

HIGH FIDELITY FM TUNER

MODEL

**HFT-90**

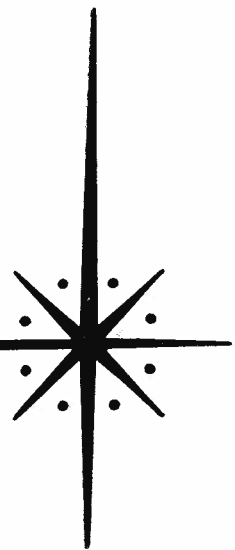


**EICO**

INSTRUCTION

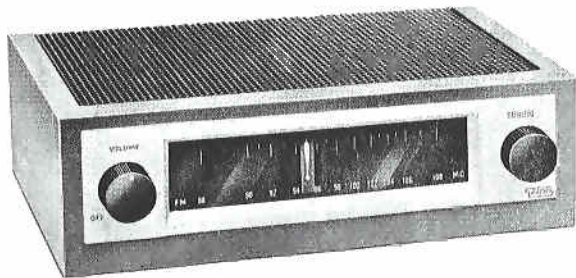
MANUAL

HFT 90-4



ELECTRONIC INSTRUMENT CO. INC.  
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**MODEL HFT 90 HIGH FIDELITY FM TUNER**

## general description

### GENERAL

Among the most advanced of the FM tuner designs both electrically and mechanically, the EICO HFT-90 FM Tuner kit is equal to or surpasses wired tuners up to three times the price. It is the first kit to include an entirely pre-wired and pre-aligned "front end" (housed and completely shielded in a solid aluminum-zinc casting). This "front end" not only provides extremely high sensitivity and low noise, but is also entirely stable and guaranteed drift-free. Through the use of the most advanced circuitry and temperature-compensated components, the need for AFC is completely eliminated and drift is less than 2 parts in 10,000 from cold start. This "front end" makes completely practical, even for a novice, the building of an FM tuner kit equal to really good factory-wired units.

Furthermore, the kit is supplied with the IF and Ratio Detector transformers pre-aligned in manufacture. Thus every tuned circuit in the tuner is pre-aligned and a completed tuner kit will give satisfactory reception without alignment providing that the indicated layout of components and wiring is followed.

### SPECIFICATIONS

**Sensitivity:** 1.5 uv for 20 db quieting; 2.5 uv for 30 db quieting; full limiting from 25 uv.

**Input:** 300 ohms balanced.

**Frequency Response:** Uniform from 20 to 20,000 cps  $\pm$  1 db

**IF Bandwidth:** 260 kc at 6 db points.

**Detector Characteristic:** Peak separation of 600 kc. Linear bandwidth of 400 kc. Broadband ratio detector preceded by stabilized limiter stage.

**Stability:** Maximum drift of 20 kc from cold start. Stable after approximately one minute.

**Radiation:** Complete shielding of oscillator circuit and tube in preassembled "front end" minimizes radiation.

The HFT-90 is the first kit, also to include the DM-70 traveling tuning eye which travels along the side-rule dial as a luminous "exclamation point" indicator, contracting at the exact center of each broadcast channel. Having a sensitivity over six times greater than other kit tuners and equaling the most expensive wired tuners, the HFT-90 provides excellent reception even in fringe areas. Other performance features include fly-wheel tuning, automatic gain control, stabilized low limiting threshold for excellent performance from weaker signals, broad-band ratio detector for improved capture ratio and easier tuning, full-wave rectifier and heavy-filtering, and very low distortion plus flat frequency response for superb audio quality.

The HFT-90 utilizes a low-silhouette construction, utilizing a horizontal chassis to permit proper layout and component separation necessary for long component life and stability. The important construction aids include simplified dial cord arrangement pre-wired tuning eye assembly. Extremely flexible design permits easy console installation with adaptability to panel thicknesses up to 3/8 inch. Optional cabinet may also be used in console installation to provide additional shielding.

**Output:** Two provided; cathode follower and multiplex. Cathode follower permits use of up to 200 ft. of connecting cable. For 10 uv input with 75 kc deviation, an audio output 1.0 volt is obtained.

**Hum:** 60 db below 1 volt.

**Controls:** Tuning, Volume/Off.

**Tubes:** 1- ECC85/6AQ8 grounded grid r-f amplifier and reflex converter; 2- 6AU6 IF amplifiers; 1- 6AU6 IF amplifier/limiter; 1- 6AL5 dual diode detector; 1- DM70 tuning indicator; 1- 6C4 cathode follower output; 1- 6X4 full wave rectifier.

**Power:** 110-125 vac, 60 cps; 40 watts drain.

**Size:** HWD: 3 5/8", 12", 8 1/4"

**Shipping Weight:** 10 lbs.

## mechanical installation

a) **HEAT DISSIPATION (VENTILATION):** In common with other electronic equipment, the HFT-90 produces considerable heat in normal operation. Unless continuous and adequate air flow is obtained around the heat producing elements, these elements will over-heat and their useful life will be greatly reduced.

Adequate ventilation will be provided if the tuner is installed in an open-back console provided that the top of the tuner is spaced at least two inches below any shelf mounted above it. If the cabinet is enclosed at the rear, provide several large holes or slots as low down and as high up in the cabinet back as possible. As an alternative, holes may be provided in the sides, bottom, or top of the cabinet. The important thing to remember is that effective ventilation requires provision for cool air to enter at the bottom and hot air to leave at the top.

If the tuner is not installed in a console, it may be situated on an open surface or on a shelf of a bookcase. Four rubber feet are also provided so that the tuner will not mar the surface of furniture on which it is placed.

If it is considered essential, because of space limitations to "stack" a matching amplifier such as the HF-12 with the tuner (not recommended for reasons described above), place the amplifier above the tuner since the amplifier produces substantially more heat and requires more ventilation.

b) **POSITION:** The specified absence of tuning drift can be fully assured only if the tuner is placed in an approximately horizontal position, which is therefore strongly recommended.

c) **EASY ACCESS TO CONTROLS:** Mount the tuner at a height which will permit easy manipulation of the controls. Amplifier controls should be located nearby.

d) **ACCESSABILITY TO PARTS:** Tubes are the most frequently replaced items in electronic equipment. If the tuner is installed in a console, sufficient space should be allotted to reach and remove any tube in the tuner. Furthermore, antenna and output terminals of the amplifier should be accessible to permit easy interchanging of system components for comparison. If antennas are strung around the back of the console in which the tuner is installed, arrange them so they will not interfere with access to the tuner.

d) **ACOUSTICAL ISOLATION:** If tuner and speaker are installed in the same cabinet (not recommended), provide sufficient separation to minimize mechanical speaker vibration reaching the tuner which may result in microphonics and howling. The minimum separation is about one foot. A baffle, usually the tuner mounting base, should be present between tuner and speaker. In extreme cases, it may be necessary to mount the tuner on sponge rubber pads.

## CONSOLE MOUNTING

**NOTE:** The tuner may be installed in a console with or without "cover", consisting of two side pieces and a perforated slide-out top. Special side brackets are required and supplied for assembly purposes when the "cover" is not used. We recommend the use of the "cover" even in console mounting for the additional shielding and protection it provides. The thickness of the console panel may be up to 3/8".

a) Operations on console front panel preliminary to amplifier mounting: (1) Tape the panel template provided to the face of the console so that the top of the mounting surface line on the template is level with the top of the amplifier mounting shelf. (2) Use an awl or a nail to pierce the centers of the two 3/8" diameter holes for the controls, and the two small holes for mounting the control plate, to transfer their locations to the console panel beneath. (3) Use an awl or nail to mark the four corners of the rectangular tuning dial cut-out. (4) Remove the panel template and draw the dial cut-out with a pencil. (5) Drill only the holes for the panel controls (the two small holes which have been marked are for wood screws). (6) Now make the dial cut-out, which must be done accurately. It is recommended that the rough cut-out be made slightly undersize and then finished accurately and smoothly with a file. Then use the file to make a smoothly finished 45 degrees bevel on the lower edge of the cut-out sloping downward from the outside surface to the inside surface. The beveled surface must be smooth so that the wire going to the tuning eye socket will not catch or otherwise be obstructed when the tuning eye is moved along the dial.

b) Tuner mounting in console: (1) Pull off the control knobs. (2) Remove the four screws that fasten the bezel to the side pieces (or the special brackets if the tuner is supplied without "cover" and remove the bezel, which is not used in console mounting. (3) Remove the control plate, which is attached to the bezel by two screws and nuts. (These may be discarded since they are unsuitable for attaching the control plate to the console panel and two 4 X 3/8 wood screws have been supplied for this purpose.) (4) Fasten the control plate to the console panel with the 2 #4 X 3/8 wood screws. (5) If the rubber feet have been inserted in the bottom plate, remove them. (They may be pried out with a thin screwdriver.) (6) Place the unit on the mounting shelf and slide it forward until the front surface of the tuning dial rests against the turned-in edge of the dial cut-out in the control plate and the control shafts are centered in the holes. (7) With a sharp pencil, draw the outline of the side and rear bottom edges on the chassis shelf. As the bottom plate falls short of the full width by 3/16" on each side, draw new side edge lines 3/16" inside the original side edge lines. (8) Now take the chassis off the shelf. (9) Remove the 6 screws which fasten the bottom plate to the side pieces (or the special

side brackets). (10) Place the bottom plate exactly in the outline drawn on the shelf and mark the position of the center hole on the left side and the center hole on the right side. (11) Remove the bottom plate and drill each of the marked holes on the shelf to a diameter of 1/4". (12) Re-fasten the bottom plate to the side pieces (or the special side brackets), with the four of the six #8 X 3/8 screws previously removed, using the two holes at the rear and the two holes at the front of the side pieces (or special brackets).

(13) Replace the chassis on the shelf, positioning it exactly in the outline previously drawn, and push on the knobs. The knob with the indicator dot is for the VOLUME/OFF control. Make sure this dot agrees with the control position. (14) From the bottom side of the shelf insert a #8 X 1" screw, with a 1/2" flat washer against the head, through both the left and right side center holes. These screws engage the stamped nut over each hole on the side piece flanges (or special side brackets) and when tightened secure the chassis to the shelf.

## electrical installation

### FM ANTENNA

Any VHF 300 ohm TV antenna will serve very well as an antenna for the tuner. If the antenna is also being used with a tv set, it is advisable to use an inexpensive two-set coupler. If an antenna is to be installed for FM reception only, a 300 ohm FM antenna composed of a folded dipole and reflector is recommended. The best reception in extreme fringe areas will be achieved with an FM yagi antenna properly oriented for maximum sensitivity in the direction of the broadcasting station. The antenna in all cases is connected to the ANT. INPUT terminals on the rear chassis apron. Good results may be obtained inexpensively with an indoor dipole antenna fashioned from 300 ohm twin lead as shown below. Note that the length of the lead to the ANT. INPUT terminals is not critical. Any convenient length may be used.

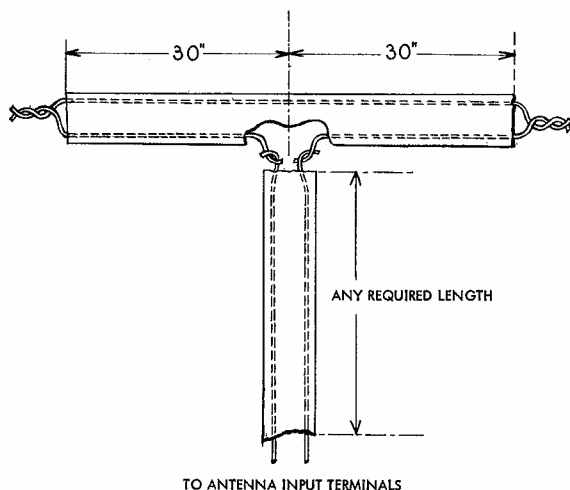


Fig. 1

### POWER

Plug the line cord into any outlet supplying 117 volts, 60 cycle AC power. Variation of the line voltage from 105 to 125 volts is not critical, but it must be 50 or 60 cycles AC. This outlet may be a switched convenience outlet on an amplifier having controls and switching facilities if the convenience of having power to the tuner controlled by the ON-OFF switch on the amplifier is desired. On the other hand, if the tuner is being operated with a power amplifier having no controls itself, plug the line cord of the power amplifier into the convenience outlet at the back of the tuner (so that the amplifier will be turned on and off with the tuner) and plug the tuner line cord into a wall outlet.

### AUDIO OUTPUT

A jack marked "AUDIO OUTPUT" will be found on the rear chassis apron. A low-capacity shielded cable of the shortest practical length possible should be used to connect this jack to the TUNER input jack of the amplifier. Such a cable with connectors may be purchased at an electrical supply store or made up from the desired length of cable and two RCA male phono connectors.

### MULTIPLEX OUTPUT

A jack marked "MULTIPLEX OUTPUT" will be found on the rear chassis apron. At this output, the audio signal before de-emphasis is obtainable. This jack is provided for use if and when multiplex FM transmission for stereophonic FM broadcasting becomes a fact. At such time, EICO and other manufacturers will make available multiplex reception equipment which will make use of this output.

## operation

The HFT-90 has only two controls, the TUNING control at the right which selects the station and the VOLUME/OFF control at the left which turns the tuner on and off and permits control of the audio output level (or volume). The traveling tuning-eye indicator shows at which frequency (or station) the tuner is set and also acts as a pilot. To turn the tuner on, rotate the VOLUME control clockwise from the AC OFF position. Allow a one minute warmup for

completely stable operation and then use the tuning control to set the tuner to the desired station. Correct tuning of each broadcast channel is indicated by maximum contraction of the luminous "exclamation point". A setting for the tuner volume control should be found and used consistently which produces the same average sound level with a given setting of the amplifier level and loudness controls that is obtained on phonograph from an average recording.

# **maintenance**

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## **OPERATING NOTES**

Your tuner should require little service except for normal tube replacement. No substitutions for tube types used in this tuner is permissible. All tube types used are distributed nationally, but replacements can be obtained directly from EICO if desired.

If dial calibration seems to be in error, it can always be corrected by re-setting the position of the tuning-eye indicator carriage on the dial cord.

When connected properly, the hum originating in your HFT-90 tuner is inaudible. If the hum level is high due to defective components, alignment or installation, please check the following.

1. Check tubes V1 through V7 for excessive heater-cathode leakage or grid-cathode short.
2. Check C20 for value of capacity and leakage.
3. Check the dress of all the leads connected to the grids of all the tubes. Dress away from AC filament and power lines. Exercise special precautions with grid lead (pin 6) of V6.
4. Check alignment of T4.
5. Reverse AC plug in receptacle to determine position for minimum hum.
6. Run wire from tuner to amplifier chassis. Connect chassis of amplifier to ground (water or steam pipe).

To facilitate servicing, a VOLTAGE CHART and a RESISTANCE CHART is also provided as an aid in locating defective components.

## **ALIGNMENT PROCEDURE**

1. Plug line cord into 117VAC, 60 cycle outlet. Rotate VOLUME control clockwise from AC OFF to turn tuner on and set at maximum clockwise position for full volume. Allow full 5 minutes warm-up time before starting alignment. Sweep generators and signal generators should be allowed to warm up a full half-hour before use to insure against drift during alignment.

2. Rotate TUNING control clockwise until tuning eye indicator is set at extreme right-hand end of dial (108 mc).

3. Check the voltages as given in the voltage chart using either a VTVM or a 20,000 ohms/volt VOM. All voltages are checked with a line voltage of 117VAC. If line voltage is actually 117VAC, all voltages should measure as stated within  $\pm 15\%$ . If line voltage is above or below 117VAC, then the discrepancy must be considered in interpreting the permissible variation in measured voltages. Note that voltages are measured under no-signal conditions. If voltages check out as given, proceed with alignment. NOTE: The visual alignment method, requiring a sweep generator and an oscilloscope, is of course preferred. If this equipment is not available however, very good results will normally be obtained by the simple signal generator method described also. Please read the whole procedure through very carefully before starting, including the IMPORTANT NOTE regarding the "front-end" (RF Tuning Assembly). Under no condition tamper with the setting of the RF SENSITIVITY TRIMMER or the OSCILLATOR TRACKING TRIMMER in the "front-end". Do not tamper with a seemingly defective "front-end" unit. Return it to EICO for repair or replacement.

## **SERVICE**

If trouble develops in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. If desired you may return the instrument to our factory where it will be placed in operating condition for \$7.50 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, New York. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.

FM VISUAL ALIGNMENT PROCEDURES FOR HFT-90 FM TUNER

EQUIPMENT REQUIRED: SWEEP GENERATOR & MARKER OSCILLATOR, OSCILLOSCOPE & VTVM or 20,000  $\Omega/V$  VOM




CONNECT SWEEP GEN.	SET SWEEP GEN. CENTER FREQ. ( $f_0$ ) & MIN. SINE SWEEP TO	SET MARKER FREQ. TO	TUNER DIAL SETTING	CONNECT SCOPE & VTVM LEADS TO	ADJUST	REMARKS
Ground lead to chassis close to V4 pin 1. Hot lead to V4 pin 1 (pt. A)	10.7 mc ( $f_0$ ) 600 kc sweep	10.7 mc	108 mc	point $\Delta$ and ground	T4 pri. (bottom) for symmetry of "S" curve. T4 sec. (top) for centering $f_0$ marker	set sweep gen. output for approx. 0.3 rms ac volt out from Pt. X to chassis ground
Ground lead to chassis close to V3 pin 1. Hot lead to V3 pin 1 (pt. B)	10.7 mc ( $f_0$ ) 260 kc sweep	10.7 mc	108 mc	point $\Delta$ and ground	T3 pri. (bottom) and T3 sec. (top) for symmetry of IF response curve about $f_0$ marker and max. output.	a) Set sweep gen. output for approx. 0.4 rms ac volt out from pt. Y to chassis gnd. b) Always adjust for max. output with symmetry about $f_0$ marker. Sacrifice additional output if it entails loss of symmetry.
Ground lead to chassis close to V2 pin 1. Hot lead to V2 pin 1 (pt. C)	10.7 mc ( $f_0$ ) 260 kc sweep	10.7 mc	108 mc	point $\Delta$ and ground	T2 pri. (bottom) and T2 sec. (top) for symmetry of response curve about $f_0$ marker and max. output	a) Set sweep gen. output for approx. 0.4 rms ac volt from out from pt. Y to chassis ground b) Always adjust for max. output with symmetry about $f_0$ marker. Sacrifice additional output if it entails loss of symmetry.

IMPORTANT NOTE: "Front-end" is factory pre-aligned and no adjustment facility thereon should be tampered with. If there is definite indication that the "front-end" is misaligned, check the positions of the cores in IF transformer T1 located inside the "front-end". The T1 primary core can be seen on the bottom chassis surface of the "front-end" and the secondary core on the top chassis surface of the "front-end" (see Figs. 2 & 3) page 7. The T1 primary core should protrude approximately 1/32" from the coil form; the T2 secondary core should be neither "in" nor "out" of the coil form but flush with it. If these conditions do not exist closely as described, then it is permissible to adjust one or both of the cores to the described condition. Please note that the T1 core adjustments will normally have already been made at the factory. If a highly skilled, properly equipped person feels it necessary to make an absolutely exact adjustment of the T1 cores, he may do so on his own responsibility as described below. (EICO does not feel such an adjustment is normally necessary and takes no responsibility for any damage done to the "front-end" if this method of adjustment is undertaken.)

CONNECT SWEEP GEN.	SET SWEEP GEN. CENTER FREQ. ( $f_0$ ) & MIN. SINE SWEEP TO	SET MARKER FREQ. TO	TUNER DIAL SETTING	CONNECT SCOPE & VTVM LEADS TO	ADJUST	REMARKS
Ground lead to chassis Hot lead to V1 pin 2 thru 5 mmf cap (short leads).	10.7 mc 260 kc sweep	10.7 mc	108 mc	point $\Delta$ and ground	T1 pri. (bottom) for symmetry; T1 sec. (top) for max. output	It is necessary to remove bottom plate of "front-end" in this operation to solder 5 mmf cap to V1 pin 2. Use small pin-point soldering iron only to avoid overheating components.

IF ALIGNMENT USING AM SIGNAL GENERATOR AND VTVM OR 20,000Ω/V VOM

EQUIPMENT REQUIRED: RF SIGNAL GENERATOR with or without amplitude modulation, VTVM or 20,000Ω/V VOM, OSCILLOSCOPE (optional)

CONNECT SIGNAL GENERATOR	TYPE OF SIGNAL	SET SIG. GEN. FREQ. TO	SET FM TUNER DIAL TO	CONNECT VTVM/VOM LEADS	ADJUST	REMARKS
Ground lead to chassis close to V4 pin 1. Hot lead to V4 pin 1 (pt.  )	unmodulated	10.7 mc	108 mc	across C13 (observe polarity)	T4 pri. core (bottom) for max. dc voltage output.	Allow sig. gen. to warm up 1/2 hour before use. If sig. gen. is inexpensive type and/or frequency calibration is doubtful, shift frequency setting above and below 10.7 mc marking on dial to find setting at which the greatest maximum output across C13 is obtained with the T4 pri. (bottom) core adjustment. The sig. gen. frequency setting found in this manner should be taken as 10.7 mc throughout the entire alignment procedure. Note that if a small error in the intermediate frequency used for alignment is maintained constantly throughout the entire alignment procedure, performance will not be greatly affected except for a small shift in the dial calibration. If, however, there is any drift or change in the sig. gen. frequency setting from the time of the Ratio detector transformer alignment to the time of the IF transformers alignment, there will be a substantial increase in distortion as well as a loss of sensitivity.
Ground lead to chassis close to V4 pin 1. Hot lead to V4 pin 1 (pt.  )	unmodulated or amplitude modulated	10.7 mc	108 mc	pt.  and ground	T4 sec. core (top) for a zero indication.	a) Set sig. gen. output to maximum (50 to 100 uv). b) If vtvm is used, set it to zero center on the 10 to 15 volts dc range. c) If 20,000Ω/V VOM is used, set the range selector at the 10 or 15 volts dc range and use the meter movement zero adjust screw to set the pointer off zero to the first major scale marking. The purpose of this is to permit observation of a negative indication on the meter. Reset the meter needle to the zero mark on the scale after this alignment step is completed. d) If an amplitude-modulated signal is used and an oscilloscope is connected to the audio output jack of the tuner, a finer adjustment can be made by setting the T4 sec. slug for minimum audio frequency output, corresponding to maximum a-m rejection.

RF SIGNAL GENERATOR ALIGNMENT METHOD  
continued on page 7 of INSTRUCTION BOOK.

## GENERAL INSTRUCTIONS

The section of the manual beginning with this page is the CONSTRUCTION section. All pages in this section have page numbers followed by "C" (1C, 2C, etc.). The INSTRUCTION section resumes on the pages following the CONSTRUCTION section. Note that the CONSTRUCTION section is located centrally in the book and may be removed without disrupting the INSTRUCTION section that both precedes it and follows it.

Care taken in the construction of this instrument will reward the constructor with many years of satisfactory service and greater confidence in his instrument. We urge you to not rush the construction, but to take all the time necessary for proper assembly and wiring.

Furthermore, we urge strongly that you follow the wire and parts layout shown in the pictorial diagrams as closely as possible. Very often wires are placed as shown for a good reason, and certainly the appearance of the completed instrument will be improved and the difficulty of finding a wiring error will be reduced by the following the wire and parts layout shown.

UNPACKING THE KIT: Unpack the kit carefully and check each part against the parts list including those parts that are mounted to the chassis. If you have trouble identifying any parts refer to the pictorial diagrams or the color code chart.

You will find that the value of a component will vary within the allowable circuit tolerance. For example, the  $4.7K\Omega$ ,  $\pm 10\%$  resistor may measure anywhere between  $4.2K\Omega$  and  $5.2K\Omega$ . Tolerances on paper capacitors are substantially greater, and the tolerance for electrolytics is usually  $+100\%$  and  $-50\%$ .

CONSTRUCTION HINTS: USE THE BEST GRADE OF ROSIN CORE SOLDER ONLY, preferably one containing the new activated fluxes such as Kester "Resin-Five", Ersin "Multicore" or similar types. UNDER NO CIRCUMSTANCES USE ACID CORE SOLDER OR ACID FLUX since acid flux can cause serious corrosion. Before soldering make a certain of a good mechanical connection. Use a clean, freshly tinned soldering iron, no smaller than 100 watts, and place the solder on the joint (not on the iron) so that the solder is melted by the heat from the joint itself. Do not remove the soldering iron until the solder flows and check to see that the resulting joint is smooth and shiny when the solder has cooled. There are two extremes to be avoided; too little heat and too much heat. If too little heat is supplied, the joint will appear pitted and grey, indicating a rosin joint which is unsatisfactory. On the other hand, if too much heat is applied to a joint, the parts connected to it may either change value, lose their protective coating, or break down. If you are soldering close to a part, hold the lead between the part and the joint being sol-

dered with the tip of a pair of longnose pliers. The pliers will conduct the heat away and prevent the component from being unduly overheated. If for any reason it is necessary to resolder a joint, be sure to use new solder.

It should also be noted that the leads on resistors, capacitors, and transformers are often longer than required. These leads should be trimmed to the proper length when necessary. Do not cut any lead until you have determined the required length when the lead is routed as shown in the diagrams.

BASIC TOOLS REQUIRED: These basic tools are required for the construction of the amplifier.

1. Screwdriver -  $3/16"$  to  $1/4"$  blade
2. Screwdriver -  $1/8"$  blade
3. Longnose pliers - 5 or 6"
4. Diagonal cutters
5. Soldering iron (100 watts), or soldergun, or pencil iron (35 watts)
6. Gas pliers
7. High quality rosin or equivalent synthetic flux core solder. Do not use acid or paste flux under any circumstances.

A set of spintites and a wire stripper are also very useful supplementary tools.

PARTS IDENTIFICATION: Please note that very many of the parts for which color coding is given may not be color coded, but have their values and ratings printed. The letter K is a multiplier ( $\times 1000$ ) and on resistors or capacitors indicates that the printed numerical value must be multiplied by one thousand to obtain the value in ohms or micro-micro farads respectively. Note also that one microfarad (mf) is equal to one million; micro-microfarads (mmf). To aid in rapid identification, keep in mind that 5%, 10%, and 20% resistors are color coded whereas 1% resistor have their values printed; also that molded tubular capacitors may or may not be color coded, whereas disc capacitors and electrolytics will always have their values printed. Please note the following relationships between the units used to express resistance or capacity.

1,000,000 ohms ( $\Omega$ ) = 1000 kilohms ( $K\Omega$ ) = 1 megohm ( $M\Omega$ )  
1,000,000 micro-micro farads (mmf) = 1 micro farads (mf)

CONSTRUCTION PROCEDURE: The complete step-by-step mounting and wiring procedure follows. To keep the drawings uncrowded, unnecessary repetition of mounting or wiring details may be omitted. Note: The abbreviation (C) means connect but do not solder (until other leads have been connected). The abbreviation (S) means connect and solder. Bend the ground lug tabs on the sockets toward the chassis to prevent accidental shorting to the socket pins.



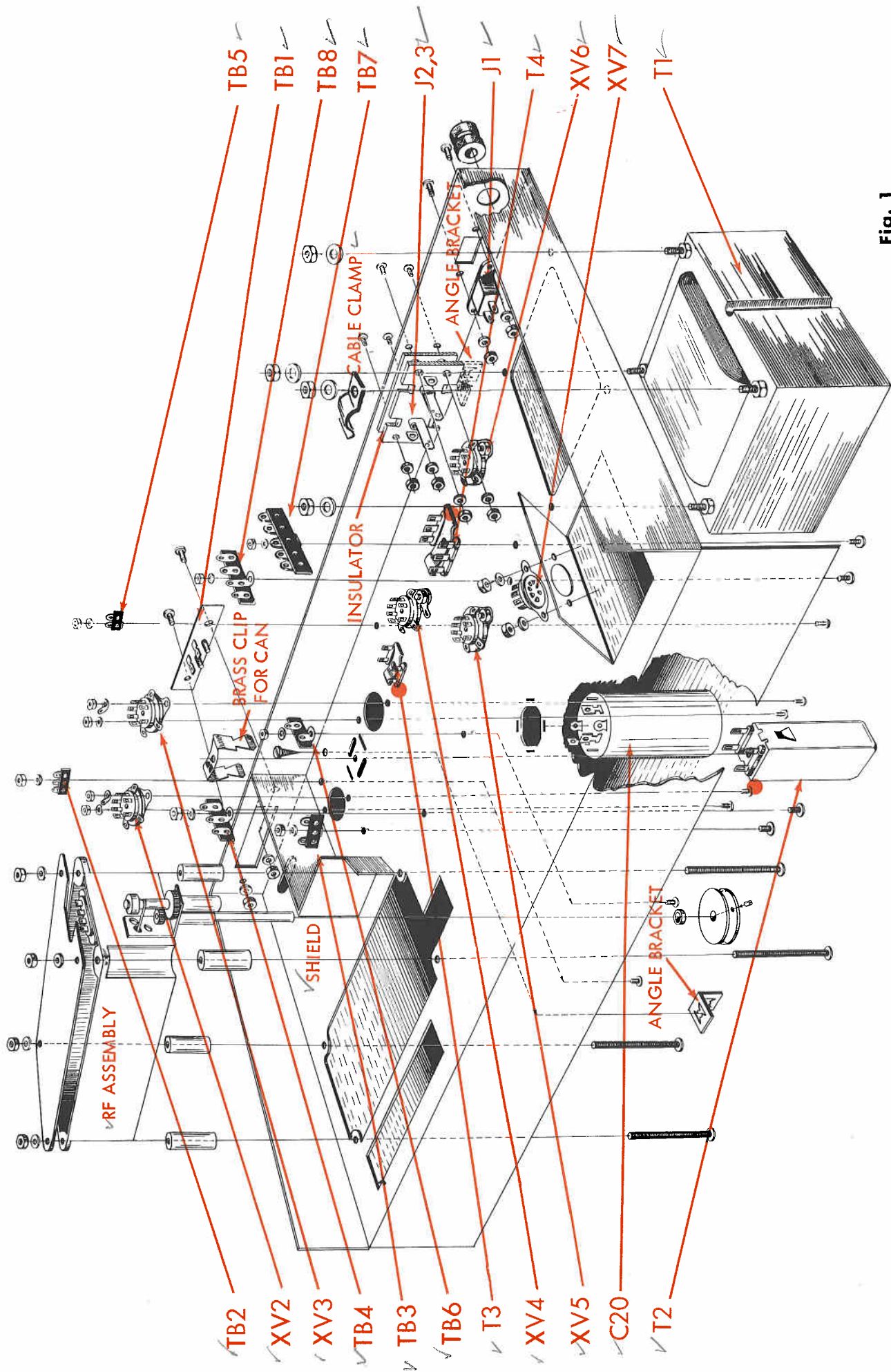


Fig. 1

## MOUNTING INSTRUCTIONS

1. (✓) Fig. 1. Mount the power transformer, T1, as shown. Use 4 #8 lockwashers and 4 #8-32 hex nuts. Position the transformer so that the black leads are towards the rear of the chassis. When the leads on the transformer are wired, pay particular attention to the color of the lead and not to the exact physical placement on drawing. Position cable clamp as shown.
2. (✓) Fig. 1. Mount electrolytic can capacitor, C20, as shown. Note direction in Fig. 3. Twist all four tabs about 1/4 turn. Do not twist too much or the tabs will shear off. Solder one tab to chassis to assure a good ground contact.
3. (✓) Fig. 1. Mount 7 pin miniature tube socket, XV7, as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts. (See Fig. 3)
4. (✓) Fig. 1. Mount 7 pin miniature tube sockets, XV2, XV3 and XV4, as shown. Use two #4-40 screws, one #4 lockwasher and two #4-40 hex nuts. Mount one #4 ground lug under one nut of each socket as shown.
5. (✓) Fig. 1. Mount 7 pin miniature tube socket, XV5 and XV6, as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.
6. (✓) Fig. 1. Mount the rectangular IF cans, T2, T3, and the rectangular ratio detector can, T4, as shown. Use special brass clip provided to hold each can. Position the cans so that the color dot (terminal 1) is as shown on Fig. 3. T2 - 34600, T3 - 34601, T4 - 34602. Each can is to be mounted using the following procedure. Orient the can as shown in figure 3. Push the plastic at the bottom of the can (in which the solder lugs are mounted) through the longer two of the four elongated slits (which surround the round hole). When this is done, the can stands on the top of the chassis. From the bottom of the chassis, insert the brass spring clip through the two remaining elongated slits, by spreading the clip apart slightly. Next, push one side of the clip up far enough so that it will catch in the "Y" shaped hole at the side of the can. Hold the can firmly against the top of the chassis with one hand. With the index finger of the other hand, working from the bottom of the chassis, push the clip up until it "clicks" into the remaining "Y" shaped hole in the other side of the can. Repeat this for each of the three cans.
7. (✓) Fig. 1. Mount convenience outlet, J1, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.
8. (✓) Fig. 1. Mount dual output jack, J2, 3, as shown. Mount the bakelite insulator between the jack and the chassis. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts on each.
9. (✓) Fig. 1. Mount the shield in the position as shown. Twist the tabs about 1/4 turn. Do not twist too much or the tabs will shear off. Solder one tab to chassis to assure a good ground contact.
10. (✓) Fig. 1. Mount two screw terminal board, TBI, as shown. Use two #6-32 screws, two #6 lockwashers, and two #6-32 hex nuts. Mount the shield under one of the lockwashers as shown.
11. (✓) Fig. 1. Mount two post with ground terminal board, TB2; two post terminal board, TB3; two post with ground terminal board, TB4; one post left with ground, terminal board, TB5; one post right terminal board, TB6; four post with ground terminal board, TB7; and three post two right with ground terminal board, TB8, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut on each.
12. (✓) Fig. 1. Mount the two angle brackets on the top, near the rear of the chassis as shown. Use one #8 self tapping screw on each.
13. (✓) Fig. 1. Mount the RF assembly as shown. Use four #6-32 x 1 1/8" screws, four 11/16" aluminum spacers, four #6 lockwashers and four #6-32 hex nuts. Before you place the RF assembly cover on the unit, be sure that the coaxial cable is passed thru the notch provided. Be extremely careful not to disturb any of the wires or components inside the assembly.
14. (✓) Fig. 1. Mount the 3/8" rubber grommet in the hole provided on the rear flange.

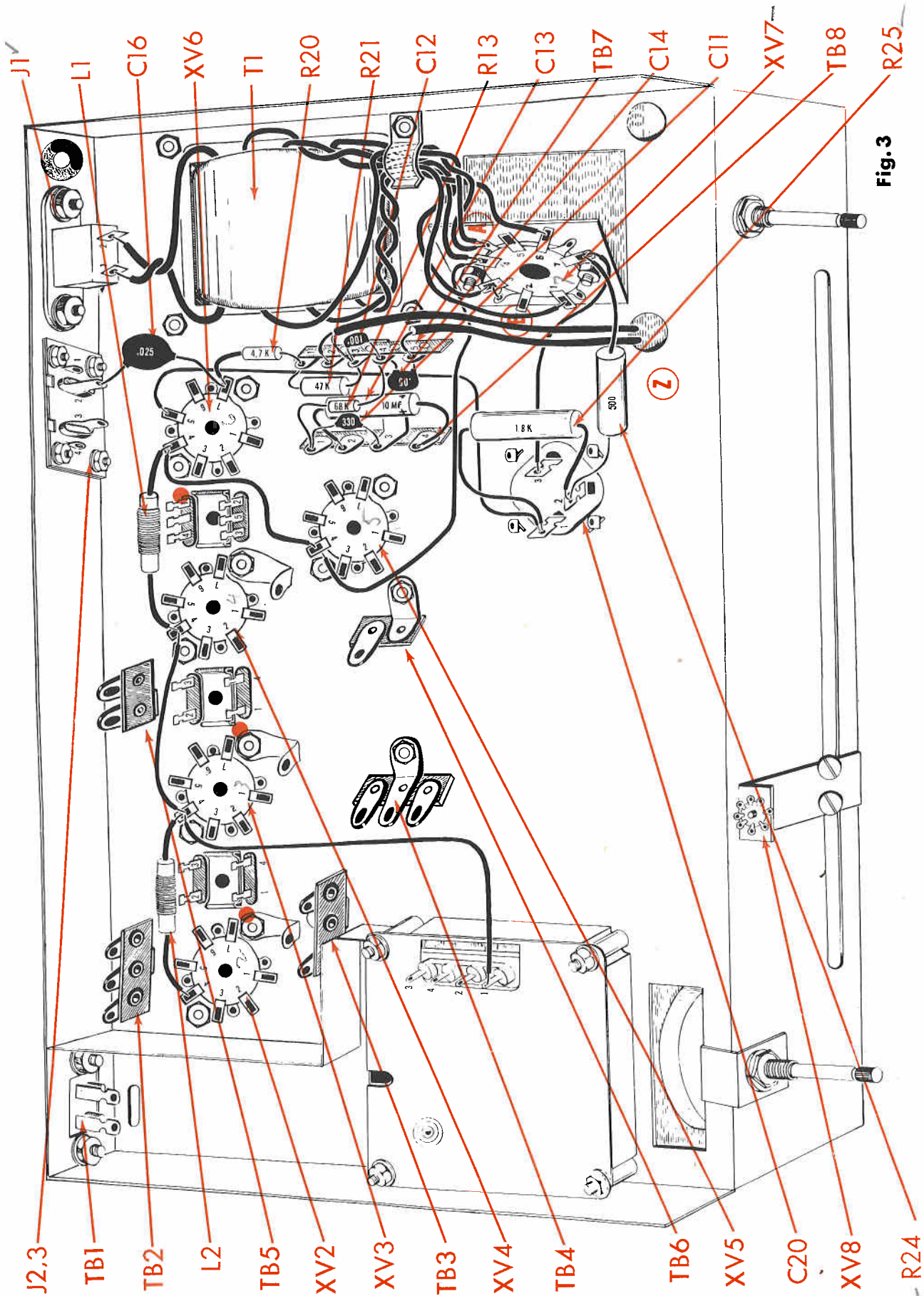


Fig. 3

## WIRING INSTRUCTIONS

1. (X) Fig. 3. Cut the two black leads from the power transformer, T1, to 2 1/2". Twist once as shown. Connect one lead to convenience outlet J1-1 (C) and the other lead to J1-2 (C).
2. (X) Fig. 3. Connect a 5" piece of brown wire from XV7-4 (C) to XV5-4 (C).
3. (X) Fig. 3. Cut the two green leads on the power transformer, T1, to 5". Twist and pass under cable clamp as shown. Connect one lead to XV7-3 (C) and the other lead to XV7-4 (S).
4. (X) Fig. 3. Cut the two red leads on power transformer, T1 to 5". Twist and pass under cable clamp as shown. Connect one lead to XV7-1 (S) and the other lead to XV7-6 (S).
5. (X) Fig. 3. Cut the white lead on power transformer, T1 to 5" and the red-white lead to 4". Twist and pass under cable clamp as shown. Connect both leads to ground lug "A" (S) on XV7.
6. (X) Fig. 3. Connect a 1/2" piece of bare wire from XV7-3 (S) to ground lug "B" (S) on XV7.
7. (X) Fig. 3. Connect a 2 1/2" piece of red wire from XV7-7 (C) to C20-3 (S).
8. (X) Fig. 3. Strip the outer insulation back 3/4" at each end of the black single conductor cable. Twist the shield braid on each end. Strip the insulation 1/4" on the inner conductor of each end. Connect the inner conductor of one end to TB7-2 (C) and the shield braid of the same end to TB7-3 (C). Run the lead along the chassis as shown and push the remainder of the lead through hole "Z".
9. (X) Fig. 3. Strip the outer insulation back 3/4" at each end of the grey single conductor cable. Twist the shield braid on each end. Strip the insulation 1/4" on the inner conductor of each end. Connect the inner conductor of one end to TB7-5 (C) and cut off the shield braid of the same end. Run the lead along the chassis as shown and push the remainder of the lead through hole "Z".
10. (X) Fig. 3. Cut both leads on the 500Ω, 5W, wire wound resistor, R24, to 1". Put a 3/4" piece of spaghetti over one end and connect to XV7-7 (S) and connect the other end to C20-2 (C). Dress away from shielded leads.
11. (X) Fig. 3. Cut one lead on the 1.8kΩ, 5W, wire wound resistor, R25 to 1" and the other lead to 1 1/2". Cover the shorter lead with a 3/4" piece of spaghetti and connect to C20-2 (C). Cover the other lead with a 1 1/4" piece of spaghetti and connect to C20-1 (C).

12. (X) Fig. 3. Connect a 3" piece of brown wire from XV5-4 (C) to XV6-4 (C).
13. (X) Fig. 3. Cut both leads on choke, L1, (one of the two larger chokes) to 1 1/4" and cover each with a 1" piece of spaghetti. Connect one lead to XV6-4 (S) and the other lead to XV4-4 (C). Do not press coil to chassis.
14. (X) Fig. 3. Connect a 3 1/2" piece of brown wire from XV4-4 (C) to XV3-4 (C).
15. (X) Fig. 3. Cut both leads on choke L2, (the other large choke) to 1 1/4" and cover each with a 1" piece of spaghetti. Connect one lead to XV2-4 (C) and the other lead to XV3-4 (C). Do not press coil to chassis.
16. (X) Fig. 3. Connect one end of a 6" piece of brown wire to XV3-4 (S) and the other end to terminal 1 (S) on the RF A assembly A1. Apply a minimum of heat to the terminal to prevent damage.
17. (X) Fig. 3. Cut both leads on a 10 mfd, 25V, electrolytic capacitor, C13, to 1 1/4" and cover both leads with a 1" piece of spaghetti. Connect the lead from the positive (+) end to TB8-4 (C) and the lead from the negative end (-) to TB8-2 (C).
18. (X) Fig. 3. Connect a 6 3/4" piece of red wire from C20-1 (C) to XV6-5 (S).
19. (X) Fig. 3. Connect a 47KΩ, 1W, (yellow, violet, orange, silver) resistor, R21, from TB7-1 (C) to TB7-3 (C). Cut both leads to 3/4".
20. (X) Fig. 3. Connect a .001 mfd (1K or 1000) disc capacitor, C12, from TB7-3 (C) to TB7-4 (C). Cut both leads to 1/2".
21. (X) Fig. 3. Connect a .05 mfd (50K) disc capacitor, C14, from TB7-5 (S) to TB7-4 (C). Cut both leads to 1/2".
22. (X) Fig. 3. Connect a 68KΩ (blue, grey, orange, silver) resistor, R13, from TB8-1 (C) to TB7-4 (S). Cut both leads to 1".
23. (X) Fig. 3. Connect a 4.7KΩ (yellow, violet, red, silver) resistor, R20, from XV6-7 (C) to TB7-1 (C). Cut both leads to 1/2".
24. (X) Fig. 3. Connect a .025 mfd (25K) disc capacitor, C16, from XV6-7 (S) to dual output jack J2, 3 - lug #2 (S) cut both leads to 3/4".
25. (X) Fig. 3. Connect a 330 mmf, disc capacitor, C11, from TB8-1 (C) to TB8-3 (C). Cut both leads to 3/4".

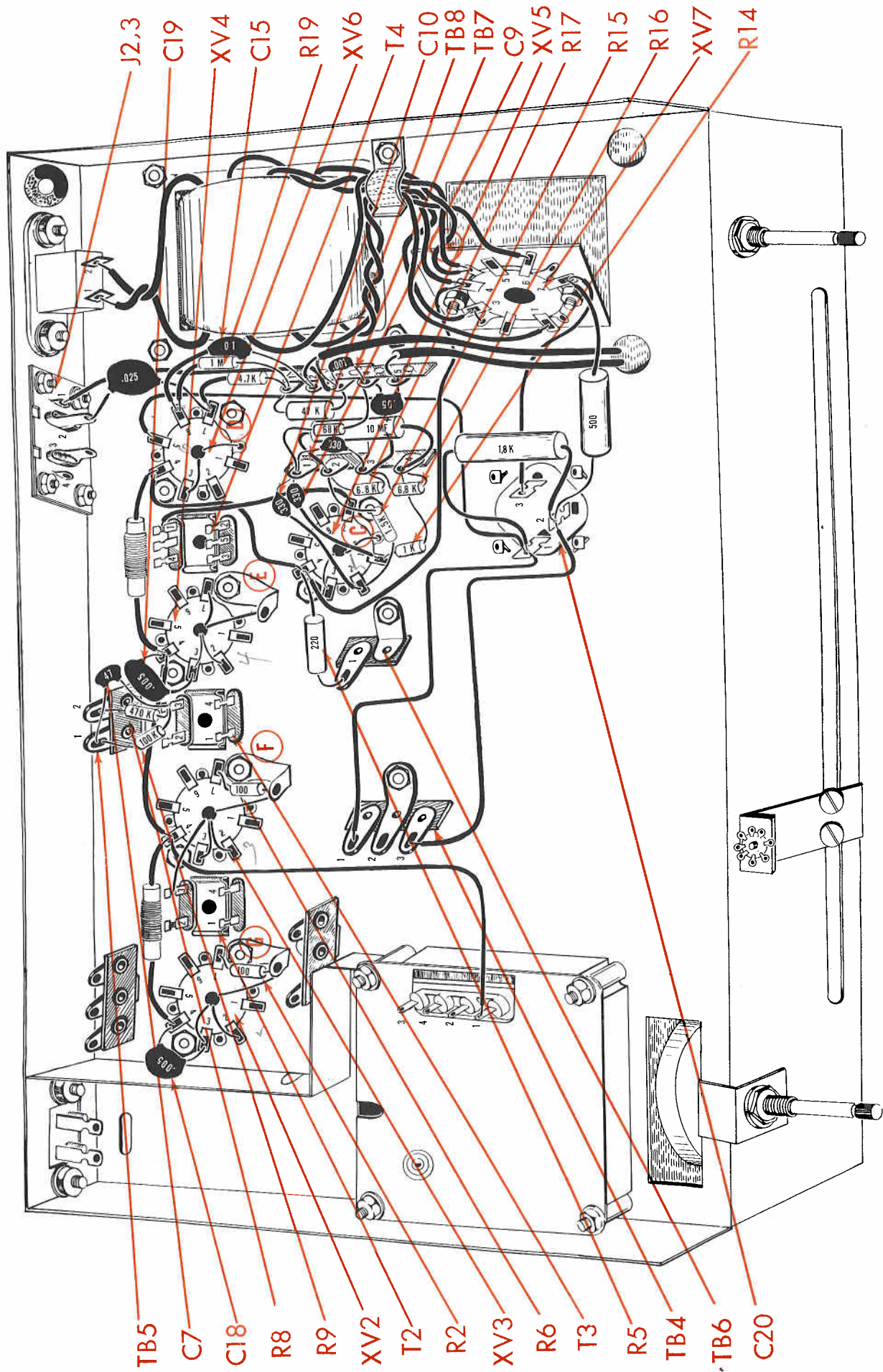


Fig. 4

1. (✓) Fig. 4. Cut both leads on a 1M $\Omega$  (brown, black, green, silver) resistor, R19, and both leads on a .01mfd (10K) disc capacitor, C15, to 1". Cover one end of the resistor and one end of the capacitor with a 1/2" piece of spaghetti on each. Connect this end of the resistor and capacitor to XV6-6 (S). Connect the other end of the resistor to TB7-1 (S) and the other end of the capacitor to TB7-2 (S).
2. (✓) Fig. 4. Connect a 3/4" piece of bare wire from center post (C) on XV5 to ground lug "C" (S) on XV5.
3. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (S) on XV5 to XV5-3 (S).
4. (✓) Fig. 4. Connect a 3/4" piece of bare wire from center post (C) on XV6 to ground lug "D" (S) on XV6.
5. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (S) on XV6 to XV6-3 (S).
6. (✓) Fig. 4. Connect a 1" piece of bare wire from center post (C) on XV4 to ground lug "E" (C).
7. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (C) on XV4 to XV4-7 (S).
8. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (C) on XV4 to XV4-3 (C).
9. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (S) on XV4 to XV4-2 (S).
10. (✓) Fig. 4. Connect a 1" piece of bare wire from center post (C) on XV3 to ground lug "F" (C).
11. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (C) on XV3 to XV3-3 (S).
12. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (C) on XV3 to XV3-2 (S).
13. (✓) Fig. 4. Connect a 1" piece of bare wire from center post (C) on XV2 to ground lug "G" (C).
14. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (C) on XV2 to XV2-3 (C).

15. (✓) Fig. 4. Connect a 1/2" piece of bare wire from center post (S) on XV2 to XV2-2 (S).
16. (✓) Fig. 4. Connect a 220 $\Omega$  (red, red, brown, gold) 1W, resistor, R5, from XV5-4 (S) to TB6-1 (C). Cut both leads to 1/2".
17. (✓) Fig. 4. Connect a 5000 mmf (.005 or 5K) disc capacitor, C19, from XV4-4 (S) to XV4-3 (S). Cut both leads to 1/2".
18. (✓) Fig. 4. Connect a 5000 mmf (.005 or 5K) disc capacitor, C18, from XV2-4 (S) to XV2-3 (S). Cut both leads to 1/2".
19. (✓) Fig. 4. Connect a 1" piece of bare wire from center post (S) on XV3 to IF can, T2-3 (S).
20. (✓) Fig. 4. Connect a 5 1/2" piece of red wire from C20-2 (S) to TB4-3 (C).
21. (✓) Fig. 4. Connect a 6" piece of red wire from C20-1 (S) to TB4-1 (C).
22. (✓) Fig. 4. Connect a 6.8K $\Omega$  (blue, grey, red, silver) resistor, R16, from TB8-4 (C) to TB8-3 (C). Cut both leads to 1/2".
23. (✓) Fig. 4. Connect a 6.8K $\Omega$  (blue, grey, red, silver) resistor, R17, from TB8-2 (C) to TB8-3 (C). Cut both leads to 1/2".
24. (✓) Fig. 4. Connect a 1K $\Omega$  (brown, black, red, silver) resistor, R14, from XV5-1 (C) to TB8-4 (S). Cut both leads to 1/2".
25. (✓) Fig. 4. Connect a 2" piece of white wire from XV5-7 (S) to ratio detector can, T4-1 (S).
26. (✓) Fig. 4. Connect a 330 mmf, disc capacitor, C9, from TB8-1 (C) to XV5-1 (S). Cut both leads to 3/4" and use 1/2" of spaghetti over the lead connected to XV5.
27. (✓) Fig. 4. Connect a 330 mmf, disc capacitor, C10, from TB8-1 (C) to XV5-2 (C). Cut both leads to 3/4" and use 1/2" of spaghetti over the lead connected to XV5.
28. (✓) Fig. 4. Connect a 1.5K $\Omega$  (brown, green, red, silver) resistor, R15, from XV5-2 (S) to TB8-2 (C). Cut both leads to 3/4".
29. (✓) Fig. 4. Connect a 4" piece of black wire from J2, 3-1 (C) to TB7-3 (S).

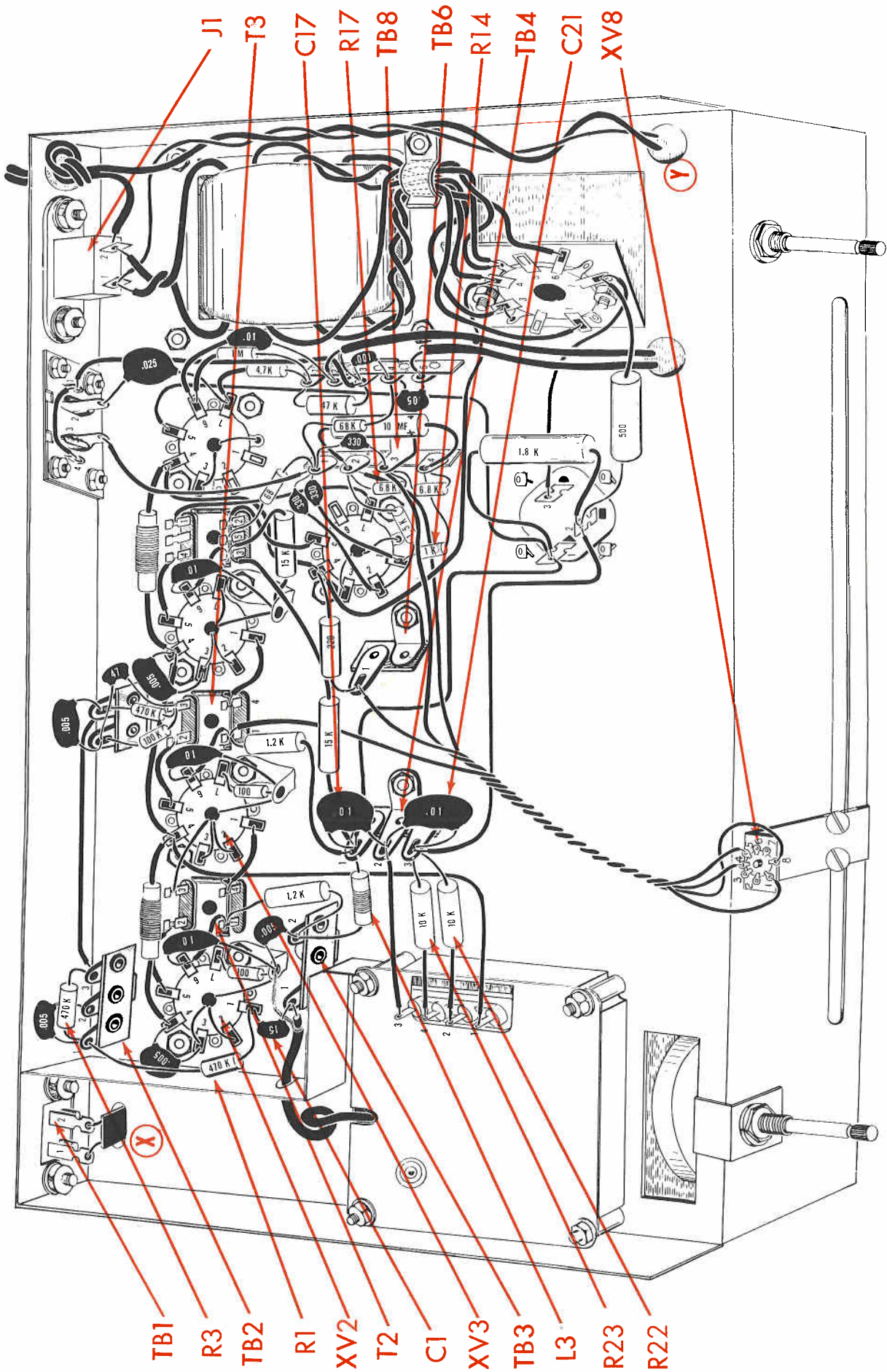


Fig. 6

1. (✓) Fig. 6. Connect a 470K $\Omega$  (yellow, violet, yellow, silver) resistor, R3, from TB2-1 (C) to TB2-3 (S). Cut both leads to 3/4".
2. (✓) Fig. 6. Connect a 470K $\Omega$  (yellow, violet, yellow, silver) resistor, R1, from TB2-1 (S) to XV2-1 (C). Keep lead to XV2-1 as short as possible.
3. (✓) Fig. 6. Push the shielded lead coming from the RF assembly through the hole in the shield. DO NOT CUT THIS LEAD TO SIZE. Curl up the excess length of lead outside the shield, as shown in the drawing. DO NOT STRIP INSULATION OFF THE LEAD. Connect the outer metal shield to ground lug "G" (S). Connect the inner conductor to TB3-1 (C).
4. (✓) Fig. 6. Connect a 15 mfd, disc capacitor, C1, from XV2-1 (S) to TB3-1 (S). Cut both leads to 1/2".
5. (✓) Fig. 6. Connect RF choke, L3, from TB3-2 (S) to TB4-1 (C). Cut both leads to 3/4".
6. (✓) Fig. 6. Connect a .01 mfd (10K) disc capacitor, C17, from TB4-1 (S) to TB4-2 (C). Cut both leads to 1/2".
7. (✓) Fig. 6. Connect a .01 mfd (10K) disc capacitor, C21, from TB4-2 (C) to TB4-3 (C). Cut both leads to 1/2".
8. (✓) Fig. 6. Connect a 2 1/2" piece of black wire from TB4-2 (S) to pin 3 (S) on the RF assembly. Do not overheat the terminal to avoid damage. The numbers of the terminals are not in numerical sequence. Check drawing for location.
9. (✓) Fig. 6. Cut the leads on the two 10K $\Omega$  (brown, black, orange, silver)
10. (✓) Fig. 6. Please note that the four flexible leads are pre-wired to socket XV8 for your convenience. Bend back all the pins on the socket so that they do not make contact with the adjacent ones.
11. (✓) Fig. 6. Cut the four wires from XV8 to the following dimensions. Black 9", Brown 7 1/4", Red 9 3/4", Yellow 9". Twist the four leads up to a length of 5 1/2" from the socket as shown in the drawing. Run the yellow lead under R14, R17 and connect to TB8-2 (S). Connect the black lead to TB8-3 (S), the brown lead to TB6 (S) and the red lead to IF can, T3-1 (S). Handle the fine wire with care, the covering melts very easily. Use a light soldering iron if possible.
12. (✓) Fig. 6. Push the line cord through the hole at the rear of the chassis and tie a knot inside the chassis 10" from the ends so that the line cord cannot pull through the grommet. Separate the two leads by pulling them apart until the knot. Cut one lead to 1 1/2" and connect to J1-2 (S).
13. (✓) Fig. 6. Connect one end of a 10" black lead to J1-1 (S). Twist this lead with the remaining lead of the line cord, run along chassis as shown, and push through hole "Y".
14. (✓) Fig. 6. Strip back both ends of the 300 $\Omega$  twin lead 1/2". Connect one lead from one end to TB1-1 (S) and the other lead from the same end to TB1-2 (S). Without twisting the lead, push the remainder of the lead through hole "X".
15. (✓) Fig. 6. Connect one end of a 10" black lead to J1-1 (S). Twist this lead with the remaining lead of the line cord, run along chassis as shown, and push through hole "Y".
16. (✓) Fig. 6. Strip back both ends of the 300 $\Omega$  twin lead 1/2". Connect one lead from one end to TB1-1 (S) and the other lead from the same end to TB1-2 (S). Without twisting the lead, push the remainder of the lead through hole "X".



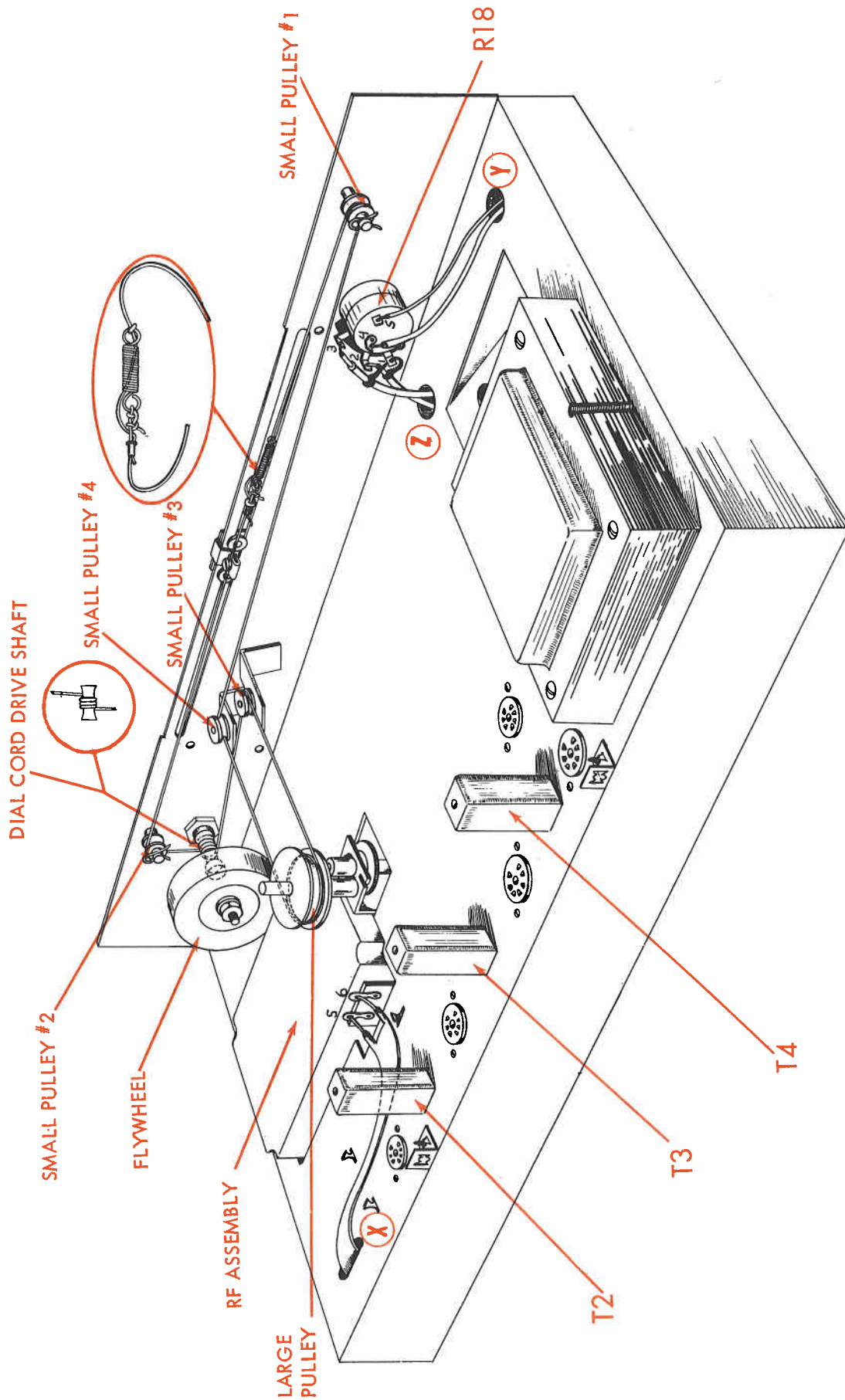


Fig. 7

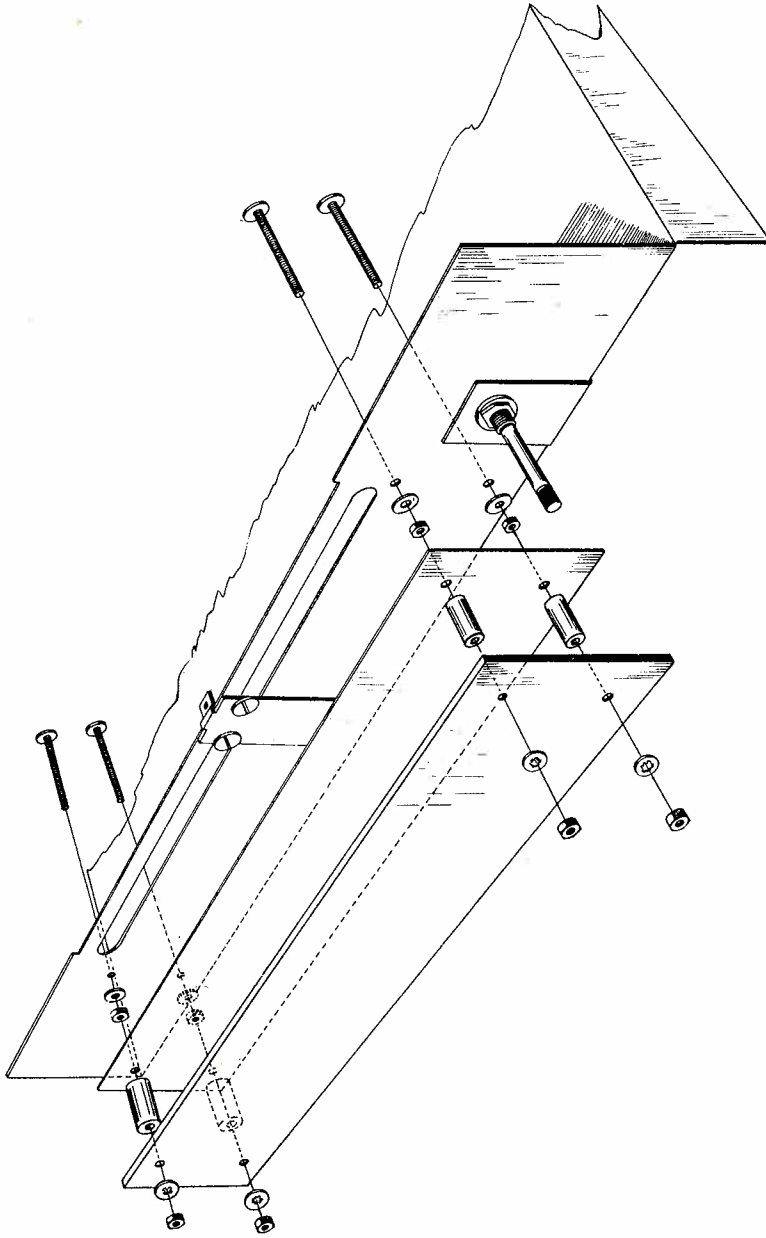


Fig. 8

1. (✓) Fig. 7. Connect one lead from hole "Y" to R18-5 (S) and the other lead to R18-4 (S).
2. ( ) Fig. 7. Connect the inner conductor of the grey single conductor cable emerging from hole "Z" to R18-3 (S). Connect the outer shield braid to R18-1 (C).
3. (✓) Fig. 7. Connect the inner conductor of the black single conductor cable emerging from hole "Z" to R18-2 (S). Connect the outer shield braid to R18-1 (S).
4. (✓) Fig. 7. Connect one lead of the twin lead cable emerging from hole "X" to pin 5 (S) on the RF assembly and the other lead to pin 6 (S). Do not overheat these terminals.
5. (✓) Fig. 7. Turn "front-end" (RF assembly) drive shaft maximum counter-

clockwise as seen from top of chassis. Do not force. (See Fig. 1)

6. (✓) Fig. 7. Place 1/4" 1 D fibre washer on "front-end" (RF assembly) drive shaft. (See Fig. 1)
7. (✓) Fig. 7. Place large pulley (1" dia.) on drive shaft loosely over fibre washer. Mark position of set screw hole on top surface of pulley. Do not use force as this may cause damage to the drive gear. Do not tighten pulley set screw as the pulley must rotate freely for dial cord threading and tuning eye carriage setting. (See Fig. 1)
8. (✓) Fig. 8. Mount the black backing plate and the dial scale to the four #6 x 1 1/8 screws previously mounted to the chassis front apron. Loosen the screws if you find it necessary for easy insertion. Use the four black spacers, four #6 lockwashers and four #6-32 hex nuts.

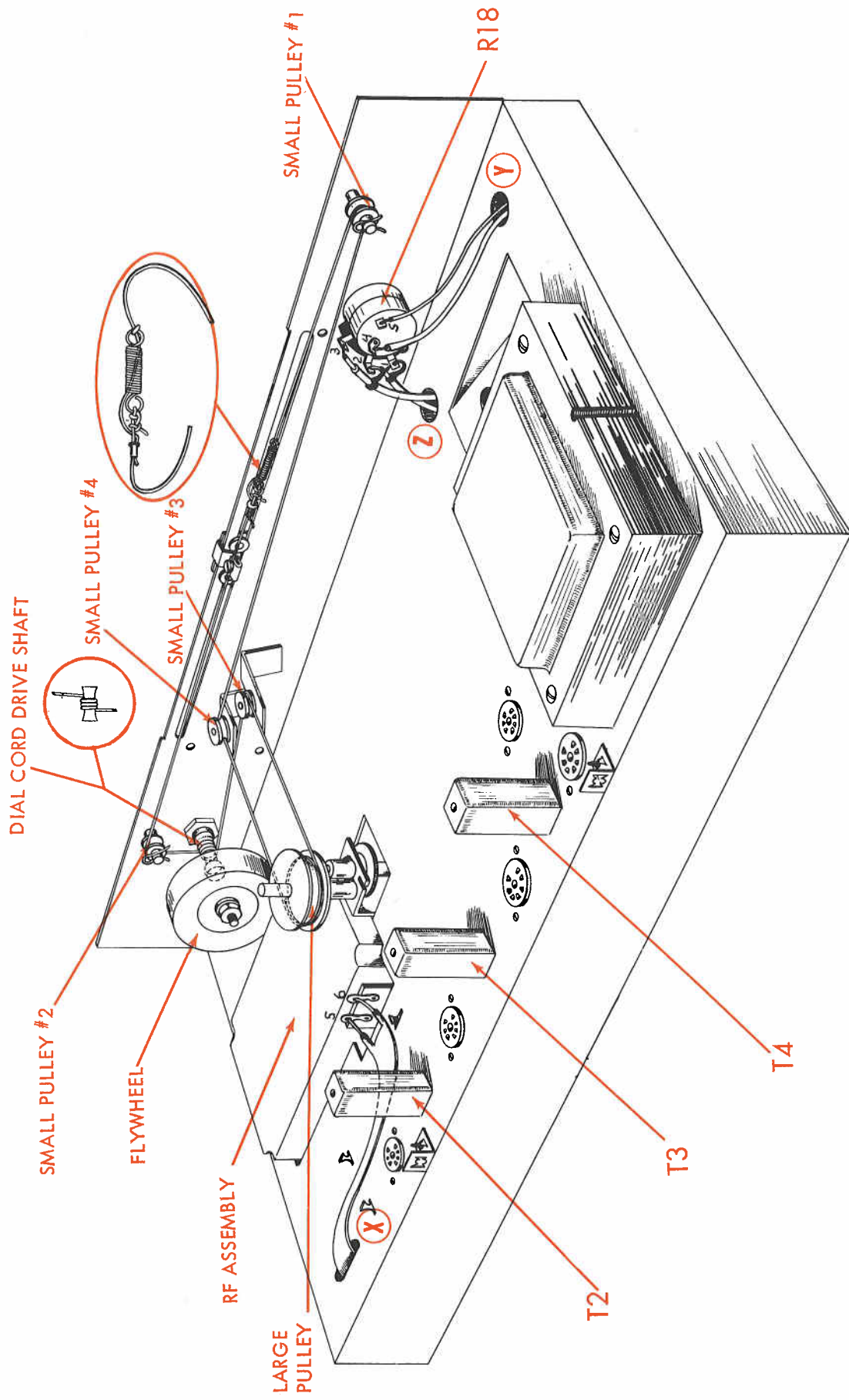


Fig. 9

## DIAL CORD STRINGING

Note: Left, right toward and rear are all as seen from the front side of the chassis.

1. ( ) Fig. 9. Tie one end of the dial cord to the spiral tension spring with a double knot\*. Place some nail lacquer on the knot and the loose string end coming off the knot to avoid loosening and unraveling. Thread the other end of the dial cord through the eyelet and then slide the eyelet up to the knot. Pass the loose end coming off the knot through the eyelet also. \*IMPORTANT NOTE: Make the double knot so that no more than 1/2" of loose cord end is obtained.

2. (✓) Fig. 9. Remove the cotter pin on small pulley 1 and remove this pulley temporarily. Hook the free end of the spring on the groove in the small pulley 1 shaft.

3. (✓) Fig. 9. Bring the free end of the dial cord over and around the top of small pulley 2 (1/4 turn), and then straight down to the dial cord drive shaft. Wind the dial cord three times around the drive shaft in a clockwise direction as seen from the front. Wind it so that each successive turn is further toward the chassis rear than the turn made before it. Do not allow one turn to cross over another.

4. (✓) Fig. 9. Next, bring the free end of the dial cord over to the front side of small pulley 3 and around it (1/4 turn).

5. (✓) Fig. 9. Now bring the free end of the dial cord straight back to the large pulley and wind it around the large pulley 1 1/2 turns. Do not allow one turn to cross over another.

6. (✓) Fig. 9. Next, bring the free end of the dial cord straight forward to small pulley 4 and around it (1/4 turn).

7. ( ) Fig. 9. Now bring the free end of the dial cord straight left, back to the location of small pulley 1. Unhook the spring from the small pulley 1 shaft and then use the left hand to hold both ends of the dial cord taut. With the right hand, restore small pulley 1 to its shaft.

8. ( ) Fig. 9. Now pass the spring-attached end of the dial cord to the right hand and with the left hand pass the free end of the dial cord under and around small pulley 1 (1/2 turn). Now adjust the position of whole dial cord so that the free end of the spring is from 1/2" to 3/4" away from small pulley 1 with no slack in the cord and little extension of the spring.

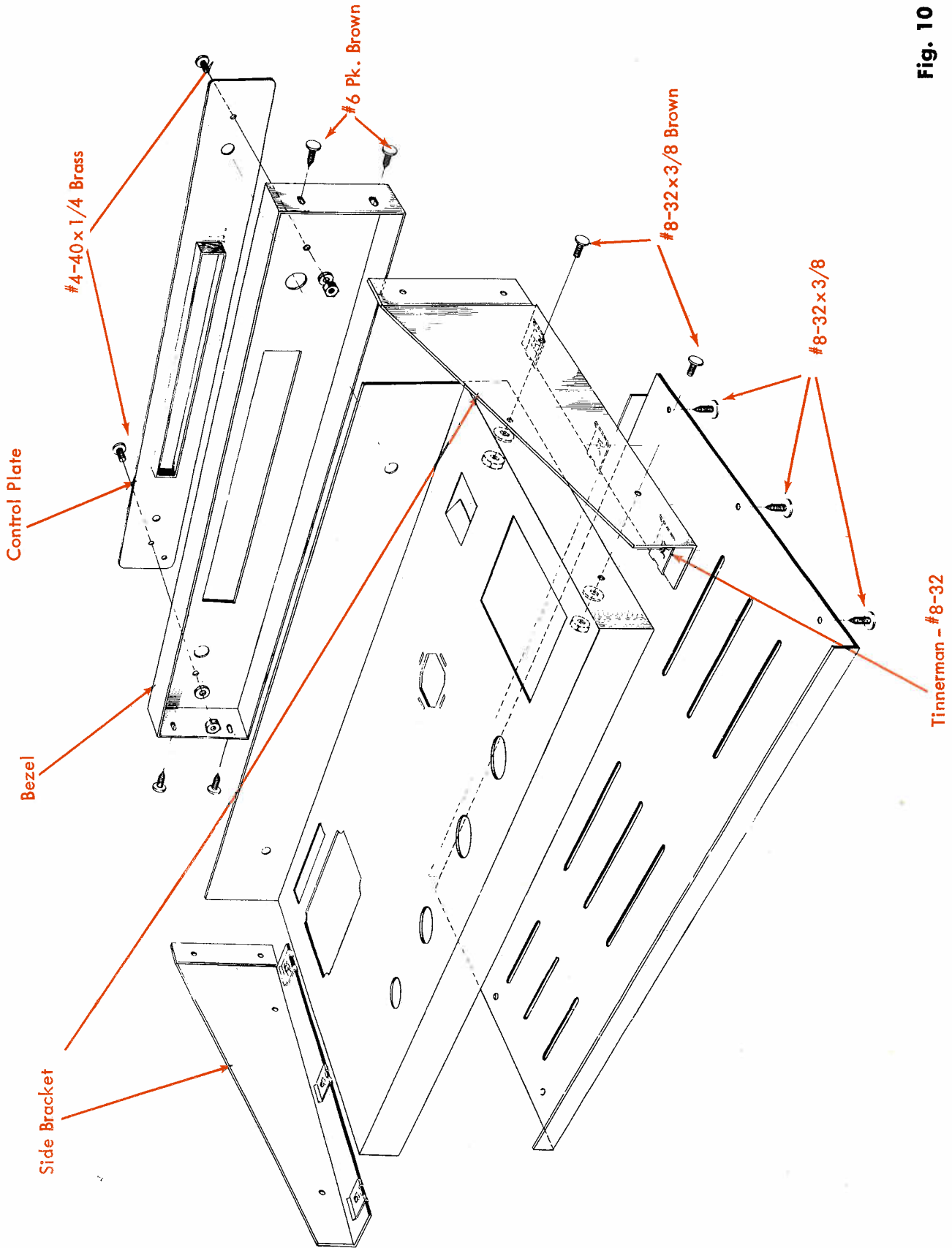
9. (✓) Fig. 9. Next, pass the free end of the dial cord through the hook on the free end of the spring and make a loose, temporary knot.

10. (✓) Fig. 9. Now, move the tuning eye carriage to the extreme left hand side of the slot (88 mc end). Note that the dial cord spring should be situated about mid-way between the tuning-eye carriage and small pulley 1. Loosen the screw and washer at the top of the tuning eye carriage and slip the upper dial cord string under the forward end of the washer. Re-tighten the screw to fasten the tuning eye carriage to the dial cord.

11. (✓) Fig. 9. Unfasten the temporary knot made in step 9 but leave the dial cord threaded through the spring end. Pull the free end of the dial cord taut until the spring is extended 1/16 to 1/8". Mark the point of contact between spring and dial cord under this condition with a piece of tape or a light crayon. Now disengage the dial cord from small pulley 1 and fasten the dial cord to the spring at the point marked with a single knot. Next, remove small pulley 1 from its shaft to engage the dial cord and then replace it on the shaft with the dial cord engaged. Check to see that the spring is extended to 1/16" to 1/8" as originally intended. If the desired spring extension is not obtained, then loosen the knot and move it away from or towards the loose end of the dial cord as required to increase or decrease the tension. When the desired point is reached, make an additional knot to avoid any slipping and then place some nail lacquer or shellac both on the knot and the loose string end. Then thread the loose cord end through the inside of the spring and through the eyelet on the other side. Draw the loose cord end through the eyelet until there is just a little slack and then crimp the eyelet closed with a long-nose pliers. This will prevent ultimate relaxation of the spring due to over-stretching.

12. (✓) Fig. 9. Now turn the dial cord drive shaft clockwise until the center of the tuning carriage is set at 108 mc on the dial\*. Remove small pulley 1 from its shaft temporarily and hook the dial cord over the bare shaft itself. Then lift up the large pulley for clearance (to avoid friction), and while holding the "front-end" (RF assembly) drive shaft stationary, turn the large pulley until the set screw hole faces to the rear. Then hold the large pulley stationary and turn the "front-end" (RF assembly) drive shaft maximum clockwise without forcing. Now, with the large pulley resting without pressure on the fibre washer beneath it, tighten the set screw in the large pulley. Finally, unhook the dial cord from the bare shaft of small pulley 1. Replace the dial cord around small pulley 1 and restore it to its drive shaft; then fasten small pulley 1 in place with the cotter pin. If the tuning eye carriage has moved from the 108 mc position during these steps, it may now be corrected by loosening the screw fastening it to the dial cord and re-positioning the carriage before tightening the screw again.

Continued on page 19C



**Fig. 10**

\* **IMPORTANT NOTE:** Do not force if the carriage seems to stick at some point on the dial before 108 mc. If you have failed to turn the "front-end" (RF assembly) drive shaft maximum counter-clockwise as instructed at the beginning, you may be stopped because the "front-end" drive shaft is at maximum clockwise rotation. Forcing will cause serious damage.

13. ( ) Fig. 9. The dial cord stringing is now completed. Check to see that there is no crossing over of the cord between small pulley 1 and small pulley 2, that there is no crossing over of turns on the dial cord drive shaft or the large pulley, and that the dial cord is actually seated in the groove of each of the smaller pulleys.

### FINAL STEPS

You have now completed the assembly and wiring of your tuner. When you have completed the following steps your tuner will be ready for use.

1) To catch any wiring errors, it is suggested that the entire wiring be checked point-by-point against the wiring instructions (and preferably also against the schematic wiring diagram in order to become more familiar with the component layout and circuitry). While doing so, check for rosin joints, loose lumps of solder, poor lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts (remove with a stiff brush dipped in carbon tetrachloride).

2. Insert tubes V1 through V8 in their sockets. Cut the leads on the DM70 tube (V8) to 1/4". If a DM71 is supplied instead of the DM70 (direct replacement), do not cut the leads for they have already been cut to size.

3) If you have a VTVM or VOM, make the following resistance checks before connecting to the a-c line: Turn ON-OFF switch to on. Check for a cold d-c resistance of approximately 12 ohms across the a-c line plug; check for a resistance of approximately 200 ohms from XV7 pin 1 to ground and XV7 pin 6 to ground; check for a resistance of at least 20KΩ from XV7 pin 7 and ground. Allow sufficient time for the electrolytic capacitors to be charged by the ohmmeter battery in this last measurement. These measurements constitute a reasonable test of the power supply components and wiring before applying power. If you do not obtain the minimum resistance values indicated, do not proceed to the next step until the cause is discovered and the condition remedied.

4. ( ) Fig. 10. Assemble the left and right side brackets to the chassis. Each side bracket is mounted with two #8-32 x 3/8 brown colored screws, two #8-32 hex nuts, and two #8 lockwashers.

5. ( ) Fig. 10. On the bottom flange of each side piece, press a finnerman #8-32 - Type J speed nut in place over each of the three holes.

6. ( ) Fig. 10. Mount the control plate on the bezel using two each #4-40 x 1/4 brass screws, #4 lockwashers, and #4 hex nuts to fasten it to the bezel.

7. ( ) Fig. 10. Fit the bezel and control plate over the projecting control shafts, onto the ends of the side brackets. Assemble the bezel to the side brackets with four #6 x 1/4 brown colored P. K. screws.

8) Set the VOLUME/OFF control to the furthest counter-clockwise position; actuating the switch. Mount the knob having the indicator dot so that the dot is at the OFF marking on the control plate. Place the other knob on the Tuning control.

9) **OPERATIONAL CHECKS ON COMPLETED KITS:** In the **INSTRUCTION** part of this manual you will find a section titled "Electrical Installation". Read this carefully and connect your amplifier to the tuner in accordance with the instructions given. Then read the section titled "Operating Instructions" and operate the controls, checking aurally for the results described. If the tuner does not operate at all or operates incorrectly, use the **VOLTAGE & RESISTANCE** chart to discover and remedy the difficulty.

10) The kit is supplied with all tuned circuits pre-aligned for the particular layout and lead dress as shown in the pictorial diagrams. Therefore, if the kit is wired as instructed, i. e., all leads and components are dressed as shown in the pictorial diagrams, the tuner will operate satisfactorily with no alignment on the part of the constructor. In general, improved sensitivity and lowered distortion can be obtained by a careful touch-up alignment of the IF and Ratio Detector transformers, particularly if the lead dress differs from the pictorial diagrams. Two methods of alignment are given: one is a visual alignment method employing sweep generator and oscilloscope; the other is a simple signal generator and VTVM or 20,000Ω/V VOM method which the average kit constructor is more usually equipped to perform. The visual alignment is certainly preferable, but the signal generator and VTVM/VOM method will give excellent results if carefully performed. The "front-end" (RF Tuning Assembly) adjustments should not be touched at all normally, and in no case should any repair work on the "front-end" be attempted. Any defective "front-end" should be returned to the factory for service. EICO reserves the right not to service any "front-end" that has been tampered with internally.

11. ( ) Fig. 10. Mount the bottom plate on the bottom flanges of the side pieces, using six #8-32 x 3/8 uncolored screws. Note that the rear flange on the bottom plate fits over the outside of the rear chassis apron.

12. ( ) Fig. 10. Install the rubber feet in the openings provided in the bottom plate. The method is to work the rounded portion of each foot into the interior of the cabinet from the outside, using a small screwdriver. The flat portion

should be the actual resting or contact surface.

13. ( ) Fig. 11. Remove the backings from the two labels supplied and place them on the outside surface of the bottom plate as shown.

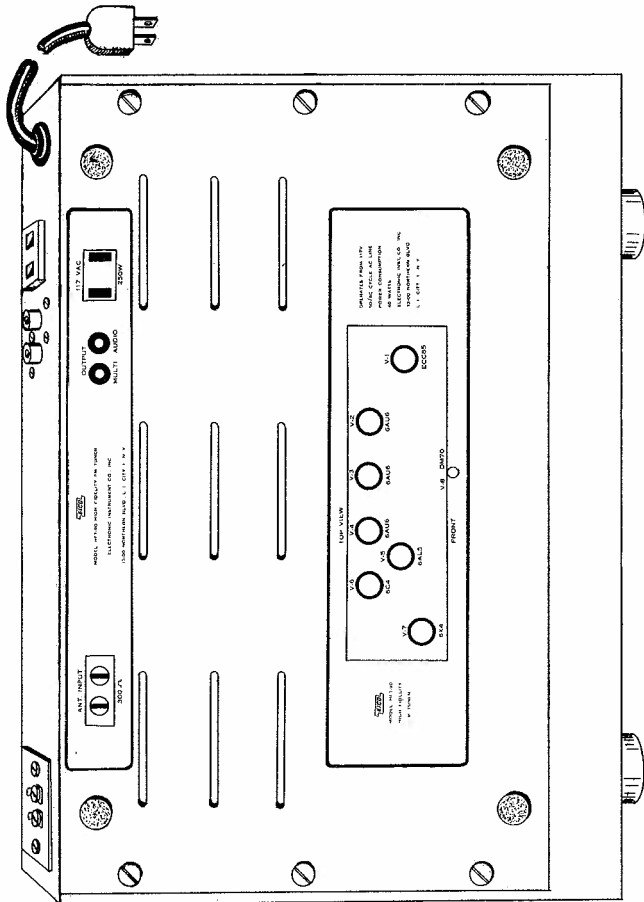


Fig. 11

14) If the tuner is to be mounted in a console, read carefully the "Mechanical Installation" section in the INSTRUCTION part of this manual and follow the procedures outlined. If the tuner is to be placed out in the open, we strongly recommend that you obtain the cover (supplied separately). The cover may also be used in console installation, if desired.

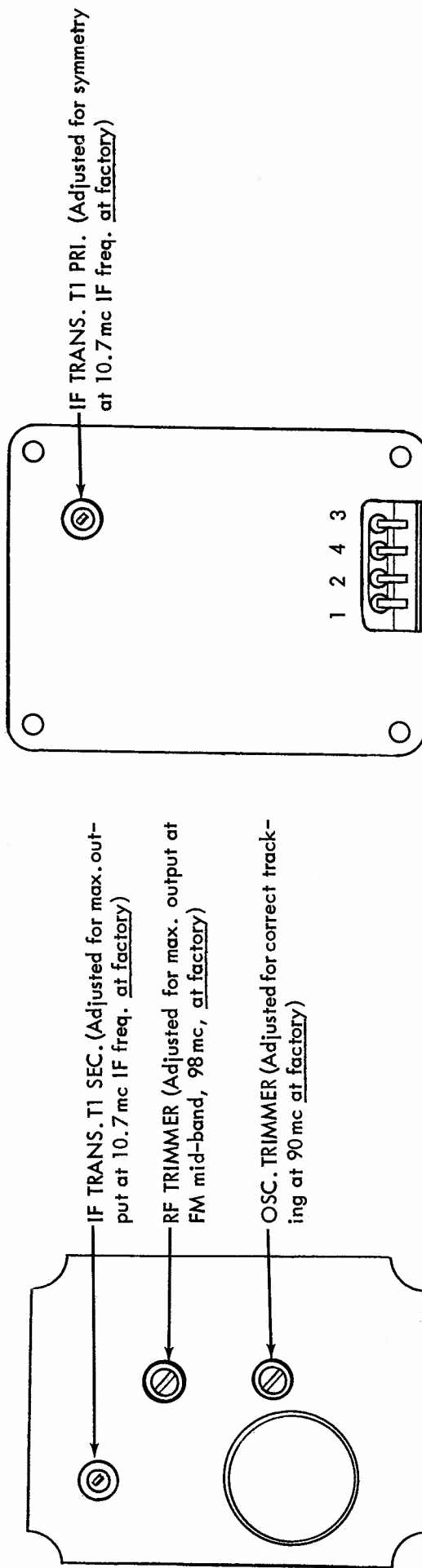
15) Information as the choice and connection of antenna, connection to amplifier input, and a-c line plug connections is given the "Electrical Installation" section in the INSTRUCTION part of this manual.

### SERVICE

If you are still having difficulty, write to our service department listing all possible indications that might be helpful. If desired, you may return the instrument to our factory where it will be placed in operating condition for \$7.50 plus the cost of parts replaced due to their being damaged in the course of construction. This service policy applies only to completed instruments constructed in accordance with the instructions as stated in the manual. Instruments that are not completed or instruments that are modified will not be accepted for repair. Instruments that show evidence of acid core solder or paste fluxes will be returned not repaired. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to the Electronic Instrument Co., Inc., 33-00 Northern Blvd., L.I.C. 1, New York. Return shipment will be made by express collect. Note that the carrier cannot be held liable for damages in transit if packing, IN HIS OPINION, is insufficient.

CONNECT SIGNAL GENERATOR	TYPE OF SIGNAL	SET SIG. GEN. FREQ. TO	SET FM TUNER DIAL TO	CONNECT VTVM/VOM LEADS	ADJUST	REMARKS
Ground lead to chassis close to V3 pin 1. Hot lead to V3 pin 1 (pt. B)	unmodulated	10.7 mc	108 mc	across C13	T3 pri. core (bottom) and T3 sec. core (top) for maximum dc voltage output.	Set sig. gen. output to obtain 3 to 5 volts dc reading on the meter.
Ground lead to chassis close to V2 pin 1. Hot lead to V2 pin 1 (pt. C)	unmodulated	10.7 mc	108 mc	across C13	T2 pri. core (bottom) and T2 sec. core (top) for maximum dc voltage output.	Set sig. gen. output to obtain 3 to 5 volts dc reading on the meter.

**IMPORTANT NOTE:** "Front-end" is factory pre-aligned and no adjustment facility thereon should be tampered with. If there is definite indication that the "front-end" is misaligned, check the positions of the cores in IF transformer T1 located inside the "front-end". The T1 primary core can be seen on the bottom chassis surface of the "front-end" and the secondary core on the top chassis surface of the "front-end" (see figs. 2 & 3). The T1 primary core should protrude approximately 1/32" from the coil form; the T2 secondary core should be neither "in" nor "out" of the coil form but flush with it. If these conditions do not exist closely as described, then it is permissible to adjust one or both of the cores to the described condition. Please note that the T1 core adjustments will normally have already been made at the factory.



TOP VIEW OF "FRONT-END"

Fig. 2

BOTTOM VIEW OF "FRONT-END"

Fig. 3



### VOLTAGE CHART

Tube Sym. #	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	ECC85	Not accessible — do not attempt to measure. See voltages at "front-end" output lugs below.								
V2	6AU6	-0.5VDC	G	G	6.2VAC	135VDC	135VDC	0.8VDC	-	-
V3	6AU6	-	G	G	6.2VAC	130VDC	130VDC	1.2VDC	-	-
V4	6AU6	-0.5VDC	G	G	6.2VAC	50VDC	50VDC	G	-	-
V5	6AL5	0.4VDC	-0.4VDC	G	6.3VAC	-0.4VDC	-	-0.4VDC	-	-
V6	6C4	-	-	G	6.3VAC	150VDC	25VDC**	55VDC	-	-
V7	6X4	205VAC	-	G	6.3VAC	-	205VAC	225VDC	-	-
V8	DM70*	0.05VDC	-	-	1.2VAC	G	-	-	130VDC	
"Front-end" output lugs (see fig. 3 for lug numbering).	lug 1	lug 2	lug 3	lug 4						
	6.2VAC	105VDC	G	150VDC						

- NOTES: a) Voltages are measured at line voltage of 117VAC, 60 cps.  
All voltages may normally vary by  $\pm 15\%$ .  
b) Measurements made with VTVM or 20,000  $\Omega/V$  VOM.  
c) All measurements made to chassis ground and under no signal conditions.

\*\* Use high VOM range or VTVM.

### RESISTANCE CHART (UNIT OFF)

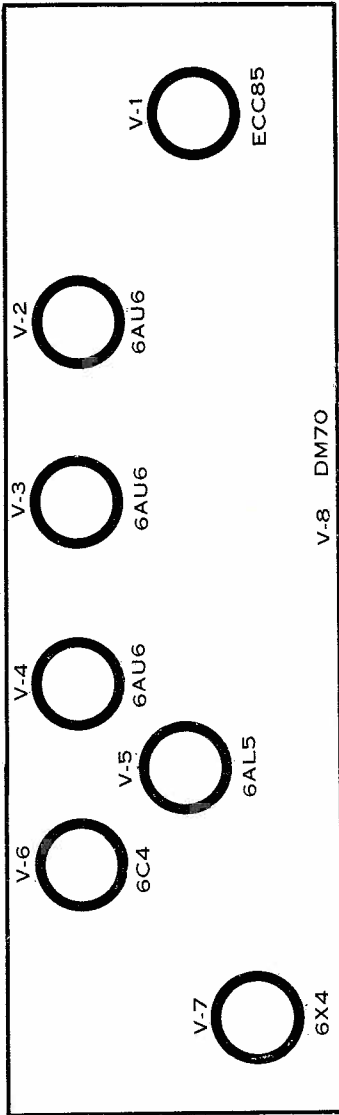
Tube Sym. #	Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	ECC85	Not accessible — do not attempt to measure. See resistances to ground at "front-end" output lugs below.								
V2	6AU6	1.2Meg	0	0	0.1	20K	20K	100	-	-
V3	6AU6	0.8	0	0	0.1	20K	20K	100	-	-
V4	6AU6	100K	0	0	0.1	15K	15K	0	-	-
V5	6AL5	8K	8K	0	0.1	INF.	-	INF.	-	-
V6	6C4	20K	-	0	0.1	20K	1 Meg	50K		
V7	6X4	200	-	0	0.1	-	200	15K	-	-
V8	DM70	7K	-	-	45	0	0	-	20K	-
"Front-end" output lugs (see fig. 3 for lug numbering)	lug 1	lug 2	lug 3	lug 4						
	0.1	30K	0	30K						

CAUTION: Be certain to disconnect unit from AC line before making measurements.

- NOTES: a) Measurements made with VOLUME control set maximum clockwise.  
b) All measurements are measured with VTVM or 20,000  $\Omega/V$  VOM.  
c) All resistance may normally vary by  $\pm 20\%$ .  
d) All measurements made with respect to chassis ground.

\* DM71 is direct replacement.

TOP VIEW



OPERATES FROM 117V  
50/60 CYCLE AC LINE  
POWER CONSUMPTION:  
40 WATTS  
ELECTRONIC INST. CO., INC.  
33-00 NORTHERN BLVD.,  
L. I. CITY 1, N. Y.

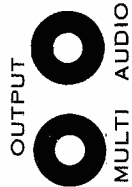
**TEICOL**  
ELECTRONIC  
MODEL HFT-90  
HIGH FIDELITY  
FM TUNER

FRONT

ANT. INPUT

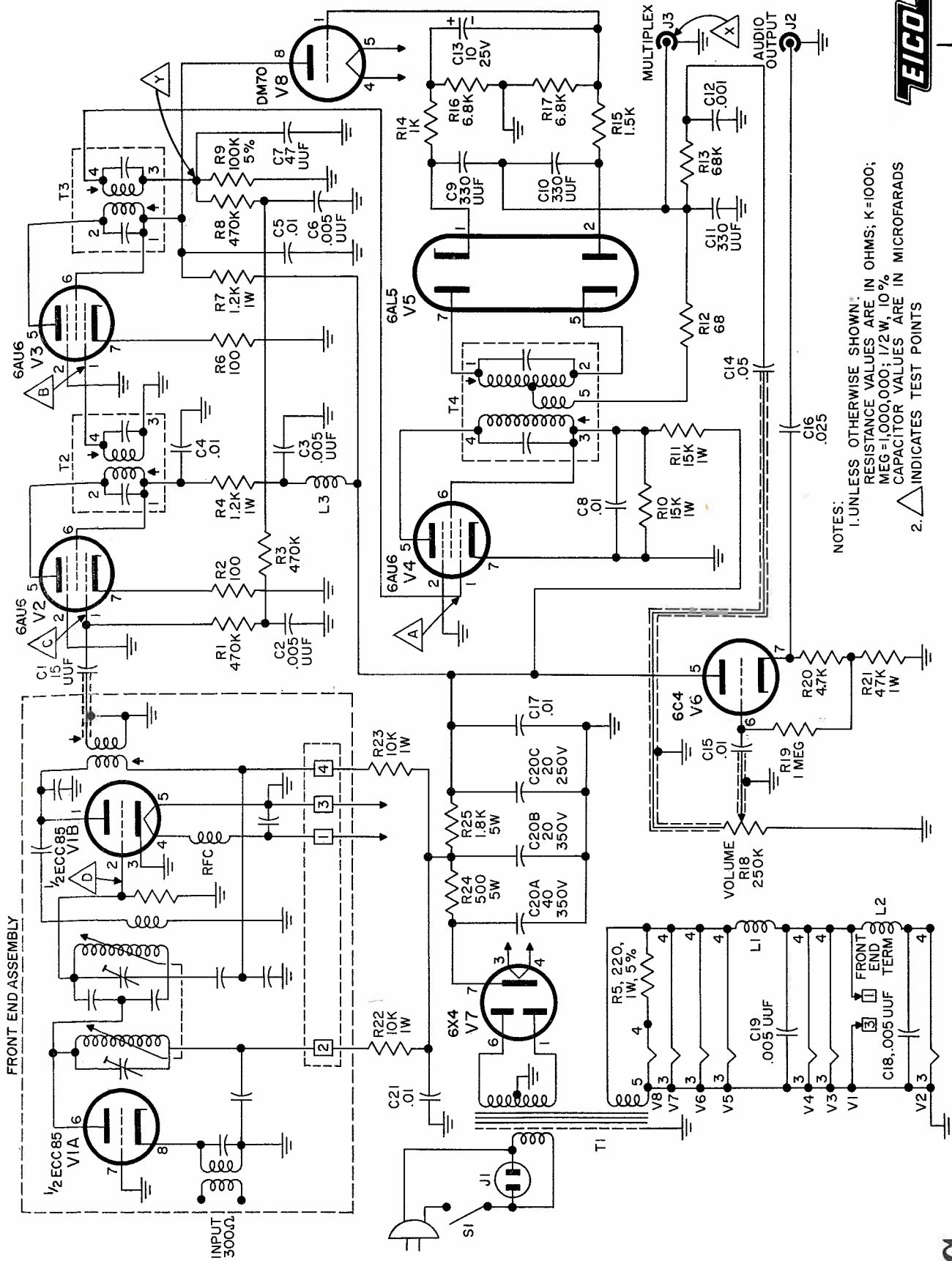


MODEL HFT-90 HIGH FIDELITY FM TUNER  
ELECTRONIC INSTRUMENT CO., INC.  
33-00 NORTHERN BLVD., L. I. CITY 1, N. Y.



## REPLACEMENT PARTS LIST

Stock#	Sym.	Description	Am't.	Stock#	Description	Am't.
22527	C1	cap., disc., .15 mfd, ±10%	1 ✓	41003	screw, #8-32 x 3/8	6
22513	C2,3,6,18,19	cap., disc., .005 mfd, ±10% (5000 or 5K)	5 ✓	41016	screw, #4-40 x 1/4	12
22519	C4,5,8,15	cap., disc., .01 mfd, ±10% (10,000 or 10K)	6 ✓	41024	screw, #8 set	1
	17,21			41026	screw, #4-40 x 1/4 brass	2
22533	C7	cap., disc., .47 mfd, ±10%	1 ✓	41027	screw, #4 wood brass	2
22522	C9,10,11	cap., disc., .330 mfd, ±10%	3 ✓	41028	screw, #8-32 x 1	2
22521	C12	cap., disc., .001 mfd, ±10% (1000 or 1K)	1 ✓	41045	screw, #6 P.K. brown	4
23001	C13	cap., elec., 10 mfd - 25 V	1 ✓	41046	screw, #8-32 x 3/8 brown	4
20042	C14	cap., disc., .05 mfd - GMV	1 ✓	41047	screw, #8 P.K.	2
22517	C16	cap., disc., .025 mfd (25000 or 25K) ✓	1 ✓	41056	screw, #8-32 brass (tuning eye carriage)	2
24010	C20	cap., elec., 40 x 20 mf - 350V - 20 mf - 250V	1 ✓	41057	screw, #4-40 w/shank (small pulley axle)	2
50016	J1	outlet, convenience	1 ✓	41059	screw, #6-32 x 1 1/8	8
50011	J2,3	jack, dual phono	1 ✓	42000	washer, lock, 3/8	2
35024	L1,2	choke, 1.2 microhenry	2 ✓	42002	washer, lock, #6	27
35025	L3	choke, 2.2 microhenry	1 ✓	42004	washer, lock, #10	1
10431	R1,3,8	res., 470KΩ, 1/2W, ±10% (Y.V.Y.S)	3 ✓	42005	washer, flat, #6	4
10439	R2,6	res., 100Ω, 1/2W, ±10% (Br.Bk.Br.S)	2 ✓	42007	washer, lock, #4	13
10875	R4,7	res., 1.2KΩ, 1W, ±10% (Br.R.R.S)	2 ✓	42008	washer, lock, #8	4
10890	R5	res., 220Ω, 1W, ±5% (R.R.Br.G)	1 ✓	42032	washer, flat, #8	2
11527	R9	res., 100KΩ, 1/2W, ±5% (Br.Bk.Y.G)	1 ✓	42038	washer, special (keyed for drive shaft)	1
10852	R10,11	res., 15KΩ, 1W, ±10% (Br.G.O)	2 ✓	42039	washer, flat, #4	3
10448	R12	res., 68Ω, 1/2W, ±10% (Bl.Gy.Bk.S)	1 ✓	42040	washer, flat, fibre, 1/41D	1
10422	R13	res., 68KΩ, 1/2W, ±10% (Bl.Gy.O.S)	1 ✓	42505	pin, hair cotter	2
10432	R14	res., 1KΩ, 1/2W, ±10% (Br.Bk.R.S)	1 ✓	42506	ring, "C"	1
10442	R15	res., 1.5KΩ, 1/2W, ±10% (Br.G.R.S)	1 ✓	43006	lug, #4	3
10421	R16,17	res., 6.8KΩ, 1/2W, ±10% (Bl.Gy.R.S)	2 ✓	44010	spacer, aluminum 11/16" long	4
18044	R18	pot., 250KΩ (volume) w/SPST switch	1 ✓	44011	spacer, black 9/16" long	4
10407	R19	res., 1MΩ, 1/2W, ±10% (Br.Bk.G.S)	1 ✓	45002	standoff	2
10430	R20	res., 4.7KΩ, 1/2W, ±10% (Y.V.R.S)	1 ✓	45003	nut shoulder #8-32 (brass)	2
10849	R21	res., 47KΩ, 1W, ±10% (Y.V.O.S)	1 ✓	45004	eyelet	1
10853	R22,23	res., 10KΩ, 1W, ±10% (Br.Bk.O.S)	2 ✓	46000	grommet, 3/8 rubber	1
14500	R24	res., 500Ω, 5W, ±10%	1 ✓	46006	feet, rubber	4
14502	R25	res., 1.8KΩ, 5W, ±10%	1 ✓	47004	spring	1
	S1	switch, SPST, on R18	1 ✓	50012	insulator, bakelite	1
30024	T1	transformer, power	1	51006	plug, phono	2
34600	T2	transformer, I.F., 1st	1	51503	mounting clip	3
34601	T3	transformer, I.F., 2nd	1	53020	knob w/dot ✓	1
34602	T4	transformer, ratio detector	1	53019	knob without dot ✓	1
54513	TB1	terminal board, 2 post	1	57000	line cord	1
54004	TB2,4	terminal strip, 2 post w/ground	2	58004	wire, hook-up	length
54003	TB3	terminal strip, 2 post	1	58300	spaghetti	length
54013	TB5	terminal strip, 1 post left w/ground	1	58402	twin lead	length
54001	TB6	terminal strip, 1 post right	1	58408	cable, single cond.	length
54018	TB7	terminal strip, 4 post w/ground	1	58501	wire, bare #22	length
54007	TB8	terminal strip, 3 post - 2 right w/ground	1	66056	manual of instruction (wired)	1
90049	V1	tube, ECC85	1	66308	manual of instruction (kit)	1
90020	V2,3,4	tube, 6AU6	3	80059	panel	1
90017	V5	tube, 6AL5	1	81092	bottom plate ✓	1
90051	V6	tube, 6C4	1	81131	shield ant.	1
90036	V7	tube, 6X4	1	81132	bezel	1
90050	V8	tube, DM70 or DM71	1	81133	bottom cover RF assembly	1
	XV1	socket, supplied with RF assembly	1	81141	dial background plate ✓	1
97035	XV2,3,4	socket, 7 pin min. bottom mount/with center post	5	81142	bracket, left	1
	5,6,			81143	bracket, right	1
97024	XV7	socket, 7 pin min. bottom mount	1	81199	chassis ✓	1
97030	XV8	socket, 8 pin sub min. (prewired)	1	81903	cable clamp	1
37001		RF assembly	1	81904	bracket drive shaft	1
40000		nut, hex, #6-32	31	81907	carriage, indicator tube	1
40001		nut, hex, 3/8	2	82002	shaft, drive	1
40005		nut, hex, #10-24	1	85000	bushing drive shaft	1
40007		nut, hex, #4-40	16	89209	label, rear layout ✓	1
40008		nut, hex, #8-32	10	89210	label, tube layout ✓	1
40023		nut, tinnerman, retainer (for 8 pin min. socket)	1	89593	pulley, large	1
40026		nut, tinnerman, #8-32	6	89594	pulley, small	4
40027		nut, tinnerman, angle bracket	2	89595	flywheel	1 ✓
40030		nut, tinnerman, #4-40	1	89596	cord, dial	1 ✓
41000		screw, #6-32 x 1/4	17	89599	dial plate	1 ✓



NOTES:  
 1. UNLESS OTHERWISE SHOWN, RESISTANCE VALUES ARE IN OHMS; K=1000; MEG=1,000,000; 1/2 W, 10% CAPACITOR VALUES ARE IN MICROFARADS  
 2.  $\triangle$  INDICATES TEST POINTS

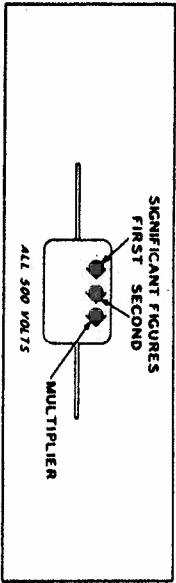


# MODEL HFT 90 HIGH FIDELITY FM TUNER

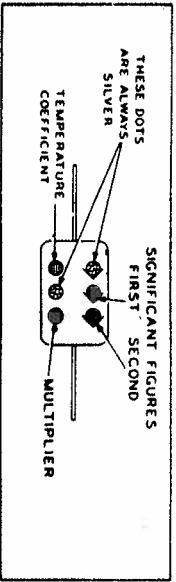


## CAPACITOR COLOR CODES

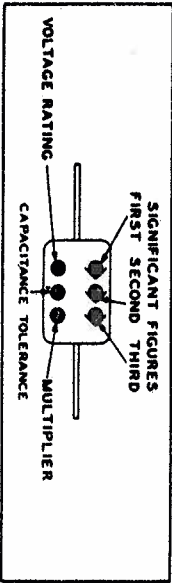
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



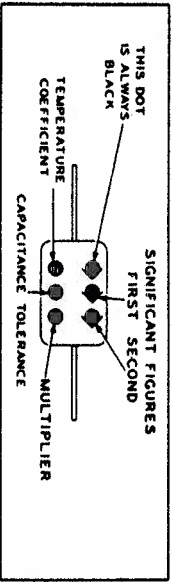
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



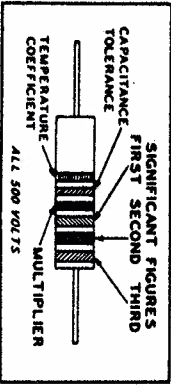
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



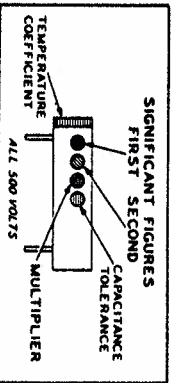
JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



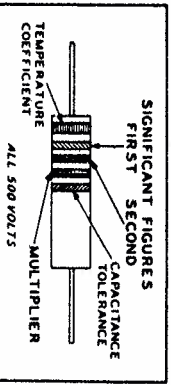
RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS RADIAL TYPE NON-INSULATED

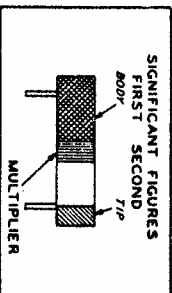
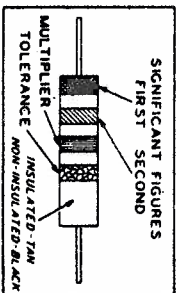


JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS AXIAL TYPE INSULATED

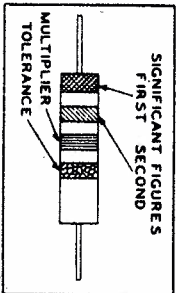


## RESISTOR COLOR CODES

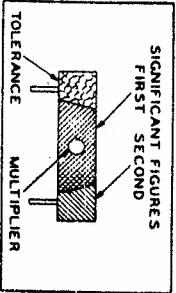
RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS



JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS AXIAL TYPE INSULATED

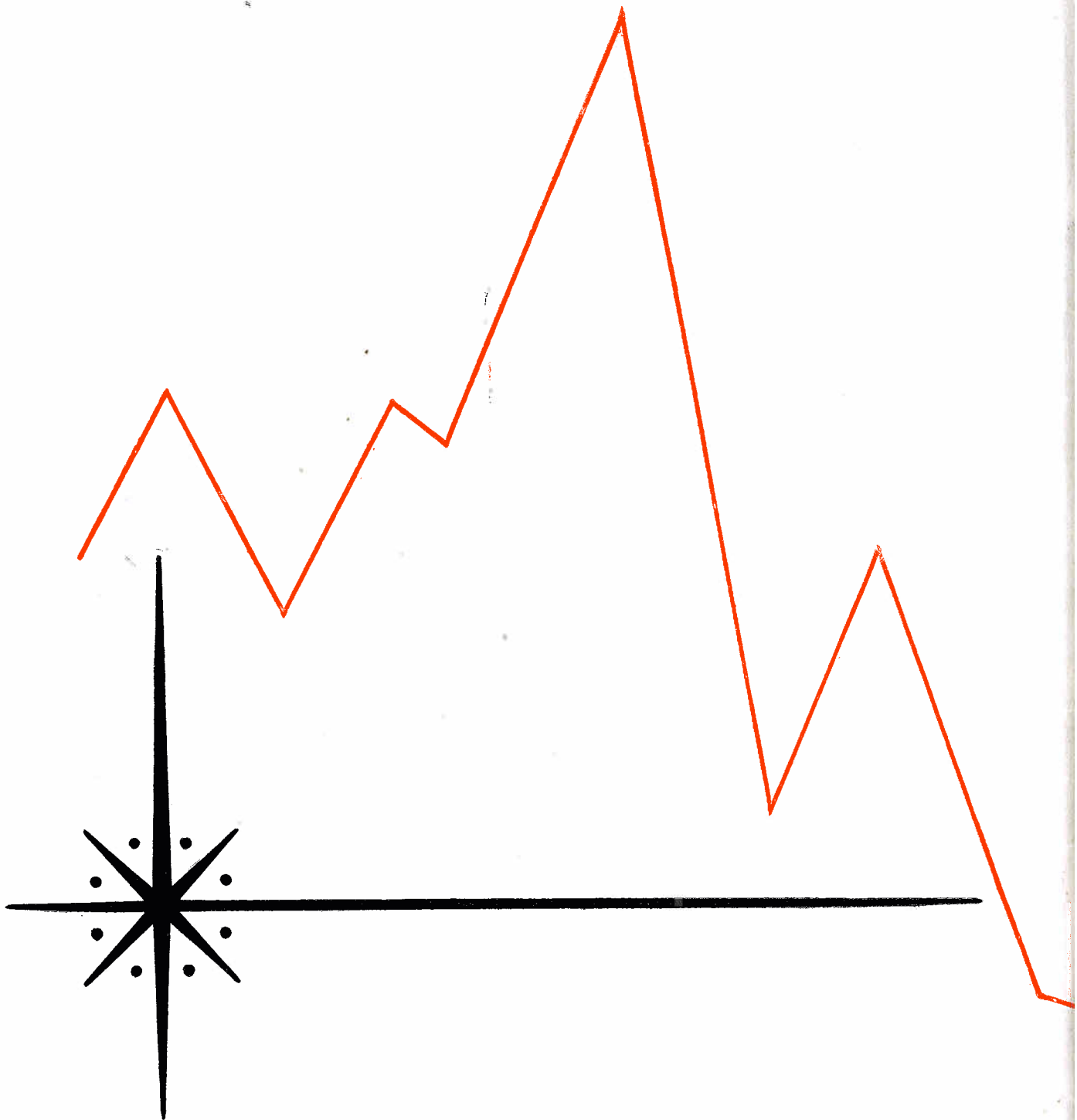


RADIAL TYPE NON-INSULATED



RESISTORS			CAPACITORS					
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC	VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	1	1	1	100	A
	10	1	BROWN	10	10	10	200	B
	100	2	RED	100	100	100	300	C
	1000	3	ORANGE	1000	1000	1000	400	D
	10000	4	YELLOW	10000			500	E
	100000	5	GREEN	100000			600	F
	1000000	6	BLUE	1000000			700	G
	10000000	7	VIOLET	10000000		0.01	800	
	100000000	8	GRAY	100000000		0.1	900	
	1000000000	9	WHITE	1000000000			1000	
	0.1		GOLD	0.1	0.1		2000	
	0.01		SILVER	0.01	0.01		3000	
			NO COLOR				500	

\$1.00



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