PRICE $3.00

AJ-11

HEATH COMPANY • BENTON HARBOR, MICHIGAN

RECEIVED JUL 3 1961

HEATHKIT®
ASSEMBLY MANUAL

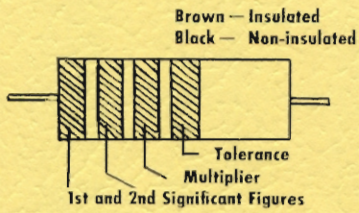
HEATHKIT by Daystrom

STEREO-MONOPHONIC AM-FM TUNER

MODEL AJ-11

STANDARD COLOR CODE — RESISTORS AND CAPACITORS

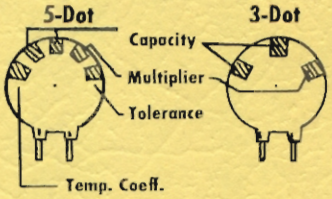
AXIAL LEAD RESISTOR



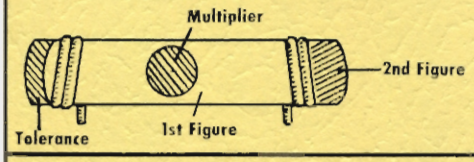
Wire wound resistors have 1st digit band double width

INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier
BLACK	0	0	None
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	,000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
VIOLET	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

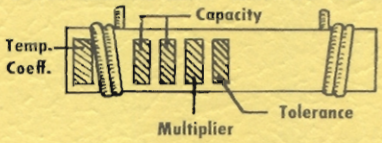
DISC CERAMIC RMA CODE



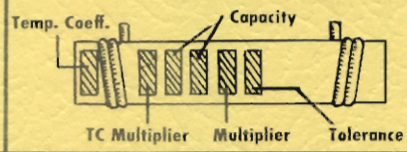
RADIAL LEAD DOT RESISTOR



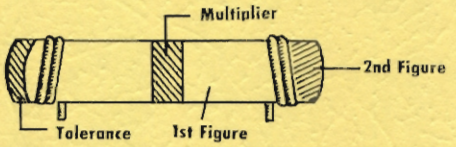
5-DOT RADIAL LEAD CERAMIC CAPACITOR



EXTENDED RANGE TC CERAMIC HICAP

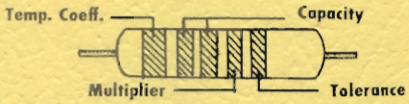


RADIAL LEAD (BAND) RESISTOR



BY-PASS COUPLING CERAMIC CAPACITOR

AXIAL LEAD CERAMIC CAPACITOR

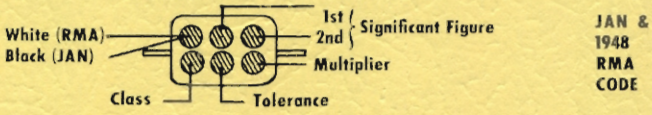


The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

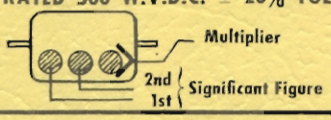
MOLDED MICA TYPE CAPACITORS

CURRENT STANDARD CODE

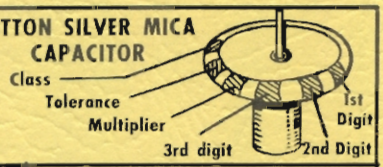


JAN & 1948 RMA CODE

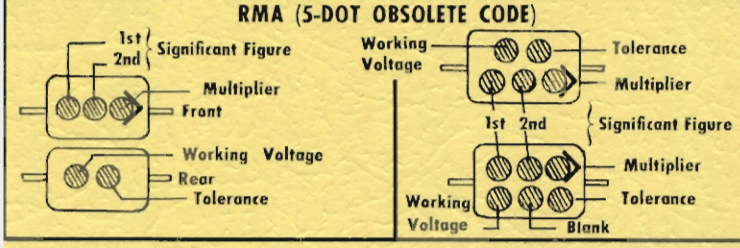
RMA 3-DOT (OBSOLETE) RATED 500 W.V.D.C. ± 20% TOL.



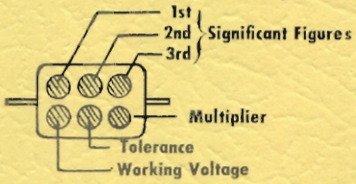
BUTTON SILVER MICA CAPACITOR



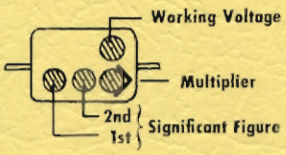
RMA (5-DOT OBSOLETE CODE)



RMA 6-DOT (OBSOLETE)

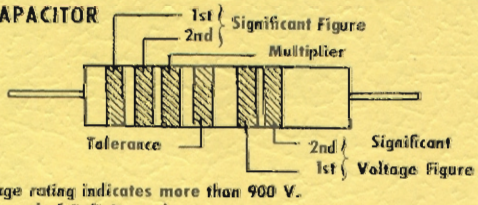


RMA 4-DOT (OBSOLETE)



MOLDED PAPER TYPE CAPACITORS

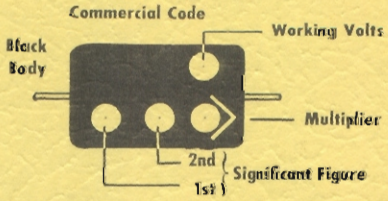
TUBULAR CAPACITOR



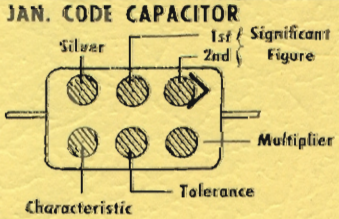
Normally stamped for value

A 2 digit voltage rating indicates more than 900 V. Add 2 zeros to end of 2 digit number.

MOLDED FLAT CAPACITOR



JAN. CODE CAPACITOR



The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

Courtesy of Centralab

HELPFUL KIT BUILDING INFORMATION

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

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

RECOMMENDED TOOLS

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

ASSEMBLY

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

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

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

WIRING

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

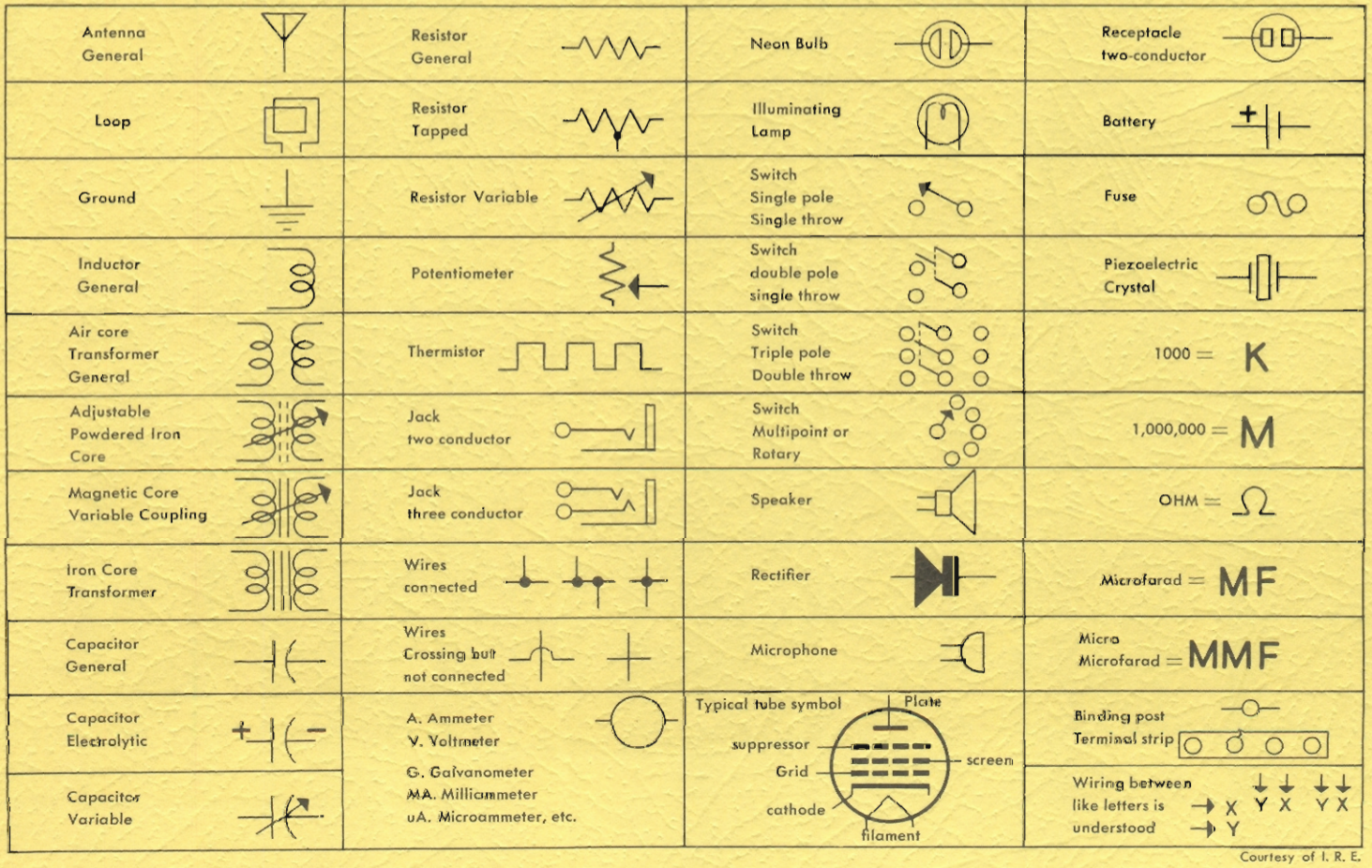
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown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

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

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

SOLDERING

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



Courtesy of I. R. E.

HEATH COMPANY

BENTON HARBOR, MICHIGAN

a subsidiary of

DAYSTROM, INCORPORATED

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

595-420

LITHO IN U. S. A.

Assembly and Operation of the

HEATHKIT® by DAYSTROM

STEREO-MONOPHONIC AM-FM TUNER

MODEL AJ-11

HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

a subsidiary of DAYSTROM, INCORPORATED

TABLE OF CONTENTS

Specifications. 2
Introduction. 4
Circuit Description. 5
Schematic. 7*
Construction Notes. 7
Parts List. 9
Proper Soldering Techniques. 11
Step-By-Step Procedure. 13

Step-By-Step Assembly. 14
Initial Wiring. 18
Component Installation. 22

Initial Test. 42
AM Front End Alignment Without Instruments. 43
AM Front End Alignment With Instruments. 44
FM Alignment Without Instruments. . . . 45

Final Assembly. 46
Installation And Operation. 46
In Case Of Difficulty. 50
Troubleshooting Chart. 52

Service Information. 53
Service. 53
Replacements. 54
Shipping Instructions. 54
Warranty. 55

*Fold-out from page.

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

Copyright 1961
Heath Company

7/21/61

SPECIFICATIONS

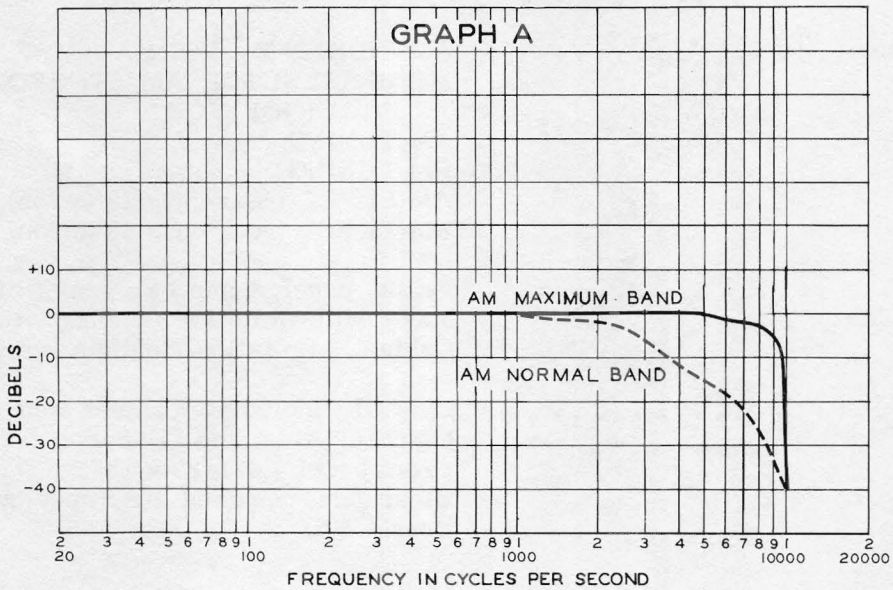
AM SECTION

Tuning Range:	550 kc - 1600 kc.
Intermediate Frequency:	455 kc.
Usable Sensitivity (normal position):	1400 kc - 10 μv (20 db of quieting). 1000 kc - 15 μv (20 db of quieting). 600 kc - 40 μv (20 db of quieting).
IF Bandwidth:	Normal - 6 db - 7 kc. Maximum - 6 db - 12 kc.
AM Antenna:	Built-in rod antenna with provisions for external antenna and ground.
Output Impedance (cathode follower):	Variable to 800 ohms.
Output Voltage (750 μv -30% Mod.):	1 volt.
Image Rejection:	1400 kc - 40 db. 1000 kc - 50 db. 600 kc - 60 db.
Harmonic Distortion (750 μv -95% Mod.):	Less than 1%.
Hum And Noise (5000 μv, 30% Mod.):	30 db.
IF Rejection:	1400 kc - 30 db. 600 kc - 50 db.
AM Audio Response:	See Graph A on Page 3.

FM SECTION

Tuning Range:	88 mc - 108 mc.
Intermediate Frequency:	10.7 mc.
Antenna:	Balanced input for external 300 Ω antenna. Internal line antenna.
Output Impedance (Cathode Follower):	Variable to 800 ohms.
Output Voltage (30 μv -30% Mod.):	1 volt.
Image Ratio (30 μv -30% Mod. -98 mc):	-45 db.
Harmonic Distortion (25 μv -100% Mod. -98 mc):	Less than 1%.
IF Rejection (98 mc):	-65 db.
FM Audio Response (20-20,000 cps):	±1 db.

AM AUDIO RESPONSE



AFC Correction Factor (Full AFC):.	100 kc per volt.
AM Suppression:.	-27 db.
Hum And Noise (25 μv, 30% Mod.):.	-48 db.
Quieting Sensitivity:.	20 db - 2-1/2 μv. 30 db - 3-1/2 μv. 48 db - 30 μv (max. quieting).

ELECTRICAL AND MECHANICAL

Tube Complement:

AM:.	2 - 6BA6, RF Amplifier-IF Amplifier 1 - 6BE6, Oscillator-Mixer 1 - 6BN8, Detector-Audio Output 1 - 6ME5, Tuning Indicator
FM:.	1 - 6CY5, RF Amplifier 1 - 6EZ8, Oscillator-Mixer-Auto. Freq. Control 3 - 6AU6, IF Amplifiers 1 - 6BN8, Ratio Detector-Audio Output 1 - 6ME5, Tuning Indicator
Power Supply:.	Transformer operated full-wave voltage doubler with (2) silicon rectifiers.
Power Requirements:.	117 volt - 50/60 cycles - 40 watts (fused).

Antenna Input Termination:.	Screw lug terminals for external antennas.
Output Terminations (AM-FM-Multiplex):.	Standard phono sockets.
Controls And Switches:.	AM FIDELITY - NORMAL/MAX. MODE SELECTOR-AM/STEREO/FM AC POWER-OFF/ON AM TUNING FM TUNING AM LEVEL (rear chassis apron) FM LEVEL (rear chassis apron)
Finish:.	Front panel, charcoal gray, bright anodized hood with imitation leather vinyl trim strip. Cabinet, imitation leather vinyl clad steel.
Dimensions:.	Overall, including cabinet and feet - 5-1/4" high, 15" wide, and 11" deep. Front panel - 4-1/2" x 15". Clearance required for input-output terminations - 1".
Net Weight:.	17 lbs.
Shipping Weight:.	21 lbs.

The preceding specifications are representative of a completely aligned tuner. Minor variations from these specifications may be encountered in kit-assembled tuners. Such factors as exact lead placement, component variations, and tube characteristics are possible sources of deviations. In a highly stable tuner such as the AJ-11, these variables may be disregarded from a performance point of view.

INTRODUCTION

The HEATHKIT Model AJ-11 Stereo-Monophonic Tuner is basically two independent tuners; an AM (amplitude modulation) tuner and a FM (frequency modulation) tuner contained in one attractively styled cabinet. High quality construction, versatility, attractive styling, and excellent performance are the basic factors of the AJ-11 design.

The high quality designed into the AJ-11 is evidenced by the prebuilt prealigned FM front end, all steel vinyl clad cabinet, and the heavy die-cast flywheels which provide positive action of the individual AM and FM tuning controls.

The separate tuning indicator eye tubes simultaneously monitor AM and FM tuning. This feature is very desirable when receiving stereo AM and FM broadcasts.

Adjustable automatic frequency control and a limiter-ratio detector combination provide stable broad-band FM reception. The AM section contains a sensitive built-in rod type antenna with provision for connecting an external antenna if needed.

Separate cathode follower output circuits provide low line impedance, which minimizes hum and high frequency losses in interconnecting cables.

A prealigned and preassembled FM front end is supplied for ease of construction, and to provide consistently good FM performance.

The full-wave, voltage-doubler power supply uses silicon rectifiers which reduce heat and provide excellent voltage regulation.

CIRCUIT DESCRIPTION

The Model AJ-11 AM-FM Tuner has three basic circuits; an AM tuner, an FM tuner, and a common power supply. Each section will be described individually. While reading the Circuit Description, we suggest that you follow the circuit on the Schematic Diagram.

AM TUNER

AM (amplitude modulation) refers to a constant frequency RF signal (carrier) whose amplitude is varied (modulated) by the audio being transmitted. This is illustrated in Figure 1.

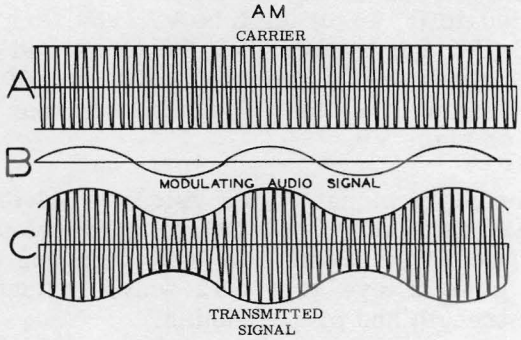


Figure 1

The modulated RF signal is received by the tuner's AM antenna and is applied to the grid of RF amplifier tube V1. The amplified RF signal from V1 is then coupled to the grid of mixer-oscillator tube V2.

The AM oscillator is tuned to a frequency 455 kc higher than that of the RF signal being received at the grid of V2. As a result, both the oscillator and RF signals are present at the plate of V2, along with the sum and difference of these two signals. These signals, which contain the same modulation as the received RF carrier, are applied to T2, the 1st IF transformer.

Transformer T2 is designed to accept only the difference frequency of 455 kc. The electrical makeup of the transformer contributes to the excellent fidelity of the AJ-11. It has a special winding to control the amount of inductive coupling between the primary and secondary circuits. When the AM FIDELITY switch is placed in the MAX. position, transformer T2 is overcoupled, and a response curve as shown in Figure 2A results. In the NORMAL position, the coupling is decreased, resulting in the response curve shown in Figure 2B. The signal from the secondary winding of T2 is applied to the grid of IF amplifier tube V3.

This modulated 455 kc IF signal, at the grid of V3, is amplified and then coupled through the second IF transformer, T3, to the diode elements of detector tube V4A, where the audio modulation is recovered.

The diodes of V4A are connected to provide a negative DC voltage and an audio signal across R11, the diode load.

The negative DC voltage is applied to the grid of each tube in the previous stages to control their gain. Strong stations provide more negative DC voltage which reduces the gain of the previous stages. This action is called AVC (automatic volume control).

Negative DC voltage from V4A is also applied to the control grid of tuning indicator eye tube

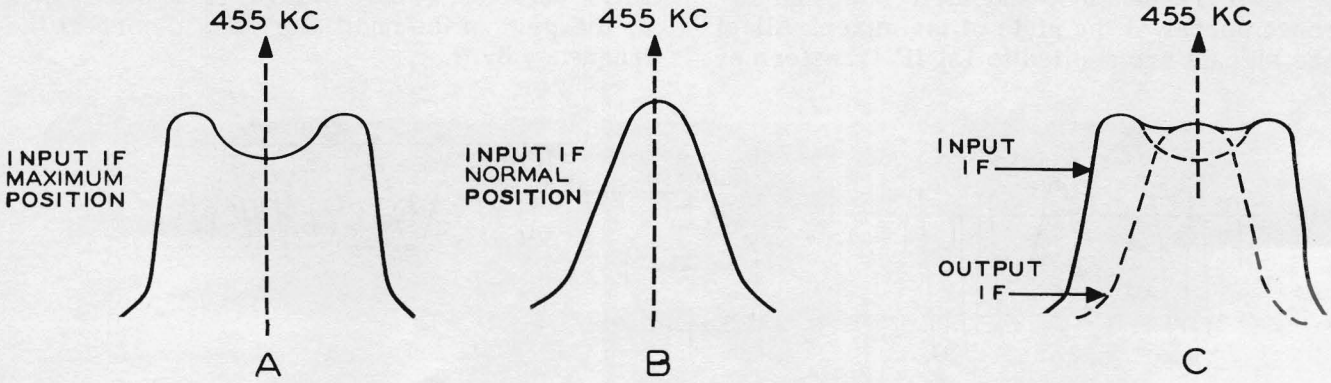


Figure 2

V11, which indicates received signal strength and proper tuning by the amount of eye closure.

Coupling capacitor C22 allows the audio signal from V4A to pass to the grid of cathode follower V4B. This stage provides isolation between the output jack and the detector stage, preventing loading of the detector. The audio signal is then coupled from the AM LEVEL control, in the cathode circuit of V4B, through the MODE SELECTOR switch to the output sockets.

A whistle filter is used in the cathode circuit of V4B to reject the 10 kc beat signal that often occurs between two adjacent stations when received on a wide-band AM tuner.

This completes the AM tuner description.

FM TUNER

FM (frequency modulation) means that the carrier amplitude is held constant while the carrier frequency is varied above and below the station frequency at a rate determined by the audio being transmitted. This is illustrated in Figure 3. The audio signal (B) is applied to the RF carrier (A) to produce the FM signal (C). This signal, as received by the tuner's FM antenna, is applied through a band-pass filter consisting of L4, L5, and C30A, to the grid of the RF amplifier tube V5. The amplified signal from V5 is coupled to the grid of mixer tube V6A through L6 and C33.

Local oscillator tube V6B is tuned to operate 10.7 mc above the received FM signal. The oscillator and received signals are mixed in the tube by means of interelectrode capacitance, and also by stray capacitance and inductance in the mixer-oscillator circuit. As in the AM tuner, these two frequencies, and their sum and difference appear at the plate of the mixer. All of these signals are applied to 1st IF transformer

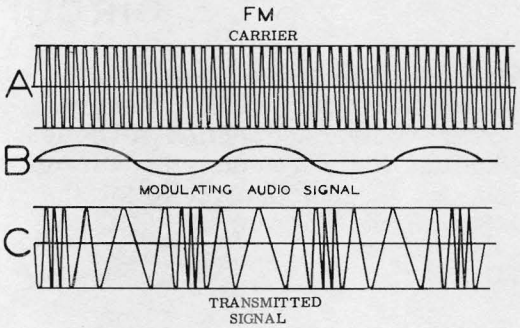


Figure 3

T5 which passes only the difference frequency, or IF, of 10.7 mc. The 10.7 mc signal from T5 is applied to IF amplifier tube V7, and then is coupled through transformer T6 to second IF amplifier tube V8. From V8, the amplified 10.7 mc signal is applied through transformer T7 to limiter stage V9.

The amount of signal at the grid of V9 determines the value of negative DC voltage developed at this point. The negative DC voltage is applied to the grid of eye tube V12 which indicates signal strength and proper tuning.

V9 acts as an IF amplifier for weak signals, and as a limiter for strong signals. The limiter stage in a FM tuner is used to remove any amplitude modulation of the FM signal. Refer to Figure 4. The limited signal from V9 is applied through transformer, T8, to ratio detector tube V10A. The ratio detector does the same job in a FM tuner that the detector stage does in an AM tuner. It recovers audio from the modulated IF signal.

If the oscillator frequency changes (drifts), a small negative DC voltage is developed in the ratio detector. This voltage is applied back to the grid of the oscillator tube to correct the frequency drift.

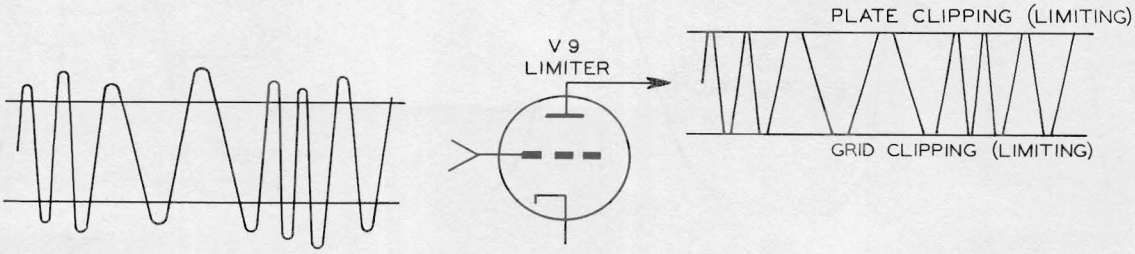


Figure 4

The audio signal from the ratio detector is coupled through the MODE SELECTOR switch to the output sockets.

POWER SUPPLY

The power supply uses a full-wave voltage-doubler circuit, consisting of diodes D1, D2, and capacitors C67 and C68. Capacitors C69A, C69B, and C69C with resistors R46 and R47 make up a filter network to remove ripple from the DC voltage.

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be a stable instrument, operating at a high degree of dependability. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

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

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

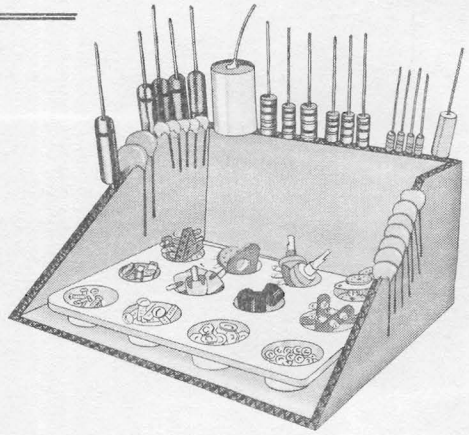
Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -50% are common for electrolytic capacitors.

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

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

2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a pen knife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.

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



HARDWARE

#6 x 3/8"
SHEET METAL SCREW

6-32 x 1/2"
TRUSS HEAD MACHINE SCREW

8-32 x 1/4"
SLOTTED SETSCREW

6-32 x 1/2"
SELF-TAPPING SCREW

3-48 x 1/4" SCREW

6-32 x 1/4" SCREW

6-32 x 3/8" SCREW

6-32 x 5/16"
SLOTTED SETSCREW

6-32 x 1/4"
TRUSS HEAD MACHINE SCREW

5-40 x 7/8" STUD

6-32 x 3/16" SCREW

#6 x 1/4"
SHEET METAL SCREW

3-48 NUT

6-32 NUT

8-32 NUT

CONTROL NUT

5-40 NUT

#253-10
CONTROL FLAT WASHER

DIAL DRIVE SHAFT
E WASHER

#253-45
FLAT STEEL WASHER

#6 LOCKWASHER

#8 LOCKWASHER

CONTROL LOCKWASHER

#3 LOCKWASHER

1/8" SPACER

1/4" SPACER

DIAL CORD SPRING

#6 SOLDER LUG

#6 SMALL SOLDER LUG

#6 SPADE LUG

IF TRANSFORMER
MOUNTING CLIP

PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-2	3	68 Ω 1/2 watt (blue-gray-black)
1-66	1	150 Ω 1/2 watt (brown-green-brown)
1-9	5	1000 Ω 1/2 watt (brown-black-red)
1-44	2	2200 Ω 1/2 watt (red-red-red)
1-19	2	6800 Ω 1/2 watt (blue-gray-red)
1-20	1	10 KΩ 1/2 watt (brown-black-orange)
1-22	1	22 KΩ 1/2 watt (red-red-orange)
1-23	2	27 KΩ 1/2 watt (red-violet-orange)
1-60	1	68 KΩ 1/2 watt (blue-gray-orange)
1-102	1	82 KΩ 1/2 watt (gray-red-orange)
1-26	1	100 KΩ 1/2 watt (brown-black-yellow)
1-27	1	150 KΩ 1/2 watt (brown-green-yellow)
1-30	2	270 KΩ 1/2 watt (red-violet-yellow)
1-33	2	470 KΩ 1/2 watt (yellow-violet-yellow)
1-68	1	820 KΩ 1/2 watt (gray-red-yellow)
1-35	6	1 megohm 1/2 watt (brown-black-green)
1-37	1	2.2 megohm 1/2 watt (red-red-green)
1-38	1	3.3 megohm 1/2 watt (orange-orange-green)
1-39	2	4.7 megohm 1/2 watt (yellow-violet-green)
1-40	1	10 megohm 1/2 watt (brown-black-blue)
1B-13	1	220 Ω 2 watt (red-red-brown)
1B-16	1	330 Ω 2 watt (orange-orange-brown)
Capacitors		
21-3	1	10 μμf disc ceramic
21-6	1	27 μμf disc ceramic
21-40	1	47 μμf disc ceramic, NPO (large)

PART No.	PARTS Per Kit	DESCRIPTION
Capacitors (Cont'd.)		
21-32	2	47 μμf disc ceramic
21-9	2	100 μμf disc ceramic
21-17	5	270 μμf disc ceramic
21-14	1	.001 μfd disc ceramic
21-36	2	.002 μfd disc ceramic
21-27	10	.005 μfd disc ceramic
21-47	5	.01 μfd disc ceramic
21-82	1	.02 μfd disc ceramic
21-48	1	.05 μfd disc ceramic
21-81	4	.1 μfd disc ceramic
23-28	2	.1 μfd tubular capacitor
25-95	1	10 μfd at 25 volt electrolytic
25-20	2	40 μfd 150 volt electrolytic
25-23	1	80-40-20 at 150 volt electrolytic
26-33	1	90-420 μμf variable (3-section)
Transformers-Coils-Chokes		
40-89	1	Oscillator coil
40-90	1	250 mh whistle filter coil
40-149	1	FM line cord antenna coil
40-309	1	AM rod antenna coil
40-324	1	AM RF transformer
45-35	2	1.7 μh filament choke
52-9	1	IF output transformer
52-26	1	1st IF transformer
52-27	1	2nd IF transformer
52-37	1	IF input transformer
53-4	1	Ratio detector transformer
54-101	1	Power transformer
Switches-Controls		
10-88	2	10 KΩ audio taper control
63-249	1	SPST AC switch
63-250	1	SPDT rotary switch
63-251	1	3-position, single-section, rotary switch (6 terminals)
63-265	1	3-position, single-section rotary switch (4 terminals)
Terminal Strips-Sockets		
431-1	3	Dual-lug terminal strip
431-2	1	2-lug terminal strip, #6 mounting hole
431-11	2	5-lug terminal strip
431-12	1	4-lug terminal strip
431-13	1	4-lug screw type terminal
431-14	1	2-lug terminal strip (one lug ground
431-16	1	2-lug terminal strip (one lug ground

PART No.	PARTS Per Kit	DESCRIPTION
Terminal Strips-Sockets (Cont'd.)		
431-32	1	2-lug #8 mounting hole terminal strip
431-35	1	7-lug terminal strip
431-45	1	6-lug terminal strip
434-14	2	7-pin tube socket
434-43	2	9-pin tube socket with shield base
434-76	1	Triple phono socket
434-88	2	Pilot light socket
434-91	6	7-pin tube socket with shield base
Diodes-Tubes-Lamps-Fuses		
57-23	2	Silicon diode
411-11	3	6AU6 tube
411-90	2	6BA6 tube
411-91	1	6BE6 tube
411-128	2	6BN8 tube
411-139	2	6ME5 tube
412-1	2	#47 pilot lamp
421-20	2	1/2 amp slow-blow type 3AG fuse (1 spare)
Hardware		
250-8	12	#6 x 3/8" sheet metal screw
250-10	6	6-32 x 1/2" truss head machine screw
250-43	2	8-32 x 1/4" slotted setscrew
250-46	2	6-32 x 1/2" self-tapping screw
250-49	16	3-48 x 1/4" screw
250-56	38	6-32 x 1/4" screw
250-89	6	6-32 x 3/8" screw
250-100	4	6-32 x 5/16" slotted set-screw
250-116	1	6-32 x 1/4" truss head machine screw (black)
250-120	4	5-40 x 7/8" stud
250-138	2	6-32 x 3/16" screw
250-170	3	#6 x 1/4" sheet metal screw
252-1	16	3-48 nut
252-3	54	6-32 nut
252-4	4	8-32 nut
252-7	6	Control nut
252-33	4	5-40 nut
253-10	2	Flat control washer
253-11	4	Dial drive shaft "E" washer
253-45	2	Flat steel washer
254-1	71	#6 lockwasher
254-2	5	#8 lockwasher
254-4	2	Control lockwasher
254-7	24	#3 lockwasher
255-1	2	1/8" spacer
255-2	4	3/16" spacer

PART No.	PARTS Per Kit	DESCRIPTION
Hardware (Cont'd.)		
255-13	4	1/4" spacer
258-1	2	Dial cord spring
259-1	4	#6 solder lug
259-6	8	#6 small solder lug
259-11	2	#6 spade lug
260-7	6	IF transformer mounting clip
Metal Parts		
90-M166	1	Cabinet shell, vinyl clad steel
100-M62	2	Dial drum
100-M302	2	Small pulley bracket
100-M312F	1	Dial pulley plate
100-M315	1	Large pulley bracket
200-M295F465-466	1	Chassis
203-M231F464	1	Control panel
203-M232	1	Control subpanel
203-M233F463-498	1	Front panel
204-M182	2	AM rod antenna mounting bracket
204-M366	1	Left end bracket
204-M367	1	Right end bracket
204-M398	2	Eye tube mounting bracket
204-M399	2	Dial shaft mounting bracket
205-M294	1	Chassis bottom plate
206-25	6	Tube shield, 7-pin
206-54	2	Tube shield, 9-pin
210-14	1	Front bezel
Wire		
89-1	1	Line cord
206-30	1	Length spiral shield
343-6	1	Length shielded audio cable
344-1	1	Length hookup wire
346-1	1	Length sleeving
346-2	1	Length clear sleeving
347-2	1	Length 300 Ω twin lead
347-7	1	Length 4-conductor cable
Miscellaneous		
73-1	1	3/8" rubber grommet
75-24	1	Line cord strain relief
100-M313	1	AM dial cord (long)
100-M316	1	FM dial cord (short)
110-3	1	FM tuner front end
207-18	2	Plastic clamp
261-17	4	Brown plastic foot
391-11	1	Nameplate
423-1	1	Fuse holder

PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (Cont'd.)		
435-2	2	Mounting ring, 7-pin tube socket
438-4	4	Phono plug
446-13F462	1	Dial plate window
453-93	2	Dial drive shaft
454-2	2	Flywheel
462-117	4	Black knob with red pointer line
462-120	2	Black knob with clear plastic skirt
463-17	1	AM dial pointer
463-18	1	FM dial pointer
481-1	1	Capacitor mounting wafer
490-1	1	Plastic alignment tool
595-420	1	Instruction manual

PROPER SOLDERING TECHNIQUES

Only a small percentage of HEATHKIT equipment purchasers find it necessary to return an instrument for factory service. Of these instruments, by far the largest portion of malfunctions are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 30 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly over the joint. Keep the iron tip clean and bright by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire); the size of the conductor is the same for all colors of hookup wires furnished with this kit. In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the construction step.

2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.

3. Leads on resistors, capacitors and similar components are generally much longer than they need to be to make the required connections. In these cases, the leads should be cut to proper length before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points.

4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated construction step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.

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

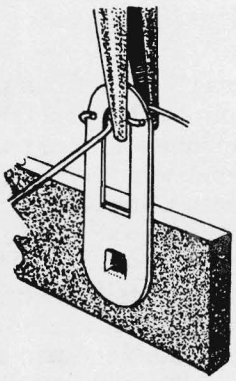
6. Position the work, if possible, so that gravity will help to keep the solder where you want it.

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

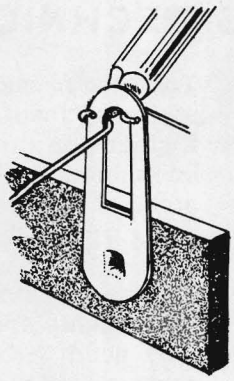
8. Place the solder against the heated terminal and it will immediately flow over the joint; use only enough solder to thoroughly wet the junction. It is usually not necessary to fill the entire hole in the terminal with solder.

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

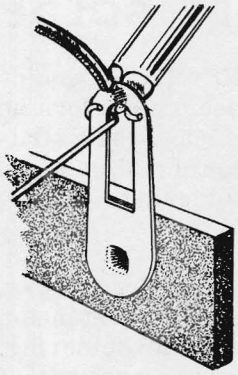
A poor or cold solder joint will usually look crystalline and have a grainy texture, or the solder will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly over the entire junction. In some cases, it may be necessary to add a little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



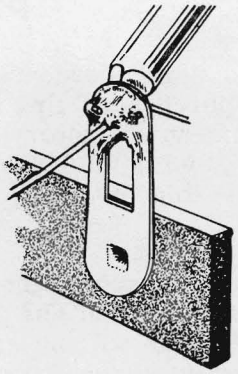
CRIMP WIRES



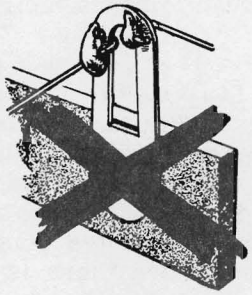
HEAT CONNECTION



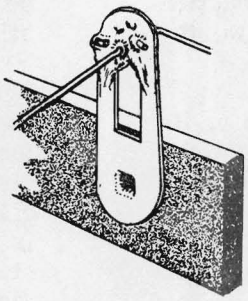
APPLY SOLDER



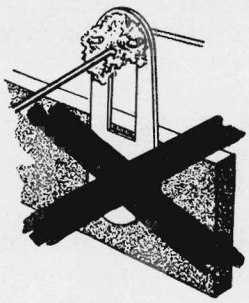
ALLOW SOLDER TO FLOW



COLD SOLDER JOINT CONNECTION INSUFFICIENTLY HEATED



PROPER SOLDER CONNECTION



COLD SOLDER JOINT CONNECTION MOVED WHILE COOLING

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

STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each lead in colored pencil on the Pictorial as it is added.

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

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

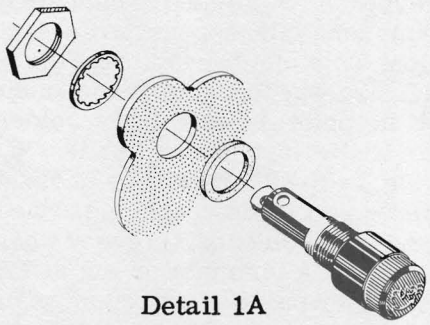
The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. (In cases where a lead passes through a terminal or lug and then connects to another point, it will count as two leads, one entering and one leaving the terminal.)

The steps directing the installation of resistors include color codes to help identify the parts. Also, if a part is identified by a letter-number designation on the Schematic, its designation will appear in the construction step which directs its installation.

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1 (fold-out from Page 17) for the following steps.

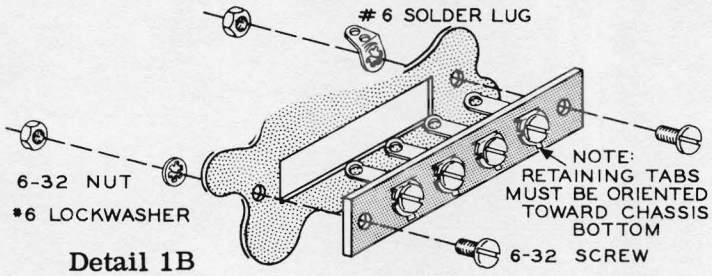
( ) Referring to Detail 1A, mount the fuse holder at location A. Use the hardware supplied with the fuse holder. Orient as shown. Bend lug 1 away from the body.



Detail 1A

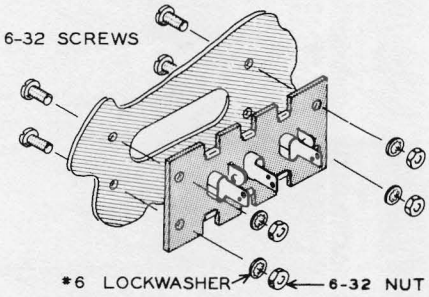
NOTE: The phrase "#6 hardware" means 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

( ) Referring to Detail 1B, mount the 4-lug screw type terminal strip and a #6 large solder lug at location C. Use #6 hardware. Orient the solder lug as shown in Pictorial 1.



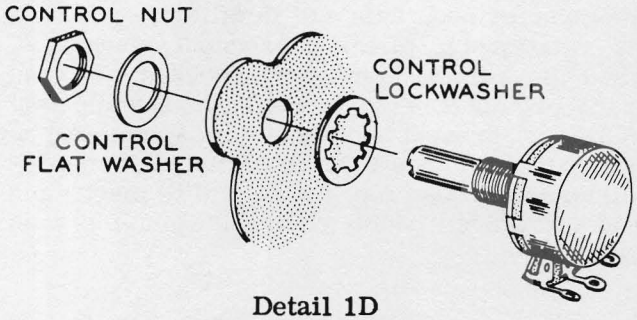
Detail 1B

( ) Referring to Detail 1C, mount the triple phono socket at location E. Use #6 hardware. Orient the lugs as shown.



Detail 1C

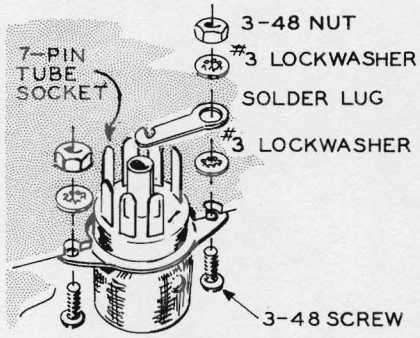
( ) R45. Referring to Detail 1D, mount a 10 KΩ control (#10-88) at location D. Use a control lockwasher, control flat washer, and control nut. Orient the lugs as shown in Pictorial 1.



Detail 1D

( ) R15. Similarly, mount another 10 KΩ (#10-88) control at location F. Use a control lockwasher, control flat washer, and control nut. Orient the lugs as shown in Pictorial 1.

( ) Referring to Detail 1E, mount a 7-pin tube socket and a #6 small solder lug at V7. Use 3-48 screws, #3 lockwashers, and 3-48 nuts. Orient the blank space as shown by the arrow in Pictorial 1. Bend the solder lugs up at a 90 degree angle to the chassis.

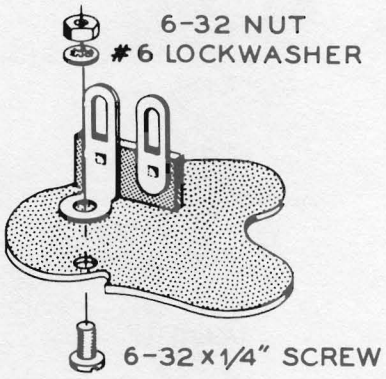


Detail 1E

( ) Similarly, mount 7-pin tube sockets and #6 small solder lugs at V8, V9, V3, V2, and V1. Use 3-48 screws, #3 lockwashers, and 3-48 nuts. Be sure to orient the blank spaces as shown by the arrows in Pictorial 1. Bend the solder lugs up at a 90 degree angle to the chassis.

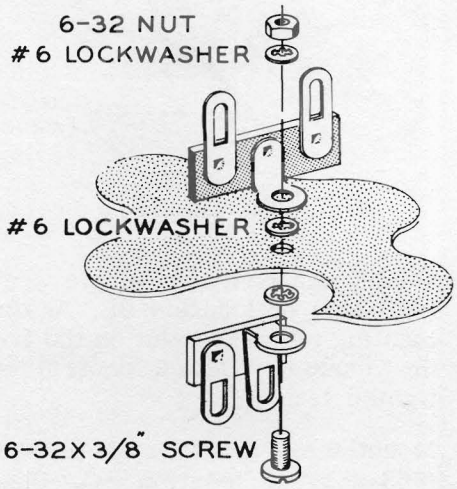
( ) Mount a 9-pin tube socket and a #6 small solder lug at V10 and V4. Use 3-48 screws, #3 lockwashers, and 3-48 nuts. Orient the blank space as shown by the arrows in Pictorial 1. Bend the solder lugs up at a 90 degree angle to the chassis and position them near lug 4 of the tube sockets.

( ) Referring to Detail 1F, mount a 2-lug terminal strip at location H. Use #6 hardware.



Detail 1F

( ) Referring to Detail 1G, mount 2-lug terminal strip G on the bottom of the chassis, and with the same screw, mount 2-lug terminal strip Y on top of the chassis. Use a 6-32 x 3/8" screw, three #6 lockwashers, and a 6-32 nut. To avoid error in selecting the proper 2-lug terminal strips, refer to Pictorial 1 and the Parts Pictorial.



Detail 1G

( ) Mount a 4-lug terminal strip at location J. Use #6 hardware.

( ) Mount a 6-lug terminal strip at M. Use #6 hardware.

( ) Mount a 7-lug terminal strip at L. Use #6 hardware on each mounting foot. Be sure that none of the lugs are shorted to ground.

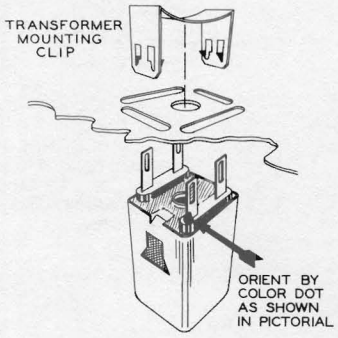
( ) Mount a 5-lug terminal strip at K. Use #6 hardware.

( ) Mount a 5-lug terminal strip at N. Use #6 hardware.

( ) Mount a dual-lug terminal strip at U. Use #6 hardware.

( ) Install the 3/8" rubber grommet in hole HB.

Locate the four IF transformers, one ratio detector transformer, and the AM RF transformer. Each transformer has the part number stamped on its cover and a color dot painted on one lug at its base. Referring to Pictorial 1 and Detail 1H, install each of the following transformers at its designated location with a mounting clip, as follows: Orient the colored dot as shown in Pictorial 1.



Detail 1H

( ) T6, FM input IF transformer (#52-26).

( ) T7, FM output IF transformer (#52-27).

( ) T8, FM ratio detector transformer (#53-4).

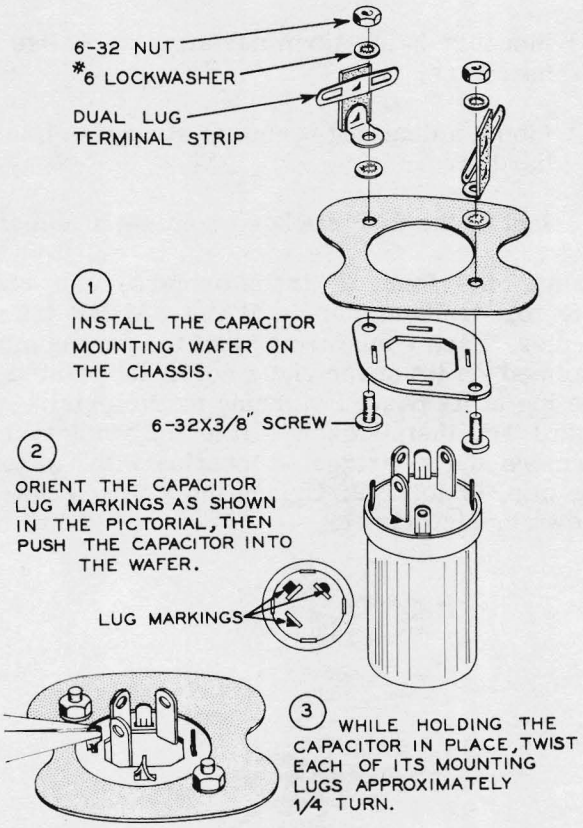
( ) T3, AM output IF transformer (#52-9).

( ) T2, AM input IF transformer (#52-37).

( ) T1, AM RF transformer (#40-324).

( ) Referring to Detail 1J, mount the electrolytic capacitor mounting wafer and dual-lug terminal strips Q and S. Use 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.

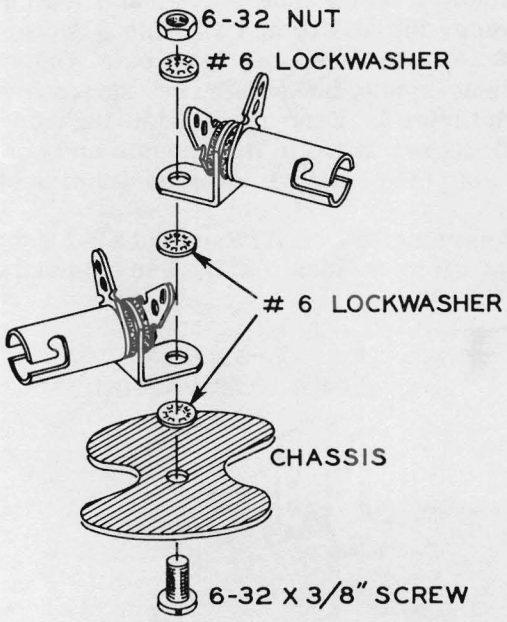
( ) C69A, C69B, C69C. Again refer to Detail 1J and mount the large electrolytic capacitor. Orient the marked lugs as shown in Pictorial 1. Secure the capacitor by twisting each mounting lug 1/4 turn.



Detail 1J

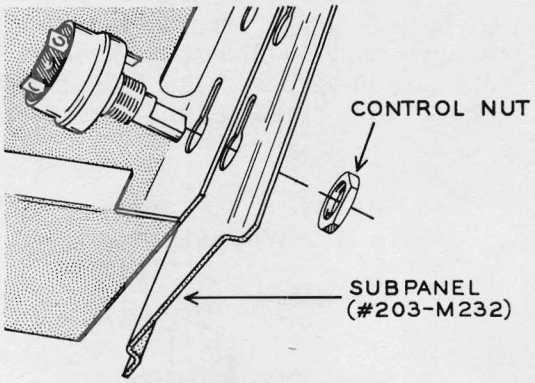
( ) Referring to Detail 1K, mount pilot light sockets W and X. Use a 6-32 x 3/8" screw, three #6 lockwashers, and a 6-32 nut. Position the pilot light sockets as shown in Pictorial 1.

( ) T9. Mount the power transformer (#54-101) and 2-lug terminal strip P. Use #8 lockwashers and 8-32 nuts. Orient as shown in Pictorial 1.



Detail 1K

( ) Referring to Detail 1L, mount the SPST AC switch (#63-249) and the control subpanel at SA. Use a control nut. The locating tab extending from the switch should fit into the slot on the front apron of the chassis. Do not tighten yet.



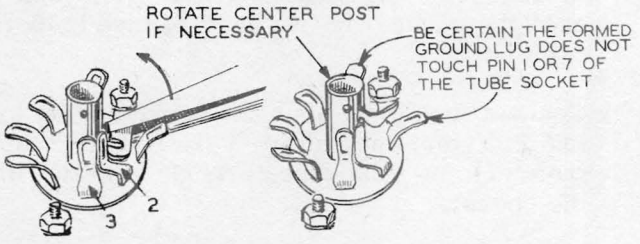
Detail 1L

( ) Mount a 3-position, single-section switch (#63-265) at location SB. Again, place the locating tab in the slot on the front apron of the chassis. Use a control nut. Do not tighten yet.

( ) Mount the 3-position single section switch (#63-251) at location SC. Use a control nut. Do not tighten yet.

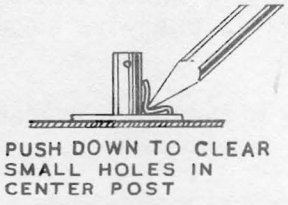
( ) Mount the SPDT rotary switch (#63-250) at location SD. Use a control nut. Be sure that the locating tab is in the slot on the front apron of the chassis. Now tighten all switches.

( ) Referring to Detail 1M, bend the solder lug installed on each 7-pin tube socket so that it comes in contact with the center post. If necessary, rotate the center post so that the slot lines up with the solder lug and a good mechanical connection can be obtained. Do not solder the center post at this time. Be sure that the solder lug does not touch lugs 1 or 7 of the tube socket.



Detail 1M

( ) Referring to Detail 1N, bend lugs 2 and 3 of tube socket V7 against the center post. Apply a small amount of solder on each formed lug and then while holding the lugs against the center post with a screwdriver, place a hot soldering iron on the solder. When the solder has flowed over the center post and the lug, remove the hot soldering iron and allow the connection to cool before removing the screwdriver.



Detail 1N

( ) Applying the above technique, bend and solder the following specified lugs on each 7-pin and 9-pin tube socket to the center post. Apply only enough solder to the lugs and center post to secure the lugs as several component leads will be attached to the small holes of each center post in later steps.

( ) Tube socket V8, lugs 2, 3, and 7 (S-3).

( ) Tube socket V9, lugs 2, 3, and 7 (S-3).

( ) Tube socket V10. No lugs are connected to the center ground post.

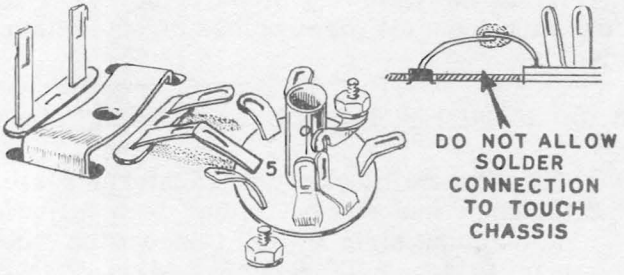
( ) Tube socket V4, lug 2 (S-1). Also bend the solder lug on V4 so that it touches lug 4 of V4 (S-1).

( ) Tube socket V3, lugs 2 and 3 (S-2).

( ) Tube socket V2, lug 3 (S-1).

( ) Tube socket V1, lugs 2 and 3 (S-2).

( ) Referring to Detail 1P, bend lug 1 of transformer T6 and lug 5 of tube socket V7 to meet as shown. While holding them in contact with one another, apply solder (S-2).



Detail 1P

( ) Bend lug 2 of transformer T6 and lug 6 of tube socket V7 to meet (NS).

( ) Bend lug 4 of transformer T6 and lug 1 of tube socket V8 to meet and solder (S-2).

( ) Bend lug 1 of transformer T7 and lug 5 of tube socket V8 to meet and solder (S-2).

( ) Bend lug 2 of transformer T7 and lug 6 of tube socket V8 to meet (NS).

( ) Bend lug 4 of transformer T7 and lug 1 of tube socket V9 to meet and solder (S-2).

( ) Bend lug 1 of transformer T8 and lug 5 of tube socket V9 to meet and solder (S-2).

( ) Bend lug 2 of transformer T8 and lug 6 of tube socket V9 to meet (NS).

( ) Bend lug 3 of transformer T8 and lug 3 of tube socket V10 to meet and solder (S-2).

( ) Bend lug 5 of transformer T8 and lug 1 of tube socket V10 to meet and solder (S-2).

( ) Bend lug 3 of transformer T2 and lug 1 of tube socket V3 to meet and solder (S-2).

( ) Bend lug 4 of transformer T2 and lug 5 of tube socket V2 to meet and solder (S-2).

( ) Bend lug 4 of transformer T1 and lug 5 of tube socket V1 to meet and solder (S-2).

This completes the mechanical assembly of the chassis.

INITIAL WIRING

NOTE: In the following steps remove 1/4" of insulation from all wires unless directed otherwise.

Refer to Pictorial 2 for the following steps.

( ) Twist the two black power transformer leads together and connect either lead to lug 1 of terminal strip P (NS). Connect the other lead to lug 2 of terminal strip P (NS).

( ) Connect either of the red power transformer leads to lug 1 of terminal strip U (NS).

( ) Connect the other red power transformer lead to lug 2 of terminal strip S (S-1).

( ) Connect the short green power transformer lead to lug 6 of electrolytic capacitor R (S-1). Apply enough solder and heat to melt the solder onto the capacitor mounting wafer.

( ) Connect the other green power transformer lead to lug 1 of terminal strip Q (NS).

( ) Cut two 16" lengths of hookup wire and strip 1/4" of insulation from each end of both wires. Twist these two wires together to form a twisted pair. Measure 5-1/2" from one end of this twisted pair and cut one wire and strip 1/4" of insulation from each of the two resulting wire ends. At this point, connect the end of the shorter cut wire to lug 2 of terminal strip P (S-2). Connect the other cut wire to lug 1 of terminal strip P (S-2).

( ) At the 5-1/2" end of this twisted pair, slip a 1/2" length of clear sleeving over each wire. Connect either wire to lug 1 of switch SA (S-1). Connect the other wire to lug 2 of SA (S-1). Now slip the sleeving over the switch lugs.

( ) On the remaining end of this twisted pair, cut 1-1/2" from the end of either of the twisted wires. Connect this shorter wire to lug 1 of terminal strip H (NS). Connect the other wire to lug 2 of fuse holder A (S-1).

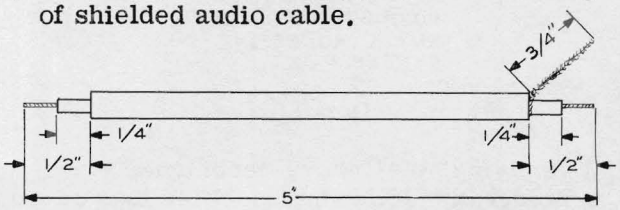
( ) Connect one end of a 5" hookup wire to lug 2 of terminal strip G (NS). Place the free end of this wire through slot HC in the chassis.

( ) Connect one end of a 3-1/2" hookup wire to lug 4 of terminal strip C (NS). Bend the solder lug secured by the mounting screw of terminal strip C so that it touches lug 4 of C. Now solder lug 4 and the solder lug (S-2). Place the free end of this wire through hole HD.

( ) Connect a 2-3/4" hookup wire from lug 4 of tube socket V7 (NS) to lug 4 of tube socket V8 (NS).

( ) Connect a 6" wire from lug 4 of tube socket V8 (NS) to lug 2 of terminal strip Q (NS). Route this wire as shown in Pictorial 2.

( ) Referring to Detail 2A, prepare a 5" length of shielded audio cable.



Detail 2A

( ) Connect the shield pigtail to the center post (NS) and the inner lead to lug 1 (NS)

of tube socket V7. Place the free end of this cable through grommet HB. It will be connected later.

( ) Connect one end of a 3-1/2" hookup wire to lug 1 of terminal strip J (NS). Place the other end of this wire through rubber grommet HB. It will be connected later.

( ) Strip 1/4" of insulation from only ONE end of a 5" hookup wire. Connect the stripped end to lug 2 of terminal strip J (NS). Place the free end of this wire through rubber grommet HB. It will be connected later.

( ) Connect a 4" hookup wire from lug 4 of terminal strip J (NS) to lug 2 of terminal strip K (NS).

( ) Connect a 3" hookup wire from lug 2 of terminal strip K (NS) to lug 4 of electrolytic capacitor R (NS).

( ) Connect one end of a 10-1/2" hookup wire to lug 5 of terminal strip K (NS). Place the other end of this wire through hole HA in the chassis. It will be connected later.

( ) Connect a 4-1/2" wire from lug 4 of terminal strip K (NS) to lug 3 of phono socket E (S-1). Route this wire as shown in Pictorial 2.

( ) Connect a 3" hookup wire from lug 4 of tube socket V9 (NS) to lug 5 of tube socket V10 (NS).

( ) Connect a 3-1/2" hookup wire from lug 5 of tube socket V10 (S-2) to lug 5 of tube socket V4 (NS).

( ) Connect a 3-1/2" hookup wire from lug 7 of tube socket V10 (S-1) to lug 7 of tube socket V4 (NS).

( ) Connect a 1-1/2" hookup wire from lug 7 of tube socket V4 (S-2) to lug 7 of terminal strip L (NS).

( ) Connect a 3" hookup wire from lug 2 of terminal strip L (NS) to lug 3 of control D (S-1).

( ) Connect a 1-1/2" hookup wire from the center post of tube socket V4 (S-1) to lug 3 of control F (NS). Route this wire between lugs 1 and 9 of V4.

( ) Connect a 1-1/2" hookup wire between lugs 2 (S-1) and 5 (NS) of phono socket E.

( ) Connect one end of a 5" hookup wire to lug 1 of control F (NS). Place the free end of this wire through hole HE in the chassis. Refer to Pictorial 2 for proper routing of this wire.

( ) Connect a 3" hookup wire from lug 5 of tube socket V4 (S-2) to lug 4 of tube socket V3 (NS).

( ) Connect one end of a 1-1/2" bare wire (stripped hookup wire) through lug 1 (NS) to lug 3 of tube socket V4 (S-1). Now solder lug 1 of V4 (S-2).

( ) Connect the remaining end of this wire to lug 1 of transformer T3 (S-1).

( ) Connect a 2-1/4" hookup wire from lug 2 of transformer T3 (NS) to lug 6 of tube socket V3 (NS).

( ) Connect a 1" length of bare wire (stripped hookup wire) from lug 4 of transformer T3 (S-1) to lug 5 of tube socket V3 (S-1).

( ) Connect a 3" wire from lug 4 of tube socket V3 (S-2) to lug 4 of tube socket V2 (NS).

( ) Connect a 3" wire from lug 4 of tube socket V2 (S-2) to lug 4 of tube socket V1 (S-1).

( ) Connect a 2" hookup wire from lug 1 of transformer T2 (NS) to lug 6 of tube socket V2 (NS). Route this wire as shown in Pictorial 2.

( ) Connect a 4-1/2" hookup wire from lug 6 of transformer T2 (NS) to lug 4 of terminal strip M (NS).

( ) Connect a 1-1/2" hookup wire from lug 7 of tube socket V2 (S-1) to lug 3 of transformer T1 (S-1).

( ) Connect one end of a 3" hookup wire to lug 1 of tube socket V1 (S-1). Place the free end of this wire through the hole HK in the chassis.

( ) Connect a 6" hookup wire from lug 2 of transformer T1 (S-1) to lug 1 of terminal strip M (NS).

( ) Connect one end of a 4" hookup wire to lug 1 of transformer T1 (S-1). Place the free end of this wire through hole HG in the chassis. Refer to Pictorial 2 for proper routing of this wire.

( ) Connect a 5-1/2" hookup wire from lug 5 of transformer T1 (NS) to lug 7 of terminal strip L (NS).

( ) Connect a 6" hookup wire from lug 7 of terminal strip L (NS) to lug 1 of electrolytic capacitor R (NS).

( ) Connect one end of a 2-3/4" hookup wire to lug 6 of terminal strip L (NS). Place the free end of this wire through hole HF in the chassis. Refer to Pictorial 2 for proper routing of this wire.

( ) Connect a 1-1/2" hookup wire between lugs 3 (NS) and 5 (NS) of terminal strip M.

( ) Connect a 10-1/2" hookup wire from lug 1 of terminal strip L (NS) to lug 4 of terminal strip N (NS). Refer to Pictorial 2 for routing of this wire.

( ) Connect a 4" hookup wire from lug 5 of terminal strip N (NS) to lug 4 of switch SB (S-1).

( ) Connect a 3-1/2" hookup wire from lug 3 of terminal strip N (NS) to lug 3 of switch SB (NS).

( ) Connect a 3" hookup wire from lug 2 of terminal strip N (NS) to lug 2 of switch SB (S-1).

( ) Connect a 3" hookup wire from lug 1 of terminal strip N (NS) to lug 1 of switch SB (S-1).

( ) Connect one end of a 12" hookup wire to lug 1 of terminal strip N (NS). Place the free end of this wire through rubber grommet HB. This end will be connected later.

( ) Remove 3/4" of insulation from one end of a 4-1/2" hookup wire. Place this end of the wire through lug 2 of pilot light socket W (NS) and connect it to lug 2 of pilot light socket X (NS). Now solder lug 2 of W (S-2).

( ) Connect the free end of this wire to lug 3 of switch SB (S-2).

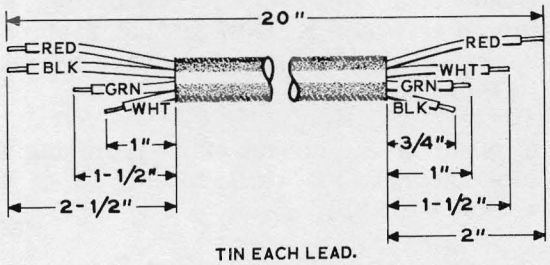
( ) Remove 1" of insulation from one end of a 7" hookup wire. Pass this end through lug 1 of pilot light socket X and connect it to lug 1 of pilot light socket W (S-1). Now solder lug 1 of X (S-2).

( ) Connect the free end of this wire to lug 2 of terminal strip Q (NS). Route this wire under the power transformer leads.

( ) Connect a 2-3/4" hookup wire from lug 2 of pilot light socket X (S-2) to lug 1 of switch SC (NS).

( ) Connect a 2" hookup wire between lugs 1 (S-2) and 6 (S-1) of switch SB.

( ) Referring to Detail 2B, prepare a 20" length of 4-conductor cable.



Detail 2B

( ) At the end of the cable with the 2-1/2" red lead, connect the red lead to lug 4 of terminal strip L (NS).

( ) Connect the black lead to lug 3 of terminal strip L (NS).

( ) Connect the green lead to lug 1 of phono socket E (S-1).

( ) Connect the white lead to lug 4 of phono socket E (S-1).

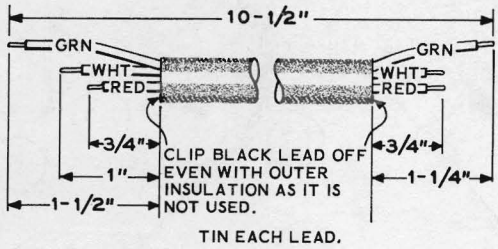
( ) Route this cable as shown in Pictorial 2 and connect the black lead on the other end to lug 5 of switch SC (S-1).

( ) Connect the green lead to lug 4 of switch SC (S-1).

( ) Connect the white lead to lug 3 of SC (S-1).

( ) Connect the red lead to lug 2 of SC (S-1).

( ) Referring to Detail 2C, prepare a 10-1/2" length of the 4-conductor cable.



Detail 2C

( ) At the 1-1/2" prepared end of the cable, connect the red lead to lug 5 of transformer T2 (S-1).

( ) Connect the white lead to lug 6 of T2 (S-2).

( ) Connect the green lead to lug 2 of T2 (S-1).

( ) At the other end of this cable, connect the red lead to lug 3 of switch SD (S-1).

( ) Connect the white lead to lug 2 of SD (S-1).

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

( ) Referring to Detail 2D, prepare a 13" 4-conductor cable.

( ) Place the end of this prepared cable with the short leads through hole HJ in the chassis as shown in Pictorial 2. This end will be connected later.

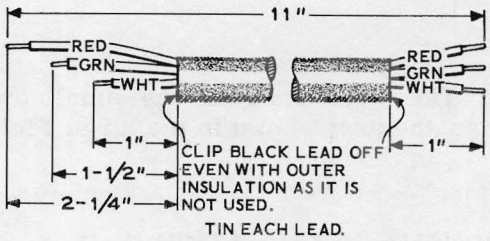
( ) Connect the green lead at the other end of this cable to lug 2 of terminal strip M (NS).

( ) Connect the white lead to lug 1 of terminal strip Q (S-2).

( ) Connect the red lead to lug 7 of terminal strip L (NS).

( ) Referring to Detail 2E, prepare an 11" 4-conductor cable.

( ) Place the end of this prepared cable with the short leads through hole HL in the chassis. Route this lead as shown in Pictorial 2. This end will be connected later.



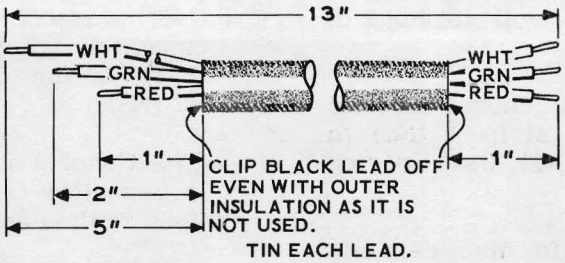
Detail 2E

( ) Connect the long red lead of this cable to lug 1 of electrolytic capacitor R (NS).

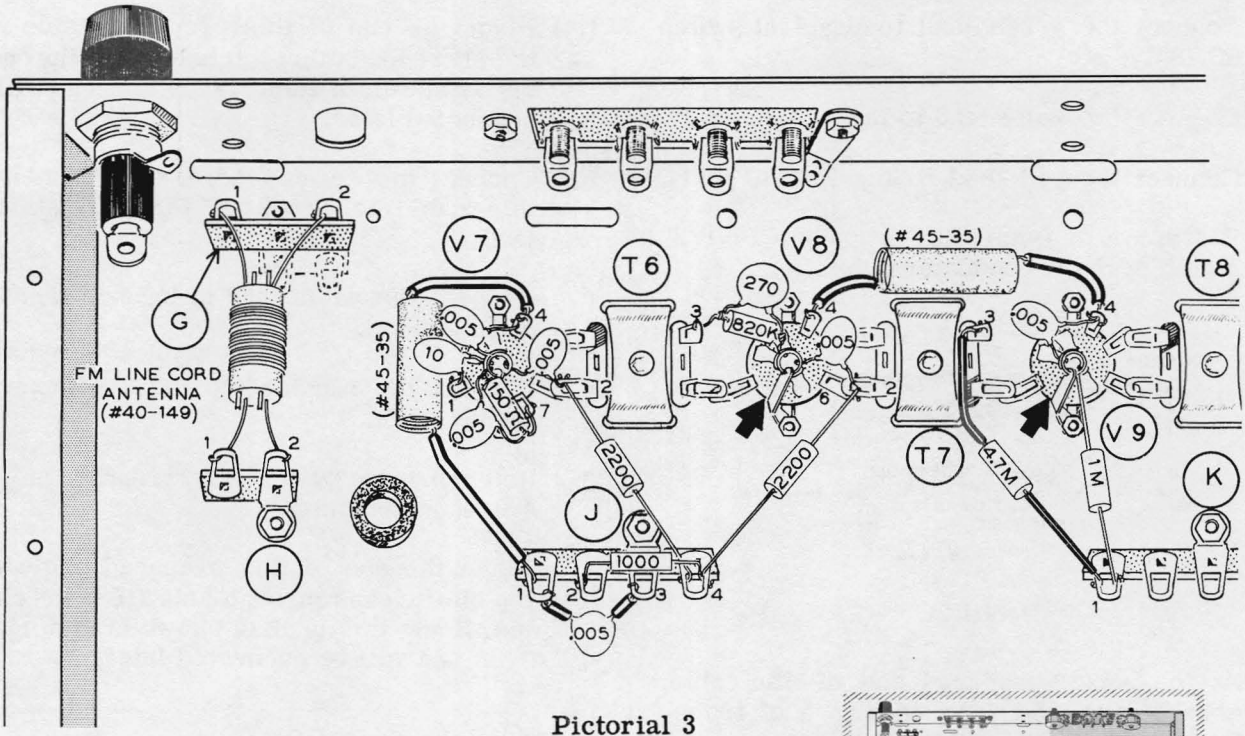
( ) Connect the white lead to lug 2 of terminal strip Q (S-3).

( ) Connect the green lead to lug 1 of terminal strip K (NS).

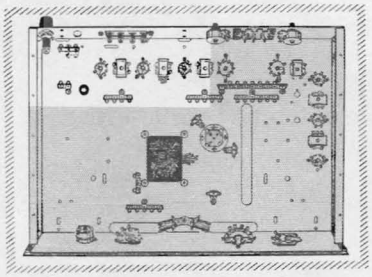
This completes the Initial Wiring of the chassis.



Detail 2D



Pictorial 3



NOTE: The light area in the small drawing indicates the area shown in the large Pictorial.

COMPONENT INSTALLATION

Refer to Pictorial 3 for the following steps.

( ) Locate the FM line cord antenna coil (#40-149) and position it between terminal strips G and H. Connect the lead nearest lug 2 of terminal strip H to lug 2 of H (S-1). Connect the other lead at this end to lug 1 of terminal strip H (S-2).

( ) At the other end of this coil, connect the lead nearest lug 1 of terminal strip G to lug 1 of G (NS). Connect the other lead at this end of the coil to lug 2 of G (S-2).

( ) L9. Connect a filament choke (#45-35) from lug 1 of terminal strip J (NS) to lug 4 of tube socket V7 (NS). Use sleeving on both leads.

( ) C71. Connect a .005 μfd disc ceramic capacitor between lugs 1 (S-3) and 3 (S-1) of terminal strip J. Use sleeving on both leads.

( ) R26. Connect a 1000 Ω (brown-black-red) 1/2 watt resistor between lugs 2 (S-2) and 4 (NS) of terminal strip J.

( ) R28. Connect a 2200 Ω (red-red-red) 1/2 watt resistor from lug 4 of terminal strip J (NS) to lug 2 of transformer T6 (NS).

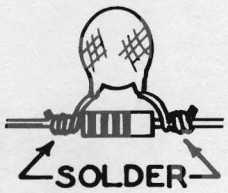
( ) Connect another 2200 Ω (red-red-red) 1/2 watt resistor from lug 4 of terminal strip J (S-4) to lug 2 of transformer T7 (NS).

( ) C46. Connect a .005 μfd disc ceramic capacitor from lug 2 of transformer T6 (S-3) to the center post of tube socket V7 (NS).

( ) C70. Connect another .005 μfd disc ceramic capacitor from lug 4 of tube socket V7 (S-3) to the center post of V7 (NS).

( ) C44. Connect a 10 μμf disc ceramic capacitor from lug 1 of V7 (S-2) to the center post of V7 (NS).

( ) R27, C45. Referring to Detail 3A, prepare a 150 Ω (brown-green-brown) 1/2 watt resistor and .005 μfd disc ceramic capacitor combination.



Detail 3A

NOTE: When soldering the center post of a tube socket, be sure that the solder flows onto the solder lug that was connected previously.

( ) Connect this resistor-capacitor combination from lug 7 of tube socket V7 (S-1) to the center post of V7 (S-6).

( ) R29, C49. Prepare another combination using an 820 KΩ (gray-red-yellow) 1/2 watt resistor and a 270 μμf disc ceramic capacitor.

( ) Connect this combination from lug 3 of transformer T6 (S-1) to the center post of tube socket V8 (NS).

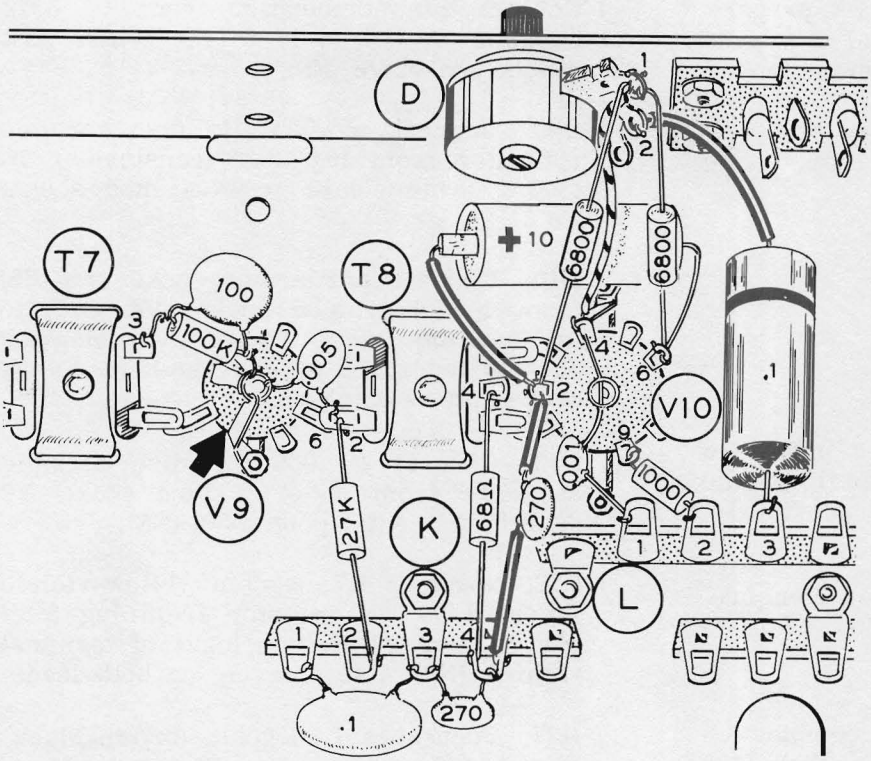
( ) C50. Connect a .005 μfd disc ceramic capacitor from lug 2 of transformer T7 (S-3) to the center post of tube socket V8 (S-2).

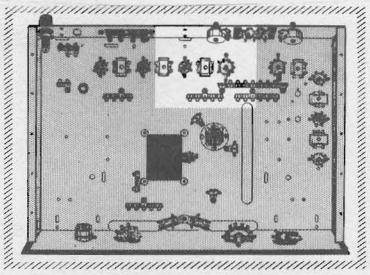
( ) L10. Connect a filament choke (#45-35) from lug 4 of tube socket V8 (S-3) to lug 4 of tube socket V9 (NS). Use sleeving on both leads. Do not pull the leads as the choke may be damaged.

( ) C72. Connect a .005 μfd disc ceramic capacitor from lug 4 of tube socket V9 (S-3) to the center post of V9 (NS).

( ) R32. Connect a 4.7 megohm (yellow-violet-green) 1/2 watt resistor from lug 3 of transformer T7 (NS) to lug 1 of terminal strip K (NS). Use sleeving on both leads.

( ) R37. Connect a 1 megohm (brown-black-green) 1/2 watt resistor from lug 1 of terminal strip K (NS) to the center post of tube socket V9 (NS).





Pictorial 4

Refer to Pictorial 4 for the following steps.

( ) R31, C53. Referring to Detail 4A, prepare a 100 KΩ (brown-black-yellow) 1/2 watt resistor and 100 μμf disc ceramic capacitor combination.

Detail 4A

( ) Connect this combination from lug 3 of transformer T7 (S-2) to the center post of tube socket V9 (NS).

( ) C54. Connect a .005 μfd disc ceramic capacitor from lug 2 of transformer T8 (NS) to the center post of tube socket V9 (S-4).

( ) R33. Connect a 27 KΩ (red-violet-orange) 1/2 watt resistor from lug 2 of transformer T8 (S-3) to lug 2 of terminal strip K (S-3).

( ) C61. Connect a .1 μfd disc ceramic capacitor between lugs 1 (S-4) and 3 (NS) of terminal strip K.

( ) C57. Connect a 270 μμf disc ceramic capacitor between lugs 3 (S-2) and 4 (NS) of terminal strip K.

( ) R34. Connect a 68 Ω (blue-gray-black) 1/2 watt resistor from lug 4 of transformer T8 (S-1) to lug 4 of terminal strip K (NS).

( ) C59. Connect a 270 $\mu\mu$f disc ceramic capacitor from lug 2 of tube socket V10 (NS) to lug 4 of terminal strip K (NS). Use sleeving on both leads.

( ) C60. Connect the positive (+) lead of the 10 μfd electrolytic capacitor to lug 2 of tube socket V10 (NS). Use sleeving on this lead. Connect the other lead of this capacitor to lug 6 of V10 (NS). Do not crimp these leads on the lugs as one of them will be removed for tuner alignment.

( ) Connect a 1-1/4" hookup wire from lug 1 of control D (NS) to lug 4 of tube socket V10 (NS).

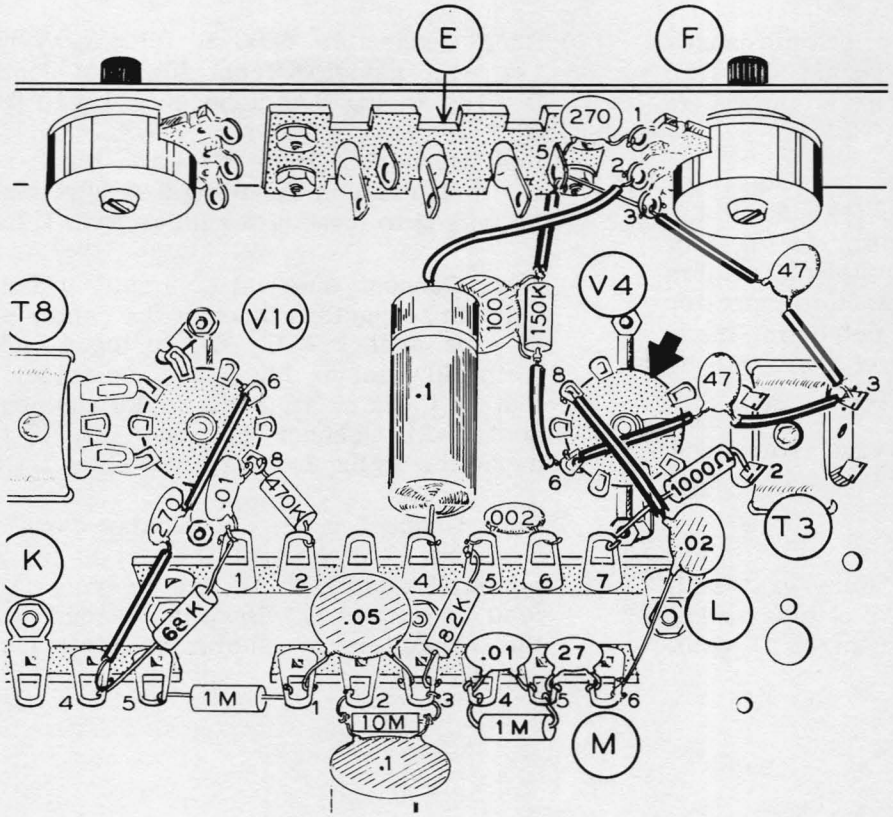
( ) R36. Connect a 6800 Ω (blue-gray-red) 1/2 watt resistor from lug 2 of tube socket V10 (S-3) to lug 1 of control D (NS).

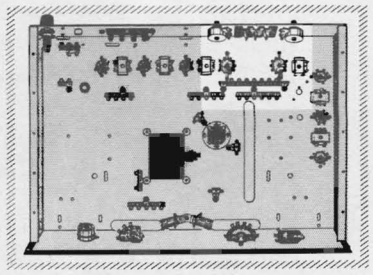
( ) R35. Connect a 6800 Ω (blue-gray-red) 1/2 watt resistor from lug 1 of control D (S-3) to lug 6 of tube socket V10 (NS).

( ) R44. Connect a 1000 Ω (brown-black-red) 1/2 watt resistor from lug 9 of tube socket V10 (S-1) to lug 2 of terminal strip L (NS).

( ) C62. Connect one end of a .001 μfd disc ceramic capacitor through the center post of tube socket V10 (NS) to lug 4 of V10 (NS). Now solder lug 4 and the solder lug that is touching it (S-3). Solder the center post (S-2). Connect the other lead of this capacitor to lug 1 of terminal strip L (NS).

( ) C65. Connect a .1 μfd tubular capacitor from lug 2 of control D (S-1) to lug 3 of terminal strip L (S-2). Use sleeving on the lead to control D. Place the banded end of the capacitor as shown in Pictorial 4.





Pictorial 5

Refer to Pictorial 5 for the following steps.

( ) C58. Connect a 270 $\mu\mu$f disc ceramic capacitor from lug 4 of terminal strip K (NS) to lug 6 of tube socket V10 (S-3). Use sleeving on both leads.

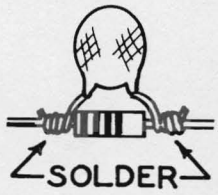
( ) R40. Connect a 68 KΩ (blue-gray-orange) 1/2 watt resistor from lug 4 of terminal strip K (S-6) to lug 1 of terminal strip L (NS).

( ) R41. Connect a 470 KΩ (yellow-violet-yellow) 1/2 watt resistor from lug 2 of terminal strip L (S-3) to lug 8 of tube socket V10 (NS).

( ) C63. Connect a .01 μfd disc ceramic capacitor from lug 8 of tube socket V10 (S-2) to lug 1 of terminal strip L (S-4).

( ) R2. Connect a 1 megohm (brown-black-green) 1/2 watt resistor from lug 5 of terminal strip K (S-2) to lug 1 of terminal strip M (NS).

( ) R18, C26. Referring to Detail 5A, prepare a 10 megohm (brown-black-blue) 1/2 watt resistor and .1 μfd disc ceramic capacitor combination.



Detail 5A

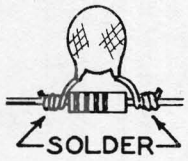
( ) Connect this resistor-capacitor combination between lugs 2 (NS) and 3 (NS) of terminal strip M.

( ) C21. Connect a 27 $\mu\mu$f disc ceramic capacitor between lugs 5 (NS) and 6 (NS) of terminal strip M.

( ) R16. Connect an 82 KΩ (gray-red-orange) 1/2 watt resistor from lug 3 of terminal strip M (NS) to lug 5 of terminal strip L (NS).

( ) C6. Connect a .05 μfd disc ceramic capacitor between lugs 1 (NS) and 3 (S-4) of terminal strip M.

( ) R11, C20. Referring to Detail 5B, prepare a 150 KΩ (brown-green-yellow) 1/2 watt resistor and 100 $\mu\mu$f disc ceramic capacitor combination.



Detail 5B

( ) Connect this resistor-capacitor combination from lug 6 of tube socket V4 (NS) to lug 5 of phono socket E (NS). Use sleeving on both leads.

NOTE: When a lead is passed through to another lug this lead is counted as two separate leads in the soldering instructions.

( ) C25. Pass one lead of a 270 $\mu\mu$f disc ceramic capacitor through lug 5 of phono socket E (NS) to lug 3 of control F (NS). Now solder lug 5 of E (S-4). Connect the other lead of this capacitor to lug 1 of control F (NS).

( ) C19. Connect a <u>small</u> 47 $\mu\mu$f disc ceramic capacitor from lug 3 of control F (S-3) to lug 3 of transformer T3 (NS). Use sleeving on both leads.

( ) C64. Connect a .1 μfd tubular capacitor from lug 4 of terminal strip L (S-2) to lug 2 of control F (S-1). Use sleeving on the lead to control F.

( ) C23. Connect a .002 μfd disc ceramic capacitor between lugs 5 (NS) and 6 (NS) of terminal strip L.

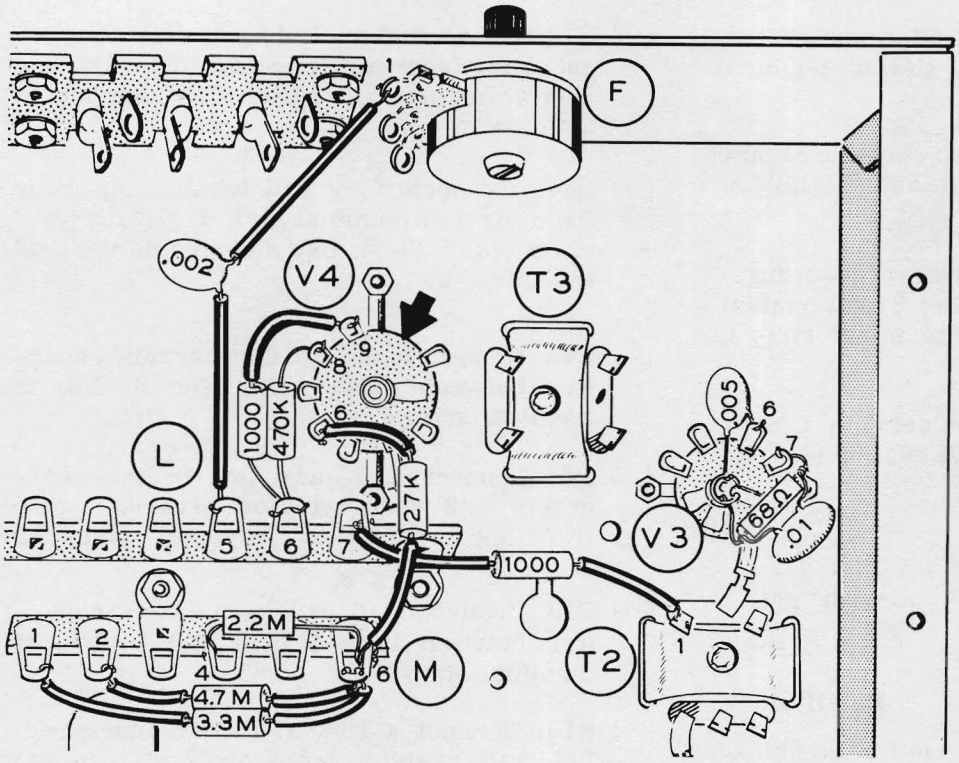
( ) R8. Connect a 1 megohm (brown-black-green) 1/2 watt resistor between lugs 4 (NS) and 5 (NS) of terminal strip M.

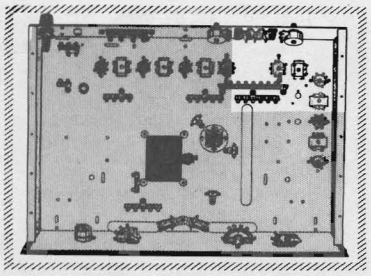
( ) C13. Connect a .01 μfd disc ceramic capacitor between lugs 4 (NS) and 5 (S-4) of terminal strip M.

( ) R10. Connect a 1000 Ω (brown-black-red) 1/2 watt resistor from lug 7 of terminal strip L (NS) to lug 2 of transformer T3 (S-2).

( ) C18. Connect a <u>small</u> 47 $\mu\mu$f disc ceramic capacitor from lug 6 of tube socket V4 (NS) to lug 3 of transformer T3 (S-2). Use sleeving on both leads.

( ) C22. Connect a .02 μfd disc ceramic capacitor from lug 6 of terminal strip M (NS) to lug 8 of tube socket V4 (NS). Position this capacitor as shown in Pictorial 5 and use sleeving on the lead to V4.





Pictorial 6

Refer to Pictorial 6 for the following steps.

( ) R17. Connect a 4.7 megohm (yellow-violet-green) 1/2 watt resistor between lugs 2 (S-3) and 6 (NS) of terminal strip M. Use sleeving on both leads.

( ) R4. Connect a 3.3 megohm (orange-orange-green) 1/2 watt resistor between lugs 1 (S-4) and 6 (NS) of terminal strip M. Use sleeving on both leads.

( ) R7. Connect a 2.2 megohm (red-red-green) 1/2 watt resistor between lugs 4 (S-4) and 6 (NS) of terminal strip M.

( ) R12. Connect a 27 KΩ (red-violet-orange) 1/2 watt resistor from lug 6 of terminal strip M (S-6) to lug 6 of tube socket V4 (S-3). Use sleeving on both leads.

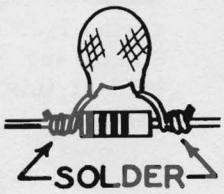
( ) R6. Connect a 1000 Ω (brown-black-red) 1/2 watt resistor from lug 7 of terminal strip L (S-6) to lug 1 of transformer T2 (S-2). Use sleeving on both leads.

( ) R13. Connect a 470 KΩ (yellow-violet-yellow) 1/2 watt resistor from lug 6 of terminal strip L (NS) to lug 8 of tube socket V4 (S-2).

( ) R14. Connect a 1000 Ω (brown-black-red) 1/2 watt resistor from lug 6 of terminal strip L (S-4) to lug 9 of tube socket V4 (S-1). Use sleeving on lead to V4.

( ) C24. Connect a .002 μfd disc ceramic capacitor from lug 5 of terminal strip L (S-3) to lug 1 of control F (S-3). Use sleeving on both leads.

( ) R9, C14. Referring to Detail 6A, prepare a 68 Ω (blue-gray-black) 1/2 watt resistor and .01 μfd disc ceramic capacitor combination.



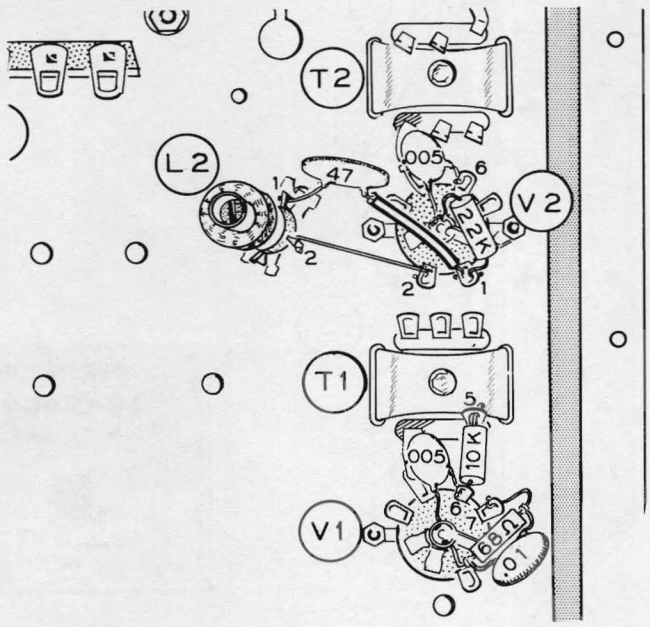
Detail 6A

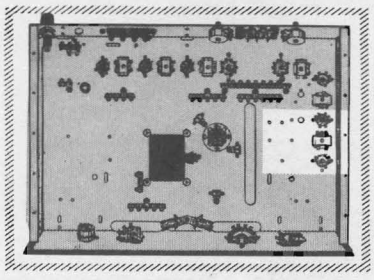
( ) Connect this resistor-capacitor combination from lug 7 of tube socket V3 (S-1) to the center post of V3 (NS).

( ) C15. Connect a .005 μfd disc ceramic capacitor from lug 6 of tube socket V3 (S-2) to the center post of V3 (S-3).

Refer to Pictorial 7 for the following steps.

( ) C10. Connect a .005 μfd disc ceramic capacitor from lug 6 of tube socket V2 (S-2) to the center post of V2 (NS).

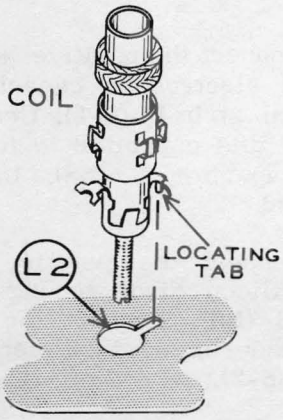




Pictorial 7

( ) R5. Connect a 22 KΩ (red-red-orange) 1/2 watt resistor from lug 1 of tube socket V2 (NS) to the center post of V2 (S-3).

( ) L2. Referring to Detail 7A, mount the AM oscillator coil (#40-89) at location L2 on the chassis. The locating tab on the mounting clip of the coil should fit into the small hole next to the coil mounting hole.



Detail 7A

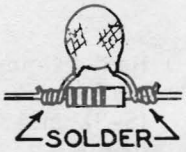
( ) C8. Connect the large 47 μμf disc ceramic capacitor from lug 1 of tube socket V2 (S-2) to lug 1 of coil L2 (NS). Use sleeving on the lead to V2.

( ) Connect a length of bare wire (stripped hookup wire) from lug 2 of coil L2 (S-1) to lug 2 of tube socket V2 (S-1).

( ) R3. Connect a 10 KΩ (brown-black-orange) 1/2 watt resistor from lug 5 of transformer T1 (S-2) to lug 6 of tube socket V1 (NS).

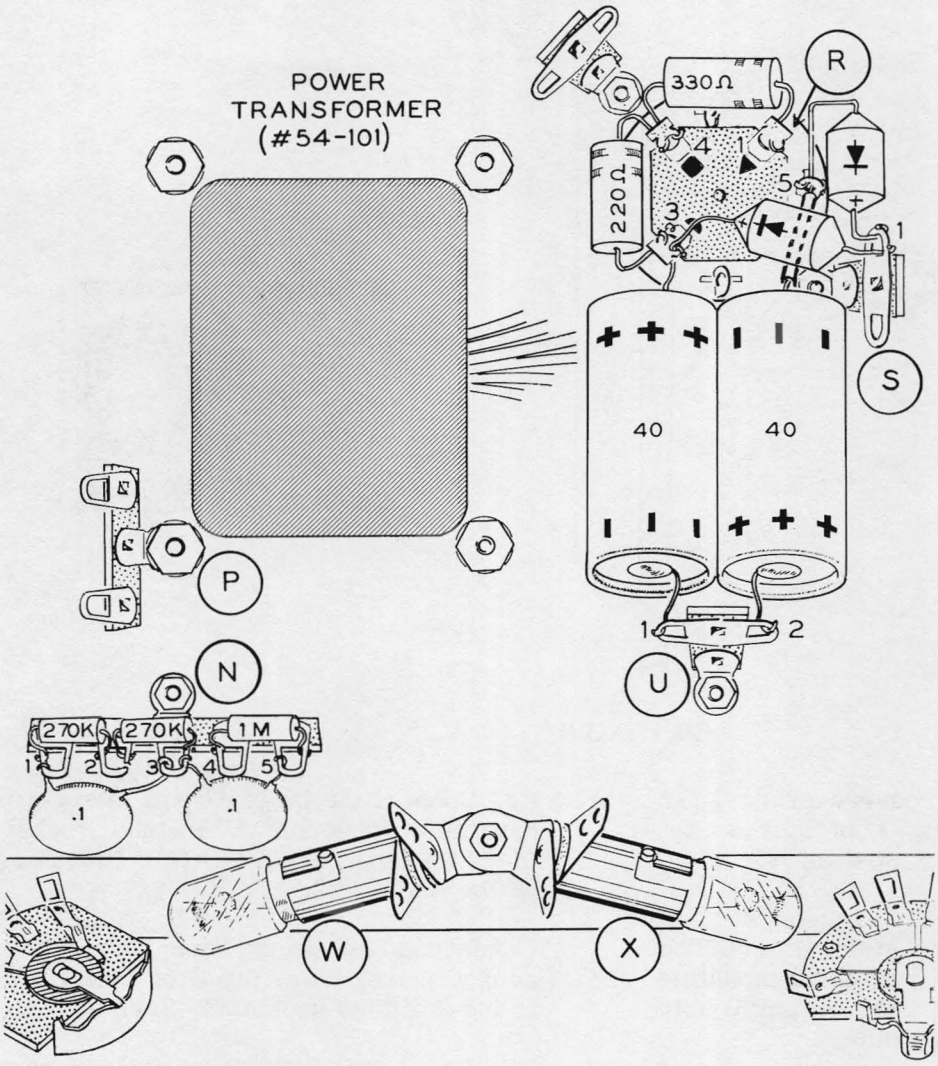
( ) C5. Connect a .005 μfd disc ceramic capacitor from lug 6 of tube socket V1 (S-3) to the center post of V1 (NS).

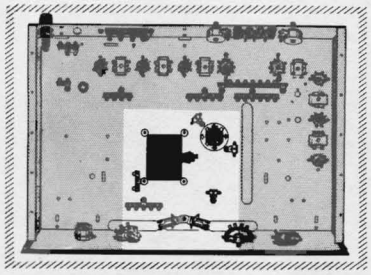
( ) R1, C4. Referring to Detail 7B, prepare a 68 Ω (blue-gray-black) 1/2 watt resistor and .01 μfd disc ceramic capacitor combination.



Detail 7B

( ) Connect this combination from lug 7 of tube socket V1 (S-1) to the center post of V1 (S-2).





Pictorial 8

Refer to Pictorial 8 for the following steps.

( ) R46. Connect a 220 Ω (red-red-brown) 2 watt resistor between lugs 3 (NS) and 4 (NS) of electrolytic capacitor R.

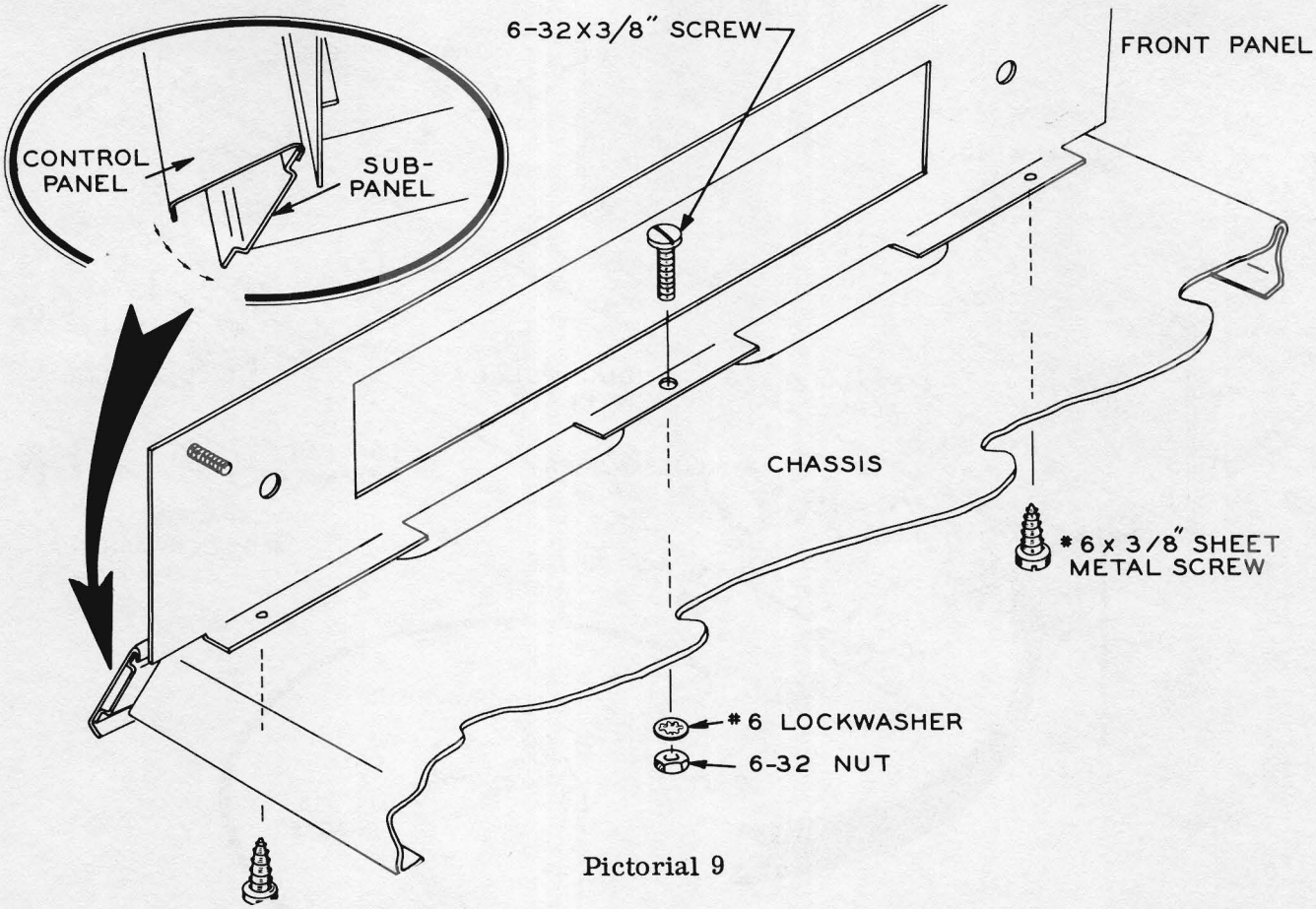
( ) R47. Connect a 330 Ω (orange-orange-brown) 2 watt resistor between lugs 4 (S-3) and 1 (S-3) of electrolytic capacitor R.

( ) C67. Connect the positive (+) lead of a 40 μfd electrolytic capacitor to lug 3 of electrolytic capacitor R (NS). Connect the other lead of this capacitor to lug 1 of terminal strip U (S-2).

( ) C68. Connect the positive (+) lead of another 40 μfd electrolytic capacitor to lug 2 of terminal strip U (S-1). Connect the other lead of this capacitor to lug 5 of electrolytic capacitor R (NS). Use sleeving on this lead.

( ) D2. Connect the positive (+) lead of a silicon diode to lug 1 of terminal strip S (NS). Connect the other lead of this diode to lug 5 of electrolytic capacitor R (S-2).

( ) D1. Connect the positive (+) of another silicon diode to lug 3 of electrolytic capacitor R (S-3). Connect the other lead of this diode to lug 1 of terminal strip S (S-2).



Pictorial 9

( ) R42. Connect a 270 KΩ (red-violet-yellow) 1/2 watt resistor between lugs 1 (NS) and 2 (NS) of terminal strip N.

( ) R43. Connect another 270 KΩ (red-violet-yellow) 1/2 watt resistor between lugs 2 (S-3) and 3 (NS) of terminal strip N.

( ) R39. Connect a 1 megohm (brown-black-green) 1/2 watt resistor between lugs 4 (S-2) and 5 (NS) of terminal strip N.

( ) C66. Connect a .1 μfd disc ceramic capacitor between lugs 3 (NS) and 5 (S-3) of terminal strip N.

( ) C73. Connect a .1 μfd disc ceramic capacitor between lugs 1 (S-4) and 3 (S-4) of terminal strip N. Use sleeving on both leads.

( ) Install a pilot light in pilot light sockets W and X.

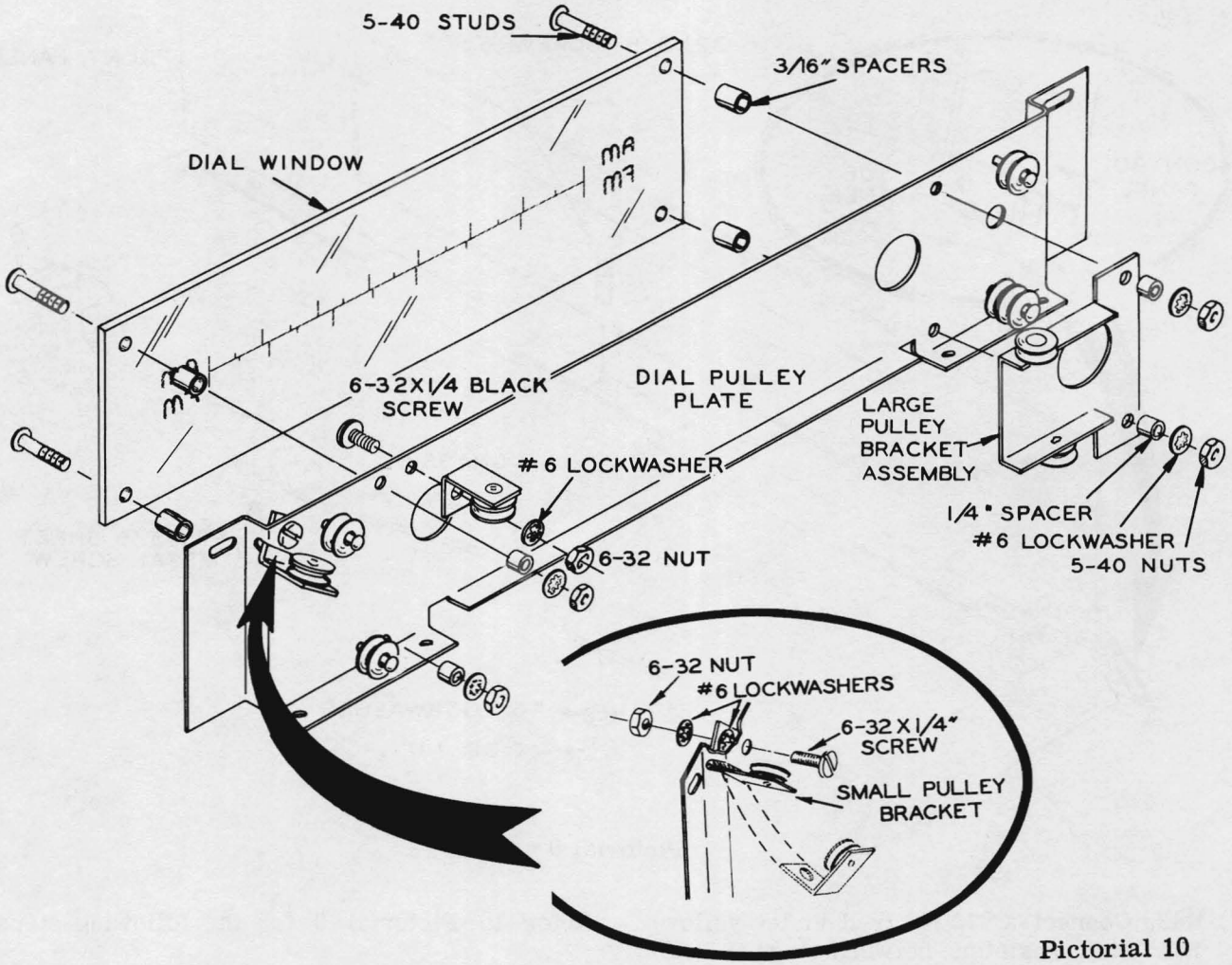
This completes the installation of components under the chassis.

Refer to Pictorial 9 for the following steps.

( ) Mount the control panel on the subpanel by placing the panel over the control shafts. Then place the top lip of the control panel over the subpanel and then snap the bottom lip of the control panel in place, as shown in Pictorial 9. The flat of each control shaft should face toward the bottom of the front apron.

( ) Locate the front panel and position it on the chassis as shown in Pictorial 9. Secure each end of the front panel to the chassis with a #6 sheet metal screw inserted from the bottom side of the chassis. The front panel should be held forward, toward the control panel, as the screws are tightened. Now place a 6-32 x 3/8" screw through the hole in the center flange of the front panel and through the chassis. Secure this screw with a #6 lockwasher and 6-32 nut.

Set the chassis aside until called for.



Pictorial 10

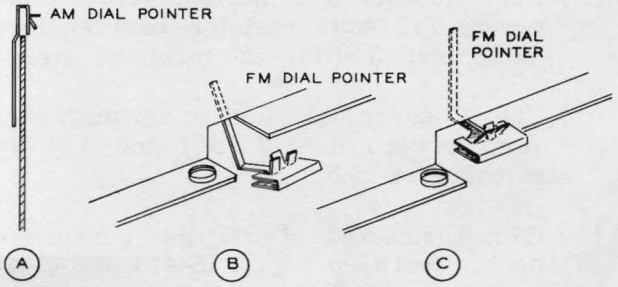
Refer to Pictorial 10 for the following steps.

( ) Locate the dial pulley plate and position it as shown in Pictorial 10.

( ) Mount one of the small pulley brackets (#100-M302) on the dial pulley plate as shown by the small detail on Pictorial 10. Use #6 hardware.

( ) Similarly mount the other small dial pulley bracket to the dial plate in the position shown in Pictorial 10. Use the black 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut. Be very careful not to scratch the paint.

( ) Referring to Detail 10A, install the AM and the FM dial pointers on the dial pulley plate subassembly. Use care when handling the dial pointers so that the thin material is not bent out of shape. Temporarily tape the pointers to the pulley plate.



Detail 10A

( ) Locate the dial pointer that is bent. Clip 1/4" from the long end.

( ) Mount the dial window and large pulley bracket as shown in Pictorial 10. Use 5-40 studs, 1/4" spacers, 3/16" spacers, #6 lockwashers and 5-40 nuts. Use care when tightening the nuts to prevent damage to the dial window.

( ) Secure the remaining end of the dial window using 5-40 studs, 1/4" spacers, 3/16" spacers, #6 lockwashers and 5-40 nuts. Use care when tightening the nuts to prevent damage to the dial window.

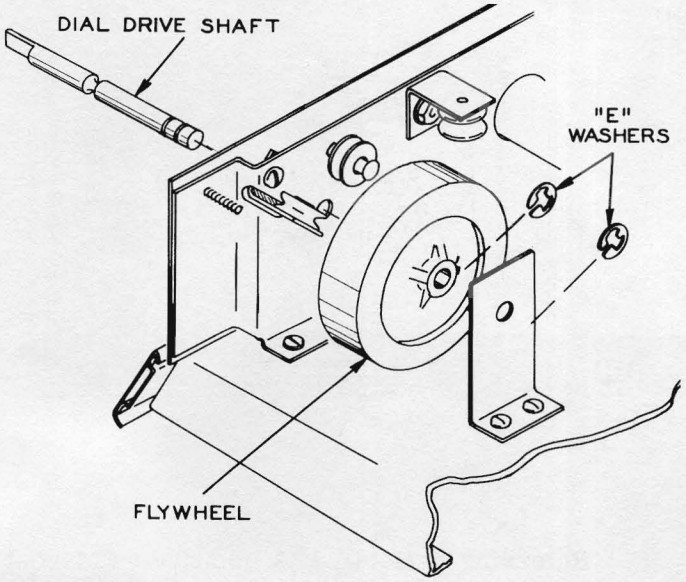
Refer to Pictorial 11 for the following steps.

( ) Mount the dial pulley plate to the front panel and the main chassis. Temporarily secure each end of the dial pulley plate to the main chassis with #6 hardware.

( ) Locate the dial shaft mounting brackets and secure them to the main chassis at the locations shown in Pictorial 11. Use #6 hardware.

( ) Start two 6-32 x 5/16" setscrews in each flywheel.

( ) Place one of the dial drive shafts through the hole provided in the front panel for the FM dial shaft. Place the dial drive shaft through the dial pulley plate and place one of the flywheels in position as shown in Detail 11A. Do not secure the flywheel at this time.



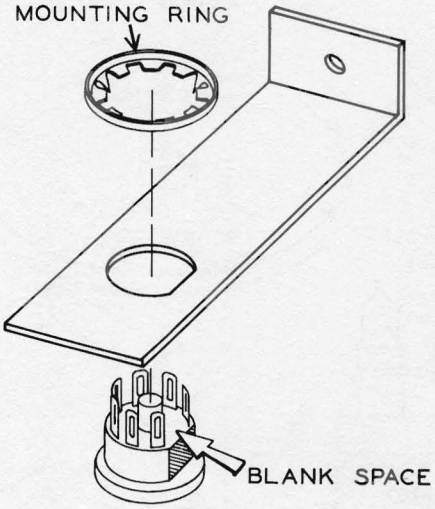
Detail 11A

( ) Clip a dial drive shaft "E" washer on the dial cord shaft next to the flywheel. Now place the shaft through the drive shaft mounting bracket and secure it with another "E" washer.

( ) Position the flywheel against the first "E" washer on the drive shaft. Now tighten the 6-32 setscrews in the flywheel. The drive shaft may be difficult to turn at this time.

( ) Similarly, install the dial drive shaft in the hole provided for the AM dial cord shaft in the front panel. Use the remaining flywheel and two "E" washers. Once again refer to Detail 11A for proper sequence of assembly.

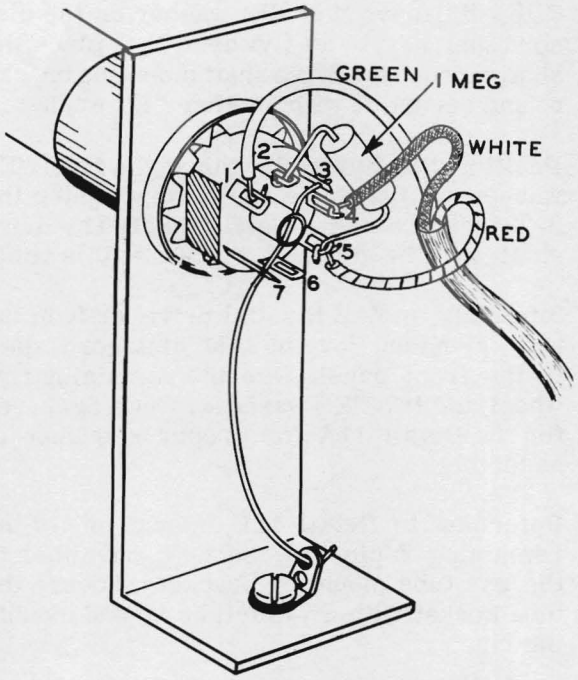
( ) Referring to Detail 11B, mount one of the remaining 7-pin tube sockets on either of the eye tube mounting brackets. Secure the tube socket with a 7-pin tube socket mounting ring.



Detail 11B

( ) Similarly, install the remaining 7-pin tube socket on the remaining eye tube mounting bracket. Secure with the 7-pin tube socket mounting ring.

( ) Temporarily mount the FM eye tube bracket (V12) at the location shown in Pictorial 11. Secure the bracket with a 6-32 x 1/4" screw, #6 solder lug, #6 lockwasher, and a 6-32 nut.



Detail 11C

Refer to Detail 11C for the following steps.
V11 V12

( ) ( ) Pass one end of a 2-1/2" length of bare wire (stripped hookup wire) through lug 7 (NS) and through the center post (NS) to lug 3 (S-1). Now solder the center post (S-2). Connect the free end of this wire to the solder lug secured at the base of the mounting bracket (S-1).

( ) ( ) R38, R19. Connect a 1 megohm (brown-black-green) 1/2 watt resistor between lugs 2 (S-1) and 5 (NS) of tube socket V11.

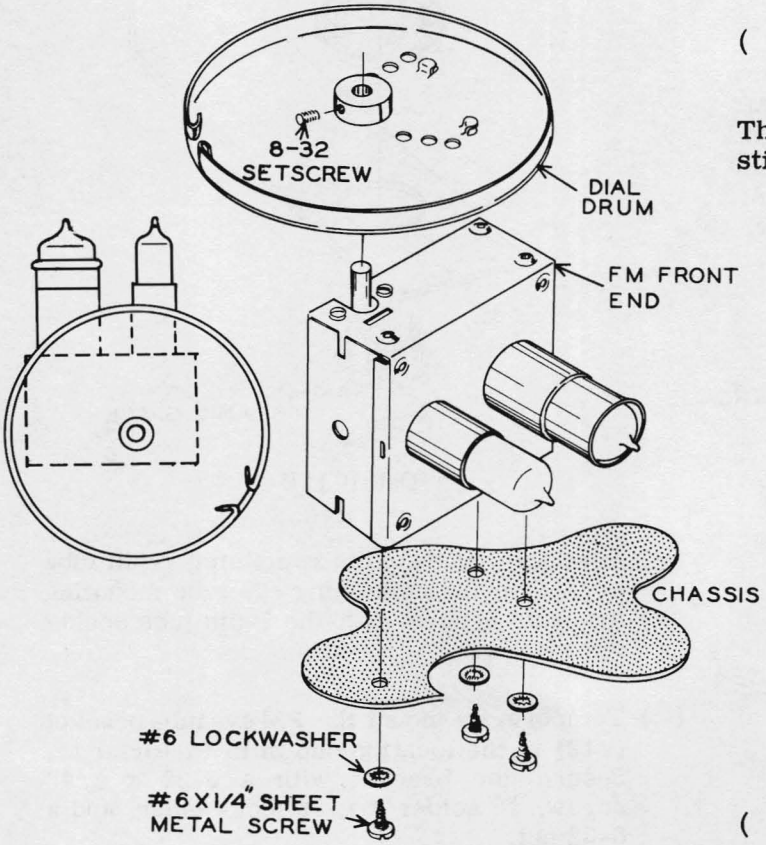
( ) ( ) The following connections are made using the cables that were placed through the chassis near the eye tube mounting brackets.

( ) ( ) Green wire to lug 1 of tube socket V11 (S-1).

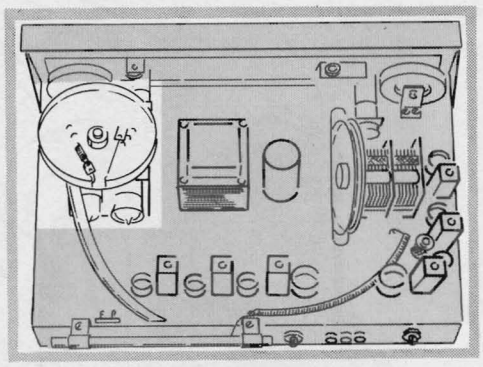
( ) ( ) White wire to lug 4 of tube socket V11 (S-1).

( ) ( ) Red wire to lug 5 of tube socket V11 (S-2).

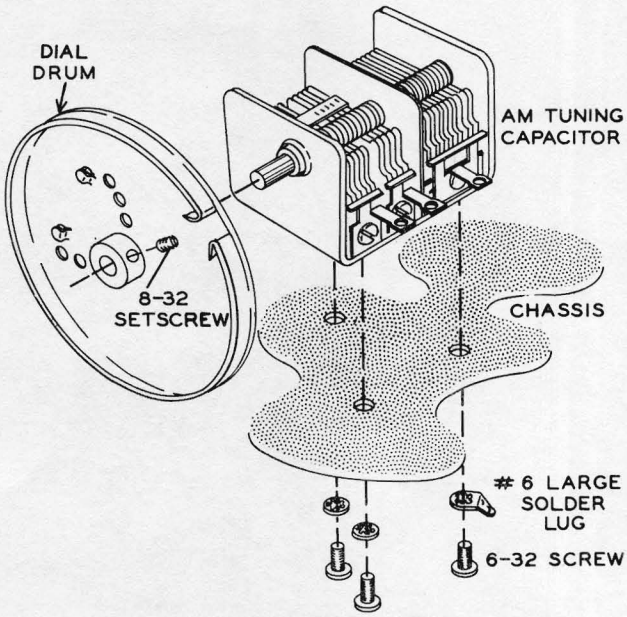
The above procedure should be repeated substituting V12 for V11.



Detail 12A



( ) Referring to Detail 12A, mount the FM front end as shown. Secure the unit with #6 x 1/4" sheet metal screws and #6 lockwashers.



Detail 12B

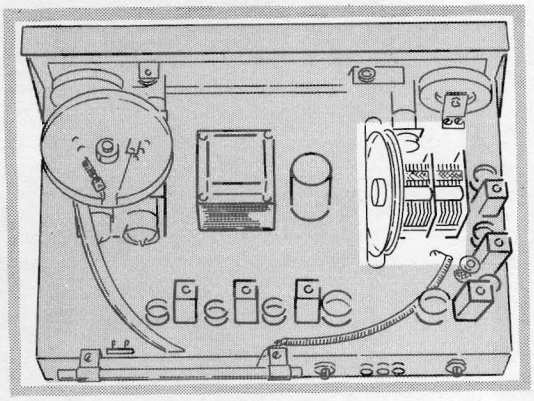
( ) Start a #8 setscrew in the bushing of one of the dial drums.

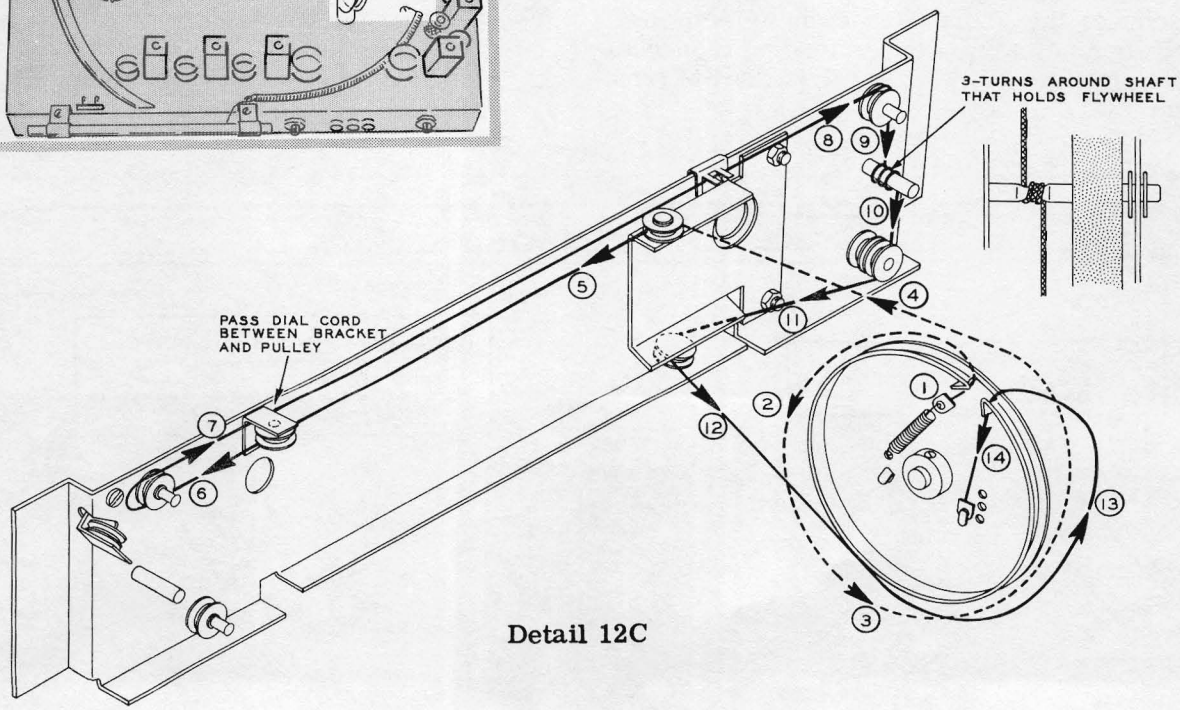
( ) Mount this drum on the shaft protruding from the top of the FM front end. Turn the shaft extending from the top of the front end to its maximum counterclockwise rotation and position the slot in the dial drum as shown in Detail 12A.

( ) Start a #8 setscrew in the remaining dial drum and mount this drum on the AM tuning capacitor as shown. Position the slot in the dial drum so that when the tuning capacitor shaft is turned to its maximum counterclockwise position, the opening points at 12 o'clock.

( ) C1A, C1B, C1C. Mount the AM tuning capacitor at the location shown in Detail 12B. The dial drum should fit through the slot in the main chassis. Secure the AM tuning capacitor in place with 6-32 x 1/4" screws, two #6 lockwashers, and a #6 solder lug.

( ) Referring to Detail 12C, string the AM dial cord (long cord). Follow the arrows and numbers for proper sequence of installation. Be sure to wrap the dial cord around the AM tuning shaft 3-turns as shown.





Detail 12C

( ) Referring to Detail 12D, install the FM dial cord (short cord). Start with the drum full counterclockwise. Once again follow the arrows and numbers for proper sequence of installation. Be sure to wrap the dial cord around the FM tuning shaft 3-turns as indicated.

( ) Turn the AM tuning shaft until the AM tuning capacitor plates are fully closed. Place the AM dial pointer over the diamond marking on the left of the dial window scale. Place the AM dial cord into the pointer fingers and pinch the fingers closed.

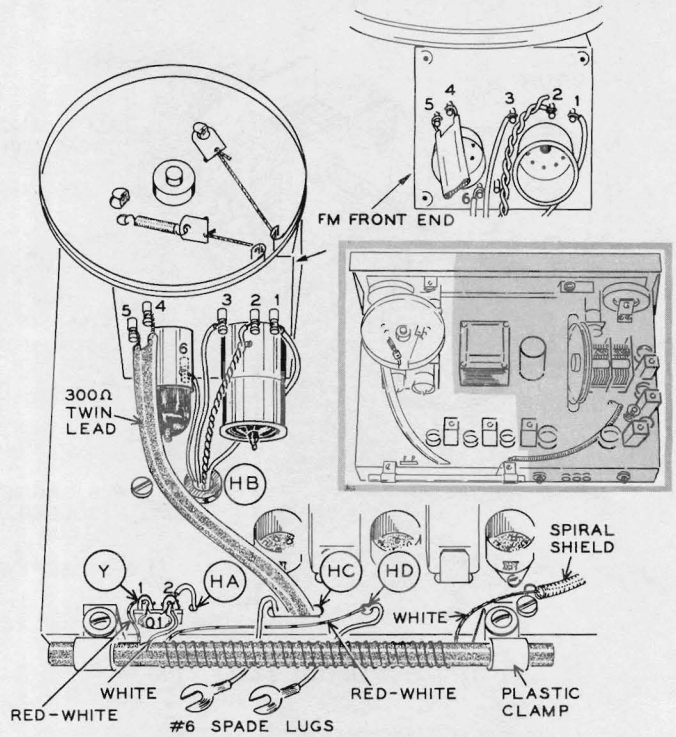
( ) Rotate the FM tuning knob fully counterclockwise. Place the FM dial cord between the fingers of the dial pointer. Pinch the fingers only enough to hold the pointer while turning the dial shaft. The dial pointers will be positioned later.

Refer to Pictorial 12 for the following steps.

CAUTION: Use care when connecting wires to the lugs on the FM front ends as it is possible to damage the ceramic insulating material.

( ) Connect the free end of the shielded audio cable coming through grommet HB to lug 2 of the FM front end (S-1).

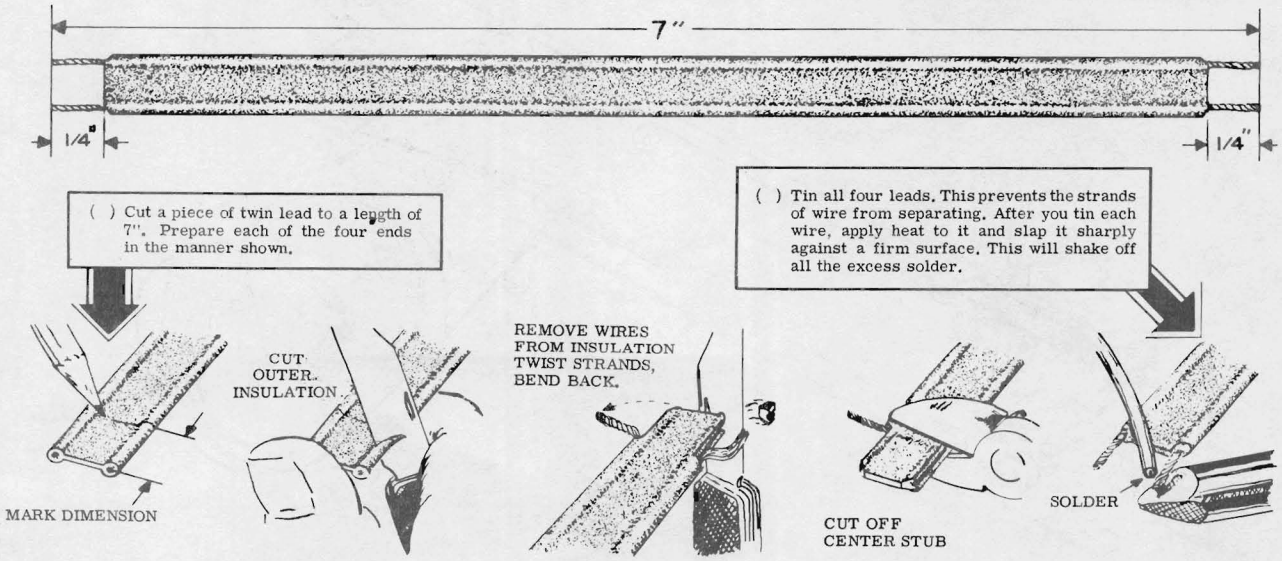
( ) Connect the short wire coming from lug 1 of terminal strip J and extending from rubber grommet HB to lug 6 of the FM front end (S-1).



Pictorial 12

( ) Connect the stripped wire coming from lug 1 of terminal strip N and extending through rubber grommet HB to lug 1 on the FM front end (S-1).

( ) Connect the unstripped length of wire coming from lug 2 of terminal strip J and extending from rubber grommet HB to lug 3 of the FM front end (S-1).



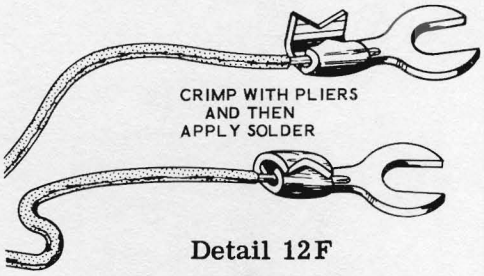
Detail 12E

( ) Cut a 7" length of the 300 Ω twin lead. Referring to Detail 12E, prepare the length of twin lead.

( ) At one end of the twin lead, connect either wire to lug 4 of the FM front end (S-1). Connect the remaining wire at this end to lug 5 of the front end (S-1).

( ) Route the twin lead as shown in Pictorial 12 and place the free end through slot HC in the chassis. This end will be connected later.

( ) Referring to Detail 12F, attach a #6 spade lug to each of the hookup wires extending through the chassis at HC and HD.



Detail 12F

( ) Connect the free end of the hookup wire extending through hole HA in the chassis to lug 2 of terminal strip Y (NS).

( ) C3. Connect a .01 μfd disc ceramic capacitor between lugs 1 (NS) and 2 (NS) of terminal strip Y.

( ) Referring to Detail 12G, install the two AM antenna mounting brackets on the rear apron of the main chassis. Use #6 hardware.

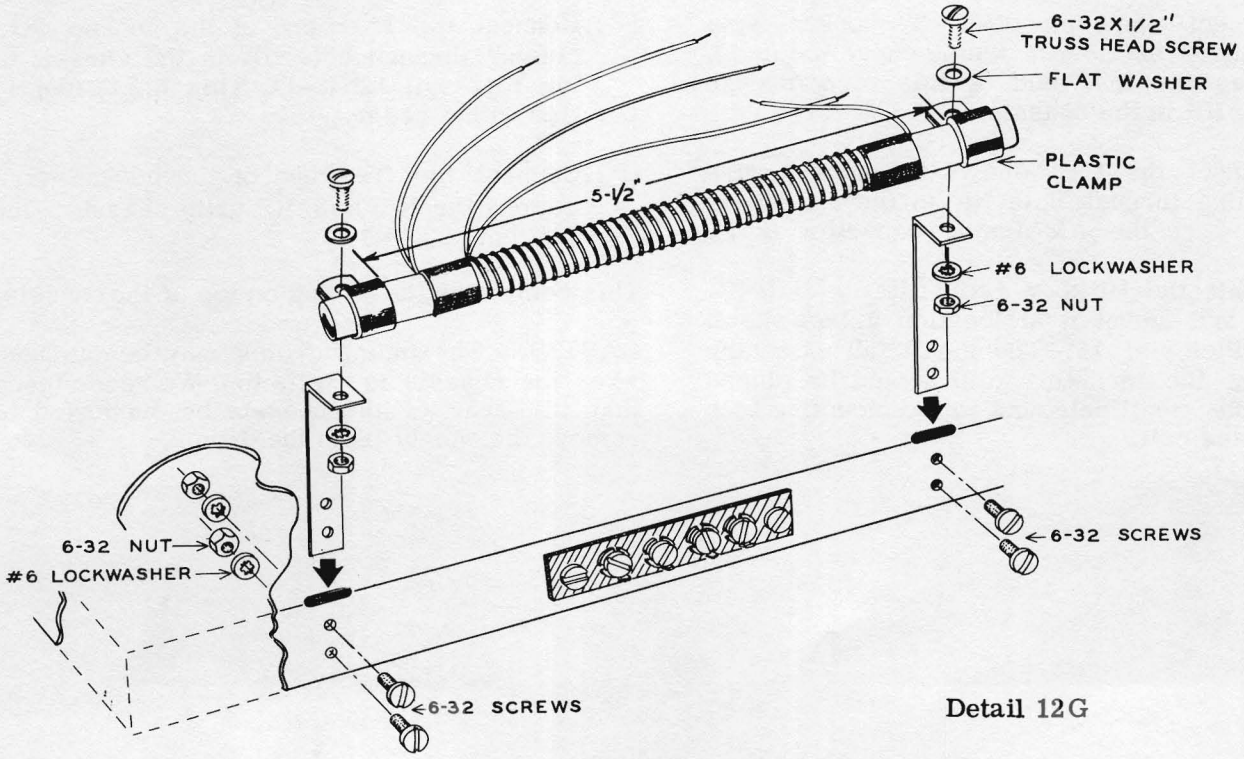
( ) Carefully unpack the rod antenna and handle it with care as a sharp blow may cause severe damage. Slip the two large plastic clamps over the ends of the rod antenna and space them 5-1/2" apart as shown.

( ) Mount the rod antenna to the antenna mounting brackets using two 6-32 x 1/2" truss head machine screws, two flat steel washers, two #6 lockwashers, and two 6-32 nuts. See Detail 12G. Be sure to orient the antenna rod with the short wires as shown.

( ) Connect the short white wire coming from the AM antenna to lug 2 of terminal strip Y (S-3).

( ) Connect the short red and white wire coming from the rod antenna to lug 1 of terminal strip Y (S-2).

( ) Place the long red and white wire from the rod antenna through hole HD. It will be connected later.



Detail 12G

( ) Locate the length of spiral shielding (spring-like shield) and unwind one end approximately 1/2". Now form a hook in the unwound end.

( ) Place a 6-32 x 1/4" screw through the hook formed in the spiral shielding and secure the spiral shielding to the main chassis in the hole near V9 using a #6 lockwasher and 6-32 nut. Route the spiral shielding as shown in Pictorials 12 and 13.

( ) Place the long white wire from the rod antenna through the spiral shielding.

Refer to Pictorial 13 for the following steps.

( ) Prepare the free end of the spiral shielding in the same manner as explained previously. Secure this end to the chassis near the AM tuning capacitor with #6 hardware.

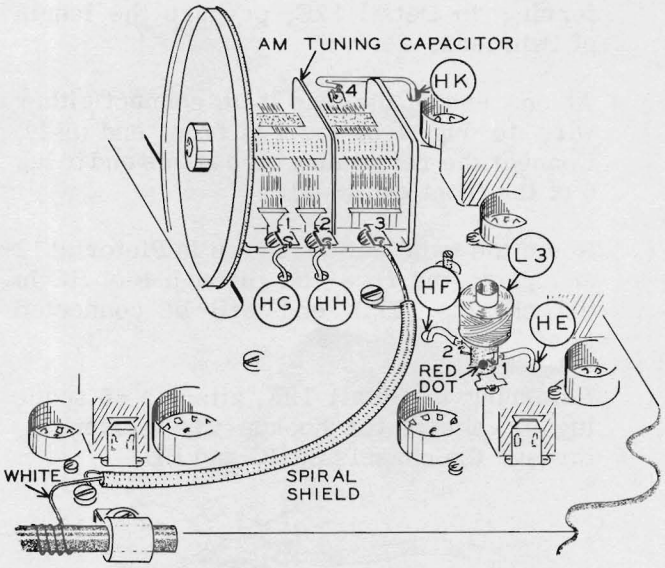
( ) Connect the free end of the white AM rod antenna lead to lug 3 of the AM tuning capacitor (S-1). Cut off the excess lead length.

( ) Connect the free end of the hookup wire coming through hole HG in the chassis to lug 1 of the AM tuning capacitor (S-1).

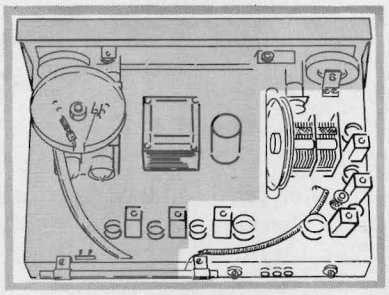
( ) Connect one end of a 3" hookup wire to lug 2 of the AM tuning capacitor (S-1). Place the free end of this wire through hole HH in the chassis.

( ) Connect the free end of the hookup wire coming through hole HK in the chassis to lug 4 of the AM tuning capacitor (S-1).

( ) Locate the 10 kc whistle filter coil (#40-90) and mount it at location L3 as shown in Pictorial 13. The small tab extending from the mounting clip should be placed in the small hole next to the mounting hole for the coil.



Pictorial 13

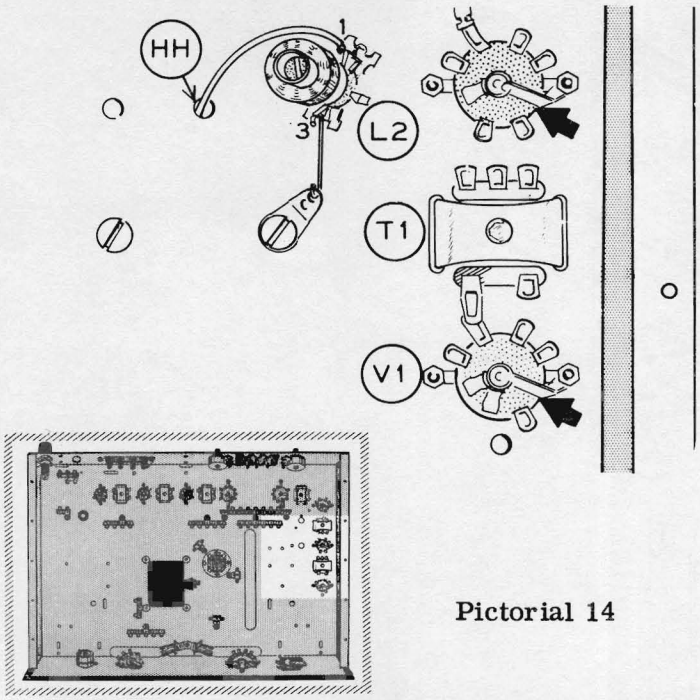


( ) Connect the free end of the hookup wire coming through hole HE in the chassis to lug 1 of coil L3 (S-1). This lug is identified with a red dot.

( ) Connect the free end of the hookup wire coming through hole HF in the chassis to lug 2 of coil L3 (S-1).

This completes the wiring on top of the chassis.

CAUTION: The tuning drums may be damaged when the chassis is on its top. We recommend that the rear of the chassis be supported to remove the weight from the drums.



Pictorial 14

Now turn the chassis over and refer to Pictorial 14 for the following steps.

( ) Connect the free end of the hookup wire coming through hole HH in the chassis to lug 1 of the AM oscillator coil (S-2).

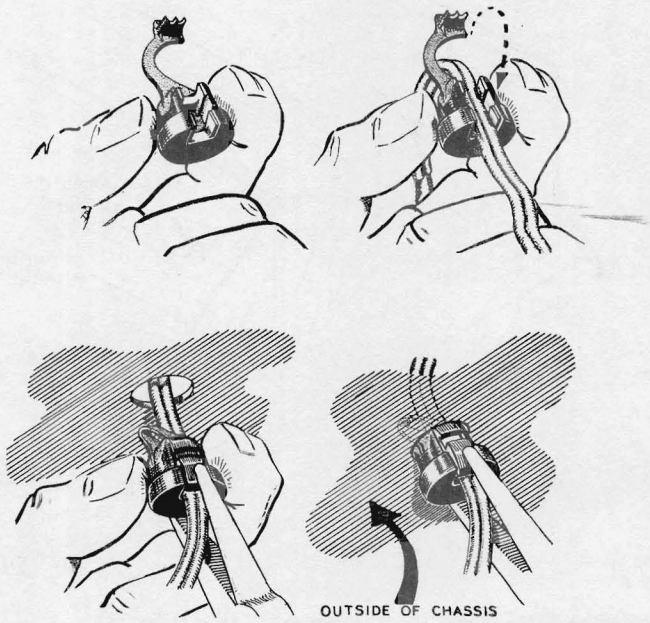
( ) Connect a bare wire (stripped hookup wire) from lug 3 of the oscillator coil (S-1) to the solder lug secured by the AM tuning capacitor mounting screw (S-1).

Refer to Pictorial 15 for the following steps.

( ) Connect the free end of the red and white wire passed through hole HD in the chassis to lug 3 of terminal strip C (S-1).

( ) Connect either wire of the 300 Ω twin lead extending through slot HC in the chassis to lug 2 of terminal strip C (S-1). Connect the other wire of this cable to lug 1 of terminal strip C (S-1).

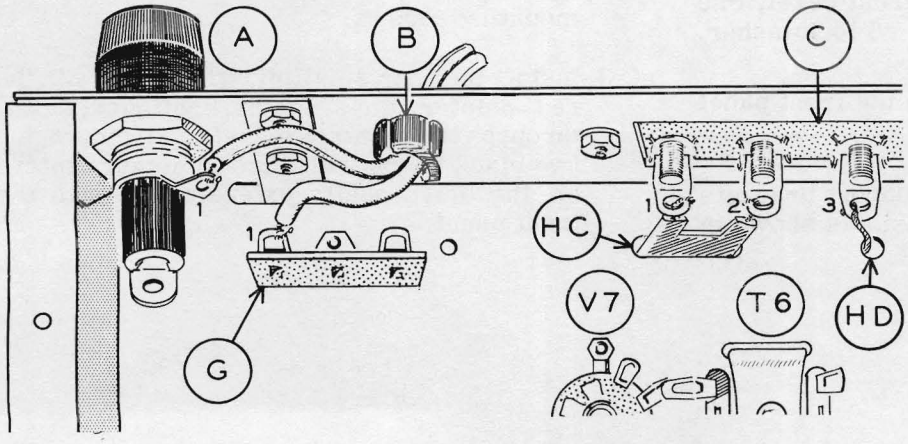
( ) Referring to Detail 15A, install the line cord and line cord strain relief. There should be approximately 2" of line cord extending on the inside of the chassis.

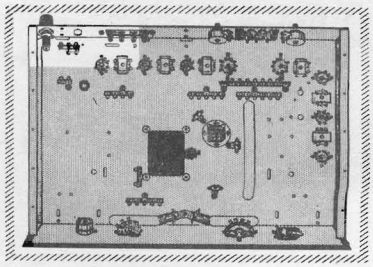


Detail 15A

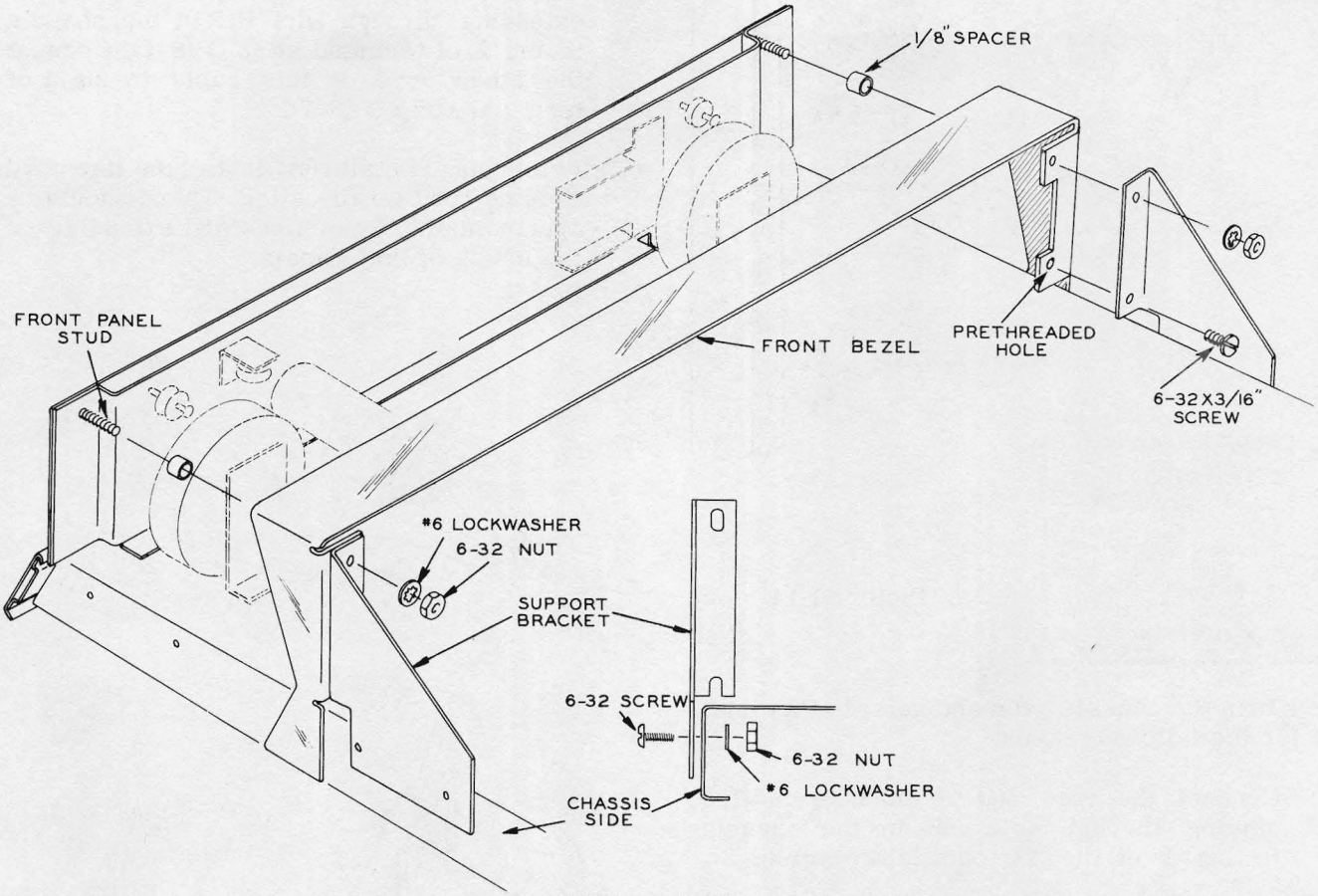
( ) Connect either of the line cord wires to lug 1 of fuse holder A (S-1).

( ) Connect the remaining line cord wire to lug 1 of terminal strip G (S-2).





Pictorial 15



Pictorial 16

Refer to Pictorial 16 for the following steps.

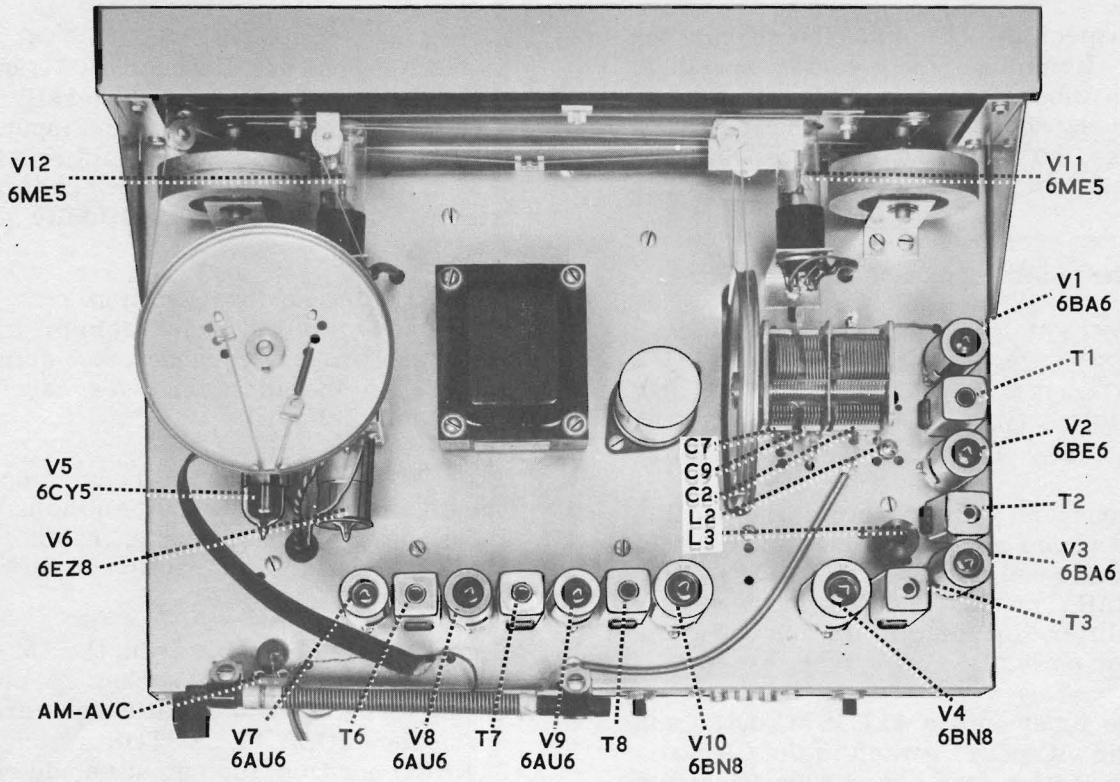
( ) Locate the front bezel and place a 6-32 self-tapping screw in the bottom hole of each mounting flange on the front bezel as shown in Pictorial 16. Now, remove the 6-32 self-tapping screws. Using these pre-threaded holes, secure a front panel support bracket to each end of the front bezel. Use a 6-32 x 3/16" screw and #6 lockwasher.

( ) Remove the 6-32 nuts from the front panel studs.

( ) Mount the front bezel and support brackets to the front panel and chassis as shown in Pictorial 16. Place 1/8" spacers on each stud on the front panel. Place the bezel on the studs, then secure the support brackets to the chassis with #6 hardware. Now secure the bezel to the front panel with #6 lockwashers and 6-32 nuts on the studs.

( ) Push the bottom of the dial pulley plate tight against the front panel and tighten the mounting screws.

( ) Install the four small plastic knobs with the red pointer lines on the shafts extending through the control panel and mount the two black knobs with the aluminum centers on the drive shafts extending through the front panel.



Pictorial 17

Refer to Pictorial 17 for the following steps.

( ) Loosen the #6 hardware securing the eye tube mounting brackets and slide the bracket toward the rear of the chassis as far as it will go.

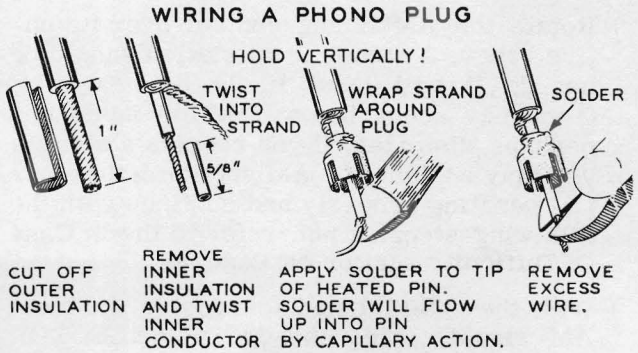
( ) Install 6ME5 eye tubes in tube sockets V11 and V12.

( ) Move the eye tube mounting brackets forward until the face of the tubes comes in contact with the dial pulley plate. Now secure the mounting hardware.

( ) Install a 1/2 amp slow-blow fuse in the fuse holder.

( ) Install the remaining tubes in their respective tube sockets.

( ) Referring to Detail 17A, prepare a length of audio cable and attach a phono plug to each end. The length should be sufficient to reach from the tuner to your amplifier.



Detail 17A

Refer to the following information for the initial test of the tuner.

INITIAL TEST

Carefully inspect the bottom of the chassis for loose wire trimmings and solder splashes. Inspect each tube socket lug and terminal strip lug for obvious shorts to one another or to the chassis. Also, be sure that each connection is soldered and that no poor solder connections exist.

( ) Place the controls in the following positions:

AM FIDELITY - NORMAL
MODE SELECTOR - AM
FM AFC - OFF
AC POWER - OFF
AM and FM LEVEL - Full clockwise

( ) Install one end of a prepared audio cable into the phono socket labeled AM. Connect the opposite end of this cable to the TUNER AUXILIARY or HIGH LEVEL input on your preamplifier or amplifier and turn the amplifier power ON.

( ) Plug the tuner into a 117 V AC outlet and place the AC power switch to the ON position. The pilot lights and tube filaments should light. Observe the two tuning eye tubes from the front panel; they should show a bright green color with an inverted "V" shadow. If no difficulty is experienced, continue with the following steps. If difficulty is encountered, turn the tuner OFF and refer to the In Case Of Difficulty section of this manual.

( ) Rotate the AM tuning control over its entire range. A strong local station should be heard. It will most likely be heard off frequency according to the dial scale and perhaps distorted. If you receive a station, you may assume the AM section of the tuner is operating properly and continue with the following steps. If not, refer to the In Case Of Difficulty section on Page 50.

( ) With the AJ-11 tuned to receive the local AM signal, place the MODE SELECTOR switch in the center or STEREO position. You should notice no difference in the output; the AM station should still be heard.

Now place the MODE SELECTOR switch in the FM position. Connect a 300 Ω antenna, FM or TV antennas are generally 300 Ω impedance, to the FM antenna input on the rear of the chassis. You should receive the FM stations available in your locality. If not, refer to the In Case Of Difficulty section.

After finding a local station of a known frequency slide the dial pointer to indicate the proper frequency and crimp the fingers to the dial cord. Be careful not to cut the dial cord.

( ) The FM section of the AJ-11 is completely prealigned and should require no adjustment. If alignment is necessary, refer to the FM Tuner Alignment section of this manual.

( ) Remove the audio cable from the AM socket and insert it into the FM socket. FM stations should be heard with no difference in output. Place the MODE SELECTOR switch in the STEREO position; the output should remain the same and FM stations should still be heard. Now place the MODE SELECTOR switch in the AM position. AM stations should now be heard.

( ) Install the tube shields on the respective tubes.

( ) If you have encountered no difficulty, you may assume that your tuner is wired correctly and the components are operating properly. The FM section of the AJ-11 and the AM coils and transformers are prealigned. However, it would be impossible to prealign the AM tuning capacitor due to its separate installation. Alignment may be accomplished very easily. There are two methods of aligning the AM front end section presented in this manual. Alignment with instruments will aid in the adjustment and show some improvement over the alignment without instruments. You should, however, be able to obtain satisfactory results without instruments.

AM FRONT END ALIGNMENT WITHOUT INSTRUMENTS

Turn the tuner on and allow it to operate for a minimum of 30 minutes for all tubes and components to warm up and stabilize.

( ) Place the MODE SELECTOR switch in the AM position, the AM FIDELITY switch in the NORMAL position, and the AM LEVEL control in the FULL CLOCKWISE position. Check the dial pointer alignment with the diamond on the left of the dial scale, with both AM and FM tuning controls turned fully counterclockwise.

The alignment of both dial pointers with the diamond is very important and should be corrected if they do not line up properly. Correction is accomplished by sliding the pointer on the dial cord.

( ) Tune in an AM station of known frequency near 1400 kc on the AM dial. Place the AJ-11 right-side-up on your work area. Refer to the chassis lettering and to Pictorial 17 for identification of the tuning capacitor trimmers and coils.

Use a non-metallic screwdriver for the following adjustments.

( ) If the known station frequency is higher than the dial pointer indication, turn the oscillator trimmer adjustment (C9) clockwise until the station is received with the dial pointer at the correct marking on the dial window.

( ) If the station frequency is below the dial pointer indication, turn capacitor C9 counterclockwise until the station falls at the correct marking on the dial window.

( ) Now adjust the RF trimmer (C7) and the antenna trimmer (C2) to produce the highest and clearest audio output.

( ) Repeat the preceding alignment procedure in the same order. This time, observe the AM tuning indicator eye tube and peak each trimmer for maximum closure of eye tube. Now detune the station, using the front panel AM tuning control and without looking at the dial pointer, retune the station for maximum closure of the AM tuning indicator eye tube. Check the dial pointer setting. If it has returned to the proper frequency setting, continue with the balance of alignment, if not, repeat the adjustment of C9, C7, and C2 until the dial pointer falls on the known station frequency with maximum closure of the tuning indicator eye tube.

( ) Tune in a station of known frequency near 600 kc. The station frequency and dial calibration should agree. The coil adjustment (L2) should not be disturbed unless there is a large difference between the station frequency and the dial pointer indication. If some adjustment is necessary, adjust the dial pointer to the known frequency of the station by means of the tuning knob and adjust the slug of the oscillator coil (L2) for maximum closure of the AM tuning eye tube. Then adjust the slug of RF transformer T1 for maximum closure of the eye tube. Repeat this procedure until the station does come in strongest when the pointer is at the station frequency on the dial window.

( ) Once the preceding adjustment has been made, recheck the station near 1400 kc to see if the dial pointer and the station frequency agree at both the high and the low end of the AM dial. If the dial scale and station frequency do not agree, repeat the alignment procedure starting with the C9 oscillator trimmer adjustment.

AM FRONT END ALIGNMENT WITH INSTRUMENTS

Turn the tuner on and allow it to operate for a minimum of thirty minutes before attempting to complete the following alignment.

( ) Place the MODE SELECTOR switch in the AM position, the AM FIDELITY switch in the NARROW position, and the AM LEVEL control turned fully clockwise.

( ) Turn the AM tuning control to indicate 1400 kc on the AM dial. Connect the AM RF signal generator to the AM antenna and ground terminals on the rear chassis apron of the AJ-11. Connect a vacuum tube voltmeter or 20,000 ohm/volt DC voltmeter between the AM-AVC (marked on rear of chassis) line and the tuner chassis. Set the selector switch of the voltmeter to read negative DC voltage. Adjust the signal generator output and frequency to cause the meter to indicate approximately 2 volts negative DC. Readjust the generator output as necessary to maintain this low reading at all times during the entire alignment procedure. The input signal may be modulated or unmodulated. Refer to Pictorial 17 (Page 41) for the location and identification of the tuning capacitor, trimmers, and coil slugs.

( ) If the generator frequency is found above 1400 kc on the dial window, turn the oscillator trimmer adjustment (C9) clockwise. Observing the meter reading for minimum deflection, alternately adjust C9 and the signal generator until the AM dial indication and the signal generator both read 1400 kc. If the generator frequency is below 1400 kc on the dial turn C9 counterclockwise until agreement between the generator and tuner frequency is obtained.

( ) Now adjust the RF trimmer (C7) and antenna trimmer (C2) for a maximum meter reading with the lowest generator output setting.

( ) Repeat the alignment of C9, C7, and C2 in the preceding order. C9 should always be adjusted before C7 and C2 are moved.

( ) Detune the AM tuner with the front panel AM tuning control and observe the meter reading. Rock the AM tuning control back and forth across 1400 kc until the highest reading on the voltmeter is obtained. If the dial pointer indicates 1400 kc with the highest meter reading, the oscillator trimmer is adjusted properly. If not, repeat the previous adjustments of C9, C7, and C2.

( ) Rotate the AM tuning control until the dial pointer indicates 600 kc on the AM dial. Adjust the signal generator frequency to provide the highest reading on the voltmeter. If the highest reading appears with the signal generator at 600 kc, the tuner is tracking properly and no further adjustments are necessary. If agreement between the signal generator and dial pointer is not reached, adjust oscillator coil L2 for the highest reading on the voltmeter with both the tuner and signal generator set to 600 kc. Now adjust the RF transformer (T1) for the highest reading on the meter.

( ) Again detune the AJ-11 and adjust the dial pointer to the highest output reading on the meter. If the dial pointer and the generator agree, no further adjustment is necessary. If they do not agree, repeat adjustment of L2 and T1 until the highest meter reading is obtained with the generator and tuner each adjusted to read 600 kc.

( ) Recheck the 1400 kc alignment. If this is not changed, the tuner may be assumed to be aligned. If the 1400 kc alignment has changed, repeat the 1400 kc alignment and then check the 600 kc alignment point.

( ) The 10 kc whistle filter coil (L3) can be adjusted using an audio generator tuned to 10 kc and measuring the AC voltage at the AM or FM output socket. The audio generator should be connected to lug 2 of terminal strip Y.

( ) Using these instruments tune L3 to a minimum output reading on the AC voltmeter.

FM ALIGNMENT WITHOUT INSTRUMENTS

The prealigned FM front end and IF transformers take most of the difficult work out of the FM alignment without instruments.

Set the controls as follows:

AFC - OFF
MODE SELECTOR - FM
FM LEVEL - Full clockwise

Tune the FM tuner to a strong local station. Using the tuning eye as an indicator, tune for maximum eye closure. Place the plastic alignment tool supplied into the top slug of transformer T8. Turn this slug for maximum audio output.

FINAL ASSEMBLY

Refer to Pictorial 18 for the following steps.

( ) Locate the bottom plate and mount a plastic foot in each corner. Use 6-32 x 1/2" truss head machine screws, #6 lockwashers and 6-32 nuts.

( ) Mount the bottom cover to the chassis using four #6 sheet metal screws, two on each edge. The front edge of the bottom cover must fit under the bottom edge of the control panel.

( ) Slide the top cover over the tuner from the back and fasten it to the bottom, using six sheet metal screws, three in each side. Use care so that the AM tuning capacitor is not damaged.

( ) Install the nameplate as follows:

a. The surface to which the nameplate is to be applied should be clean and dry.

b. Remove the paper backing from the nameplate. A pin or pointed knife blade can be used to start removal of the paper backing and to remove any paper that might remain in the back of the nameplate. Do not touch the adhesive back with your fingers.

c. Apply the nameplate with firm even finger pressure; firm even pressure is the key to good adherence.

This completes assembly of your Model AJ-11 AM-FM Stereo Tuner. We suggest that you read the following information concerning installation and operation.

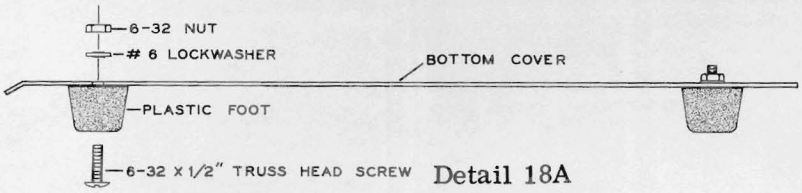
INSTALLATION AND OPERATION

Heat is generated in most all electronic equipment, therefore adequate ventilation around the unit is necessary. One inch of open area around the bottom cover, behind the rear apron, and above the top of the cabinet would be considered the minimum ventilation requirement for the AJ-11. Vertical mounting of the chassis with the supplied cabinet is not recommended. The chassis without the cabinet may be vertically mounted in a custom installation if certain precautions are exercised. The front panel should be spaced 1/8" above the mounting surface to provide air circulation around the panel and sufficient ventilation should be supplied within the cabinet to provide a free flow of air around the entire chassis.

Figure 5 illustrates a typical stereo installation of the AJ-11. A multiplex adaptor and a stereo preamplifier, or power amplifier, is shown. A monaural installation is also shown in Figure 5.

The stereo installation illustrated in Figure 5 shows the most versatile application of the AJ-11. Your choice of the following types of program reproduction is at your fingertips with this type of system.

1. AM alone, from one or both speakers.
2. FM alone, from one or both speakers.
3. AM and FM (AM from one speaker and FM from the other speaker) simultaneously.
4. FM Multiplex stereo (one speaker for each stereo channel).



Detail 18A

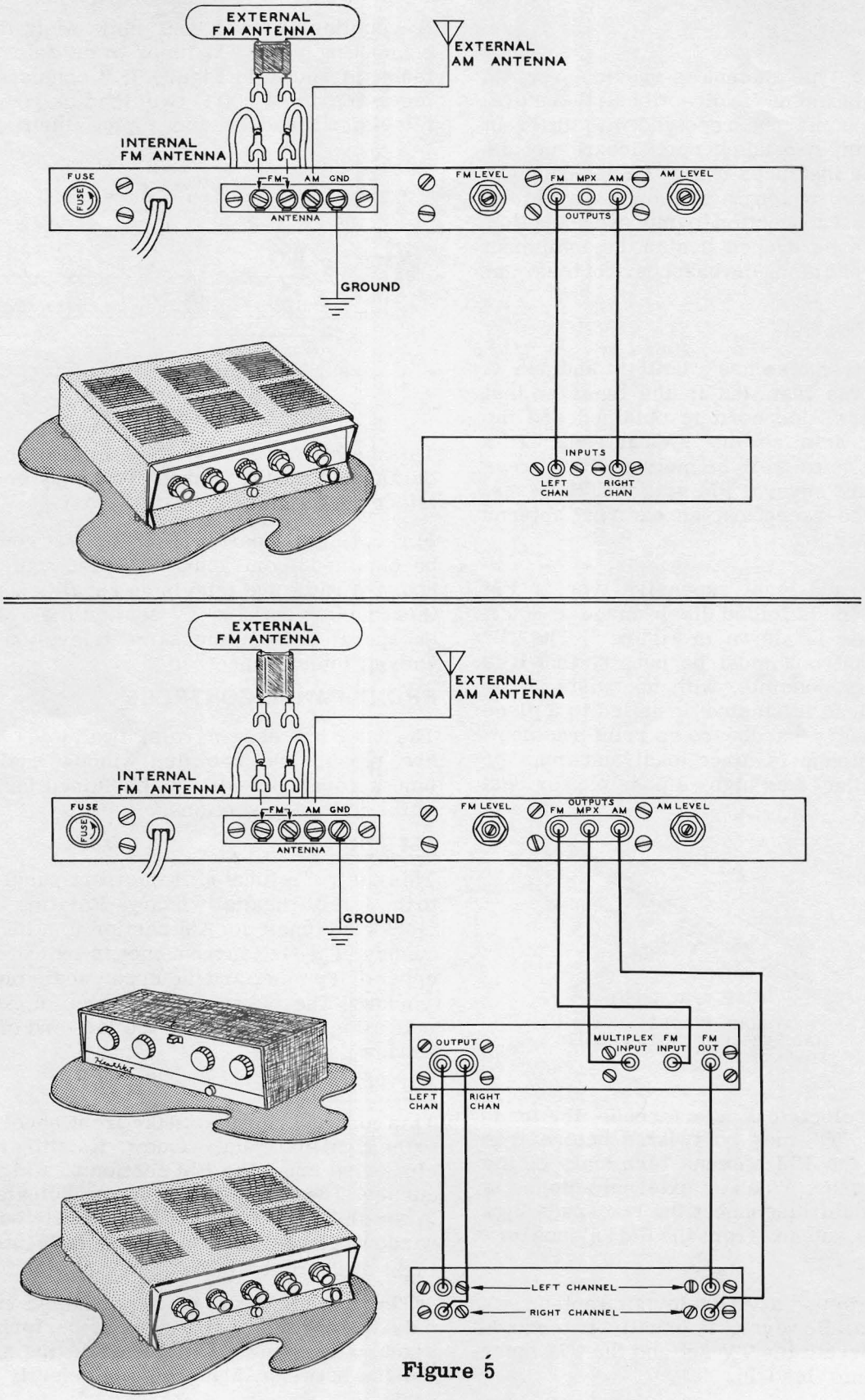

EXTERNAL FM ANTENNA
EXTERNAL AM ANTENNA
INTERNAL FM ANTENNA
FUSE
FM
AM
GND
ANTENNA
FM LEVEL
FM
MPX
AM
OUTPUTS
AM LEVEL
GROUND
INPUTS
LEFT CHAN
RIGHT CHAN
EXTERNAL FM ANTENNA
EXTERNAL AM ANTENNA
INTERNAL FM ANTENNA
FUSE
FM
AM
GND
ANTENNA
FM LEVEL
OUTPUTS
FM
MPX
AM
AM LEVEL
GROUND
OUTPUT
LEFT CHAN
RIGHT CHAN
MULTIPLEX INPUT
FM INPUT
FM OUT
LEFT CHANNEL
RIGHT CHANNEL

Figure 5

AM ANTENNA

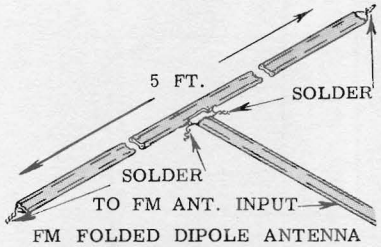
A built-in rod type antenna is provided for AM reception. This antenna is directional, therefore, the AM station may be received with different signal strength, depending upon location of the tuner. In some instances it may be necessary to install a 6 or 8 ft. length of hookup wire to the external antenna connection to improve reception. This wire can be draped behind the equipment cabinet or spread along the baseboard of the room.

FM ANTENNA

The FM receiver also has a built-in antenna. A special coil was installed in the tuner so that coupling to the line cord is obtained and the house wiring acts as the FM antenna. This should work quite well in metropolitan areas where there are several FM stations. However, for fringe area reception, an external antenna will be required.

The simplest and least expensive type of FM antenna is a simple folded dipole made of 300 Ω twin lead. This is shown in Figure 6. The "T" part of this antenna must be hung so that it is as straight as possible, with no twists. Frequently this lead is stapled or nailed to a piece of wood or heavy cardboard as reinforcement. This type antenna is directional and must be oriented and placed as high as possible for best reception.

Figure 6



FM FOLDED DIPOLE ANTENNA MADE FROM 300 OHM TWINLEAD TRANSMISSION LINE

To minimize electrical interference, the lead-in from the "T" may be twisted before it is connected to the FM antenna terminals on the rear of the tuner. When an external antenna is used, you should disconnect the two spade lugs of the internal antenna from the FM antenna terminals.

It is possible to use a VHF television antenna as a FM antenna. However, it usually is not advisable to operate the TV set and the FM tuner from the same lead-in.

A coupling method you may wish to use in connecting your FM tuner to the television antenna is shown in Figure 7. It consists of placing a length of 300 Ω twin lead on your present television lead-in and taping them together.

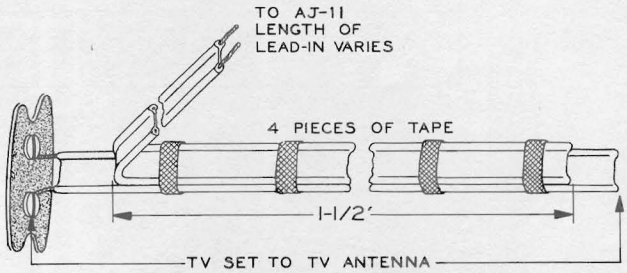


Figure 7

This method will cause some mismatch between the antenna and the TV set. This may or may not affect reception.

For optimum operation, a two-set coupler can be obtained from your local electronics supply house or radio and television repair shop. Using this coupler, both the TV set and the FM set can be operated from the same television antenna without interference.

FRONT PANEL CONTROLS

The tuner has six controls, two tuning indicator eye tubes, and two dial window scales. The function of each control is explained individually in the following sections.

AM TUNING

This control is located on the front panel directly to the left of the dial window. Rotating this knob clockwise tunes the AM section to a higher frequency. The station frequency is indicated by the upper dial pointer and the upper scale on the dial window. The correct tuning eye for AM tuning indication is located on the left-end of the dial window.

FM TUNING

This control is located on the front panel directly to the right of the dial window. Rotating this knob clockwise tunes the FM section to a higher frequency. The station frequency is indicated by the lower dial pointer and the lower scale on the dial window. The correct tuning eye is located at the right of the dial window.

NOTE: The 6ME5 Eye tubes are tuning indicators only and do not indicate tuner performance or signal strength. A difference in the amount of closure between AM and FM is perfectly normal.

AM FIDELITY

This switch is located on the control panel, directly below the AM tuning control. It has two positions and permits selection of either of two bandwidths. The NORMAL position limits the bandwidth and should be used when stations are close together and when sharp tuning is required.

The MAX position should be used whenever possible. This position of the AM FIDELITY switch provides the widest bandwidth and allows for the greatest fidelity.

MODE SELECTOR

This switch is located on the control panel and is the second switch from the left. It has three positions and controls the routing of the AM and FM signals to the output sockets. The AM position routes the AM signal to both output sockets.

The stereo position routes the AM signal to the AM output socket and simultaneously routes the FM signal to the FM socket.

The FM position routes the FM signal to both output sockets.

FM-AFC

This switch is located on the control panel and is the third switch from the left. It has three positions and controls the degree of automatic frequency control applied to the FM tuner.

The FULL position provides maximum AFC action. This position is used to hold a very weak FM signal and should be used only when the HALF position allows the tuner to drift off frequency.

The HALF position provides half of the maximum AFC actually available. This position should prove satisfactory for average reception conditions.

The OFF position eliminates AFC entirely and should always be used when tuning an FM station. If the FM-AFC switch is left in the HALF or FULL position when tuning or changing stations, it is possible to completely skip over a wanted station or to tune to the edge of a station rather than to the center of the signal.

AC POWER

This switch is located on the control panel at the right end. It controls the application of power and therefore turns the tuner ON and OFF.

AM AND FM TUNING INDICATOR TUBES

The AM tuning indicator eye tube is located on the left side of the dial window. It indicates when an AM station is correctly tuned by a narrowing of the inverted V (this tube always indicates AM tuning regardless of the selector switch position).

The FM tuning indicator eye tube is located on the right side of the dial window. It indicates correct tuning of an FM station by a narrowing of the inverted "V." This tube will always indicate FM tuning regardless of the selector switch position.

REAR CHASSIS APRON CONTROLS-SOCKETS-TERMINALS

ANTENNA

The two FM receiving antenna leads should be connected to the two FM terminal screws. The input circuit is not polarized, therefore either lead may be connected to either screw. The AM receiving antenna lead should be connected to the AM terminal screw and the earth-ground lead should be connected to GND.

FM LEVEL

This control adjusts the output audio level of the FM signal, whether the AM or FM output socket is used. It should be left in the full clockwise position unless there is a need for attenuation of the FM signal in a stereo application or for other specific reasons.

AM LEVEL

This control adjusts the output audio level of the AM signal whether the AM or FM output socket is used. It should be left in the full clockwise position unless there is need for attenuation of the AM signal in a stereo application or for other specific reasons.

AM OUTPUT

The AM output may be used for monaural audio reproduction of the AM or FM output or the AM signal of a stereo AM-FM broadcast. This output is controlled by the front panel MODE SELECTOR switch.

FM OUTPUT

The FM output may be used for monaural audio reproduction of the AM or FM output or the FM signal of a stereo AM-FM broadcast. This output is controlled by the front panel MODE SELECTOR switch.

MULTIPLEX

The multiplex output jack is provided for use with the multiplex adapter only, and is not controlled by either level control or the front panel selector switch.

IN CASE OF DIFFICULTY

This section of the manual is presented in two parts: a generalized procedure, and a chart of specific difficulties which is shown on Page 52. While the chart indicates typical troubles that may be encountered, it is impossible to list all of the difficulties that could occur.

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

2. It is interesting to note that about 90% of the kits that are returned for repair, 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 Proper Soldering Techniques section of this manual.

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

4. Check the tubes with a tube tester or by substitution of tubes of the same types and known to be good.

5. Check the values of the component 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 beneath the chassis.

7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those found on the Schematic Diagram. NOTE: All voltage readings were taken with a HEATHKIT Vacuum Tube Voltmeter. Voltages may vary as much as 10% due to line voltage variations.

8. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

CAUTION: To avoid any shock hazard when making the following tests, make sure that only the pins that are mentioned in the text are touched with the screwdriver, and that the other hand or any other part of the body is not in contact with the chassis or any conductor that may provide a return path to ground.

9. If the source of the difficulty has not been located, turn the volume control of the amplifier up and while holding the insulated handle of a screwdriver, touch the center terminal of the audio output jack with the screwdriver blade tip. You should hear a loud sound out of your speaker. If you do not, the output level control is grounded, your amplifier is at fault, or the audio cable has an open or short circuit in it.

If you hear a sound here, proceed back to pin 8 of V4 (AM) or pin 8 of V10 (FM). If you do not hear a sound at this point, this means that this cathode follower circuit is at fault. If you hear a sound, proceed back further.

Next, touch pin 7 of V2 (AM) or pin 1 of V9 (FM). You should hear a scratching noise in your speaker. No sound at this point means that you have trouble between the cathode follower and the preceding stage.

In a like manner, you can check pin 1 of V1 (AM), pins 1 of V8 and V7 (FM) to find out in which area your troubles lie. Once you have found the general area, the trouble should be located by using a voltmeter and checking the voltage readings on the Schematic, and by careful visual examination.

NOTE: If the trouble should seem to be in the prealigned FM tuning unit, it is inadvisable to probe around inside it as it is a relatively delicate piece of equipment. Moving a lead can throw the tuning unit completely out of alignment.

If the tuner operates, but sensitivity seems to be low or the stations do not seem to be tuning properly, the cause may be a defective tube or improper alignment. The tuner is factory aligned as perfectly as possible, but significant differences in wiring the remainder of the FM system from one builder to another can make quite a difference. The tuner may be misaligned to a greater or lesser extent by wiring arrangements other than those shown in the pictorials, or by using longer leads than necessary.

If, after appying all of these procedures, your difficulties are not resolved, check the SERVICE section of this manual for information on the facilities that the Heath Company makes available for this purpose.

ELECTRICAL TROUBLESHOOTING	
TYPE OF DIFFICULTY	POSSIBLE CAUSE
Dead tuner, filaments not lighted.	AC line cord, fuse, defective switch, open power transformer, open 6.3 volt transformer lead to ground.
Some filaments lighted.	Open or cold solder joint on unlighted tubes. Poor ground to unlighted tubes.
Dead tuner, filaments lighted.	Defective output cable, level control turned counterclockwise. No B+ voltage.
No B+ voltage.	Silicon rectifier, defective filter capacitors C66, C67, C68 A, B, C, open B+ resistor R46-R47, open power transformer (red to red).
AM operating, FM dead.	Check tubes and voltages from V4 through V10. FM LEVEL control tuned down or defective MODE SELECTOR switch or switch wiring.
FM operates, AM dead.	Defective output cable, AM LEVEL control, MODE SELECTOR switch. Check tubes and voltages V1, V2, and V3.
Noise but no audio.	Check antennas, MODE SELECTOR switch, tubes and tube voltages.
Tuning indicator tube inoperative.	Check wiring of cable from tuning tube sockets to main chassis, check tube socket voltages.
Hum.	Check filter capacitors, heater to cathode leakage in any tube.
Low sensitivity.	Alignment (refer to noise but no audio).
Dial setting changes when AM BAND switch is changed from NORMAL to MAXIMUM.	AM front end not tracking. Align the AM front end. Improper IF alignment.
Distorted audio output.	IF alignment. Cathode follower. FM detector.

MECHANICAL TROUBLESHOOTING	
TYPE OF DIFFICULTY	POSSIBLE CAUSE
No flywheel action of tuning knobs.	Setscrews not tight or drive shaft, front panel and main chassis not properly aligned.
Dial pointer travel not smooth.	Dial pointer rubbing on window or dial pulley plate, dial cord not tight, setscrew on drum not tight.

SERVICE INFORMATION

SERVICE

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

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

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

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

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

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase, if available.

5. Print or type your name and address, preferably in two places on the letter.

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

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

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

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

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

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

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

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

REPLACEMENTS

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

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

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

C. Mention date of purchase.

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

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

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed. Leave all tubes installed in their sockets, return audio cables, and make sure the cabinet shell and bottom plate are properly installed.

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

To: HEATH COMPANY
Benton Harbor, Michigan

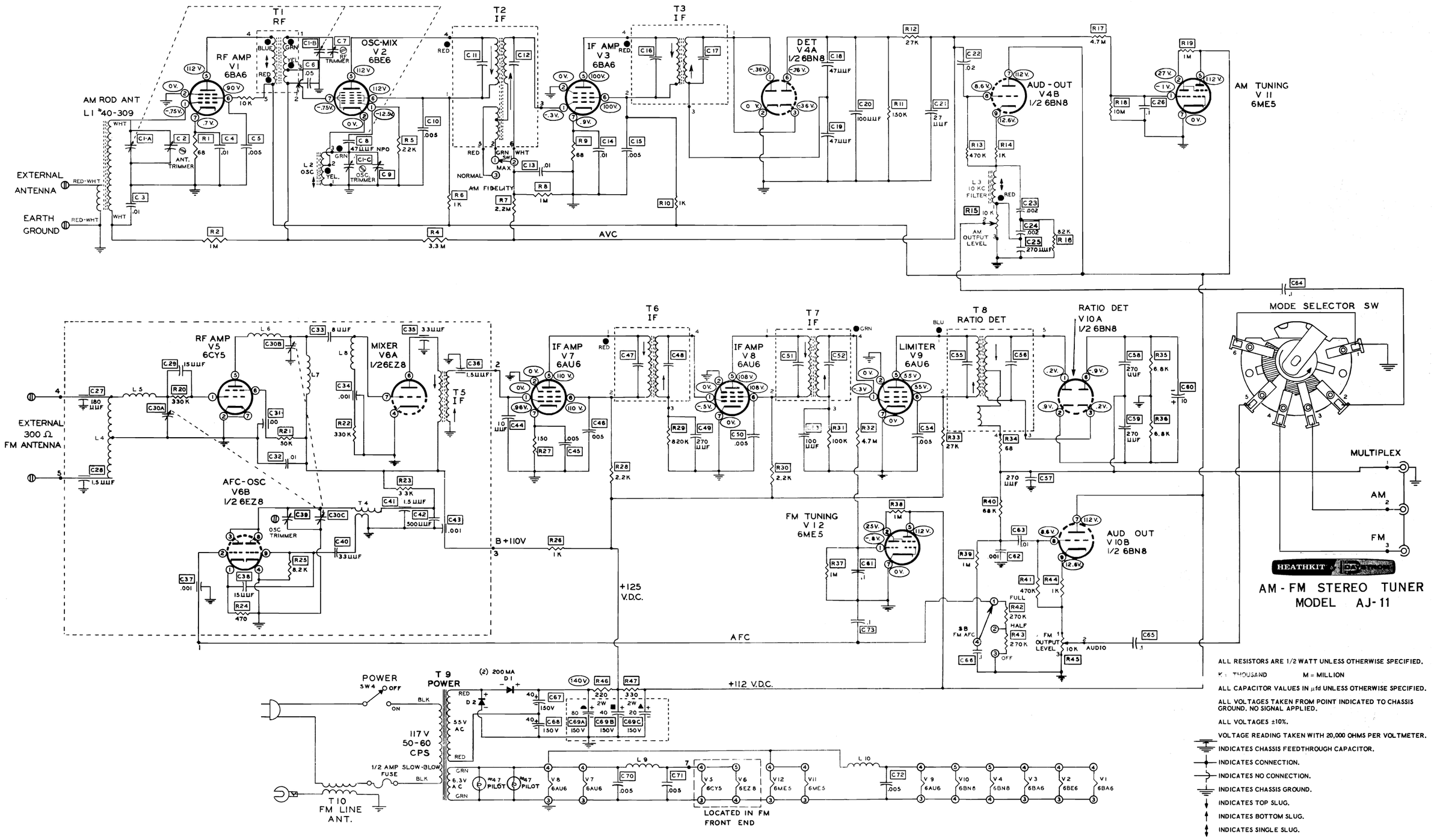
Include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by parcel post or prepaid express; note that a carrier cannot be held responsible for damage in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

WARRANTY

Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

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

HEATH COMPANY



ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.

K = THOUSAND M = MILLION

ALL CAPACITOR VALUES IN μfd UNLESS OTHERWISE SPECIFIED.

ALL VOLTAGES TAKEN FROM POINT INDICATED TO CHASSIS GROUND. NO SIGNAL APPLIED.

ALL VOLTAGES ±10%.

VOLTAGE READING TAKEN WITH 20,000 OHMS PER VOLTMETER.

INDICATES CHASSIS FEEDTHROUGH CAPACITOR.

INDICATES CONNECTION.

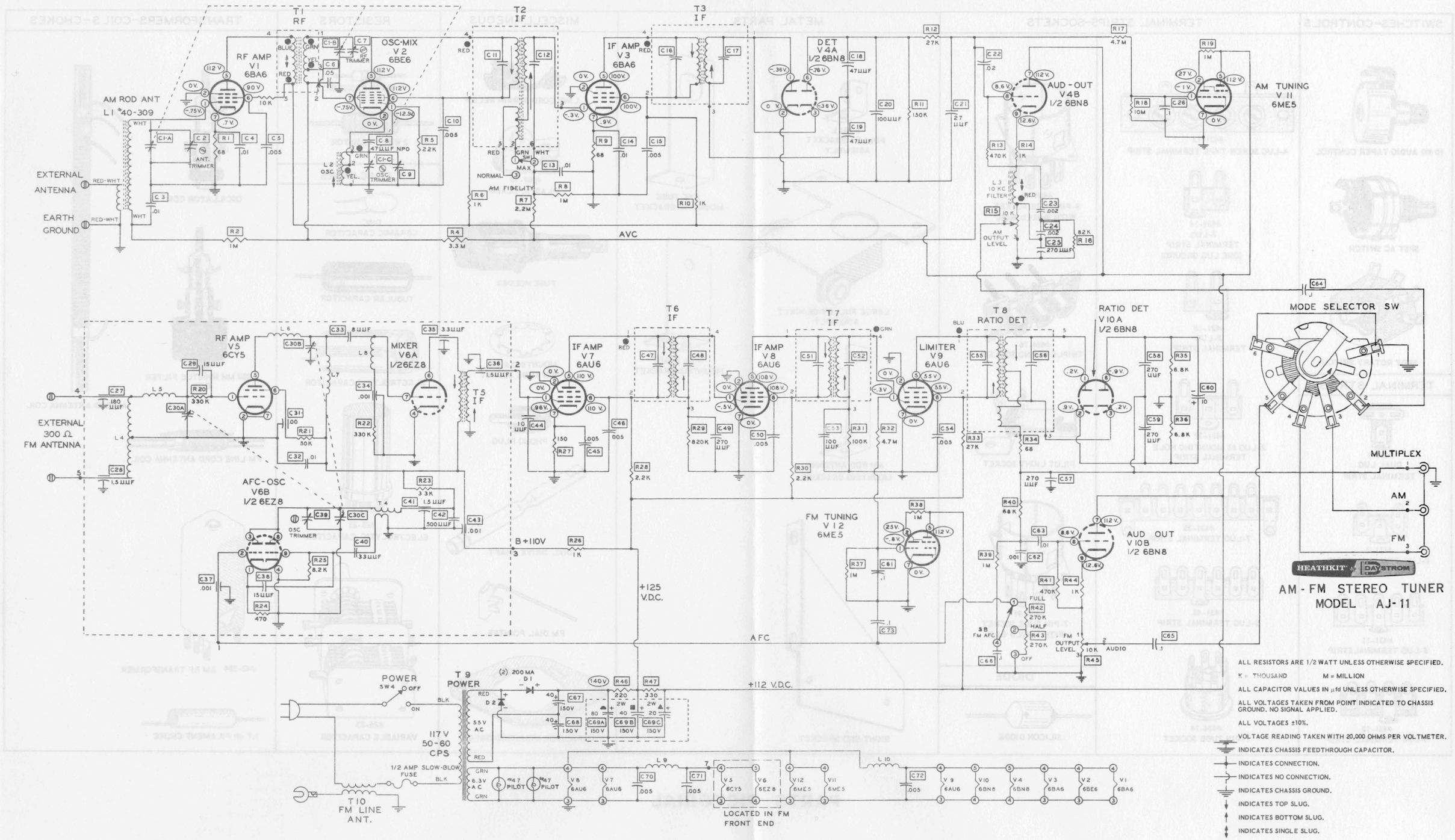
INDICATES NO CONNECTION.

INDICATES CHASSIS GROUND.

INDICATES TOP SLUG.

INDICATES BOTTOM SLUG.

INDICATES SINGLE SLUG.



ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.

K = THOUSAND M = MILLION

ALL CAPACITOR VALUES IN μfd UNLESS OTHERWISE SPECIFIED.

ALL VOLTAGES TAKEN FROM POINT INDICATED TO CHASSIS GROUND. NO SIGNAL APPLIED.

ALL VOLTAGES ±10%.

VOLTAGE READING TAKEN WITH 20,000 OHMS PER VOLTMETER.

INDICATES CHASSIS FEEDTHROUGH CAPACITOR.

INDICATES CONNECTION.

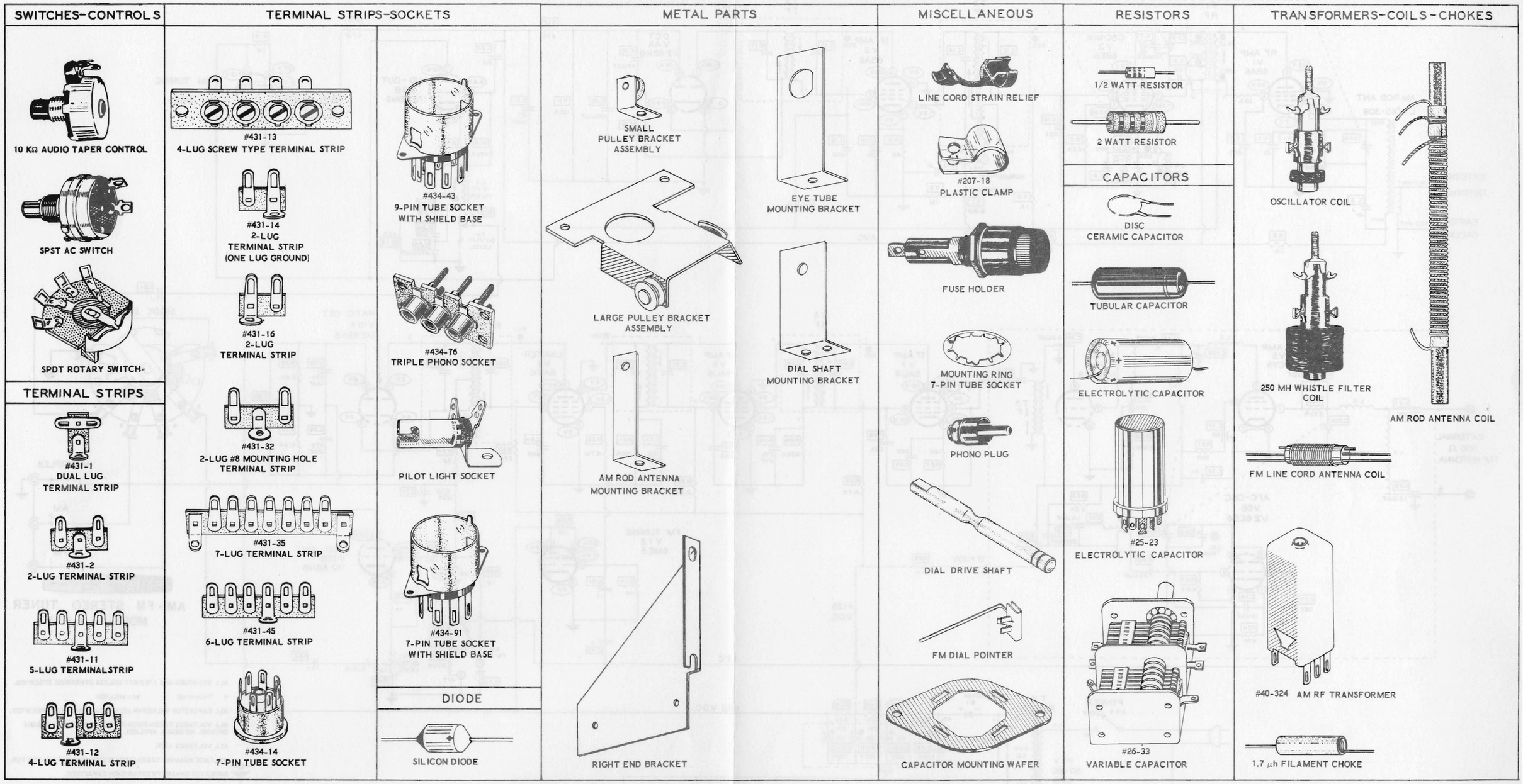
INDICATES NO CONNECTION.

INDICATES CHASSIS GROUND.

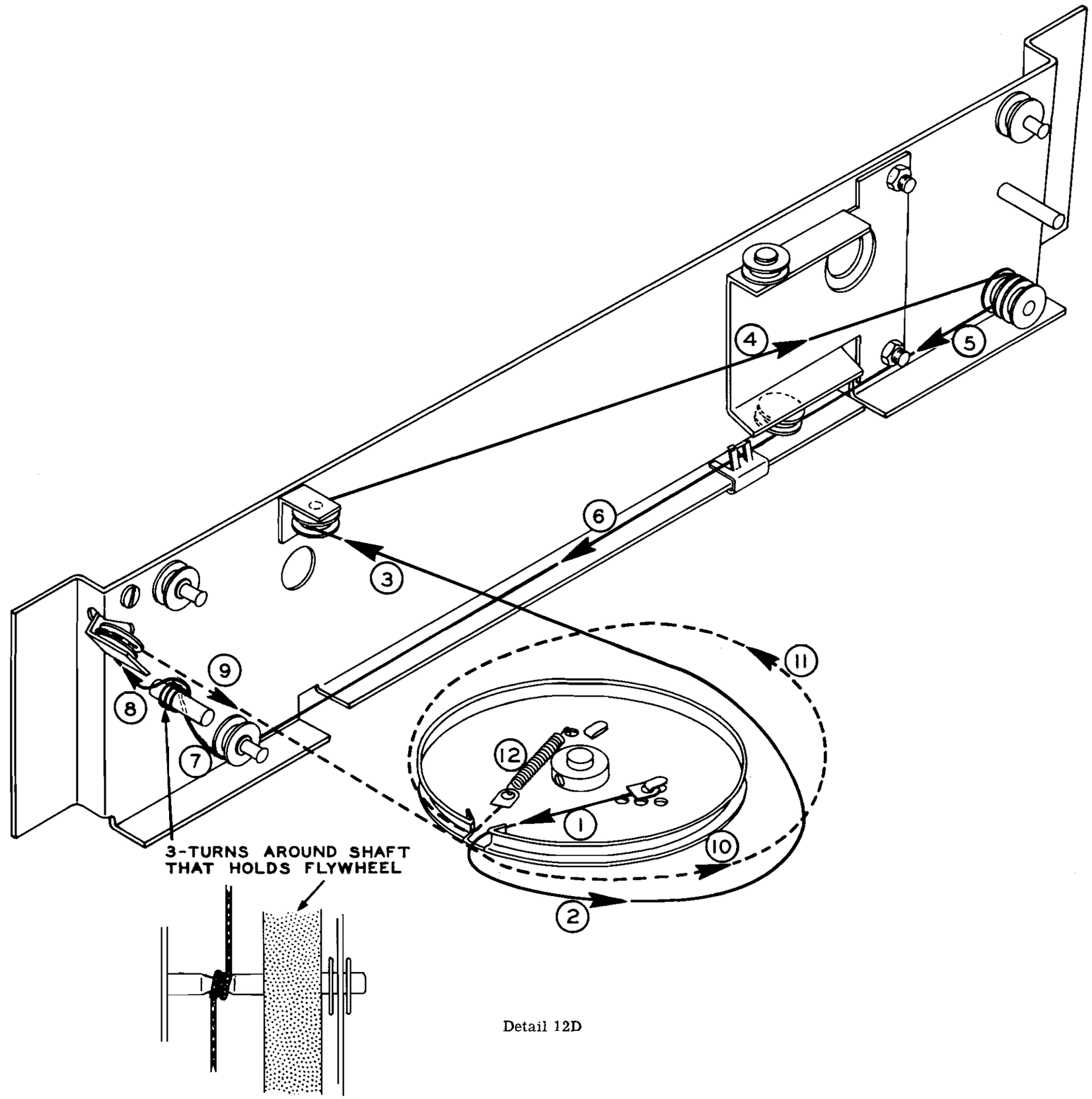
INDICATES TOP SLUG.

INDICATES BOTTOM SLUG.

INDICATES SINGLE SLUG.



PARTS PICTORIAL



Detail 12D

DIAL PULLEY PLATE

V11

EYE TUBE MOUNTING BRACKETS

6-32 SCREW

V12

6-32 SCREWS

#6 SOLDER LUG

CHASSIS

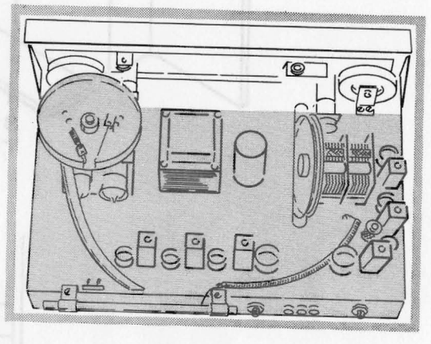
DIAL SHAFT MOUNTING BRACKET

#6 LOCKWASHER

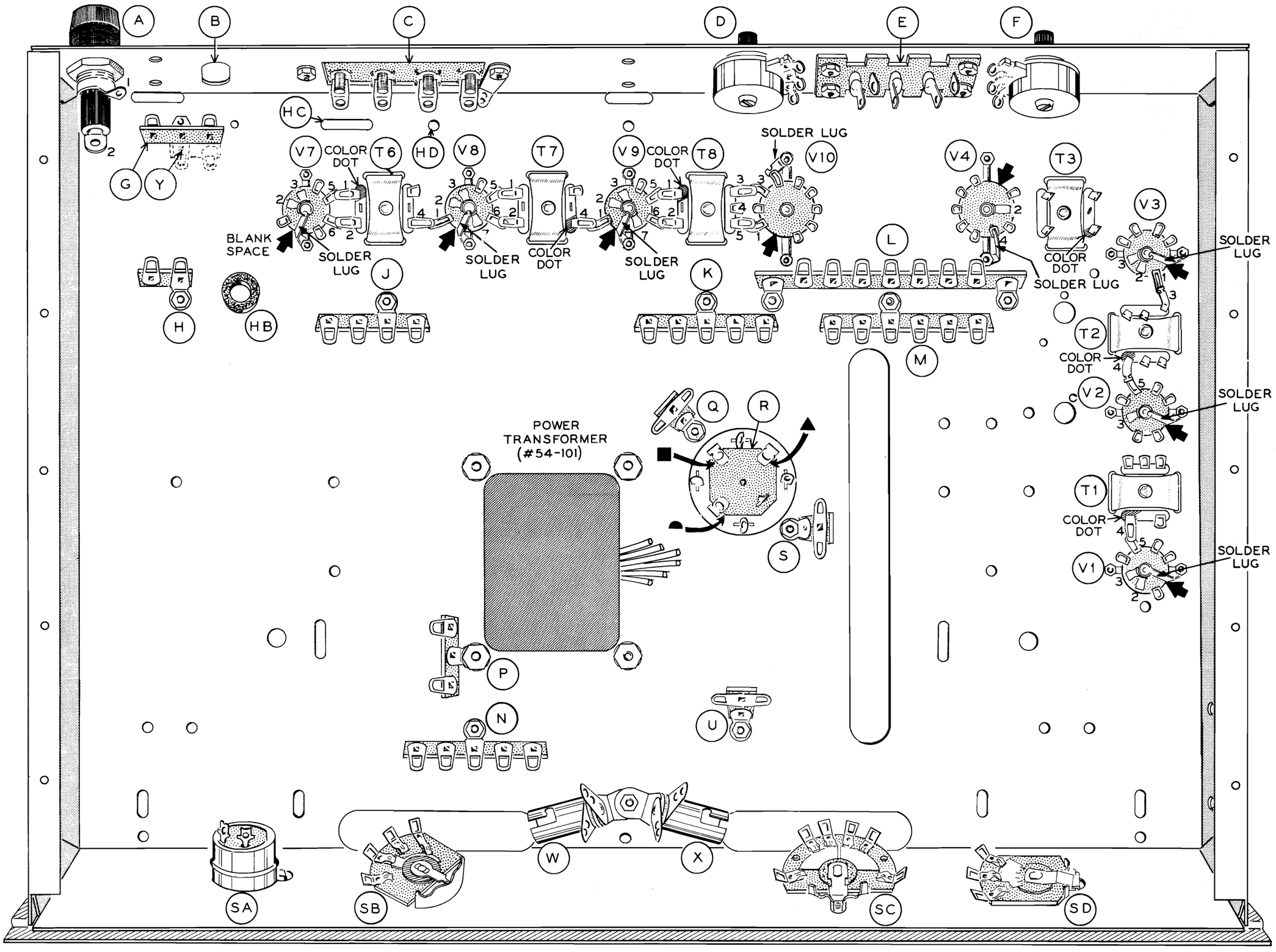
6-32 NUTS

#6 LOCKWASHER

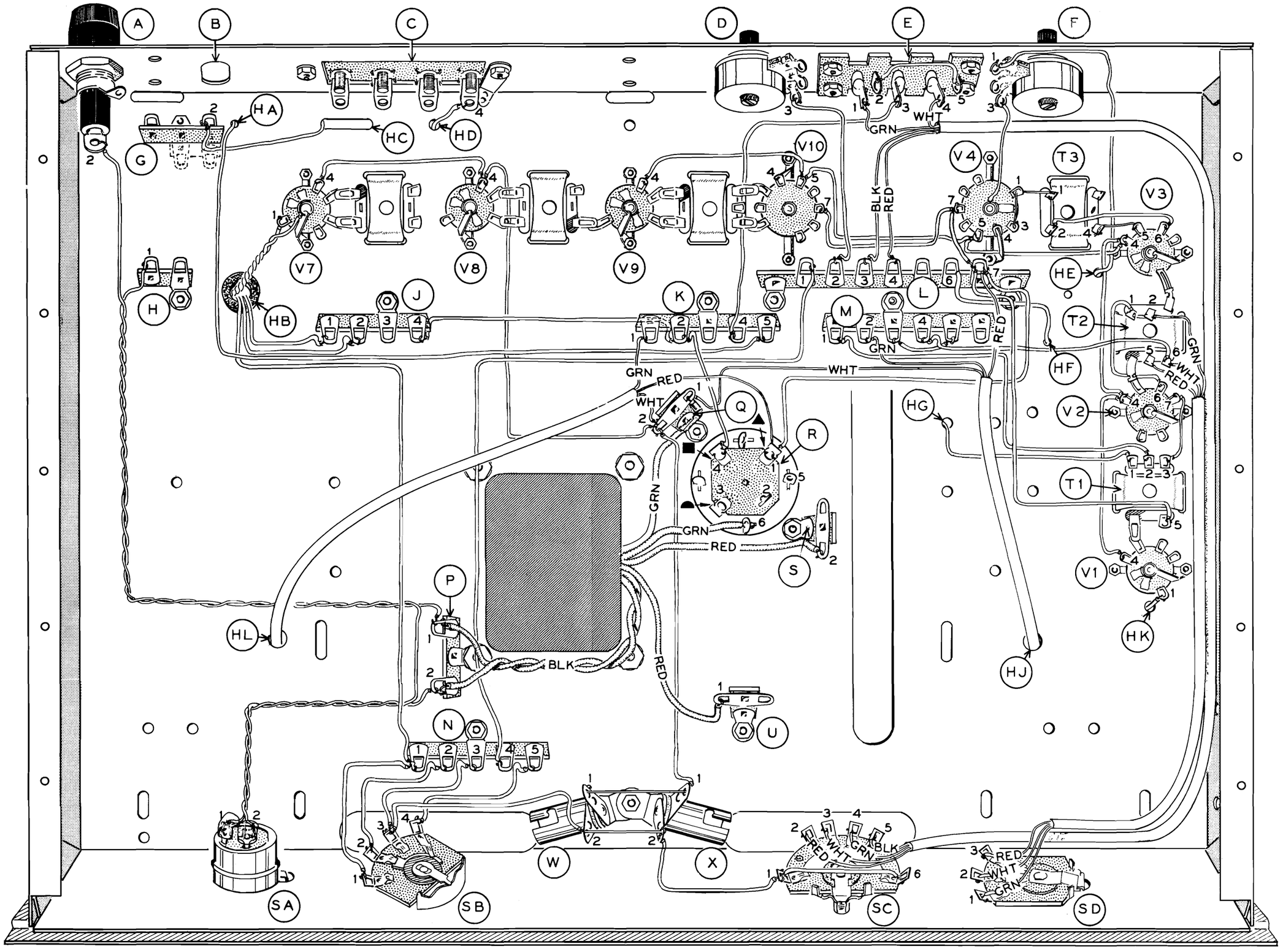
6-32 NUT



Pictorial 11


A
B
C
D
E
F
HC
HD
G
Y
V7
COLOR DOT
T6
V8
T7
V9
COLOR DOT
T8
SOLDER LUG
V10
V4
T3
V3
BLANK SPACE
SOLDER LUG
SOLDER LUG
COLOR DOT
SOLDER LUG
L
COLOR DOT
SOLDER LUG
SOLDER LUG
J
K
H
HB
M
T2
COLOR DOT
V2
SOLDER LUG
Q
R
POWER TRANSFORMER (#54-101)
S
T1
COLOR DOT
V1
SOLDER LUG
P
N
U
W
X
SA
SB
SC
SD

Pictorial 1

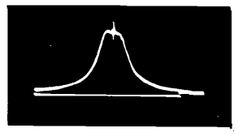
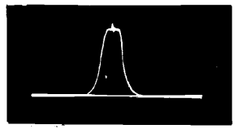
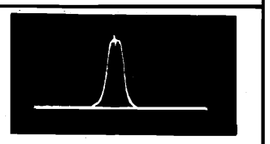
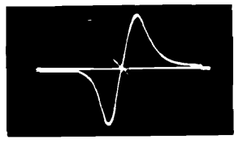
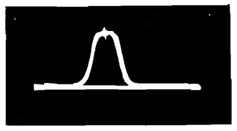

A
B
C
D
E
F
HA
HB
HC
HD
HE
HF
HG
HH
HJ
HK
HL
G
H
J
K
L
M
N
P
Q
R
S
T1
T2
T3
U
V1
V2
V3
V4
V7
V8
V9
V10
W
X
SA
SB
SC
SD
WHT
GRN
RED
BLK

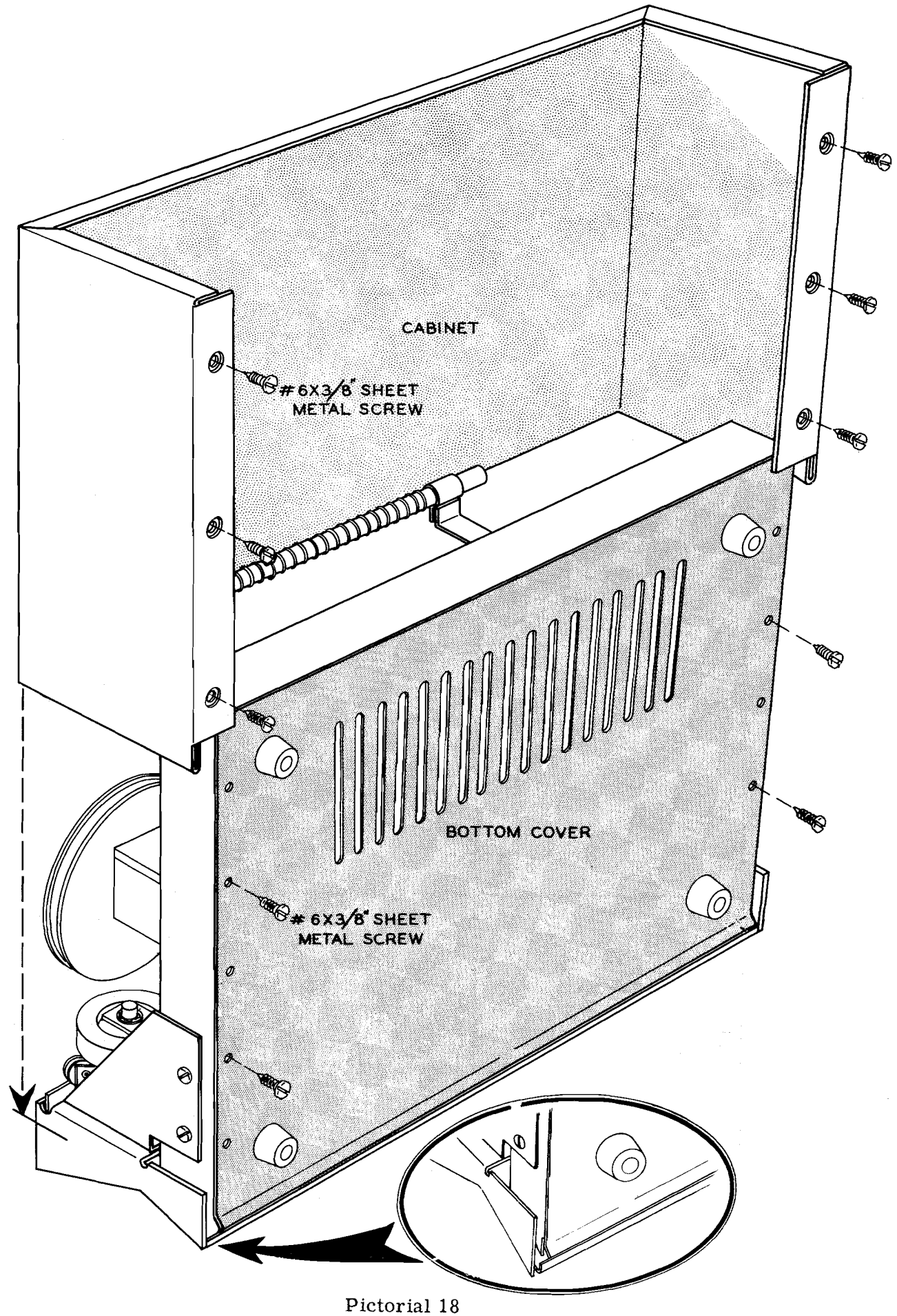
Pictorial 2

COMPLETE FM ALIGNMENT PROCEDURE

USING A SWEEP GENERATOR, MARKER GENERATOR AND OSCILLOSCOPE

Tuning Control - off station position
FM level control - full clockwise
AFC Switch - OFF

PREPARATION	SWEEP GENERATOR		OSCILLOSCOPE	ADJUST	
	Connect sweep generator	Sweep generator and marker generator frequency	To be connected	for maximum gain and bandwidth	for approximate response
Disconnect positive (+) lead of C60 from pin 2 of V10.	Through .01 μfd capacitor to Pin 1 of V9	10.7 mc	Across 6.8 KΩ resistor (R36) to center post (ground)	Bottom slug of T8	
	Through .01 μfd capacitor to Pin 1 of V8	10.7 mc		Top and bottom slugs of T7	
	Through .01 μfd capacitor to Pin 1 of V7	10.7 mc		Top and bottom slugs of T6	
	Through .01 μfd capacitor to Pin 1 of V9	10.7 mc	To audio output jack	Top slug of T8 for straightest center portion of curve and balanced plus (+) and minus (-) swing	
Reconnect (+) lead of C60. Tune the dial pointer to 98 mc.	To Antenna input with 240 Ω in series with hot lead (for 50 Ω generator Z)	Sweep generator -98 mc Marker generator - 10.7 mc	To pin 1 of V9 through 100 KΩ resistor Ground lead to V9 center post	Top and bottom slugs of T5 located on prewired front end	
Tune the dial pointer to 106 mc.		Sweep generator 106 mc Marker generator 106 mc		Adjust C39 located on top of prewired front end	



Pictorial 18