PRICE $1.00

# HEATHKIT®
# ASSEMBLY MANUAL

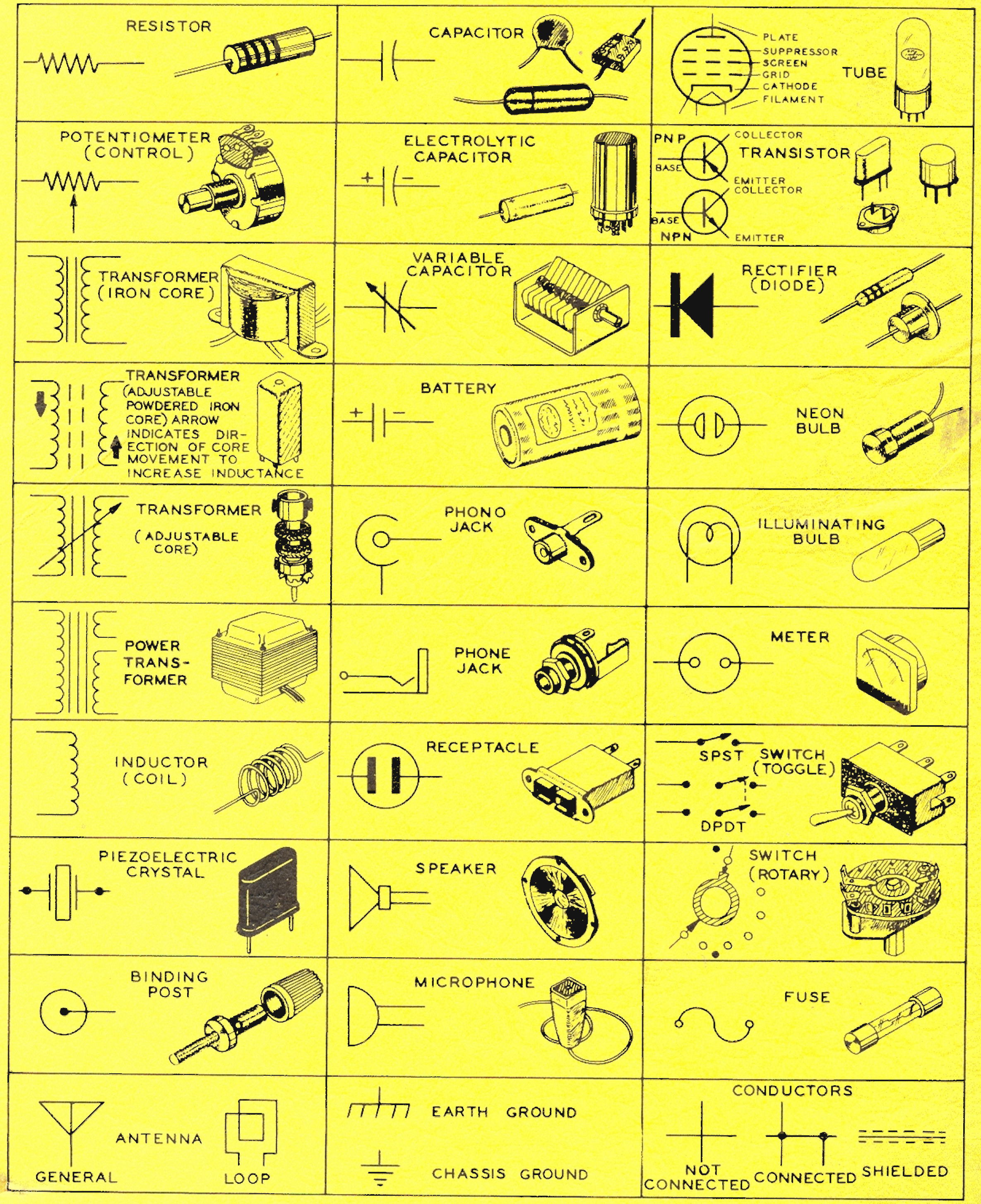
HEATHKIT

## ELECTRONIC KEYER
### MODEL HD-1

HEATH COMPANY, BENTON HARBOR, MICHIGAN

# 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.



Assembly

and

Operation

of the

HEATHKIT

# ELECTRONIC KEYER

## MODEL HD-10


HEATH COMPANY

BENTON HARBOR,
MICHIGAN

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3/25/66

# INTRODUCTION

The Heathkit Model HD-10 Electronic Keyer uses solid-state (transistor) circuitry to provide clean, "bounce-free" keying. It will produce self-completing dots and dashes at speeds adjustable from 15 to over 60 words per minute. (Alternate connections provide a speed range of 10 to 20 words per minute.)

Transmitters that use grid-block keying, or other types of keying where a negative (bias) voltage is shorted to ground to key the transmitter, can be used with the Electronic Keyer.

A built-in audio generator and speaker allows you to monitor the keying of the transmitter. Also a speaker-muting headphone jack is provided in case you prefer to use headphones for monitoring. When using headphones you can also listen to the received signal without external switching. Screw terminals are provided on the rear of the Electronic Keyer for connecting to the headphone output of the receiver.

Keying is accomplished with a keying lever and two small snap-action switches, one for dots and the other for dashes. For dots, the keying lever is moved to the right; for dashes, the keying lever is moved to the left. This keying sequence can be reversed by simply reversing the connections to the snap-action switches.

The Hold position of the slide switch can be used to continuously key the transmitter for tuning or other adjustments. Also, you can connect a straight or speed key to the Electronic Keyer for conventional nonautomatic keying.

Normally, the Electronic Keyer is operated from a standard 105 to 125 volt AC line. However, there are provisions for battery operation for emergency service. Operation from a 230 volt 50 or 60 cps AC line is also possible by adding a suitable capacitor (not supplied) in series with one side of the AC line. Information on battery and 230 volt operation is included in the Installation section of the Manual.

The Electronic Keyer will prove to be a valuable and most versatile addition to your other amateur radio equipment. When you become familiar with its use, you will undoubtedly improve the clarity of your CW transmissions and the convenience of operating.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, tools, wiring, soldering, and step-by-step assembly procedures.

# PARTS LIST

The numbers in parentheses correspond to the numbers in the parts pictorial (fold-out from Page 5).

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **RESISTORS (1/2 Watt)** | | |
| (1)1-49 | 1 | 22 Ω (red-red-black) |
| 1-42 | 3 | 270 Ω (red-violet-brown) |
| 1-46 | 6 | 3900 Ω (orange-white-red) |
| 1-16 | 1 | 4700 Ω (yellow-violet-red) |
| 1-20 | 8 | 10 KΩ (brown-black-orange) |
| 1-21 | 4 | 15 KΩ (brown-green-orange) |
| 1-22 | 7 | 22 KΩ (red-red-orange) |
| 1-23 | 2 | 27 KΩ (red-violet-orange) |
| 1-24 | 4 | 33 KΩ (orange-orange-orange) |
| 1-25 | 5 | 47 KΩ (yellow-violet-orange) |
| 1-60 | 5 | 68 KΩ (blue-gray-orange) |
| 1-31 | 1 | 330 KΩ (orange-orange-yellow) |
| **CAPACITORS** | | |
| (2)21-13 | 4 | 500 μμf disc |
| 21-82 | 4 | .02 μfd disc |
| 21-48 | 4 | .05 μfd disc |
| (3)25-131 | 3 | 250 μfd electrolytic |
| (4)27-20 | 1 | .4 μfd resin |
| (5)27-2 | 2 | 1 μfd tubular |
| **CONTROLS-SWITCHES** | | |
| (6)10-100 | 1 | 1000 Ω control |
| 12-59 | 1 | 100 KΩ dual control |
| (7)60-10 | 1 | DPTT slide switch |
| (8)64-23 | 2 | SPDT snap switch |
| **HARDWARE** | | |
| **Screws** | | |
| (9)250-175 | 4 | 2-56 x 3/8" |
| (10)250-2 | 8 | 3-48 x 5/16" |
| (11)250-56 | 8 | 6-32 x 1/4" |
| (12)250-89 | 7 | 6-32 x 3/8" |
| (13)250-127 | 1 | 6-32 x 1/2" self-tapping |
| (14)250-26 | 10 | 6-32 x 5/8" |
| (15)250-126 | 1 | 10-32 x 1/2" |
| **Nuts** | | |
| (16)252-51 | 4 | 2-56 |
| (17)252-1 | 8 | 3-48 |
| (18)252-3 | 18 | 6-32 |
| (19)252-23 | 2 | 6-32 thumb |
| (20)252-7 | 3 | Control |
| (21)252-32 | 1 | Push-on |
| **Washers** | | |
| (22)253-10 | 3 | Control flat |
| (23)253-19 | 3 | 3/4" OD flat |
| (24)254-7 | 8 | #3 lock |
| (25)254-1 | 22 | #6 lock |
| (26)254-5 | 3 | Control lock |
| **Other Hardware** | | |
| (27)259-1 | 2 | #6 solder lug |
| (28)255-60 | 4 | 5/16" OD spacer |
| (29)255-44 | 1 | 3/4" OD shoulder spacer |
| (30)259-11 | 2 | #6 spade lug |
| **WIRE-CABLE-SLEEVING** | | |
| 89-1 | 1 | Line cord |
| 343-6 | 1 | Shielded cable |
| 347-7 | 1 | 4-wire cable |
| 347-1 | 1 | 8-wire cable |
| 346-1 | 1 | Sleeving |
| **DIODES-TRANSISTORS-LAMP-FUSE** | | |
| (31)56-26 | 5 | 1N191 crystal diode (brown-white-brown) |
| (32)57-29 | 2 | Silicon diode |
| 417-43 | 1 | 2N398A transistor |
| 417-28 | 7 | 2N407 transistor |
| 417-67 | 3 | 2N2712 transistor |
| (33)412-13 | 1 | Neon lamp |
| 421-12 | 1 | 1/8 ampere fuse |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **SOCKETS-JACK-PLUG-KNOBS** | | |
| (34)434-70 | 8 | 3-pin transistor socket |
| 434-101 | 3 | 4-pin transistor socket |
| (35)436-4 | 1 | Phone jack |
| 438-3 | 1 | Phone plug |
| (36)462-105 | 1 | Key knob |
| 462-187 | 1 | Knob for 1/4" shaft |
| 462-209 | 1 | Knob with hole |
| **METAL PARTS** | | |
| 90-M291F | 1 | Cabinet bottom |
| 100-M511P73,74 | 1 | Cabinet top |
| (37)100-M512 | 3 | Switch bracket |
| 205-M455 | 1 | Ballast plate |

| PART No. | PARTS Per Kit | DESCRIPTION |
|---|---|---|
| **MISCELLANEOUS** | | |
| 51-118 | 1 | Audio transformer |
| (38)54-156 | 1 | Power transformer |
| (39)75-17 | 4 | Plastic insulator |
| (40)73-1 | 1 | 3/8" rubber grommet |
| (41)205-456 | 1 | Key lever |
| 209-17 | 1 | Speaker grille |
| 261-20 | 4 | Rubber feet |
| 401-84 | 1 | Speaker |
| 431-66 | 1 | 8-screw terminal board |
| 85-94P320P321 | 1 | Circuit board |
| (42)211-M26 | 2 | Plastic paddle handle |
| (43)258-M64 | 2 | Leaf spring |
| (44)258-M65 | 1 | Flat spring |
| 490-5 | 1 | Nut starter (See the Kit Builders Guide) |
| 331-6 | | Solder |
| 595-703 | 1 | Manual |

# STEP-BY-STEP ASSEMBLY

Before starting the assembly of this kit, read the Kit Builders Guide for complete information on tools, wiring, soldering, and Step-By-Step Assembly procedures.

## CIRCUIT BOARD ASSEMBLY

Soldering to the circuit board will be easier if you solder and clip off the excess leads after every six or eight components are installed.

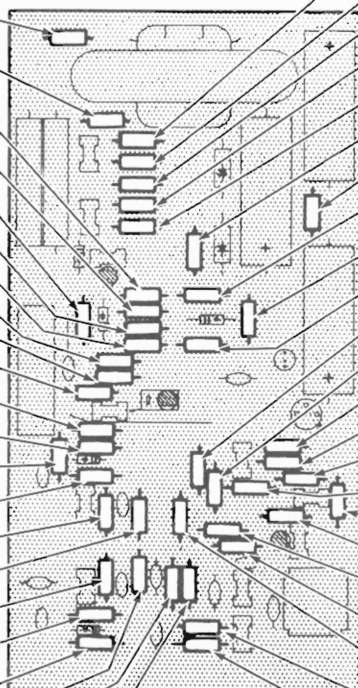
Perform the steps on Pictorials 1 through 3.

*Use 10 KΩ (brown-black-orange) for 15 to 60 words-per-minute speed. Use 68 KΩ (blue-gray-orange) for 10 to 20 words-per-minute speed.

## START

Locate the circuit board and position it lettered side up, as shown.

( ) 68 KΩ (blue-gray-orange).
( ) 33 KΩ (orange-orange-orange).
( ) 10 KΩ (brown-black-orange).
( ) 47 KΩ (yellow-violet-orange).
( ) 270 Ω (red-violet-brown).
( ) 47 KΩ (yellow-violet-orange).
( ) 22 KΩ (red-red-orange).
( ) 33 KΩ (orange-orange-orange).
( ) 22 KΩ (red-red-orange).
( ) 10 KΩ (brown-black-orange).
( ) 270 Ω (red-violet-brown).
( ) 15 KΩ (brown-green-orange).
( ) 68 KΩ (blue-gray-orange).
( ) 27 KΩ (red-violet-orange).
( ) 33 KΩ (orange-orange-orange).
( ) 3900 Ω (orange-white-red).
( ) 33 KΩ (orange-orange-orange).
( ) 27 KΩ (red-violet-orange).
( ) 15 KΩ (brown-green-orange).
( ) 3900 Ω (orange-white-red).
( ) 22 KΩ (red-red-orange).
( ) 22 KΩ (red-red-orange).



## CONTINUE

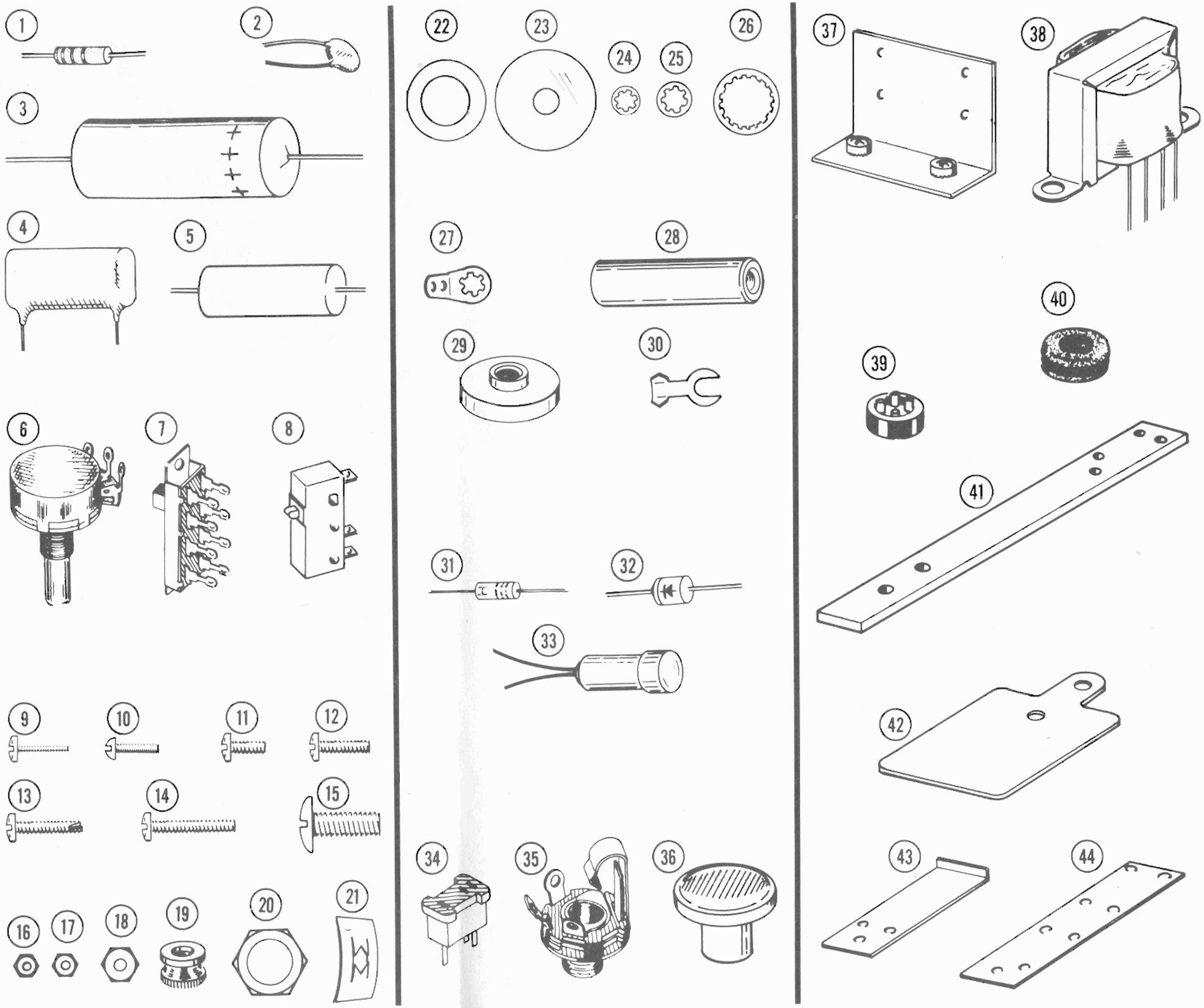
( ) 3900 Ω (orange-white-red).
( )* 68 KΩ
( ) 10 KΩ (brown-black-orange).
( )* 68 KΩ
( ) 3900 Ω (orange-white-red).
( ) 68 KΩ (blue-gray-orange).
( ) 22 Ω (red-red-black).
( ) 10 KΩ (brown-black-orange).
( ) 15 KΩ (brown-green-orange).
( ) 15 KΩ (brown-green-orange).
( ) 4700 Ω (yellow-violet-red).
( ) 330 KΩ (orange-orange-yellow).
( ) 22 KΩ (red-red-orange).
( ) 47 KΩ (yellow-violet-orange).
( ) 10 KΩ (brown-black-orange).
( ) 10 KΩ (brown-black-orange).
( ) 270 Ω (red-violet-brown).
( ) 22 KΩ (red-red-orange).
( ) 3900 Ω (orange-white-red).
( ) 47 KΩ (yellow-violet-orange).
( ) 22 KΩ (red-red-orange).
( ) 47 KΩ (yellow-violet-orange).
( ) 3900 Ω (orange-white-red).
( ) Check to see that all connections are soldered, and cut off excess leads.

PICTORIAL 1

## FINISH

PROCEED TO PICTORIAL 2.

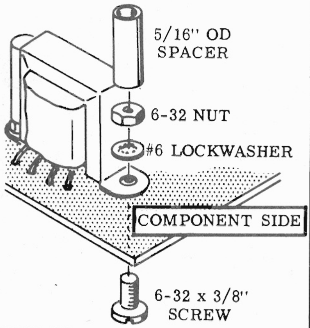
# PARTS PICTORIAL



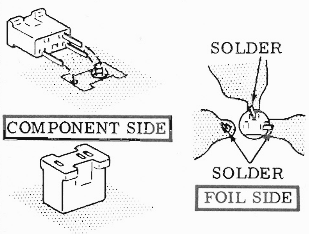
## START

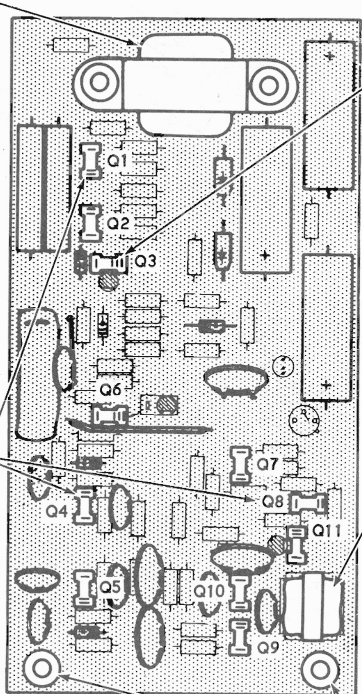
NOTE: Solder the connections of each component as it is installed.

( ) Install the power transformer (#54-156) and 5/16" OD spacers. Use 6-32 x 3/8" screws, #6 lockwashers and 6-32 nuts. Position the transformer leads through the indicated holes in the circuit board. Solder and cut off the excess leads.




( ) Install 3-pin transistor sockets at Q1, Q2, Q4, Q5, Q7, Q8, Q9, and Q10. Solder all 3 pins of each socket. Be careful not to bridge foils with solder.

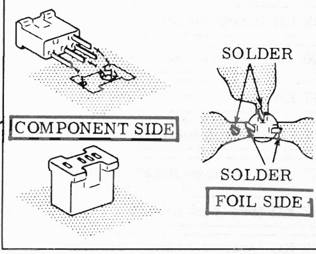


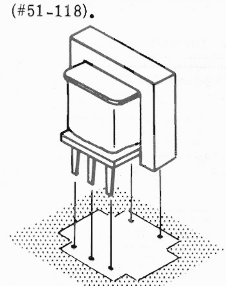

PICTORIAL 2

## CONTINUE

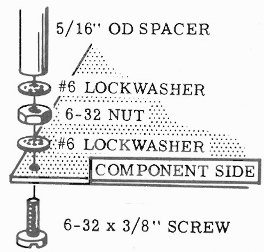
( ) Install 4-pin transistor sockets at Q3, Q6, and Q11. Solder all 4 pins of each socket. Be careful not to bridge foils with solder. Two pins of each socket go to the same foil.




( ) Install the audio transformer (#51-118).



( ) Install two 5/16" OD spacers, using 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.




PROCEED TO PICTORIAL 3.

START

NOTE: Solder the connections of each large component as it is installed.

( ) 1 µfd tubular capacitor.

( ) 1 µfd tubular capacitor.

NOTE: When installing crystal diodes, position the color band end as shown.

( ) Crystal diode (brown-white-brown). Note banded end.

( ) Crystal diode (brown-white-brown). Note banded end.

( ) .02 µfd disc capacitor.

( ) .4 µfd resin capacitor.

( ) Crystal diode (brown-white-brown). Note banded end.

( ) 500 µµf disc capacitor.

( ) 500 µµf disc capacitor.

( ) .05 µfd disc capacitor.

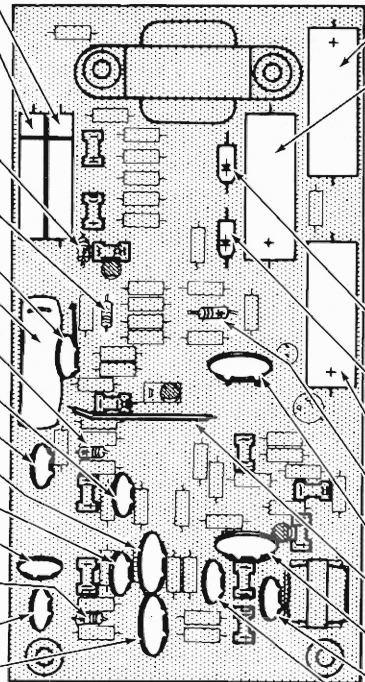
( ) 500 µµf disc capacitor.

( ) .02 µµf disc capacitor.

( ) Crystal diode (brown-white-brown). Note banded end.

( ) 500 µµf disc capacitor.

( ) .05 µfd disc capacitor.



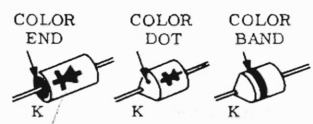
CONTINUE

NOTE: When installing electrolytic capacitors, position the lead from the positive (+) end of the capacitor at the positive (+) marking on the circuit board.

( ) 250 µfd electrolytic capacitor. Note (+) marking.

( ) 250 µfd electrolytic capacitor. Note (+) marking.

NOTE: When installing silicon diodes, position the cathode (K) end as shown.




( ) Silicon diode. Note body marking.

( ) Silicon diode. Note body marking.

( ) 250 µfd electrolytic capacitor. Note (+) marking.

( ) Crystal diode (brown-white-brown). Note banded end.

( ) .05 µfd disc capacitor.

( ) Wire. Use excess capacitor lead with 1-3/8" sleeving.

( ) .05 µfd disc capacitor.

( ) .02 µfd disc capacitor.

( ) .02 µfd disc capacitor.

( ) Check to see that all connections are soldered, and cut off excess leads

FINISH

Set the circuit board aside and proceed to the steps on Page 8.

PICTORIAL 3

## PARTS MOUNTING-CABINET TOP

Refer to Pictorial 4 for the following steps.

Position a soft cloth on your working area. This will help prevent scratching the cabinet top in the following steps.

( ) Locate the cabinet top, and bend the two spade bolts as shown in the inset drawing on Pictorial 4. Start 6-32 nuts on the spade bolts before bending them, to prevent damage to the threads.

( ) Install a 3/8" rubber grommet in hole B.

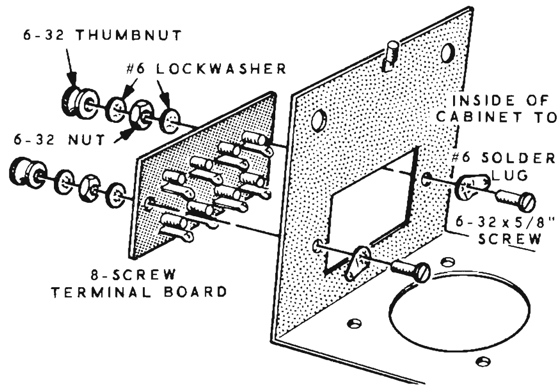
NOTE: Lockwashers and nuts will be used with all screws when mounting parts, unless stated otherwise in the assembly steps. Consequently, the following steps will call out only the size and type of the hardware to be used. For example, the phrase "Use 6-32 x 1/4" hardware" means to use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts. Refer to the Details for the proper installation of hardware.

( ) Referring to Detail 4A, install the 8-screw terminal board at C. Use 6-32 x 5/8" hardware, #6 solder lugs, and 6-32 thumbnuts. The terminal board must be mounted on the outside of the cabinet top. Position the terminal board and the #6 solder lugs as shown.

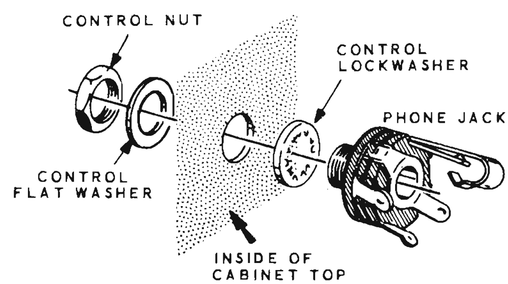
( ) Referring to Detail 4B, install the phone jack at A. Use a control lockwasher, control flat washer, and a control nut. Position the phone jack and bend all three lugs inward as shown.

( ) Referring to Detail 4C, install a 1000 Ω control (#10-100) at E. Use a control lockwasher, a control flat washer, and a control nut. Position the control as shown.

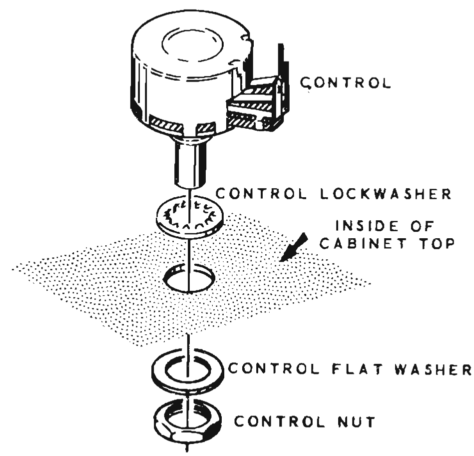
( ) In a like manner, install a 100 KΩ dual control (#12-59) at F. Position the control as shown.



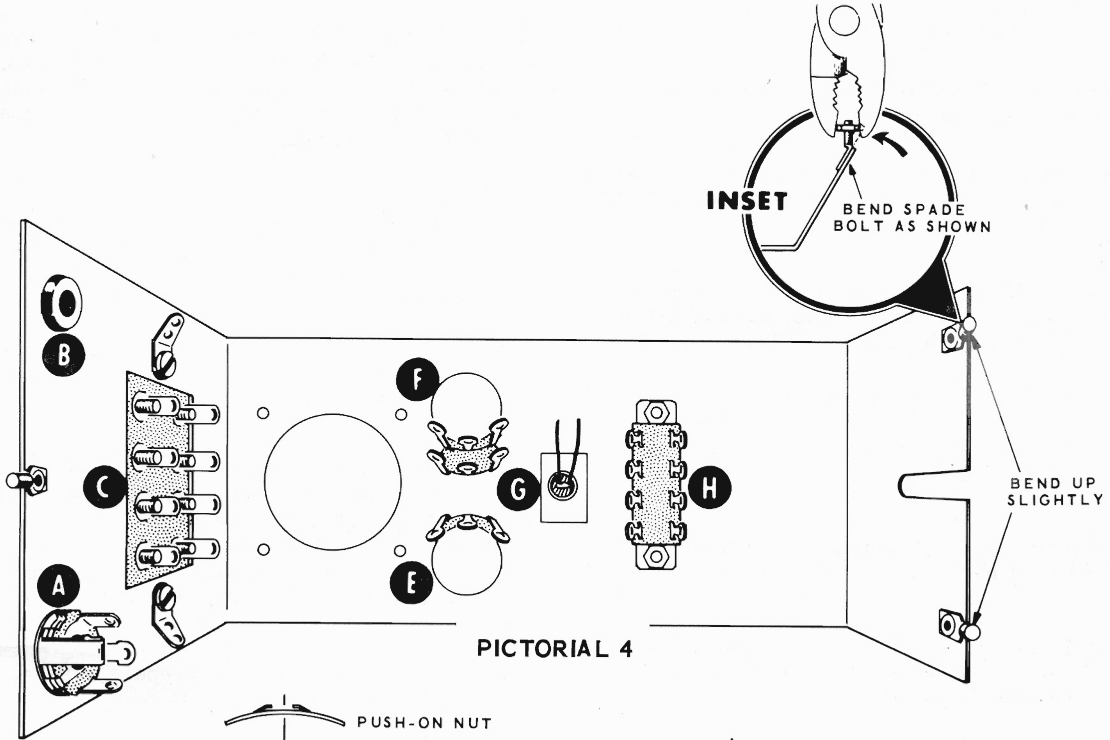

**Detail 4A**



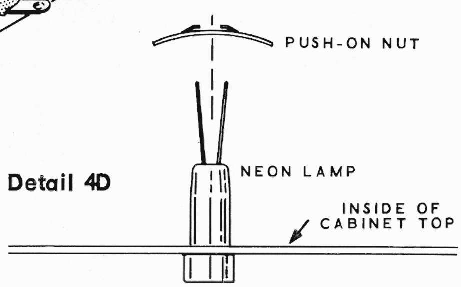

**Detail 4B**




**Detail 4C**




PICTORIAL 4




Detail 4D

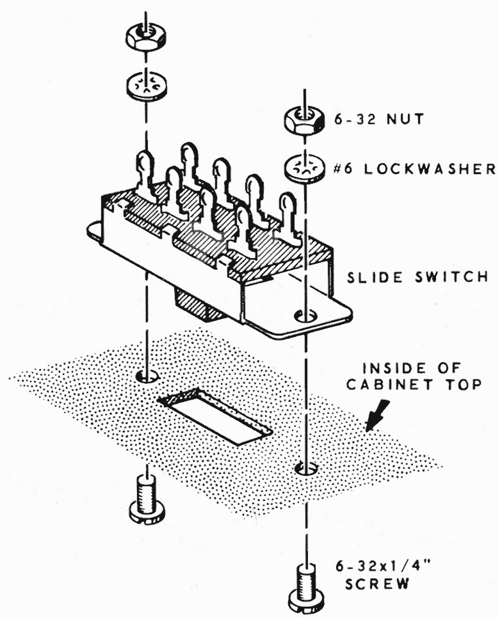
( ) Referring to Detail 4D, install the neon lamp at G, using the push-on nut. Position the nut as shown.

( ) Referring to Detail 4E, install the DPTT slide switch at H, using 6-32 x 1/4" hardware.

( ) Turn the shafts of both controls fully counterclockwise.

( ) Push the knob with the hole through it on the Speed control shaft. The knob pointer should be approximately at the 7 o'clock position.

( ) Place the 1/4" shaft knob on the Volume control shaft. Position the pointer at the 7 o'clock position and tighten the setscrew.




Detail 4E

## WIRING-CABINET TOP

Refer to Pictorial 5 (fold-out from Page 11) for the following steps.

( ) Bend lug 5 of switch H against the switch frame (S-1). See the inset drawing on Pictorial 5.

NOTE: After the neon lamp is wired in the following steps, be sure the leads of the lamp do not touch each other in the base of the lamp.

( ) Place a 3/4" length of sleeving on one lead of neon lamp G. Pass the end of this lead through lug 1 of switch H (S-2). Do not cut off this lead.

( ) Place a 1/2" length of sleeving on this same neon lamp lead. Then connect this lead to lug 3 of switch H (NS).

( ) Place a 3/4" length of sleeving on the other lead of neon lamp G. Connect this lead to lug 4 of switch H (NS).

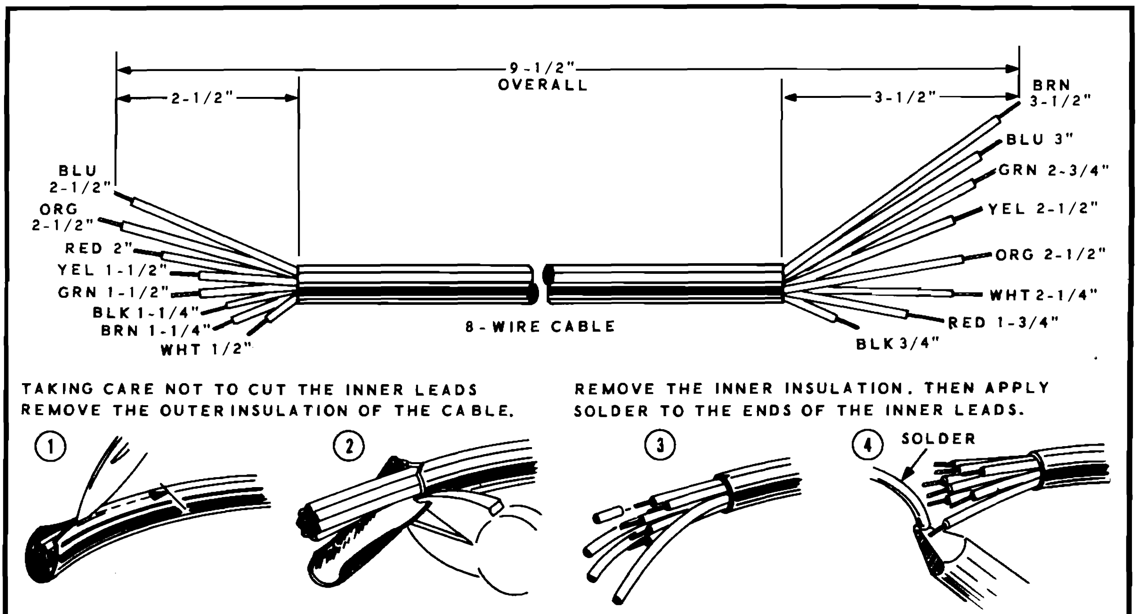
NOTE: In the following two steps, do not wrap the leads of the fuse around the switch lugs. Position the fuse as shown in the inset drawing on Pictorial 5. Be sure the body of the fuse does not touch the cabinet top.

( ) Locate the 1/8 ampere fuse. Cut one lead to 7/8" and the other to 1/2". Place a 5/8" length of sleeving on the longer lead and connect it to lug 2 of switch H (S-1).

( ) Place a 1/4" length of sleeving on the other lead of the fuse, and connect it to lug 8 of switch H (NS).

NOTE: When preparing the cables in the following steps, remove the outer insulation and cut the wires at each end of the cable as specified. Then strip 1/4" of insulation from each wire. Twist the small wires together and melt a small amount of solder on the exposed wire ends to hold the small strands together.

( ) Referring to Detail 5A, prepare a 9-1/2" length of 8-wire cable as shown.




Detail 5A

NOTE: When installing prepared cables, apply only enough heat to make a good solder connection. Excessive heat will melt the insulation on the wires.

( ) At the end of this prepared cable with the short white wire, connect the white wire to solder lug K (S-1).

Connect the remaining wires from this end of the prepared cable to terminal board C as follows. Be sure all the small wire strands of each wire go into the terminal board lugs.

( ) Black to lug 8 (S-1).

( ) Brown to lug 4 (S-1).

( ) Yellow to lug 7 (S-1).

( ) Green to lug 3 (S-1).

( ) Red to lug 2 (NS).

( ) Blue to lug 5 (S-1).

( ) Orange to lug 1 (S-1).

Position the circuit board along the side of the cabinet top as shown. Connect the wires from the other end of the prepared cable to the circuit board as follows.

( ) Black to hole C (S-1).

( ) Red to hole E (S-1).

( ) Green to hole D (S-1).

( ) White to hole G (S-1).

( ) Yellow to hole B (S-1).

( ) Orange to one of the holes at H (S-1).

( ) Blue to hole K (S-1).

( ) Brown to one of the holes at R (S-1).

( ) Referring to Detail 5B, prepare a 14" length of 4-wire cable as shown.

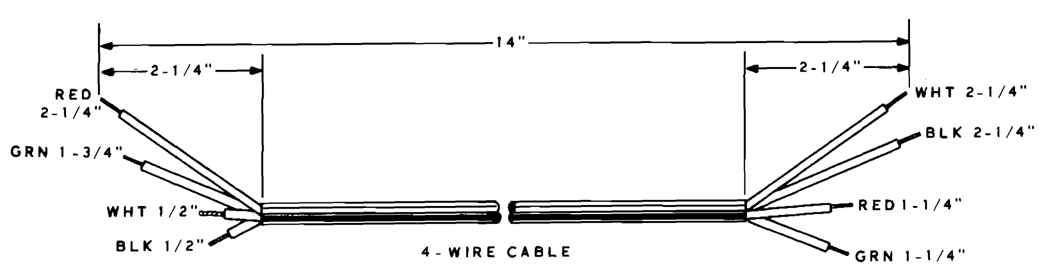
( ) At the end of the prepared cable with the short white wire, connect the black and white wires to solder lug J (S-2).

Connect the remaining wires at this end of the cable to terminal board C as follows.

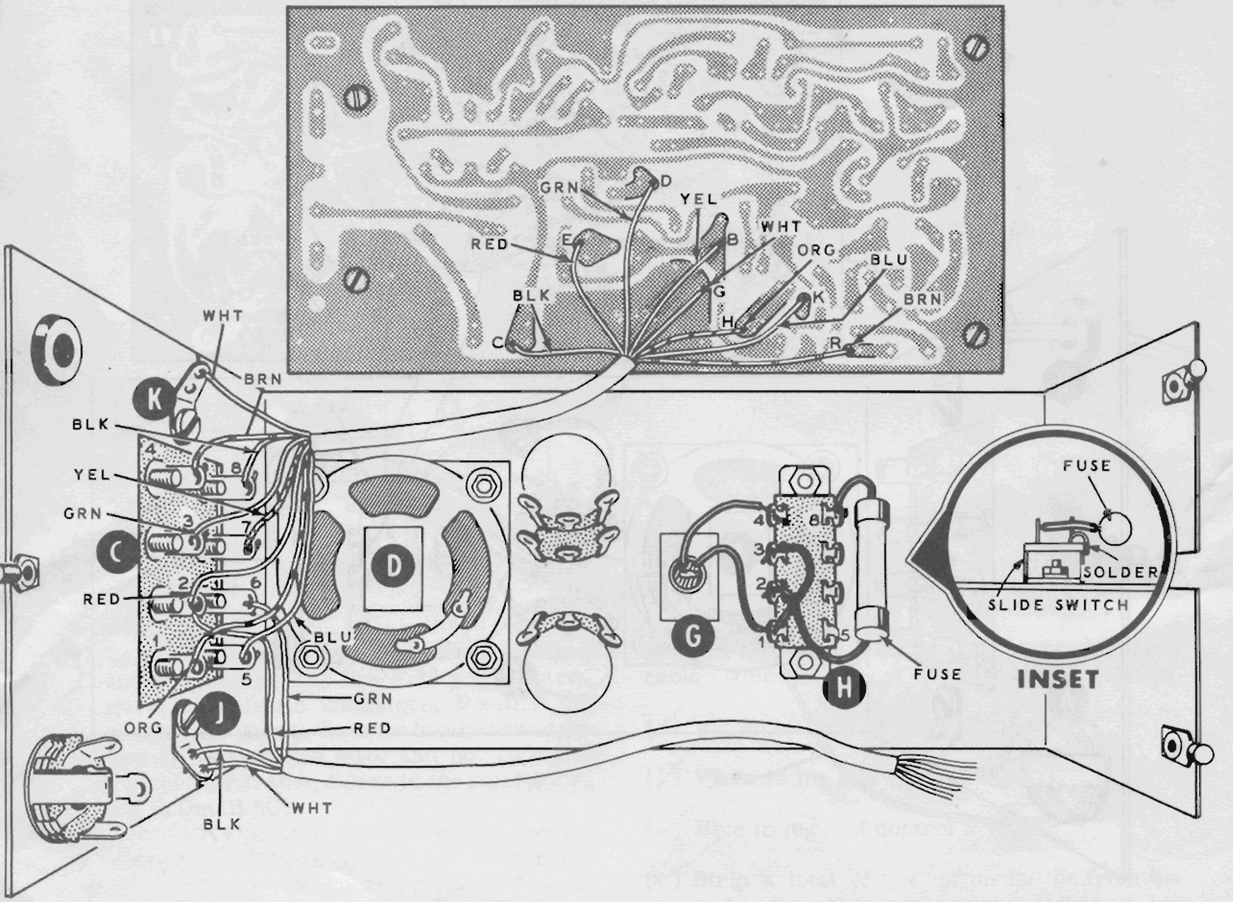
( ) Green to lug 6 (S-1).

( ) Red to lug 2 (S-2).

The other end of the cable will be connected later.




Detail 5B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RED
E
YEL
WHT
B
ORG
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BLU
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K
BRN
C
H
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K
BLK
4
8
YEL
GRN
3
7
C
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D
BLU
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ORG
J
GRN
RED
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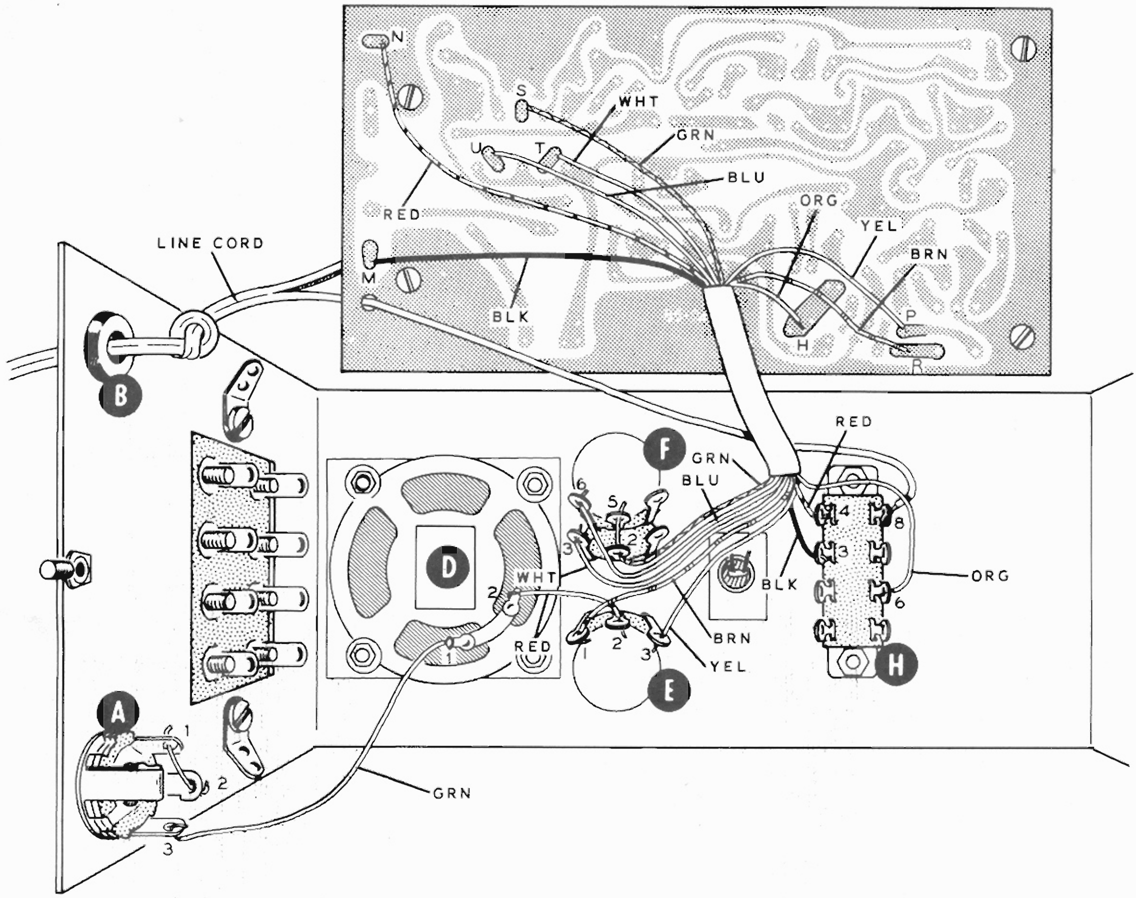
H
FUSE
FUSE
SOLDER
SLIDE SWITCH
INSET

PICTORIAL 5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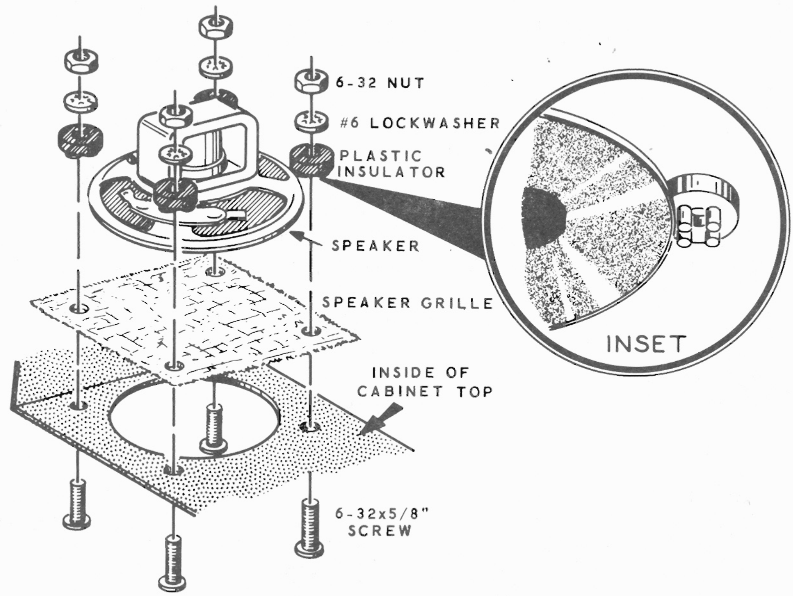
**PICTORIAL 6**




Detail 5C

( ) Referring to Detail 5C, install the speaker and speaker grille. Use 6-32 x 5/8" hardware and plastic insulators. Position the speaker as shown. Turn the insulators so the tips fit against the edge and not on top of the speaker frame. Refer to the inset drawing in Detail 5C.

Refer to Pictorial 6 for the following steps.

( ) Referring to Detail 6A, prepare an 8-1/2" length of 8-wire cable as shown.

Connect the wires from the end of this prepared cable with the short red wire as follows.

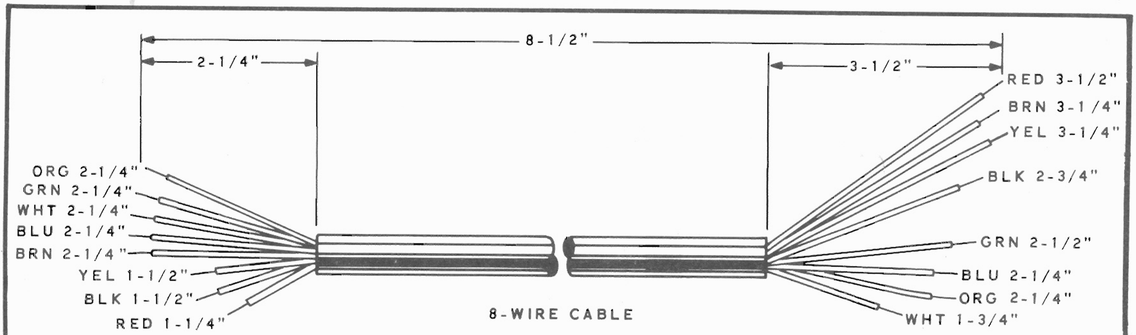
( ) Brown to lug 1 of control E (S-1).

( ) White to lug 3 of control F (S-1).

( ) Blue to lug 6 of control F (S-1).

( ) Strip a total of 3/4" of insulation from the end of the green wire and pass it through lug 2 (S-2) to lug 5 (S-1) of control F.

( ) Yellow to lug 3 of control E (S-1).




Detail 6A

In the following three steps, pass the remaining cable wires under the existing wires going to switch H.

( ) Orange to lug 6 of switch H (S-1).

( ) Black to lug 3 of switch H (S-2).

( ) Red to lug 4 of switch H (S-2).

Connect the wires from the other end of this cable to the circuit board as follows.

( ) Black to hole M (S-1).

( ) Red to hole N (S-1).

( ) Blue to hole U (S-1).

( ) Green to hole S (S-1).

( ) White to hole T (S-1).

( ) Orange to hole H (S-1).

( ) Brown to hole R (S-1).

( ) Yellow to hole P (S-1).

( ) Pull the wires out of the outer insulation of the remaining length of 4-wire cable. These wires will be used as hookup wire in the remaining steps.

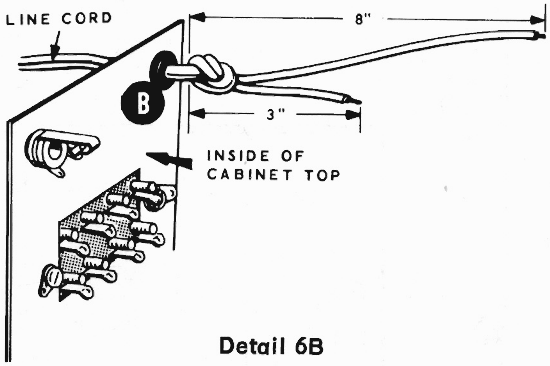
( ) Connect a 4" green wire from lug 3 of phone jack A (S-1) to lug 1 of speaker D (S-1). Position the wire as shown.

( ) Connect a 1-3/4" red wire from lug 2 of speaker D (S-1) to lug 2 of control E (S-1).

( ) Connect a 3/4" bare wire (cut-off resistor lead) between lugs 1 (S-1) and 2 (S-1) of phone jack A.

( ) Referring to Detail 6B, pass the stripped end of the line cord through grommet B. Tie a knot 8" from the end of the line cord and separate the two wires to the knot.

( ) Cut one line cord wire to 3" from the knot, and strip 1/4" of insulation from the end. Twist the small wire strands together and melt a small amount of solder on the exposed wire ends.




**Detail 6B**

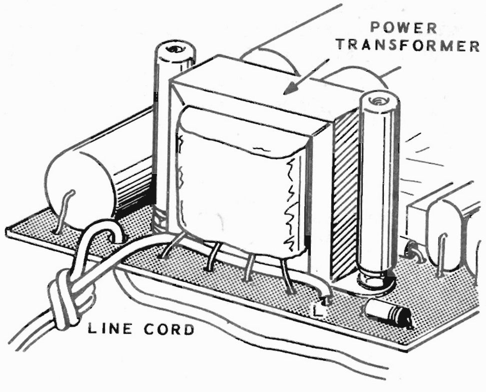
( ) Referring to Detail 6C, pass the free end of the shorter line cord wire between the frame and leads of the power transformer on the circuit board. Connect the wire to hole L (S-1).

( ) Pass the free end of the longer line cord wire through the hole in the circuit board and connect it to lug 8 of switch H (S-2). Position the wire as shown.

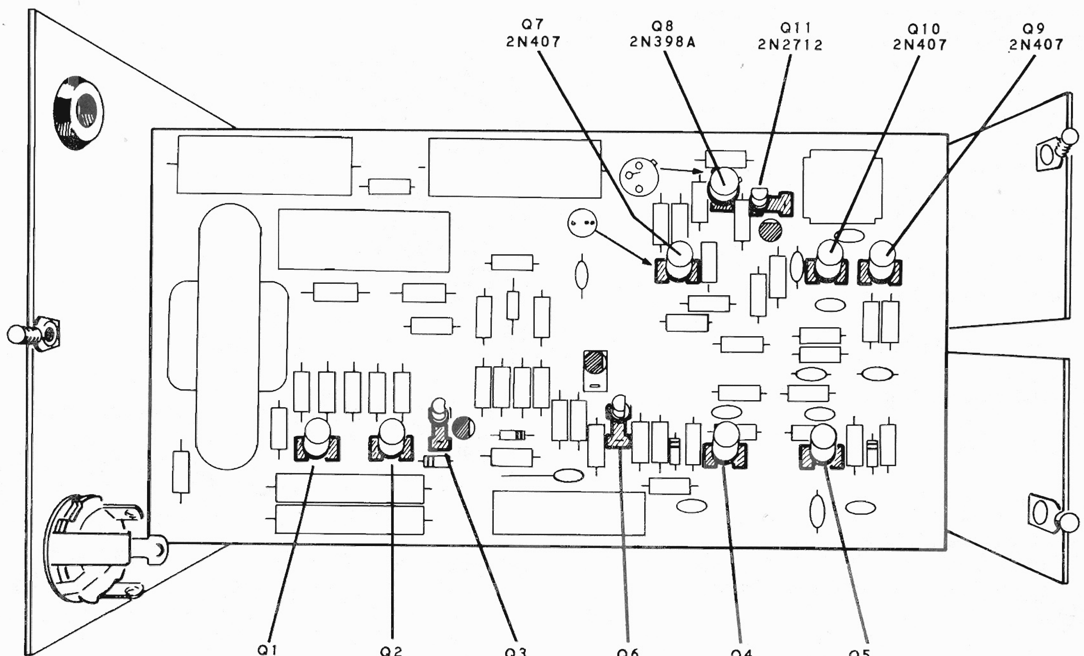
Lugs 1 and 4 of control F, and lug 7 of switch H, are not used.

This completes the wiring on the cabinet top and the circuit board. Check to see that all connections are soldered.

Inspect the circuit board to be sure none of the wires that are connected to the foil side protrude through the board and touch the component leads. Cut off any wires that are touching component leads. Also, be sure there are no solder bridges between foils.




**Detail 6C**



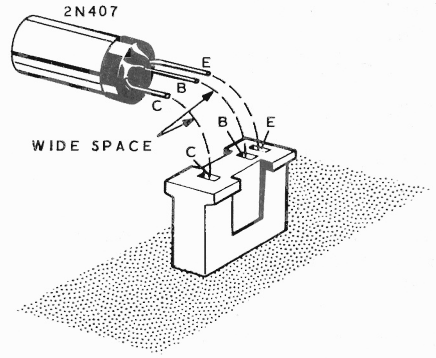

PICTORIAL 7

## TRANSISTOR INSTALLATION

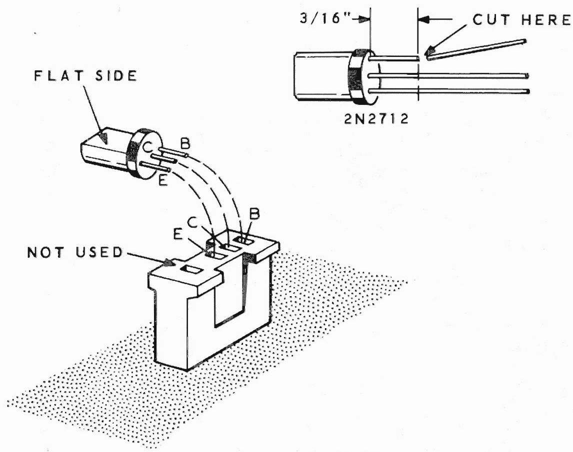
Refer to Pictorial 7 for the following steps.

Carefully turn the circuit board over and position it as shown.

( ) Referring to Detail 7A, install 2N407 transistors in sockets Q1, Q2, Q4, Q5, Q7, Q9, and Q10. Support the circuit board from the foil side as you install the transistors. This will prevent damage to the board.




Detail 7A




Detail 7B

( ) Referring to Detail 7B, cut the leads of the three 2N2712 transistors to 3/16". Install these transistors in sockets Q3, Q6, and Q11. Note flat side of transistor.

( ) Referring to Detail 7C, bend and position the center lead of the 2N398A transistor as shown. Cut all three leads to 3/16". Install the transistor in socket Q8.

Check to see that none of the transistor socket solder connections were pulled loose from the circuit board when the transistors were installed.

Temporarily, set the cabinet top and circuit board assembly aside.

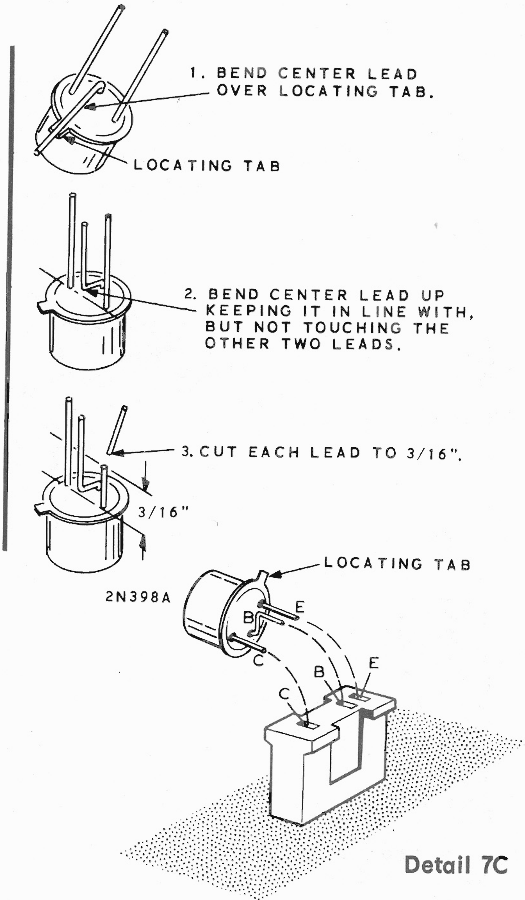
## KEY-MECHANICAL ASSEMBLY

Refer to Pictorial 8 on Page 16 for the following steps.

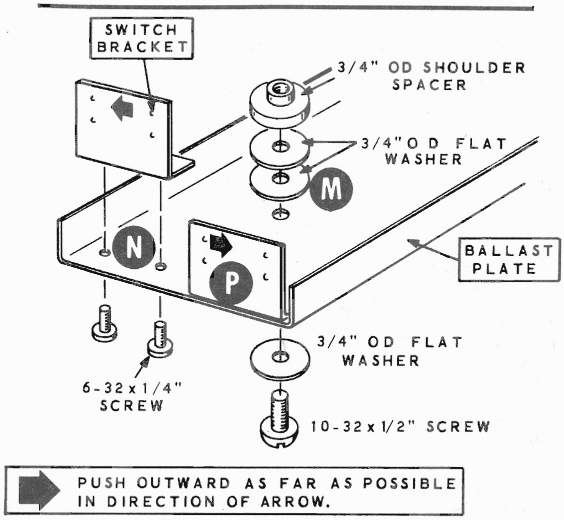
Locate the ballast plate and position it on the work area as shown.

( ) Referring to Detail 8A, install the 3/4" OD shoulder spacer at M. Use a 10-32 x 1/2" screw and three 3/4" OD flat washers. Do not tighten the screw at this time.

( ) Install switch brackets at N and P, using 6-32 x 1/4" screws. Position the brackets as shown. Push them as far as possible toward the outside of the ballast plate. Tighten the screws just enough to hold the brackets in place. They will be readjusted later.

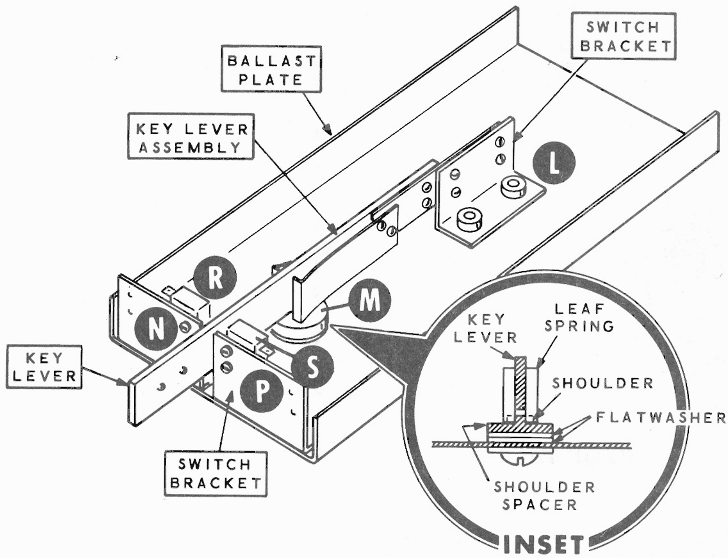



Detail 7C



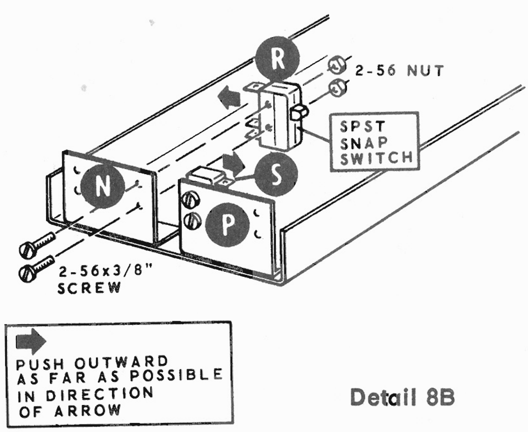

Detail 8A

PICTORIAL 8




( ) Referring to Detail 8B, install an SPST snap switch at R on switch bracket N. Use 2-56 x 3/8" screws and 2-56 nuts. The wide spaced lugs go to the top. Push the switch toward the outside of the ballast plate as far as possible. Tighten the screws just enough to hold the switch in place.

( ) In a like manner, install an SPST snap switch at S on switch bracket P. Use 2-56 x 3/8" screws and 2-56 nuts. Push the switch toward the outside of the ballast plate as far as possible. Tighten the screws just enough to hold the switch in place.




Detail 8B

Refer to Detail 8C for the following steps.

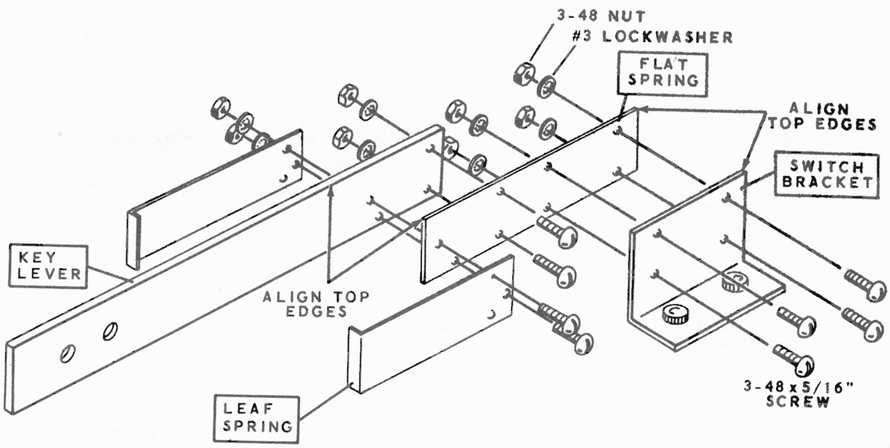
( ) Install the flat spring on a switch bracket, using 3-48 x 5/16" hardware. Be sure to position the holes of the spring as shown. Align the top of the spring with the top edge of the bracket and tighten the hardware.

( ) Install the key lever on the flat spring using 3-48 x 5/16" hardware in the two holes nearest the switch bracket. Be sure all the holes in the key lever line up with the holes of the spring. Align the top edge of the key lever with the top of the spring and tighten the screws just enough to hold the key lever in place.

( ) Install the two leaf springs on the key lever, using 3-48 x 5/16" hardware. Position the springs as shown and tighten the screws just enough to hold the springs in place.

Refer to Pictorial 8 for the following steps.

( ) Install the key lever assembly on the ballast plate with the switch bracket at L using 6-32 x 1/4" screws. The leaf springs must be outside the shoulder of spacer washer M as shown in the inset drawing of Pictorial 8. The key lever must be between switch brackets N and P. Tighten the screws just enough to hold the bracket in place.



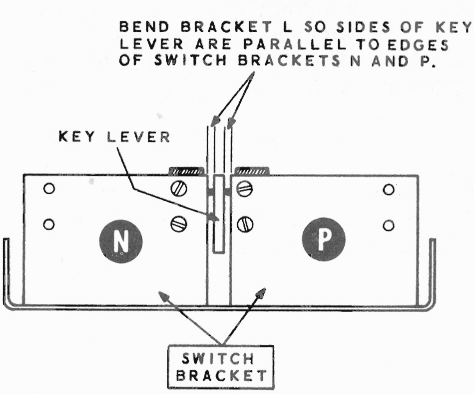

**Detail 8C**

( ) Check to see that spacer M is loose and slides freely, and that the lower edges of the leaf springs are not touching the large flat surface of this spacer.

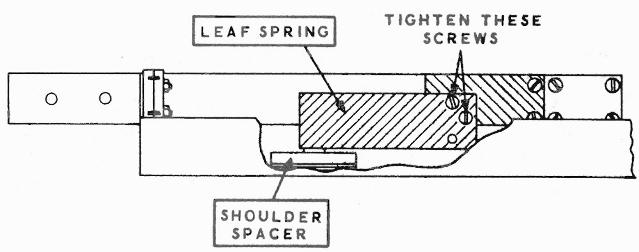
( ) Referring to Detail 8D, position the top edge of the key lever even with the top edges of switch brackets N and P. Tighten the two screws in the key lever nearest bracket L.

( ) If the sides of the key lever are not parallel to the edges of switch brackets N and P, bend bracket L to correct the condition.

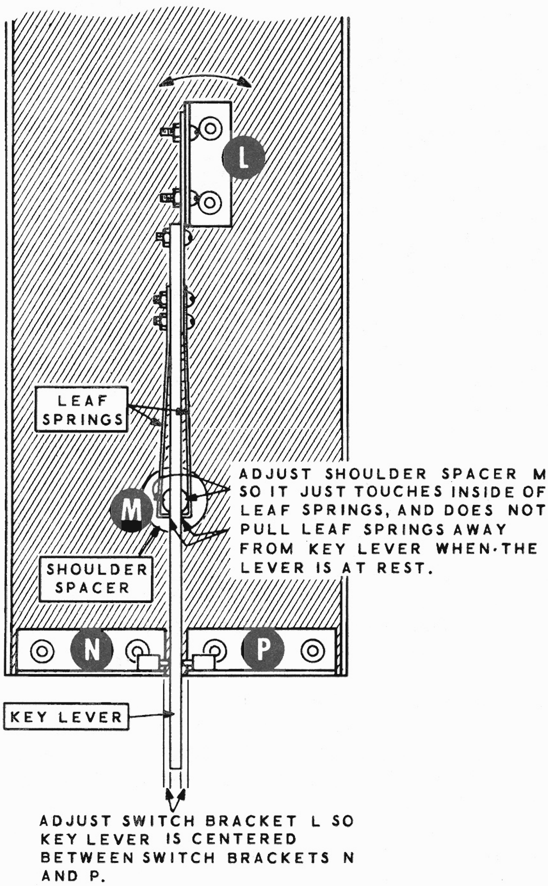
( ) Referring to Detail 8E, position the leaf springs so their bottom edges just clear the flat surface of the shoulder spacer. Then tighten the two screws that secure the leaf springs to the key lever.




**Detail 8D**




**Detail 8E**




Detail 8F

Refer to Detail 8F for the following steps.

(✓) Loosen the screws in bracket L and position it so the key lever is centered between switch brackets N and P. Tighten the screws to secure bracket L in place.

(✓) Without changing the centered position of the key lever, slide spacer M toward the rear of the ballast plate so the shoulder just touches each leaf spring. Then tighten the screw in the spacer. Be sure the key lever is still centered between switch brackets N and P, and that the leaf springs are not spread away from the key lever.

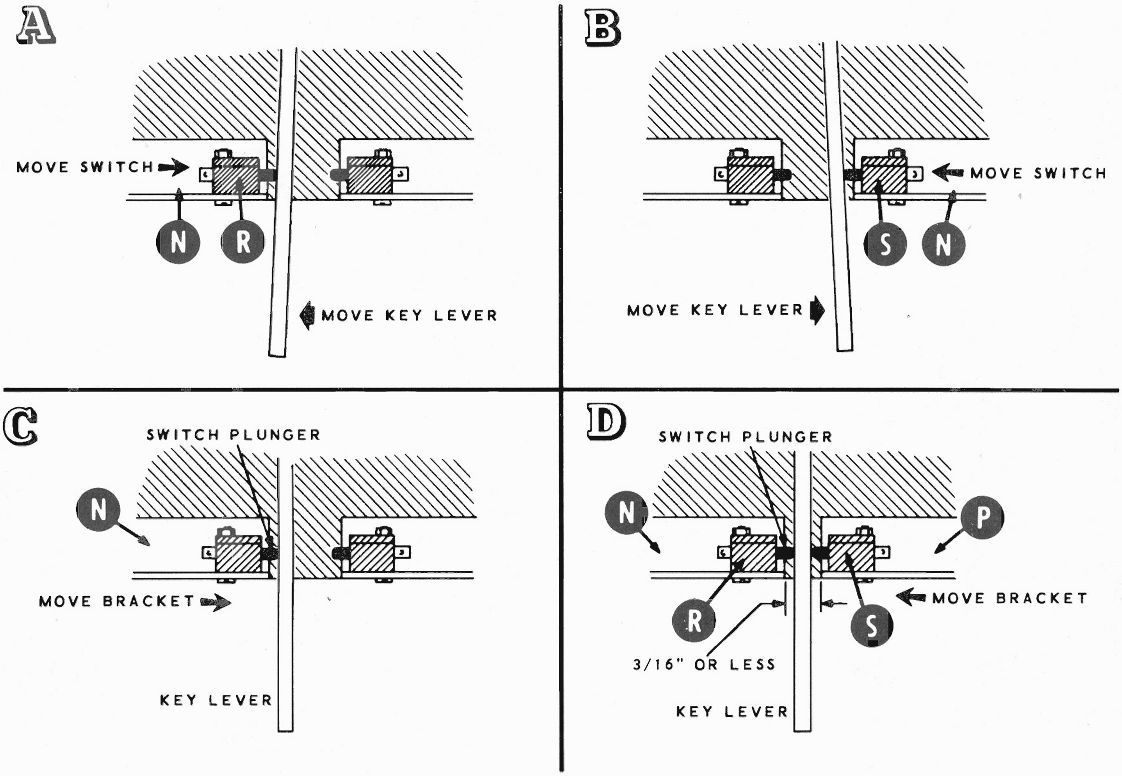
## SWITCH ADJUSTMENT

Refer to Pictorial 9A for the following steps.

(✓) Without moving switch bracket N, loosen the screws of switch R and move this switch toward the key lever slightly. While holding the switch in place with your fingers, move the key lever to the left (toward switch R) until it touches bracket N. You should hear switch R snap just before the key lever touches the bracket. If it does not snap, move the switch a little more toward the key lever, and again move the key lever to the left. When the switch is positioned so it snaps just before the key lever touches the switch bracket, tighten the switch screws. Do not overtighten the switch screws as the switch may be damaged.

(✓) Referring to Pictorial 9B, adjust switch S in a like manner. This time however, move the key lever to the right (toward switch S). When the switch is positioned so it snaps just before the key lever touches switch bracket P, tighten the screws of switch S.

NOTE: After adjustment, one switch may be closer to the switch lever than the other one. This is because the inward travel of the switch plungers may be different. This will be corrected in the following steps.




PICTORIAL 9

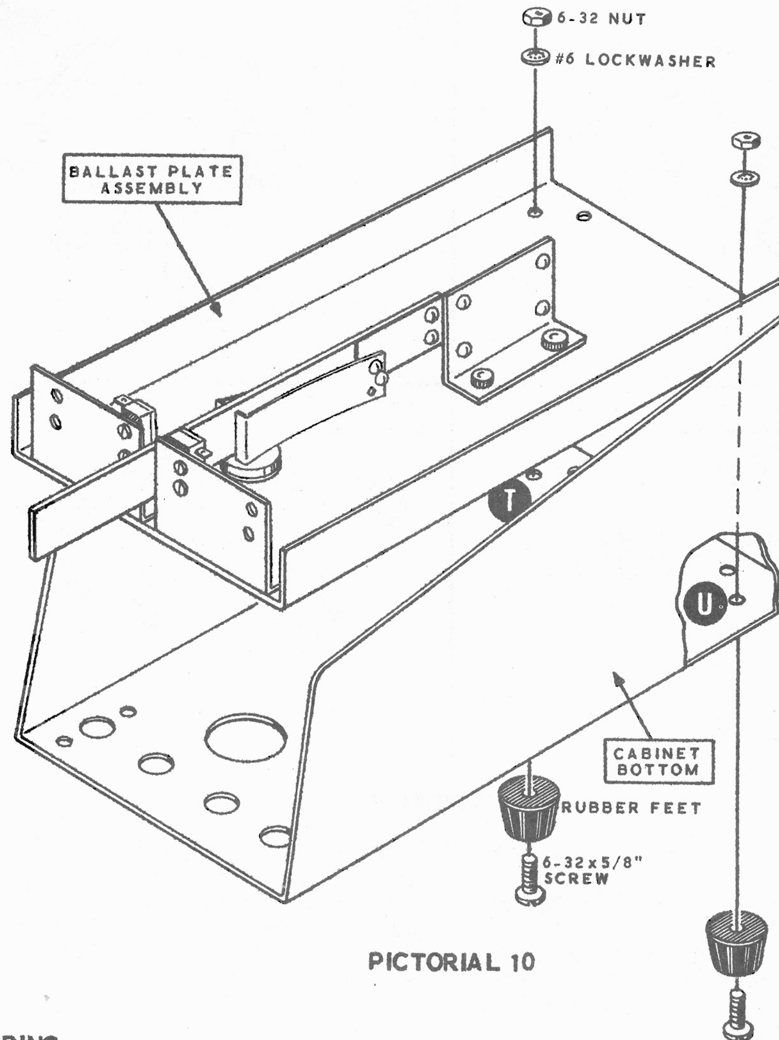
Refer to Pictorial 9C for the following step.

( ) Loosen the screws of switch bracket N. Move the bracket toward the key lever until the switch plunger just touches the key lever, then retighten the bracket screws. Keep the edge of the bracket even with the end of the ballast plate.

( ) Referring to Pictorial 9D, loosen the screws of switch bracket P and move it toward the key lever until the switch plunger just touches the key lever. Tighten the screws of the bracket, keeping its front edge even with the end of the ballast plate.

If the preceding adjustments have been performed properly, there should be approximately a 3/16" or less gap between the ends of switch brackets N and P and still obtain proper switch action. The entire adjustment procedure should be repeated if this gap is wider than 3/16".

The leaf springs should move away from the shoulder on spacer M when the key lever is moved in one direction or the other. If the leaf springs do not move away, the spacer should be readjusted to maintain proper centering of the key lever.




PICTORIAL 10

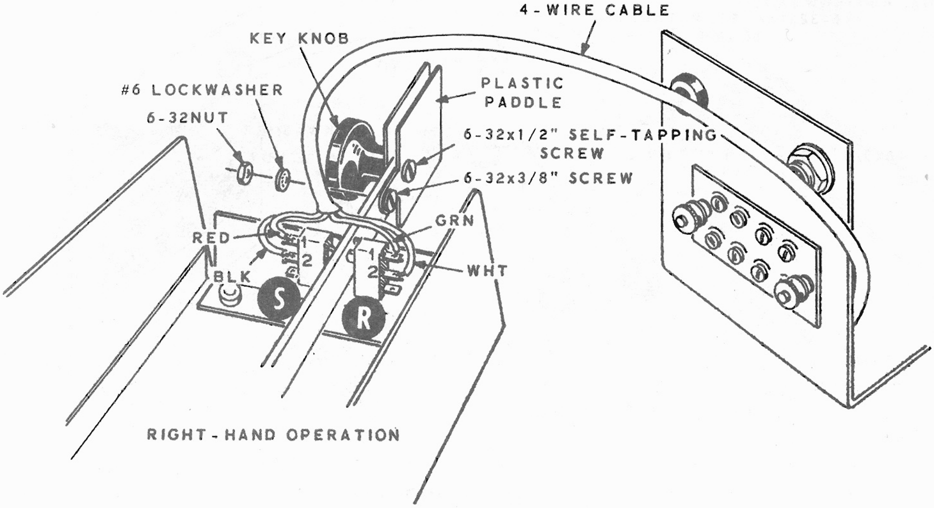
## FINAL WIRING

Refer to Pictorial 10 for the following steps.

( ) Install the ballast plate assembly to the cabinet bottom. Use 6-32 x 5/8" hardware and rubber feet at locations T and U. Be sure the other holes of the ballast plate and cabinet bottom are lined up properly.

NOTE: The following steps are in two specific groups. One group is for right-hand operation, and the other group is for left-hand operation. Use the group of steps for the desired type of operation.

( ) Position the cabinet top and the cabinet bottom assembly next to each other as shown in Detail 10A.




Detail 10A

## Right-Hand Operation

Refer to Detail 10A for the following steps.

( ) Install the plastic paddle handles on the key lever. Use 6-32 x 3/8" hardware in the hole furthest from the end of the key lever. Align the other holes of the paddles and key lever, and tighten the screw.

( ) Install the key knob in the end hole of the key lever, using a 6-32 x 1/2" self-tapping screw. Do not overtighten the screw as the threads can be stripped from the knob. Position the knob as shown.

Connect the free ends of the wires coming from the 4-wire cable, to switches R and S as follows.

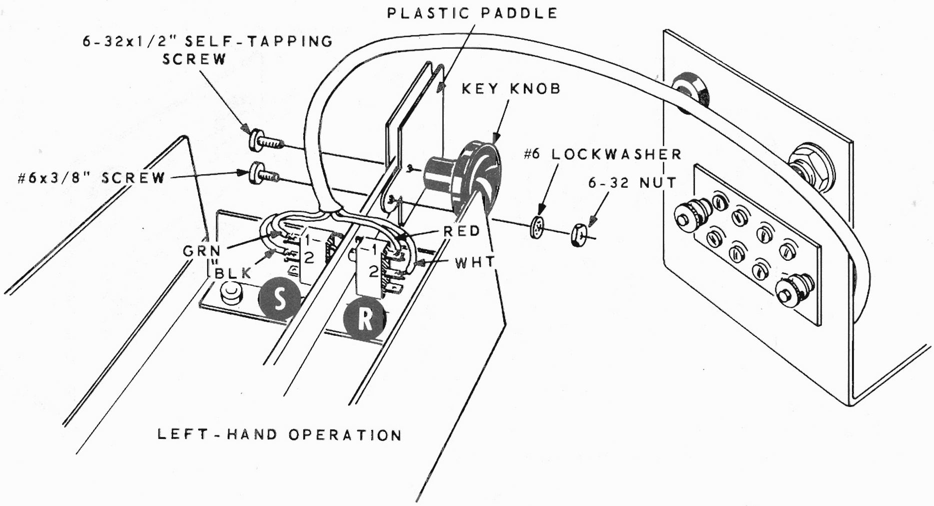
( ) White to lug 2 of switch R (S-1).

( ) Green to lug 1 of switch R (S-1).

( ) Black to lug 2 of switch S (S-1).

( ) Red to lug 1 of switch S (S-1).

( ) Position the cable wires as shown.




Detail 10B

## Left-Hand Operation

Refer to Detail 10B for the following steps.

( ) Install the plastic paddle handles on the key lever. Use 6-32 x 3/8" hardware in the hole furthest from the end of the key lever. Align the other holes in the paddles and key lever, and tighten the screw.

( ) Install the key knob in the end hole of the key lever, using a 6-32 x 1/2" self-tapping screw.

Connect the free ends of the wires coming from the 4-wire cable, to switches R and S as follows.

( ) White to lug 2 of switch R (S-1).

( ) Red to lug 1 of switch R (S-1).

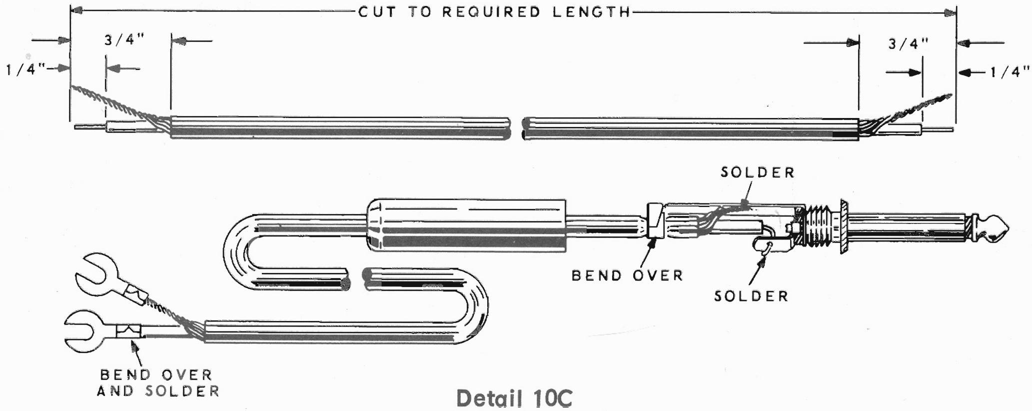
( ) Black to lug 2 of switch S (S-1).

( ) Green to lug 1 of switch S (S-1).

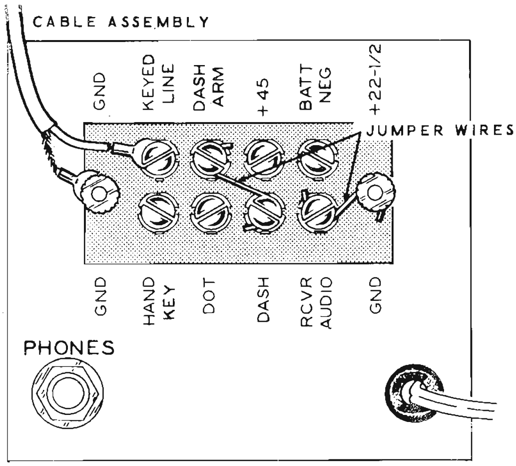
( ) Position the cable wires as shown.

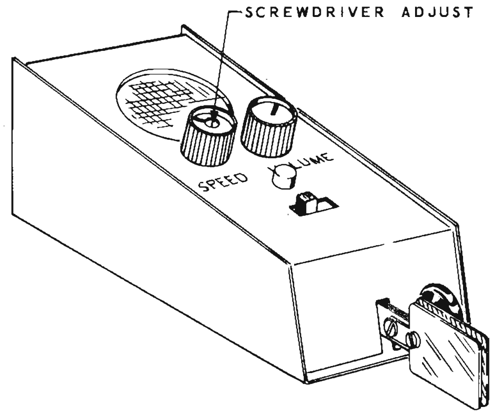
## Rear Panel Wiring

( ) Referring to Detail 10C, prepare a cable assembly. Use a shielded cable, phone plug, and two #6 spade lugs as shown.




Detail 10C




Detail 10D

Refer to Detail 10D for the following steps.

Connect the leads at the end of the shielded cable with the spade lugs, to the 8-screw terminal board as follows.

( ) Inner lead to KEYED LINE screw.

( ) Shield lead to GND screw.

Make the following connections on the 8-screw terminal board. Use cut-off capacitor leads, or the wire removed from the 4-wire cable.

( ) Connect a wire between the DASH and DASH ARM screws.

( ) Connect a wire between the RCVR AUDIO and GND screws.

( ) Turn the SPEED control fully counterclockwise, and with a screwdriver, adjust the Dot-Space control (in the center of the Speed control knob) fully counterclockwise. This makes the dot-space ratio approximately equal.

# INITIAL TEST AND ADJUSTMENT

## INITIAL TEST

NOTE: If the unit does not perform properly in any of the following checks, unplug the line cord and refer to the In Case Of Difficulty section of the manual.

For the following steps, position the Electronic Keyer as shown in Pictorial 11 on Page 25. Clear the work area of any wire clippings to guard against any short circuits in the unit.

( ) Advance the VOLUME control to the 12 o'clock position.

( ) With the slide switch in the OFF position, measure the resistance between each of the A.C. plug terminals and the chassis. An infinite reading should be obtained in both instances.

( ) The resistance between the A.C. plug terminals with the slide switch in the OFF position should be infinite. A reading of 1200 ohms should be obtained with the slide switch in the OPR or HOLD positions of the slide switch.

( ) With the slide switch in the Off position, plug the cord into a 117 V AC outlet.

( ) Place the slide switch in the OPR (Operate) position. The neon lamp should light.

( ) Moving the key lever to the dot position (right for right-hand operation) should result in dots being heard from the speaker, and moving the key to the dash position (left for right-hand operation) should produce dashes. No sound should be heard from the speaker when the lever is in the center (neutral) position.

( ) Turning the SPEED control clockwise should increase the speed of the dots and dashes.

( ) Moving the slide switch to the HOLD position should produce a steady tone from the speaker.

## DOT-SPACE RATIO ADJUSTMENT

The following adjustment will make the dot-space ratio equal.

The SPEED and screwdriver adjust controls are clutch type and will track together to maintain the proper dot-space ratio at all settings of the SPEED control.

If a VTVM is available, an accurate check of the dot-space ratio can be made in the following manner.

( ) Set the SPEED control to the 9 o'clock position.

( ) Set the slide switch to the OPR position.

( ) Turn the VOLUME control to the desired listening level.

( ) Connect the DC test leads of the VTVM between the GND and KEYED LINE screws of the 8-screw terminal board. Set the VTVM to the +15 V DC range. A meter reading of approximately 3 volts should be obtained, with the key lever in the center (neutral) position.

( ) Hold the key in the dot position. The meter reading should be 50% of the previous reading. If not, hold the SPEED control and adjust the screwdriver adjust control for the proper meter reading. Place some object against the key lever to keep it to the right (dot position) while making this adjustment.

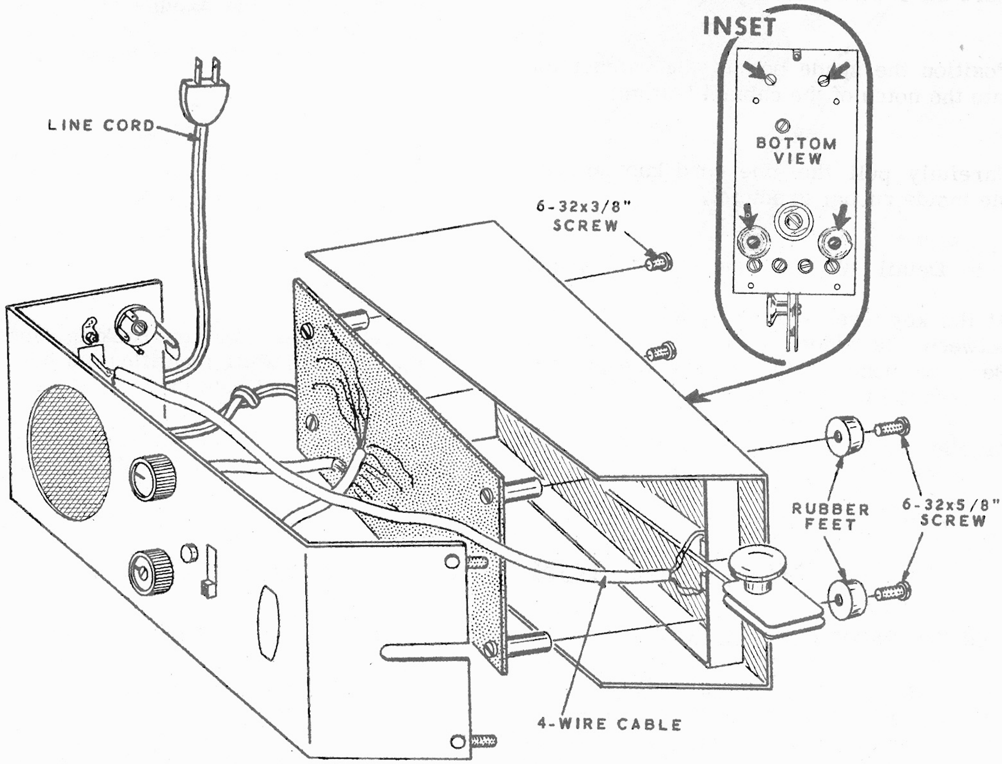
# FINAL ASSEMBLY

Refer to Pictorial 11 for the following steps.

( ) Disconnect the power plug and position the assemblies as shown.

( ) Carefully position the circuit board into the cabinet bottom. Position the 4-wire cable as shown. Push the line cord far enough back through the rubber grommet so the knot will fit under the circuit board.

( ) Secure the circuit board to the cabinet, using 6-32 x 3/8" screws into the spacers at the power transformer end of the circuit board. Use 6-32 x 5/8" screws and rubber feet into the remaining circuit board spacers. The locations are indicated by the arrows on the inset drawing of Pictorial 11.




PICTORIAL 11

Refer to Pictorial 12 for the following steps.

( ) Now position the cabinet top between the sides of the cabinet bottom. Carefully guide the phone jack under the circuit board. Be sure the 4-wire cable is positioned as shown.

( ) Position the spade bolt of the cabinet top into the notch of the cabinet bottom.

( ) Carefully pull the line cord knot against the inside rubber grommet.

Refer to Detail 12A for the following steps.

( ) At the key lever end, swing the cabinet top between the sides of the cabinet bottom. Be sure none of the cables are pinched between the metal parts.

( ) Fit the spade bolts of the cabinet top into the holes of the cabinet bottom.

( ) Secure the cabinet top in place, using #6 lockwashers and 6-32 nuts on the spade bolts.

( ) Check to see that the key lever is centered in the slot of the cabinet top. If the lever hits the cabinet top, repeat the key lever adjustments on Pages 17 through 19.

( ) To open the cabinet, remove the nuts and screws indicated by the arrows in the inset drawing of Detail 12A. Then lift the cabinet top and circuit board out of the cabinet bottom.

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear of the cabinet. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.

# INSTALLATION AND OPERATION

## PROPER TRANSMITTER VOLTAGES

CAUTION: The key jack of the transmitter, to which the KEYED LINE of the Electronic Keyer will be connected, must not have open circuit or spike voltages in excess of -105 volts. Also, the key circuit current must be less than 35 milliamperes. Most transmitters are well within these ratings, however, the transmitter should be checked before connecting the Electronic Keyer. If the transmitter voltage or current is in excess of these ratings, the 2N398A transistor may be damaged. Also, any positive voltage applied will immediately damage the 2N398A transistor at Q10.

These transmitter ratings will be checked in the following steps.

( ) Connect a standard key to the transmitter and place the transmitter in operation.

( ) Check the open-circuit (key-up) voltage across the key contacts. It should be less than -105 DC volts (measured with a VTVM).

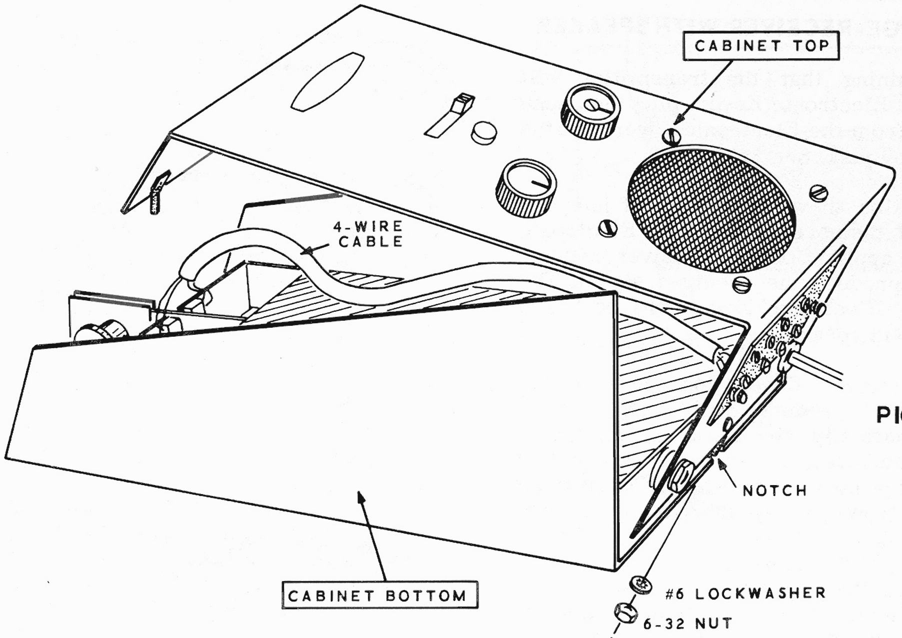
( ) Next, connect a milliampere meter across the key contacts (key-up). This current must be less than 35 milliamperes.

The following step is to check for spike voltages in excess of -105 DC volts to ground or any positive peaks.

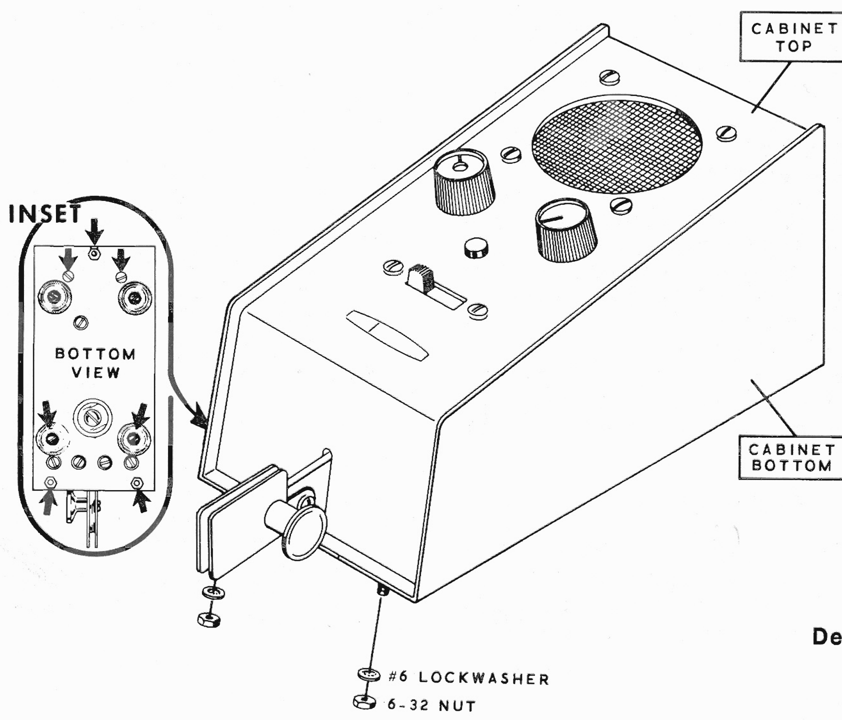
( ) Connect an oscilloscope across the key. Then operate the key while observing the oscilloscope screen.

If the open-circuit voltage is too high, it can usually be reduced by connecting a suitable value resistor across the key circuit. Normally, a transmitter will require approximately 50 volts to obtain proper keying bias. Higher keying bias voltages are sometimes used, as they are readily available from transmitter power supplies. Try various values of resistors until a safe key circuit voltage is obtained, and satisfactory transmitter cutoff is maintained.

If the spike voltages are too high, refer to the ARRL Handbook under the use of key-click, TVI, and BCI measures.




PICTORIAL 12




Detail 12A

## NORMAL USAGE-RECEIVER WITH SPEAKER

After determining that the transmitter will work with the Electronic Keyer, plug the phone plug, coming from the Electronic Keyer, into the transmitter key jack. See Figure 1.

This Figure also shows the required jumpers and hookup of the normal use of the Electronic Keyer. In this application, the receiver speaker is used to reproduce the received signal. The output of the Electronic Keyer will be heard from its built-in speaker.

With the Electronic Keyer connected in this manner, it will produce continuous dots or dashes automatically depending on the position of the key lever. The rate is determined by the setting of the Speed control. The desired output level from the speaker is set by the Volume control.

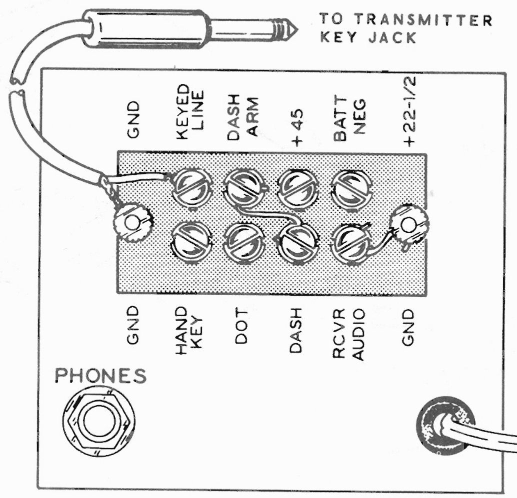
It is advisable that the operator practice operating the Electronic Keyer for sometime before using it "on the air." The Electronic Keyer will have a different feel from other types of keying devices.

In use, the Electronic Keyer should be placed so the forearm rests on a table to keep the wrist from becoming tired and tense. It is important that the letters and words do not run together, as this would make copying impossible. It is also well to remember that it is possible to send much faster with the Electronic Keyer than many operators can copy. If a tape recorder is available, it is advisable to record a few minutes of your sending. Playing back of the tape will permit you to determine if more practice will be required before you start "on-the-air" sending.

To use the Electronic Keyer as a code practice oscillator it should be wired as shown in Figure 1. However, do not connect it to the transmitter.

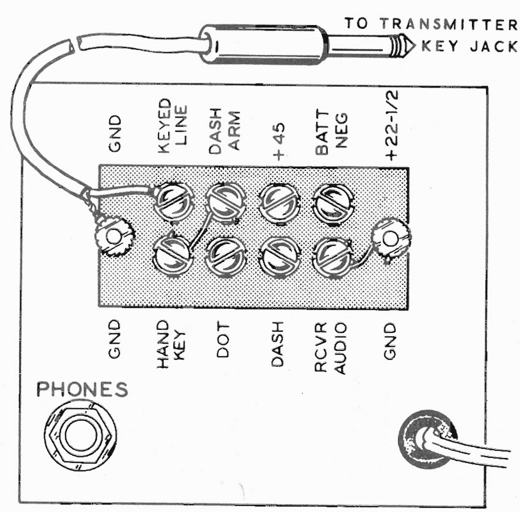
## AUTOMATIC DOT-MANUAL DASH

Figure 2 shows the Electronic Keyer wired for manual dash operation. When wired in this way a single dash is made each time the lever is pushed to the dash position, as long as desired.



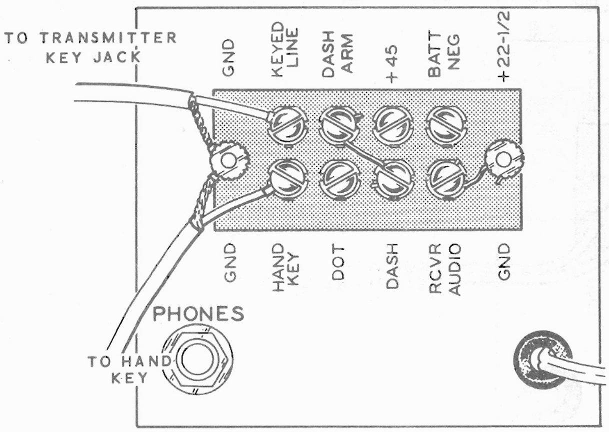

NORMAL USE AUTOMATIC DOT - AUTOMATIC DASH

Figure 1

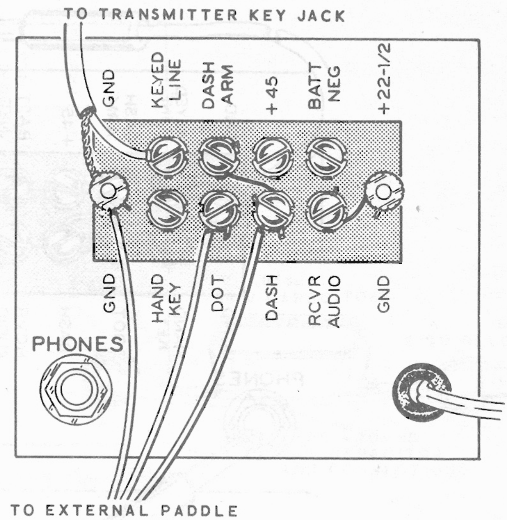



ALTERNATE USE
AUTOMATIC DOT - MANUAL DASH

Figure 2




ALTERNATE USE WITH HAND KEY
Figure 3




ALTERNATE USE WITH EXTERNAL PADDLE
Figure 4

## ALTERNATE HAND KEY

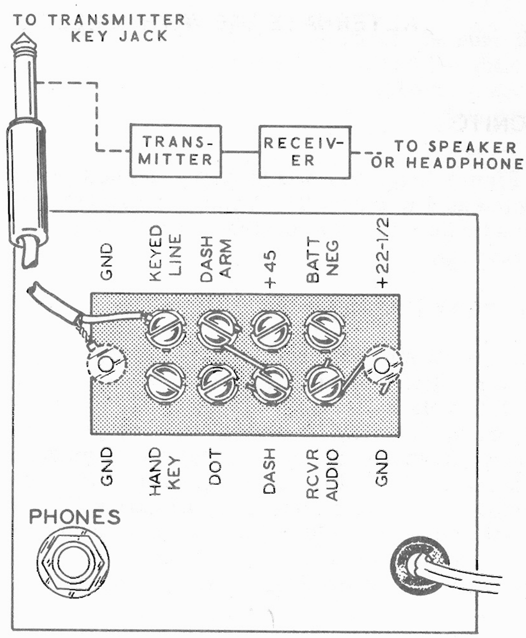
Figure 3 shows a hand key connected between the GND and HAND KEY screws. This allows the operator to use either the hand key or the Electronic Keyer at his own discretion.

## EXTERNAL PADDLE

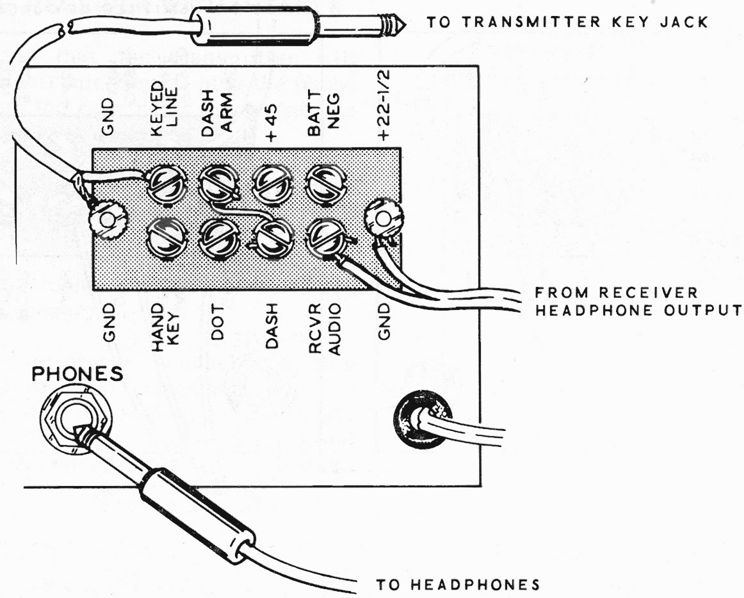
An external paddle may be connected to the GND, DOT, and DASH terminals of the Electronic Keyer. This will permit the use of either the external connected paddle or the Electronic Keyer without any interaction. See Figure 4. The external paddle may be of a type that will allow simultaneous operation of two separate paddles.

## SIDETONE

Figure 5 shows the Electronic Keyer used with a transmitter having a built-in sidetone, such as the Heathkit SB-400. The receiver speaker or headphones connected to the receiver may be used to reproduce the transmitted and received signals. The Volume control on the Electronic Keyer should be turned fully counterclockwise.




USE WITH TRANSMITTER HAVING BUILT-IN SIDETONE
Figure 5



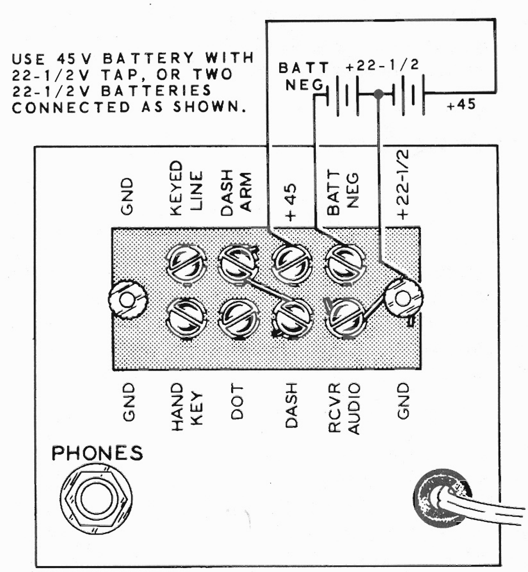

**ALTERNATE USE WITH ELECTRONIC KEYER USED AS MONITOR**
**Figure 6**

## MONITOR

In Figure 6, the Electronic Keyer is shown connected as a monitor. The Volume control should be adjusted for the desired output from the earphones.

## BATTERY OPERATION

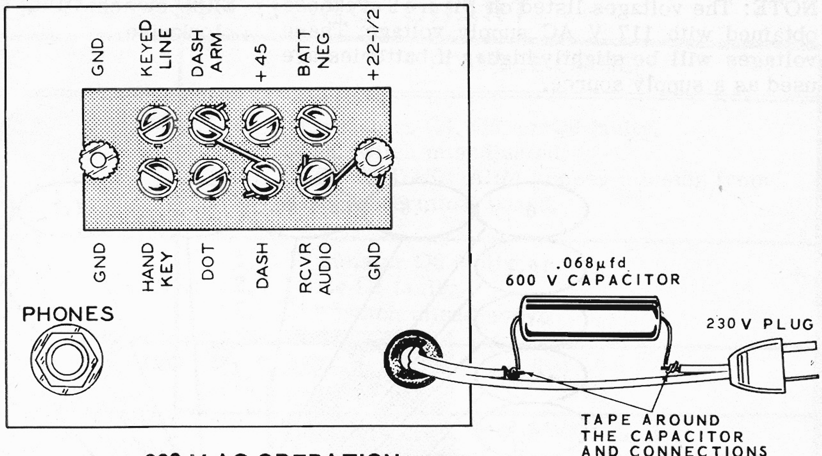
The Electronic Keyer may be powered with a 45 volt battery having a 22-1/2 volt tap or two 22-1/2 volt batteries connected as shown in Figure 7. The slide switch will not turn the batteries off, therefore, an external switch must be provided. If a switch is not used, the batteries should be disconnected when the Electronic Keyer is not in use. The 120 V AC line cord should not be connected to a wall outlet when batteries are connected to the Electronic Keyer.




**BATTERY OPERATION**
**Figure 7**

### 230 V AC OPERATION

Figure 8 shows the Electronic Keyer powered from a 230 V AC line source. A .068 $\mu$fd 600 volt capacitor is connected in series with one side of the AC line. This capacitor can be obtained from a local Radio and TV Service store.




230 V AC OPERATION
Figure 8

## IN CASE OF DIFFICULTY

NOTE: Refer to the Kit Builders Guide for Service and Warranty information.

1. A review of the Operating and Installation sections of the Manual may indicate any conditions overlooked.

2. The Circuit Descripton will prove helpful in indicating where to look for trouble.

3. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

4. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Soldering section of the Kit Builders Guide.

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

6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring, and pinched cables.

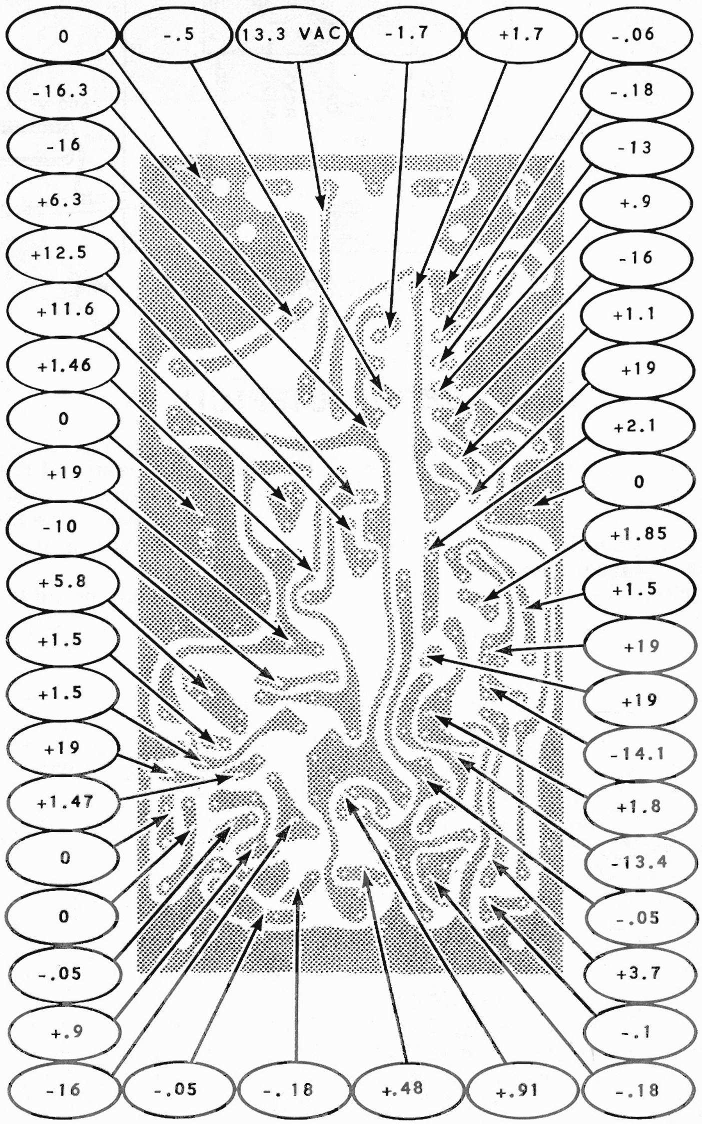
7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown in Figure 9. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

To aid in servicing or troubleshooting the Electronic Keyer, refer to the voltage readings on Figure 9 on Page 32 and the Circuit Board X-Ray Views shown on Page 41.

Breaks in the foil of the circuit board can easily be detected by placing a bright light under the foil side of the board and looking through the board from the lettered side. A break will appear as a hair-line crack in the foil. A break in the foil can be repaired by soldering a short length of bare wire across the break.

NOTE: The voltages listed on Figure 9 are those obtained with 117 V AC supply voltage. These voltages will be slightly higher if batteries are used as a supply source.

Slide switch-OPR. Both controls fully counter-clockwise.




VOLTAGE CHART

# TROUBLESHOOTING CHART

| DIFFICULTY | POSSIBLE CAUSE |
|---|---|
| Dot output only. | 1. Transistors Q4, Q5, or Q6 faulty.<br>2. Dash switch misadjusted.<br>3. DASH to DASH ARM jumper missing from 8-screw terminal board. |
| Dash output only. | 1. Transistor Q6 faulty.<br>2. Diode D1 faulty.<br>3. Dot switch misadjusted. |
| Tone varies with volume. | 1. Normal. |
| No tone. | 1. Transistors Q9, Q10, or Q11 faulty.<br>2. Jumper between GND and RCVR AUDIO missing from 8-screw terminal board.<br>3. Too high impedance across receiver output connections - connect a .005 μfd capacitor between GND and RCVR AUDIO connections on 8-screw terminal board.<br>4. Phone jack wired wrong or not making contact. |
| Dots will not stop. | 1. Dot switch misadjusted.<br>2. Transistor Q3 faulty. |
| Output circuit will not key - no tone. | 1. Transistor Q7 or Q8 faulty. |
| Transmitter will not turn off after being keyed. | 1. Voltage on the transmitter key jack too high - may damage transistor Q8. |
| Transmitter will not give full output with Electronic Keyer. | 1. Transistor Q7 or Q8 faulty.<br>2. Current on transmitter key jack may be too high - may damage transistor Q8. |
| Tone sounds unstable. | 1. Transistor Q8 not in its socket. |
| Tone will not stop. | 1. Transistor Q11 faulty.<br>2. Auxiliary hand key closed. |
| Minimum setting of Speed control - speed still too fast. | 1. Increase values of R13 and R22. This will, however, limit Speed control range. |
| No "HOLD." | 1. Frame of switch S3 is not grounded to the panel. |

# SPECIFICATIONS

## KEYING

| | |
|---|---|
| Speed | 15 to over 60 words per minutes code group. (Alternate connections for 10 to 20 words per minute code group.) |
| Keying Output | Keyed line to chassis ground. |
| Voltage Polarity | Negative to ground only. |
| Maximum Open Circuit Or Spike Voltage | 105 volts. |
| Key-Closed Voltage | 0.2 volts, maximum. |
| Key-Closed Current | 35 milliamperes, maximum. |

## GENERAL

| | |
|---|---|
| Audio | Internal speaker or high impedance headphone jack. |
| Transistor Complement | 7 - 2N407 PNP.<br>3 - 2N2712 NPN.<br>1 - 2N398A PNP. |
| Controls | Off-Operate-Hold switch.<br>Speed control.<br>Dot-to-Space ratio control.<br>Volume control. |
| Rear Panel Connections | Keyed Line.<br>Receiver audio.<br>Battery +45 volts.<br>Battery +22-1/2 volts.<br>Hand Key.<br>Dash Arm.<br>Dash.<br>Dot. |
| Power Requirements | AC operation: 105-125 volts AC, 50/60 cps. Battery operation: 45 volts with 22-1/2 volt tap; 14 milliamperes. |
| Dimensions | 3-3/4" wide x 4-1/4" high x 10-1/2" deep. |
| Net Weight | 5 lbs. |

# CIRCUIT DESCRIPTION

Refer to the Schematic (fold-out from Page 43) and Block Diagram while reading the Circuit Description.

## SCHEMATIC DIAGRAM

The letter-number designations on the Schematic Diagram are used to identify resistors, capacitors, and diodes. Each designation is related by the first number to the transistor stage in which it is used. For example, the resistors in transistor stage Q1 are designated R10, R11, etc. In transistor stage Q7 they are designated R70, R71, etc.

Letter-number designations using numbers 1 through 9 are not directly related to any transistor stage. This system of circuit component designations is used throughout the Schematic.

Circled letter designations on the Schematic Diagram indicate wire connecting locations on the circuit board.

## POWER SUPPLY

With slide switch S3 in the Operate or Hold position, the AC line voltage is applied across the primary winding of power transformer T1. Resistor R8 drops the line voltage that is applied to the neon pilot lamp, which indicates when the Keyer is on. The fuse provides protection in case of a short circuit.

The output of power transformer T1 is rectified by silicon diode D2 and filtered by capacitor C2 to produce a positive (+) 19 volts DC. Silicon diode D3 and a filter network consisting of capacitors C3 and C4 and resistor R9 provides a negative (-) 16 volts DC. These voltages are the operating and bias voltages for the transistor stages.

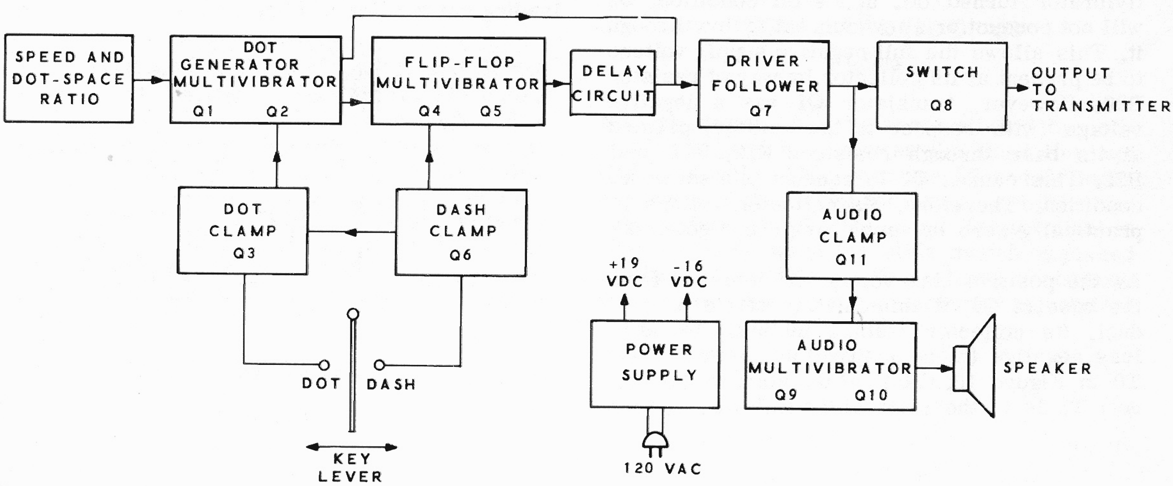
## KEY SWITCHING

The key lever is moved in one direction or the other to actuate switch S1 or S2. Switch S1 turns on the dot generator multivibrator circuit to produce dots. Switch S2 turns on the flip-flop and the dot generator multivibrators to produce dashes. The operation of these circuits will be explained later.

## DOTS

### Dot Clamp Circuit

When the key lever is in the center (neutral) position, a positive voltage is present at the base of dot clamp transistor Q3. This voltage which is applied from the power supply through resistors R1, R5, and R6, biases Q3 in an on




BLOCK DIAGRAM

condition (conducting). When Q3 is on, a positive voltage is applied to the base of Q2, one of the dot generator multivibrator transistors, keeping it turned off (not conducting).

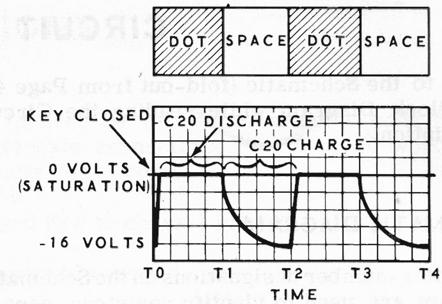
When the key lever is moved to the dot position, switch S1 closes. This removes the positive supply voltage present at the base of Q3 by directing it to ground through resistor R6. A negative supply voltage from the voltage divider consisting of resistors R1, R2, and R5, is applied to the base of transistor Q3. The negative voltage at the base turns Q3 off. This removes the positive bias voltage at the base of transistor Q2. Diode D30 isolates Q3 from Q2.

## DOT GENERATOR MULTIVIBRATOR

Transistors Q1 and Q2 and their associated circuitry make up the basic timing dot generator which is a free running multivibrator. Capacitors C10 and C20 with Speed control R11 and R21 control the switching speed of the multivibrator. Control R21 (screwdriver adjust) is adjusted so that the spaces are the same length in duration as the dots. Since the dot and space ratio must be maintained for all settings of the Speed control, the two sections of the control are clutched. Turning the Speed knob turns both sections of the control a like amount without changing the space and dot duration ratio.

The positive bias voltage from Q3 that is present at the base of Q2, keeps the dot generator multivibrator turned off. In the off condition, Q2 will not conduct or allow current to flow through it. This allows the full negative supply voltage to be present at its collector by way of resistor R20. However, transistor Q1 has a negative voltage (with respect to the emitter) present at its base through resistors R12, R21, and R22. This causes Q1 to conduct to a saturated condition. Therefore, its collector voltage is practically zero or very near ground potential.

As the positive bias voltage is removed from the base of Q2, it immediately starts to conduct. Its collector voltage instantly becomes less negative (more positive) as shown at point T0 in Figure 10. (T0 is at the start of the first dot; T1 is at the start of the following space.)

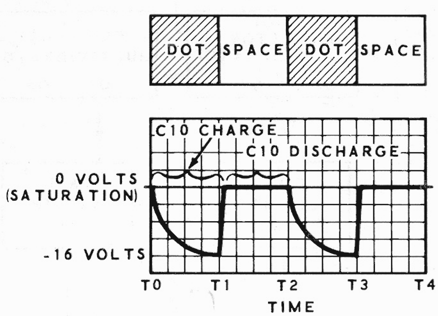



**Q2 COLLECTOR VOLTAGE**

**Figure 10**

This positive rise is coupled through capacitor C20 to the base of Q1. This drives the base of Q1 to collector cutoff. With the collector current of Q1 cutoff, the collector voltage increases to its maximum (most negative) potential. Instantaneously the Q2 collector current reaches it maximum (saturation). The result is to turn transistor Q2 fully on and Q1 off.

Although this on and off (switching) action is fast, it is not repeated instantly, since the voltage across C10 requires time to change. When the collector voltage of Q1 goes more negative, capacitor C10 must charge to this higher collector voltage. The charge path is through the base of conducting transistor Q2 and through collector load resistor R10. The collector voltage of Q1 will rise with a slight rounding off. This is shown between points T0 and T1 on the leading curved line in Figure 11.




**Q1 COLLECTOR VOLTAGE**

**Figure 11**

Although Q1 is now off and Q2 is on, the circuit cannot remain in this inactive (quiescent) condition indefinitely because of the action of capacitor C20. This capacitor has previously been charged to the Q2 collector voltage. Since the Q2 collector voltage has very rapidly become less negative C20 must now discharge. This is shown by the flat top line in Figure 10. The discharge path is through control R21. The time constant of the discharge curve is determined by capacitor C20 and control R21. The charging time of C20 is very short with respect to the discharge time. This is due to the high resistance value of control R21 as compared with resistor R20. As C20 discharges, the voltage at the base of Q1 becomes less positive (more negative).

When the conducting level of Q1 is reached and the transistor starts to conduct as shown at T1, the complete cycle is now reversed, with Q1 conducting to saturation and turning off Q2. The circuit then reaches its second inactive (quiescent) condition. Capacitor C1 having previously been charged, now discharges at a time constant determined by the value of C10 and control R11. As long as the key lever is held in the dot position, the dot generator multivibrator continues to run free. Each stage is then alternately on and off for relatively long periods (determined by the values of C10 and R11, and C20 and R21), followed by a very rapid switchover to the opposite stage.

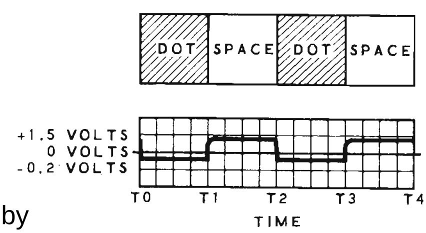


The collector output signals of Q1 and Q2 are fed to other sections of the circuit. The output from the collector of Q1 is fed through R30 to the base of Q3, and through R79 to the base of Q7. The output is fed to Q3 to make the multivibrator action self-completing. Once the multivibrator is started, any movement of the key lever will not have any effect until the dot and following space have been completed. The operation of Q7 will be explained in the following section.

## Driver Follower And Switch

The base of switch transistor Q8 draws more current than can be supplied by the dot generator transistors. Therefore driver transistor Q7 is used as an emitter follower to supply the necessary drive for Q8. Resistors R73, R74, R75, R76, and R78 divide the power supply voltages to set the proper bias voltages to fully control Q7 and Q8.

Transistors Q7 and Q8 have a positive base bias voltage which keeps them cut off (no current flow). Each time the collector voltage of Q1 is at -16 volts, transistor Q7 is biased to conduction. This action then biases Q8 to a point where it will also conduct. The output from Q7 is fed through resistor R111 to the base of audio clamp Q11. The operation of Q11 will be explained later. The collector output of Q8 is used to key the transmitter. This waveform is shown in Figure 12.




**SIGNAL AT BASE OF Q8**

**Figure 12**

Manual keying may be accomplished by connecting a hand key between the Hand Key and Gnd terminals. This operates Q7 and Q8 independently of the Keyer operation by shifting the bias voltage on Q7. The Hand Key terminal is also grounded when the slide switch is placed in the Hold position. This allows continuous transmitter operation for tuning or adjustment purposes.

## DASHES

### Dash Clamp

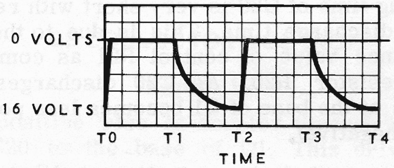
Dash clamp Q6 operates the same as did the dot clamp. Transistor Q6 keeps the flip-flop multivibrator circuit turned off by applying a positive bias voltage to the base of Q4. This bias voltage will cause Q4 to be cut off.

### Flip-Flop Multivibrator

The flip-flop multivibrator consisting of transistors Q4 and Q5 and their associated circuit are similar in construction and appearance to the dot generator multivibrator. However, instead of having cross-coupling (collector of one to the base of the other) capacitors, it uses resistors. Therefore, it cannot oscillate as did the dot generator multivibrator. This circuit will stay in either of two states, where one transistor is cut off (fully off) and the other is saturated (fully on).

When the base of Q4 is positive with respect to the emitter, it cannot conduct. The collector voltage of Q4 is then maximum negative and is coupled through resistor R41 to the base of Q5. This negative voltage on the base causes Q5 to conduct, thus keeping it at saturation. In this condition, the multivibrator cannot switch. It will stay in this condition until a positive-going pulse is fed to the base of the transistor that is in the saturated condition. In this case it is Q5. A positive pulse on the base of Q5 will turn it off, causing its collector current to decrease and its collector voltage to become more negative. This increase in negative voltage at the collector of Q5 is coupled through resistor R51 to the base of Q4 to turn it on. The negative voltage will continue until Q4 is driven to maximum collector current (fully conducting), while the collector current of Q5 is cut off (nonconducting). Nothing further can happen until Q4 gets a positive pulse at its base to turn it off, causing the cycle to repeat itself in the opposite direction. This switching action takes place very rapidly.

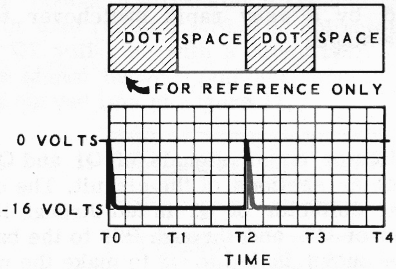
As mentioned before, the flip-flop multivibrator cannot switch as long as the bias voltage from clamp Q6 is present at the base of Q4. Moving the key lever to the dash position removes the bias voltage from Q6, letting Q4 operate. Simultaneously, diode D1 turns off dot clamp Q3, allowing the dot generator multivibrator to run free. In its starting condition it will be remembered that Q2 was off (maximum negative voltage at the collector). As soon as the dot multivibrator started to operate, the Q2 collector voltage decreased rapidly from maximum to near zero. This produces a positive (less negative) going pulse from the collector of Q2 to the junction at the bottom of capacitors C41 and C51. This waveform is shown at points T0 and T2 in Figure 13.




**Q2 COLLECTOR VOLTAGE**

**Figure 13**

These positive going pulses trigger the flip-flop multivibrator. They are coupled through capacitor C41 and diode D40 to the base of Q4. These pulses are also coupled through capacitor C51 and diode D50 to the base of Q5. These pulses affect only the transistor that is in the saturated condition. In this instance, it is Q5. The waveform of the pulse at the junction of C51 and the diode D50 is shown in Figure 14.




**TRIGGER PULSE AT JUNCTION OF C51 AND D50 WITH KEY LEVER IN DOT POSITION.**

**Figure 14**

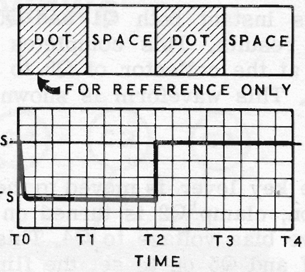
As Q5 turns off, a negative going pulse is produced. This is because Q5 stops drawing current, permitting the collector voltage to become more negative. Capacitor C50 is used to pass this pulse to the base of Q4 to speed up the switching action. Capacitor C40 performs the same task in the opposite cycle.

The collector output of Q5, as shown in Figure 15, is coupled to the junction of resistors R33 and R61. Resistor R33, diode D31, capacitor C3, resistors R61 and R62, and capacitor C60 form filters. These filters direct voltage from Q5 to clamp Q3 and Q6 to make the dashes self-completing. They also keep the control voltage from interacting between dots and dashes.

The output from the collector of Q5 is also coupled through a delay line consisting of resistors R70, R71, R72, and capacitors C70 and C71 to the base of Q7. This delay is necessary to insure that the output switching caused by the flip-flop multivibrator slightly overlaps that of the dot generator, while making dashes. Failure to overlap may leave holes in the dashes similar to that caused by the bouncing contacts of relays.

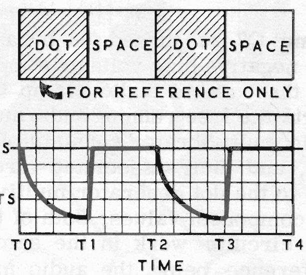
When the collector output of Q5 remains at its maximum negative voltage level, it produces a negative voltage to turn on transistors Q7 which drives Q8. Before Q5 can switch to on, the flip-flop must be triggered again by a positive going pulse from the collector of Q2. The pulse that just triggered Q5 was a positive going pulse from Q2. The output from the dot generator multivibrator is now a negative voltage from the collector of Q1. This is fed to the base of Q7, which is already on because of the negative voltage at Q5. Therefore, the output from Q1 has no additional effect. The next pulse from Q2 will be a negative going pulse, as Q2 turns off. This negative pulse from Q2 has no effect on the flip-flop multivibrator, as only positive going pulses can reset it. After the dot generator multivibrator goes through another half cycle, a positive going pulse from Q2 will result. This positive pulse is coupled to the base of Q4 (saturated transistor), resetting the flip-flop multivibrator.

Note in Figure 14 that the flat portion of the waveform is equal to the length of a dot and a space. This is because Q2 produces a positive going pulse every time it switches on. Since the positive pulses switch the flip-flop transistors alternately, they operate at half the rate of the dot generator multivibrator. The output from the dot generator and flip-flop multivibrators add at



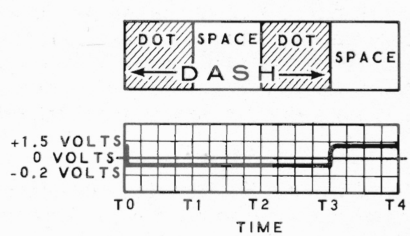

Q5 COLLECTOR VOLTAGE
Figure 15

the base of Q7. This produces the first third of a dash signal from the collectors of Q1 and Q5, as shown in Figure 15. The middle third of the dash is produced by the collector output of Q5 alone.




Q1 COLLECTOR VOLTAGE
Figure 16

The last third of the dash is filled in by the next dot signal from Q1 alone as shown in Figure 16. The result of these two signals at the base of Q8 is the waveform shown in Figure 17.




SIGNAL AT BASE OF Q8
Figure 17

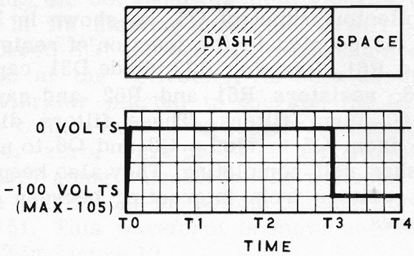
At this instant both Q1 and Q5 are on and a space results. This completes a dash and a space at the collector of Q8 to key the transmitter. This waveform is shown in Figure 18.

As the key lever is moved to the center or dot position, clamp Q2 is turned on and applies a positive bias voltage to Q4. This voltage turns Q4 off and Q5 on to set the flip-flop multivibrator. Thus, it is ready to start a dash the next time the key lever is moved to the dash position.

## MONITOR CIRCUIT

### Audio Clamp

Each time Q7 is turned on by a dot or dash signal, a negative bias voltage is applied through R111 to the base of audio clamp Q11. This in turn starts the free running audio multivibrator. The audio multivibrator consists of transistors Q9, Q10, and their associated circuitry. It is identical to the dot generator multivibrator, except for component values. Both of these multivibrator circuits work in the same way. The only difference being the audio multivibrator oscillates at an audio rate. This rate is determined by the time constant of resistors R90 and R100, with capacitors C90 and C100.

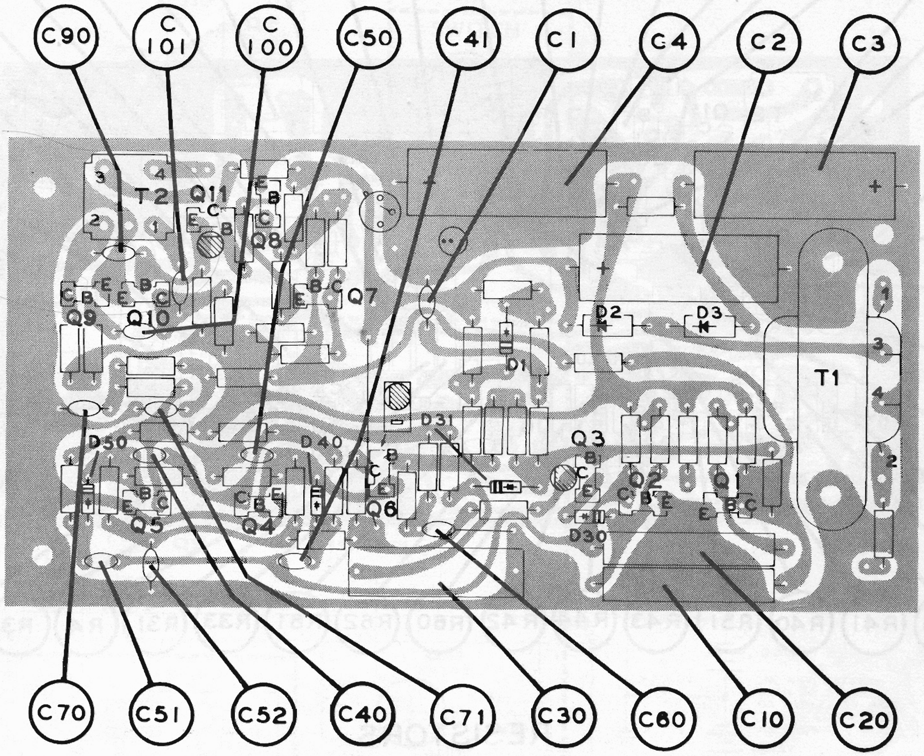



**Q8 COLLECTOR OUTPUT TO TRANSMITTER**
**Figure 18**

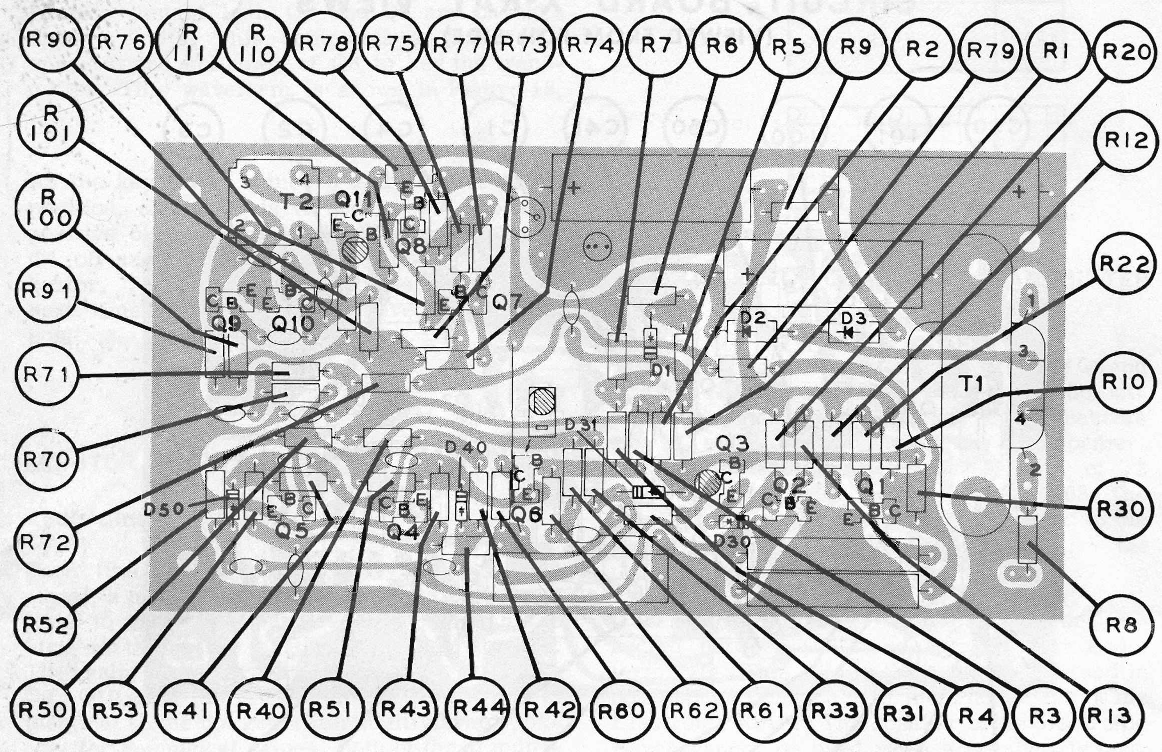
The output signals from the collectors of Q9 and Q10 are fed to the primary winding of audio output transformer T2. Capacitor C101 prevents any DC voltage from reaching the transformer. The signal from the secondary winding of T2 is connected across volume control R102. The wiper of the volume control is connected to the speaker. The control may be adjusted for the desired listening level.

If desired, the receiver output may be connected between GND and the Receiver Audio terminals. This allows the audio to be heard in headphones connected to the Phone jack of the Electronic Keyer. The speaker of the Electronic Keyer cannot be used when a receiver is connected, as it is of too high an impedance and cannot handle the output level of the receiver. If speaker operation is desired, the individual speakers of the Electronic Keyer and the receiver must be used.

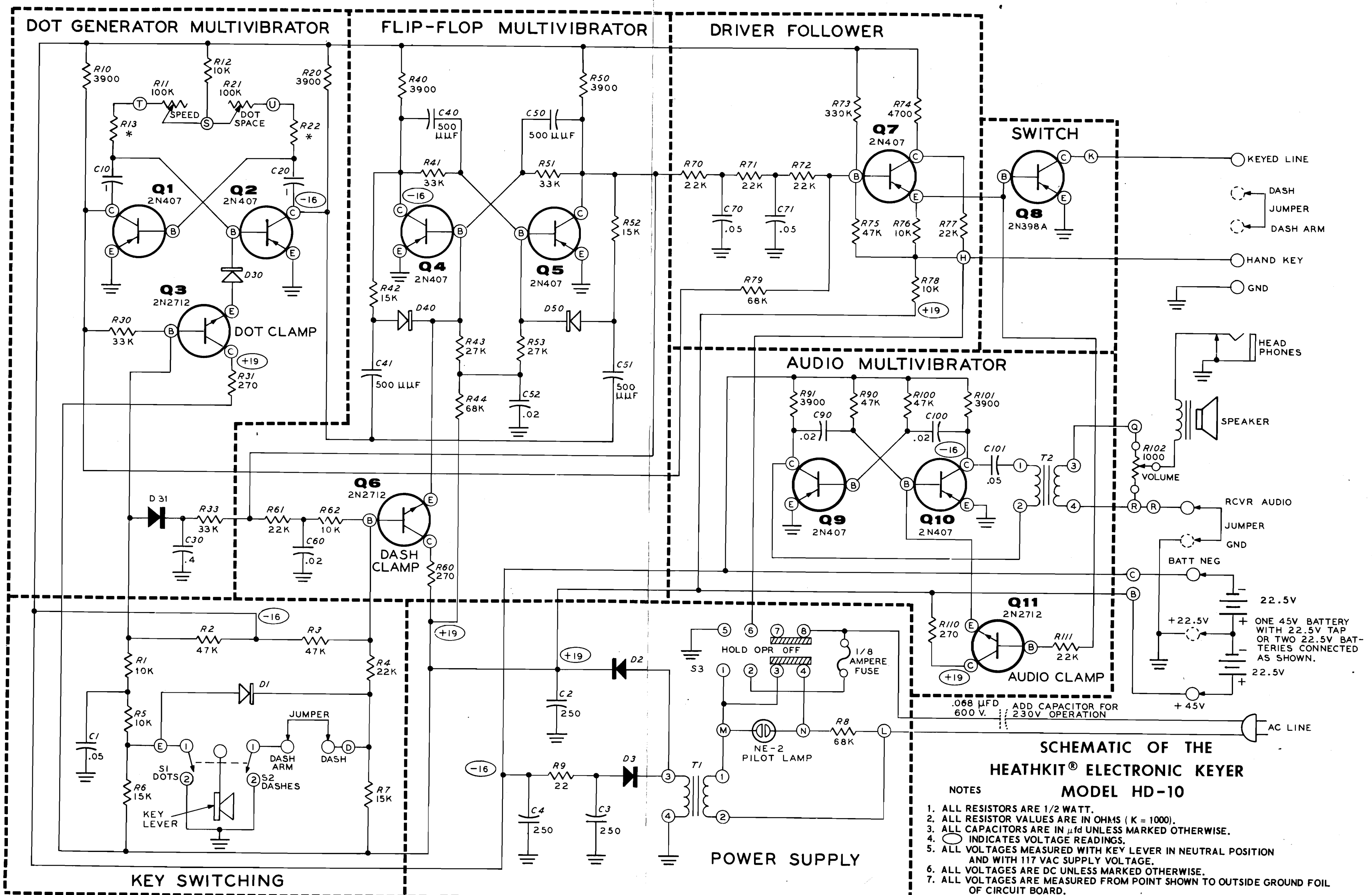
# CIRCUIT BOARD X-RAY VIEWS
(VIEWED FROM FOIL SIDE)




CAPACITORS


R90
R76
R 111
R 110
R78
R75
R77
R73
R74
R7
R6
R5
R9
R2
R79
R1
R20
R 101
R 100
R91
R71
R70
R72
R52
R12
R22
R10
R30
R8
R50
R53
R41
R40
R51
R43
R44
R42
R60
R62
R61
R33
R31
R4
R3
R13
T2
Q11
Q8
Q7
Q9
Q10
D1
D2
D3
T1
Q3
Q2
Q1
D31
D40
Q6
Q4
Q5
D50
D30

RESISTORS




# SCHEMATIC OF THE HEATHKIT® ELECTRONIC KEYER MODEL HD-10

NOTES

1. ALL RESISTORS ARE 1/2 WATT.
2. ALL RESISTOR VALUES ARE IN OHMS (K = 1000).
3. ALL CAPACITORS ARE IN µfd UNLESS MARKED OTHERWISE.
4. ◯ INDICATES VOLTAGE READINGS.
5. ALL VOLTAGES MEASURED WITH KEY LEVER IN NEUTRAL POSITION AND WITH 117 VAC SUPPLY VOLTAGE.
6. ALL VOLTAGES ARE DC UNLESS MARKED OTHERWISE.
7. ALL VOLTAGES ARE MEASURED FROM POINT SHOWN TO OUTSIDE GROUND FOIL OF CIRCUIT BOARD.
8. VOLTAGE READINGS TAKEN WITH 11 MEGOHM INPUT VTVM.
9. DOTTED TERMINALS DUPLICATE SOLID TERMINALS AS SHOWN.
10. *10 KΩ FOR 15 TO 60 WORDS PER MINUTE SPEED. 68 KΩ FOR 10 TO 20 WORDS PER MINUTE SPEED.

HEATH COMPANY

BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

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