1 (NS).

( ) Connect the inner wire to H2-3 (S-1).

( ) Cut another piece of shielded cable 14 1/2" long and prepare both ends as before.

( ) At one end tin the twisted end of the shield and cover with a 5/8" length of sleeving. Connect to QQ1 (S-4).

( ) At the same end, connect the inner wire to B8 (S-1).

( ) Run the cable toward the right hand end of the chassis (viewed as in Pictorial 1), in the corner formed by the front apron and its flange. At the other end, connect the inner lead to M1 (S-1).

( ) Connect the shield to M4 (S-2).

( ) Identify the power transformer as bearing the stamped part #54-58. Mount the power transformer on top of the chassis, using 8-32 hardware. First pull the black, green, and green-yellow leads through grommet X1 and the red and gray leads through grommet X2. Mount with 8-32 screws, lockwashers, and nuts in the three holes nearest the rear of the chassis, and one screw and nut in one of the other holes. (The latter screw will be removed later, when the power supply bracket is installed.)

( ) In similar manner, mount the output transformer. Referring to Pictorial 1, pull the indicated leads through holes Y1 and Y2. Secure with 8-32 hardware in the three holes nearest the rear of the chassis, and the hole nearest terminal strip MM. (The two other screws will be installed later.)

( ) At the output transformer, connect the black lead coming from hole Y1 to NN1 (S-3).

( ) Connect the brown lead coming from the same hole to W1 (S-2).

( ) Connect the yellow lead to W2 (S-1).

( ) Connect the green lead to W3 (S-1).

( ) Connect the blue lead to W4 (S-1).

( ) At the power transformer, connect the shorter black lead coming from grommet X1 to P2 (S-1).

( ) Cut the longer black lead to 3 1/2" and connect to P1-1 (S-1).

( ) Use the remaining black lead and connect from P1-2 (S-1) to S2 (S-2).

( ) Twist together the two green leads coming from grommet X1. Connect either lead to O1 (NS) and the other lead to O2 (NS).

( ) Cut two wires 13" long and twist together. At one end, connect either wire to O1 (S-3) and the other wire to O2 (S-3). Leave the other end free temporarily.

( ) The green-yellow lead coming from the power transformer is the center tap from the filament winding and is to be taped up and dressed flat against the chassis near grommet hole X1.

( ) Cut a wire 11 1/2" long. Connect one end to O3 (S-3). Leave the other end free temporarily.

( ) Cut another wire 12 3/4" long and connect to O5 (S-1). Leave the other end free temporarily.

( ) Insert the line cord through grommet Q. Inside the chassis, tie a knot in the line cord 3 1/2" from the end, for strain relief. Connect either wire of the line cord to R1 (S-2) and the other wire to R2 (S-3).

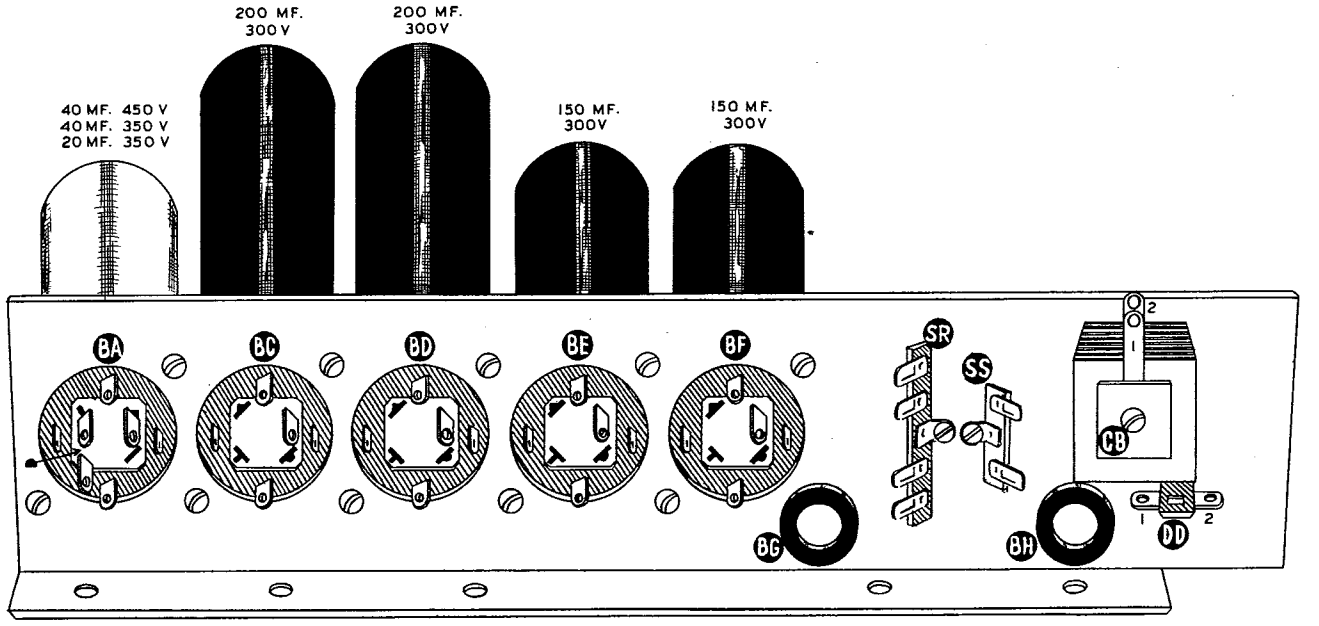


Figure 14

PARTS MOUNTING AND WIRING OF POWER SUPPLY BRACKET

( ) Viewing the power supply bracket as shown in Figure 14, mount the five fiber electrolytic mounting wafers at BA, BC, BD, BE, and BF, using 6-32 hardware. Be sure to mount the wafers on the side away from the flange.

( ) Install 3/4" rubber grommets at BG and BH.

( ) Install 4-lug terminal strip SR with mounting lug to the right. Use 6-32 hardware.

( ) Install 2-lug terminal strip SS with mounting lug to the left. Use 6-32 hardware.

( ) Mount selenium rectifier CB. The positive (+) terminal must be toward the bracket. Secure with 6-32 x 1 1/4" screw and hardware.

( ) Install the 1-lug terminal strip DD at the hole near the lower right hand corner of the selenium rectifier. Use 6-32 hardware.

( ) Mount a 150 $\mu\mu$f 300 V electrolytic capacitor on wafer BF. Orient so that the large (+) terminal is positioned as shown in Figure 14, with the four mounting lugs protruding through the slots in the wafer. While holding the capacitor firmly against the wafer, twist each of the four mounting lugs 1/8 turn, using pliers.

( ) In the same manner, install the other 150 μfd 300 V electrolytic capacitor on wafer BE.

( ) Install a 200 μfd 300 V electrolytic capacitor at BD. Orient as shown.

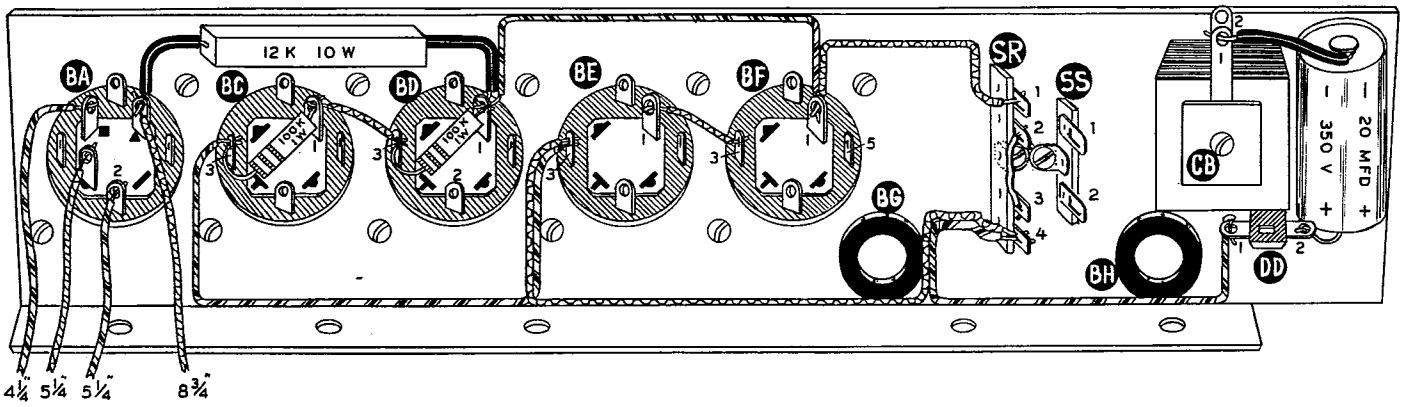
( ) In the same manner, install another 200 μfd 300 V electrolytic capacitor at BC.

( ) Install the 3-section (40/20 μfd 350 V and 40 μfd 450 V) electrolytic capacitor at BA. Orient so that the lugs are positioned as shown in Figure 14.

WIRING

Refer to Pictorial 2 in wiring the power supply bracket. You will find it helpful to use the tube cage to support the bracket while wiring it.

( ) Observing polarity, connect a 20 μfd 350 V tubular electrolytic capacitor between DD2 (S-1) and CB1 (NS). The + lead goes to DD2.) Use a 1" length of sleeving on the lead to CB1.



Pictorial 2

Dress the three following wires along the bend of the flange.

( ) Cut a 5 1/4" length of wire and strip 1/4" of insulation from each end. Connect one end to DD1 (NS) and the other end to SR4 (NS).

( ) Prepare a 6 1/4" length of wire and connect between SR4 (NS) and BE3 (NS).

( ) Connect a 6" length of wire between BE3 (S-2) and BC3 (NS).

( ) Connect a 5 1/2" length of wire between BF1 (NS) and BD1 (NS). Dress as shown.

( ) Connect a 2 3/4" length of wire between SR1 (NS) and BF1 (NS). Dress as shown.

( ) Connect a short length of wire between BE1 (S-1) and BF3 (S-1).

( ) Connect a short bare wire between SR2 (NS) and SR3 (NS).

( ) Connect another short length of wire between BC1 (NS) and BD3 (NS).

( ) Connect a 100 KΩ 1 watt resistor (brown-black-yellow) between BD3 (S-2) and BD1 (NS).

( ) Connect another 100 KΩ 1 watt resistor between BC1 (S-2) and BC3 (S-2).

( ) Prepare a 5 1/4" length of wire and connect one end to the lug marked ▲ on electrolytic capacitor BA (S-1). Leave the other end free.

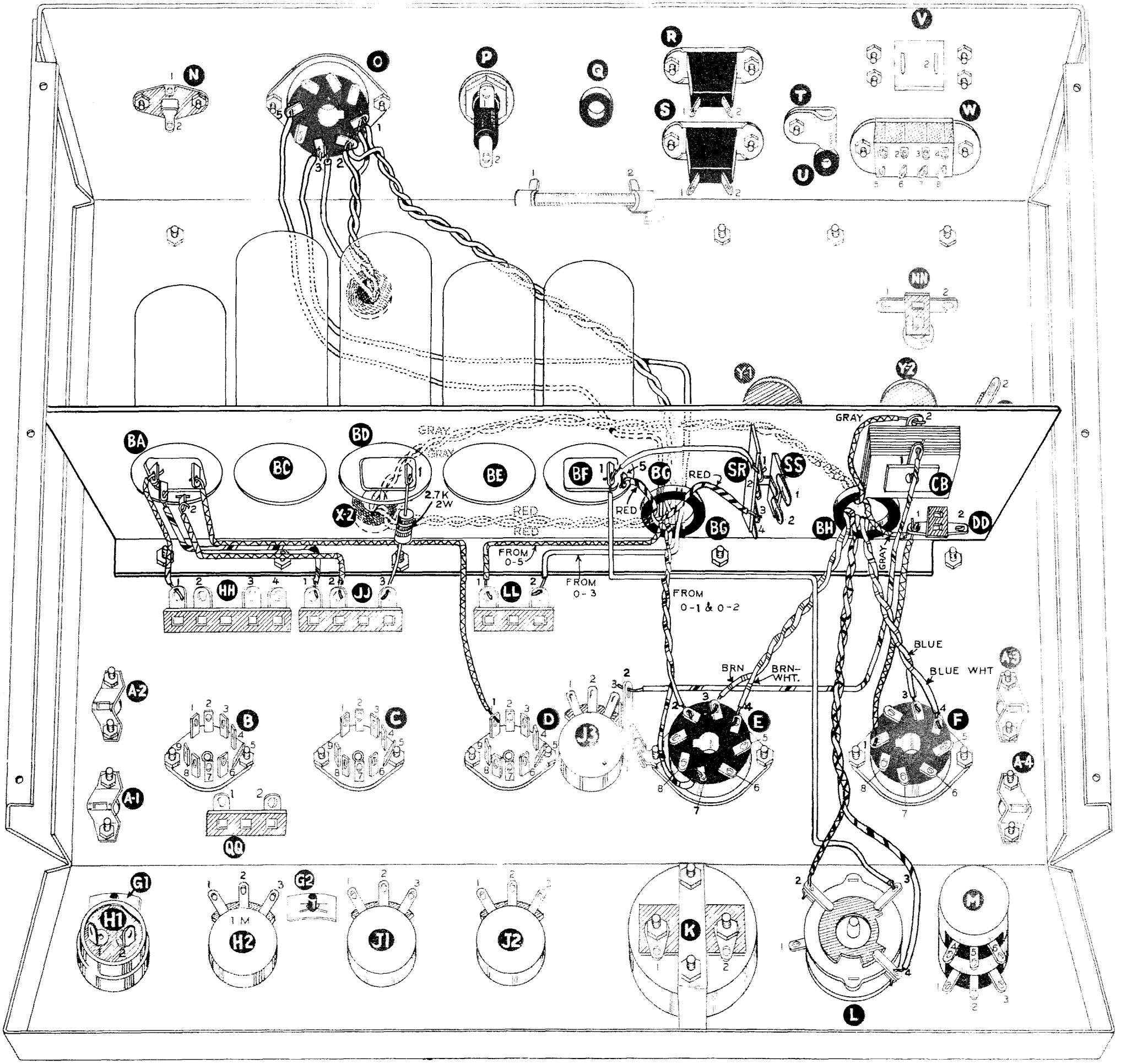
( ) Connect one end of a 4 1/4" length of wire to the lug marked ■ on the same electrolytic capacitor (S-1). Leave the other end free.

( ) Connect one end of an 8 3/4" length of wire to the lug marked ▲ on the same electrolytic capacitor (NS). Leave the other end free.

( ) Install a 12 KΩ 10 watt resistor from lug 1 of electrolytic capacitor BD (NS) to the ▲ lug of capacitor BA (S-2). Use sleeving on both resistor leads and position body of resistor flat against bracket.

( ) Connect one end of a 5 1/4" wire to BA2 (S-1). Leave the other end free.

This completes the prewiring of the power supply bracket assembly.


N
O
P
Q
R
S
T
U
V
W
NN
BA
BC
BD
BE
BF
BG
SR
SS
CB
BH
DD
X-Z
Y1
Y2
GRAY
RED
2.7K
2W
FROM
0-5
FROM
0-3
FROM
0-1 & 0-2
HH
JJ
LL
BRN
BRN-
WHT.
BLUE
BLUE WHT
A-2
A-1
A-4
B
C
D
J3
E
F
QQ
G1
G2
H1
H2
1 M
J1
J2
K
L
M

Pictorial 3

FINAL ASSEMBLY AND WIRING

( ) Remove the 8-32 screw and nut which were temporarily used to secure the front flange of the power transformer.

( ) Twist together the two red leads coming from grommet X2.

( ) Twist together the two gray leads coming from the same grommet. Dress all four leads toward the right hand end of the chassis.

( ) Refer to Pictorial 3 which shows the power supply bracket installed under the chassis. Dress all unconnected wires out of the way, and place the power supply bracket as shown. Secure with 8-32 hardware through the transformer flanges, chassis, and bracket flange.

( ) Pass the twisted red leads from the power transformer through grommet BG on the bracket. Connect either lead to SR3 (NS) and the other lead to BF5 (S-1).

( ) Pass the twisted gray leads from the power transformer through grommet BH on the bracket. Connect the longer gray lead to CB2 (S-1) and the shorter lead to DD1 (NS).

( ) Connect a 3 3/4" length of wire from DD1 (S-3) to F1 (S-3).

( ) Connect an 8" length of wire from CB1 (S-2) to EE2 (S-2). Dress close to chassis.

( ) Pass the twisted pair of wires coming from O1 and O2, through grommet BG. Connect either wire to E2 (S-3) and the other to E7 (S-3).

( ) Pass the wire coming from O5 through grommet BG. Connect to LL1 (S-3).

( ) Pass the wire from O3 through the same grommet and connect to LL2 (S-4).

( ) Connect the wire coming from the ■ lug of electrolytic capacitor BA to HH1 (S-4).

( ) Connect the wire from the ▬ lug of the same capacitor to JJ1 (S-4).

( ) Connect the wire from the ▲ lug of the same capacitor to D1 (S-2). Dress as shown and run under the .25 μfd capacitor.

( ) Connect the wire from twisted mounting lug 2 of the same capacitor, to JJ2 (S-4).

( ) Connect an 11 1/4" wire from BF1 (S-3) to lug 3 of switch L (S-2). Dress as shown.

( ) Twist together the red and red-yellow leads coming from hole Y2. Pass through grommet BH, and connect the red lead to L4 (S-2).

( ) Connect the red-yellow lead to L2 (S-1).

( ) Twist together the blue and blue-white leads also coming from hole Y2. Pass through grommet BH, and connect the blue lead to F3 (S-1).

( ) Connect the blue-white lead to F4 (S-1).

( ) Twist together the brown and brown-white leads coming from hole Y2. Pass through grommet BH and connect the brown lead to E3 (S-1).

( ) Connect the brown-white lead to E4 (S-1).

( ) Run a 2.7 KΩ 2 watt resistor (red-violet-red) between BD1 (S-4) and JJ3 (S-4).

( ) Carefully study Figure 15 before installing the four silicon rectifiers in terminal strips SR and SS.

NOTE: OBSERVE POLARITY IN ORDER TO AVOID POSSIBLE SERIOUS DAMAGE TO THE RECTIFIERS AND FILTER CAPACITORS.

See Figure 14A and cut the leads of each rectifier as shown. Wire each rectifier into its terminal after making sure in each case, that polarity is correct as follows:

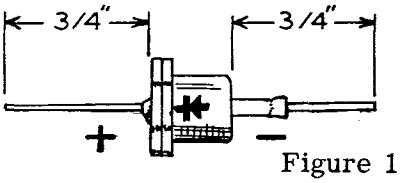


Figure 14A

( ) Select one of the four silicon rectifiers (refer to Figure 15) and connect the positive (+) lead to terminal strip SS2 (NS); the negative (-) lead should be connected to terminal strip SR4 (S-3). Apply only enough heat to make proper connection.

( ) In the same manner, connect another silicon rectifier with the positive (+) end to SR3 (S-3), the negative (-) end to SS2 (S-2).

( ) Select another silicon rectifier and connect the positive (+) end to SS1 (NS), the negative (-) end to SR2 (S-2).

( ) Connect the last silicon rectifier with the positive (+) end to SR1 (S-2), the negative (-) end to SS1 (S-2).

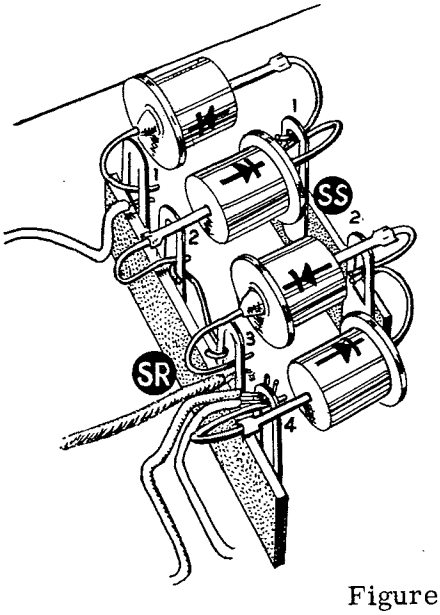


Figure 15

This completes the wiring of your amplifier. At this point carefully go over your work. Check to make sure all connections are securely soldered, and that there are no short circuits between adjacent terminal lugs due to stray drops of solder, wire clippings, etc. Finally, turn chassis right side up and shake out all foreign particles.

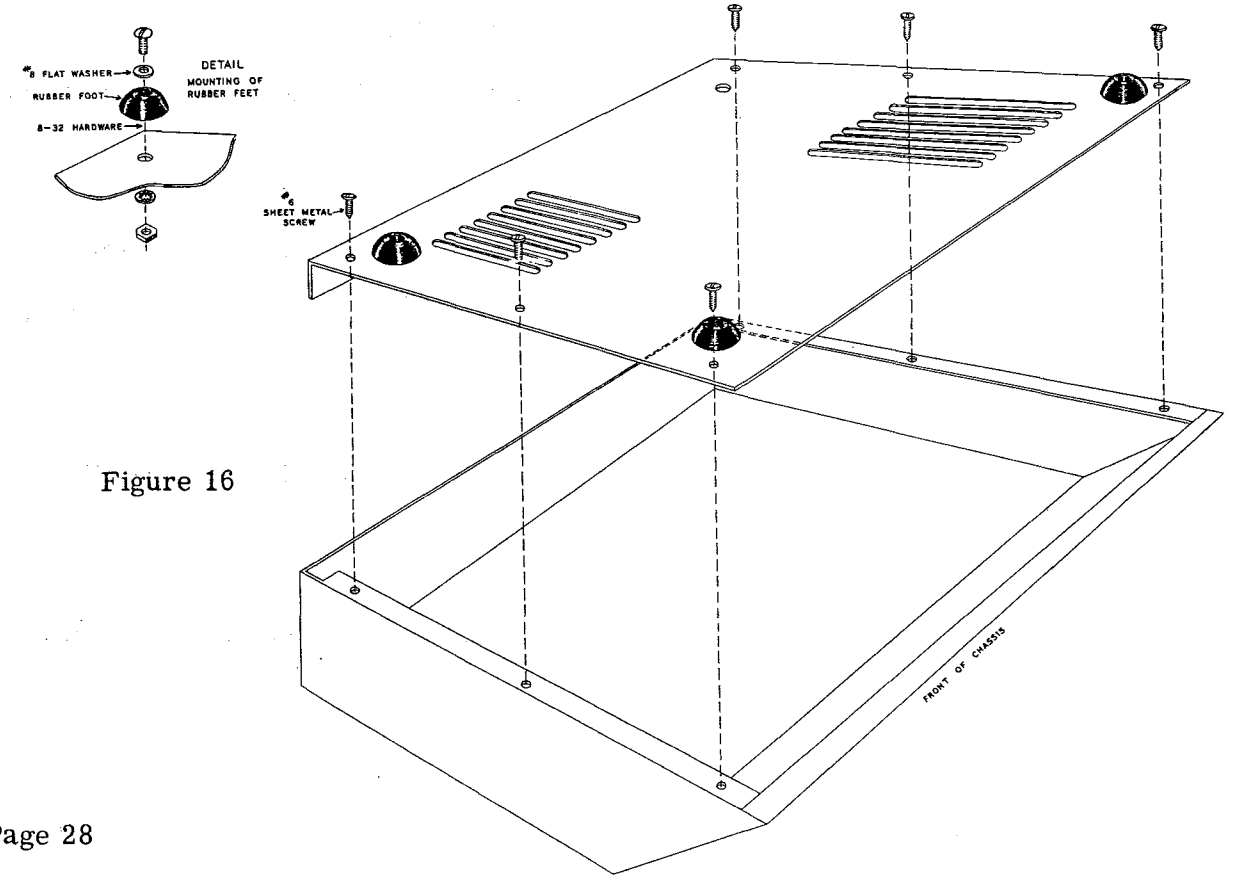
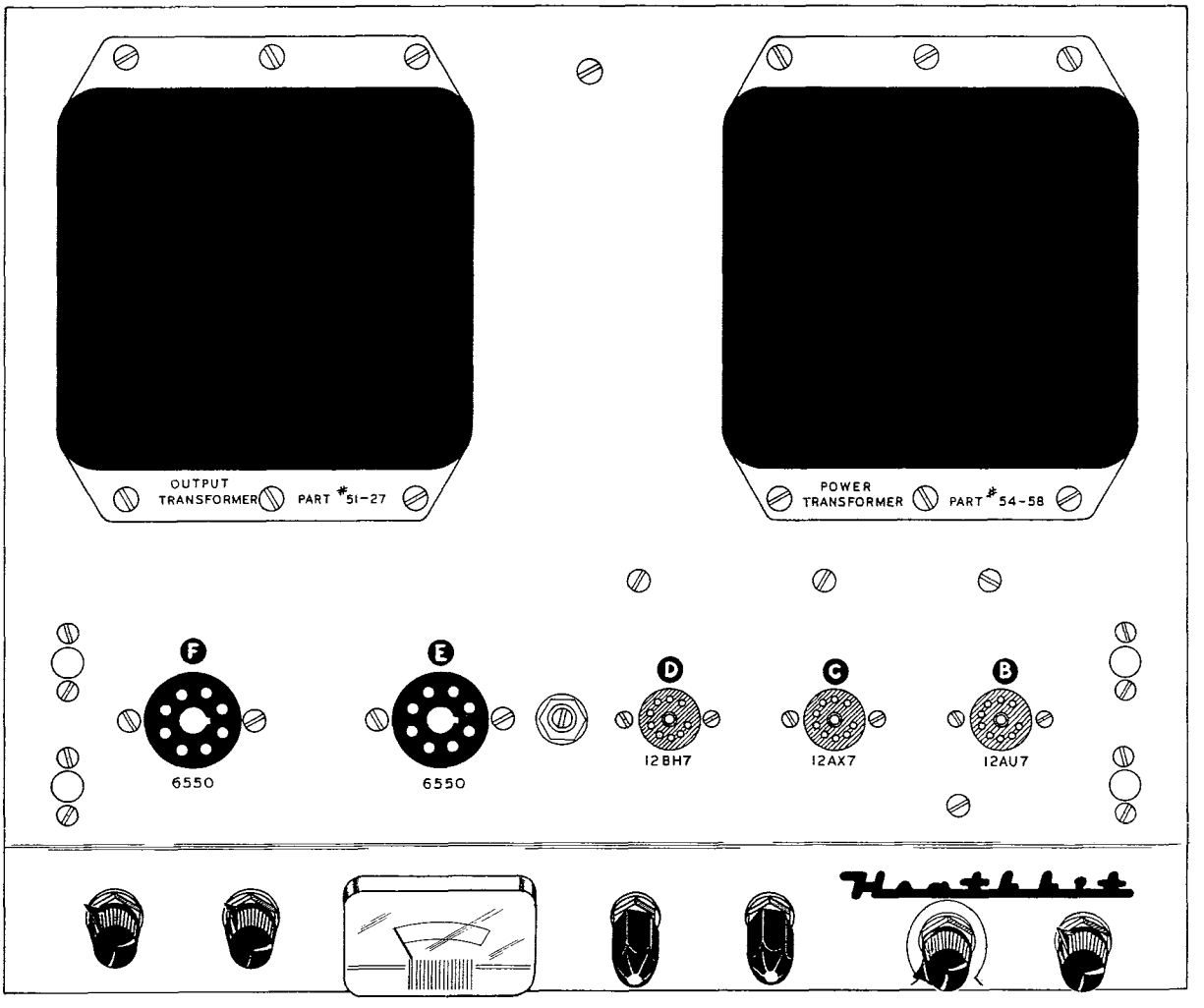


Figure 16

( ) Refer to the detail of Figure 16 and install rubber feet at the four corners of the bottom cover. Use 8-32 screws, flat washers, lockwashers, and nuts.

( ) Secure bottom cover on chassis, using six #6 sheet metal screws. The flange on the bottom cover goes toward the rear of the chassis.



Pictorial 4

IMPORTANT WARNING: TUBES CAN BE DAMAGED WHEN INSTALLING THEM IN THEIR SOCKETS. THEREFORE, USE EXTREME CARE WHEN INSTALLING TUBES AS WE DO NOT GUARANTEE OR REPLACE TUBES BROKEN DURING HANDLING OR INSTALLATION.

( ) Referring to Pictorial 4, install the tubes in their sockets.

Socket B -- Type 12AU7
Socket C -- Type 12AX7
Socket D -- Type 12BH7
Socket E -- Type 6550
Socket F -- Type 6550

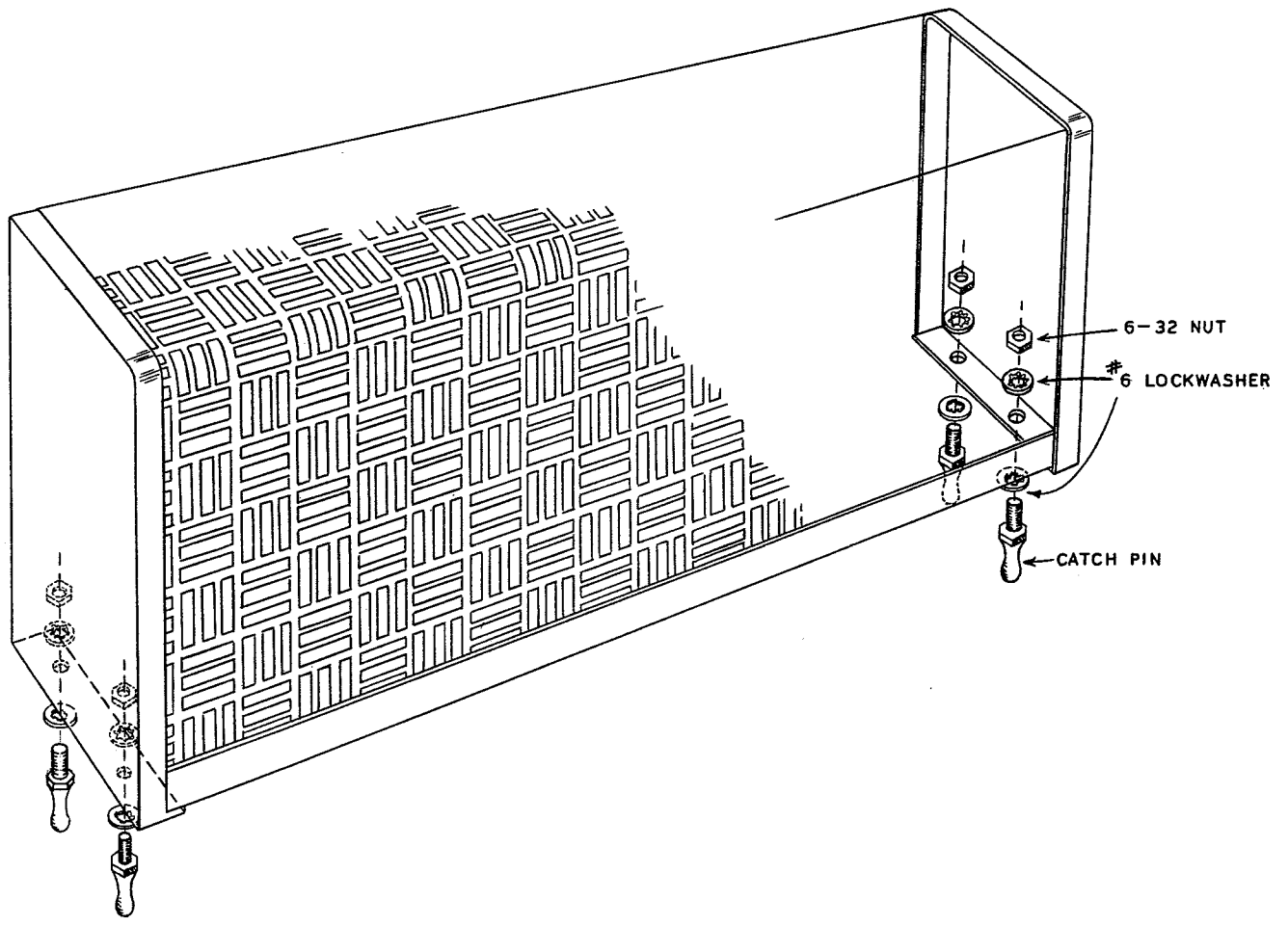


Figure 17

( ) Prepare the tube cage, by installing the four catch pins on the end flanges. See Figure 17. Install the tube cage atop the chassis over the five tubes. Secure by pressing down firmly, to engage the pins in the four catch clips.

( ) Install the knob on the damping factor control. Orient knob on shaft so that knob pointer is at 10 when control is in the full clockwise position.

( ) Install a pointer knob on the meter switch. Orient so knob pointer is at OFF when switch is fully counterclockwise.

( ) Turn the level adjust control fully counterclockwise and align pointer with the slanted line to the left. The long bushing on the level control makes the knob stick out quite far.

( ) Install the last pointer knob on the ON-OFF switch. Orient knob on shaft so that knob pointer is at OFF when switch is fully counterclockwise.

This completes construction of the amplifier.

IMPORTANT

If the HEATHKIT WA-P2 Preamplifier is to be used, please refer to the notice on Page 37.

Any preamplifier requiring a separate power supply can be used with the W-6A Amplifier providing the AC and DC current drain does not exceed the ratings listed in the chart below. An adapter can be wired to supply the following voltages on a 6 or 8 conductor cable:

Pin 1 -- One side of filament circuit, 6.3 volts at 1.0 amp AC.
Pin 2 -- Other side of filament circuit.
Pin 3 -- Negative plate supply.
Pin 4 -- No connection.
Pin 5 -- Positive plate supply, approximately 300 V at 10 ma DC.
Pin 6 -- AC switch terminal.
Pin 7 -- AC switch terminal.
Pin 8 -- AC line terminal.

PRELIMINARY TEST AND ADJUSTMENT

( ) Turn METER switch to OFF.

( ) Turn BIAS ADJUST controls to their maximum counterclockwise position.

( ) Turn BIAS RANGE control on top of chassis, to maximum counterclockwise position.

CAUTION: DO NOT CONNECT THIS AMPLIFIER TO A DC (DIRECT CURRENT) LINE. SERIOUS DAMAGE TO THE POWER TRANSFORMER WILL RESULT. Do not attempt to operate the amplifier from a 25 cycle source for it will not operate and the transformer will be damaged.

( ) Plug power cord into a 117 volt AC 50-60 cycle source and turn power switch ON. The filaments of all tubes should glow; if a preamplifier is powered by the W-6A main amplifier, the tube filaments of the preamplifier should also be lit. If the filaments fail to light, check the steps outlined under IN CASE OF DIFFICULTY.

( ) Let the amplifier warm up for about one minute, then place METER switch in position 1. The meter should read below the red line. Turn #1 BIAS ADJUST control in a clockwise direction until the meter reads to the red line. Should the meter read off scale and the bias control have little or no effect, turn the amplifier OFF immediately and refer to the IN CASE OF DIFFICULTY section.

( ) Turn METER switch to position 2 and adjust the #2 BIAS ADJUST control until meter reads to red line.

( ) If the meter reads above the red line, either on position 1 or position 2 or both, turn the bias range control clockwise until the meter reads below the red line on both positions. In any case, do not let the meter read more than 1/16" above the red line.

( ) Repeat the above adjustments until the meter reads exactly to the red line in both positions of the METER switch. Under this condition, the output tubes are balanced. Return METER switch to OFF. Screw the three black Bakelite cap nuts on the threaded bushings of the BIAS ADJUST controls and the bias range control.

NOTE: This adjustment should be repeated after 2 to 4 hours of operation, after the output tubes have stabilized to their final values of plate current. No further adjustment should be required. It might be well, however, to check the adjustment occasionally, due to possible variations in tube aging effects. It is important that no input signal be applied when checking this adjustment; the DC component of plate current which occurs with signal would result in a high meter reading. Such a reading would be invalid and meaningless for purposes of adjustment. The meter switch should always be returned to the OFF position, as the meter movement could be damaged by heavy low frequency passages and transients which frequently occur in program material.

CAUTION: A wiring error or defective component in the W-6A could possibly result in a high level of hum or oscillation at the output; conceivably, of sufficient power to damage a speaker. This is the reason for the earlier statement, at the beginning of this section, that the speaker was not to be connected when the amplifier was first turned on. However, a dangerously high level of hum or oscillation would make it impossible to adjust for correct plate current, as described above. As a further precaution, the speaker should be connected to the amplifier with the load selector plug not inserted in its receptacle. Finally, (with the amplifier operating) momentarily insert the load selector plug in the proper position, depending upon the rated impedance of the speaker. If no hum or oscillation is heard in the speaker, then it is safe to leave the plug inserted.

In order never to subject the speaker to excessive power, it is important to turn the W-6A Amplifier OFF or turn the LEVEL control all the way counterclockwise.

This completes the assembly and adjustment of your HEATHKIT W-6A Amplifier. See Page 33 for INSTALLATION AND OPERATION.

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 are defective 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 tube locations to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.

4. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagram and as called out in the wiring instructions.

5. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring beneath the chassis.

6. 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.

7. A review of the circuit description and block diagrams will prove helpful in indicating where to look for trouble.

If voltages and tubes are normal, try the following procedure:

With the input signal disconnected from the amplifier and the LEVEL ADJUST control fully clockwise, touch terminal lug 5 of tube socket F with one lead of a .01 μfd capacitor, holding the other lead with your hand. CAUTION: Do not touch the chassis or any other metallic body with your other hand while making this test. Dangerously high voltage is present throughout the circuit and due care should be exercised. This should cause a hum level to be evident in the speaker, if the circuit from this point is normal. Work on forward in the circuit, touching terminals E5, D2, D7, C1, C6, C2, C7, B1, B3, B2, B7, QQ1, and N2. The hum level should increase somewhat as you work back toward the amplifier input. At some point in the amplifier, the circuit will appear to be dead and all circuitry following that stage may be disregarded in your troubleshooting. In this way, you can easily locate the source of the trouble and expedite its correction.

UNUSUAL TROUBLES AND CORRECTIVE PROCEDURES

Output tubes will not balance. This condition could be caused by a defective 12BH7 tube, a seriously unbalanced pair of 6550 tubes, a defective resistor in grid or cathode circuit of the 12BH7 or a leaky .25 μf coupling capacitor.

Plate current meter reads off-scale. This would be caused by insufficient bias voltage, due to defective selenium rectifier (CB) or the 20 μfd 350 V electrolytic capacitor in the bias supply.

Also, the 10 KΩ 10 watt or the 4.7 KΩ 2 watt resistor in the control circuit may be open or off-value. The condition could also stem from low-level parasitic oscillation of the output stage; the wires to pin 5 of sockets E and F should be dressed close to the chassis, and be no longer than necessary. The output transformer leads connecting to pins 3 and 4 of sockets E and F should also be as short as possible, and dressed close to chassis.

Meter reads low. This could result from insufficient plate supply voltage due to a defective electrolytic capacitor. silicon rectifier, or reversed polarity of one of the silicon rectifiers. If the voltage is normal, one of the resistors in the control circuit (referred to above) may be defective.

Hum may be caused by a open electrolytic (filter) capacitor, improper ground connections in the amplifier, incorrect dress of filament wires at the 12AU7 and 12AX7 tubes, or a heater-cathode short in one of the miniature tubes. When wired according to the instructions, there is only one ground connection to the chassis, at input jack terminal N-1. Any other point of contact between ground and chassis will produce a "ground loop", and will definitely raise the hum level of the amplifier.

Noise in the amplifier can usually be traced to a defective resistor or faulty tube. The troublesome point can be located quickly by removing tubes one at a time, starting with the 12AU7, then the 12AX7, etc. When a point is found where the noise dissappears, the troublesome stage has been isolated, and a replacement tube should be tried. If this fails to help, one of the resistors is probably noisy or a poor connection exists somewhere in the circuit. Noisy resistors can be located by shorting out resistances connected to tube socket B, then proceeding to sockets C and D. (CAUTION: Do not short the 10 KΩ 10 watt resistors connected to lugs 3 and 8 of socket D.) In following this procedure, short out the resistor in question, not between one end of the resistor and ground. The first point at which the noise disappears isolates the defective component.

CAUTION: In making these checks, observe due caution at all times. Dangerously high voltages are present throughout the circuit.

INSTALLATION AND OPERATION

The amplifier should be located where it is protected from dampness, where it is readily accessible, and where adequate ventilation is assured. An inch or so of space should be provided above the tube cage.

Use shielded cable, terminated in a standard phono plug, for connecting the preamplifier output to the W-6A. Full instructions for preparation of this cable are included with the HEATHKIT WA-P2 Preamplifier kit. Brief instructions are included here, should other equipment be used.

Follow Figure 18 to connect the phono plug to shielded cable which has a spirally wrapped shield. Certain cables are furnished with braided shields; in such cases, unbraid the shield using a sharp pick or scribe, until sufficient conductor is available for connecting to the plug shell.

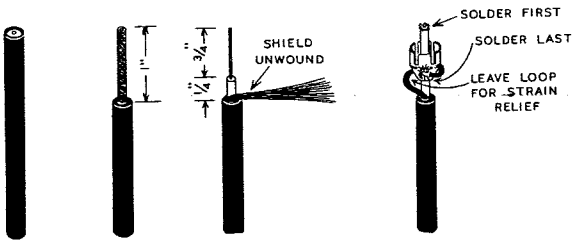


Figure 18

OUTPUT (SPEAKER) CONNECTIONS

A speaker system rated at 4, 8, or 16 ohms or a "70 volt" speaker line, connected to the OUTPUT terminals, will be correctly matched to the amplifier by inserting the flat, 2-prong plug into the appropriate pair of contacts on the LOAD SELECTOR connector. The 70 volt line output will find application in multiple-speaker music distribution systems. For information on the use of 70 volt output, see Page 38.

DAMPING FACTOR CONTROL

"Damping Factor" is defined as the ratio of load resistance to the internal resistance of the amplifier. In other words, if the internal resistance of the amplifier is small in comparison with the load resistance (speaker impedance), the damping factor is high, and vice-versa. The term "damping" arises from the fact that cone resonance effects are controlled, or "damped" by the internal resistance of the amplifier, which is effectively in parallel with the speaker voice coil. The lower this internal resistance, the greater the degree of damping or in other words, the higher the damping factor.

It has been found that speaker systems which inherently have a high degree of acoustical damping may be overdamped when used with an amplifier having a high damping factor, with a resulting loss of bass efficiency.

On the other hand, too low a damping factor will result in boomy or "one-note" bass, which is undesirable.

The range of the damping factor control in the W-6A is sufficient for optimum damping of any conceivable speaker system. The proper setting is highly dependent upon the characteristics of the speaker in its enclosure and to some extent, upon the acoustical properties of the room. The adjustment should be made for the best and most clearly-defined bass response. Where an optimum value of damping factor is recommended by the speaker manufacturer, this should be followed. (A damping factor or unity is recommended for the HEATHKIT Model HH-1 Speaker System.)

NOTE: The variable-damping feature is not intended to operate when the 70 volt line output is used. The control should be left in the maximum clockwise position when using this output tap.

GROUND LOOPS IN AUDIO CABLES

Under most conditions, lower overall hum will result if the shield on the input cable is grounded to the shell at both ends. Be sure to see the IMPORTANT NOTICE on Page 37. If hum is objectionable under operating conditions, experiment by ungrounding one end of the cable. Occasionally, hum will develop because of ground loops between a phono pickup and the preamplifier or between other program sources and the preamplifier. Try disconnecting each input to the preamplifier in turn until the hum level drops. Then experiment by opening the ground return at each end of the cable for that particular source. As a last resort try an in-

dependent ground conductor from each program source to a ground point, with a short heavy conductor from this point to virtual earth ground, such as a cold water pipe. Independent grounds from the preamplifier chassis and the power amplifier chassis may also help. This procedure should rarely be necessary and is mentioned only as a desperate measure. If required, an earnest investigation of the program sources is in order; leakage from their power circuits to ground is indicated. Self-powered preamps must be grounded to the W-6A chassis with a grounding wire or through the audio cable shielding.

USE OF AC OUTLETS

Two AC outlets are provided on the rear chassis apron. The one marked AC NORMAL is not controlled by the switching circuit. The one marked AC SWITCHED is controlled. Neither of these outlets is fused.

We suggest that the AC NORMAL outlet be used for record changers equipped with automatic shut-off switches or other accessories for which independent switching is desired. The AC SWITCHED outlet will be convenient for tuners, tape recorders, etc. CAUTION: Do not use the switched outlet for powering professional type turntables. These units are equipped with interlocking mechanisms to lift idler pulleys from capstans and table rims when they are turned off. If the turntable switch is not used, the idlers will not be lifted and may become deformed.

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 the purpose of providing Heath customers with a personalized technical consultation service; this service is available to you without charge. The technical consultants are thoroughly familiar with all details of the instrument and can usually localize the trouble from a suitable description of the difficulty encountered. It is, of course, necessary that you provide full and complete information concerning your problem when writing to the Technical Consultation Department for assistance. For instance, clearly identify the kit involved, giving the purchase date and, if possible, the invoice number; describe in detail the difficulty that you have encountered; state what you have attempted to do to rectify the trouble, what results have been achieved, and include any information or clues that you feel could possibly be of value to the consultant who handles your problem. Failure to provide complete descriptive details may lead to incorrect assumptions on the part of the consultant and needless delay in the solution to your problem. Quite frequently, when the information given the consultants is complete, concise and reliable, a diagnosis of the difficulty can be made with confidence and specific instructions given for its correction. If replacement of a component is involved in the correction, the component will be shipped to you, subject to the terms and conditions 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 W-6A to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a fixed fee of $8.00, plus the price of any additional parts or material required. However, if the instrument is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase and give invoice number, if possible.

Local Service by Authorized HEATHKIT Dealers is also available 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 those listed in HEATHKIT manuals (for factory service), the amount of increase is usually offset by the transportation charges you will pay if you elect to return your kit to the Heath Company.

HEATHKIT dealers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company. It will be necessary that you verify the purchase date of your kit by presenting your copy of the Heath Company invoice to the authorized dealer involved.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if your local dealer assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, he may charge you 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.

THESE SERVICE POLICIES APPLY 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 the use of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modifications 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 outlet stores. Although the Heath Company welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for specific purposes. Therefore, such modifications must be made at the discretion of the kit builder, according to information which will be much more readily available from some local source.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper 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 the order number and 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. If tubes are to be returned, pack them carefully to prevent breakage in shipment. 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 W-6A must be returned for service, these instructions should be carefully followed.

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, INVOICE NUMBER ON WHICH THE KIT WAS PURCHASED, 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, Mich.

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 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. Your W-6A will be returned by express collect.

SPECIFICATION CHANGES

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.

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

IMPORTANT NOTICE

A minor wiring change has been made in the HEATHKIT WA-P2 Preamplifier to obtain the lowest possible hum and noise when used with the W-6A Amplifier. If the WA-P2 to be used was purchased prior to the first five months in 1957, it is recommended that the following change be made. If in doubt, refer to the Preamplifier manual to see which way it was wired. The modification is easily accomplished and requires no additional parts.

1. Identify the wire coming from lug GG of filter capacitor G. This wire passes through grommet J, and connects to lug 2 of terminal strip Y.

2. Disconnect this wire from lug 2 of terminal strip Y, and connect it to lug 1 of input socket LS. (This is the phono input socket.) Solder this connection securely.

3. When this change is made, the shield of the audio cable between the WA-P2 output and the W-6A input should be grounded to the connector shell at both ends.

70.7 Volt Amplifier Output

Most modern public address type audio amplifiers and many up-to-date high fidelity amplifiers have a constant voltage output rated at 70.7 volts. Usually, this is in addition to the standard outputs of 4, 8 and 16 ohms.

The basic purpose of the 70.7 volt output (commonly called 70 volt output) is identical to that of the other outputs. This purpose is, of course, to drive one or more speakers, however, the 70 volt output is characteristically different in that it facilitiates the use of a large number of speakers without the involved process of matching total speaker impedance to the amplifier output impedance.

In using several speakers with an amplifier whose output is designated in terms of impedance, it is necessary that the speakers be interconnected in series, parallel, or series-parallel so that the total, or resulting, speaker impedance matches one of the output impedance taps of the amplifier. This can involve making numerous Ohm's Law calculations. Also, the impedance of the available speakers is often such that they cannot be electrically arranged to both match one of the amplifier output impedance taps and satisfy the sound distribution requirements. These problems are easily solved by using an amplifier with a 70 volt output.

Proper matching between a 70 volt amplifier output and the speakers is accomplished with 70 volt line-to-voice coil transformers. The primary winding of a typical 70 volt line transformer will have several power taps. Any number of these transformers may be connected in parallel up to the point where the total power rating of the 70 volt transformers equals the power rating of the amplifier with which they are used. This reduces the necessary calculations to simple addition of the individual speaker power requirements.

The secondary winding of a 70 volt line transformer is usually tapped at 4, 8 and 16 ohms to match standard speakers.

An example of a commercial 70 volt speaker line application would be in an auditorium where four speakers are required, two for the audience, one in the lobby and one backstage. Assuming that a 70 watt amplifier is to be used and considering that the total power rating of the 70 volt line transformers should not exceed the power rating of the amplifier, the first step is to allocate sufficient power to the four speakers. This will depend on the desired volume levels and the acoustical qualities of each listening area. A reasonable allocation would be 24 watts for each auditorium speaker, 10 watts for the lobby speaker and 5 watts for the backstage speaker. In that a 70 watt amplifier is to be used, there will be a surplus of power over the total speaker requirement of 63 watts. This surplus can be used if an additional speaker is needed or if it is necessary to increase the power to one of the first four speakers.

A suitable electrical arrangement for this sound distribution system, using standard components. is shown in the following diagram.

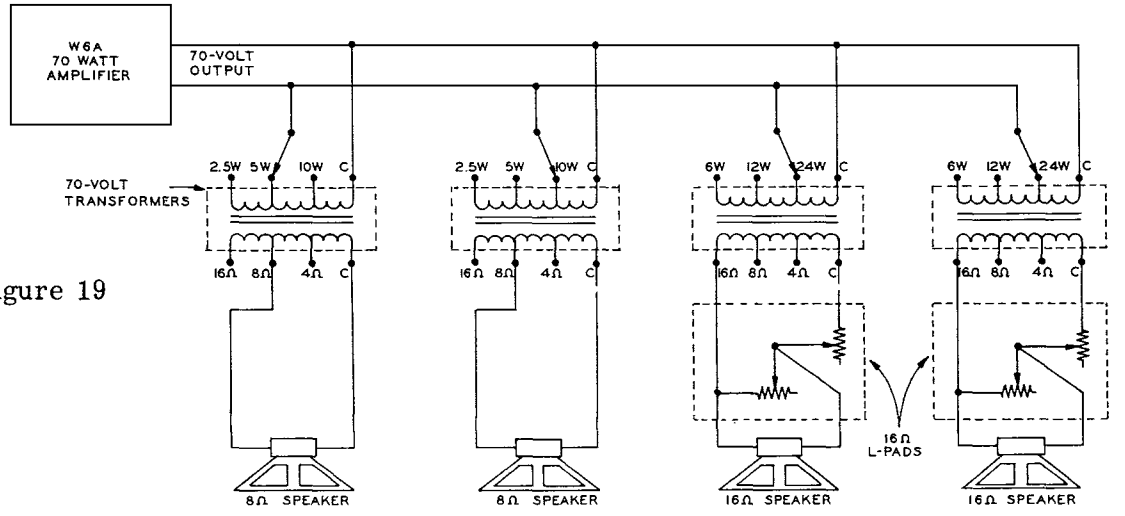


Figure 19

Similar arrangements, using a 70 volt speaker line, would satisfy the requirements of a sound distribution system in an office building, church, business establishment, etc.

A suggested home application of the 70 volt speaker line is shown in Figure 20 below. The power allocation shown is flexible in that the volume level in any of the listening areas can be changed by resetting the L-pad control or by using a different power tap on the 70 volt transformer.

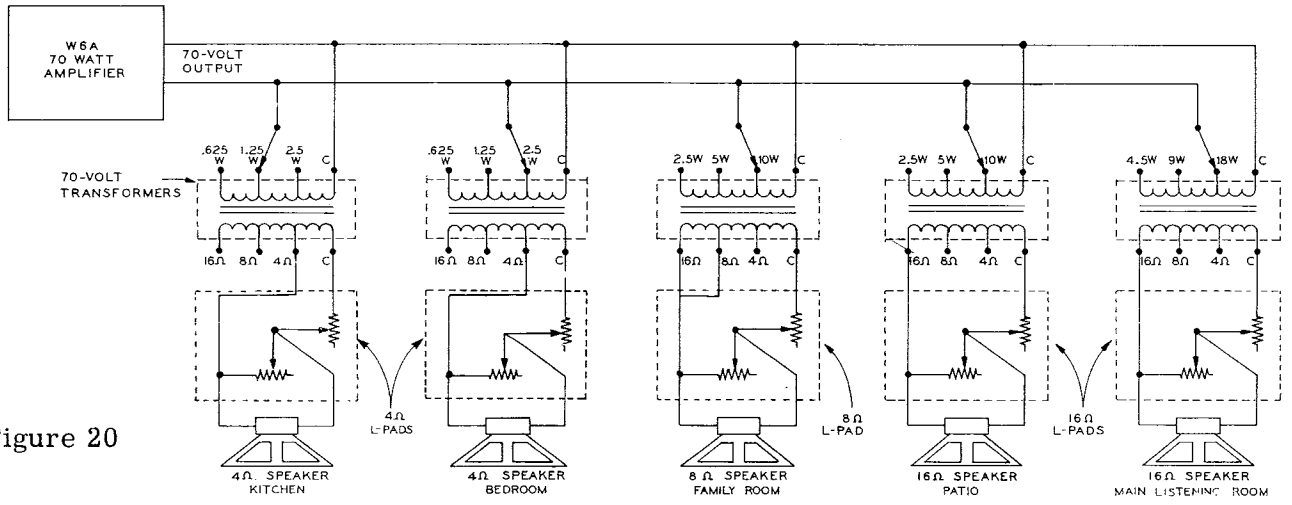


Figure 20

A 70 volt system is wired much the same as the 110 volt AC power system in the home. Only two wires are required from the amplifier which can be run to the various parts of the home in exactly the same manner as the 110 volt AC wires. For long runs, up to several hundred feet, #12 or larger wire should be used. For shorter runs, #14 or #16 wire is adequate.

Although open wires can be used, a better installation will result by using conduit and following recommended power wiring practices. Where practical, the 70 volt wiring should be run several feet from the 110 volt AC wiring to minimize the possibility of hum induction into the audio system.

The 70 volt line may be run into every room of the home and to desirable outside locations. The proper power taps of the 70 volt transformers may be connected directly to the 70 volt line, or outlet sockets could be connected to the 70 volt line. By using outlet sockets in several of the listening areas, it would be possible to move a single speaker and 70 volt transformer from one area to another as an economy measure.

NOTE: The outlet sockets should not be of the same type as those used for the 110 volt AC wiring to eliminate the possibility of plugging 110 volt AC appliances into the 70 volt speaker line.

A rough adjustment of volume is provided by the power taps on 70 volt transformers, however, it is sometimes desirable to have a finer adjustment of volume for a given listening area, in which case an L-pad speaker volume control may be wired between the secondary winding of the 70 volt transformer and the voice coil terminals of the speaker. The L-pad should be of the same impedance as the speaker.

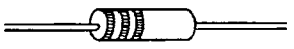
Most of the larger electronic equipment sources handle a variety of 70 volt transformers, L-pad controls and outlet sockets suitable for use with 70 volt speaker lines. As indicated above, the 70 volt transformer should be chosen on the basis of primary power rating and secondary impedance.

Obviously, all aspects of 70 volt speaker operation are not covered herein, however, the basic principles are explained and a few examples of the more popular applications are included. With this information it is possible to design, select equipment for, and install any reasonable 70 volt sound system.

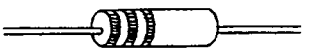
PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-7	1	680 Ω 1/2 watt
1-9	1	1000 Ω 1/2 watt
1-32	1	390 KΩ 1/2 watt
1-33	2	470 KΩ 1/2 watt
1-35	2	1 megohm 1/2 watt
1-105	3	10 KΩ 1/2 watt 5%
1-111	1	150 Ω 1/2 watt 5%
1A-7	1	47 KΩ 1 watt
1A-28	2	100 KΩ 1 watt
1A-28	2	100 KΩ 1 watt (matched)
1B-1	1	2.7 KΩ 2 watt
1B-2	1	4.7 KΩ 2 watt 10%
1B-4	1	15 KΩ 2 watt
1B-6	1	27 KΩ 2 watt
1B-15	1	1000 Ω 2 watt
1B-24	1	100 KΩ 2 watt
2A-36	2	22 KΩ 1 watt 1% precision
3E-8	1	.22 Ω 5 watt 5% wire-wound
3G-10	1	.11 Ω 7 watt 5% wire-wound
3G-11	1	.15 Ω 7 watt wire-wound
3J-7	3	10 KΩ 10 watt wire-wound
3J-13	1	12 KΩ 10 watt wire-wound
Capacitors		
20-35	1	910 μμf mica (.00091 μfd)
20-63	1	47 μμf mica (.000047 μfd)
23-2	2	.005 μfd 600 V tubular
23-24	2	.25 μfd 600 V tubular
25-16	1	20 μfd 350 V tubular electrolytic
25-50	2	150 μfd 300 V electrolytic
25-51	2	200 μfd 300 V electrolytic
25-52	1	40/20 μfd 350 V 40 μfd 450 V electrolytic
Wire-Sleeving		
89-1	1	Line cord
340-1	1	Length #14 solid copper tinned bare wire
343-3	1	Length shielded cable
344-1	1	Length hookup wire
346-1	1	Length insulating sleeving
346-4	1	Length braided insulating sleeving

PART No.	PARTS Per Kit	DESCRIPTION
Meter-Knobs		
252-20	3	Plastic cap nut
407-40	1	Meter
462-17	4	Pointer knob
Controls-Switches		
10-56	3	2000 Ω control
10-67	1	1 megohm linear control
12-10	1	300 Ω/10 Ω dual control
63-132	1	3-position rotary switch
63-171	1	ON-OFF switch
Chassis Parts		
90-58	1	Tube cage
100-M256F315-316	1	Chassis
204-M296	1	Condenser mounting bracke
205-M205	1	Bottom plate
391-2	1	HEATHKIT nameplate
Connectors-Insulators-Sockets		
73-1	1	3/8" rubber grommet
73-2	4	3/4" rubber grommet
73-4	1	3/16" rubber grommet
207-3	1	Plastic cable clamp
423-1	1	Fuse holder
431-1	3	1-lug terminal strip
431-2	4	2-lug terminal strip
431-3	1	3-lug terminal strip
431-5	2	4-lug terminal strip
431-30	1	2-contact terminal block
432-9	1	8-contact female connector
432-13	1	2-pin male connector
434-16	3	9-pin tube socket
434-20	2	117 volt power socket
434-42	1	Phono socket
434-58	3	Octal tube socket
481-3	5	Electrolytic capacitor mounting wafer
Surgistor-Rectifiers-Tubes-Fuse		
9-3	1	Surgistor (100-300 W)
57-16	1	Selenium rectifier
57-20	4	Silicon rectifier
411-25	1	12AU7 tube
411-26	1	12AX7 tube
411-73	1	12BH7 tube
411-102	2	6550 tube
421-6	1	3-ampere fuse (slow blow)

PART No.	PARTS Per Kit	DESCRIPTION
Transformers		
51-27	1	Output transformer
54-58	1	Power transformer
Hardware		
250-2	6	3-48 x 5/16" screw
250-8	6	#6 sheet metal screw
250-9	36	6-32 x 3/8" screw
250-18	16	8-32 x 3/8" screw
250-48	4	6-32 x 1/2" screw
250-49	2	3-48 x 1/4" pan head screw
250-52	8	4-40 x 1/4" pan head screw
250-79	1	6-32 x 1 1/4" screw
252-1	8	3-48 x 7/32" hex nut
252-2	8	4-40 x 1/4" hex nut
252-3	46	6-32 x 1/4" hex nut
252-4	16	8-32 x 3/8" hex nut
252-7	7	3/8" control nut
252-16	2	Speednut
253-9	4	#8 flat washer
253-10	7	Control washer
254-1	50	#6 lockwasher
254-2	16	#8 lockwasher
254-4	7	3/8" control lockwasher
254-7	2	#3 lockwasher
254-9	8	#4 lockwasher
260-11	4	Spring catch clip
261-6	4	Rubber feet
262-4	4	Spring catch pin
595-311	1	Manual

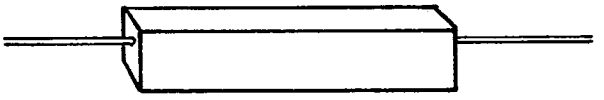


½ WATT RESISTOR

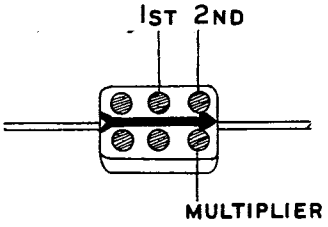


1 WATT RESISTOR

2 WATT RESISTOR



WIRE WOUND RESISTOR

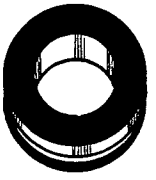


MICA CAPACITOR

GROMMETS

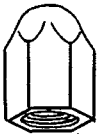
3/16

3/8

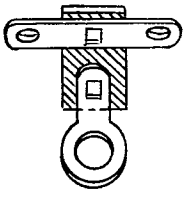


3/4

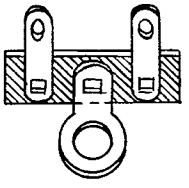
SPEED NUT



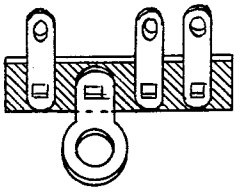
PLASTIC CAP NUT



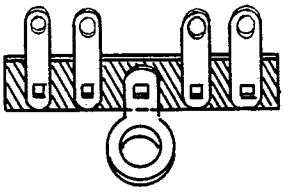
1-LUG TERMINAL STRIP



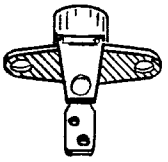
2-LUG TERMINAL STRIP



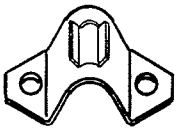
3-LUG TERMINAL STRIP



4-LUG TERMINAL STRIP

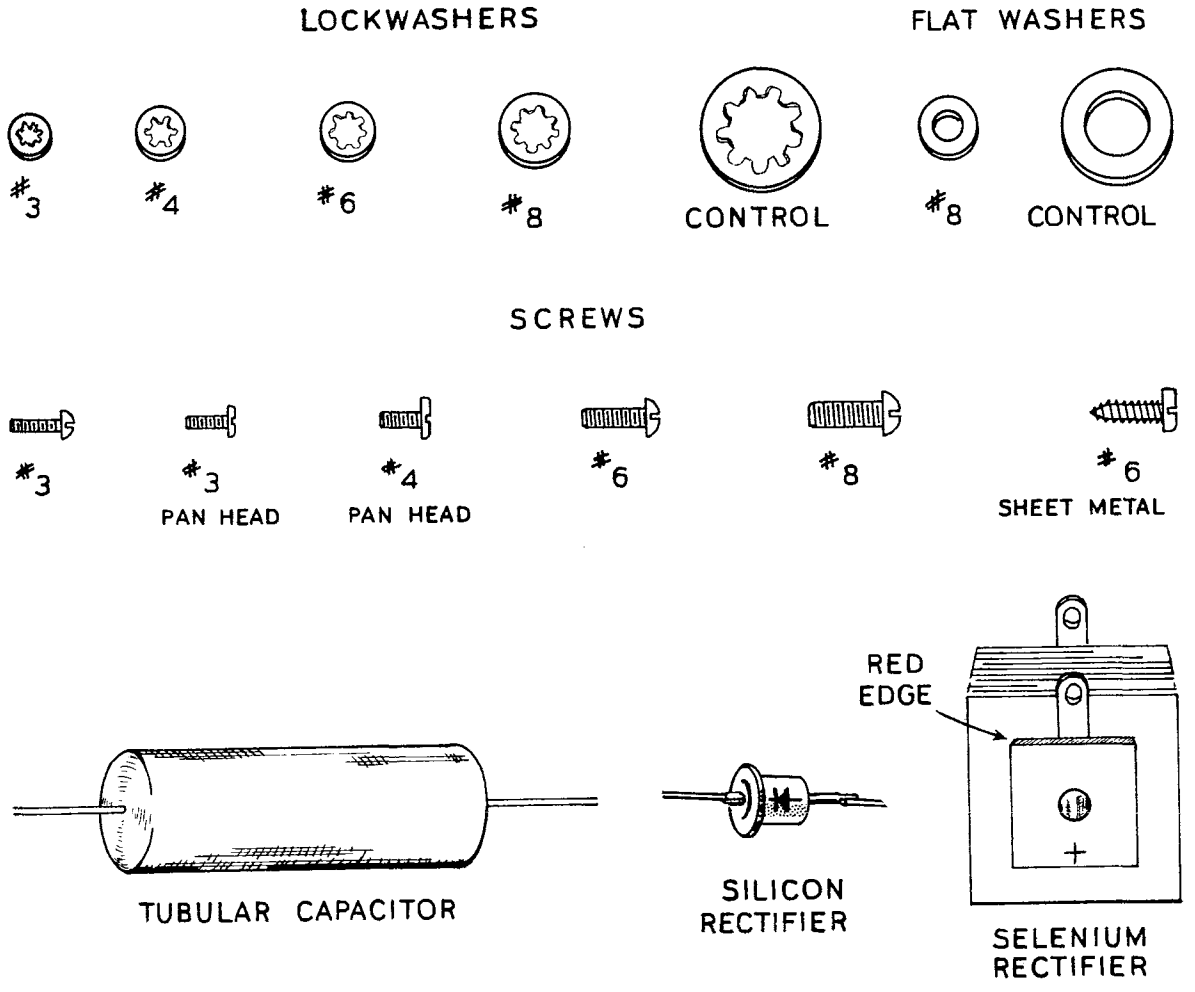


PHONO SOCKET



SPRING CATCH CLIP

SPRING CATCH PIN


LOCKWASHERS
FLAT WASHERS
#3
#4
#6
#8
CONTROL
#8
CONTROL
SCREWS
#3
#3
PAN HEAD
#4
PAN HEAD
#6
#8
#6
SHEET METAL
RED
EDGE
TUBULAR CAPACITOR
SILICON
RECTIFIER
SELENIUM
RECTIFIER

HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

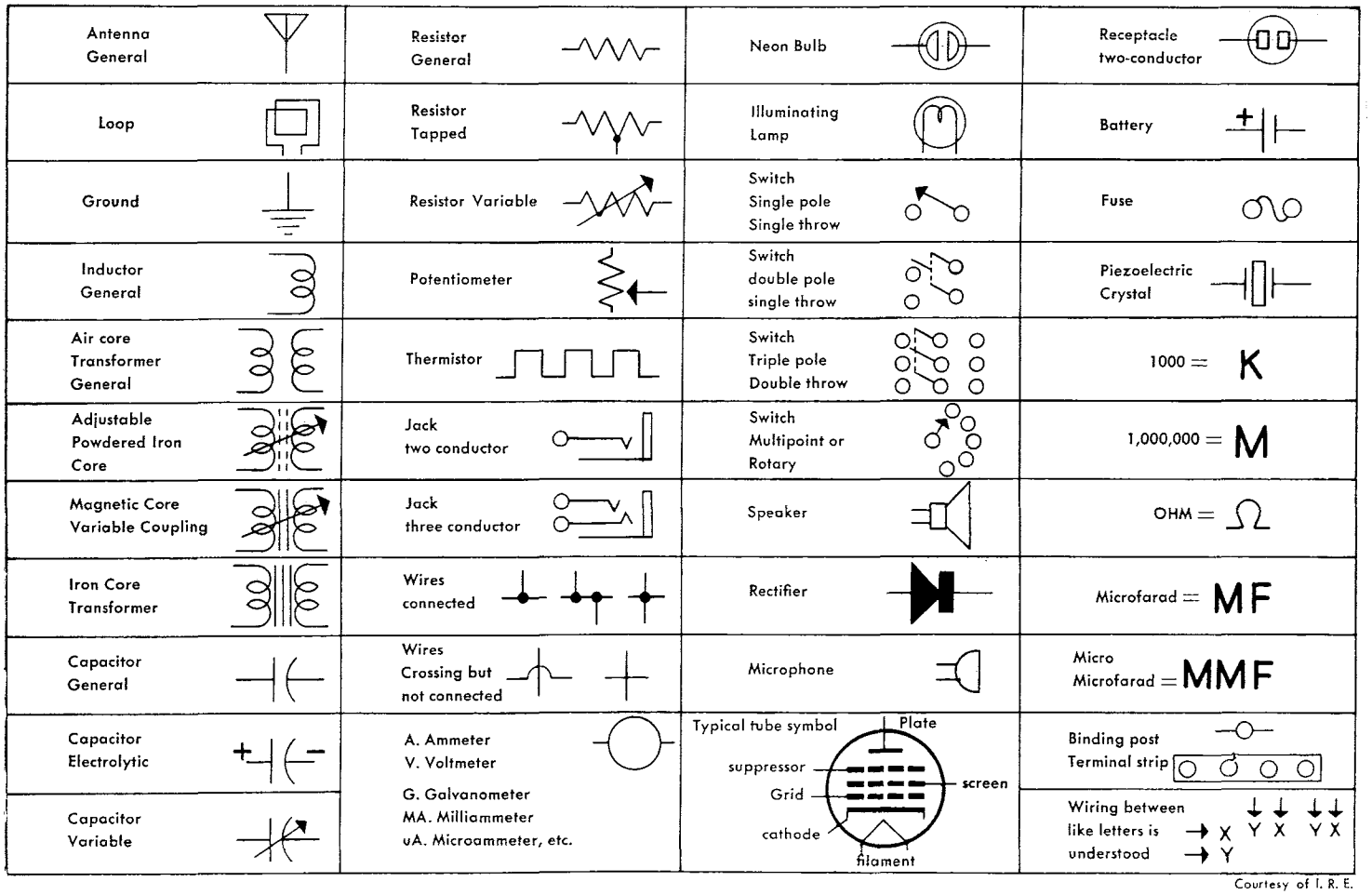
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.



Courtesy of I. R. E.

HEATH COMPANY

A Subsidiary of Daystrom Inc.

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

BENTON HARBOR, MICHIGAN

Litho in U. S. A.