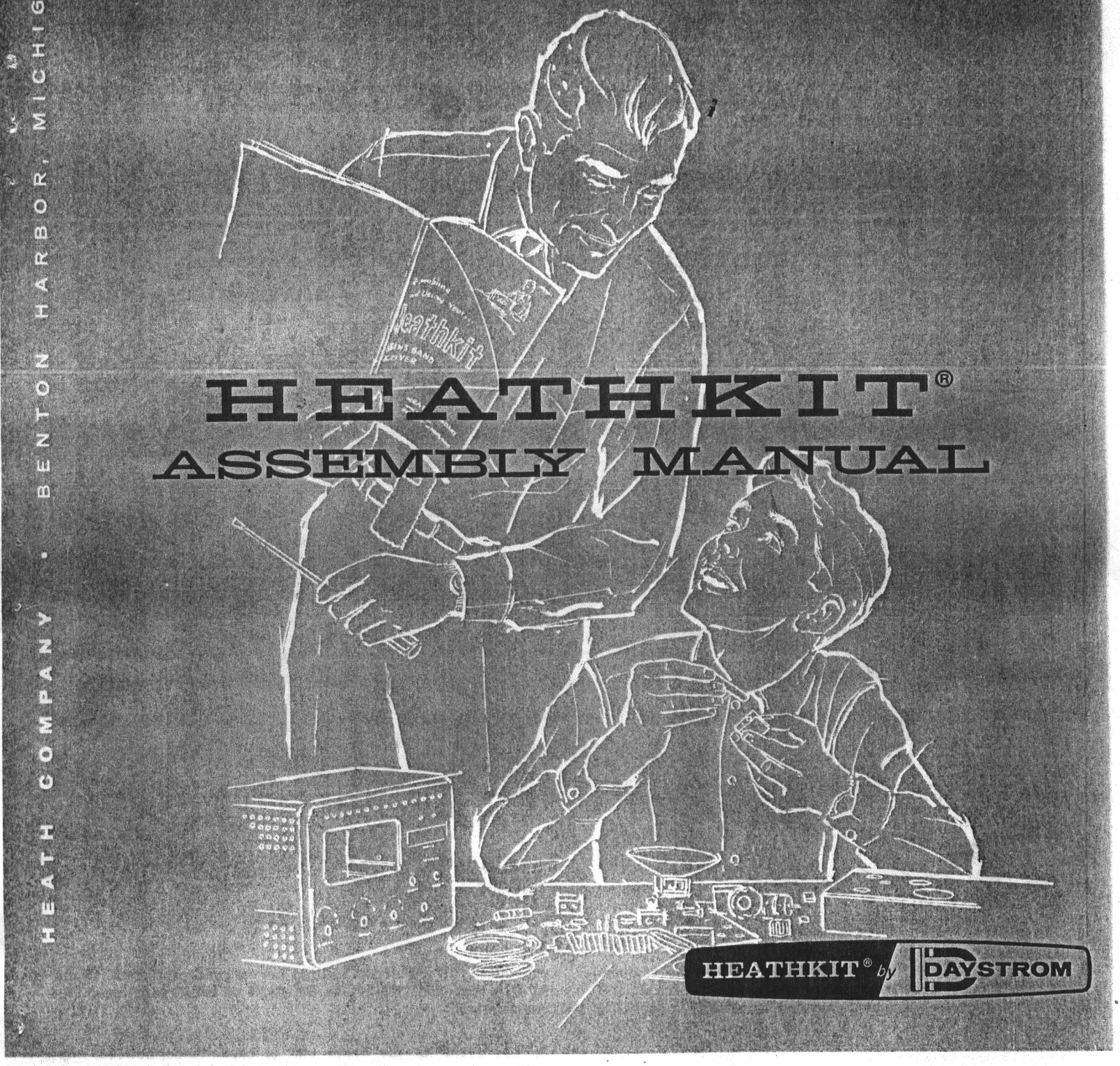
PRICE $2.00

HEATH COMPANY • BENTON HARBOR, MICHIGAN



HEATHKIT®
ASSEMBLY MANUAL

EDUCATIONAL ELECTRONIC ANALOG COMPUTER

MODEL EC-1

5 5

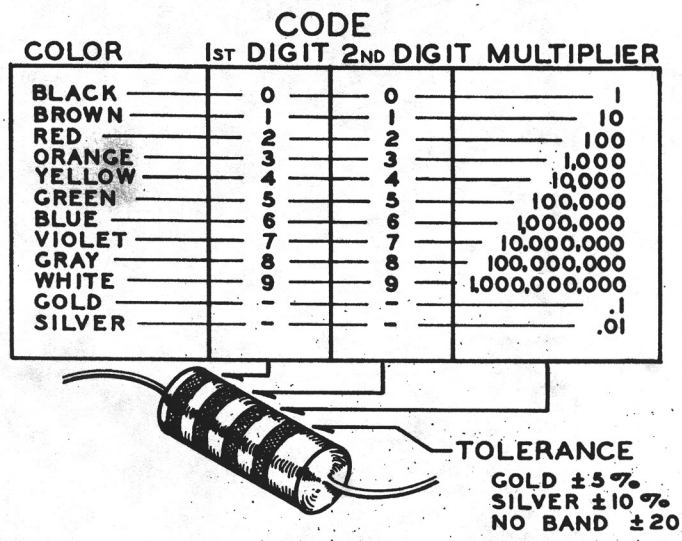
RESISTOR AND CAPACITOR COLOR CODES

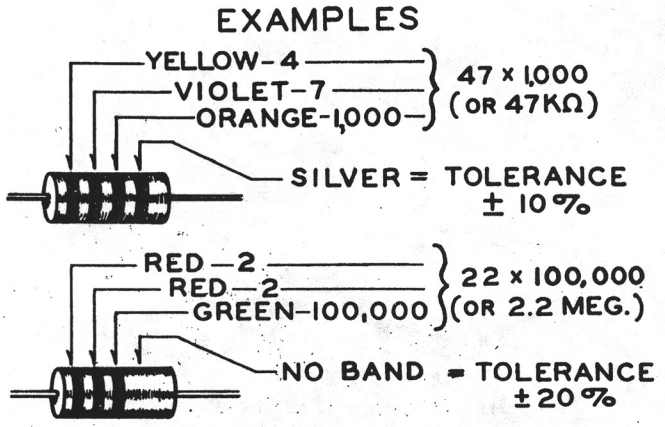
RESISTORS

The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

The physical size of a composition resistor is related to its wattage rating. Size increases progressively as the wattage rating is increased. The diameters of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

The color code chart and examples which follow provide the information required to identify color coded resistors.

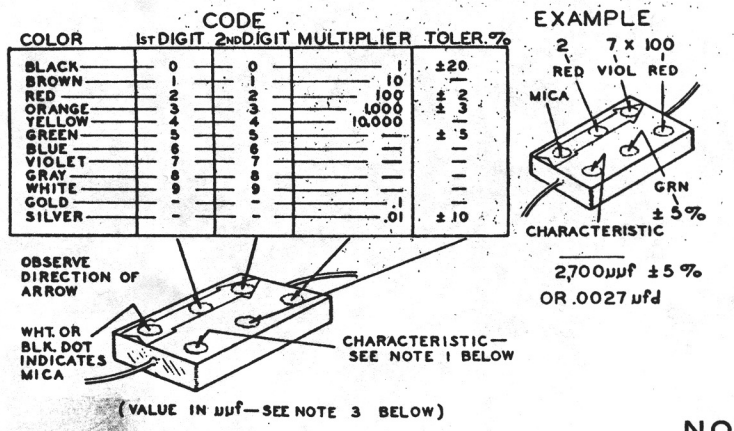




CAPACITORS

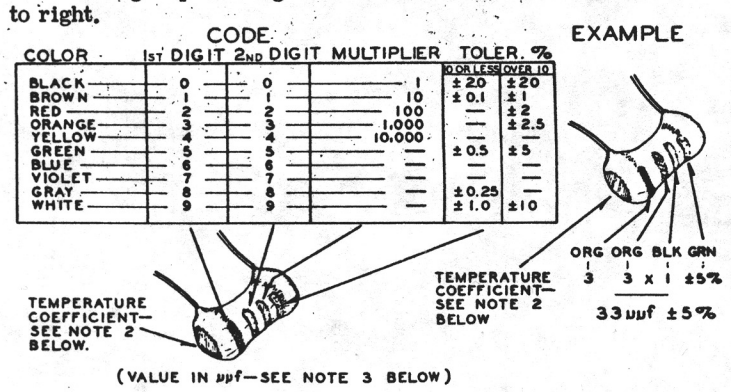
Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA



TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.



NOTES:

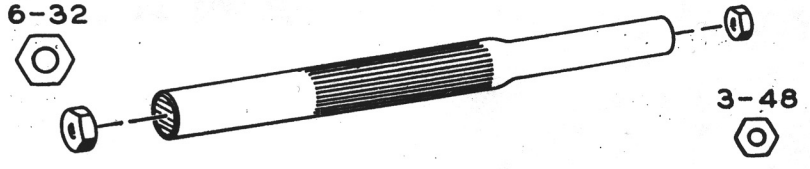
1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of μfd (microfarad, .000001 farad) and μμf (micro-micro-farad, .000001 μfd); therefore, 1,000 μμf = .001 μfd, 1,000,000 μμf = 1μfd.

USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.



INSTRUCTION MANUAL FOR THE ASSEMBLY OF THE HEATHKIT EDUCATIONAL ELECTRONIC ANALOG COMPUTER

MODEL EC-1

Power Requirements:	105-125 volts: 50-60 cycles 100 watts
Dimensions:	19 5/8" wide x 11 1/2" high x 15" deep
Net Weight:	37 1/2 lbs.
Shipping Weight:	43 lbs.

2/22/63

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. While the arrangement shown is probably not the only satisfactory arrangement, nevertheless it is the result of extensive experimentation and trial. If followed carefully, it will result in a stable instrument, operating at a high degree of accuracy and 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.

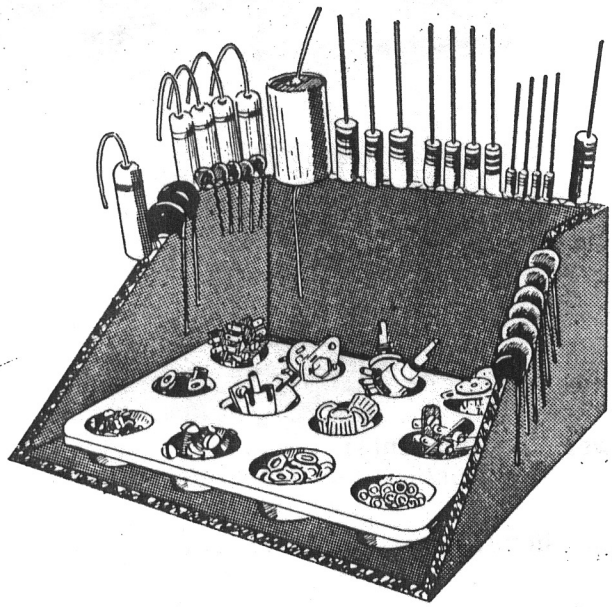
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the charts and other information on the inside covers of your manual to help you identify the components. If some shortage or parts damage is found in checking the Parts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

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

Tube manufacturers occasionally add letter suffixes to tube numbers for various reasons. The EC-1 will operate equally well with tubes which do or do not have such suffixes.

For convenience, the Parts List has been divided into two sections: Construction Components and Problem Solving Components. The latter components are not used in the assembly of the Computer, but for the solving of problems after the Computer is assembled.

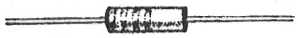
Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends placed in the edge of a piece of corrugated cardboard until they are needed.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



To aid in the identification of parts, drawings of some of the parts are shown opposite the part description.

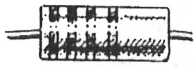
CONSTRUCTION COMPONENT PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Composition Resistors		
1-10	1	1200Ω 1/2 watt
1-69	10	18 KΩ 1/2 watt
1-26	2	100 KΩ 1/2 watt
1-30	1	270 KΩ 1/2 watt
1-33	1	470 KΩ 1/2 watt
1-34	9	680 KΩ 1/2 watt
1-35	1	1 meg 1/2 watt
1-37	10	2.2 meg 1/2 watt
1-40	9	10 meg 1/2 watt
1A-24	1	4.7 KΩ 1 watt
1A-28	9	100 KΩ 1 watt
1B-9	4	3.3 KΩ 2 watt
3G-14	1	2 KΩ 7 watt
3J-8	2	15 KΩ 10 watt
Precision Resistors		
2-145	1	19 KΩ 1%
2-54	1	200 KΩ 1 %
2-14	2	1 megohm 1%
2-55	1	2 megohm 1 %
2-17	1	10 megohm 1 %
Controls-Switches		
10-91	9	3 KΩ linear, screwdriver adjust
10-12	8	100 KΩ linear
10-14	1	250 KΩ linear
10-94	1	7.5 megohm linear
60-3	9	DPDT slide switch
61-9	2	SPST toggle switch with hardware
63-190	1	3-position rotary switch
63-191	1	4-position rotary switch
63-192	1	12-position, 2-deck rotary switch
Capacitors		
21-21	9	200 μμf 500 volt ceramic
23-3	1	0.01 μfd 400 volt plastic tubular
23-59	2	0.05 μfd 200 volt plastic tubular
23-28	1	0.1 μfd 200 volt plastic tubular
23-56	1	0.5 μfd 200 volt plastic tubular
25-30	1	20-20 μfd 350 volt electrolytic
25-41	6	40 μfd 350 volt electrolytic

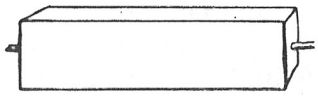


1/2 Watt Resistor

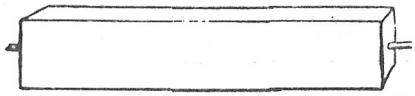
1 Watt Resistor



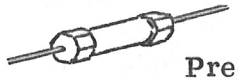
2 Watt Resistor



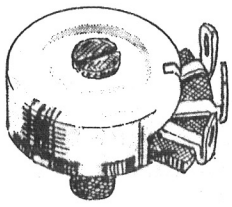
7 Watt Wire Wound Resistor



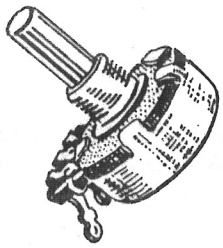
10 Watt Wire Wound Resistor



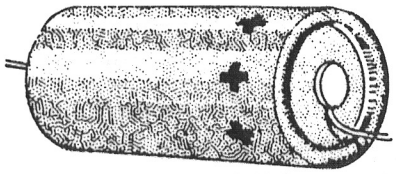
Precision Resistor



Linear Control Screwdriver Adjust



Linear Control

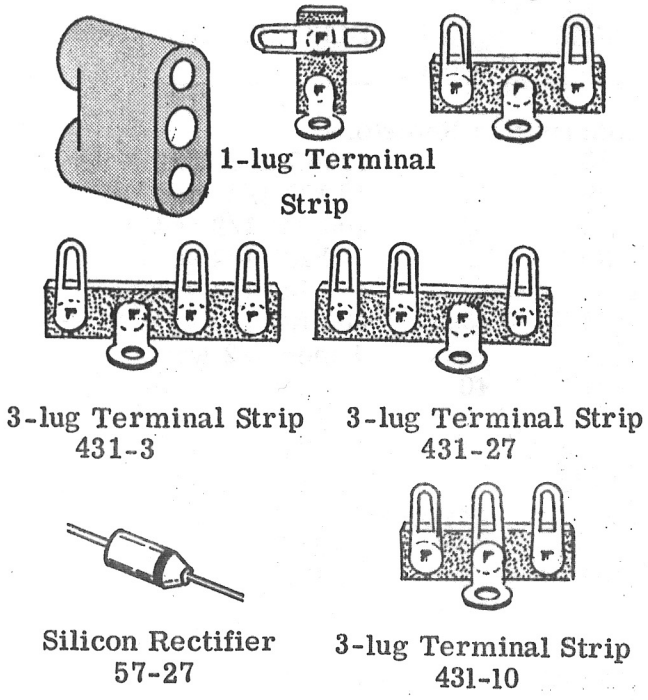


Tubular Electrolytic Capacitor

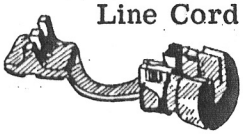
Plastic Molded Paper Capacitor

Ceramic Capacitor

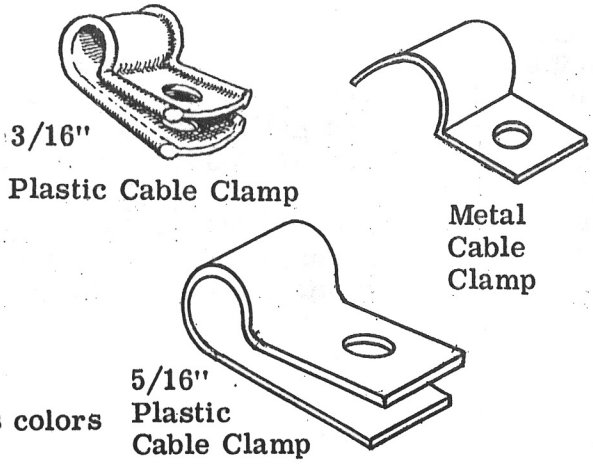
PART No.	PARTS Per Kit	DESCRIPTION
Sockets-Terminal Strips-Knobs		
434-15	7	7-pin miniature wafer socket
434-16	10	9-pin miniature wafer socket
434-38	27	Crystal socket
434-22	1	Pilot lamp assembly, green
434-69	1	Pilot lamp assembly, clear
431-1	8	1-lug terminal strip
431-2	13	2-lug terminal strip
431-3	1	3-lug terminal strip
431-10	9	3-lug terminal strip
431-27	1	3-lug terminal strip
431-5	6	4-lug terminal strip
431-45	1	6-lug terminal strip
462-13	1	Small black knob
462-52	12	Black knob, indexed
Transformers-Rectifiers		
54-76	1	Filament transformer
54-78	1	Plate transformer
57-13	7	50 ma selenium rectifier
57-27	6	500 ma silicon rectifier



Meter-Tubes-Lamps		
407-58	1	50-0-50 microampere meter with mounting hardware
411-46	4	OB2 tube
411-59	1	OA2 tube
411-60	1	6AQ5 tube
411-73	1	12BH7 tube
411-80	9	6U8 tube
411-95	1	6BH6 tube
412-1	1	#47 pilot lamp
412-15	18	NE-2H neon lamp
412-3	1	NE-51 neon lamp

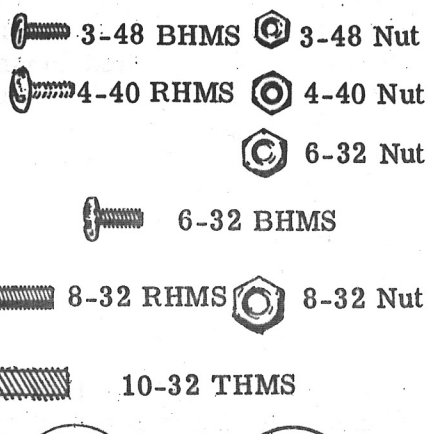


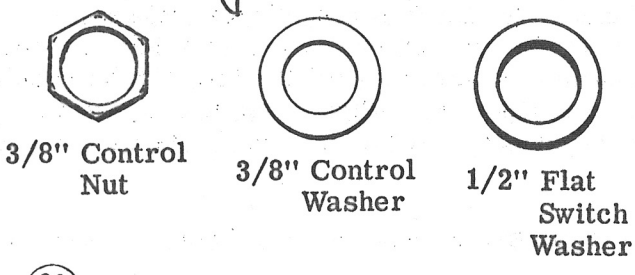
Grommets-Bushings-Clamps		
73-4	18	3/16" rubber grommet
73-2	4	3/4" rubber grommet
75-17	146	Nylon bushing
75-24	1	Plastic strain relief bushing
207-5	2	3/16" plastic cable clamp
207-8	1	Metal cable clamp
207-19	1	5/16" plastic cable clamp

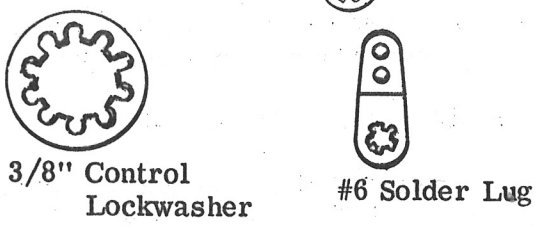


Wire-Cable-Sleeving		
340-2	1	Roll #20 bare wire
340-3	1	Roll #16 bare wire
340-1	1	Roll #14 bare wire
344-1	5	Lengths hookup wire, various colors

PART No.	PARTS Per Kit	DESCRIPTION
Wire-Cable-Sleeving (con't.)		
347-7	1	Length 4-conductor cable
347-1	1	Length 8-conductor cable
134-2	1	8-conductor laced cable assembly
134-3	1	9-conductor laced cable assembly
89-1	1	Line cord
346-1	1	Length insulating sleeving
346-2	1	Length 3/16" clear plastic sleeving
346-7	1	Length #5 clear plastic sleeving (largest)
Hardware		
250-63	2	3-48 x 1/8" round head machine screw
250-49	34	3-48 x 1/4" binding head machine screw
250-34	27	4-40 x 1/2" round head machine screw
250-89	69	6-32 x 3/8" binding head machine screw
250-18	12	8-32 x 3/8" round head machine screw
250-126	8	10-32 x 1/2" truss head machine screw
252-1	34	3-48 x 3/16" hex nut
252-2	27	4-40 x 1/4" hex nut
252-3	131	6-32 x 1/4" hex nut
252-4	12	8-32 x 5/16" hex nut
252-7	22	3/8" hex control nut
253-10	22	3/8" flat control washer
253-30	2	1/2" flat switch washer
254-1	87	#6 lockwasher
254-2	12	#8 lockwasher
254-4	22	3/8" control lockwasher
259-1	92	#6 solder lug
Sheet Metal Parts		
200-M201	1	Chassis
203-M167F245	1	Panel
204-M219	1	Right panel support bracket
204-M220	1	Left panel support bracket
204-M221	1	Rear chassis support
90-97	1	Cabinet
Miscellaneous		
69-9	1	Relay
423-1	1	Fuse post assembly
421-2	1	3 amp fuse
427-3	73	Binding post base
100-M16B	28	Black binding post cap
100-M16R	45	Red binding post cap
261-6	4	Rubber feet
331-6		Solder
595-234	1	Construction manual
595-235	1	Operational manual

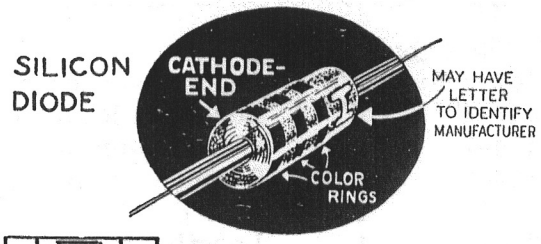


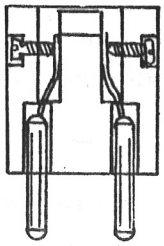




PROBLEM SOLVING COMPONENTS PART LIST

PART No.	PARTS Per Kit	DESCRIPTION
2-11	9	100 KΩ 1% precision resistor
2-14	9	1 meg 1% precision resistor
27-1	3	0.1 μfd 200 volt 5% mylar capacitor
27-2	3	1.0 μfd 200 volt 5% mylar capacitor
56-5	2	Silicon diode
438-10	27	Plastic double plug
438-13	48	Banana plug
70-6	48	Red banana plug cap
341-2	1	Roll red test lead wire





INTRODUCTION

Two manuals are supplied with the EC-1 Computer, an Assembly Manual and an Operational Manual. While it is possible to build the Computer by use of the Assembly Manual alone, it is recommended that some time be spent in reading at least parts of the Operational Manual before beginning construction of the kit. Those sections dealing with circuit description and operation will be especially helpful when wiring the Computer, as they will provide a better understanding of the functions of the various parts as the Computer is built.

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

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

2. Read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations.

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

4. Provide yourself with good quality tools. Basic tool requirements consist of a good 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. Nut drivers of the following sizes, while not necessary, will aid extensively in construction of the kit: a #6 to fit 3/16" nuts which are used on 3-48 screws; a #8 to fit 1/4" nuts which are used on 4-40 and 6-32 screws; a #10 to fit 5/16" nuts which are used on 8-32 screws; and one to fit 1/2" nuts which are used on controls and rotary switches.

   Thin flat open end wrenches to fit the 9/16" nuts which are used on toggle switches and the 13/16" nuts which are used on pilot lamp assemblies will also be found helpful.

5. Provide a clean work space and at all times keep a pad or cloth on the work surface so as to protect from damage, especially scratching, the part of the Computer being worked on at the time. This is especially necessary when working on the panel.

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. 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.

The drawings below show mounting details for the components used on the panel.

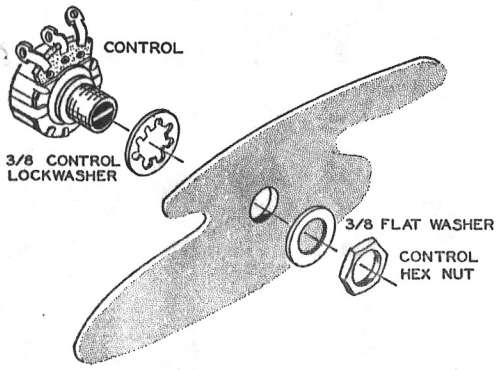
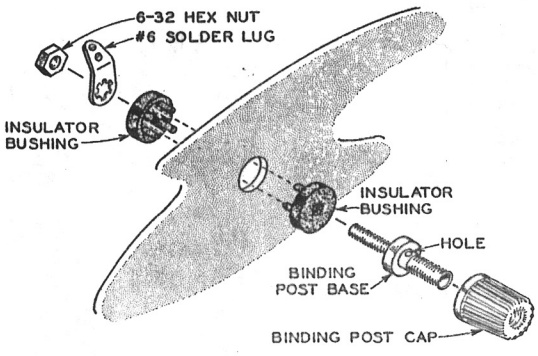
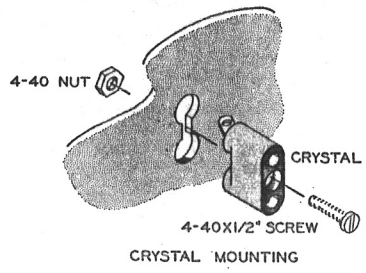


Figure 1



ASSEMBLE INSULATORS SO PINS INTERMESH

Figure 2



CRYSTAL MOUNTING

Figure 3

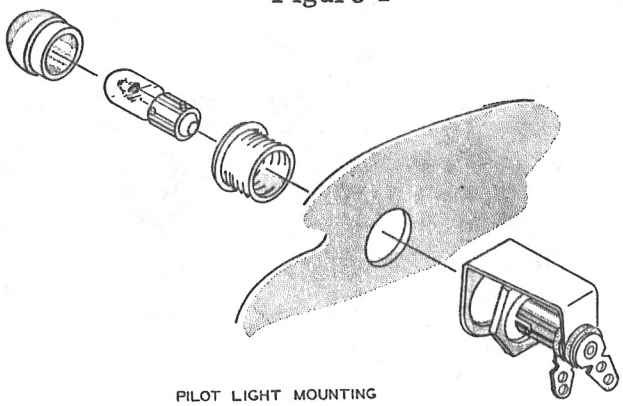


Figure 4

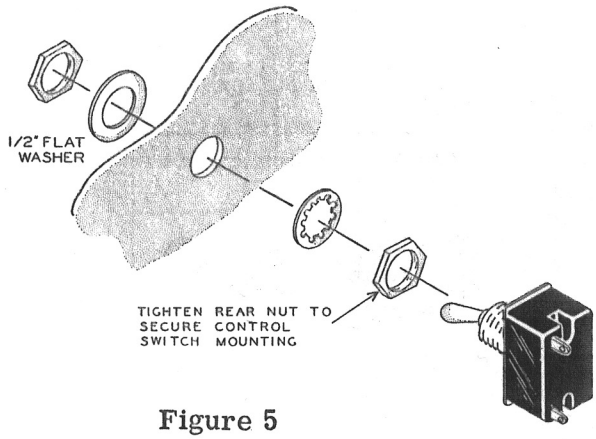
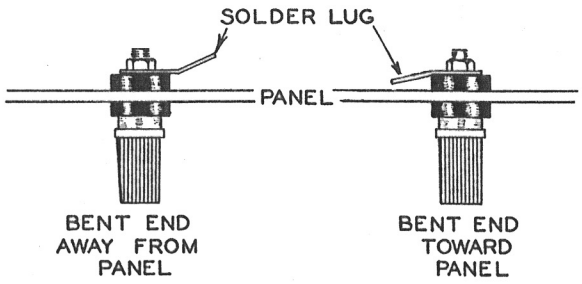


Figure 5

In mounting binding post bases, solder lugs are mounted under the nuts. In some cases the instructions will call for having the bent end of the solder lug away from the panel, and in some cases will call for having the bent end toward the panel. The drawing at the right shows how these should look.



The part of the binding post base which is against the front of the panel has a hole through it near the base into which the wire is inserted before clamping with the binding post cap. Wiring of problems on the panel will be facilitated if the holes in all the binding post bases, except the four above the meter, are oriented so they are parallel with respect to the length of the panel. The four posts above the meter should have the holes perpendicular with respect to the length of the panel.

An appropriate size of nail or rod may be found useful in aligning the binding post bases.

18. ( ) MOUNT FOUR BINDING POST BASES. UNDER EACH NUT, MOUNT ONE SOLDER LUG WITH THE BENT END AWAY FROM THE CHASSIS. THE LUGS SHOULD BE DIRECTED TOWARD THE METER AND BENT UP SO AS TO CLEAR THE METER.

17. ( ) MOUNT THE METER, USING THE MOUNTING HARDWARE SUPPLIED WITH THE METER. UNDER THE LOWER RIGHT HAND NUT, PLACE A 5/16" (LARGE) PLASTIC CABLE CLAMP. DO NOT TIGHTEN THIS NUT AT THIS TIME. REMOVE THE WIRE BETWEEN THE METER TERMINALS AND REVERSE THE DIRECTION OF THE LUG ON THE + TERMINAL OF THE METER, AS SHOWN.

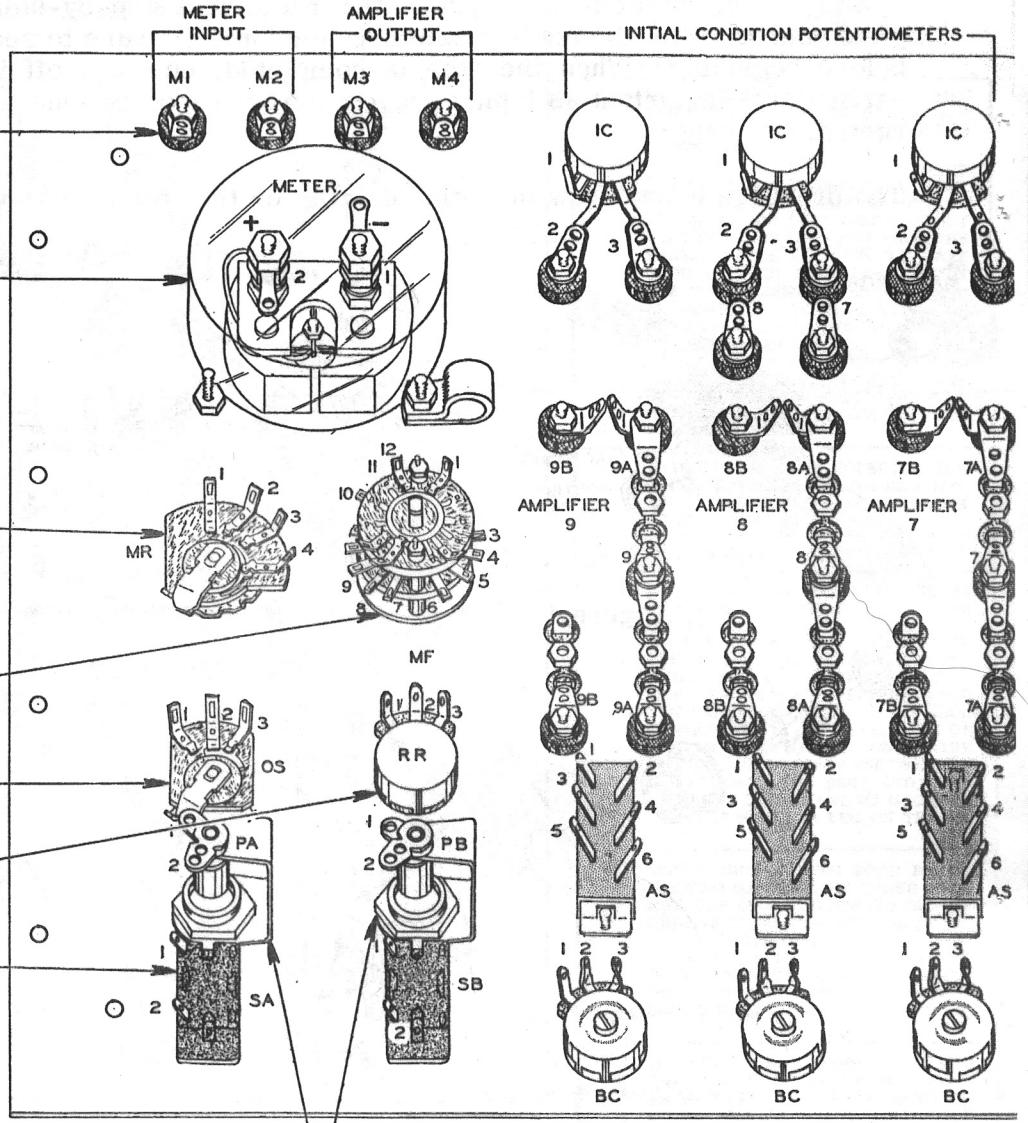
16. ( ) MOUNT THE 4-POSITION ROTARY SWITCH (#63-191).

15. ( ) MOUNT THE 2-DECK, 12-POSITION ROTARY SWITCH (#63-192).

14. ( ) MOUNT THE 3-POSITION ROTARY SWITCH (#63-190). SEE FIGURE 1 FOR MOUNTING DETAIL AND ORIENT AS SHOWN.

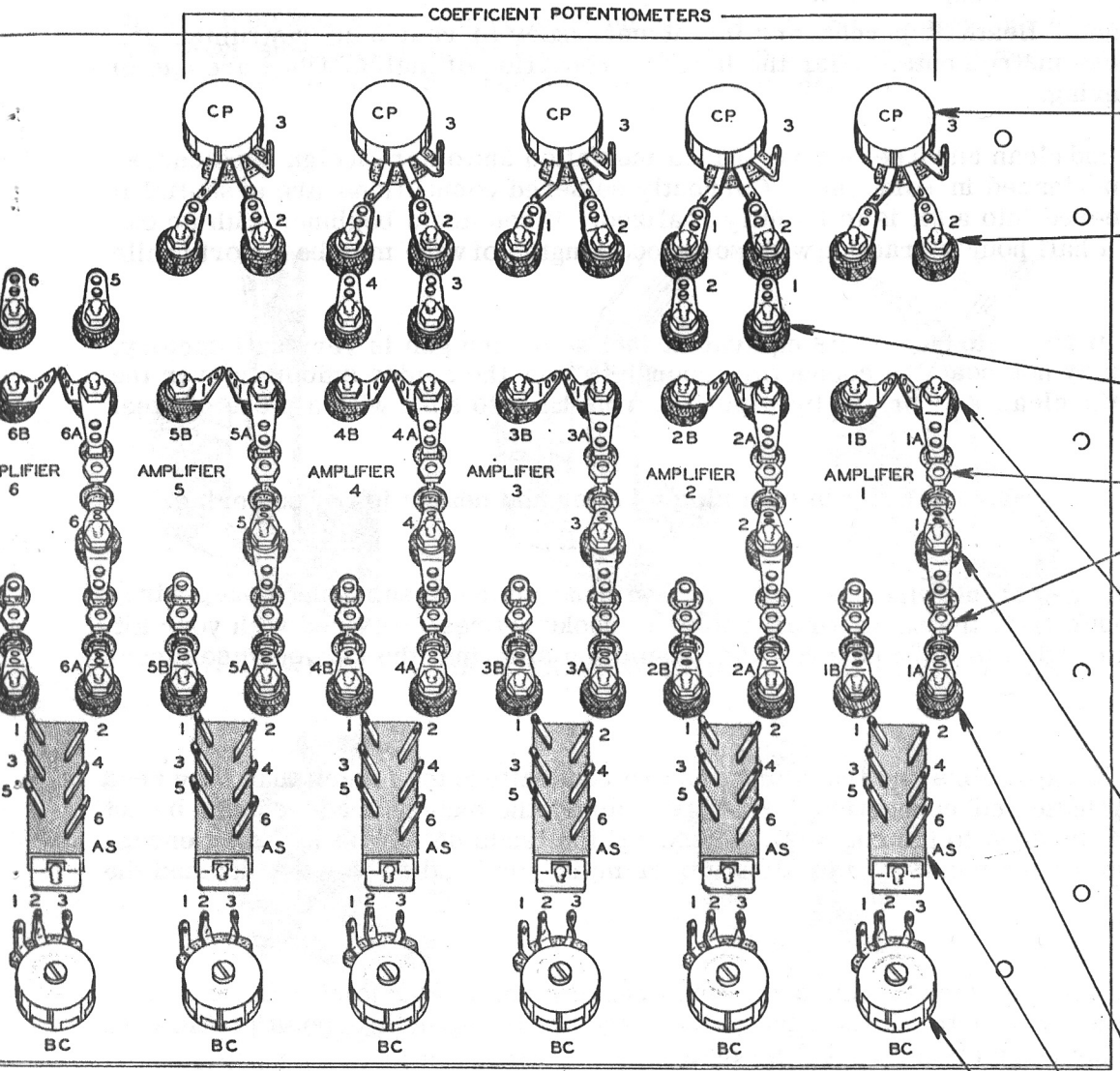
13. ( ) MOUNT A 7.5 MEGOHM CONTROL (#10-94).

12. ( ) MOUNT TWO SPST TOGGLE SWITCHES. SEE FIGURE 5 FOR MOUNTING DETAILS. ADJUST THE REAR NUT SO THAT ONE THREAD IS EXPOSED AT THE FRONT NUT. TIGHTEN THE REAR NUT.



11. ( ) MOUNT TWO PILOT LAMP SOCKETS. SEE FIGURE 4 FOR MOUNTING DETAILS.

Pictorial 1



Start

1. ( ) MOUNT EIGHT 100 KΩ POTENTIOMETERS (#10-12). SEE FIGURE 1 FOR MOUNTING DETAIL. ORIENT LUGS AS SHOWN.

2. ( ) MOUNT SIXTEEN BINDING POST BASES. SEE FIGURE 2 FOR MOUNTING DETAIL. USE ONE SOLDER LUG UNDER EACH NUT WITH THE BENT END AWAY FROM THE PANEL. THESE LUGS SHOULD MAKE GOOD CONTACT WITH THE LUGS OF THE COEFFICIENT POTENTIOMETERS AS SHOWN. IT MAY BE NECESSARY TO BEND THE LUGS OF THE POTENTIOMETERS TO ACHIEVE THIS.

3. ( ) MOUNT EIGHT BINDING POST BASES. USE ONE SOLDER LUG UNDER EACH NUT WITH THE BENT END AWAY FROM THE PANEL.

4. ( ) MOUNT NINE 2-PIN SOCKETS. USE 4-40 x 1/2" SCREWS AND 4-40 x 1/4" NUTS. SEE FIGURE 3 FOR MOUNTING DETAIL.

5. ( ) MOUNT EIGHTEEN 2-PIN SOCKETS.

6. ( ) MOUNT EIGHTEEN BINDING POST BASES. UNDER THE NUT ON THE "A" BASES USE TWO SOLDER LUGS; THE ONE DIRECTED TO THE LEFT SHOULD HAVE THE BENT END AWAY FROM THE PANEL WHILE THE ONE DIRECTED DOWN SHOULD HAVE THE BENT END TOWARD THE PANEL AND SHOULD MAKE GOOD CONTACT WITH THE UPPER LUG OF THE CRYSTAL SOCKET. UNDER THE NUT ON THE "B" BASES USE ONE SOLDER LUG WITH THE BENT END AWAY FROM THE CHASSIS AND MAKING GOOD CONTACT WITH THE LUG ON THE "A" BASE.

7. ( ) MOUNT NINE BINDING POST BASES. USE TWO SOLDER LUGS UNDER EACH NUT, ONE DIRECTED TOWARD THE TOP AND ONE TOWARD THE BOTTOM OF THE PANEL. BOTH OF THE LUGS SHOULD HAVE THE BENT END TOWARD THE PANEL AND BOTH LUGS SHOULD MAKE GOOD CONTACT WITH THE CORRESPONDING LUGS ON THE 2-PIN SOCKET.

8. ( ) MOUNT EIGHTEEN BINDING POST BASES. UNDER EACH NUT MOUNT ONE SOLDER LUG WITH THE BENT END TOWARD THE PANEL, MAKING SURE IT MAKES GOOD CONTACT WITH THE LUG OF THE 2-PIN SOCKET.

9. ( ) MOUNT NINE DPDT SLIDE SWITCHES. USE 6-32 x 3/8" BINDING HEAD SCREWS. NUTS ARE NOT NECESSARY AS THE SWITCH MOUNTING LUGS ARE TAPPED. THE PLASTIC SLIDE PROJECTING THROUGH THE FRONT OF THE PANEL SHOULD BE AT THE TOP OF THE SLOT IN THE PANEL.

10. ( ) MOUNT NINE 3 KΩ CONTROLS (#10-91).

PROPER SOLDERING AND WIRING 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 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 piece of steel wool or a cloth.

Observing the following procedure will aid in obtaining a better and neater job of 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 your kit. In the case that bare wire is to be covered with insulating sleeving, the phrase "use sleeving" will be used.

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 and to allow for crimping or bending the lead around the terminal.

3. 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, position the wire so that a good solder connection can still be made.

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

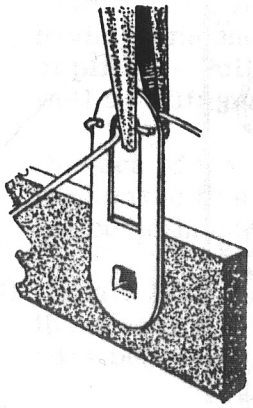
5. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.

6. 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.

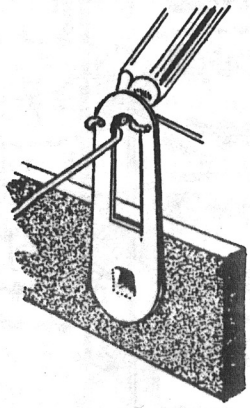
7. Remove the solder and then the iron from the completed junction. Use care not to move the leads until the solder is solidified.

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

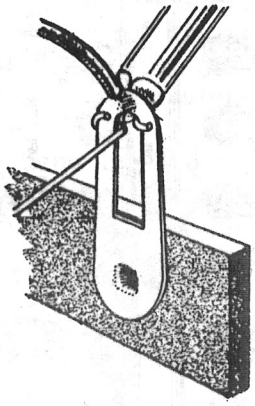
A poor or cold solder joint will usually look crystalline and have a grainy texture, or will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly over the entire junction. In some cases, it may be necessary to add a little more solder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



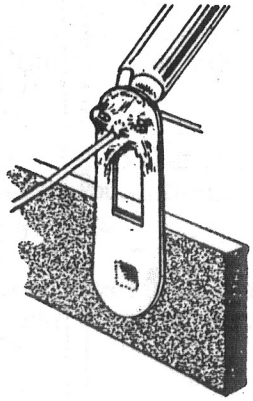
CRIMP WIRES



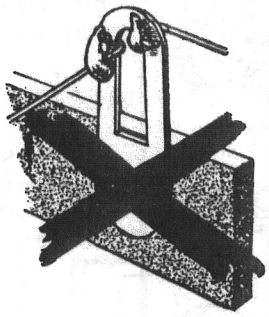
HEAT CONNECTION



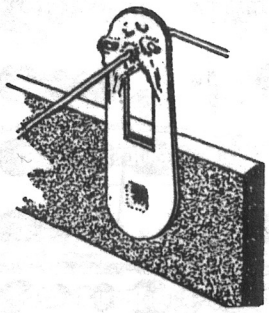
APPLY SOLDER



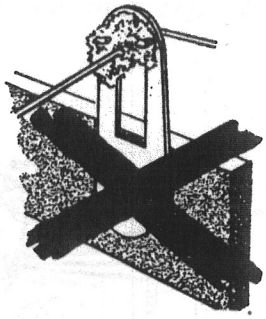
ALLOW SOLDER TO FLOW



COLD SOLDER JOINT CONNECTION INSUFFICIENTLY HEATED



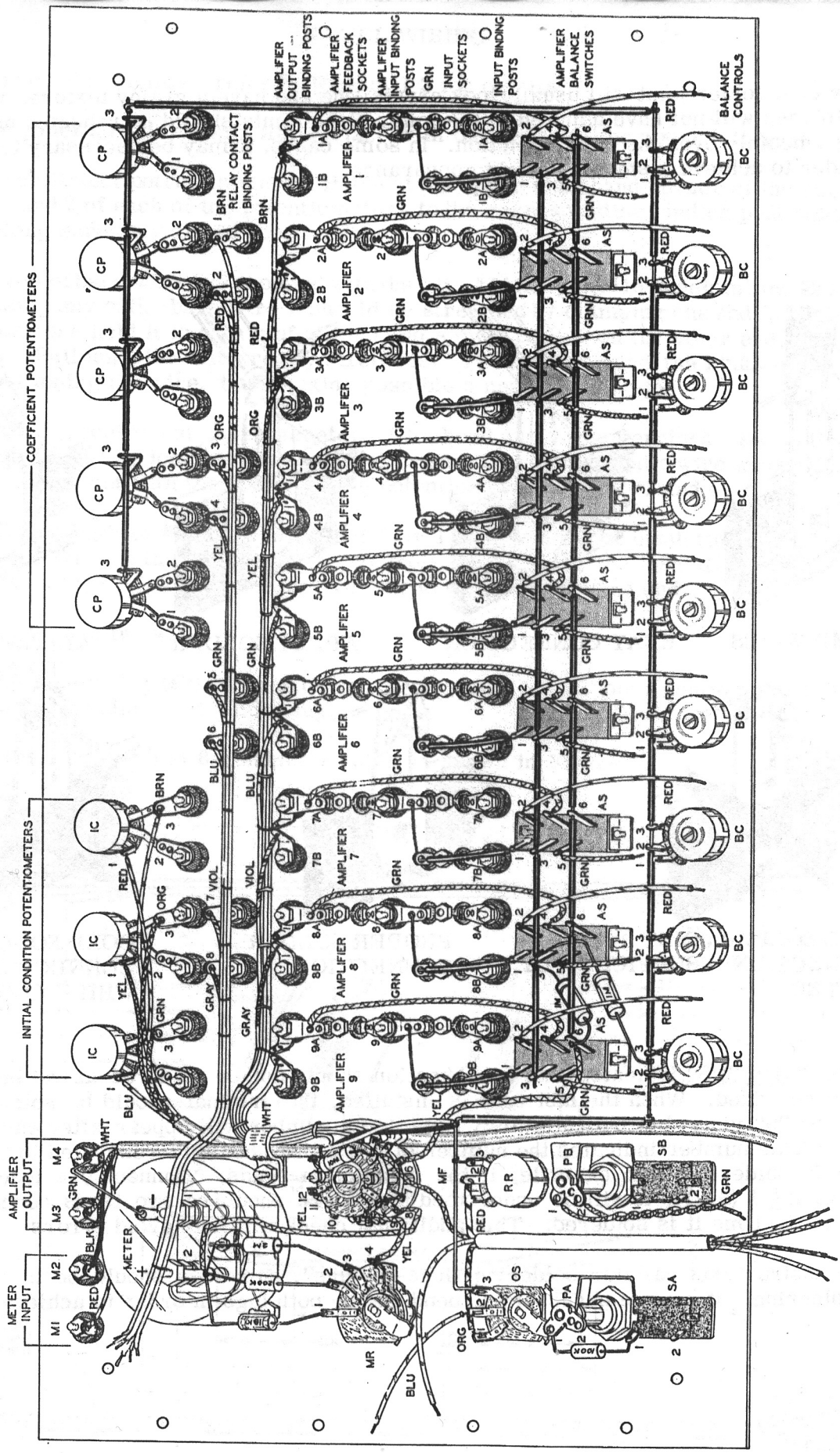
PROPER SOLDER CONNECTION



COLD SOLDER JOINT CONNECTION MOVED WHILE COOLING

The abbreviation "NS" indicates that a connection should not be soldered as yet because 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 should be connected to the terminal before it is soldered. For example, if the instruction reads, "Connect one lead of a 47 KΩ resistor to lug 1 (S-2)", it will be understood that there should be two leads connected to the terminal at the time it is soldered. This additional check will help avoid errors.

When the instructions call for soldering "lugs-to-lugs", both lugs should be in firm contact before soldering. It may be necessary to bend one or both lugs in order to achieve this.


COEFFICIENT POTENTIOMETERS
INITIAL CONDITION POTENTIOMETERS
METER INPUT
AMPLIFIER OUTPUT
M1
M2
M3
M4
AMPLIFIER OUTPUT BINDING POSTS
AMPLIFIER FEEDBACK SOCKETS
AMPLIFIER INPUT BINDING POSTS
GRN INPUT SOCKETS
INPUT BINDING POSTS
AMPLIFIER BALANCE SWITCHES
BALANCE CONTROLS
RELAY CONTACT BINDING POSTS
AMPLIFIER 1
AMPLIFIER 2
AMPLIFIER 3
AMPLIFIER 4
AMPLIFIER 5
AMPLIFIER 6
AMPLIFIER 7
AMPLIFIER 8
AMPLIFIER 9
METER
CP
IC
BC
AS
RR
PB
SB
PA
SA
MF
MR
OS

Pictorial 2

In the operations which follow, refer to Pictorial 2 for details.

( ) Place the panel face down on a flat surface with the meter in the upper left hand corner.

( ) The five coefficient potentiometers CP are at the upper right hand corner of the panel. Solder lugs 1 and 2 of each of the potentiometers to the corresponding binding post solder lugs, after making sure they are in good contact.

( ) Three sizes of bare wire are supplied with the kit: #14 (large), #16 (medium) and #20 (small). Before using any of the bare wire it should be stretched by clamping one end in a vise (or by having someone hold it in a pair of pliers) and slowly pulling on the other end, using a pair of pliers. Pull until the wire really stretches. This will remove the kinks in the wire as well as stiffening the wire, thus making possible a neater wiring job.

( ) On each of the coefficient potentiometers CP, bend lug 3 counterclockwise so that the #3 lugs on the five potentiometers are parallel and in line, and so that a wire through them will not come in contact with the bodies of the potentiometers or the #1 and #2 lugs.

( ) Cut a 6 1/2" length of #16 bare wire and four 1 1/4" lengths of insulating sleeving. Pass the bus wire through the #3 lugs of the controls CP, placing the insulating sleeving on the wire between lugs. Let the excess wire extend on the right hand end.

( ) Solder the lugs to the wire.

( ) Solder the center lug (#2) of each of the three initial condition potentiometers IC to the corresponding binding post solder lug.

( ) Prepare the 24" length of 8-conductor cable as shown in Figure 6.

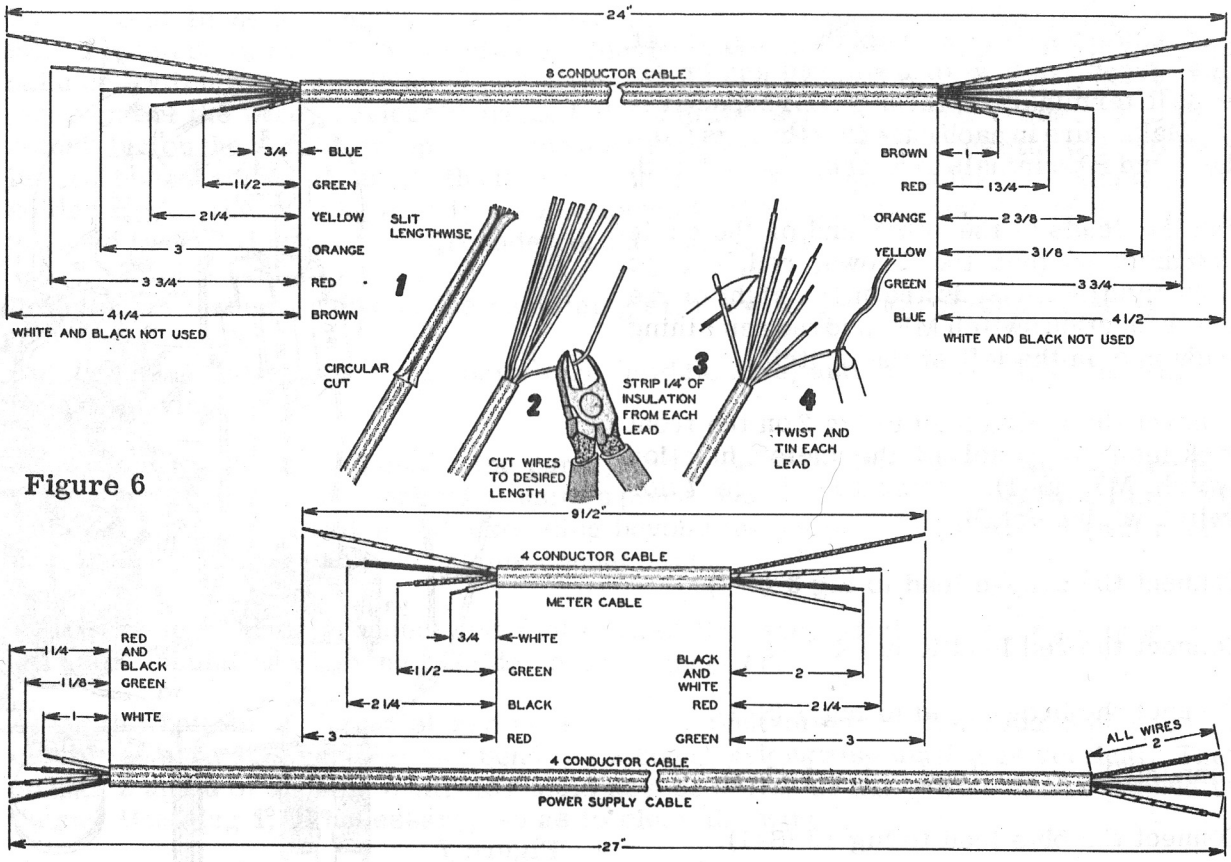


Figure 6

( ) Using the end with the 4 1/4" brown wire, connect the blue lead to lug 1 of the IC potentiometer at the left, nearest the meter (S-1). Dress the cable through the cable clamp, as shown.

( ) Connect the green lead to lug 3 of the same potentiometer (S-2). The two connections to be soldered are the wire just connected and the solder lug of the corresponding binding post.

( ) In the same manner, connect the yellow lead to lug 1 and the orange lead to lug 3 of the next IC potentiometer. Solder both connections.

( ) Likewise, connect the red lead to lug 1 and the brown lead to lug 3 of the third IC potentiometer. Solder both connections. The other end of the cable is not connected at this time.

( ) Select the cable assembly with eight wires. Dress the end of the cable assembly with the long leads along the binding posts marked "relay contacts".

( ) Connect the gray lead to binding post 8 (S-1). Keep the other wires of the assembly away from the lug while soldering as the heat will melt the plastic insulation. After soldering and the lugs have cooled, the wires are dressed against the lugs.

( ) Connect the violet, blue, green, yellow, orange, red and brown leads to binding posts 7 through 1 respectively. Solder each connection. The other end of the cable is not connected at this time.

( ) Select the cable assembly having nine conductors. Dress this through the cable clamp and along the amplifier output terminals.

( ) Connect the white lead to lug 9B of the amplifier output binding post. Solder this connection, at the same time soldering together the lugs from binding posts 9A and 9B.

( ) In the same manner, connect the gray, violet, blue, green, yellow, orange, red and brown leads to terminals 8B through 1B respectively. Make sure in each case that the lugs from the A and B terminals are securely soldered.

( ) Fan the leads at the other end of the cable assembly so that the brown, red, orange yellow and green leads are on the right of the meter function switch MF, and the remaining leads are on the left of the switch.

( ) Connect the yellow lead to lug 2 on the front deck (nearest panel) of the meter function switch MF (S-1). Refer to Figure 7 for switch wiring detail.

( ) Connect the orange lead to lug 3 (S-1)

( ) Connect the red lead to lug 4 (S-1).

( ) Connect the brown lead to lug 5 (S-1).

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

( ) Connect the blue lead to lug 12 (S-1).

( ) Connect the violet lead to lug 11 (S-1).

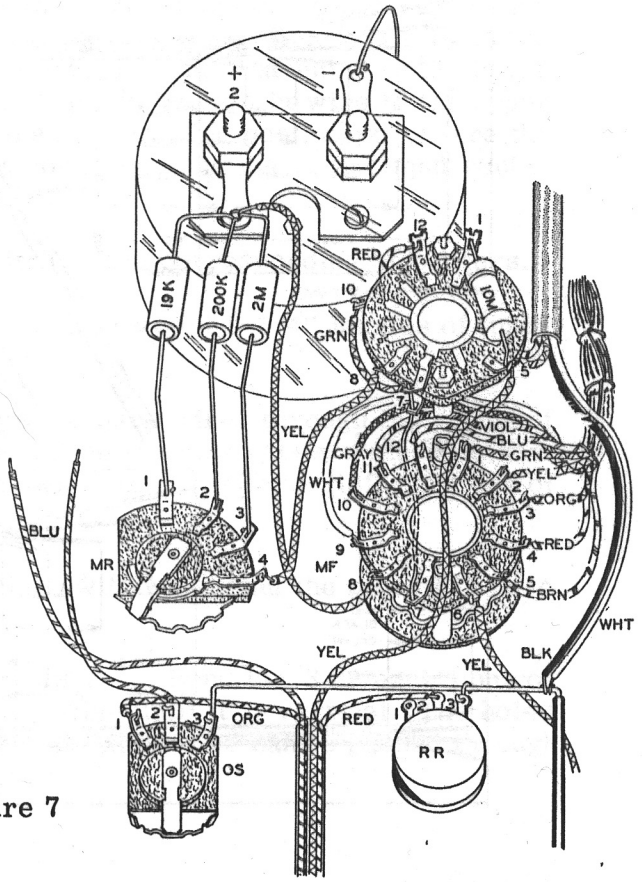


Figure 7

( ) Connect the gray lead to lug 10 (S-1).

(✓) Connect the white lead to lug 9 (S-1).

(✓) Cut and strip nine 5" lengths of green hookup wire.

(✓) Connect one length of wire between the lug of amplifier output binding post 9A (NS) and lug 4 (S-1) on the amplifier balance switch AS of amplifier 9. Now solder the lug 9A (S-2) to the adjacent lug of the amplifier feedback socket and the wire just connected to lug 9A.

(✓) In the same manner, using the remaining eight lengths of wire, connect the output terminal with the balance switch on the other eight amplifiers. Solder all connections, making sure the output binding post lug is soldered to the socket lug in each case, and that the lugs have not been grounded to the chassis by the soldering operation.

(✓) Solder the upper lug of the amplifier input binding post 9 to the lower lug of the amplifier feedback socket 9, again making sure that the lugs are not grounded to the chassis.

(✓) In the same manner, solder the corresponding lugs of the remaining eight amplifiers.

(✓) Solder the lugs of input binding posts 9A and 9B to the lower lugs of the corresponding input sockets 9A and 9B of amplifier 9.

(✓) In the same manner, solder the remaining input binding post lugs to the corresponding input socket lugs of amplifiers 8 through 1.

(✓) Cut nine 3" lengths of #20 bare wire (the smallest diameter).

(✓) Cut nine 1 7/8" lengths of insulating sleeving.

( ) Pass one of these 3" lengths of bare wire through the upper lug of amplifier input socket 9B. Place one of the 1 5/8" lengths of sleeving over the wire on the end toward amplifier balance switch AS of amplifier 9 and connect this end to lug 1 of the switch (S-1). Bend the other end of the wire previously passed through the socket lug and connect it to the lower solder lug on the amplifier input binding post 9B of amplifier 9. Solder the wire to the upper lug of the input socket 9B and to the lower solder lug of the input binding post, making sure the solder lug of the binding post is also soldered to the corresponding lug of the input socket 9A, and that the lugs are not grounded to the chassis.

(✓) In the same manner, connect the remaining eight switches and corresponding amplifiers.

(✓) Cut two 12 1/4" lengths of #16 bare wire (middle size) and sixteen 1 1/4" lengths of insulating sleeving.

(✓) Starting at the right hand end of the panel, pass one of the bare wires through the #3 lug of the nine amplifier balance switches, using a piece of insulating sleeving between the switches. Leave the small excess length extending beyond the switch of amplifier 9 (left hand end of panel). Now solder each of the nine connections.

(✓) In the same manner, connect lug 6 of each of the nine switches, using the other #16 bare wire and insulating sleeving. Solder each connection.

(✓) Along the bottom of the panel are nine balance controls BC. Bend lug 3 of each control clockwise until it is vertical and bend lug 2 counterclockwise until it is vertical. The holes on lugs 2 and 3 of all nine controls should now be in line so that a wire can be passed through them. Bend lug 1, if necessary, so as to clear the wire.

( ) Cut a 13 1/2" length of #16 bare wire and eight 1" lengths of insulating sleeving. Starting at the right hand end of the panel, pass the wire through lugs 2 and 3 of each of the nine balance controls, using insulating sleeving between controls, not between lugs of the same control. Let 1/2" of the wire extend at the right hand end and the remainder extend at the left hand end. Do not cut off the excess.

( ) Solder the eighteen connections (two on each of nine controls).

( ) Cut an 8 1/2" length of #16 bare wire. Slip a 7 1/4" length of insulating sleeving over the wire. Connect one end of the wire to the bare wire extending through lug 3 of the coefficient potentiometer CP at the upper right hand end of the panel (S-1). Connect the other end of the wire to the bare wire extending through lug 3 of the balance control BC at the lower right hand end of the panel (S-1).

( ) Cut a 6" length of #16 bare wire. Slip a 2 3/4" length of insulating sleeving over one end of the wire. Make a right angle bend 3 1/4" from this end and connect this end to the bare wire which extends from lug 2 of balance control BC of amplifier 9. Solder this connection. See Pictorial 2 for proper placement of this wire.

( ) Connect the other end to operate switch OS, lug 3 (S-1).

( ) Prepare a 9 1/2" length of 4-conductor cable, as shown in Figure 6 on page 13.

( ) There are four binding posts above the meter. The end of the 4-conductor cable with the 3" red lead is connected to these posts. Connect the red lead to M1 (S-1), the black lead to M2 (S-1), the green lead to M3 (S-1) and the white lead to M4 (NS).

( ) Dress the cable along the meter through the plastic cable clamp on the meter, as shown in Pictorial 2 on page 12.

( ) At the other end of the cable, connect the green lead to lug 10 on the rear deck of the meter function switch MF (S-1). This lug is on the side of the deck toward the panel. Refer to Figure 7 on page 14 for switch wiring detail.

( ) Connect the red lead to lug 12 on the rear deck of the same switch (S-1). This lug is on the side of the deck away from the panel.

( ) Connect the black and white leads to the ground bus running below the switch. This bus connects to lug 3 on the operating switch OS. Solder these connections.

( ) Using a 2" length of #20 bare wire, connect meter terminal 1 (S-1) to meter binding post M4 (S-2). The wire should not touch the meter case.

( ) Connect a short length of #20 bare wire from lug 7 on the front deck of the meter function switch MF (S-1) to lug 7 on the two sides of the rear deck (S). The wire passes through and is soldered to three lugs.

( ) Connect a 10 megohm precision resistor between lug 1 (S-1) and lug 5 (NS) on the rear deck of switch MF.

( ) Connect a 19 KΩ precision resistor from the meter range switch MR, lug 1 (S-1) to the + meter terminal 2 (NS).

( ) Connect a 200 KΩ precision resistor from the meter range switch MR, lug 2 (S-1) to the + meter terminal 2 (NS).

( ) Connect a 2 megohm precision resistor from the meter range switch MR, lug 3 (S-1) to the + meter terminal 2 (NS).

( ) Connect a 4 1/2" length of yellow wire from switch MF, front deck lug 8 (S-1) to the + meter terminal 2 (S-4).

( ) Connect a short length of yellow hookup wire from the meter range switch MR, lug 4 (S-1) to the meter function switch MF, lug 8 on the rear deck (S-1).

( ) Connect a short length of bare wire from repetition rate control RR, lug 3 (S-1) to the bare wire which connects to switch OS, lug 3 (S-1).

( ) Connect a 4" length of yellow wire from switch MF, front deck, lug 6 (S-1) to the bare wire projecting from amplifier balance switch AS, lug 6 (NS).

( ) Connect one lead of a 1 megohm precision resistor to the bus wire at lug 3 of amplifier balance switch AS of amplifier 8 (NS). Connect the other lead to the bus wire at lug 6 of amplifier balance switch AS of amplifier 9 (S-2). Make sure the leads do not touch the case of the switch.

( ) Connect one lead of a 1 megohm precision resistor to the bus wire at lug 3 of switch AS of amplifier 8 (S-2). Connect the other lead to the bare wire between lugs 2 and 3 of control BC of amplifier 9 (S-1).

( ) Cut and strip nine 3" lengths of red hookup wire.
( ) Connect one of these wires to each of the amplifier balance switches, lug 2 (S-1). The other ends of these wires are not connected at this time.

( ) Connect one end of a 10" yellow wire to switch MF, rear deck, lug 5 (S-2). Dress the lead as shown, leaving the other end free.

( ) Connect a 6" orange wire to switch OS, lug 1 (S-1). Again dress as shown and leave the other end free.

( ) Connect a 5 1/2" red wire to control RR, lug 2 (S-1). Dress as shown and leave the other end free.

( ) Strip both ends of an 11" blue wire. Lay it along the red, yellow and orange wires, as shown. Slip a 3" length of the larger of the two sizes of clear plastic sleeving over the four wires, leaving 6" of the blue wire extending beyond the sleeving on the end toward the meter.

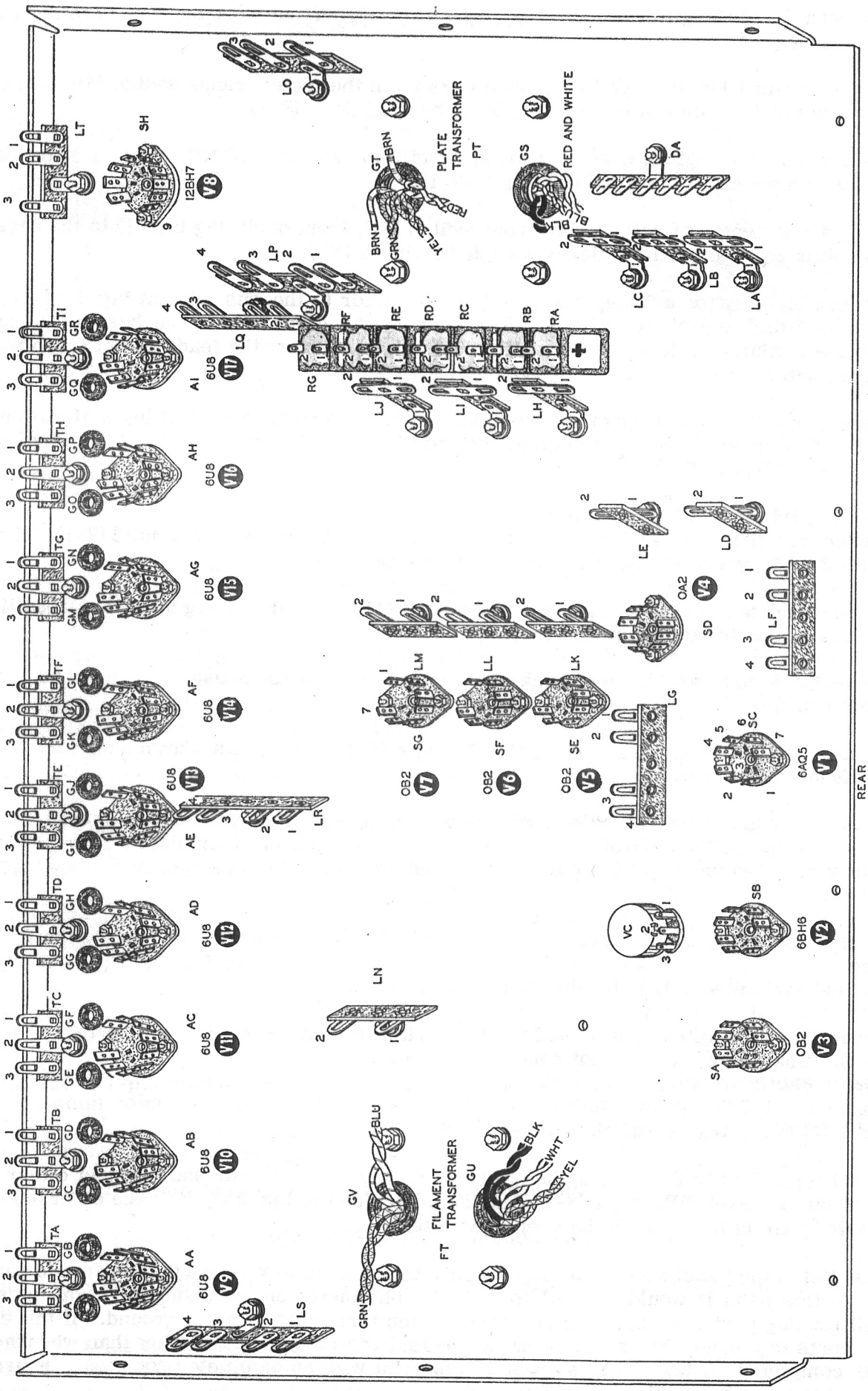
( ) Connect a 6" blue wire to switch OS, lug 2 (S-1). Dress as shown, leaving the other end free.
( ) Cut and strip nine 1 1/4" lengths of green hookup wire.

( ) Connect one end of each of these leads to each of the amplifier balance switches AS, lug 5 (S-1). The other ends are not connected at this time.

( ) Connect a 100 KΩ (brown-black-yellow) 1/2 watt resistor between pilot lamp socket PA, lug 1 (S-1) and toggle switch SA, lug 1 (NS).

( ) Twist together two 3 1/2" lengths of green hookup wire. At one end, connect either lead to pilot lamp socket PB, lug 1 (S-1) and the other lead to lug 2 (S-1). The other end of this twisted pair is left free, to be connected later.

This completes the panel wiring for the present. Check carefully to see that no errors have been made. At this point it would be well to make an ohmmeter check (using the high-ohms scale) from all binding posts, socket terminals and switch terminals to panel ground. If there should be any shorts to ground, they are a lot easier to find and correct at this time than when the Computer is completed. A few minutes spent at this point with an ohmmeter could save hours later.


REAR
PLATE TRANSFORMER PT
FILAMENT TRANSFORMER FT
RED AND WHITE
12BH7
6U8
OB2
6BH6
6AQ5
OA2
V1
V2
V3
V4
V5
V6
V7
V8
V9
V10
V11
V12
V13
V14
V15
V16
V17
VC

Pictorial 3

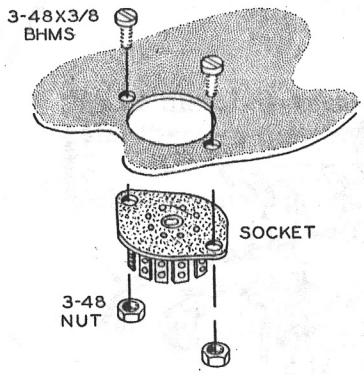
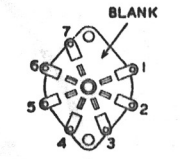
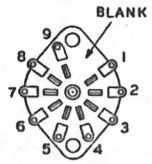


Figure 8



NUMBERING ON 7-PIN TUBE SOCKET



NUMBERING ON 9-PIN TUBE SOCKET

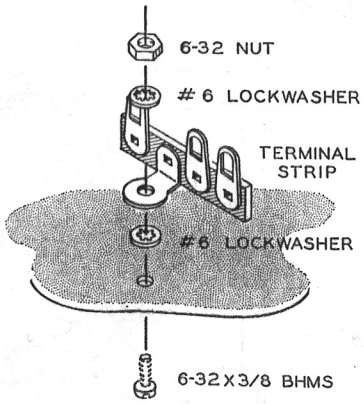


Figure 9

Use 3-48 x 3/8" binder head screws and 3-48 nuts for mounting miniature sockets as shown in Figure 8. Socket pins are numbered clockwise, starting at the widest spacing, when viewed from the bottom of the socket.

When 6-32 hardware is called for, a 6-32 x 3/8" binder head machine screw, #6 lockwasher and 6-32 nut are to be used, unless otherwise specified. Special length and size hardware is to be used only when specifically called for. Transformers are mounted with 8-32 x 3/8" round head machine screws, #8 lockwashers and 8-32 nuts.

Three types of 3-lug terminal strips are used. Make sure the correct one is used in each case.

MOUNTING PARTS ON CHASSIS

Refer to Pictorial 3 for the following operations.

( ) Install eighteen 3/16" rubber grommets in locations GA through GR.

( ) Install four 3/4" rubber grommets in locations GS, GT, GU and GV.

( ) Mount ten 9-pin miniature sockets in locations AA through AI and SH. Orient the lugs as shown. Use 3-48 screws and nuts, as shown in Figure 8.

( ) Mount seven 7-pin miniature sockets in locations SA through SG, orienting lugs as shown.

( ) Mount eight 1-lug terminal strips in locations LA, LB, LC, LH, LI, LJ, LD and LE. Use 6-32 hardware, as shown in Figure 9.

( ) Mount four 2-lug terminal strips in locations LK through LN.

( ) Mount nine 3-lug terminal strips (#431-10) in locations TA through TI.

( ) Mount 3-lug terminal strip #431-3 in location LT and 3-lug terminal strip #431-27 in location LO.

( ) Mount six 4-lug terminal strips at LP through LS, LF and LG.

( ) Mount a 6-lug terminal strip at DA.

( ) Mount a 250 KΩ control (#10-14) at VC. See Figure 1 on Page 7 for mounting detail.

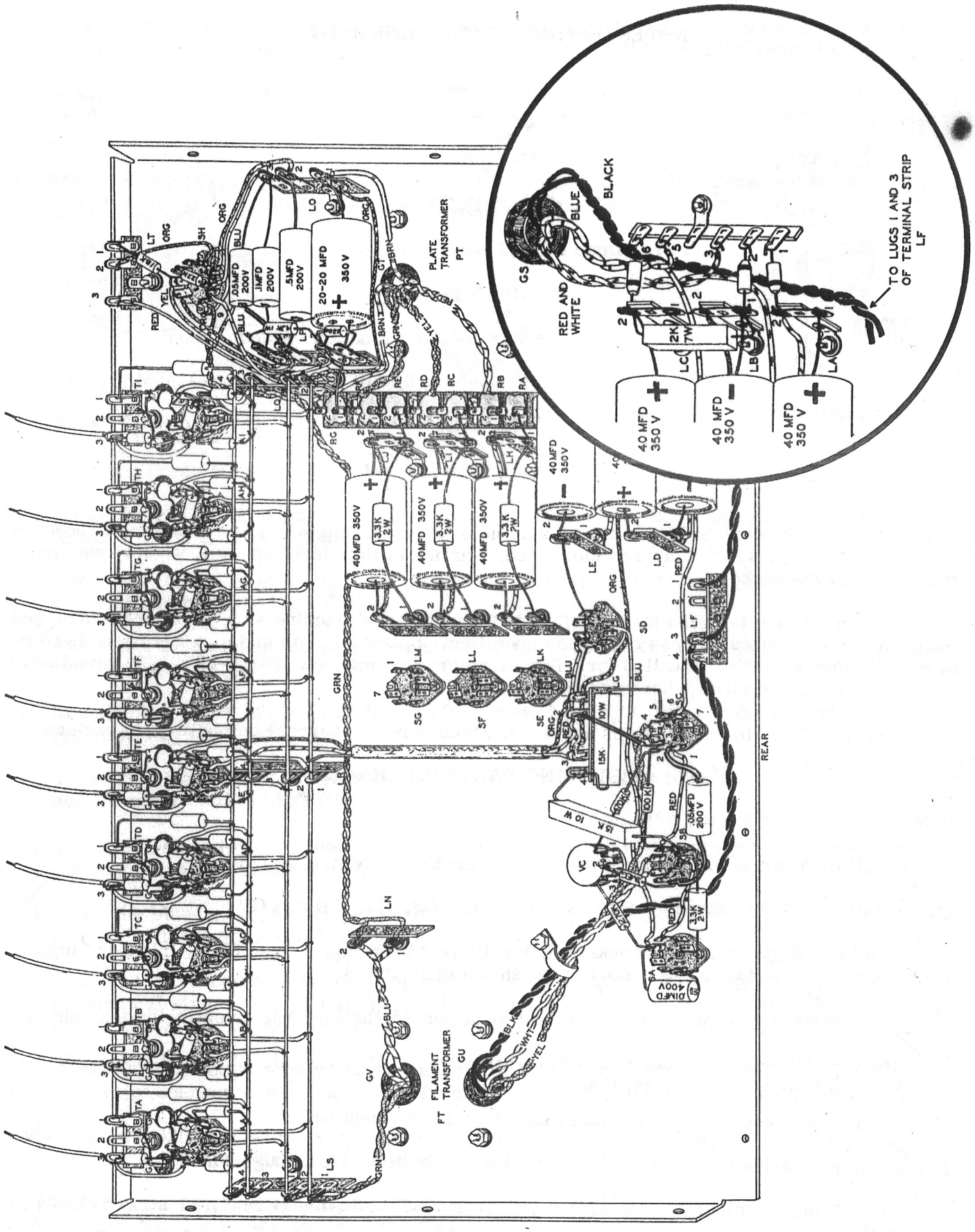


PLATE TRANSFORMER PT
FILAMENT TRANSFORMER FT
REAR
TO LUGS 1 AND 3 OF TERMINAL STRIP LF
RED AND WHITE
BLACK
BLUE
GS
40 MFD 350 V
40 MFD 350 V
40 MFD 350 V
2K 7W
3.3K 2W
15K 10 W
100 K
.05MFD 200V
.1MFD 200V
.5MFD 200V
20-20 MFD 350 V
.05MFD 400V

Pictorial 4

( ) Mount seven M50 selenium rectifiers at RA through RG. Use #6 lockwashers and nuts. Make sure that the sides of the rectifiers marked + are all toward the rear of the chassis.

( ) Mount the filament transformer (#54-76) at FT. Use 8-32 screws, lockwashers and nuts. The black, white and yellow leads should pass through the grommet nearer the rear of the chassis.

( ) Mount the plate transformer (#54-78) at PT. The black, blue and red and white tracer leads pass through the grommet nearer the rear of the chassis.

( ) Install a small black knob on the shaft of the 250 KΩ control VC.

CHASSIS WIRING

( ) Place the chassis, bottom up, on the work surface.

Refer to Pictorial 4 in performing the following operations.

POWER SUPPLY WIRING

The following seven steps refer to plate transformer #54-78.

( ) Twist the red leads; connect the short lead to rectifier RB, lug 2 (S-1) and the long lead to terminal strip LK, lug 2 (NS).

( ) Twist the yellow leads; connect the short lead to rectifier RD, lug 2 (S-1) and the long lead to terminal strip LL, lug 2 (NS).

( ) Twist the green leads; connect the short lead to rectifier RF, lug 2 (S-1) and the long lead to terminal strip LM, lug 2 (NS).

( ) Connect the short brown lead to terminal strip LO, lug 1 (NS) and the long brown lead to rectifier RG, lug 2 (S-1).

( ) Twist the black leads and dress as shown; connect one lead to terminal strip LF, lug 1 (NS) and the other lead to lug 3 (NS).

( ) Twist the red and white leads; connect the shorter lead to terminal strip DA, lug 3 (NS) and the longer lead to terminal strip LD, lug 1 (NS).

( ) Twist the blue leads; connect the shorter lead to terminal strip DA, lug 5 (NS) and the longer lead to terminal strip LE, lug 1 (S-1).

( ) Strip and twist together two 16" lengths of green wire. Connect one end of this twisted pair to terminal strip LN, lugs 1 (NS) and 2 (NS). Dress the pair as shown and connect the other end to socket SH, lugs 6 (NS) and 5 (NS).

( ) Connect a #20 bare wire from rectifier RA, lug 1 (S-1) to terminal strip LH, lug 1 (NS).
( ) Likewise connect a #20 bare wire from RC, lug 1 (S-1) to terminal strip LI, lug 1 (NS).

( ) Connect a #20 bare wire from RE, lug 1 (S-1) to terminal strip LJ, lug 1 (NS).
( ) Connect a #20 bare wire from rectifier RA, lug 2 (S-1) to RB, lug 1 (S-1).

( ) In the same way, connect RC, lug 2 (S-1) to RD, lug 1 (S-1).
( ) Connect RE, lug 2 (S-1) to RF, lug 1 (S-1).
( ) Connect a #20 bare wire from rectifier RG, lug 1 (S-1) to terminal strip LP, lug 1 (NS).

( ) Connect the positive (+) lead of a 40 μfd, 350 volt capacitor to terminal strip LC, lug 2 (NS). Connect the negative (-) lead to terminal strip LE, lug 2 (NS). Position the capacitor against rectifier RA with the "+" end even with the right side of RA.

( ) Connect an 8" length of orange wire from terminal strip LB, lug 2 (S-1) to terminal strip LG, lug 3 (NS).

( ) Connect the positive (+) lead of a 40 μfd, 350 volt capacitor to terminal strip LD, lug 2 (S-1). Connect the negative (-) lead to terminal strip LB, lug 1 (NS).

( ) Connect a 7-1/2" length of red wire from terminal strip LA, lug 2 (NS), to socket SC, through pin 6 (NS) to pin 5 (NS). Now solder pin 6.

( ) Connect the positive (+) lead of a 40 μfd, 350 volt capacitor to terminal strip LA, lug 1 (S-1). Connect the negative (-) lead to terminal strip LD, lug 1 (S-2).

( ) Connect a 2000 Ω, 7 watt resistor from terminal strip LC, lug 2 (NS) to terminal strip LB, lug 1 (NS).

( ) Connect the lead at the marked end of a silicon diode to terminal strip LA, lug 2 (S-2). Connect the other lead to terminal strip DA, lug 1 (NS). Refer to Pictorial 4 and Figure 10.

( ) Connect the lead at the marked end of a silicon diode to terminal strip DA, lug 2 (NS). Connect the other lead to terminal strip LB, lug 1 (S-3).

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

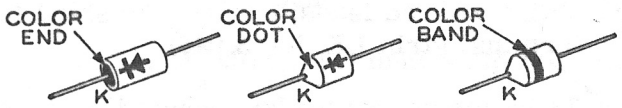


Figure 10

( ) Connect a silicon diode to terminal strip DA, between lugs 2 (S-2) and 3 (NS). Connect the lead at the marked end to lug 3.

( ) Connect a silicon diode to terminal strip DA, between lugs 1 (S-2) and 3 (S-3). Connect the lead at the marked end to lug 1.

( ) Connect the lead at the marked end of a silicon diode to terminal strip LC, lug 2 (S-3). Connect the other lead to terminal strip DA, lug 6 (NS).

( ) Connect a silicon diode to terminal strip DA, between lugs 5 (S-2) and 6 (S-2). Connect the lead at the marked end to lug 6.

( ) Connect a #20 bare wire from terminal strip LE, lug 2 (S-2) through pins 7 and 4 on socket SD (NS) to terminal strip LG, lug 1 (NS). Now solder pins 7 and 4 on socket SD.

( ) Connect the positive (+) lead of a 40 μfd, 350 volt capacitor to terminal strip LH, lug 2 (S-1). Connect the other lead of the capacitor to terminal strip LK, lug 2 (NS).

( ) In the same manner connect the positive (+) lead of a 40 μfd, 350 volt capacitor to LI, lug 2 (S-1) and the negative (-) lead to LL, lug 2 (NS).

( ) Connect the positive (+) lead of a 40 μfd, 350 volt capacitor to LJ, lug 2 (S-1) and the negative (-) lead to LM, lug 2 (NS).

( ) Connect a 3.3 KΩ (orange-orange-red) 2 watt resistor from terminal strip LH, lug 1 (S-2) to terminal strip LK, lug 1 (NS).

( ) Connect a 3.3 KΩ, 2 watt resistor from LI, lug 1 (S-2) to LL, lug 1 (NS).

( ) Connect a 3.3 KΩ, 2 watt resistor from LJ, lug 1 (S-2) to LM, lug 1 (NS).

( ) Connect one of the positive (+) leads of a 20-20 μfd, 350 volt capacitor to terminal strip LP, lug 1 (NS) and the other positive (+) lead to lug 2 (NS) of the same strip. Connect the negative (-) lead to terminal strip LO, lug 1 (NS).

Z 70,000

( ) Connect a 1290Ω (brown-red-red) 1/2 watt resistor from terminal strip LP, lug 1 (S-3) to lug 2 (NS) of the same strip.

( ) Connect a 5 1/2" orange wire from terminal strip LO, lug 1 (S-3) to terminal strip LQ, lug 1 (NS).

( ) Connect a 0.5 μfd, 200 volt capacitor between terminal strips LO, lug 2 (NS) and LP, lug 3 (NS).

( ) Connect a 3 1/2" orange wire between terminal strip LO, lug 2 (S-2) and socket SH, pin 6 (NS).

( ) Connect a 3" length of orange wire from socket SH, lug 6 (S-2) to terminal strip LT, lug 2 (NS).

( ) Connect one lead of a 0.1 μfd, 200 volt capacitor to terminal strip LO, lug 3 (NS) and the other lead to LP, lug 4 (NS).

( ) Connect one lead of an 0.05 μfd, 200 volt capacitor to terminal strip LO, lug 3 (NS) and, using sleeving, connect the other lead to LP, lug 3 (NS).

( ) Connect a 3" blue wire from terminal strip LO, lug 3 (S-3) to socket SH, pin 7 (NS).

( ) Connect a 5 1/2" red wire from terminal strip LP, lug 2 (NS) to terminal strip LT, lug 3 (NS).

( ) Connect a 4 1/2" yellow wire from terminal strip LP, lug 3 (S-3) to socket SH, pin 2 (NS).

( ) Connect a 3 1/2" orange wire from terminal strip LP, lug 4 (NS) to socket SH, pin 1 (S-1).

( ) Connect a 4.7 KΩ (yellow-violet-red) 1 watt resistor between lugs 2 (S-4) and 4 (S-3) on terminal strip LP. 4 7 0 0

( ) Connect a short piece of bare wire between pins 4 (S-1) and 5 (NS) of socket SH.

( ) Connect an 18 KΩ (brown-gray-orange) resistor from socket SH, pin 2 (S-2) to terminal strip LT, lug 1 (NS).

( ) Connect a 3 1/2" blue wire from terminal strip LQ, lug 1 (NS) to socket SH, pin 8 (NS).

( ) On socket SH connect a short piece of bare wire from pin 8 (S-2) to pin 3 (NS).

( ) On socket SH connect a 2.2 megohm (red-red-green) 1/2 watt resistor from pin 3 (S-2) to pin 7 (S-2).

The following six steps refer to filament transformer #54-76.

( ) Twist together the blue leads. Connect either lead to terminal strip LN, lug 1 (S-2) and the other lead to lug 2 (S-2).

( ) Twist together the white leads and connect one lead to socket SB, pin 3 (S-1) and the other lead to pin 4 (S-1).

( ) Twist the yellow leads and connect to socket SC, pin 3 (S-1) and pin 4 (S-1).

( ) Cut each green lead to the required length, strip, tin, then twist the leads and connect to terminal strip LS, lug 1 (NS) and lug 2 (NS).

( ) Twist the black leads, dress between sockets SB and SA. Connect either lead to terminal strip LF, lug 3 (NS) and the other lead to lug 4 (NS).

( ) Using 6-32 hardware, mount the metal cable clamp at CC, placing it over the black, white and yellow twisted leads just connected.

( ) Connect a 3" blue wire from socket SD, pin 5 (S-1) to terminal strip LG, lug 3 (NS).

( ) Connect a 6 1/2" blue wire from socket SD, pin 1 (S-1) to socket SA, pin 4 (NS).

( ) Connect a 15 KΩ, 10 watt resistor from socket SC, pin 5 (S-2) to terminal strip LG, lug 4 (NS). Make sure this is placed as shown.

( ) Connect a 2 1/4" red wire from socket SC, pin 1 (S-1) to socket SB, pin 5 (NS).

( ) Connect a 2" red wire from socket SB, pin 7 (NS) to socket SA, pin 5 (S-1).

( ) On socket SB, connect a short bare wire between pin 2 (S-1) and pin 7 (S-2).

( ) Connect a 470 KΩ (yellow-violet-yellow) 1/2 watt resistor from socket SC, pin 2 (NS) to control VC, lug 1 (S-1).

( ) Connect a 100 KΩ (brown-black-yellow) 1/2 watt resistor from socket SC, pin 2 (NS) to socket SB, pin 5 (S-2).

( ) Connect a 15 KΩ, 10 watt resistor from terminal strip LG, lug 4 (S-2) to socket SB, pin 6 (NS).

( ) Using sleeving, connect an 0.05 μfd, 200 volt capacitor from socket SC, pin 2 (NS) to socket SB, pin 1 (NS).

( ) Using sleeving, connect a length of bare wire from terminal strip LG, lug 2 (NS) to socket SC, pin 2 (S-4).

( ) Connect a 1 megohm (brown-black-green) 1/2 watt resistor from socket SB, pin 1 (S-2) to control VC, lug 2 (S-1).

( ) Connect a 270 KΩ (red-violet-yellow) 1/2 watt resistor from control VC, lug 3 (S-1) to socket SA, pin 4 (NS).

( ) On socket SA, connect an 0.01 μfd, 400 volt capacitor from pin 1 (NS) to pin 4 (S-3).

( ) Connect a 3.3 KΩ (orange-orange-red) 2 watt resistor from socket SB, pin 6 (S-2) to socket SA, pin 1 (S-2). Use sleeving.

This completes the power supply wiring.

AMPLIFIER-WIRING

For amplifier wiring detail, refer to Pictorial 5.

( ) Pass a 13 1/2" #14 bus wire through terminal strip LQ, lug 1 (S-3), terminal strip LR, lug 1 (S-1) and terminal strip LS, lug 1 (NS).

( ) Connect one end of a 7" #14 bus wire to terminal strip LG, lug 3 (S-3). Direct this toward the front of the chassis.

( ) Connect one end of a 9" red wire to terminal strip LG, lug 2 (S-2).

( ) Connect one end of a 10" orange wire to terminal strip LG, lug 1 (S-2).

( ) Pass a 5" length of the smaller clear plastic sleeving over the bare wire, the red and the orange wires just connected to terminal strip LG. Dress the wires toward terminal strip LR as shown in Pictorial 4 on page 20.

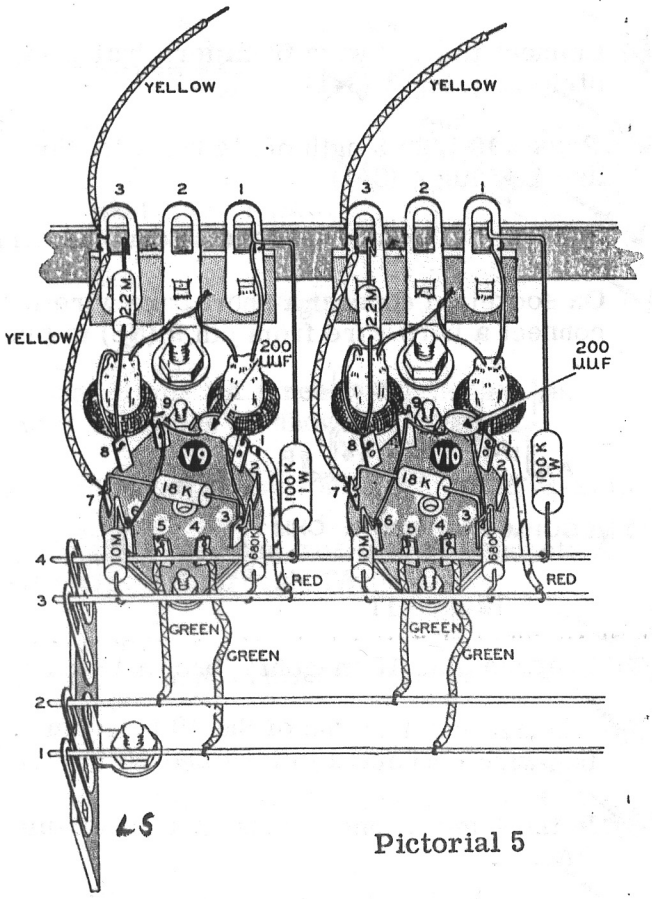
( ) Connect the free end of the bare wire to the bus wire passing through terminal strip LR, lug 1 (S-1). See Pictorial 4.

( ) Dress the red and orange wires under the bus wire.

( ) Cut nine pieces of green wire, each 3" long.

( ) Connect one of the 3" green wires between socket AI, pin 4 (S-1), and the bus wire connected to terminal strip LQ, lug 1 (S-1).

( ) In the same manner connect the remaining eight wires to sockets AH through AA and to the bus wire. Solder both ends of each wire.



Pictorial 5

( ) Connect a 13 1/2" length of #14 bus wire through terminal strips LQ, lug 2 (S-1), LR, lug 2 (S-1) and LS, lug 2 (S-2).

( ) Cut nine pieces of green hookup wire, each 2 5/8" long.

( ) Connect one of these 2 1/2" wires from socket AI, pin 5 (S-1) to the bus wire connected to terminal strip LQ, lug 2 (S-1).

( ) In the same manner, connect the remaining eight wires to sockets AH through AA. Solder all connections.

( ) Connect a 13 1/2" length of #14 bus wire through terminal strips LQ, lug 3 (NS), LR, lug 3 (S-1) and LS, lug 3 (S-1).

( ) Cut nine pieces of red hookup wire, each 2 1/2" long.

( ) Connect one of the red wires from socket AI, pin 1 (S-1) to the bus wire connected to terminal strip LQ, lug 3 (S-1).

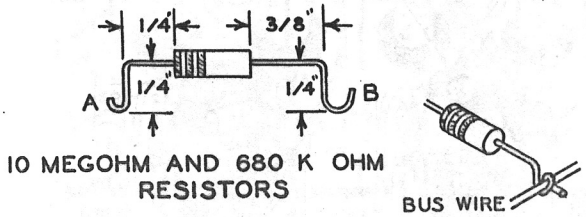
( ) In the same manner, connect the eight remaining red wires to sockets AH through AA. Solder all connections.

( ) Connect the red wire from terminal strip LG, lug 2 to the bus wire connected to terminal strip LR, lug 3 (S-1).

( ) Pass a 13 1/2" length of #14 bus wire through terminal strips LQ, lug 4 (NS), LR, lug 4 (S-1) and LS, lug 4 (S-1).

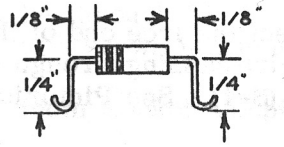
( ) Connect the orange lead from terminal strip LG, lug 1 to the bus wire just installed (S-1).

( ) On socket AI connect a short bare wire from pin 9 (NS) to pin 6 (NS). In the same manner, connect a bare wire from pin 9 (NS) to pin 6 (NS) on sockets AH through AA.



10 MEGOHM AND 680 K OHM RESISTORS

Figure 11



18 K OHM RESISTOR

Figure 12

( ) Prepare nine 10 megohm (brown-black-blue) 1/2 watt resistors as shown in Figure 11.

( ) Connect end A of one of the 10 megohm resistors to socket AI, pin 6 (S-2) and end B to the bus wire connected to terminal strip LQ, lug 3 (S-1).

( ) In the same manner, connect the remaining eight 10 megohm resistors to sockets AH through AA.

( ) Prepare nine 18 KΩ (brown-gray-orange) resistors as shown in Figure 12.

( ) On socket AI, connect one of the 18 KΩ resistors between pin 3 (NS) and pin 7 (NS).

( ) In the same manner, connect the eight remaining 18 KΩ resistors on sockets AH through AA.

( ) Prepare nine 680 KΩ (blue-gray-yellow) 1/2 watt resistors as shown in Figure 11.

( ) On socket AI, connect one of the 680 KΩ resistors from pin 3 (NS) to the bus wire connected to terminal strip LQ, lug 3 (S-1).

( ) In the same manner, connect the remaining eight 680 KΩ resistors to sockets AH through AA.

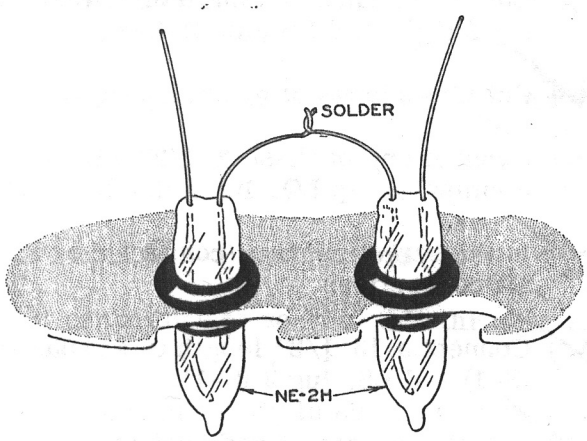


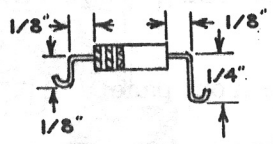
Figure 13

( ) Insert the eighteen NE-2H neon lamps in the rubber grommets adjacent to sockets AA through AI, as shown in Figure 13. Moistening the bulbs with saliva will make this easier.

CAUTION: The lead wires in the neon lamps may break if bent sharply against the glass seal. Any bending of the lead wire should not be closer to the glass than approximately 1/8".

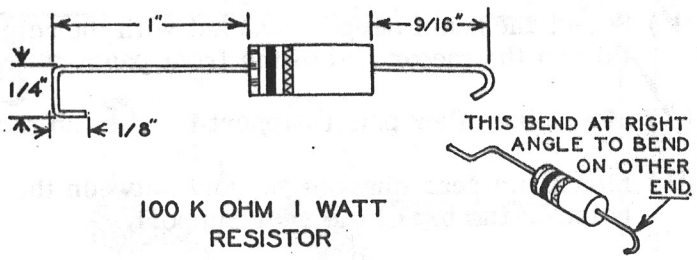
( ) Twist together the two near leads from the two bulbs adjacent to each socket (S-2), as shown in Figure 13.

( ) Connect the lead of the nearest NE-2H to pin 8 of the socket (NS). Do this for each of the nine sockets AA through AI.



2.2 MEGOHM RESISTOR

Figure 14



100 K OHM 1 WATT RESISTOR

Figure 15

( ) Connect the free lead of the other NE-2H to terminal strips TA through TI, lug 1 (NS).
( ) Prepare nine 2.2 megohm (red-red-green) 1/2 watt resistors as shown in Figure 14.

( ) Connect one of these 2.2 megohm resistors, just prepared, from socket AI, pin 8 (S-2) to terminal strip TI, lug 3 (NS).
( ) In the same manner, connect the remaining eight 2.2 megohm resistors to sockets AH through AA (S-2) and the corresponding terminal strips TH through TA (NS).

( ) Cut and strip nine 1 1/2" lengths of yellow hookup wire.
( ) Connect one of these wires between socket AI, pin 7 (S-2) and terminal strip TI, lug 3 (NS).
( ) Do the same for sockets AH through AA.
( ) Cut and strip nine 2 3/4" lengths of yellow hookup wire.

( ) Connect one of these wires to each of the terminal strips TA through TI, lug 3 (S-3). Leave the other end free.

( ) Prepare eight 100 KΩ (brown-black-yellow) 1 watt resistors as shown in Figure 15.

( ) Connect these eight resistors between terminal strips TA through TH, lug 1 (NS) and the bus wire running through terminal strips LQ, LR and LS, lug 4 (S-1).

( ) Connect a 100 KΩ, 1 watt resistor between terminal strip T1, lug 1 (NS) and terminal strip LQ, lug 4 (S-2).

( ) Cut the leads of each 200 $\mu\mu$f capacitor (#21-21) to 5/8".

( ) Connect a 200 $\mu\mu$f capacitor on socket AI, between pin 3 (S-3) and pin 9 (S-2).

( ) In the same manner, connect the remaining eight capacitors to sockets AH through AA.

This completes the chassis wiring for the time being. Check carefully to see that no errors or omissions have been made, and that all wire clippings have been removed.

MOUNTING CHASSIS TO PANEL

Refer to Figure 16 when doing the following operations.

In assembling the sheet metal parts, it is well to not tighten the screws until all are in place. This will allow for any adjustment necessary in lining up holes. After the parts are assembled, tighten all the nuts.

( ) Select the panel support bracket with the relay mounting holes. Using 6-32 hardware, mount this on the meter end of the front panel.

( ) Mount the other panel support bracket on the other end of the front panel.

( ) Mount the rear chassis support between the two panel support brackets. The edge with the holes is the top of the rear support.

Before performing the next operation, make sure that all of the leads from the amplifier balance switches are against the front panel. Also the four leads in the plastic tubing should lie against the front panel. These leads should all terminate under the chass[redacted]after the front panel is attached to the chassis.

( ) Mount the chassis between the panel support brackets and on top of the rear chassis support, using 6-32 hardware. On the end of the chassis nearest the filter capacitors, mount plastic cable clamps under the nuts of the two end screws. At the other end of the chassis, mount a solder lug under the nut of the middle screw.

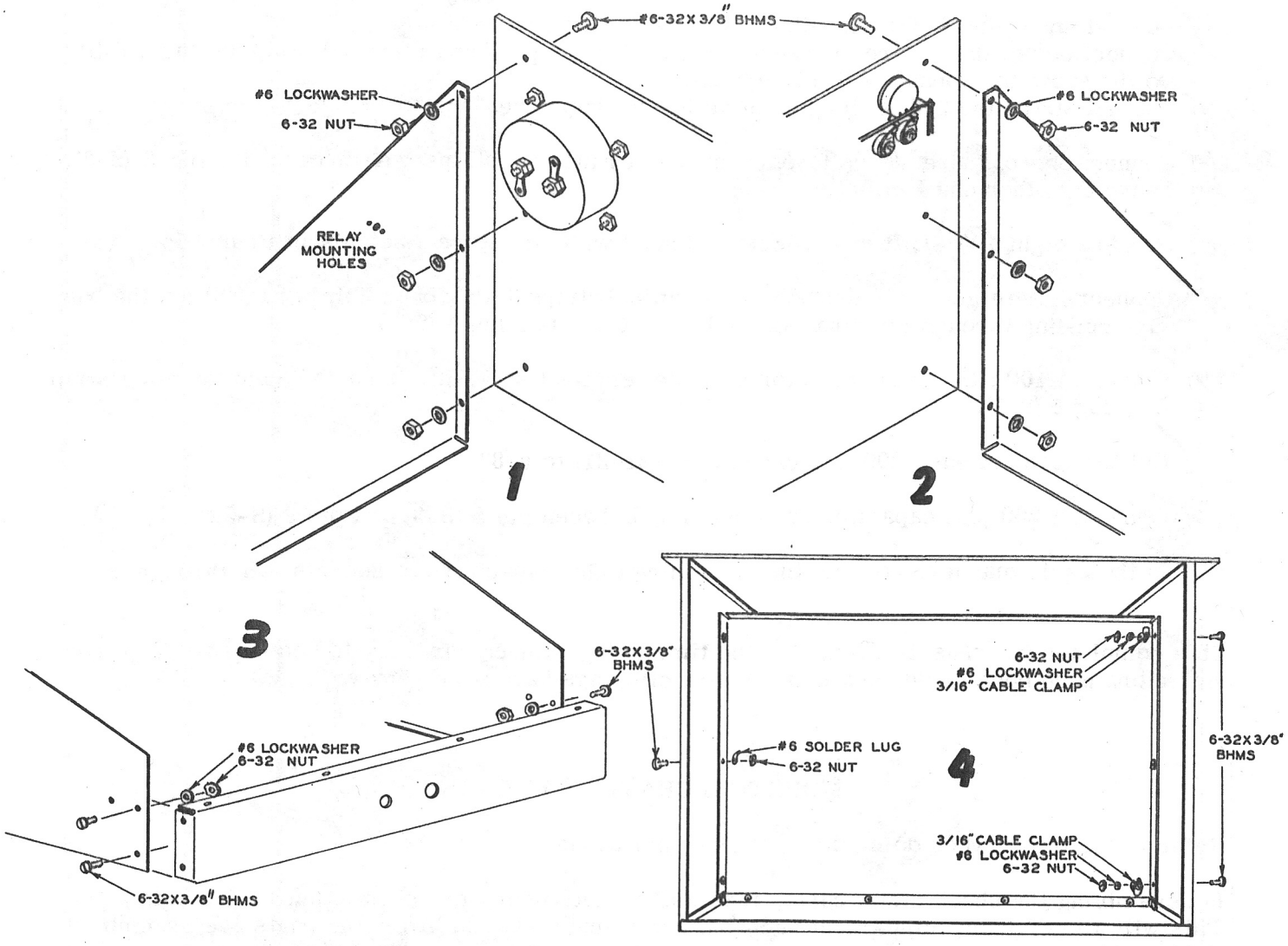


Figure 16

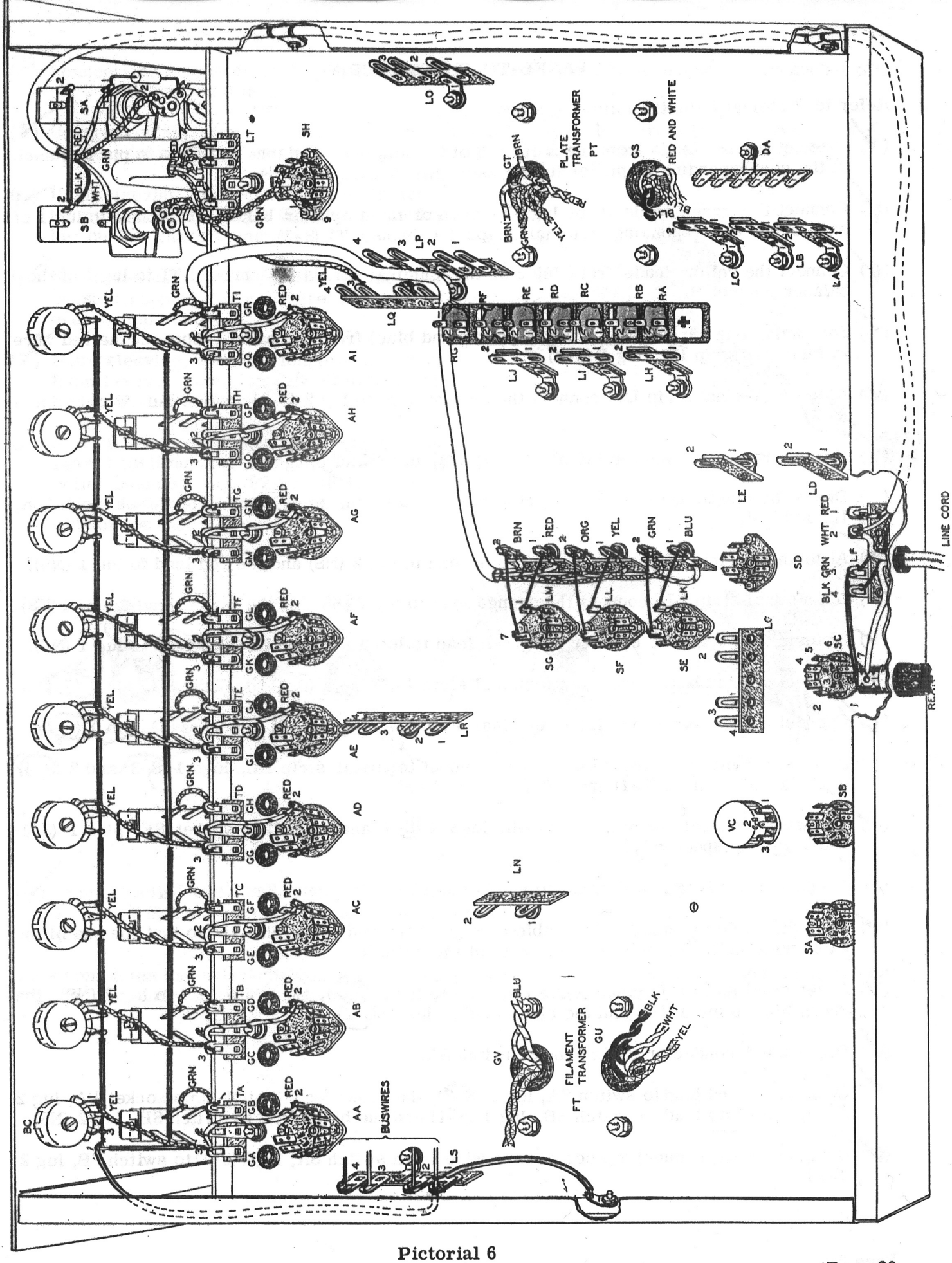


PLATE TRANSFORMER PT
RED AND WHITE
FILAMENT TRANSFORMER FT
BUSWIRES
LINE CORD
REAR

Pictorial 6

PANEL-TO-CHASSIS WIRING

Refer to Pictorial 6 for the following steps.

( ) Connect the red leads from lug 2 of each of the amplifier balance switches to pin 2 of each of the corresponding amplifier tube sockets AA through AI (S-1).

( ) Connect the green leads from lug 5 of each of the amplifier balance switches to lug 1 of each of the corresponding terminal strips TA through TI (S-3).

( ) Connect the yellow leads from lug 3 of the terminal strips TA through TI to lug 1 of the balance control BC (S-1).

( ) Select the four wires (red, orange, yellow and blue) from the panel. Connect the red wire to terminal strip LT, lug 1 (S-2).

( ) Also at terminal strip LT, connect the orange wire to lug 2 (S-2) and the blue wire to lug 3 (S-2).

( ) Connect the yellow lead to terminal strip LQ, lug 3 (S-2)

( ) Dress the plastic covered 6-conductor cable around the amplifiers to terminal strips LK, LL and LM.

( ) At terminal strip LM, connect the brown lead to lug 2 (NS) and the red lead to lug 1 (NS).

( ) At terminal strip LL, connect the orange lead to lug 2 (NS) and the yellow lead to lug 1 (NS).

( ) At terminal strip LK, connect the green lead to lug 2 (NS) and the blue lead to lug 1 (NS).

( ) Connect a short bare wire from terminal strip LM, lug 2 (S-4) to socket SG, pin 7 (S-1).

( ) Connect a short bare wire from terminal strip LM, lug 1 (S-3) to socket SG, pin 1 (S-1).

( ) In the same manner, using bare wire, connect terminal strip LL, lugs 1 (S-3) and 2 (S-4) to socket SF, pins 1 (S-1) and 7 (S-1) respectively.

( ) Likewise, connect terminal strip LK, lugs 1 (S-3) and 2 (S-4) to socket SE, pins 1 (S-1) and 7 (S-1) respectively.

( ) Prepare a 27" length of 4-conductor cable as shown in Figure 6 on page 13.

( ) Pass the cable through the two cable clamps at the end of the chassis so that the end of the cable with the long leads is at the front of the chassis.

( ) At terminal strip LF, connect the red lead to lug 1 (S-1), the white lead to lug 2 (NS), the green lead to lug 3 (NS) and the black lead to lug 4 (S-2).

( ) Dress the 4-conductor cable around switch SA.

( ) Connect the red lead to switch SA, lug 1 (S-2), the green lead to pilot lamp socket PA, lug 2 (S-1), the white lead to switch SB, lug 1 (S-1) and the black lead to switch SB, lug 2 (NS).

( ) Using sleeving, connect a piece of bare wire from switch SA, lug 2 (S-1) to switch SB, lug 2 (S-2).

( ) Connect the free ends of the green twisted pair from pilot lamp socket SB to socket SH, pin 5 (S-3) and pin 9 (S-2).

( ) Using sleeving, connect a #20 bare wire approximately 6" long from the bus wire through the nearest amplifier balance control BC, lug 3 (S-1) to terminal strip LS, lug 1 (NS).

( ) Using sleeving, connect a #20 bare wire from terminal strip LS, lug 1 (S-4) to the solder lug on the chassis mounting screw (S-1).

( ) Mount the fuse post assembly on the rear chassis support. See Figure 17. Do not overtighten the nut.

( ) Using sleeving, connect a length of bare wire from the fuse post, lug 2 (S-1) to terminal strip LF, lug 3 (S-4).

( ) Pass the line cord through the hole in the rear chassis support, using the plastic strain relief bushing. See Figure 18 for details. Leave about 3 1/2" of the cord on the inside of the chassis.

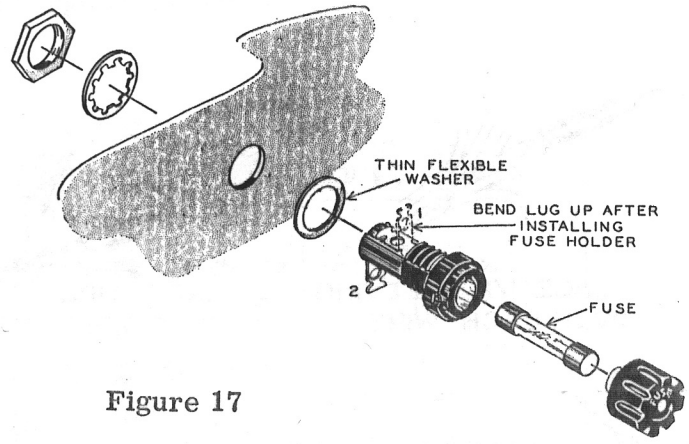


Figure 17

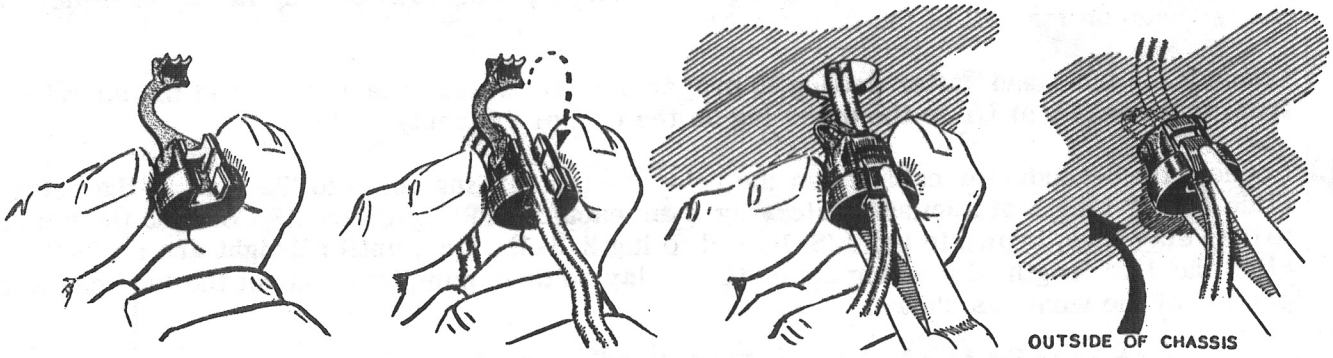
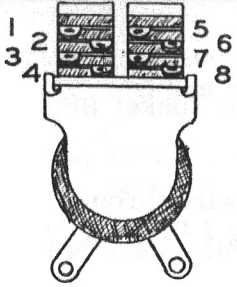


Figure 18

( ) Connect either of the line cord leads to terminal strip LF, lug 2 (S-2) and the other lead to the fuse post, lug 1 (S-1).

This completes the under-chassis wiring. Make sure that any wire clippings, loose solder and any other particles that might have dropped in the chassis are removed.



1 ——— BROWN
2 ——— RED
3 ——— ORANGE
4 ——— YELLOW
5 ——— GREEN
6 ——— BLUE
7 ——— VIOLET
8 ——— GRAY

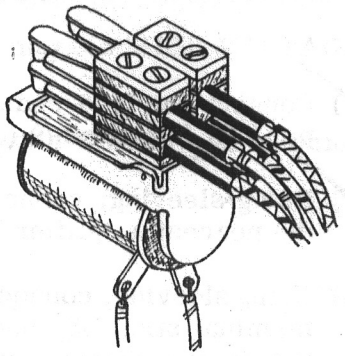
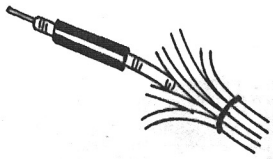
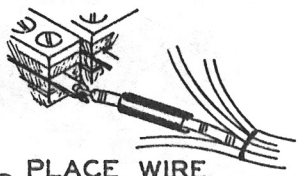


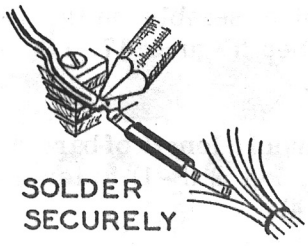
Figure 19



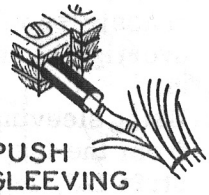
1 PLACE 1/2" SLEEVING OVER EACH WIRE



2 PLACE WIRE ON PROPER LUG



3 SOLDER SECURELY



4 PUSH SLEEVING UP OVER WIRE AND LUG

Figure 20

(✓) Mount the relay on the right panel mounting bracket, using the two 3-48 x 1/8" screws. The wiring lugs should be on top, that is, away from the chassis. See Figures 19 and 20.

( ) Connect the blue lead, after cutting to proper length, from switch OS, lug 2, to either of the two lugs on the coil of the relay (S-1).

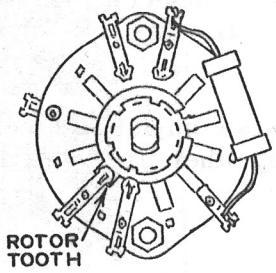
( ) Connect the blue lead, after cutting to proper length, which is one of four in the sleeving, from terminal strip LT to the other lug on the coil of the relay (S-1).

(✓) Connect the 8-conductor cable from the relay contact binding posts to the lugs on the relay. Slide a 1/2" length of insulating sleeving over each of the eight wires. Connect the wires to the relay lugs, brown to lug 1 (S-1), red to lug 2 (S-1), etc., until all eight are connected. Slide the 1/2" length of sleeving against the relay so as to completely cover the lug and bare portion of the wire, as shown.

This completes the wiring of the Computer. Carefully check all of the work completed to this point.

(✓) Install knobs on all the controls and switches on the panel, making sure the position of the pointer on each knob corresponds to the proper marking on the panel.

Since the meter function switch does not have stops, use the following procedure for proper indexing of the knob. Temporarily attach the knob to the shaft with the pointer in any position. Rotate the knob and shaft until the rotor of the rear deck of the switch is in the position shown. Loosen the setscrew and rotate the knob without rotating the switch shaft until the knob index points to AMPLIFIER OUTPUT 3. Then tighten the setscrew. The knob is now properly indexed.



(✓) Install binding post caps on the binding posts, referring to Figure 21 for information as to which binding posts receive red binding post caps and which receive black binding post caps.

(✓) Insert a #47 pilot lamp in socket PB. This is over the switch marked FILAMENT and has a green jewel.

(✓) Insert an NE-51 neon bulb in socket PA. This is over the switch marked HIGH VOLTAGE and has a clear jewel.

(✓) Insert a fuse in the fuse post assembly. Two fuses are provided with the kit, one of which is a spare.

(✓) *Insert the tubes in the proper sockets, as shown in Figure 22.*

This completes the assembly and wiring of the EC-1 Analog Computer.

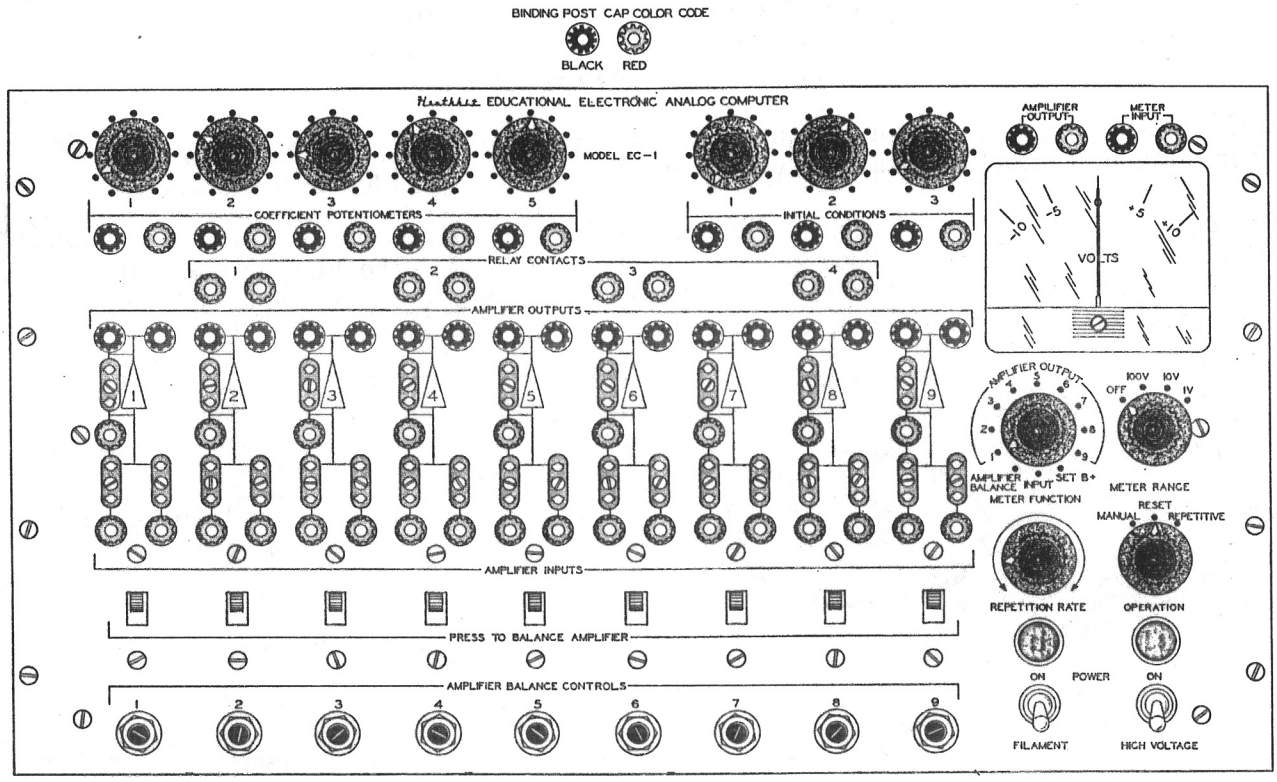


Figure 21

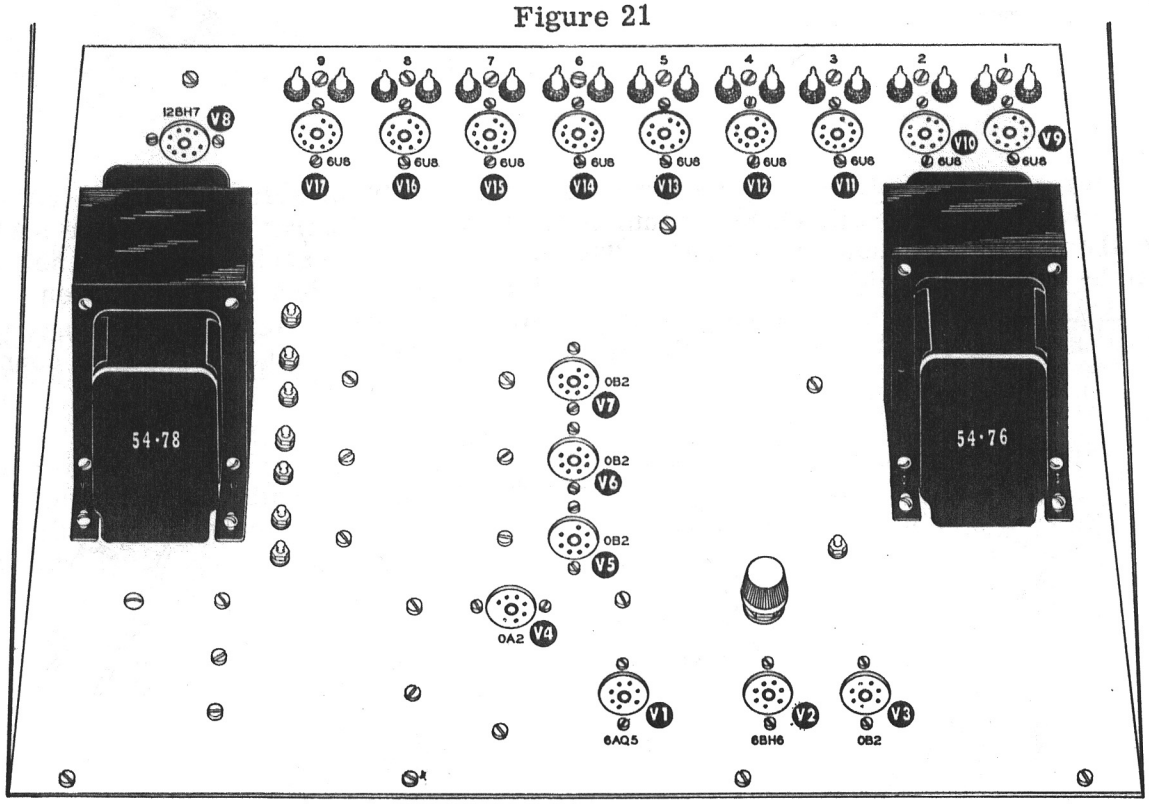


Figure 22

PREPARATION OF PATCH CORDS

Wire and banana plugs are provided for twenty-four patch cords. The number and lengths of patch cords required depend on the problem to be solved. As a starter, six 6", twelve 12" and six 18" cords are recommended.

( ) Cut six 6" lengths of red test lead wire. Strip both ends of each length.

( ) Cut twelve 12" lengths of red test lead wire. Strip as before.

( ) Cut six 18" lengths of red test lead wire. Strip as before.

( ) Attach banana plugs to both ends of each of the twenty-four prepared leads. See Figure 23 for method of attaching banana plugs to leads.

( ) Occasionally it is necessary to connect two leads to the same terminal of an amplifier. When this is necessary, hookup wire can be used under the binding post cap and a lead with banana plug can be plugged in the top of the binding post, as shown in Figure 24. By using different colors of wire, circuits may be traced more readily.

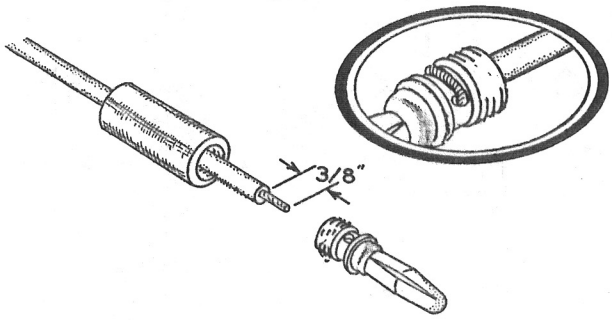


Figure 23

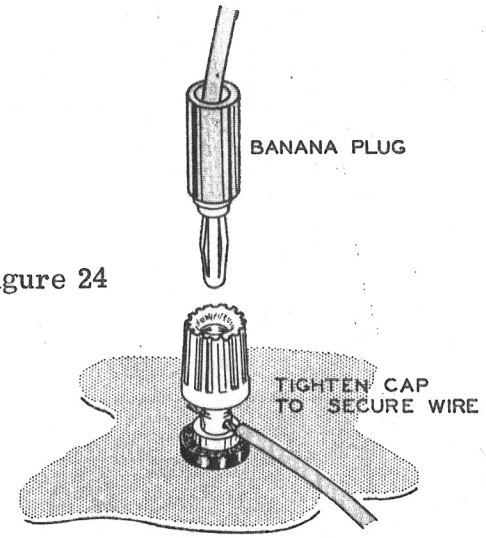


Figure 24

( ) Plugs are provided for mounting components used in problem solving. Suggested methods for the mounting of supplied components as well as special parts which may be needed for special problems are shown in Figure 25. The plugs fit into the sockets on the panel, making possible easy and rapid changes in values of components when solving problems. When mounting components on the plugs, it is recommended that the leads be left long enough so they can be doubled back before insertion into the plug. This will insure a better connection.

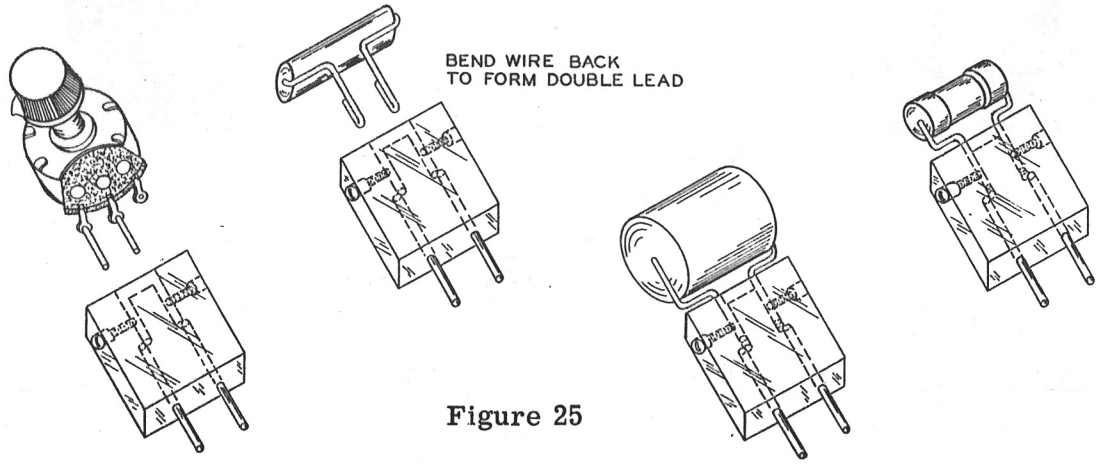


Figure 25

( ) Set both toggle switches in OFF position. Set all controls to full counterclockwise position. Set the operate switch to RESET, the meter range switch to OFF, and the meter function switch to SET B+.

( ) Plug the line cord into a 105-125 volt AC, 50-60 cycle outlet. Do not plug in a DC outlet or an outlet of other voltage or frequency as the Computer will not operate properly and may be damaged.

( ) Turn the filament switch to ON. The green pilot lamp should light, as should the filaments in all the tubes. The VR tubes (OA2 and OB2), having no filaments, will not light.

( ) Allow a few minutes for the tubes to become warm, then turn the high voltage switch to ON. The clear pilot lamp should light. The eighteen neon lamps in the amplifier circuits should also light, as well as the OA2 and the four OB2 tubes.

( ) The meter should read between +5 and +10. Adjust the control VC on the chassis until the meter needle is at SET B+ on the scale.

( ) Set the meter function switch to AMPLIFIER BALANCE and the meter range to 10 V. Starting with amplifier 1, press the slide switch under the amplifier terminals and, using a screwdriver, turn the amplifier balance control until the meter reads zero. Repeat with the meter range switch in the 1 V position.

( ) Repeat the above procedure for the remaining eight amplifiers.

( ) Set the meter function switch to INPUT and the meter range switch to 100 V. Connect the output of initial condition power supply 1 to the meter terminals marked INPUT. Turn the initial condition control clockwise. The meter should read over 100 volts when the control is in full clockwise position.

( ) Repeat for initial condition supplies 2 and 3.

( ) Turn the operate switch to MANUAL. The relay should operate, pulling in and holding. When the switch is returned to RESET, the relay should release.

( ) Turn the operate switch to REPETITIVE. The relay should open and close at a rate controlled by the repetition rate control. The rate should increase as the control is turned clockwise.

( ) Mount the rubber feet on the cabinet, using 8-32 hardware. Refer to Figure 26 for mounting detail.

( ) Place the Computer in the cabinet, using the 10-32 x 1/2" truss head screws for holding the panel in place. The positioning of the mounting holes is such that the Computer may be mounted on a standard relay rack, if desired.

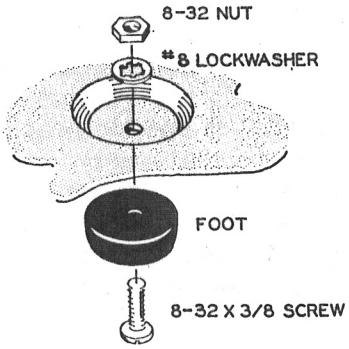


Figure 26

IN CASE OF DIFFICULTY

Carefully check the wiring. Marking the wiring in the Pictorials with a red pencil as the work is done will help avoid mistakes. Having a friend check the wiring will often expose an error consistently overlooked by the kit builder. Check the soldered connections. A large portion of the difficulties encountered are due to poorly soldered connections.

Check the tubes.

Check the voltages at the tube pins. These should fall within approximately 10% of the readings listed below if measured with a high impedance meter, such as a VTVM.

CIRCUIT	TUBE		TUBE PIN NUMBERS								
			1	2	3	4	5	6	7	8	9
+250 Volt Power Supply	6AQ5	V1	250	300	H	H	540	540	250	-	-
	6BH6	V2	102	102	H	H	250	150	102	-	-
	OB2	V3	104	0	0	0	104	0	0	-	-
-150 Volt Power Supply	OA2	V4	0	-144	0	-144	0	0	-144	-	-
Initial Condition Power Supplies	OB2	V5 thru V7	The voltage between pins 1 and 7 of the OB-2 of each of the supplies should be approximately 108 volts with pin 1 positive and pin 7 negative.								
Repetitive Oscillator (Reset Position)	12BH7	V8	70	-0.5	0	H	-0.5	-0.5	0	H	
Amplifier All 6U8's should read approximately the same	6U8	V9 thru V17	300	0	8-10	H	H	145	1	240	145

All voltages measured with respect to ground except in the case of the initial condition power supplies.

All voltages positive unless otherwise specified.

Measurements made with Heathkit VTVM, 11 megohms input impedance.

H indicates heater connection. 6.3 volts AC between pins indicated by H.

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

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

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

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

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

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.
4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)
5. Print or type your name and address, preferably in two places on the letter.

With the above information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. He will make no incorrect assumptions nor waste time checking files for the correct spelling of name and address. (The automatic letter opener sometimes cuts through the letter, hence the suggestion to print the name and address twice.) In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed instrument (including all connecting cables) to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a fixed fee of $25.00, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

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

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

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

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

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

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

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

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

SHIPPING INSTRUCTIONS

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

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

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

SPECIFICATION CHANGES

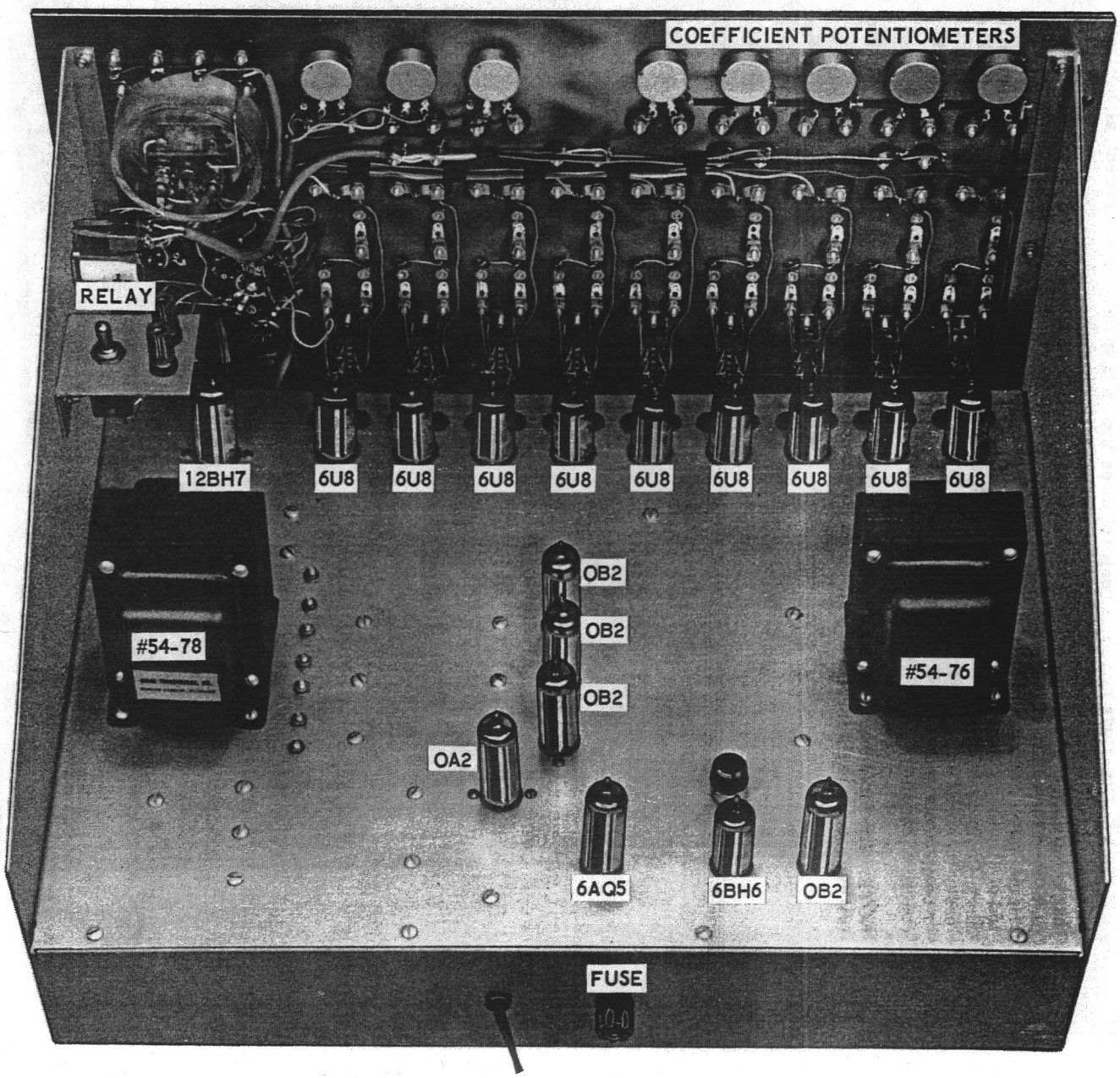
All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

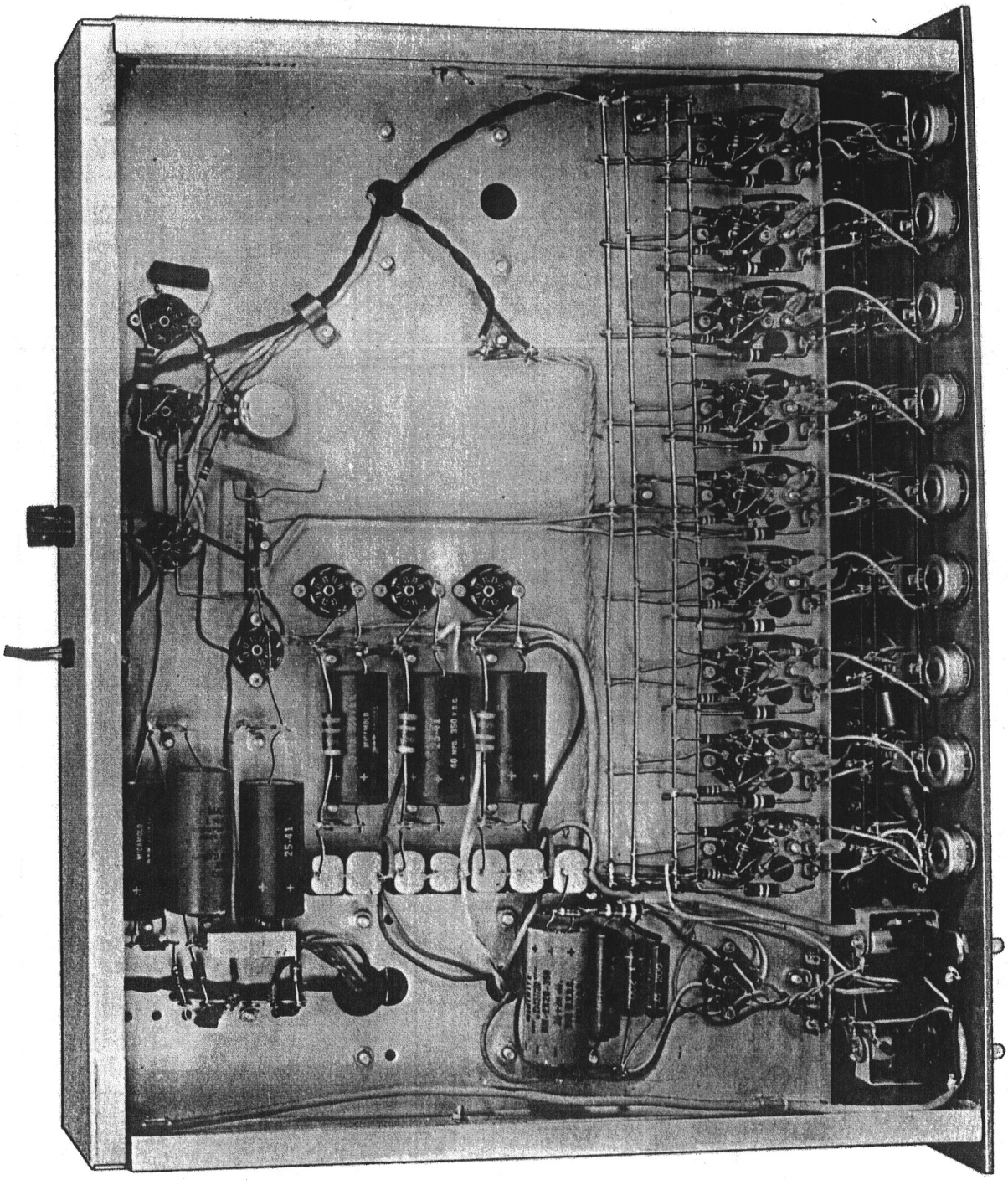
WARRANTY

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.

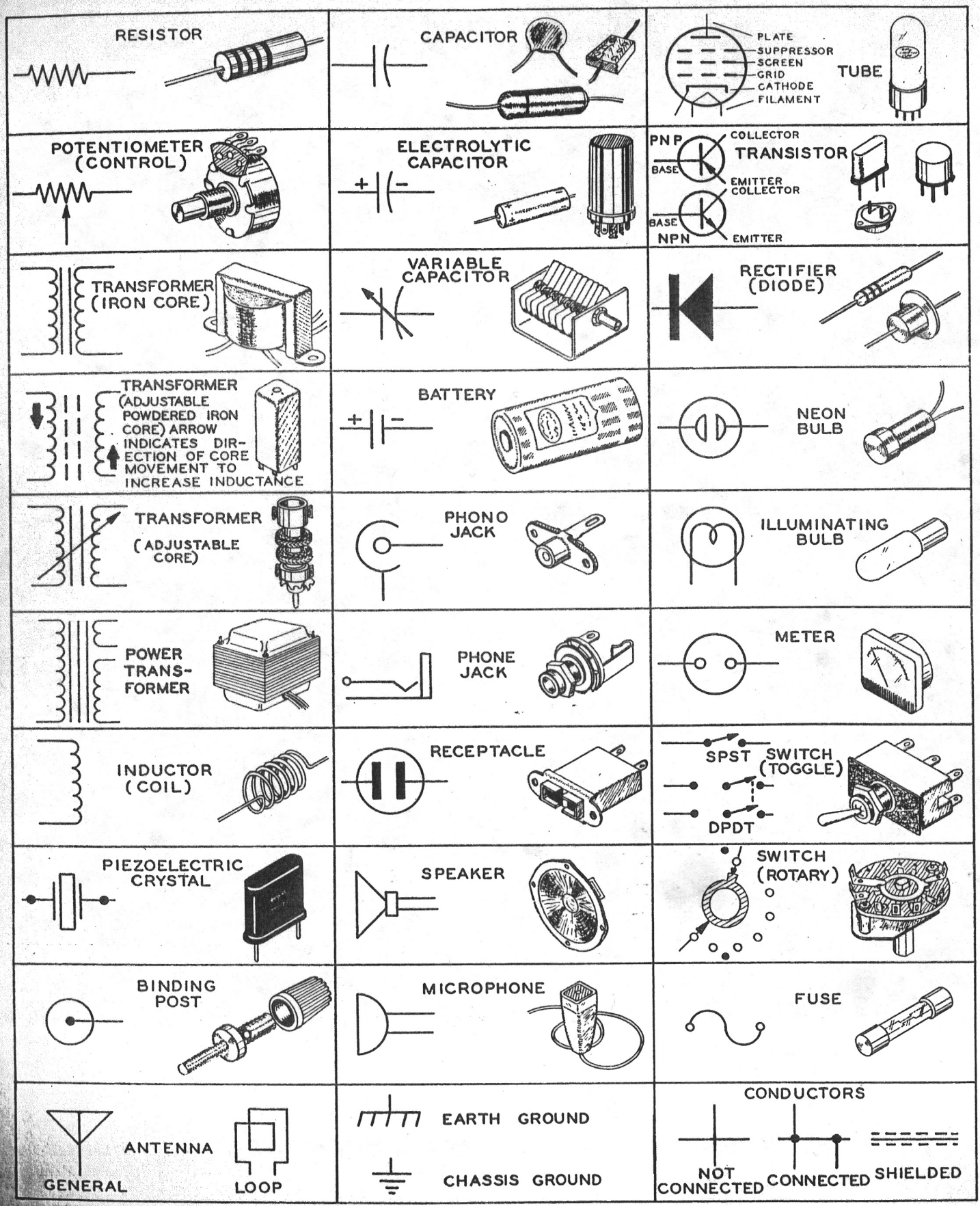
HEATH COMPANY


COEFFICIENT POTENTIOMETERS
RELAY
12BH7
6U8
6U8
6U8
6U8
6U8
6U8
6U8
6U8
6U8
#54-78
#54-76
OB2
OB2
OB2
OA2
6AQ5
6BH6
OB2
FUSE


25-41
40 MFD 350 VOLTS

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



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