

ASSEMBLING AND  
USING YOUR

*Heathkit*

Audio Generator  
Model AG-7



THE HEATH COMPANY  
BENTON HARBOR, MICH.

PRICE \$1.00

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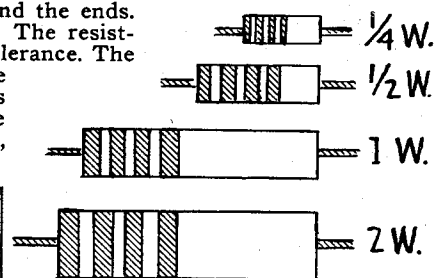
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## USEFUL INFORMATION FOR KIT BUILDERS

Resistors are identified by a color code used in several bands around the resistors. There are two general types of resistors. One, the uninsulated type, has the connecting wires bound around the ends. The other, the insulated type, has the wire connected internally and coming out the ends. The resistance code uses three bands or colors, while a fourth, usually silver or gold, indicates the tolerance. The colors are arranged so that the first two indicate the first two figures of the resistance, while the third indicates the number of digits (zeros or multiplier) which follow the first two figures. On un-insulated resistors, the body is the first figure, the end color the second figure, and the dot the number of digits. On insulated resistors, the band nearest the end is the first figure, the next band is the second figure and the third band the number of digits.

**WATTAGE.** Resistors are rated as to wattage (power dissipation) according to size. The chart shows approximate sizes which vary with manufacturers. To determine wattage size necessary multiply current through resistor in amperes by voltage drop across resistors in volts. Example — A plate loading resistor for a tube drawing 10 milliamperes (.01 Amperes) has a voltage on one side of 300 volts and on the other side 200 volts, giving a drop of 100 volts. Therefore  $100 \text{ volts} \times .01 \text{ A.} = 1 \text{ Watt}$ .

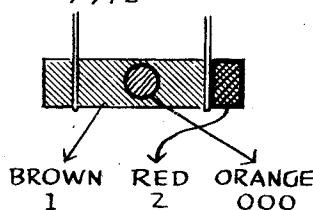
A higher wattage resistor can always be substituted for smaller size.



WATTAGE SIZES

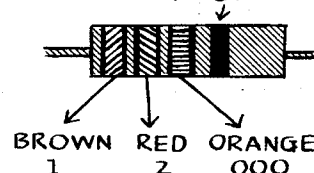
Uninsulated Insulated	Body Color First Ring	End Color Second Ring	Dot Color Third Ring
Color	First Figure	Second Figure	Number of Digits
Black	0	0	None
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Violet	7	7	0000000
Grey	8	8	00000000
White	9	9	000000000

UNINSULATED TYPE



Examples

INSULATED TYPE  
Fourth Band  
For Tolerance



### Some Popular Sizes of Resistors

RESISTANCE IN OHMS

50  
250  
1500  
30,000  
220,000  
1 Megohm

BODY OR FIRST BAND

Green  
Red  
Brown  
Orange  
Red  
Brown

END OR SECOND BAND

Black  
Green  
Green  
Black  
Red  
Black

DOT OR THIRD BAND

Black  
Brown  
Red  
Orange  
Yellow  
Green

The fourth ring or other end may be silver (10% tolerance) or gold (5% tolerance) or it may be omitted entirely which indicates 20% tolerance.

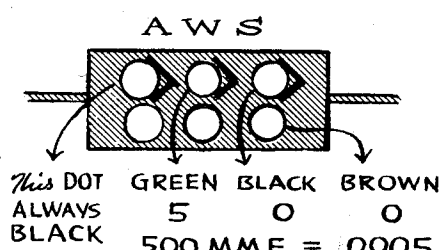
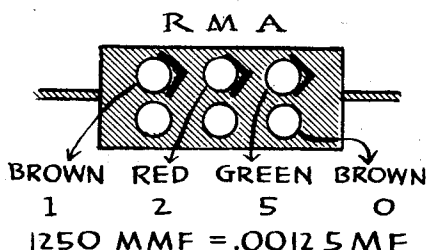
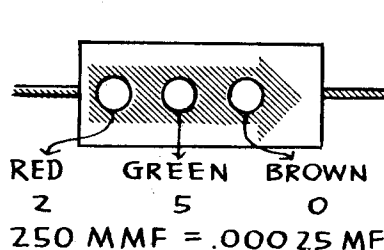
### Condenser Code

Condensers use the same code as resistors and are read in micromicrofarads.

If there is one row of dots, they are read in direction of arrow or if manufacturer's name appears in the same direction as name. If two rows of dots appear, it can either be of two different codes: The RMA or the AWS (American War Standard). In the RMA, the top row of dots are the first three figures (carried to three figures), the bottom row are left to right the voltage rating, tolerance, and decimal multiplier.

In the AWS code, the top row of dots are the first three figures while the bottom row are, left to right, characteristic, tolerance, and decimal multiplier.

### Examples



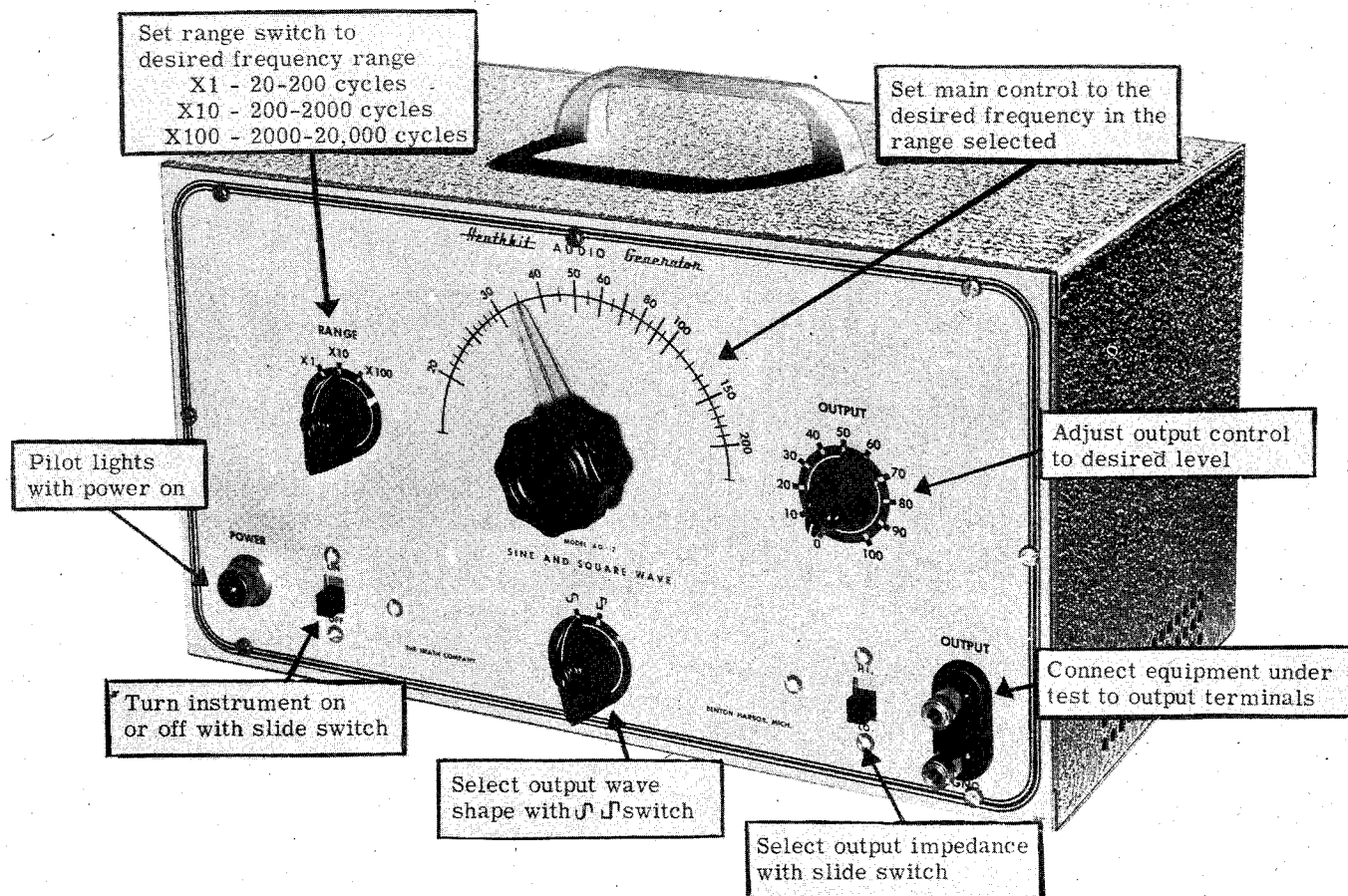
### Some Commonly Used Sizes of Condensers

MMF.	MF.	FIRST DOT	SECOND DOT	THIRD DOT
10	.00001	Brown	Black	Black
50	.00005	Green	Black	Black
100	.0001	Brown	Black	Brown
250	.00025	Red	Green	Brown
500	.0005	Green	Black	Brown
1000	.001	Brown	Black	Red
3000	.003	Orange	Black	Red
10,000	.01	Brown	Black	Orange

The tolerance rating corresponds to the color code, i.e., red — 2%, green — 5%, etc.

The voltage rating corresponds to the code multiplied by 100. Example: Orange dot — 300 volt rating; Blue — 600 volt rating.

# HEATHKIT MODEL AG-7 AUDIO GENERATOR



## SPECIFICATIONS

Output Frequency .....	20-20,000 cycles
Output Voltage at 1% Distortion .....	1 volt across 10,000 ohms
	5 volt across 33,000 ohms
	10 volt across 100,000 ohms
	.5 volt across 500 ohms
	1.0 volt across 1000 ohms
	1.5 volt across 2000 ohms
Square Wave Range .....	60 cycles (5% tilt) to 6000 cycles (5% round off)
Generator Impedance .....	HI: 15,000 ohms LO: 700 ohms
Power Requirements .....	105-125 volts 50/60 cycle 30 watts
Dimensions .....	7½" high x 13¼" wide x 7½" deep

# ASSEMBLY OF THE HEATHKIT

## MODEL AG-7

# AUDIO GENERATOR

The Heathkit Audio Generator will offer excellent operating characteristics if properly constructed. To insure many years of troublefree service, the assembly and wiring should be undertaken without hurrying. Take your time to do a good job.

This manual is intended to facilitate proper construction. THEREFORE READ THE MANUAL COMPLETELY THROUGH BEFORE PROCEEDING WITH THE CONSTRUCTION. In this manner you will become familiar with the contents of the manual. Then during construction you can readily refer back to specific paragraphs and pictorials.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing you will become acquainted with the parts. If a shortage is found, please notify us promptly, and attach the inspection slip to your claim. Screws, nuts and washers are counted mechanically, and if a few are missing, please secure them locally. Use the charts on the inside covers of this manual to identify the parts.

Read the note on soldering on the inside of the back cover. Make a good mechanical connection with clean metal to clean metal. Use only the best quality Rosin Core Radio type solder. Paste fluxes or acids are difficult to remove and even minute quantities left behind will combine with moisture from the air to form a corrosive product. This corrosive product is generally a good conductor and may cause short circuits between switch contacts or tube socket lugs. After weeks or months the corrosion may result in untimely failure of the instrument.

**NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES ARE USED.**  
(When in doubt about solder, it is recommended that a new roll plainly marked "Rosin Core Radio Solder" be purchased.)

Resistors and controls generally have a tolerance rating of plus or minus 20%, unless otherwise stated. Therefore a 10,000 ohm resistor may test anywhere from 8,000 to 12,000 ohms. The tolerance on condensers is generally even greater. Limits of minus 50% and plus 100% are common for paper tubular types. This Heathkit is designed to accommodate such variations.

Small changes in parts may be made by the Heath Company. All parts supplied will work just as well as the part for which it was substituted. By reading the color code on resistors, for instance, it will be readily understood that a value of 3.9 megohms is a substitute for the specified 3.3 megohms, or a resistor coded 8200 ohms is a substitute for the specified 10,000 ohms, provided the specified values are not supplied. Such changes will only be made if the specified parts are unobtainable at the time, and are only made to insure a minimum delay in filling your order.

The tube socket pins are numbered from 1 to 8, starting at the keyway and reading clockwise, when viewed from the bottom.

Follow the pictorial diagram for the best placement of the wiring. The "lead dress" or placement of the wires is quite important in this instrument as incorrect placement may result in higher distortion levels.

## STEP BY STEP ASSEMBLY

Use of bare wire where indicated will facilitate wiring, but insulated wire may be used. Use spaghetti (insulated sleeving) over bare wires on condensers and resistors where necessary to prevent the leads from accidentally touching other bare wires or metal parts. Use lockwashers under all 6-32 and 8-32 nuts and between all controls and panel. Read each paragraph fully through before proceeding.

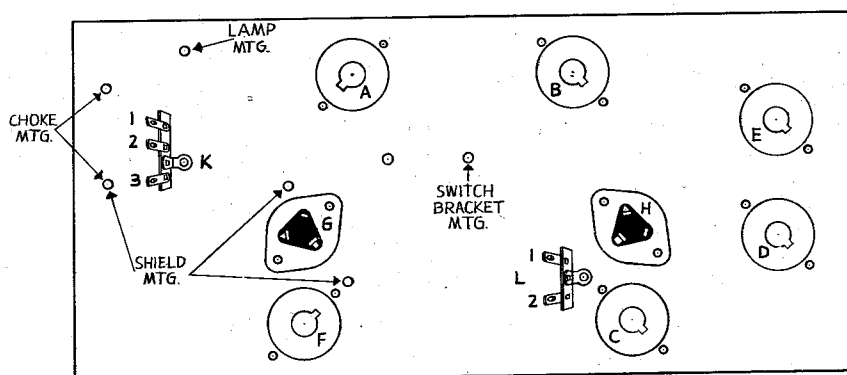
Check off each step in the space provided (✓) as it is completed.

(S) means solder the connection

(NS) means do not solder yet

### 1. Begin by mounting the parts.

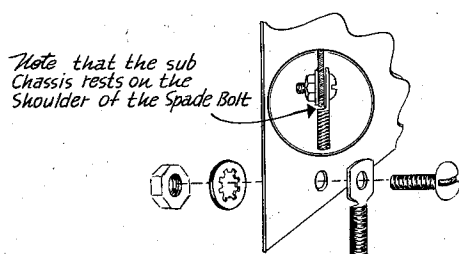
- ( ) On the chassis (AG67) mount the tube sockets (AR32) with the keyways as shown in the pictorials, using 6-32 screws and nuts.
- ( ) Mount the filter condenser mounting wafers (SW43) in the position shown with 6-32 screws and nuts.
- ( ) Mount the 2 lug terminal strip (S32) and the 3 lug terminal strip (SW37) in the proper position with 6-32 screws and nuts.
- ( ) Mount the lamp socket (G37) with a solder lug (O37) under the head of a 6-32 screw (on top of the chassis) and a nut below the chassis. Install the 3 watt lamp (G34).



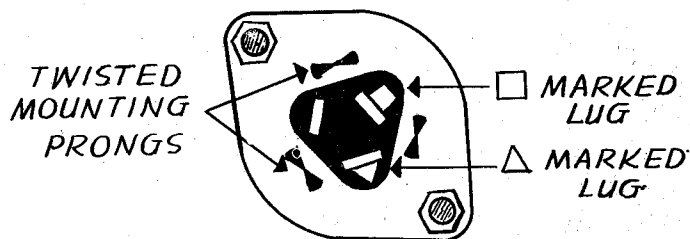
AG-7 CHASSIS BOTTOM

### 2. Continue mounting parts.






- ( ) Mount the switch bracket (AG71) as shown with a 6-32 screw and nut.
- ( ) Attach the spade bolts (G32) to the power supply shield (AG68) with short 6-32 screws and nuts as shown, and install the shield on top of the chassis with a nut on each of the two spade bolts nearest the center of the chassis.
- ( ) Install the filter choke (S35) using a nut on the third spade bolt to fasten one side and a 6-32 screw and nut on the other side.
- ( ) Install the filter condensers (SW20) by placing the mounting prongs through the slits in the wafers, and then twisting these prongs 1/8 turn with pliers. Observe the condenser lug markings and install as shown.
- ( ) Mount the power transformer (FM46) with 8-32 nuts.

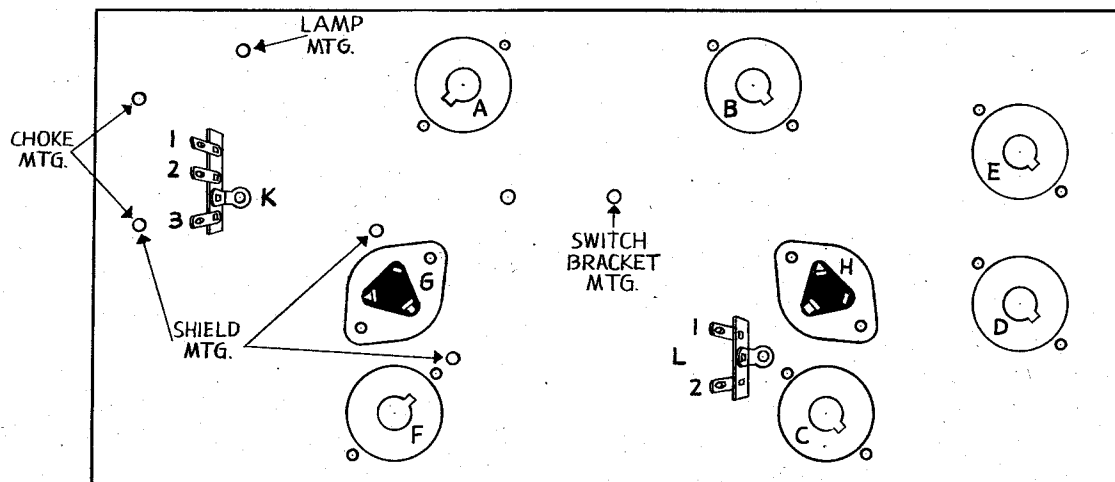


SPADE BOLT ASSEMBLY





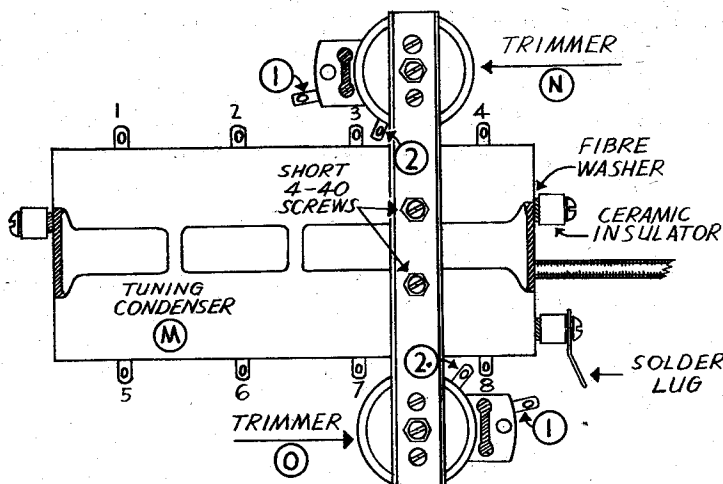
FILTER CONDENSER MOUNTING

3. Begin the wiring by connecting the transformer leads. Leads carrying A. C. current should be twisted together in pairs whenever possible to reduce the stray fields.
  - ( ) One red lead to pin #3 (S) and the other red lead to pin #5 (S) on socket F.
  - ( ) The red-yellow lead to the nearest ground lug (S) on socket F.
  - ( ) One green lead to pin #2 (NS) and the other green lead to pin #7 (NS) on socket F.
  - ( ) The black-red lead to lug 3 (NS) and the black lead to lug 2 (NS) on terminal strip K.
4. Start wiring the heater circuit.
  - ( ) Connect a wire to pin #2 (NS) and another wire to pin #7 (NS) on socket F, and, after twisting the wires together, connect the other end of the wires: one wire to pin #7 (NS) and the other wire to pin #8 (NS) on socket C.
  - ( ) In the same manner connect pins #7 (S) and #8 (S) on socket C to pins #2 (NS) and #7 (NS) on socket D.
  - ( ) Likewise pins #2 (S) and #7 (S) on socket D to pins #2 (S) and #7 (S) on socket E.
  - ( ) Also pins #2 (S) and #7 (S) on socket B to pins #2 (NS) and #7 (NS) on socket A.
5. Proceed with the wiring of the power supply section.
  - ( ) Connect the filter choke leads: one lead to the  marked lug (NS) and the other lead to the  marked lug (NS) on condenser G.
  - ( ) A bare wire to a twisted mounting prong (S) on condenser G, and through pin #1 (S) to the nearest ground lug (S) on socket F.
  - ( ) A bare wire to pin #8 (S) on socket F, and to the  marked lug (S) on condenser G.
  - ( ) A wire to the  marked lug (NS) on condenser G, and to lug 1 (NS) on terminal strip L.
  - ( ) A 10K resistor (O11) to the  marked lug (S), and to the unmarked lug (NS) on condenser G.



AG-7 CHASSIS BOTTOM

6. Continue the chassis wiring.
  - ( ) A wire to the unmarked lug (S) on condenser G, and to pin #6 (NS) on socket A.
  - ( ) A wire to the  marked lug (NS) on condenser H, and to pin #6 (NS) on socket B.
  - ( ) A wire to the  marked lug (NS) on condenser H, and to pin #3 (NS) on socket D.
  - ( ) A wire to pin #4 (NS) on socket D, and to pin #3 (NS) on socket E.
  - ( ) A wire to pin #8 (S) on socket D, and to pin #8 (NS) on socket E.
7. Prepare the tuning condenser for mounting. Handle these condensers with great care and always keep the plates fully meshed to prevent accidental damage.
  - ( ) Install the trimmer bracket (AG72) on the tuning condenser (G27A) with short 4-40 screws.
  - ( ) Install the trimmers (G25) on the trimmer bracket with 4-40 screws.
  - ( ) Install the ceramic insulators (G29A) with the long 6-32 screws and using a fibre washer (O27) between the insulator and the condenser. Install a solder lug (O37) under the head of one screw as shown.

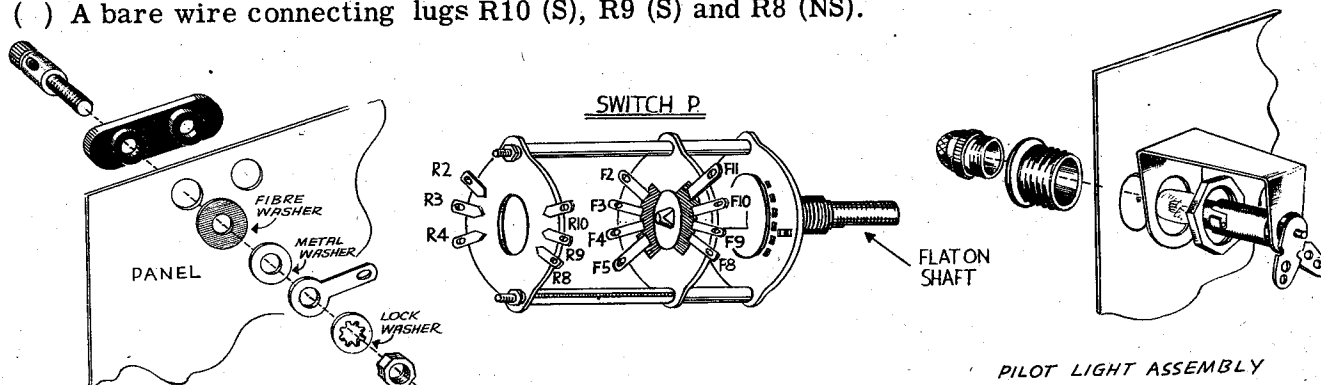


8. Wire the tuning condenser assembly and mount it on the chassis.

- ( ) A bare wire to lug 3 (S) on condenser M, and through lug 1 (NS) on trimmer N, to lug 2 (S) on condenser M.
- ( ) A wire to lug 2 (S) on trimmer N, and to the solder lug (NS).
- ( ) A wire to lug 5 (S), and to lug 8 (NS) on condenser M.
- ( ) A bare wire to lug 8 (S) on condenser M, and to lug 1 (NS) on trimmer O.
- ( ) A bare wire to lug 2 (S) on trimmer O, and to the solder lug (NS).
- ( ) Mount the assembly on the chassis with 8-32 screws.

9. Prepare the range switch (S34) (switch P).

- ( ) A 10 meg precision resistor (AG63) between lug F2 (S) and lug R2 (NS).
- ( ) A 1 meg precision resistor (AG62) between lug F3 (S) and lug R3 (NS).
- ( ) A 100K precision resistor (AG64) between lug F4 (S) and lug R4 (NS).
- ( ) A bare wire connecting lugs R2 (S), R3 (S) and R4 (NS).
- ( ) A 10 meg precision resistor (AG63) between lug F8 (S) and lug R8 (NS).
- ( ) A 1 meg precision resistor (AG62) between lug F9 (S) and lug R9 (NS).
- ( ) A 100K precision resistor (AG64) between lug F10 (S) and lug R10 (NS).
- ( ) A bare wire connecting lugs R10 (S), R9 (S) and R8 (NS).



10. Install the parts on the panel.

- ( ) Install the first panel bushing (G30) in the center with a control lockwasher and a control nut on the back of the panel.
- ( ) Mount the pilot light assembly (O40, O41, O42, O52) and install the pilot lamp (O39).
- ( ) Install the on-off slide switch (O94) as shown with 6-32 screws and nuts.
- ( ) Install the HI-LO slide switch (G59) with 6-32 screws and nuts.
- ( ) Install the output terminal assembly (IB31, IB32, IB33, IB34, IB36, IB37, IB38 and O109).
- ( ) Install the 100K output control (O58) with a control lockwasher between control and panel and a nickel washer between the panel and the control nut.
- ( ) Install the range switch assembly in the same manner with the flat on the shaft towards the bottom edge of the panel.

11. Fasten the panel to the chassis and finish mounting the parts.

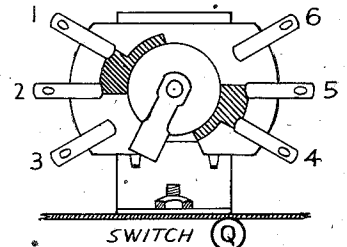
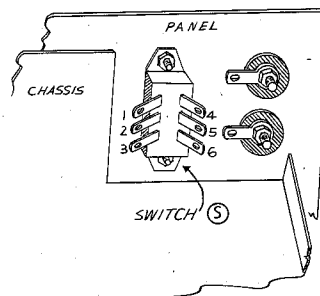
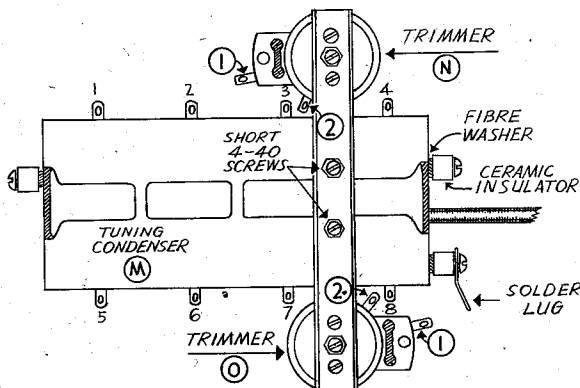
- ( ) Fasten the shaft coupling (G39) on the tuning condenser shaft and attach the extension shaft (G33) to the coupling.
- ( ) Fasten the panel to the chassis with two 6-32 screws and nuts and the second panel bushing.
- ( ) Install the  $\sim$  switch (AG65) on the switch bracket with a control lockwasher under the control nut.
- ( ) Install the knobs (O51, G38) and make sure that the pointer positions check with the panel markings.
- ( ) Install the line cord grommet (O35) in the rear edge of the chassis.

12. Wire the range switch and the tuning condenser.

- ( ) A wire to lug 1 (S) on trimmer N, and straight down to the chassis and then over to the solder lug (NS) below switch P.
- ( ) A bare wire to lug R8 (S) on switch P, and to the solder lug (S) on the chassis.
- ( ) A wire to lug F5 (S) on switch P, and to lug 1 (S) on trimmer O.
- ( ) Install the 6J7 tube (AG69) in its socket and install the grid cap (K18).
- ( ) A wire to lug F11 (S) on switch P, and to the solder lug (NS) on the tuning condenser assembly.
- ( ) A wire to this solder lug (S), and to the grid cap (S) on the 6J7 tube.

13. Complete the wiring between the above-chassis and below-chassis areas.

- ( ) A wire to lug R4 (S) on switch P, and through the chassis hole below trimmer O to lug 2 (NS) on the  $\sim$  switch Q.
- ( ) A wire to pin #5 (S) on socket D, and to lug V (S) on output control R.
- ( ) A wire to lug R (S) on control R, and to pin #6 (NS) on socket E.
- ( ) A bare wire to lug L (S) on control R, and to the solder lug (NS) on the output terminal marked GND.



14. Continue the below-chassis wiring.

- ( ) In the same manner as in step 4 connect pins #2 (S) and #7 (S) on socket F to the two lugs (NS) on the pilot light socket.
- ( ) Likewise connect the two lugs (S) on the pilot light socket to pins #2 (S) on #7 (NS) on socket A.
- ( ) Also connect the two lugs (S) on the on-off switch to lugs 1 (NS) and 2 (S) on terminal strip K.
- ( ) A bare wire to the solder lug (S) on the output terminal marked GND, and through lug 4 (S) on the output switch S, on through the nearest ground lug (S) and to pin #5 (S) on socket E.
- ( ) A wire to the solder lug (S) on the unmarked output terminal, and to lug 2 (S) on switch S.
- ( ) A wire to lug 6 (S) on switch Q, and to pin #5 (NS) on socket C.

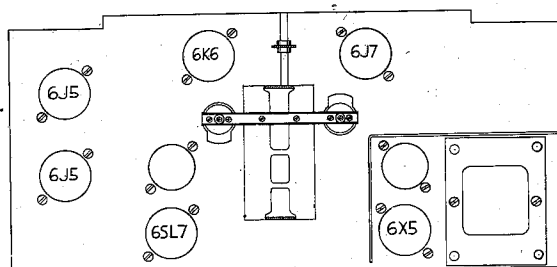
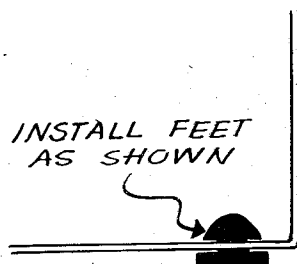


15. Complete the wiring on the 6J7 oscillator tube socket A.
  - ☐ A bare wire to one lug (S) on the lamp socket, and through pin #1 (S) to the nearest ground lug (S).
  - ☐ A bare wire to the other lug (S) on the lamp socket, and through pin #8 (NS) to pin #5 (S).
  - ☐ A bare wire to pin #7 (S), and to the nearest ground lug (S).
  - ☐ A 47K resistor (A10) to pin #4 (NS), and to the nearest ground lug (S).
  - ☐ A 100K resistor (O12) to pin #4 (S), and to pin #6 (NS).
  - ☐ A 100K resistor (O12) to pin #6 (S), and to pin #3 (NS).
  - ☐ A .1 condenser (O49) to pin #3 (S) on socket A, and to pin #5 (NS) on socket B.
  - ☐ A 3600 resistor (G11) to pin #8 (S), and to lug 2 (NS) on switch Q.
16. Complete the wiring on the 6K6 tube socket B.
  - ☐ A 470K resistor (O18) to pin #5 (S), and to the nearest ground lug (S).
  - ☐ A 33K resistor (BV23) to pin #4 (S), and to pin #6 (NS).
  - ☐ An 8 MFD condenser (O50) with the positive lead to pin #3 (NS), and the other lead to lug 2 (S) on switch Q.
  - ☐ An 820 resistor (G10) with one lead to pin #8 (S), and with the other lead through a ground lug (S) to pin #1 (S).
  - ☐ A 10K-2 watt resistor (AG70) to pin #3 (S), and to pin #6 (S).
17. Continue with the wiring on the 6SL7 tube socket C.
  - ☒ A bare wire to the nearest twisted mounting prong (S) on condenser H, and to the nearest ground lug (S) on socket C.
  - ☒ A 47K-1 watt resistor (G18) with one lead through pin #6 (NS) to the unmarked lug (NS) on condenser H, and the other lead to the nearest ground lug (S).
  - ☒ A 47K-1 watt resistor (G18) to the unmarked lug (S), and to the ☐ marked lug (NS) on condenser H.
  - ☒ A 10K resistor (O11) to pin #5 (S), and to the ☐ marked lug (NS) on condenser H.
  - ☒ A 10K resistor (O11) to pin #6 (S), and through pin #4 (S) to pin #2 (S).
18. Complete the wiring around the 6SL7 tube socket C.
  - ☒ A 470K resistor (O18) to lug 2 (NS) on terminal strip L, and through pin #3 (S) to the nearest ground lug (S).
  - ☒ A 470K resistor (O18) to lug 2 (NS) on terminal strip L, and to pin #1 (S).
  - ☒ A .25 condenser (O97) to lug 3 (S) on switch Q, and to lug 2 (S) on terminal strip L.
  - ☒ A 1000 resistor (SW12) to lug 1 (S) on terminal strip L, and to the ☐ marked lug (NS) on condenser H.
  - ☒ A 2700 resistor (K10) to the ☐ marked lug (S), and to the ☐ marked lug (S) on condenser H.
19. Continue with the wiring on the 6J5 tube sockets D and E.
  - ☒ A bare wire to pin #1 (S), and to the nearest ground lug (S) on socket D.
  - ☒ A 47K resistor (A10) to pin #3 (S), and to pin #4 (S) on socket D.
  - ☒ A bare wire to pin #1 (S), and to the nearest ground lug (S) on socket E.
  - ☒ An 8 MFD condenser (O50) with the positive lead to pin #3 (S) on socket E, and with the other lead to lug 3 (S) on switch S.
  - ☒ A .25 condenser (O97) to pin #4 (NS) on socket E, and to lug 5 (S) on switch Q.
20. Complete the wiring of the instrument.
  - ☒ A 390K resistor (SG54) to pin #4 (S), and to pin #6 (S).
  - ☐ A 470 resistor (O14) to pin #8 (NS), and to lug 5 (S) on switch S.
  - ☐ A 100 MFD condenser (AG73) to pin #8 (S), and through lug 6 (S) to lug 1 (S) on switch S.
  - ☐ A bare wire to lug 1 (S), and to lug 4 (S) on switch Q.
  - ☐ Place the line cord (O78) through the grommet in the rear of the chassis and tie a knot inside the chassis to keep it from being pulled out.

Allow sufficient length inside the chassis to permit it to be dressed around the transformer as shown. Connect one lead to lug 1 (S), and the other lead to lug 3 (S) on terminal strip K.

21. Complete the instrument.

- ( ) Install the 6K6, 6SL7, both 6J5, and the 6X5 tubes in their proper sockets.
- ( ) Install the rubber feet (O34) in the four holes in the bottom of the cabinet.
- ( ) Install the handle (O79) with two 10-24 screws in the top of the cabinet.
- ( ) After making the initial adjustments, install the instrument in the cabinet and fasten with two #6 screws through the rear into the chassis, and with seven #6 screws through the panel into the cabinet.



AG-7 TOP VIEW

### INITIAL ADJUSTMENTS

The initial adjustments compensate for variations in component parts and wiring capacities. If these adjustments are properly made, the output voltage will be constant within 1 db over the whole frequency range, and the dial calibration will closely coincide with the output frequency.

As a starting point set the trimmer nearest the 6J7 tube so the plates are  $\frac{3}{4}$  meshed. Set the other trimmer so the plates are  $\frac{1}{4}$  meshed.

Plug the line cord into a 105-125 volt 50/60 cycle AC outlet only. (CAUTION: This instrument will not operate and the power transformer may be damaged if plugged into a 25 cycle or DC outlet.) Switch the instrument on and allow a minute for the tubes to heat up.

Turn the output control not over halfway on, and set the range switch in the x10 position. With the tuning control set for the lowest frequency (main condenser fully meshed) check and note the output voltage on a meter or an oscilloscope. This is the reference voltage.

If a meter is used, proceed as follows: Without touching the output control, set the range switch in the x1 position. Observe the fluctuation of the meter pointer as the tuning control is turned past 60. Near the 60 mark, the fluctuations slow down to a standstill (zero beat). This same effect may be noted to a lesser extent near the 30, 120 and 180 markings.

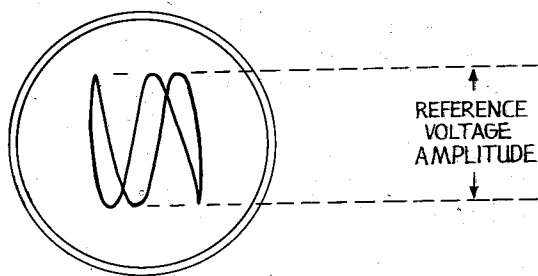
Set the pointer on the tuning control to 180. With a non-metallic screwdriver adjust both trimmers slightly (one at a time) to produce the zero beat (indicating proper frequency calibration) and also the reference voltage (showing constant output level). Each trimmer is generally capable of producing either the desired zero beat or the constant output level, but only one combination of trimmer settings will result in constant output and proper calibration.

If an oscilloscope is used, proceed as follows: Connect a signal of line frequency (60 cy. test) to the horizontal input. Connect the output from the audio generator to the vertical input. Set the oscilloscope gain controls to a convenient size trace. Without touching the output control set the range switch in the x1 position. Turn the tuning control and observe the circular pattern obtained near the 60 mark, and the stationary patterns obtained near the 30, 120 and 180 markings.

Set the pointer on the tuning control to 180. With a non-metallic screwdriver adjust both trimmers slightly (one at a time) to produce the stationary pattern illustrated (indicating proper frequency calibration) and also the reference voltage amplitude (showing constant output level).

If both a meter and an oscilloscope are available, it may be found convenient to use the meter for the output voltage measurement while the oscilloscope indicates the correct frequency.

The calibration may be affected slightly when the instrument is installed in the cabinet. The adjustments should therefore be rechecked and possibly readjusted to compensate for such variations.



The fluctuation of the meter pointer at 60 cycles is the result of pickup of stray electrostatic fields (hum pickup) by the tuning condenser and other parts in the grid circuit of the 6J7 tube. Installation in the cabinet eliminates this effect.

### IN CASE OF DIFFICULTY

If the instrument fails to perform properly, locate the trouble as outlined.

1. Check the wiring by following each wire on the pictorial and in the instrument, inspecting the soldered connections on each end, and then checking off that wire in the pictorial with a colored pencil. This will reveal mistakes and omissions in wiring, which is the most frequent cause of difficulties.
2. Check the voltages between tube socket pins and chassis. The readings should come reasonably close to the values tabulated below, if a vacuum tube voltmeter with 11 megohm input resistance is used. Other type meters may give considerably lower readings. If a voltage reading fails to check with the tabulation, investigate the portion of the circuit involved (by checking the resistors and condensers for instance), and determine the cause.

Socket	A	B	C	D	E	F
Pin	6J7	6K6	6SL7	6J5	6J5	6X5
1	0	0	5-15 NEG	0	0	0
2	5-7 AC	*	110-140	*	*	*
3	130-170	130-170	0	210-250	110-150	210-250AC
4	50-80	140-180	110-140	Tie Point	Tie Point	No Conn.
5	1-3	1-3 NEG	230-270	0	0	210-250AC
6	Tie Point	Tie Point	120-150	No Conn.	Tie Point	No Conn.
7	0	*	*	*	*	*
8	1-3	10-15	*	3-7	3-7	280-320

\*VOLTAGE BETWEEN PINS IS 5-7 VOLTS AC.

Voltage readings may be expected to fall within the ranges indicated. Readings outside these ranges are not necessarily indicative of faulty operation.

3. If a part is found to be faulty, please return it promptly for a replacement, and attach a letter to the package describing the nature of the fault.
4. If the generator operates improperly, particularly on the lowest band, the feedback may require adjustment. A slight adjustment in the 3600 ohm resistor (G11) by adding 50 ohms or more in series or 100,000 ohms or less in parallel (shunt) may correct the condition.
5. Should the procedure outlined above fail to clear up the difficulty, write to the Heath Company, describing the trouble encountered by giving all possible details, such as voltage readings. We will attempt to analyze your trouble and advise you accordingly.

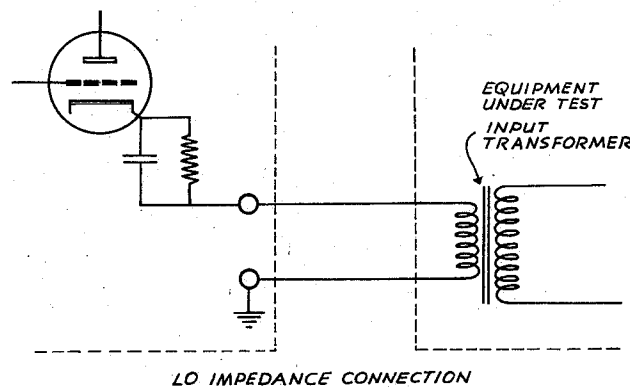
IN ALL CORRESPONDENCE REFER TO THIS INSTRUMENT AS THE MODEL AG-7 AUDIO GENERATOR.

### CIRCUIT DESCRIPTION

**OSCILLATOR.** The oscillator section is a two stage resistance coupled amplifier with both positive and negative feedback over both stages. Positive feedback is applied through a frequency selective circuit comprising resistors and condensers. This section determines the oscillator frequency. The negative feedback is used to stabilize the operation of the circuit, and is applied through a voltage dividing network. A part of this network consists of a non linear resistor (3 watt lamp). This lamp controls the amount of feedback and thus provides stable operating conditions.

**CLIPPER.** The square wave is generated by feeding the sine wave output from the oscillator into a clipper circuit. This circuit uses a two stage direct coupled amplifier. The signal overloads the amplifiers and thus clips the peaks of the sine wave input. Thus only a square wave remains.

**AMPLIFIER.** The output from the oscillator is fed either through the clipper or directly into the output amplifier. This amplifier isolates the oscillator from the external load. The signal is passed through a gain control (Output Control) into the grid of a triode cathode follower. For low impedance output, the cathode resistor is bypassed and the low impedance (500-600 ohm) transformer primary winding of the equipment under test forms the load impedance for the cathode follower. For high impedance output (10,000 ohms and up), the cathode resistor is not bypassed, and drives a grounded grid triode amplifier. The output from the plate circuit is then available at the output terminals.



### ACCURACY

The accuracy of the frequency calibration depends on the initial adjustment, the accuracy of the tuning condenser and the accuracy of the multiplier resistors. In addition to these factors, the phase shift at the higher frequencies causes the oscillation to occur at a frequency lower than predicted.

This phase shift will vary with wiring capacity and the oscillator frequency at the high end of the highest range may fall short by as much as 10% of the calibration. On the lower ranges, the calibration should fall within  $\pm 3\%$ .

For precision work, the use of Lissajous figures derived from the power line frequency present convenient calibration points on the lower frequency ranges.

## APPLICATION

This instrument may be used as a source of sine wave audio voltage with a distortion of less than 1% at any frequency between 20 cycles and 20,000 cycles.

The high impedance output circuit is designed to work into a high impedance load. The maximum output voltage with 1% distortion varies with the load resistance and is approximately 1 volt at 10,000 ohms, 5 volts at 30,000 ohms and 10 volts at 100,000 ohms. The source impedance of the instrument is approximately 15,000 ohms.

The low impedance output circuit is designed to work into a low impedance transformer primary with negligible DC resistance. The maximum output voltage with 1% distortion varies with the transformer characteristics (and therefore the frequency) and the load resistance, and is approximately 0.5 volt at 500 ohms, 1.0 volt at 1000 ohms and 1.5 volts at 2000 ohms. The source impedance is approximately 700 ohms. Resistance loads of 500 to 2,000 ohms may be used with a slight decrease in maximum output voltage with 1% distortion.

The square wave output, while usable over the full frequency range covered, is substantially square over a range of frequencies between 60 cycles (5% tilt) and 6000 cycles (5% round off).

The sine wave output is suitable for applications when a constant level low distortion source of audio frequency signals is required, such as fidelity and distortion measurements on amplifiers, speaker testing and operation of A. F. bridges.

The square wave output is particularly useful in applications requiring rapid determination of frequency and phase response characteristics of amplifiers and networks.

## BIBLIOGRAPHY

For additional reading material about Audio Generators and their applications, we suggest the many articles in the popular radio and service magazines, such as:

### RADIO AND TELEVISION NEWS (RADIO NEWS)

January	1944	Square Wave Testing of Amplifiers
September	1945	Audio Oscillators and Their Applications
August	1946	Audio Oscillators
November	1946	Low Cost Audio Oscillator
December	1946	Simple Square Wave Generator
January	1947	R-C Audio Oscillator
March	1950	Square Wave Clipper
June	1950	Audio Oscillator and VTVM
August	1950	100 Kc. Square Wave Generator
September	1950	Wide Range R-C Oscillator
October	1950	Square Wave Generator
November	1950	R-C Beat Frequency Oscillator

## ELECTRONICS

September 1948 Low Frequency Oscillator

## RADIO ELECTRONICS (RADIO CRAFT)

August-September	1947	Bandsread Audio Oscillator
May	1948	Laboratory Type Oscillators
July	1948	Audio Generator
August	1948	Single Control Audio Oscillator
October	1948	Calibrating Audio Oscillators
February	1949	Versatile Audio Oscillator
August	1949	Laboratory Square Wave Generator
July	1950	Square Wave Analysis
July	1950	Extended Range Oscillator

An excellent description of the principles of R-C oscillators may be found in the "H. P. Journal," Volume 1 Nos. 3 and 4, November and December 1949, published by the Hewlett-Packard Company, Palo Alto, California, under the title of "Design Notes on the Resistance-Capacity Oscillator Circuit." The Hewlett-Packard name has for years been synonymous with R-C oscillators as they manufacture the greatest variety of the finest equipment of this type.

## SERVICE

If correspondence fails to clear up operational difficulties of the completed instrument, the facilities of the Heath Company Service Department are available.

The Heath Company Service Department will inspect your instrument and put it into operating condition for a service charge of \$5.00 plus the cost of any new parts or extra labor required because of damage through improper construction.

As an assurance to the customer that the Heath Company stands solidly behind all its products and will do its utmost to insure proper operation of every kit, it is making this service available until one year from purchase date.

After this time limit, repair work will still be accepted, but the cost of repairs will be determined after an examination by the Heath Company Service Department, and the customer will be advised of the cost before work is begun.

NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag, giving name, address and trouble experienced, to the unit. Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. DO NOT use folded newspaper. DO NOT ship in original carton only. Ship by prepaid express if possible. Return shipment will be made by express collect.

NOTE that a carrier cannot be held liable for damage in transit if packing, in HIS opinion, is insufficient.

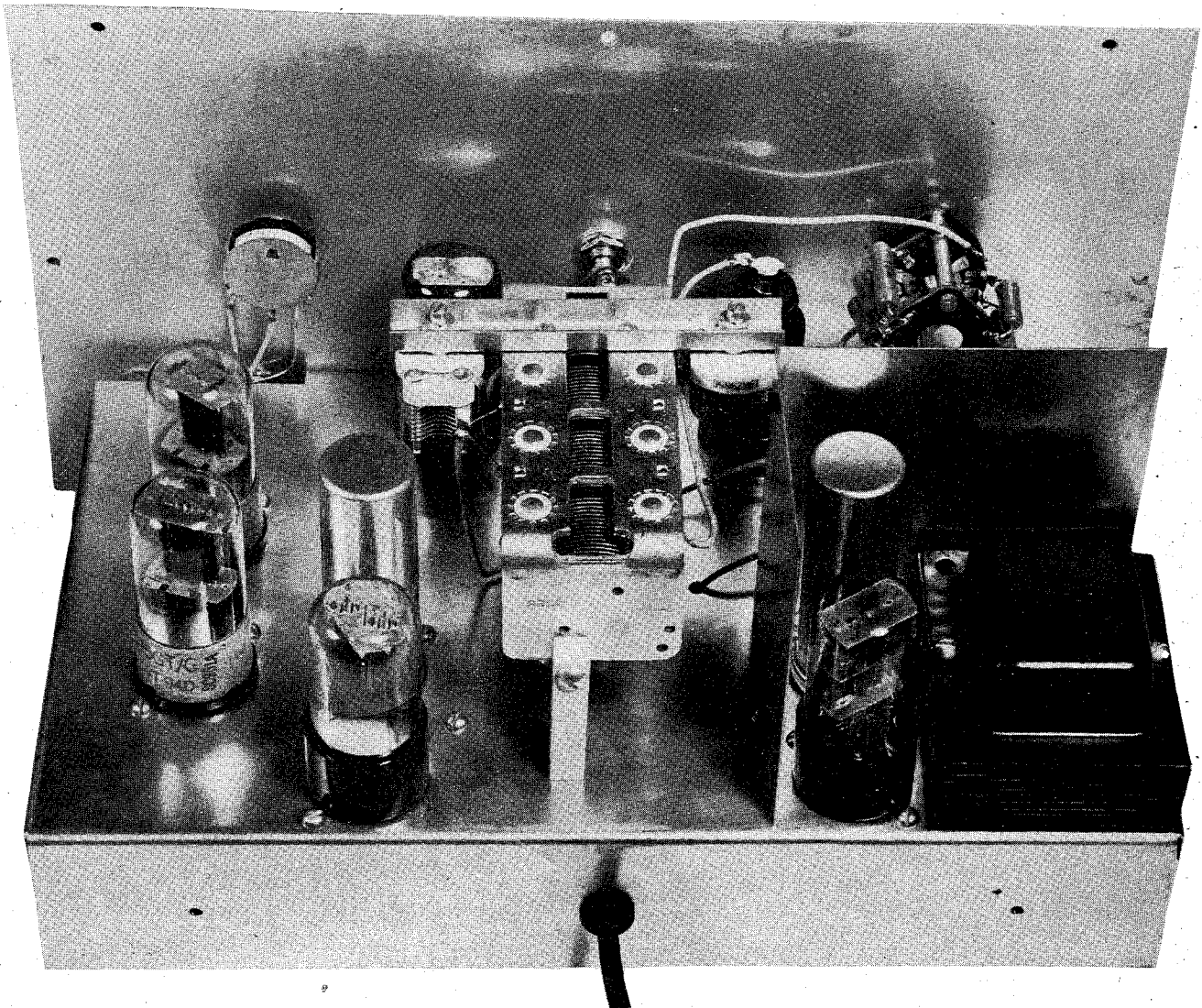
Prices subject to change without notice. The Heath Company reserves the right to change the design without incurring liability for equipment previously supplied.

## WARRANTY

The Heath Company limits its warranty on any part supplied with any Heathkit (except tubes, meters, and rectifiers, where the original manufacturer's guarantee only applies) to the replacement within three (3) months of said part which, when returned with prior permission, post-paid, was, in the judgment of the Heath Company, defective at the time of sale.

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility or liability for any damages or injuries sustained in the assembly of the device or in the operation of the completed instrument.

HEATH COMPANY  
Benton Harbor, Michigan



# AG7 PARTS LIST

Part No.	Parts Per Kit	Description
<b>Resistors</b>		
O14	1	470 ohms
G10	1	820 ohms
SW12	1	1000 ohms
K10	1	2700 ohms
G11	1	3600 ohms
O11	3	10 K ohms
AG70	1	10 K ohms 2 watt
BV23	1	33 K ohms
A10	2	47 K ohms
G18	2	47 K ohms 1 watt
O12	2	100 K ohms
SG54	1	390 K ohms
O18	3	470 K ohms
AG64	2	100 K ohms, precision
AG62	2	1 Meg ohm, precision
AG63	2	10 Meg ohm, precision

<b>Condensers</b>		
O49	1	.1 MFD
O97	2	.25 MFD
O50	2	8 MFD-475 V
AG73	1	100 MFD-15 V
SW20	2	20-20-20 MFD-300 V
G25	2	50 MMF Trimmer
G27A	1	4 section Tuning

<b>Control--Switches</b>		
O58	1	100 K ohm Control
S34	1	3 pos. Rotary Switch
AG65	1	2 pos. Rotary Switch
G59	1	DPDT Slide Switch
O94	1	SPST Slide Switch

<b>Tubes--Lamps</b>		
AG69	1	6J7 (GT) Tube
G43	1	6K6GT Tube
G42	1	6SL7GT Tube
A48	2	6J5 (GT) Tubes
V30	1	6X5 (GT) Tube
G34	1	3 watt Lamp
O39	1	#47 Pilot Lamp.

<b>Sockets--Terminal Strips--Knobs</b>		
AR32	6	Octal Tube Sockets
G37	1	Candelabra Lamp Socket
S32	1	2 lug Terminal Strip
SW37	1	3 lug Terminal Strip
O51	3	Pointer Knobs
G38	1	Indicator Knob

<b>Pilot Light Assembly</b>		
O40	1	Nut
O41	1	Bushing
O42	1	Jewel
O52	1	Socket

Part No.	Parts Per Kit	Description
<b>Insulators--Wafers--Grommet</b>		
G29A	3	Ceramic Insulators
IB31	1	Binding Post Insulator
SW43	2	Condenser Mounting Wafers
O35	1	3/8" Grommet

<b>Screws--Nuts--Washers</b>		
AG74	2	4-40 x 3/16 Screws
G31	6	4-40 x 3/8 Screws
K16	3	6-32 x 3/16 Screws
O31	27	6-32 x 3/8 Screws
G53	3	6-32 x 1/2 Screws
G52	3	8-32 x 3/8 Screws
O30	2	10-24 Handle Screws
O102	9	#6 Sheet Metal Screws
S22	33	6-32 Nuts
TP16	2	8-32 Nuts
O33	5	Control Nuts
TS72	33	#6 Lockwashers
BR36	5	#8 Lockwashers
O101	5	Control Lockwashers
O28	4	Nickel Washers
O27	3	Fibre Flat Washers
O37	2	Solder Lugs
G32	3	Spade Bolts

<b>Bushings--Shaft--Coupling</b>		
G30	2	Panel Bushings
G33	1	Shaft
G39	1	Shaft Coupling

<b>Terminal Hardware</b>		
IB32	2	Binding Post Bases
IB33	2	Thumbscrews
IB34	2	10-32 Nuts
IB36	2	#10 Lockwashers
IB37	2	#10 Fibre Washers
IB38	2	#10 Nickel Washers
O109	2	#10 Solder Lugs

<b>Sheet Metal Parts</b>		
AG67	1	Chassis
AG66	1	Panel
AG71	1	Switch Bracket
AG68	1	Power Supply Shield
AG72	1	Trimmer Mtg. Bracket
PS10	1	Cabinet
O79	1	Handle

<b>Miscellaneous</b>		
FM46	1	Power Transformer
S35	1	Filter Choke
K18	1	Grid Cap
O34	4	Rubber feet
O78	1	Line Cord
O77	1	Length Hookup Wire
O81	1	Length Spaghetti



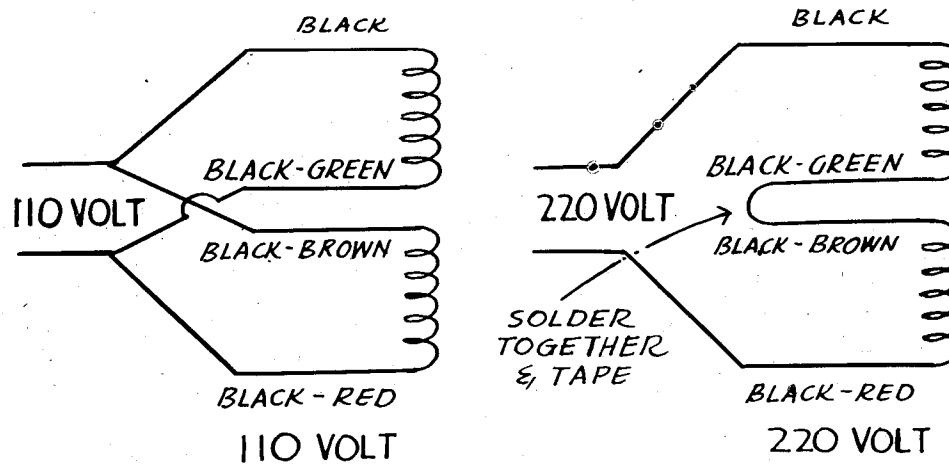






WIRING OF EXPORT TYPE  
110/220 VOLT POWER  
TRANSFORMERS

These transformers have a dual primary for use on either 110 Volts or 220 Volts.  
Wire as shown.



Notes

# Notes