



MODEL HF-81

DUAL 14 WATT HI-FI STEREO AMP-PREAMP

general description

GENERAL

The EICO Model HF-81 is a complete high fidelity stereophonic control center and a pair of 14 watt amplifiers, all on one chassis. With it you can select preamplify, and control accurately any stereophonic source (tape, discs, or broadcasts) and feed it through the self-contained dual 14 watt amplifiers to a stereo pair of speaker systems. When you play a monophonic source, the 14 watts available per channel adds up to a total of 28 watts for your two speaker systems. If you desire, both amplifiers can be connected in parallel and driven by one preamplifier-control section while the other preamplifier-control section is free to drive an external power amplifier. In this way your old amplifier can be put to use in a stereophonic system. Construction is of the "low silhouette" type that permits you to dispense with cabinetry if desired.

FEATURES

1. Separate low level input in each channel for mag. phono, tape head, and microphone. Circuitry carefully designed to provide the high gain required by tape heads and high quality, low output mag. cartridges without hum and noise problems. A front panel switch permits choice of the proper NARTB tape head equalization for either 7 1/2 & 15 or 3 3/4 ips tape speeds.
2. Separate high level inputs for AM, FM, and FM Multiplex. Also two auxiliary A inputs (one in each

channel) and two auxiliary B inputs (one in each channel). Input Selector switch on front panel has positions for feeding FM tuner output to one channel and AM tuner to other, or FM tuner to one channel and FM Multiplex adapter output to other.

3. May be used as either two independent amplifier-preamplifiers, or one preamplifier-control section may be set free to operate an external power amplifier and the other preamplifier-control section used to drive both internal power amplifiers connected in parallel at the speaker connection terminals. A top-of-chassis slide switch permits choice of operation.
4. Ganged level controls and a separate focus (balance) control.
5. Independent full-range bass and treble tone controls in each channel. Tone controls of the low distortion variable cross-over feedback type.
6. Identical Williamson type, push-pull EL84 power amplifiers with high quality output transformers.
7. Hum balance control, panel-mounted fuse, pilot lamp, convenience outlets.
8. EICO "low silhouette" construction employing horizontal chassis for proper layout and component separation. Easy console installation, if desired, with complete shielding and adaptability to any panel thickness.

SPECIFICATIONS *

Output Power: 28 watts continuous; 56 watts peak.

IM Distortion (60 c & 7 kc at 4:1): 2% at 28 watts; 0.5% at 10 watts.

Frequency Response: (2w) ± 0.5 db 10 c to 100 kc.

Harmonic Distortion: 16 watts at less than 1% 30 c to 10 kc; 20 watts at less than 1% 40 c to 10 kc; 28 watts at less than 1% 50 c to 5 kc; 8.4 watts at less than 2% at 20 c.

Transient Response: excellent square wave reproduction (4 usec risetime) negligible ringing, rapid settling on 10 kc square wave.

Transient Distortion (60 cps tone burst): less than 1% at full power.

Inverse Feedback: 20 db

Stability Margin: 12 db

Damping Factor: above 8, 20 cps - 15 kc.

Sensitivity (input for rated output): mag. phono 4 mv; tape head 7.5 ips - 2 mv; tape head 3.75 ips - 3.5 mv; mic - 6 mv; tuners, auxiliaries - 0.5 V.

** Hum & Noise Level (below rated output): mag. phono - 60 db; tape head - 51 db; mic - 57 db; tuners, auxiliaries - 75 db.

Tone Control Range: ± 15 db at 50 c and 10 kc.

Speaker Connections: 4, 8, and 16 ohms.

Tubes: 4 - ECC83/12AX7, 2 - ECC82/12AU7, 4 - EL84, 2 - EZ81.

Size: 15" wide, 4 3/4" high, 10 1/2" deep.

Weight: 24 lbs.

* Where power output is involved, figures are given for two channels combined; divide power output figures by two for specifications of each channel alone. Design property specifications refer, of course, to either or both channels.

** Measured with tone controls set "flat", LEVEL control maximum, and FOCUS control set for maximum gain in channel checked.

mechanical installation

GENERAL

a) **HEAT DISSIPATION (VENTILATION):** In common with other electronic equipment, the HF-81 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 curtailed.

It is useful to understand the process of convection whereby heat is removed in judging the suitability of a location. Air heated by the heat-producing elements expands and rises; cool air is drawn from beneath to take the place of the heated air. In this manner, a stream of air is set in motion which continually removes heat from the amplifier. (In particular, we are mainly concerned with the major heat-producing elements; the four EL84 output tubes and the two EZ81 rectifier tubes.) If there is any impediment to or constriction of the air flow, the essential process of heat removal will be adversely affected.

Adequate ventilation will be provided if the amplifier is installed in an open-back console provided that the top of the amplifier 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 alternate, 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 amplifier 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 amplifier will not mar the surface of furniture on which it is placed.

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

c) **ACCESSIBILITY TO PARTS:** Tubes are the most frequently replaced items in electronic equipment. If the amplifier is installed in a console, sufficient space should be allotted to reach and remove any tube in the amplifier. Furthermore, input and output terminals of the amplifier should be accessible to permit easy interchanging of system components for comparison, and connection or disconnection of a portable tape recorder which is stored away when not in use. If antennas are strung around the back of the console in which the amplifier is installed, arrange them so they will not interfere with access to the amplifier.

d) **ACOUSTICAL ISOLATION:** If amplifier and speaker are installed in the same cabinet (not recommended), provide sufficient separation to minimize mechanical speaker vibration reaching the amplifier. The minimum separation is about one foot.

CONSOLE MOUNTING

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. Note: When shelf is not available, tape the template at any convenient spot on the face of the console. (2) Use an awl or a nail to pierce the centers of the four extreme outer holes for mounting the control plate, to transfer their locations to the console panel beneath. (3) Trace out the rectangular cutout with an awl or nail and then pierce the centers of the four 1/2" holes, one in each corner of the cutout. (4) Remove the panel template. (5) Drill the four 1/2" holes in the console panel, one in each corner of the rectangular cutout area. Cut out the rectangular piece with a keyhole saw, using the four 1/2" holes as starting holes.

b) Amplifier mounting in console: (1) Pull off the control knobs. (2) Remove the four screws that fasten the bezel to the side pieces and remove the bezel. (3) Remove the two screws and nuts that fasten the control plate to the bezel. The bezel is not used in console mounting. (4) Fasten the control plate to the console panel with the two #4 x 3/8 wood screws supplied. (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 slide switch support bracket is up against the panel and the slide switch accessible from the front; the control shafts should be approximately centered in the corresponding holes in the control plate. (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 remove the knobs and take the chassis off the shelf. (9) Remove the 6 screws which fasten the bottom plate to the chassis. (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) Refasten the bottom plate to the chassis, 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 chassis. (13) Replace the chassis on the shelf, positioning it exactly in the outline previously drawn, and restore the knobs. This time make sure that the indicator dot on each knob 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 chassis flange and when tightened secure the chassis to the shelf.

electrical installation

The HF-81 can be used in two ways for a stereophonic system. In all cases, plug monophonic sources and one track of monophonic/stereophonic sources in the channel 1 inputs; plug the other track of stereo sources in the channel 2 inputs. It is assumed in what follows that a stereophonic phono cartridge is being used. Monophonic phono refers to playback of a monophonic recording with a stereophonic cartridge.

a) INTERNAL POWER AMPLIFIERS OPERATED SEPARATELY, EACH DRIVING ONE SPEAKER OF A STEREO PAIR. This arrangement is used when there is no other amplifier the user desires to include in the system. The SERVICE SEL. slide switch on top of the chassis must be set to SEP-arate. Signal connections are all internal, so only the speaker connection need to be shown (Fig. 1a, rear chassis view). The internal arrangement in the HF-81 at each of the positions of the FUNCTION selector are shown in Figs. 1b, 1c, 1d, 1e, 1f, and 1g, as an aid to understanding the operation with this arrangement.

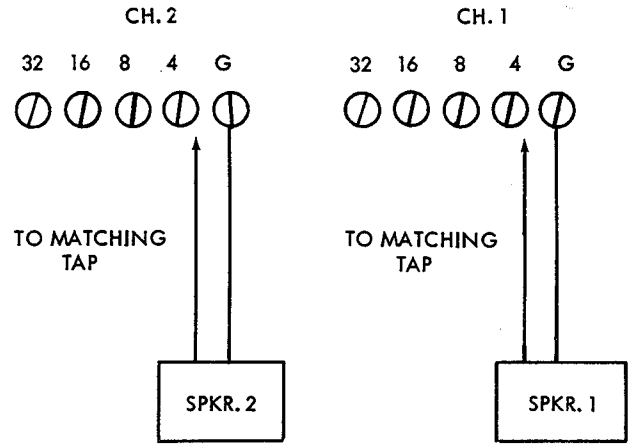


FIG. 1a. SPEAKER CONNECTIONS

FIG. 1b
CHECK AMPL. 1

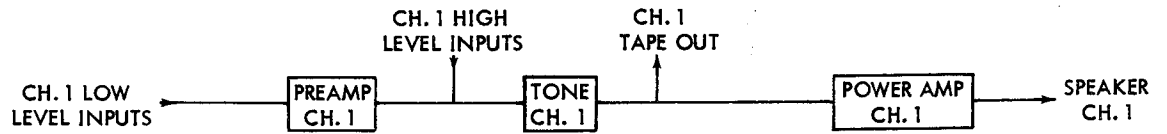


FIG. 1c
CHECK AMPL. 2

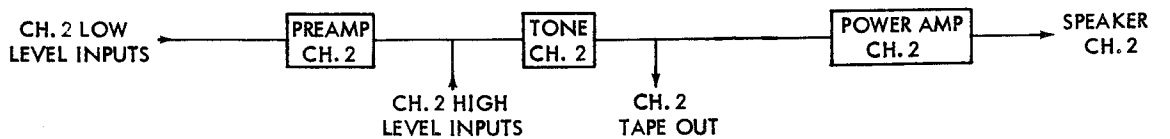


FIG. 1d
STEREO NORMAL

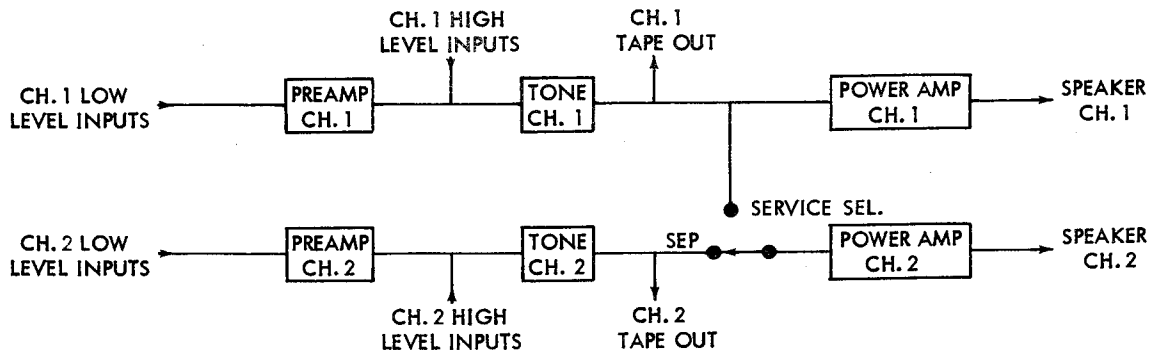


FIG. 1e
STEREO REVERSE

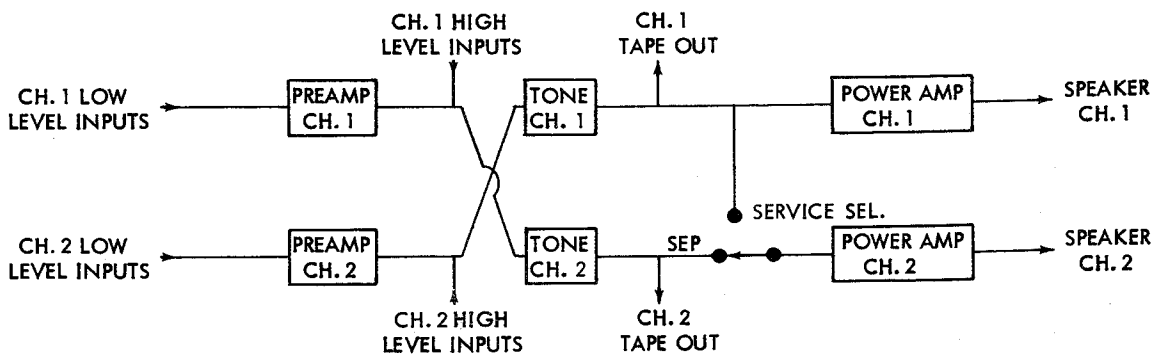


FIG. 1f
MONOPHONIC TUNER,
TAPE, TV

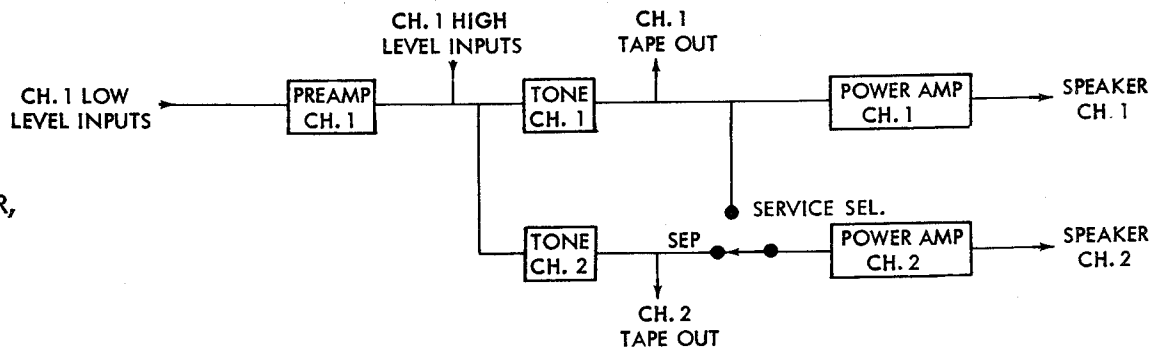
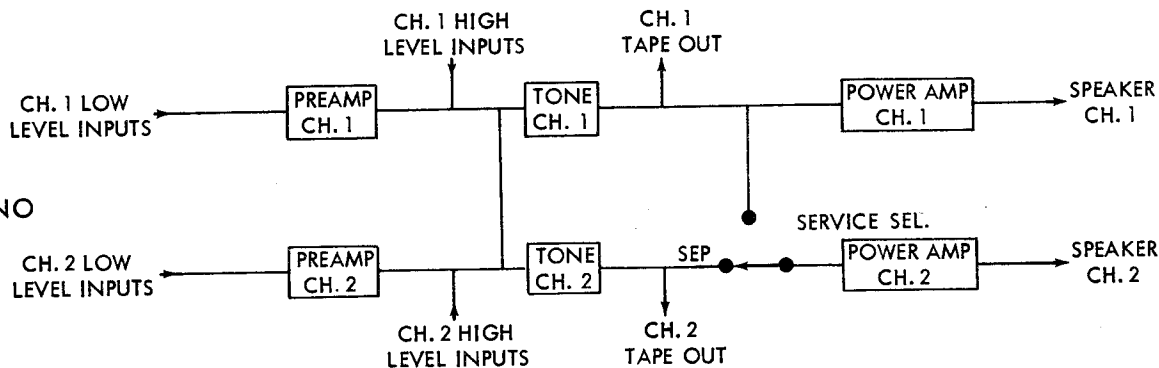
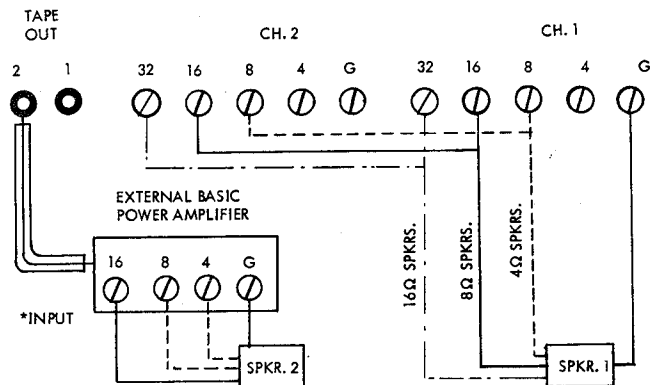


FIG. 1g
MONOPHONIC PHONO



b) INTERNAL POWER AMPLIFIERS COMBINED (TIED TOGETHER AT THE INPUTS AND PARALLELED AT THE OUTPUTS) TO DRIVE ONE SPEAKER OF A STEREO PAIR. This arrangement is employed when the user already has a high quality amplifier (usually 20 watts or more if it is to be worthwhile) which he desires to include in the system. The preamp-tone control combination including the regular CH1 tone control feeds the combined internal power amplifiers; the preamp-tone control combination including the regular CH2 tone control feeds out through the CH2 TAPE OUT jack to an external power amplifier. The SERVICE SELECTOR switch on the chassis must be set at the COMBINED position for this service in order to disconnect the input of the CH2 power amplifier from the output of the CH2 tone control and connects it instead to the input of the CH1 power amplifier. The CH1 and CH2 power amplifiers are paralleled at the outputs, as shown, by an external jumper connected between corresponding speaker connection taps. The external signal connection and the speaker connections are shown in Fig. 2a. The internal arrangements in the HF-81 at each of the positions of the FUNCTION selector are shown in Figs. 2b, 2c, 2d, 2e, 2f, and 2g, as an aid to understanding the operation with this arrangement.



* On integrated amplifiers HF20, HF32 feed into TAPE OUTPUT jack; on HF52, feed into ELECTRONIC CROSS-OVER INPUT jack, after severing connection between ELECTRONIC CROSSOVER IN and OUT jacks.

FIG. 2a. SPEAKER & EXTERNAL
SIGNAL CONNECTIONS

FIG. 2b
CHECK AMPL. 1

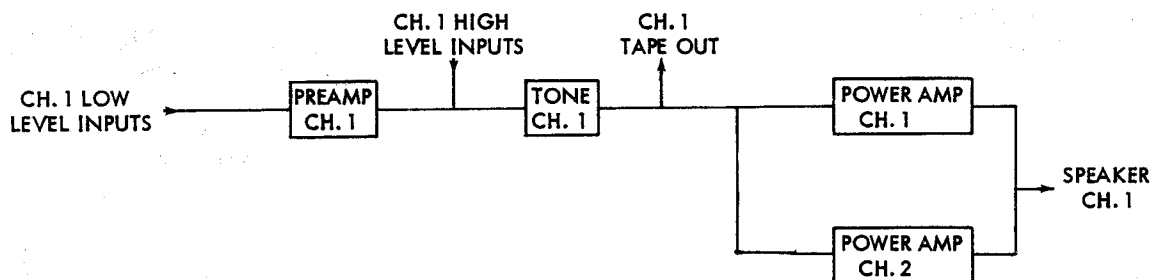


FIG. 2c
CHECK AMPL. 2

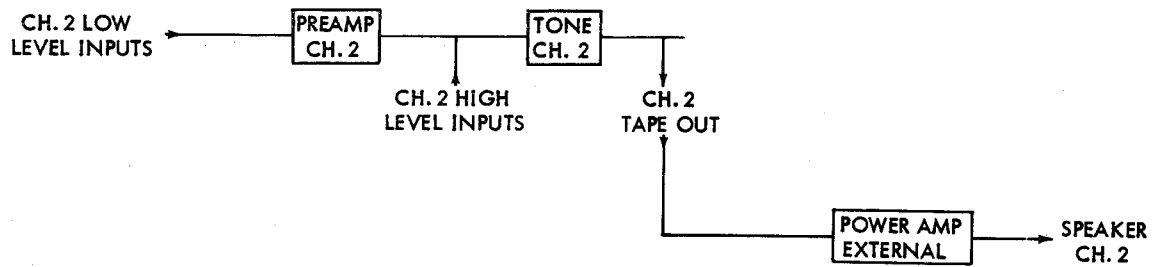


FIG. 2d
STEREO NORMAL

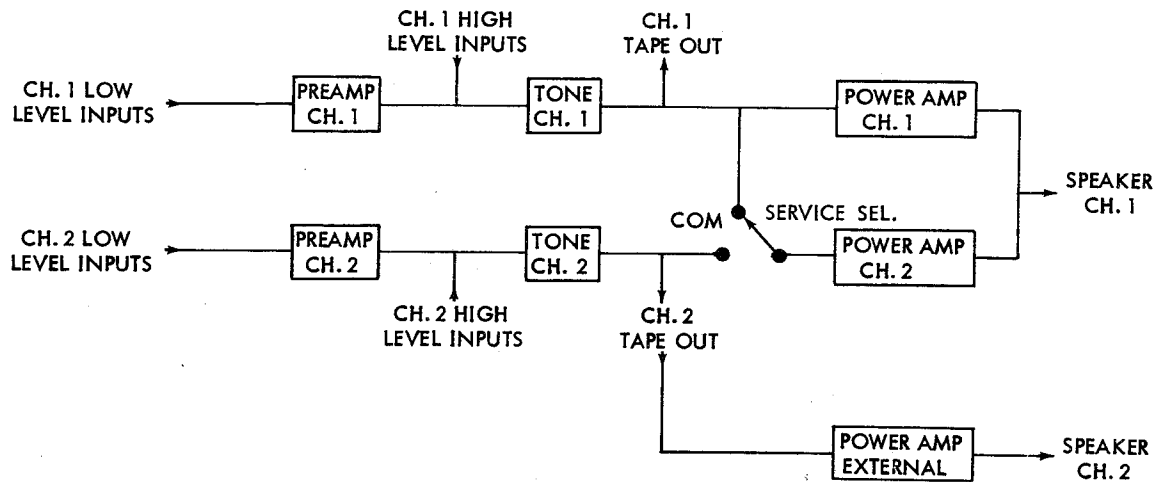


FIG. 2e
STEREO REVERSE

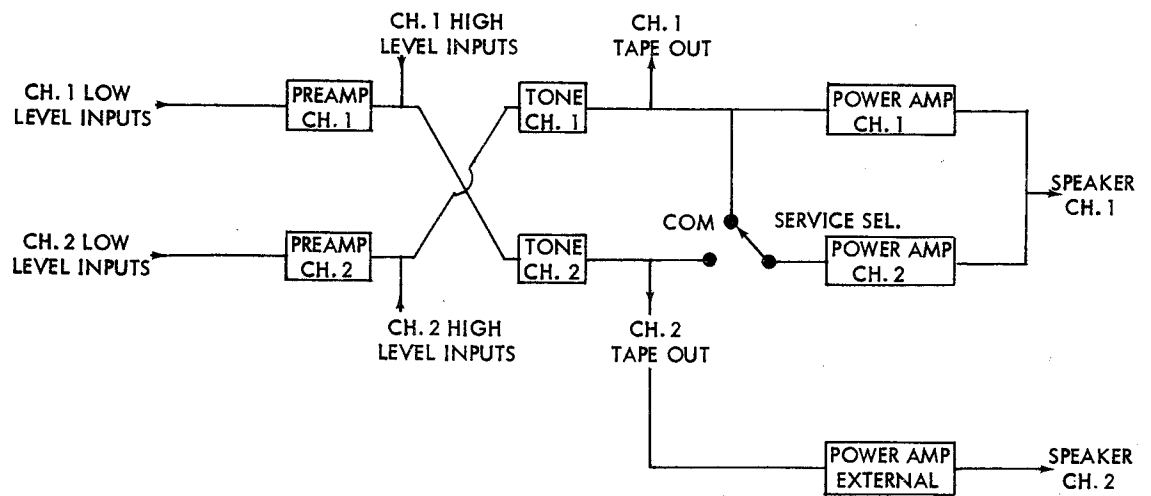


FIG. 2f
MONOPHONIC TUNER,
TAPE, TV

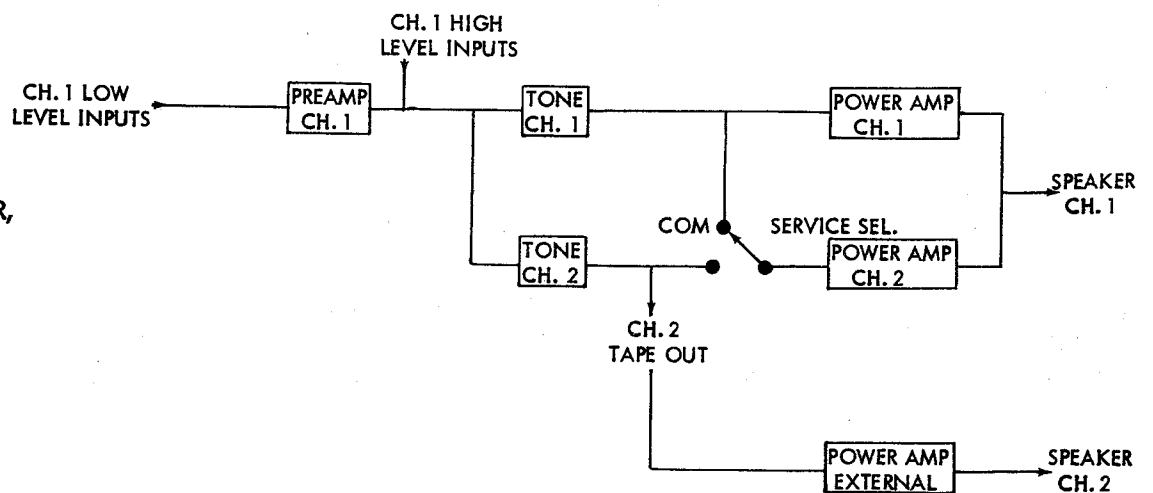
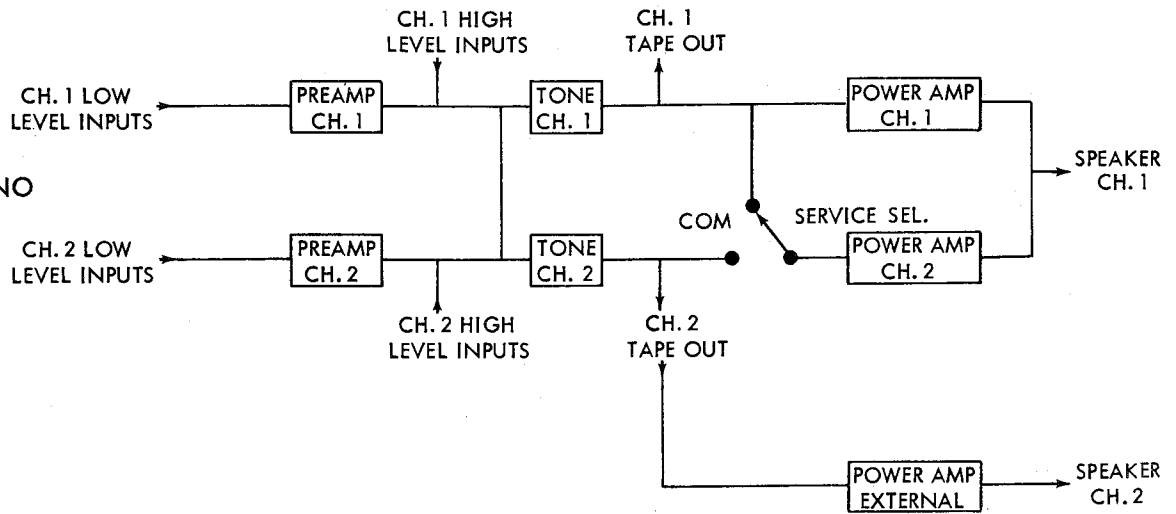


FIG. 2g
MONOPHONIC PHONO



c) **INPUTS:** There are identical pairs of MAG. PHONO, TAPE HEAD, MICROPHONE, AUXILIARY A, and AUXILIARY B inputs — one of each pair in channel 1 and channel 2 — and each is identified accordingly by the suffix 1 or 2. The MAG. PHONO, TAPE HEAD, and MICROPHONE pairs of inputs are all "low level" inputs, meaning that they all feed through a preamplifier/equalizer stage in either channel 1 or 2. The AUXILIARY A and AUXILIARY B pairs of inputs are "high level" inputs, meaning that they enter either channel 1 or 2 at a point after the preamplifier/equalizer stages. The AM, FM and FM-FM Multiplex inputs are also "high level inputs", which are internally selected in pairs — one for each channel — by the INPUT SEL. switch. At the MONAURAL position of the FUNCTION SEL., AM only is selected at the AM-FM position of the INPUT SEL., and FM only is selected at the FM-FM MULTI. position of the INPUT SEL.

1) **MAG. PHONO 1, MAG. PHONO 2:** These inputs are intended for the two outputs of a stereo magnetic cartridge, or for a stereo ceramic cartridge with adaptors. The correct method for wiring a three terminal cartridge is shown in Fig. 3. If the cartridge is a four terminal type, short the two inside terminals of the cartridge together and treat it exactly as if it were the single center terminal shown in Fig. 3. The loading presented to each output of the cartridge by each MAG. PHONO input is 100,000 ohms. If a lower loading resistance is required by the particular cartridge used, connect a shunt resistor of appropriate value from each outside terminal of the cartridge to the center (common) terminal. This can be done actually by mounting a 3-post terminal strip on the underside of the phonograph mounting board at a point near the lead break-out from the pickup arm. These shunt resistors are then wired to this terminal strip as shown in Fig. 3. The value of each of the two shunt resistors (R_s) can be determined from the desired loading resistance (R_l) by this formula

$$R_s = \frac{100,000 \times R_l}{100,000 - R_l} \text{ ohms}$$

or this table; for $R_l = 50K\Omega$, use $R_s = 100K\Omega$; for $R_l = 33K\Omega$, use $R_s = 50K\Omega$; for $R_l = 25K\Omega$, use $R_s = 33K\Omega$.

* **NOTE:** All ceramic cartridge manufacturers have developed simple networks which when connected the outputs of their cartridges result in a characteristic identical to that of magnetic cartridges. By interposing the recommended adaptor for the particular ceramic cartridge between the cartridge outputs and the MAG. PHONO inputs of the amplifier, it is possible to use the MAG. PHONO inputs for the ceramic cartridge with excellent results. Adaptor networks are given in the literature for the particular ceramic cartridge and can be built on a terminal strip mounted on the underside of the phonograph base, or may be available in convenient component form from the cartridge manufacturer. Stereophonic crystal cartridges (Ronette "Binofluid" OV and BF40) can be connected directly to auxiliary high level inputs.

2) **TAPE HEAD 1, TAPE HEAD 2:** These inputs are intended for direct connection to the two outputs of a stereo tape playback head. A front panel slide switch permits choice of NARTB tape head equalization either for 7 1/2 (& 15) ips or 3 3/4 ips tape speeds. The loading resistance presented by each tape head input is 100,000 ohms.

3) **MICROPHONE 1, MICROPHONE 2:** These inputs are intended for receiving the output signals directly from two separate microphones. It is preferable that the microphones used be of the high impedance type.

4) **AUXILIARY A1, AUXILIARY A2:** These inputs are intended for either a stereophonic or monophonic high level source. A stereophonic high level source might be a stereo tape deck with built-in playback equalization for both tracks. A monophonic high level source might be a monophonic crystal cartridge or tv sound. Plug a monophonic source into AUXILIARY A1, leaving the AUXILIARY A2 input unused. Note that the input impedance at all these high level inputs is 0.5 megohm, which is too low for ceramic cartridges requiring 2 to 3 megohms input impedance. For ceramic cartridges, use the MAG. PHONO inputs with the simple adaptor networks recommended by the manufacturers. For stereophonic crystal cartridges (Ronette "Binofluid" OV turnover and BF40 single needle), the 0.5 megohm load provided at the high level inputs is exactly the loading impedance required.

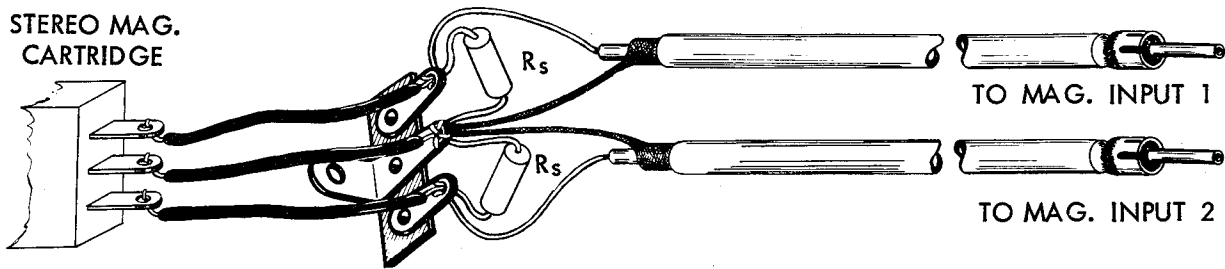


FIG. 3

5) AUXILIARY B1, AUXILIARY B2: Same as for AUXILIARY A1, AUXILIARY A2 above.

6) AM: This input is intended for AM tuner or the AM output of an FM-AM tuner where the FM and AM sections are independent.

7) FM: This input is intended for an FM or FM-AM tuner where the FM and AM sections are not independent.

8) FM MULTIPLEX: This input is intended to receive the output from an FM Multiplex adaptor.

NOTE: A shielded cable with a shielded "phono-type" plug should be used to connect from each of the above-

mentioned sources to the corresponding amplifier input jack. Unless the source has a low-impedance output such as a cathode follower (with which up to 50ft. of cable can be used), use the shortest possible connection and low-capacity shielded cable (cable having as low as 25mmfd capacitance per foot is available).

d) TAPE OUTPUT 1, TAPE OUTPUT 2: When no external amplifier is used in the system, both these outputs are available for feeding out to a stereo recorder. When an external power amplifier is used in the system, TAPE OUTPUT 2 is used to feed out to the external power amplifier. If it is desired to do stereo recording under the latter conditions, construct a device such as shown in Fig. 4. Use low capacity shielded cable for connections.

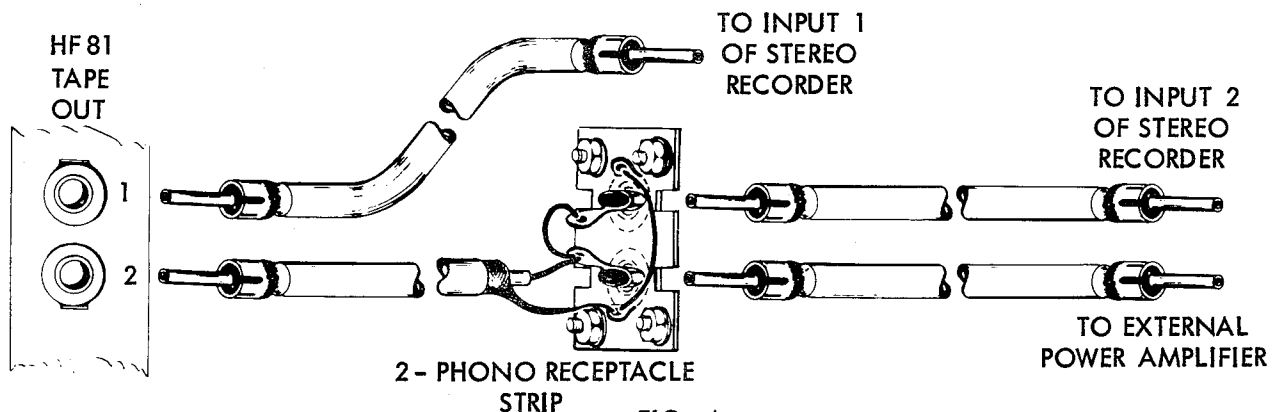


FIG. 4

e) POWER CONNECTIONS: The line cord of the HF-81 must be plugged into a house outlet providing normally 117 volts, 60 cycles AC power. A convenience receptacle on the rear chassis can be used, if desired, with a cube tap to provide 117VAC power to the associated equipment. This convenience receptacle is not switched or fused and provides 117VAC at all times, regardless of whether the HF-81 is turned on or off.

HUM ADJUSTMENT

After checking the amplifier for proper operation, remove all input cables to the amplifier and make the following control settings which hold throughout the process of hum adjustment: INPUT SELECTOR at PHONO, FUNCTION SELECTOR at STEREO, FOCUS control at 0, LEVEL control at 10, both TREBLE controls at -5, both BASS controls at 0; the two speaker systems must be in phase and placed near one another for this adjustment. Next, procede as

follows: With your ear held close to the speakers, insert the amplifier power plug into the wall outlet and listen to the hum level. Now pull out the plug and re-insert it with the prongs reversed. Choose the prong position with the least hum. Now connect the tuner input connector to the amplifier input jack, and with the tuner set between stations and the tuner volume control set at a minimum, do the same with the power plug of the tuner; use either the 117VAC receptacle on the HF-81 or one receptacle of a cube tap inserted in the 117VAC receptacle on the HF-81. Next, connect the phono cartridge leads to the MAG. PHONO 1 and 2 inputs, and, with turntable off and pick-up arm at the rest position, find the insertion position of the turntable line cord plug that yields lowest hum. Finally, connect the tape head leads to the TAPE HEAD 1 and 2 inputs, and, with the tape deck turned off, find the insertion position of the tape deck line cord plug that results in lowest hum. When all of this is completed, adjust the hum balance control on top of the amplifier chassis for least hum.

operation

PRELIMINARY: Be sure all tubes are firmly seated in their sockets and that the tube shields are making good contact with their bases. As initial adjustments, set these controls as follows: LEVEL at 0, FOCUS at 0, both BASS controls at 0. Turn the amplifier on by turning the TREBLE 2 control clockwise from AC OFF and set it at zero initially. Also set the TREBLE 1 control at zero. Please note that in the instructions that follow, it is assumed that a stereo pick-up and/or a stereo tape head is being employed in the system.

LISTENING TO PHONOGRAPH: Set the INPUT SELECTOR to PHONO if you have a magnetic cartridge or a ceramic cartridge with adaptors interposed between the cartridge outputs and the MAG. PHONO 1 and 2 inputs. (The RIAA equalization provided at the PHONO position is now the international standard in the recording industry for both monophonic and stereophonic records and is also a very good compromise for the most important of the older monophonic recording characteristics.) Set the INPUT SELECTOR to AUX A or AUX B if you are using a stereophonic crystal cartridge (Ronette) connected to either AUX A or AUX B inputs. Set the FUNCTION SELECTOR at either STEREO position. To balance levels between the channels, play a conventional monophonic (lateral) recording on the changer or turntable and turn the LEVEL control up until you have normal listening level. Note that the action of the FOCUS control (sometimes called a "balance" control) is to simultaneously raise the level in one channel while lowering the level in the other as it is turned in any one direction. At the zero setting of the FOCUS control, equal sound volumes would obtain on both channels only if the ideal conditions of identically efficient loudspeakers and identical overall gains in both channels existed. With the conventional monophonic recording being played, adjust the FOCUS control for equal volume from each speaker system. With the FOCUS setting properly made, any stereo recording played back will have close to the same balance as actually exists in the recording. The FOCUS control setting can be a semi-permanent adjustment in that, at any given time, the setting achieved as described above will usually be satisfactory for tape stereo, and may also be for broadcast stereo, if it means exist of adjusting for equal output levels from the stereo broadcast receiving equipment. As components age, a shift of the normal FOCUS control setting may be necessary. Note that there are a concentric pair of bass controls, one in each channel and a concentric pair of treble controls, one in each channel. Use the separate bass and treble controls to compensate for any audible deviation of the recording from the standard recording characteristic, as well as to compensate for the over-all characteristics of your audio system (including room acoustics). Set the FUNCTION SELECTOR to STEREO NORMAL or STEREO REVERSE for stereophonic records and to MONOPHONIC PHONO for CONVENTIONAL MONOPHONIC records.

LISTENING TO TAPE DECK (direct connection to tape

head): Set the INPUT SELECTOR to TAPE. NARTB tape head equalization is provided in both channels for the tape speed selected with the TAPE switch on the front panel. One position is for 7 1/2 and 15 ips tapes and the other for 3 3/4 ips tapes. These equalizations are the industry standard for pre-recorded stereophonic and monophonic tapes. If the FOCUS control has been set as described in the preceding paragraph, it will usually be satisfactory for this function also. Otherwise, it may be set in a similar manner using a test tape or simply by ear. Set the FUNCTION SELECTOR to STEREO NORMAL or REVERSE for stereophonic tapes or to MONOPHONIC TUNER, AUX for monophonic tapes. Use the BASS and TREBLE tone controls as described above.

LISTENING TO A MONOPHONIC SOURCE CONNECTED TO AUXILIARY A1, AUXILIARY B1, TO MONOPHONIC AM BROADCAST, OR TO MONOPHONIC FM BROADCAST: Set the INPUT SELECTOR to AUX. A, AUX. B, AM-FM, or FM-MULTI, respectively and the FUNCTION SELECTOR to MONOPHONIC TUNER, AUX. Use the BASS and TREBLE controls as described previously.

LISTENING TO A STEREOHONIC SOURCE CONNECTED TO AUXILIARY A1 and A2, AUXILIARY B1 and B2, AM and FM, FM and FM MULTIPLEX: Set the INPUT SELECTOR to AUX A, AUX B, AM-FM, or FM-MULTI respectively. Set the FUNCTION SELECTOR at STEREO NORMAL or STEREO REVERSE. The FOCUS, BASS and TREBLE controls are set as described previously.

MAKING RECORDINGS: Tape recordings may be made by connecting the recorder to the TAPE OUTPUT jacks. See "TAPE OUTPUT 1, TAPE OUTPUT 2" under ELECTRICAL INSTALLATION. Please note that recordings cannot be made on tape decks unless those decks are equipped with the electronics required for recording.

FUNCTION SELECTOR: The STEREO NORMAL and STEREO REVERSE positions are both used for stereophonic reproduction. At the STEREO REVERSE position, the channel 1 and channel 2 amplifiers from the tone controls to the speaker connections are interchanged. These two positions permit interchanging the signals fed to the two speakers so that the correct left to right display of the orchestra can be achieved on all recordings or broadcasts. The CHECK AMPL. 1 and CHECK AMPL. 2 positions permit hearing either channel 1 alone or channel 2 alone for comparison or balancing purposes during stereophonic use. The MONOPHONIC TUNER, AUX position is used for monophonic FM, AM, tv sound, monophonic phono cartridge monophonic pre-amplified tape etc., fed into channel 1 inputs. At this position, the channel 2 inputs which are unused in this type of operation, are disconnected from the active channel so that they cannot contribute interference. At the MONOPHONIC PHONO position, the channel 1 and 2 corresponding inputs are mixed, which is useful when playing monophonic records with a stereophonic cartridge to cancel vertical rumble components.

BASS CONTROL 1, BASS CONTROL 2 (CONCENTRIC):

The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) bass response; the minus sign on the left side indicates that counter-clockwise rotation from the mid-point decreases (cuts) bass response. There is no interaction with the TREBLE control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since bass response is neither cut nor boosted at this position.

TREBLE CONTROL 1, TREBLE CONTROL 2 (CONCENTRIC):

The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) treble response; the minus sign indicates that counter-clockwise rotation from the mid-point decreases (cuts) treble response. There is no interaction with the BASS control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since treble response is neither cut nor boosted at this position.

maintenance

GENERAL

Your amplifier should require little service except for normal tube replacement. We recommend no substitutions for the tube types used in this amplifier except as stated. All the tube types used are distributed nationally, but replacements can be obtained directly from EICO if desired.

To facilitate servicing, remedial and trouble-shooting procedures have been provided in the TROUBLE-SHOOTING CHART that follows. A VOLTAGE AND RESISTANCE CHART is also provided as an aid in locating defective components. DC operating voltages are given both at no signal and signal developing 14 watts output, as well as the corresponding 1 kc signal voltages.

TROUBLE-SHOOTING PROCEDURES

Connect the leads from the stereo cartridge and from the two speakers to the amplifier. These connections are made as described in the section "Electrical Connections". Set the Input Selector control at PHONO and the Function Selector at STEREO. Play a known high quality stereo recording on the phonograph. If there is no output to the speaker or if the output is low or audibly distorted, proceed to the checks for those symptoms. If there is excessive hum in the output, disconnect the phono input cable from the amplifier and short the phono input jack to chassis. If the hum disappears, the trouble is not in the amplifier but in the phonograph or in the connection to the amplifier. In each case, check for the trouble in the amplifier which seems defective. If both amplifiers are defective, check the power supply.

The cause of phonograph hum may be a metal pick-up arm not grounded to the cable shield (try a good single ground connection to the cable shield from turntable frame, pick-up arm, and cartridge case), direct hum pick-up by the magnetic cartridge from the record player motor (try using a rubber mat on the turntable to increase the separation of the pick-up from the motor), or pick-up from a power transformer or other magnetic field in the vicinity (try moving phonograph away from suspected source). Check also that the phono input cable shielding is grounded to the amplifier chassis at one point only, through the skirt of the input connector where it plugs into the amplifier. Finally, try a good building ground such as a connection from a cold water pipe terminated under speaker terminal

"G" on the amplifier. Do not connect such a ground wire to other components in the system. If possible, let each channel be connected to the amplifier using a separate shielded cable to the amplifier input. It is also desirable that the ground leads on both cables not be connected together at any point — not even at the cartridge. However, with some cartridges, it will not be possible to do this. In this case, just disregard this last instruction.

Excessive hum on other inputs may be checked in a similar manner. Disconnect the input cable in question and short the particular input jack to the chassis. If the hum disappears, the trouble is external to the amplifier. Note that on all inputs, the braid of the input cable should connect to the amplifier only through the skirt of the input connector. The cause and remedies for the following symptoms are then based on the assumption that checks made in the manner described above have eliminated the possibility of the trouble being external to the amplifier.

If the trouble is no output or low output, check AC signal voltages and DC operating voltages starting at the input and work step-by-step toward the output in each amplifier. Set the VOLUME control to maximum (10), the FOCUS, BASS and TREBLE controls to their mid-points (0), the INPUT SELECTOR to PHONO and the FUNCTION SELECTOR to STEREO. Use a 1000 cycle sine-wave signal, such as supplied by the EICO 377 Sine & Square Wave Audio Generator. In addition, use a precision 100:1 attenuator to permit obtaining a level of 0.0035 volt fed into MAG. PHONO from an audio generator output of 0.35 volts, which can easily be measured on the lowest AC volts range of your VTVM (also improves signal to hum from generator). Use a high input impedance VTVM for all AC signal voltage measurements; a VTVM or 20,000 Ω/v VOM for DC volts measurements.

If the trouble is an excessively distorted output, try tube replacement, signal tracing, or proceed directly to voltage and resistance measurements.

When the defective stage is localized, proceed to a resistance and voltage check of the stage, using the data in the VOLTAGE and RESISTANCE chart. Disconnect the amplifier from the power line and discharge capacitors prior to making any resistance check and prior to removing any or all of the EL84 output tubes. Do not turn the amplifier on with any of the output tubes removed.

CHECKING A TYPICAL TUBE STAGE

1. Check tube.
2. Check plate and cathode resistor.
3. Check coupling capacitors for leakage or short.
4. For output stage, check dc resistance of transformer windings.
5. Check grid leak resistor for open.
6. Check cathode by-pass capacitors for short.
7. If no or low B+ voltage on tube, check decoupling path for open or defective R60, R61, R62, R63 and filter capacitor C37, C38 or C39.
8. If wiring and circuit components including the tube check O.K. and B+ voltage is excessive, check the decoupling path for short or defective R60, R61, R62 and R63.

Suspected trouble in the equalization, tone, focus, and volume controls and networks should lead to specific resistance and capacitance checks to localize the trouble. In general, if the user suspects poor frequency response, defective equalization, or defective operation of the tone controls, the amplifier should be tested thoroughly with audio generator, vtm, and scope.

SPEAKER PHASING

IMPORTANT NOTE ON SPEAKER PHASING: The two loudspeaker systems must be connected so that they operate in phase, meaning that corresponding cones or diaphragms in the systems move in and out together when actuated by the same or similar signals. A simple method of checking this is to play a conventional monophonic (lateral) recording having considerable bass program material, setting the FUNCTION SELECTOR at MONAURAL. After listening for a few minutes, reverse the connections of the speaker leads at only one of the speaker systems — not both — and listen again to the same program material. Normally, you will notice that one of these connections seems to give

bass re-inforcement and the other bass cancellation. The connection that gives bass re-inforcement is the in-phase connection and should be used.

Another criterion for the in-phase connection is that of blending, which can be best applied if the speaker systems are identical or at least have similar middle and high frequency range reproducers. With the in-phase connection and both speakers operating at approximately the same volume level, a monophonic source will appear to be emanating from a point mid-way between and the two speakers will blend. With the out-of-phase connection, the two sources will appear to remain separate.

SERVICE

If trouble develops in your instrument which you cannot 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 \$12.50 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.

TROUBLE-SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
Amplifier causes power line fuse to blow. Power line fuse blows again with V11 & V12 out of their sockets.	Line cord, J16, primary or high voltage secondary windings of T1 shorted internally or externally (wiring).	Replace or repair.
Amplifier causes power line fuse to blow. Power line fuse does not blow again with V11 & V12 out of their sockets.	V11, V12, C39, V7, V8, V9, V10, or T2 or T3 primary shorted internally or externally.	Replace or repair.
Any or all tube filaments not lit.	Open tube filament. Open lead from 6.3V winding of T1. 6.3V winding of T1 open.	Replace or repair.
Output tube bias too high (resulting in distorted output waveform).	Open R56, R57.	Replace or repair.
DC voltage at V11, V12 cathodes (pin 3) is incorrect as specified below.		
a) No voltage.	Defective V11 or V12. C39 shorted internally or externally.	Replace Replace or repair.
b) High voltage.	Connection from C39 to pin 3 of V11 & V12 broken. Connection to center tap of h.v. secondary winding of T1 open. Output tubes V7, V8, V9, V10 over-biased or not drawing current. May result from open R56 or R57.	Repair Repair Replace, repair, or see trouble-shooting typical tube stage.
c) Low voltage.	Excessive current drain in amplifier. Defective V11, V12.	See trouble-shooting typical tube stage. Replace
Excessive hum on mag. phono tape head or mic.	V1 or V2 defective. Fil. leads dressed too close to grid lead. Tube shield not making electrical contact to base or base not making electrical contact to chassis. Shielding and grounding of wiring to input jacks not exactly as instructed and shown in drawings.	Replace Dress fil. leads away from grid lead. Check and correct. Correct
Excessive noise on mag. phono tape head or mic.	V1 and V2 and contacts dirty.	Clean thoroughly with carbon tetrachloride.
Sustained oscillations.	Poor dress of output transformer T2 or T3 leads.	Dress all input leads and T3 leads away from each other. Keep T3 leads away from input jacks.
Sustained microphonics on mag. phono, tape head or mic.	V1 or V2 defective.	Replace
Hum on all inputs.	V3 or V4 defective, not properly shielded, or dirty sockets and contacts. Dress of power transformer T1 leads.	Replace, correct, or clean. Correct

VOLTAGE AND RESISTANCE CHART

TUBE	PIN#	OPERATING VOLTS AT NO SIGNAL (DC UNLESS NOTED)	OPERATING VOLTS AT 14W OUT (DC UNLESS NOTED)	SIGNAL VOLTS (1 kc) at 30W OUT	OHMS UNIT DISCONNECTED FROM POWER)
ECC83/12AX7 V1	1	80	80	.48	290KΩ
	2	0	0	.014	1MΩ
	3	1	1	0	4.7KΩ
	4&5	filament (0VDC; 6.3VAC to pin 9)			0-50Ω
	6	60	60	0.14	290KΩ
	7	0	0	.0035	90KΩ
	8	0.7	0.7	0	2.2KΩ
	9	filament	-	-	0-50Ω
	ECC83/12AX7 V2	1	80	80	0
2		0	0	0	1MΩ
3		1	1	0	4.7KΩ
4&5		filament (0VDC; 6.3VAC to pin 9)			0-50Ω
6		60	60	0	290KΩ
7		0	0	0	90KΩ
8		0.7	0.7	0	2.2KΩ
9		filament	-	-	0-50Ω
ECC82/12AU7 V3, V4		1	82	80	1.2
	2	0	0	.23	610KΩ
	3	3.8	3.7	.1	3.3KΩ
	4&5	filament (0VDC; 6.3VAC to pin 9)			0-50Ω
	6	50	48	1.65	170KΩ
	7	0	0	.2	190KΩ
	8	1.8	1.75	.065	1.8KΩ
	9	filament	-	-	0-50Ω
	ECC83/12AX7 V5, V6	1	195	190	6.2
2		94	92	7.7	470KΩ
3		95	93	6.2	100KΩ
4&5		filament (0VDC; 6.3VAC to pin 9)			0-50Ω
6		94	92	6.7	470KΩ
7		0	0	1.15	250KΩ
8		0.8	0.8	1.1	1.7KΩ
9		filament	-	-	0-50Ω
EL84/6BQ5 V7		1	0	0	6.2
	2	0	0	6.2	340KΩ
	3	12.7	14.7	.03*	165Ω
	4&5	filament (0VDC; 6.3VAC between pins 4 & 5)			0-50Ω
	6	0	0	6.2	330KΩ
	7	335	325	180	165 190Ω
	8	0	0	6.2	330KΩ
	9	330	320	0.8*	350Ω
	EL84/6BQ5 V8	1	0	0	6.2
2		0	0	6.2	340KΩ
3		12.7	14.7	.03*	165Ω
4&5		filament (0VDC; 6.3VAC between pins 4 & 5)			0-50Ω
6		0	0	6.2	330KΩ
7		335	325	180	330KΩ
8		0	0	-	-
9		330	320	0.8*	350Ω

EL84/6BQ5 V9, V10	1	0	0	6.2	340K Ω
	2	0	0	6.3	340K Ω
	3	12.7	14.7	.03*	165 Ω
	4 & 5	filament (0VDC; 6.3VAC between pins 4 & 5)			0-50 Ω
	6	-	-	-	-
	7	335	325	180	165-190 Ω
	8	0	0	6.2	330K Ω
	9	330	320	0.8	350 Ω
	EZ81/6CA4 V11, V12	1	290VAC*	290VAC*	290*
2		-	-	-	-
3		340	335	7.4*	100K Ω
4 & 5		filament (340VDC; 6.3VAC between pins 4 & 5)			100K Ω
6		-	-	-	-
7		290VAC*	290VAC*	290*	45-55 Ω
8		-	-	-	-
9		-	-	-	-

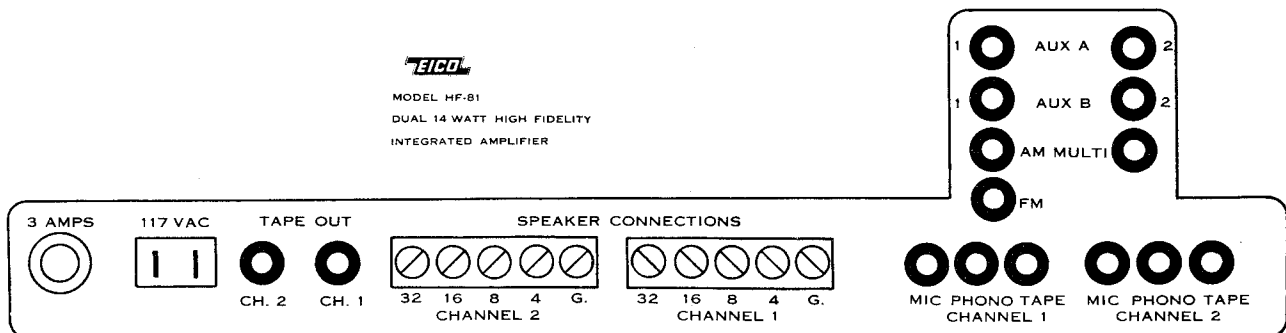
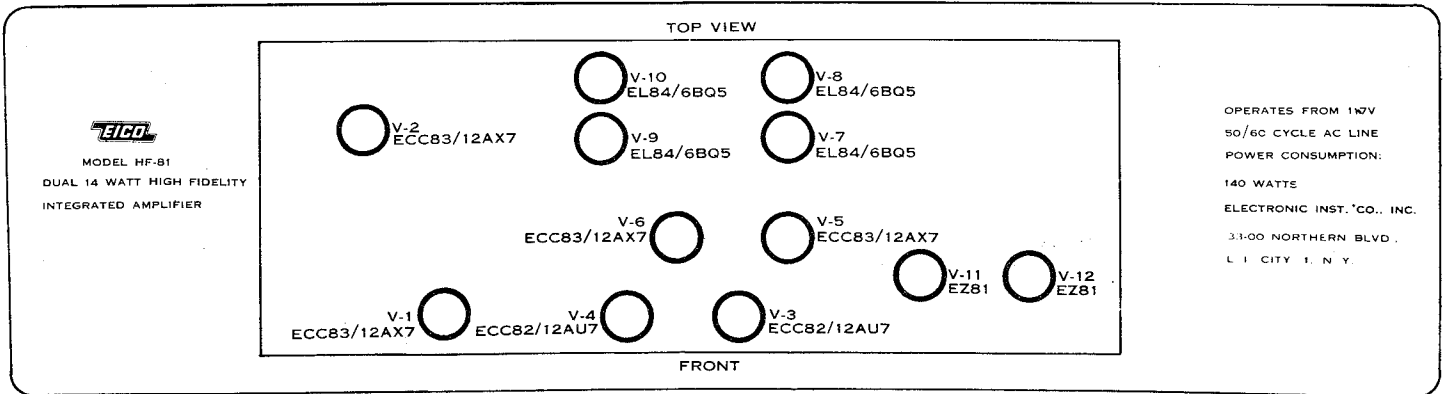
* = 60 cycles

All resistance measurements, except those made from pin 3 of V11 and V12 (EZ81 rectifier), are made with pin 3 of V11 and V12 grounded. All voltage and resistance measurements are measured to chassis with the controls set as follows: INPUT SELECTOR to PHONO, FUNCTION SELECTOR to STEREO NORMAL, LEVEL at 10, BASS, TREBLE & FOCUS controls at 0. For voltage measurements at 14W output, set the input selector to the PHONO position and feed a 0.0035 volt (3.5mv) 1kc signal to the CH 1 & CH 2 Mag. Phono Input jacks; connect a resistive (preferably non-inductive) load to the output of each amplifier, of equal resistance to the tap selected ($\pm 20\%$), and capable of handling 15 watts. Voltage measurements are made with a VTVM. Operating line voltage at which voltage measurements are made is 117VAC, 60 cps. NOTE: ALL VOLTAGE & RESISTANCE VALUES NORMALLY BY $\pm 15\%$.

INPUT SELECTOR SWITCH S1	SECTION	AUX A	AUX B	AM-FM	FM-MULTI	MIC	PHONO	TAPE
	A	7-8-9-10	7-8-9-10	7-8-9-10	7-8-9-10	8-9-10	7-9-10	7-8-10
	B	3-11 5-8	9-11	11-12		5-7 11-12	5-8 3-11	5-9 4-11
	C	1-2-6-7-9- 10-11-12	1-2-6-7-8- 10-11-12	1-2-6-7-8- 9-12	1-2-6-7-8- 9-10-12	1-2-6- 8-9-10-11	2-6-8- 9-10-11-12	1-6-8-9- 10-11-12
	D	3-8	3-9	3-10	3-11	3-7-12	1-3-7	2-3-7
	E	4-9	4-10	4-11	4-12	1-4-8	2-4-8	3-4-8
	F	1-2-3-6- 8-10-12	1-2-3-6- 8-9-12	1-2-3-6- 8-9-10-12	1-2-3-6- 8-9-10	2-3-6- 9-10-12	1-3-6- 9-10-12	1-2-6- 9-10-12
	G	4-12 6-9	10-12	1-12	NC	1-12 6-8	4-12 6-9	5-12 6-10
	H	8-9-10-11	8-9-10-11	8-9-10-11	8-9-10-11	9-10-11	8-10-11	8-9-11

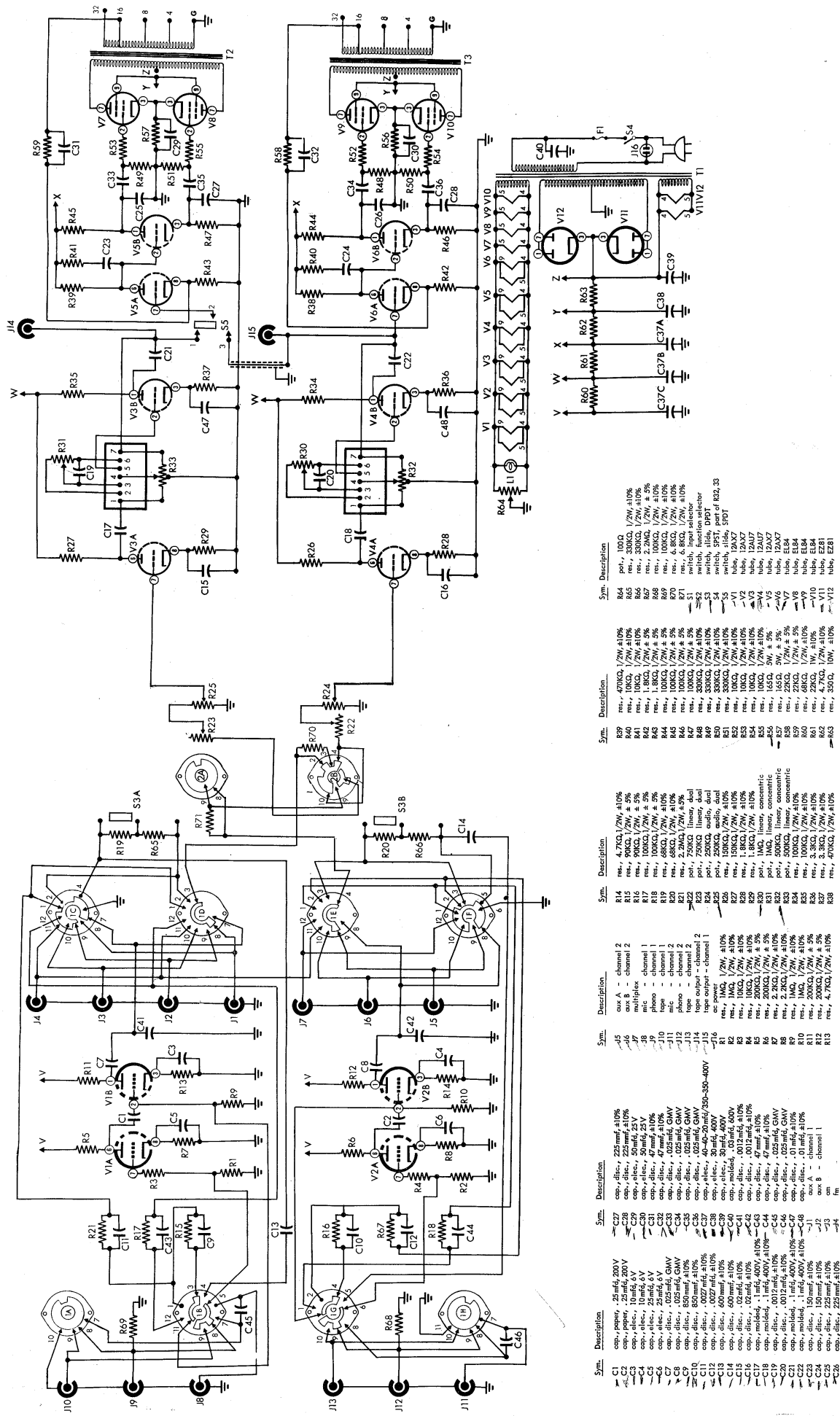
FUNCTION SELECTOR SWITCH S2	SECTION	AMPL. 1	AMPL. 2	NORMAL	REVERSE	TUNER AUX.	PHONO
	A	8-9	8-9	8-9	8-9	8-9	NC
	B	2-3-4-10	7-9	7-9 2-3-4	9-10 7-2-3	2-3-4-7	3-4-7-9

- 1) Entries are numbers of those switch contacts which are connected together by the rotors at the particular position. NC means no connection.
- 2) On schematic diagram, all switch wafers shown in the maximum counter-clockwise position (AUX A and CH 1 CHECK) as seen from the front or shaft end.



REPLACEMENT PARTS LIST

Stock#	Symbol	Description	Am't.	Stock#	Description	Am't.	
20050	C1, 2	cap., paper, .25mfd, 200V	2	54019	TB15, 21	terminal strip, 2 post right	2
23014	C3, 4	cap., elec., 10mfd, 6V	2	54000	TB17	terminal strip, 1P left	1
23020	C5, 6	cap., elec., .25mfd, 6V	2	90034	V1, 2, 5, 6	tube, 12AX7	4
22517	C7, 8, 33, 34	cap., disc., .025mfd, GMV (25K or 25,000mmf)	8	90033	V3, 4	tube, 12AU7	2
	C35, 36, 45, 46			90039	V7, 8, 9, 10	tube, EL84	4
22514	C9, 10	cap., disc., .850mmf, ±10%	2	90038	V11, 12	tube, EZ81	2
22518	C11, 12	cap., disc., .0027mfd, ±10% (2.7K or 2700mmf)	2	97800	XF1	fuseholder	1
22550	C13, 14	cap., disc., .600mmf, ±10%	2	97712	X11	pilot assembly	1
22506	C15, 16	cap., disc., .02mfd, ±10% (20K or 20,000mmf)	2	97027	XV1, 2, 3, 4	socket, 9 pin min. w/shield	4
20039	C17, 18, 21, 22	cap., molded, .1mfd, 400V, ±10%	4	97025	XV5, 6, 7, 8, 9, 10, 11, 12	socket, 9 pin min.	8
22520	C19, 20, 41, 42	cap., disc., .0012mfd, ±10% (1.2K or 1200mmf)	4				
22529	C23, 24	cap., disc., .150mmf, ±10%	2	40000		nut, hex, #6-32	56
22543	C25, 26, 27, 28	cap., disc., .225mmf, ±10%	4	40001		nut, hex, #3/8-32	7
23007	C29, 30	cap., elec., .50mfd, 25V	2	40007		nut, hex, #4-40	30
22533	C31, 32, 43, 44	cap., disc., .47mmf, ±10%	4	40008		nut, hex, #8-32	16
24005	C37	cap., elec., 40-40-20mfd/350-350-400V	1	40016		nut, for fuseholder	1
23016	C38, 39	cap., elec., .30mfd, 400V	2	40026		nut, tin., #8-32	6
20043	C40	cap., molded, .03mfd, 600V	1	40027		nut, tin., angle bracket	2
22519	C47, 48	cap., disc., .01mfd, ±10% (10K or 10,000mmf)	2	41000		screw, #6-32 x 1/4	54
91005	F1	fuse, 3 amp	1	41003		screw, #8-32 x 3/8	16
92000	I1	pilot light, #47	1	41016		screw, #4-40 x 1/4	28
50020	J1-2-3-4,	jack, quad.	1	41026		screw, #4-40 x 1/4 brass	2
50018	J5-6-7,	jack, triple	3	41027		screw, #4 wood	2
	8-9-10,			41028		screw, #8-32 x 1	2
	11-12-13			41045		screw, #6 P. K. brown	4
50011	J14-15	jack, dual	1	41046		screw, #8-32 brown	4
50016	J16	outlet, convenience	1	41047		screw, #8 P. K.	6
29751	PC1, 2	printed circuit	2	42000		washer, #3/8 lock	7
10407	R1, 2, 9, 10	res., 1MΩ, 1/2W, ±10% (brown, black, green, silver)	4	42002		washer, #6 lock	56
10400	R3, 4, 40, 41,	res., 10KΩ, 1/2W, ±10% (brown, black, orange, silver)	8	42007		washer, #4 lock	30
	52, 53, 54, 55			42008		washer, #8 lock	16
11526	R5, 6, 11, 12	res., 200KΩ, 1/2W, ±5% (red, black, yellow, gold)	4	42029		washer, rubber, for fuseholder	1
10423	R7, 8	res., 2.2KΩ, 1/2W, ±10% (red, red, silver)	2	42032		washer, flat, #8	2
10430	R13, 14	res., 4.7KΩ, 1/2W, ±10% (yellow, violet, red, silver)	2	43000		lug, #6 ground	2
11504	R15, 16	res., 90KΩ, 1/2W, ±5% (white, black, orange, gold)	2	43001		lug, #3/8 pot ground	1
11527	R17, 18, 44, 45,	res., 100KΩ, 1/2W, ±5% (brown, black, yellow, gold)	6	43004		lug, #8 ground	3
	46, 47			46000		grommet, 3/8	1
10422	R19, 20, 50	res., 68KΩ, 1/2W, ±10% (blue, grey, orange, silver)	3	46006		feet, rubber	4
11518	R21, 67	res., 2.2KΩ, 1/2W, ±5% (red, red, green, gold)	2	50012		insulator for 50011	1
18045	R22, 23	pot., 750KΩ linear, dual	1	50019		insulator for 50018	3
18046	R24, 25	pot., 250KΩ audio, dual	1	50021		insulator for 50020	1
10435	R26, 27	res., 150KΩ, 1/2W, ±10% (brown, green, yellow, silver)	2	51006		phono plug	15
10414	R28, 29	res., 1.8KΩ, 1/2W, ±10% (brown, grey, red, silver)	2	53016		knob, outer concentric	2
18048	R30, 31	pot., 1MΩ linear, concentric	1	53017		knob, inner concentric	4
18047	R32, 33, 54	pot., 500KΩ linear, concentric w/SPST switch	1	53018		knob, dual concentric	2
10410	R34, 35, 68, 69	res., 100KΩ, 1/2W, ±10% (brown, black, yellow, silver)	4	57000		line cord	1
10420	R36, 37	res., 3.3KΩ, 1/2W, ±10% (orange, orange, red, silver)	2	58004		wire, hook-up, thin wall	length
10431	R38, 39	res., 470KΩ, 1/2W, ±10% (yellow, violet, yellow, silver)	2	58300		spaghetti	length
11543	R42, 43	res., 1.8KΩ, 1/2W, ±5% (brown, grey, red, gold)	2	58302		spaghetti, heavy	length
10412	R48, 49, 50, 51,	res., 330KΩ, 1/2W, ±10% (orange, orange, yellow, silver)	6	58408		cable, 1 conductor	length
	65, 66			58410		cable, 4 conductor	length
14600	R56, 57	res., 165Ω, 5W, ±5%	2	58412		cable, 3 conductor	length
11538	R58, 59	res., 22KΩ, 1/2W, ±5% (red, red, orange, gold)	2	58501		wire, bare	length
10851	R61	res., 22KΩ, 1W, ±10% (red, red, orange, silver)	1	80057		panel	1
10952	R62	res., 4.7KΩ, 2W, ±10% (yellow, violet, red, silver)	1	81109		bottom plate	1
14302	R63	res., 350Ω, 10W, ±10%	1	81110		bracket, left	1
19009	R64	pot., 100Ω	1	81111		bracket, right	1
10421	R70, 71	res., 6.8KΩ, 1/2W, ±10% (blue, grey, red, silver)	2	81116		bezel	1
60057	S1	switch, Input Selector	1	81124		chassis	1
60065	S2	switch, Function Selector	1	81134		shield w/spade bolts	1
62000	S3	switch, slide, DPDT	1	81144		perforated screen	1
62002	S5	switch, slide, SPDT	1	81145		bracket, input	1
30021	T1	transformer, power	1	81146		bracket for DPDT switch	1
32013	T2, 3	transformer, output	2	81154		shield bottom	1
54516	TB1, 2	terminal board, 5 screw	2	81903		clamp, wire	4
54002	TB3, 20	terminal strip, 1P right w/ground	2	89207		label, rear apron	1
54001	TB4	terminal strip, 1P right	1	89208		label, tube layout	1
54014	TB5	terminal strip, 3P 2 left	1	89219		label, service	1
54003	TB6, 7, 8, 13, 16	terminal strip, 2 post	5	97300		tube shield	4
54006	TB9, 11, 18	terminal strip, 3P 2 right	3	97710		jewel, red	1
54013	TB10, 19	terminal strip, 1P left w/ground	2	66067		manual of instructions (wired)	1
54008	TB12, 14	terminal strip, 4 post	2	66316		manual of instructions (kit)	1



Sym.	Description	Sym.	Description	Sym.	Description	Sym.	Description	Sym.	Description
C1	cap., paper, .05 mfd., 250V	R39	res., 470K Ω , 1/2W, \pm 10%	S3	pot., 500K, linear, dual	V1	tube, 6X4	V10	tube, 6V6
C2	cap., paper, .05 mfd., 250V	R40	res., 10K Ω , 1/2W, \pm 10%	S4	pot., 500K, linear, dual	V2	tube, 6V6	V11	tube, 6V8
C3	cap., elec., 20 mfd., 25V	R41	res., 10K Ω , 1/2W, \pm 10%	S5	pot., 500K, linear, dual	V3	tube, 6V7	V12	tube, 6X5
C4	cap., elec., 10 mfd., 5V	R42	res., 2.2M Ω , 1/2W, \pm 5%	S6	pot., 500K, linear, dual	V4	tube, 6V8	V13	tube, 6V6
C5	cap., elec., 20 mfd., 5V	R43	res., 1.8K Ω , 1/2W, \pm 5%	S7	pot., 500K, linear, dual	V5	tube, 12AU7	V14	tube, 12AU7
C6	cap., elec., 20 mfd., 5V	R44	res., 100K Ω , 1/2W, \pm 5%	S8	pot., 500K, linear, dual	V6	tube, 12AU7	V15	tube, 12AU7
C7	cap., elec., 20 mfd., 5V	R45	res., 100K Ω , 1/2W, \pm 5%	S9	pot., 500K, linear, dual	V7	tube, 12AU7	V16	tube, 12AU7
C8	cap., elec., .025 mfd., 50V	R46	res., 100K Ω , 1/2W, \pm 5%	S10	pot., 500K, linear, dual	V8	tube, 6V6	V17	tube, 6V6
C9	cap., elec., .025 mfd., 50V	R47	res., 100K Ω , 1/2W, \pm 5%	S11	pot., 500K, linear, dual	V9	tube, 6V6	V18	tube, 6V6
C10	cap., elec., .025 mfd., 50V	R48	res., 100K Ω , 1/2W, \pm 5%	S12	pot., 500K, linear, dual	V10	tube, 6V6	V19	tube, 6V6
C11	cap., elec., .025 mfd., 50V	R49	res., 100K Ω , 1/2W, \pm 5%	S13	pot., 500K, linear, dual	V11	tube, 6V6	V20	tube, 6V6
C12	cap., elec., .025 mfd., 50V	R50	res., 100K Ω , 1/2W, \pm 5%	S14	pot., 500K, linear, dual	V12	tube, 6V6	V21	tube, 6V6
C13	cap., elec., .025 mfd., 50V	R51	res., 100K Ω , 1/2W, \pm 5%	S15	pot., 500K, linear, dual	V13	tube, 6V6	V22	tube, 6V6
C14	cap., elec., .025 mfd., 50V	R52	res., 100K Ω , 1/2W, \pm 5%	S16	pot., 500K, linear, dual	V14	tube, 6V6	V23	tube, 6V6
C15	cap., elec., .025 mfd., 50V	R53	res., 100K Ω , 1/2W, \pm 5%	S17	pot., 500K, linear, dual	V15	tube, 6V6	V24	tube, 6V6
C16	cap., elec., .025 mfd., 50V	R54	res., 100K Ω , 1/2W, \pm 5%	S18	pot., 500K, linear, dual	V16	tube, 6V6	V25	tube, 6V6
C17	cap., elec., .025 mfd., 50V	R55	res., 100K Ω , 1/2W, \pm 5%	S19	pot., 500K, linear, dual	V17	tube, 6V6	V26	tube, 6V6
C18	cap., elec., .025 mfd., 50V	R56	res., 100K Ω , 1/2W, \pm 5%	S20	pot., 500K, linear, dual	V18	tube, 6V6	V27	tube, 6V6
C19	cap., elec., .025 mfd., 50V	R57	res., 100K Ω , 1/2W, \pm 5%	S21	pot., 500K, linear, dual	V19	tube, 6V6	V28	tube, 6V6
C20	cap., elec., .025 mfd., 50V	R58	res., 100K Ω , 1/2W, \pm 5%	S22	pot., 500K, linear, dual	V20	tube, 6V6	V29	tube, 6V6
C21	cap., elec., .025 mfd., 50V	R59	res., 100K Ω , 1/2W, \pm 5%	S23	pot., 500K, linear, dual	V21	tube, 6V6	V30	tube, 6V6
C22	cap., elec., .025 mfd., 50V	R60	res., 100K Ω , 1/2W, \pm 5%	S24	pot., 500K, linear, dual	V22	tube, 6V6	V31	tube, 6V6
C23	cap., elec., .025 mfd., 50V	R61	res., 100K Ω , 1/2W, \pm 5%	S25	pot., 500K, linear, dual	V23	tube, 6V6	V32	tube, 6V6
C24	cap., elec., .025 mfd., 50V	R62	res., 100K Ω , 1/2W, \pm 5%	S26	pot., 500K, linear, dual	V24	tube, 6V6	V33	tube, 6V6
C25	cap., elec., .025 mfd., 50V	R63	res., 100K Ω , 1/2W, \pm 5%	S27	pot., 500K, linear, dual	V25	tube, 6V6	V34	tube, 6V6



DUAL 14 WATT HI-FI STEREO AMP-PREAMP

MODEL HF-81



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 (X1000) 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.

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

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.

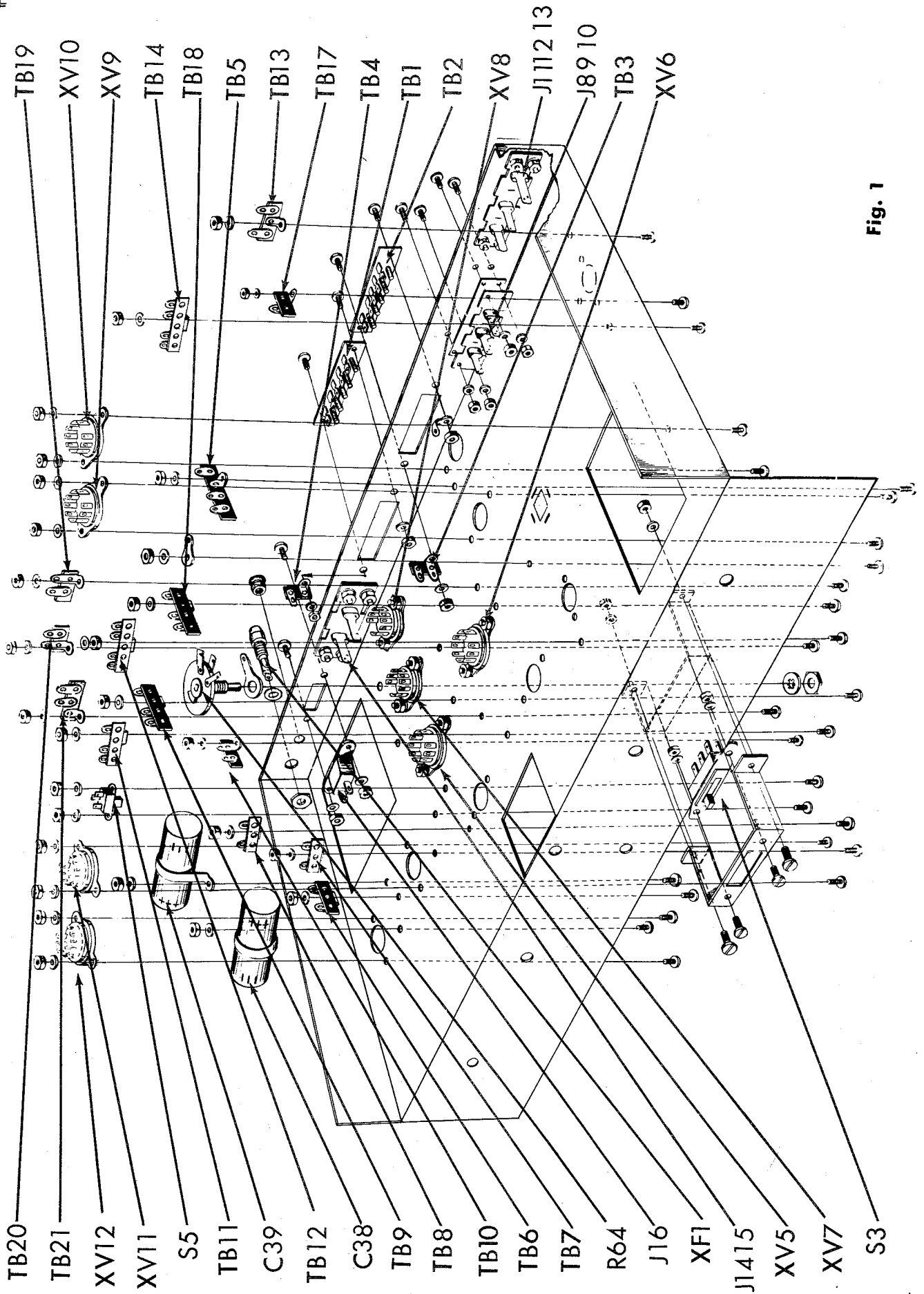


Fig. 1



BELOW CHASSIS ASSEMBLY

Note: In addition to Fig. 1, it will be required to refer to Fig. 6 in the following mounting procedure in order to settle such matters as orientation of terminal boards, keyways on tube sockets, etc. The wiring which comes later will be greatly facilitated if, after mounting each part, the symbol number of the part is written on the bottom of the chassis next to the part with a crayon or soft pencil.

1. (✓) Fig. 1. Mount the 9 pin miniature tube socket, XV12, as shown. Use two #4-40 screws, two #4 lockwashers, and two #4-40 hex nuts. Note the mounting direction in figure 6.
2. (✓) Fig. 1. Similar to the above, mount 9 pin miniature sockets, XV11, XV5, XV6, XV7, XV8, XV9 and XV10. Use two #4-40 screws, two #4 lockwashers, and two #4-40 hex nuts on each. In each case, note the mounting direction in figure 6.
3. (✓) Fig. 1. Mount the 3 terminal input jack strip, J8, 9, 10 as shown. Use four #6-32-screws, four #6 lockwashers and four #6-32 hex nuts. Mount the 3 hole insulator between the chassis and the input jack strip. (Fig. 10).
4. (✓) Fig. 1. Mount the 3 terminal input jack strip, J11, 12, 13, as shown. Note mounting direction in figure 10 Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts. Mount a 3 hole insulator between the chassis and the input jack strip. (Fig. 10)
5. (✓) Fig. 1. Mount the double pole 2 position slide switch, S3, into the switch bracket, as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.
6. (✓) Fig. 1. Mount the switch bracket with the switch (previously mounted in step 5) on the chassis, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.
7. (✓) Fig. 1. Mount the 2 terminal tape output jack strip, J14, 15, as shown. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts.. Mount a 2 hole insulator between the chassis and the jack strip.
8. (✓) Fig. 1. Mount the 5 screw terminal board, TB1, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts. Under one of the lockwashers, mount one post right terminal strip, TB4.

9. (✓) Fig. 1. Mount the 5 screw terminal board, TB2, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts. Under the lockwasher, mount one post right with ground terminal strip, TB3. Under the remaining nut, mount a #6 ground lug.
10. (✓) Fig. 1. Mount the fuseholder, XF1, as shown. Use rubber washer against the outside of the chassis under the wider part of the holder. Slide the large nut over the fuseholder on the inside of the chassis. DO NOT tighten nut.
11. (✓) Fig. 1. Push a rubber grommet into the 3/8" hole next to the fuseholder.
12. (✓) Fig. 1. Mount the convenience outlet, J16, as shown. Use two #6-32 screws, two #6 lockwasher and two #6-32 hex nuts.
13. (✓) Fig. 1. Mount the 30mfd, 400V electrolytic capacitor, C38, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut. Note direction of positive side.
14. (✓) Fig. 1. Mount the 30mfd, 400V electrolytic capacitor, C39, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut. Note direction of positive side. (It is the reverse of C38 in step 13 above.)
15. (✓) Fig. 1. Mount hum bucking potentiometer, R64, as shown. Use one 3/8" lockwasher and one 3/8 hex nut. Between the potentiometer and the chassis, use one 3/8 pot grounding lug. When tightening potentiometer, line up the lug with terminal #2. The grounding lug will eventually be soldered to this terminal.
16. (✓) Fig. 1. Mount the following terminal strips as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut on each. The terminal strips to be mounted in this manner are: three post, two left, TB5; two post, TB6; two post, TB7; two post, TB8; three post, two right, TB9; one post. left with ground, TB10; three post, two right, TB11; four post, TB12; two post, TB13; four post, TB14; one post left, TB17; three post, two right, TB18; one post left with ground, TB19; one post right with ground, TB20, and two post right, TB21.
17. (✓) Fig. 1. Mount the single pole 2 position slide switch, S5, as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.
18. (✓) Fig. 1. Mount the #6 ground lug "G" with one #6-32 screw, one #6 lockwasher and one #6-32 hex nut. Note position of lug on figure 6.

PREWIRING OF SELECTOR SWITCH

Turn the switch to its maximum counter-clockwise position. The switch is shown in the figure from the rear view. The exact position of the lugs referred to are determined by looking at the switch from the view shown in the figure. Each side of the wafer has been assigned a letter. Each lug has been assigned a number. The lug is referred to by the wafer number and lug designation. Thus lug S1D-3 refers to selector switch S1, the "D" side of the wafer (rear side of the second wafer-side facing you when holding the switch as shown in the drawing) and 3 refers to the lug on this particular side of the wafer.

1. (✓) Fig. 2. Cut all leads on two .025 mfd (25K or 25,000 mmf) disc capacitors, C45 and C46, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect C45 from S1B-6 (C) to S1B-7 (S1). Connect C46 from S1H-7 (C) to S1H-8 (S1).
2. (✓) Fig. 2. Cut all leads on two 90KΩ (white, black, orange, gold) 5% resistors, R15 and R16, to 1/2". Connect R15 from S1B-3 (C) to S1B-1 (C). Connect R16 from S1G-2 (C) to S1G-4 (C).
3. (✓) Fig. 2. Cut all leads on two 850 mmf disc capacitors, C9 and C10, to 3/4". Connect C9 from S1B-3 (S2) to S1B-1 (C). Connect C10 from S1G-2 (C) to S1G-4 (S2).
4. (✓) Fig. 2. Cut all leads on two 2.2MΩ (red, red, green, gold) 5% resistors, R21 and R67, to 1/2". Connect R21 from S1B-1 (C) to S1C-1 (C). Connect R67 from S1F-2 (C) to S1G-2 (C).
5. (✓) Fig. 2. Cut all leads on two .0027 mfd (2.7K or 2700 mmf) disc capacitors, C11 and C12, to 1/2". Cover each lead with a 1/4" piece of spaghetti. Connect C11 from S1B-1 (S4) to S1C-1 (S2). Connect C12 from S1F-2 (S2) to S1G-2 (S4).
6. (✓) Fig. 2. Cut all leads on two 100KΩ (brown, black, yellow, gold) 5% resistors, R17 and R18, to 1/2". Connect R17 from S1B-12 (C) to S1C-12 (C). Connect R18 from S1F-1 (C) to S1G-1 (C).
7. (✓) Fig. 2. Cut all leads on two 47 mmf disc capacitors, C43 and C44, to 3/4". Connect C43 from S1B-12 (S2) to S1C-12 (S2). Connect C44 from S1F-1 (S2) to S1G-1 (S2).
8. (✓) Fig. 2. Cut all leads on two 600 mmf disc capacitors, C13 and C14, to 3/4". Connect C13 from S1B-4 (S1) to S1C-4 (C). Connect C14 from S1G-5 (S1) to S1F-5 (C).

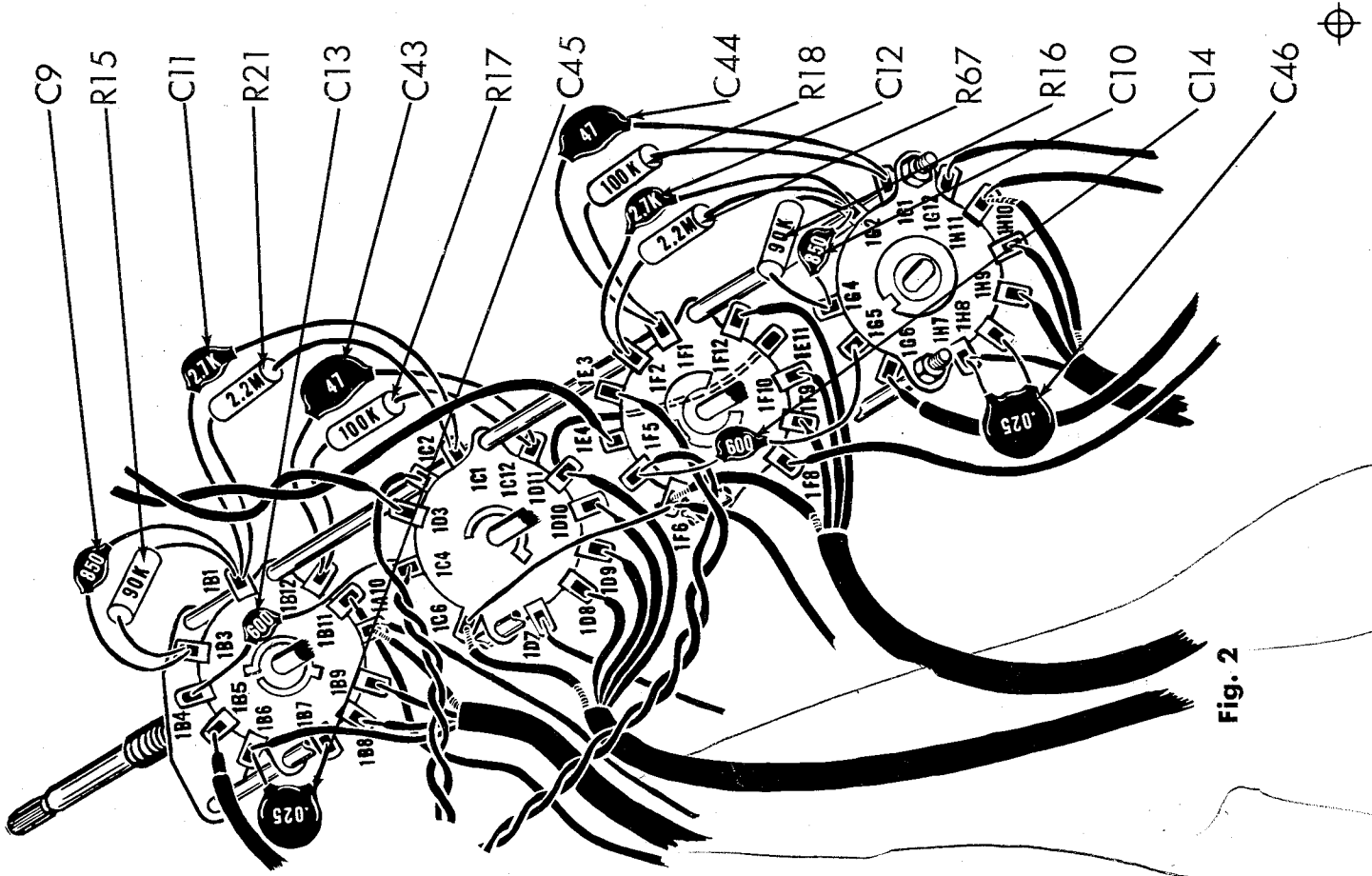


Fig. 2

9. (✓) Fig. 2. Strip back the outer insulation 1 1/2" from one end of a 10" piece of 3 conductor shielded cable. Twist the shield strands together and cover with a 1 1/4" piece of thick spaghetti. Cut the brown lead to 1 1/4", the red lead to 3/4" and the orange lead to 1". Strip back the insulation 1/4" from the end of each of these leads. Connect the brown lead to SIB-6 (S2), the red lead to SIB-8 (S1), the orange lead to SIB-9 (S1) and the twisted shield strands to SIA-10 (C). On the other end of the same piece of shielded cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.
10. (✓) Fig. 2. Connect one end of a 3 1/2" piece of black wire to SIA-10 (S2).
11. (✓) Fig. 2. Strip back the outer insulation 1 3/4" from one end of a 10" piece of the 4 conductor shielded cable. Twist the shield strands together and cover with a 1 1/2" piece of thick spaghetti. Cut the brown, red and orange leads to 3/4" each and the yellow lead to 1 1/4". Strip back the insulation 1/4" from the end of each of these leads. Connect the brown lead to SID-8 (S1), the red lead to SID-9 (S1), the orange lead to SID-10 (S1) and the yellow lead to SID-11 (C). Connect a 1" piece of bare wire from SID-11 (S2) to SIE-11 (S1). Connect the twisted shield strands to SIC-6 (C). On the other end of the same piece of shield cable, strip the outer insulation back 1 1/4". Twist the shield strands. Cut the red, orange, and yellow leads to 1". Cut the shield strands to 3/4". Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.
12. (✓) Fig. 2. Strip back the insulation 1 3/4" from one end of a 9 1/2" piece of 3 conductor shield cable. Twist the shield strands together and cover with a 1 1/2" piece of thick spaghetti. Cut the brown and red leads to 3/4" and the orange lead to 1". Strip back the insulation 1/4" from the end of each of these leads. Connect the orange lead to SIF-12 (S1), the red lead to SIF-10 (S1), the brown lead to SIF-9 (S1) and the twisted shield strands to SIF-6 (C). On the other end of the same piece of shielded cable, strip the outer insulation back 1 1/4". Twist the shield strands. Cut the shield strands, red lead and orange lead to 3/4" and the brown lead to 1". Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.
13. (✓) Fig. 2. Connect one end of a 4 1/2" piece of black wire to SIF-6 (C).
14. (✓) Fig. 2. Connect a 1 1/2" piece of bare wire from SIC-6 (S2) to SIF-6 (S3).
15. (✓) Fig. 2. Strip back the outer insulation 1 1/4" from one end of a 7 1/2" piece of 3 conductor shield cable. Twist the shield strands together,

and cover with a 1" piece of thick spaghetti. Cut the orange and red leads to 3/4" and the brown lead to 1". Strip the insulation back 1/4" from this end of each of these leads. Connect the orange lead to SIH-10 (S1), the red lead to SIH-9 (S1), the brown lead to SIH-7 (S2) and the shield strands to SIH-11 (C). On the other end of the same piece of shielded cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip back the insulation 1/4" from the end of each of the inner conductors. This end of the cable does not get connected until later.

16. (✓) Fig. 2. Connect one end of a 2" piece of black wire to SIH-11 (S2).
17. (✓) Fig. 2. Connect one end of a 2 1/2" piece of grey wire to SIB-11 (S1).
18. (✓) Fig. 2. On one end of a 4 1/2" piece of single conductor shielded cable, strip the outer insulating back 1/2". Twist the shield strands together and cut off. Strip back the inner insulation 1/4" and connect to SIB-5 (S1). On the other end of the same piece of shielded cable, strip back the outer insulation 3/4". Twist the shield strands together. Strip back the inner insulation 1/4". This end of the cable does not get connected until later.
19. (✓) Fig. 2. Connect one end of a 5" piece of brown wire to SID-7 (S1).
20. (✓) Fig. 2. Connect one end of a 3" piece of brown wire to SIF-8 (S1).
21. (✓) Fig. 2. On one of a 4" piece of single conductor shielded cable, strip the outer insulated back 1/2". Twist the shield strands together and cut off. Strip back the inner insulation 1/4" and connect to SIG-6 (S1). On the other end of the same piece of cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip back the inner insulation 1/4". This end of the cable does not get connected until later.
22. (✓) Fig. 2. Connect one end of a 3" piece of grey wire to SIG-12 (S1).
23. (✓) Fig. 2. Connect one end of a 5" piece of grey wire to SID-3 (S1) and one end of a 5" piece of yellow wire to SIE-4 (S1). Twist the two leads together.
24. (✓) Fig. 2. Connect one end of a 4 1/2" piece of green wire to SIC-2 (S1) and one end of a 4 1/2" piece of blue wire to SIC-4 (S2). Twist the two leads together.
25. (✓) Fig. 2. Connect one end of a 5 1/2" piece of brown wire to SIE-3 (S1) and one end of a 5 1/2" piece of white wire to SIF-5 (S2). Twist the two leads together.

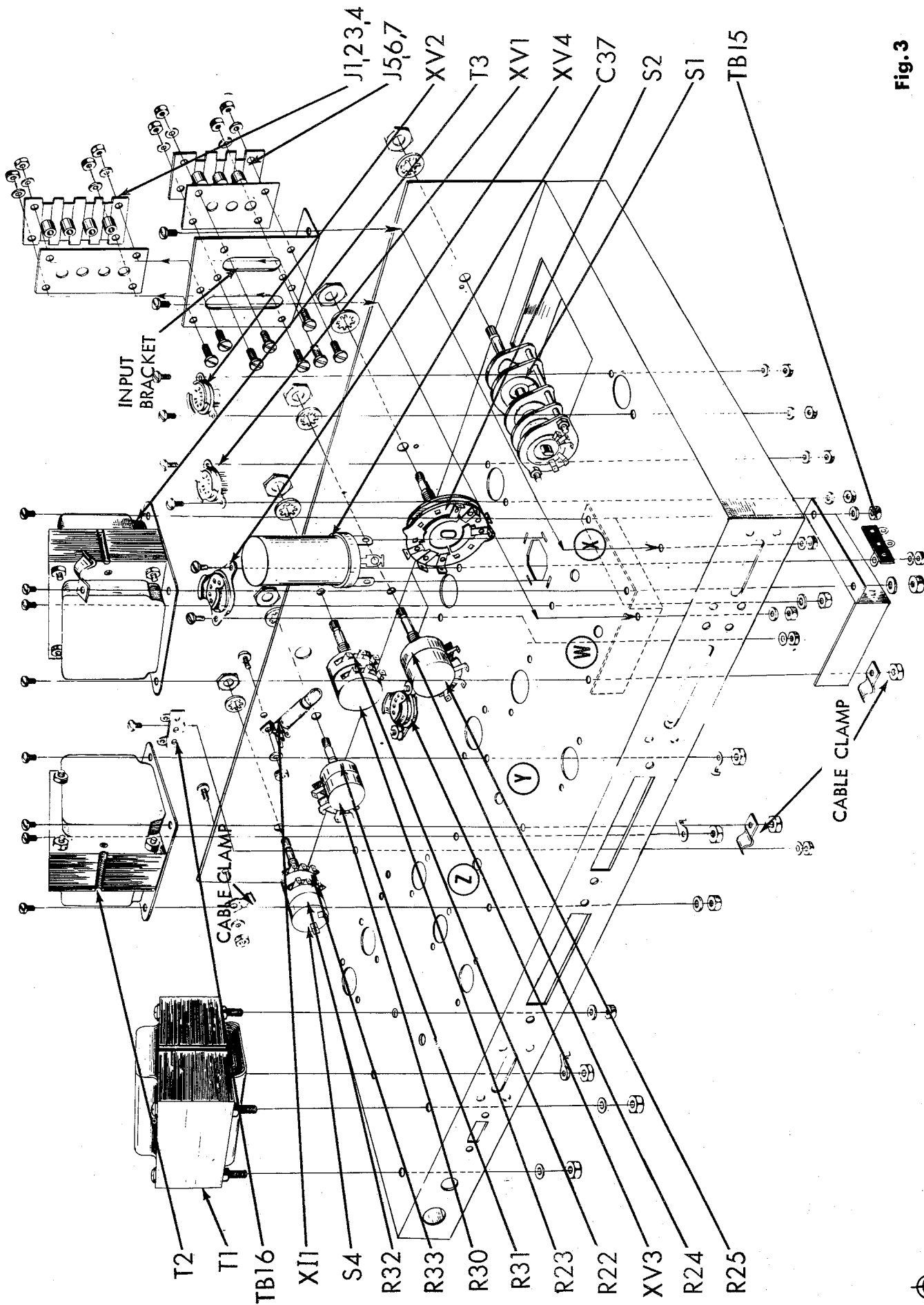


Fig. 3



TOP OF CHASSIS ASSEMBLY

1. (✓) Fig. 3. Mount the 9 pin miniature tube socket with shield support, XV2, from the top of the chassis. Use two #4-40 screws, two #4 lockwashers, and two #4-40 hex nuts. Note mounting direction in figure 6.
2. () Fig. 3. Similar to the above, mount the 9 pin miniature tube socket with shield support, XV1 and XV3, from the top of the chassis. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts on each. Note mounting direction figure 6.
3. () Fig. 3. Similar to the above, mount the 9 pin miniature tube socket with shield support, XV4, from the top of the chassis. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts. Note mounting direction in figure 6.
4. (✓) Fig. 3. Mount the dual concentric treble control potentiometer with on-off switch, R32, R33, S4, as shown. Slide the locating lug on the potentiometer into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut (stock # 18047).
5. (✓) Fig. 3. Mount the dual concentric bass control potentiometer, R30, as shown. Slide the locating lug on the potentiometer into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut. (stock # 18048)
6. () Fig. 3. Mount the dual 250KΩ level control potentiometer, R24, R25, as shown. Slide the locating lug on the potentiometer into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut. (stock # 18046)
7. (✓) Fig. 3. Mount the dual 750KΩ focus control potentiometer, R22, R23 into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut (stock # 18045).
8. () Fig. 3. Mount the function selector switch, S2, as shown. Slide the locating lug on the switch into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut.
9. () Fig. 3. Mount the input selector switch, S1, as shown. Slide the locating lug on the switch into the small hole adjacent to the mounting hole. Use one 3/8 lockwasher and one 3/8 hex nut.
10. (✓) Fig. 3. Mount the two post terminal strip, TB16, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.

NOTE: Before the next step, remove the fuseholder mounted in step 10, on page 3C. After completing step 11 on this page (page 7C), remove the fuseholder as indicated in step 10 on page 3C. This time, tighten the nut but do not tighten too much or holder will crack. Next, continue with step 12 on this page (page 7C), and follow the normal sequence of steps.

11. (✓) Fig. 3. On the power transformer, T1, cut both green leads, the red-yellow lead and the white lead to 2 1/2"; both yellow leads to 3 1/2"; both red leads and both black leads to 5 1/2". Mount the power transformer as shown. Position so that the green and yellow leads face the center of the chassis (see figure 6). Use three #8 lockwashers and three #8-32 hex nuts on three of the screws. On the fourth screw, use one #8 grounding lug and one #8-32 hex nut.
12. (✓) Fig. 3. On the output transformer, T2, cut the black, brown, green, orange and yellow lead to 4". Cut the blue, red and brown-yellow lead to 3". Mount the output transformer as shown. Push the red, blue and brown-yellow leads through hole "Z" nearest the power transformer mounted in step 11. Push the other leads through the hole "Y". Use four #8-32 screws, one #8 lockwasher, two #8 ground lugs, and one cable clamp. Secure each with a #8-32 hex nut. Slide all leads from hole "Y" under the cable clamp before tightening. See Fig. 8.
13. (✓) Fig. 3. On output transformer, T3, cut the orange, yellow, red and green leads to 6". Cut the brown lead to 5". Cut the blue and brown-yellow leads to 4". Push the red, blue and brown-yellow leads through hole "X". Push the other leads through hole "W". Use four #8-32 screws, three #8 lockwashers and four #8-32 hex nuts. Under two of the lockwashers, mount the shield. Under the nut without the lockwasher, mount the cable clamp. On the top of the chassis, mount a cable clamp under one of the screw heads. Do not tighten this screw yet. Run all leads from hole "W" under the cable clamp under the chassis in the direction shown in figure 8. Tighten all nuts except the one holding the clamp on the top side of the chassis.
14. (✓) Fig. 3. Mount the electrolytic can capacitor, C37, as shown. In figure 6, note the direction of the half moon, square and triangle near lugs to determine direction of mounting. Insert the mounting tabs into the slots in the chassis and twist the tabs somewhat less than a quarter turn. DO NOT twist the tabs excessively or they will shear off. Solder the tab without a hole to the chassis at its slot.
15. (✓) Fig. 3. Insert the pilot light, I1, into the pilot light assembly, XI1. Screw the assembly to the chassis as shown using one #6-32 screw, one #6 lockwasher and one #6-32 hex nut. Tighten the mounting screw and nut after the pilot light has been lined up with the hole in the front chassis apron.
16. (✓) Fig. 3. Mount the input bracket as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts. Follow arrows to mounting holes.
17. () Fig. 3. Mount the four terminal input strip, J1, 2, 3, 4, as shown. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts. Use a four hole insulator between the input strip and the input bracket.
18. () Fig. 3. Mount the three terminal input strip, J5, 6, 7, as shown. Use four #6-32 screws, four #6 lockwasher and four #6-32 hex nuts. Use a three hole insulator between the input strip and the input bracket.
19. (✓) Fig. 3. Mount the cable clamp on the upper left hand corner of the front apron as shown. Use one #8-32 screw, one #8 lockwasher and one #8-32 hex nut.

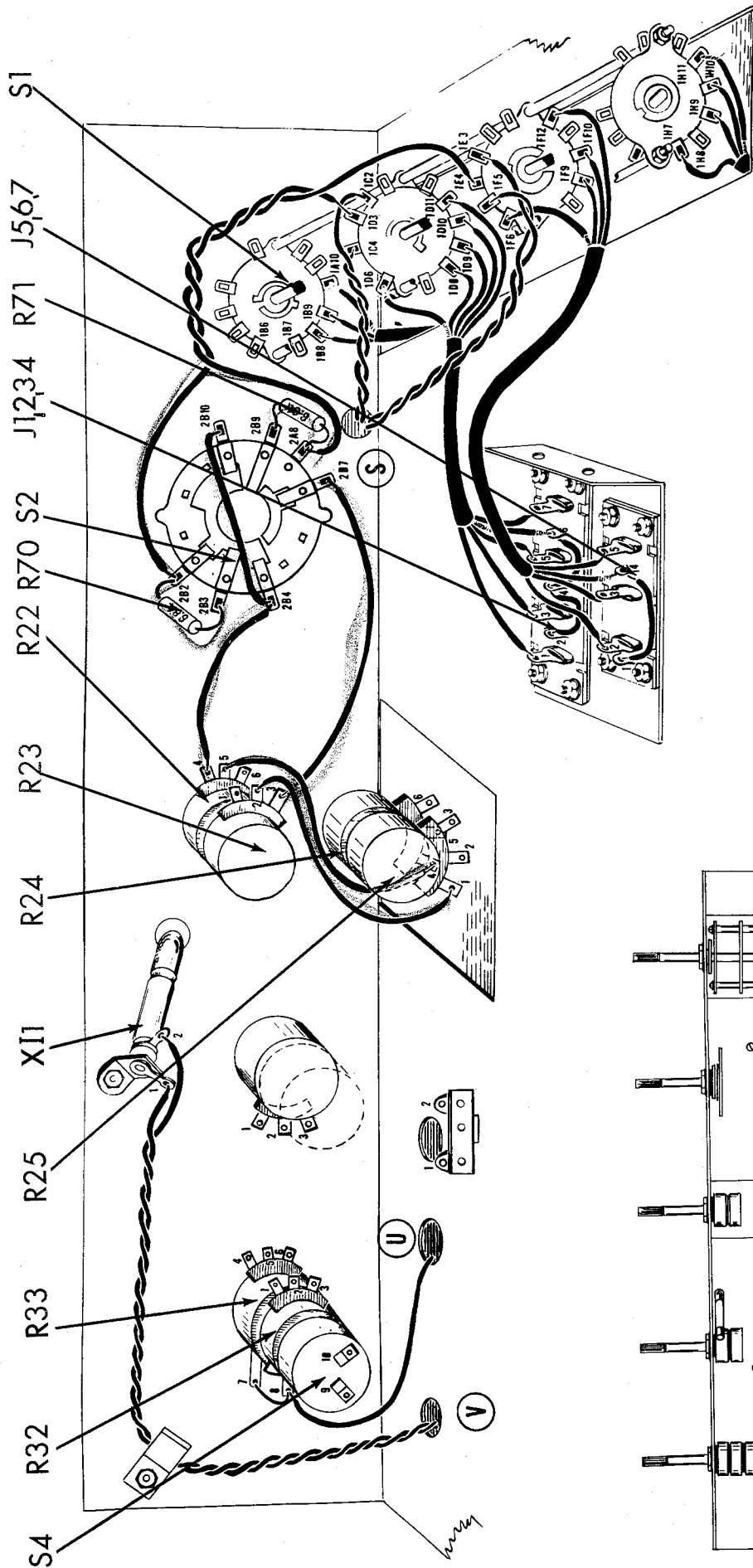
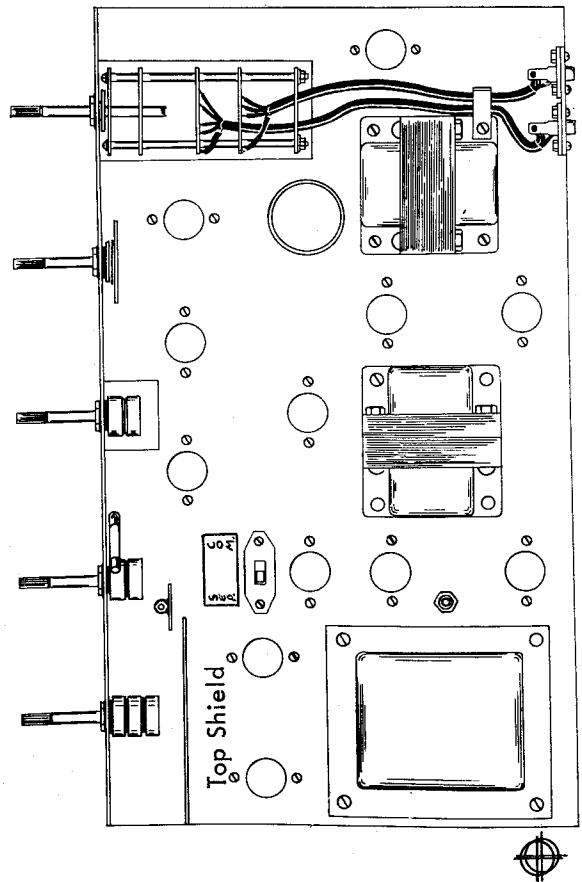


Fig. 4



TOP OF CHASSIS WIRING

1. (✓) Fig. 4. Run the four conductor cable from switch wafer, SID and the three conductor cable from switch wafer, SIF along the top of the chassis. Run these under the cable clamp mounted on the output transformer, T3, and tighten this screw. Connect the outer shield from the four conductor cable to J1, 2, 3, 4-6 (C). The four leads from the cable are connected as follows:

(✓) brown to J1, 2, 3, 4-1 (S1) (✓) orange to J1, 2, 3, 4-5 (S1)
 (✓) red to J1, 2, 3, 4-3 (S1) (✓) yellow to J1, 2, 3, 4-7 (S1)

2. (✓) Fig. 4. Connect a 1" piece of black wire from J1, 2, 3, 4-6 (S2) to J1, 2, 3, 4-4 (C).

3. (✓) Fig. 4. Connect a 1" piece of black wire from J1, 2, 3, 4-4 (S2) to J1, 2, 3, 4-2 (S1).

4. (✓) Fig. 4. Connect a 1 1/2" piece of bare wire covered with a 1" piece of spaghetti from J5, 6, 7-4 (C) to J5, 6, 7-1 (S1).

5. (✓) Fig. 4. Connect the outer shield from the three conductor cable from wafer SIF to J5, 6, 7-4 (S2). The three leads from the cable are connected as follows:

(✓) brown to J5, 6, 7-2 (S1) (✓) orange to J5, 6, 7-5 (S1)
 (✓) red to J5, 6, 7-3 (S1)

6. (✓) Fig. 4. Push the twisted green and blue leads (originating at SIC-2 and SIC-4 respectively) through the hole "S" in the front panel between the two rotary switches and behind the slide switch, S3.

7. (✓) Fig. 4. Run the twisted white and brown leads (originating at SIF-5 and SIF-3 respectively) along the chassis as shown. Push leads through hole "S" in the front panel between the two rotary switches and behind the slide switch, S3.

8. (✓) Fig. 4. Cut all leads on two 6.8K Ω (blue, grey, red, silver) resistors, R70 and R71, to 1/2". Connect one resistor from S2B-2 (C) to S2B-3 (S1) and the second resistor from S2B-9 (S1) to S2A-8 (C).

9. (✓) Fig. 4. Connect the yellow lead (from the twisted yellow and grey leads originating at SIF-4 and SID-3 respectively) to S2A-8 (S2) and the grey lead from the pair to S2B-2 (S2).

10. (✓) Fig. 4. Push all the remaining loose leads from input selector switch, S1 through the rectangular hole below the switch.

11. (✓) Fig. 4. Connect a 2" piece of grey wire from S2B-4 (C) to R22-4 (S1).

12. (✓) Fig. 4. Connect a 3 1/2" piece of yellow wire from S2B-7 (S1) to R23-3 (S1).

13. (✓) Fig. 4. Connect a 3" piece of yellow wire from R23-2 (S1) to R25-1 (S1).

14. (✓) Fig. 4. Connect a 3" piece of grey wire from R22-5 (S1) to R24-4 (S1).

15. (✓) Fig. 4. Connect one end of a 17" piece of yellow wire to X11-1 (S1) and one end of a 16" piece of brown wire to X11-2 (S1). Twist the two leads together. Run along the front of the chassis and under the cable clamp, as shown. Push unsoldered end through hole "V" to the bottom of the chassis.

16. (✓) Fig. 4. Connect a 1" piece of bare wire from R33-7 (S1) to R32-8 (C).

17. (✓) Fig. 4. Connect one end of a 4 1/2" piece of black wire to R32-8 (S2). Push the other end through hole "U".

18. (✓) Fig. 4. Connect a 2" piece of grey wire from S2B-10 (S1) to S2B-4 (S2).

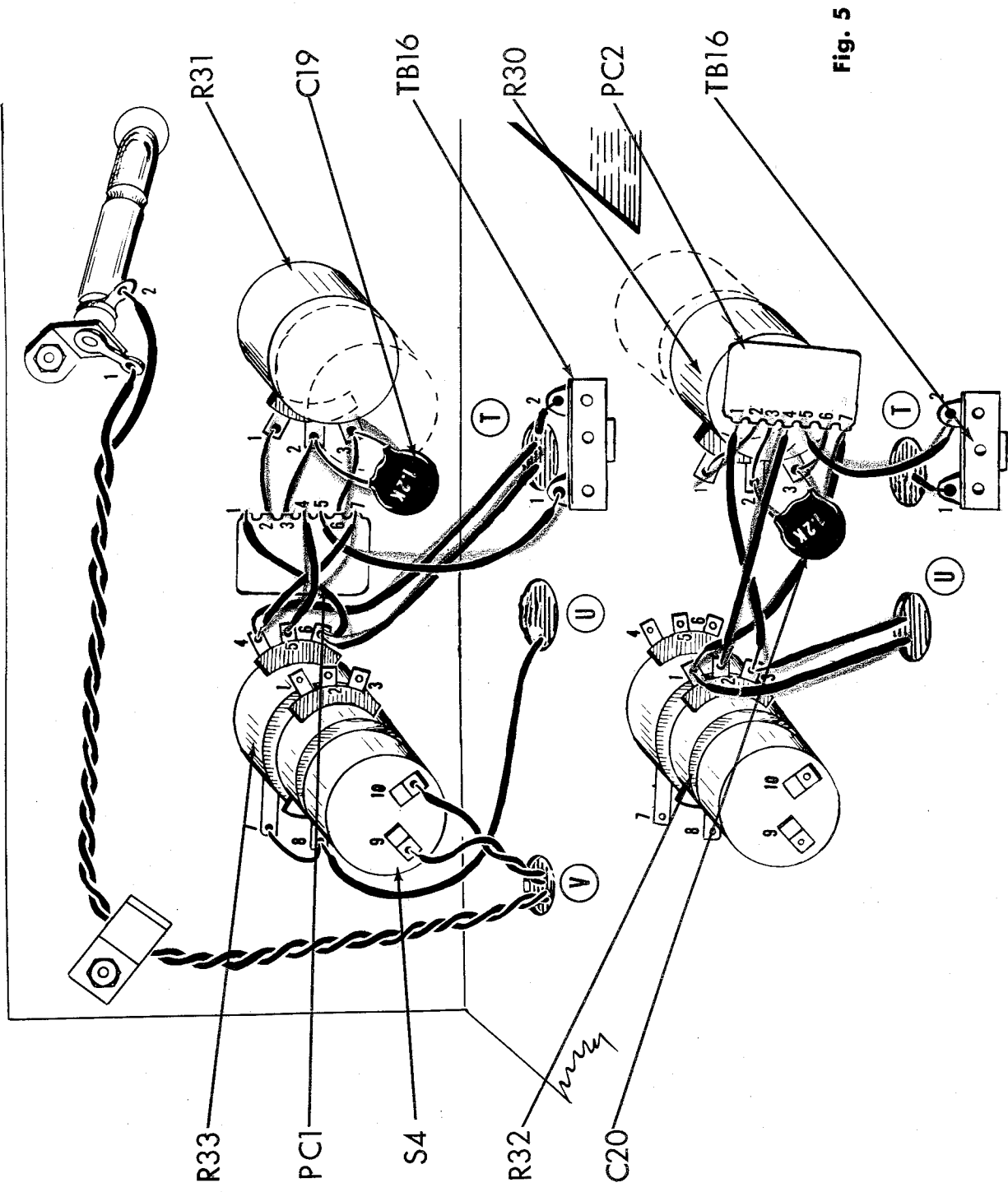


Fig. 5



Two printed circuit plates are soldered to the dual potentiometers. One printed circuit plate, PC1 gets connected to the potentiometers, R31 and R33 nearest the front apron. The other printed circuit plate, PC2 gets connected to the potentiometers R30 and R32 mounted on the rear of the front potentiometers. To keep the drawings clear and simple, the first plate, PC1 is mounted and wired in first, with the associated connections. The rear potentiometer is shown dotted in.

Below this drawing, the second plate, PC2 is mounted and wired in the circuit, with its associated connections. In this drawing, the front potentiometer, R31 is shown dotted in. All the connections made previously for PC1 are not shown in this drawing to avoid confusion.

We now wire the circuit using the first printed plate, PC1, using the upper drawing.

1. (✓) Fig. 5. Strip the outer insulation back 1/2" on one end of a 8" piece of single conductor shielded cable. Twist the shield strands together and cut off. Strip the inner insulation back 1/4". Connect this end to R33-4 (C). On the other end of the same piece of cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip the inner insulation back 1/4". Push this end of the cable through hole "T" to the bottom of the chassis.

2. (✓) Fig. 5. Connect one end of a 7" piece of brown wire to R33-6 (C). Push the other end through hole "T".

3. (✓) Fig. 5. On the printed circuit plate, PC1, cut leads #2, #3 and #6 to 1/2". Cut leads #1, #5 and #7 to 2". Cut lead #4 to 1 1/2". Connect lead #6 to R31-3 (C), lead #3 to R31-2 (C) and lead #2 to R31-1 (S1). Cover leads #1 and #7 each with a 1 3/4" piece of spaghetti. Connect lead #1 to R33-6 (S2) and lead #7 to R33-4 (S2). Cover lead #4 with a 1 1/4" piece of spaghetti and connect to R33-5 (S1). Cover lead #5 with a 1 3/4" piece of spaghetti and connect to TB16-1 (C).

4. (✓) Fig. 5. Cut both leads on a .0012 mfd (1.2K or 1200mmf) disc capacitor, C19, to 1/2". Connect from R31-2 (S2) to R31-3 (S2).

5. (✓) Fig. 5. Connect one end of a 5 1/2" piece of green wire to TB16-2 (C) Push the other end through hole "T" to the bottom of the chassis.

6. (✓) Fig. 5. Connect one end of a 10" piece of grey wire to the switch S4-9 (S1) which is mounted on the rear of the dual treble control potentiometers. Connect one end of a 14" piece of black wire to S4-10 (S1). Twist the two leads together and push the unsoldered end through hole "Y" to the bottom of the chassis.

The wiring of the front potentiometers and the printed circuit plate PC1, has now been completed. Referring to the set below the main drawing, wire the rear section of the dual concentric potentiometer, with the printed circuit plate, PC2, as follows:

7. (✓) Fig. 5. Cut the leads #2, #3 and #6 on printed circuit plate PC2, to 1/2". On the same printed circuit plate PC2, cut leads #1 and #7 to 2 1/4", lead #5 to 1 1/4" and lead #4 to 1 3/4". Connect lead #6 to R30-3 (C), lead #3 to R30-2 (C) and lead #2 to R30-1 (S1). Cover leads #1 and #7 each with a 2" piece of spaghetti. Connect lead #7 to R32-1 (C) and lead #1 to R32-3 (C). Cover lead #4 with a 1 1/2" piece of spaghetti and connect to R32-2 (S1). Cover lead #5 with a 1" piece of spaghetti and connect to TB16-2 (S2).

8. (✓) Fig. 5. Cut both leads on a .0012 mfd (1.2K or 1200mmf) disc capacitor, C20, to 1/2". Connect from R30-3 (S2) to R30-2 (S2).

9. (✓) Fig. 5. Connect one end of an 8" piece of grey wire to TB16-1 (S2). Push the other end through hole "T" to the bottom of the chassis.

10. (✓) Fig. 5. Connect one end of a 4" piece of yellow wire to R32-3 (S2). Push the other end through hole "U" to the bottom of the chassis.

11. (✓) Fig. 5. Strip the outer insulation back 1/2" on one end of a 5" piece of single conductor shielded cable. Twist the shield strands together and cut off. Strip the inner insulation back 1/4". Connect this end to R32-1 (S2). On the other end of the same piece of cable, strip the outer insulation back 3/4". Twist the shield strands together. Strip the inner insulation back 1/4". Push this end of the cable through hole "U" to the bottom of the chassis.

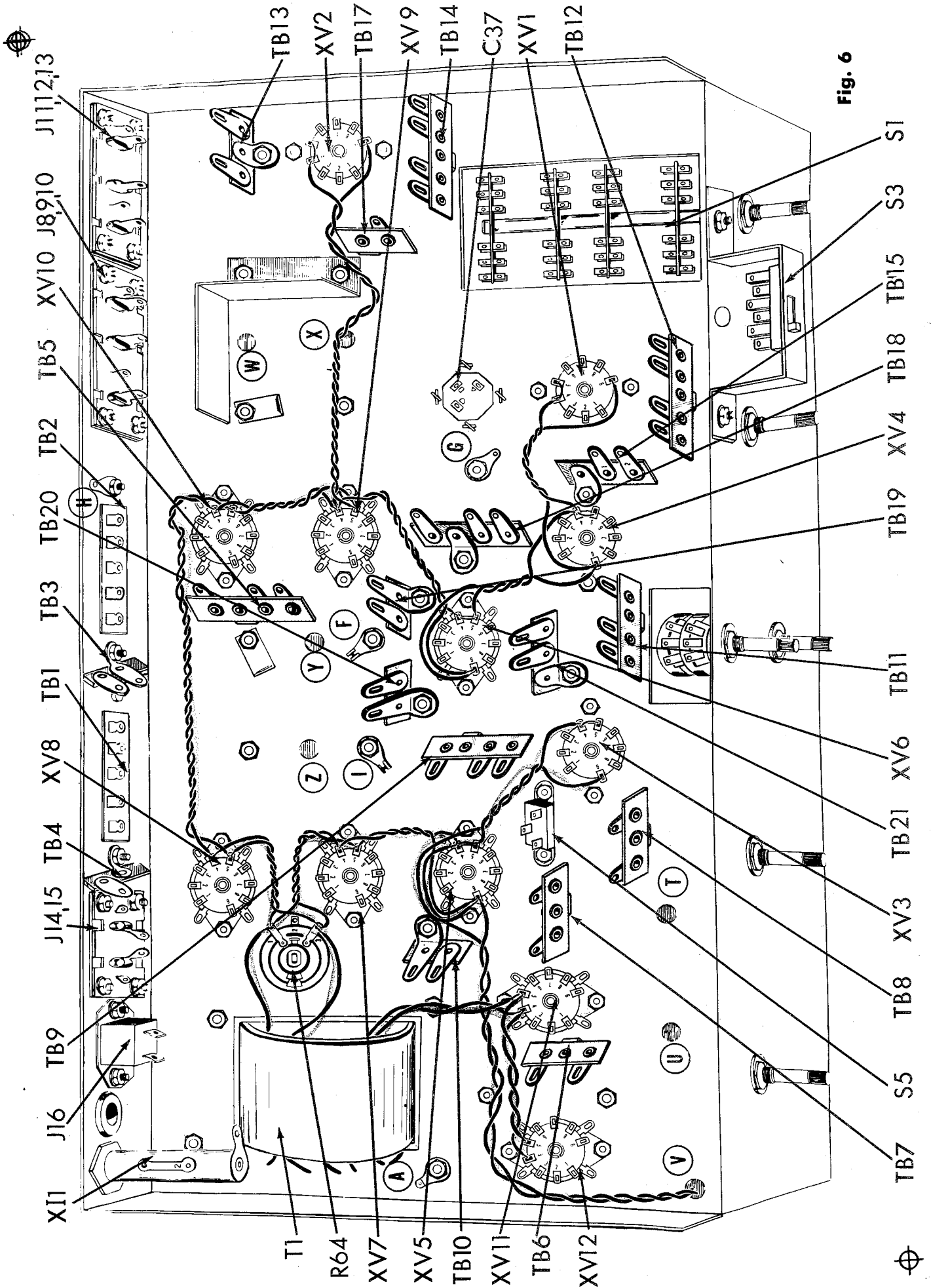


Fig. 6

BELOW CHASSIS WIRING

1. (✓) Fig. 6. From the power transformer, T1, connect one green lead to R64-1 (C) and the other green lead to R64-3 (C).
2. (✓) Fig. 6. Fold the pot grounding lug over terminal #2 on R64. Solder this lug to this terminal R64-2 (S1).
3. (✓) Fig. 6. Connect one end of a 4" piece of yellow wire to R64-3 (C) and one end of a 4" piece of brown wire to R64-1 (C). Twist the wires together. Connect the other end of the yellow wire to XV7-4 (C) and the other end of the brown wire to XV7-5 (C).
4. (✓) Fig. 6. Connect one end of a 5" piece of yellow wire to R64-3 (S3) and one end of a 5" piece of brown wire to R64-1 (S3). Twist the wires together. Connect the other end of the yellow wire to XV8-4 (C) and the other end of the brown wire to XV8-5 (C).
5. (✓) Fig. 6. Connect one end of a 4 1/2" piece of brown wire to XV7-5 (S2) and one end of a 3" piece of yellow wire to XV7-4 (S2). Twist the leads together. Connect the other end of the yellow wire to XV5-4 (C) and the other end of the brown wire (running along the chassis as shown) to XV5-9 (C).
6. (✓) Fig. 6. Run the twisted pair of brown and yellow wires from hole "V" along the chassis as shown. Connect the brown lead to XV5-9 (C) and the yellow lead to XV5-4 (C).
7. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV5-4 (S3) to XV5-5 (C).
8. (✓) Fig. 6. Connect one end of a 4" piece of yellow wire to XV5-5 (S2) and one end of a 5 1/2" piece of brown wire to XV5-9 (S3). Twist the two wires and run along the chassis as shown. Connect the other end of the yellow wire to XV3-4 (C) and the other end of the brown wire to XV3-9 (S1).
9. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV3-4 (S2) to XV3-5 (S1).
10. (✓) Fig. 6. Connect one end of a 6" piece of brown wire to XV8-5 (S2) and one end of a 6" piece of yellow wire to XV8-4 (S2). Twist the wires and run along the chassis as shown. Connect the other end of the brown wire to XV10-5 (C) and the other end of the yellow wire to XV10-4 (C).
11. (✓) Fig. 6. Connect one end of a 5" piece of yellow wire to XV10-4 (S2)

and one end of a 5" piece of brown wire to XV10-5 (S2). Twist the wires and run along the chassis as shown. Connect the other end of the yellow wire to XV9-4 (C) and the other end of the brown wire to XV9-5 (C).

12. (✓) Fig. 6. Connect one end of a 4" piece of yellow wire to XV9-4 (C) and one end of a 5" piece of brown wire to XV9-5 (C). Twist the wires and run along the chassis as shown. Connect the other end of the yellow wire to XV6-4 (C) and the other end of the brown wire to XV6-9 (C).
13. (✓) Fig. 6. Connect one end of a 7" piece of yellow wire to XV9-4 (S3) and one end of a 7" piece of brown wire to XV9-5 (S3). Twist the wires and run along the chassis as shown. Connect the other end of the yellow wire to XV2-4 (C) and the other end of the brown wire to XV2-9 (S1).
14. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV2-4 (S2) to XV2-5 (S1).
15. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV6-4 (S2) to XV6-5 (C).
16. (✓) Fig. 6. Connect one end of a 4 1/2" piece of brown wire to XV6-9 (S2) and one end of a 3" piece of yellow wire to XV6-5 (S2). Twist the wires and run along the chassis as shown. Connect the other end of the yellow wire to XV4-4 (C) and the other end of the brown wire to XV4-9 (C).
17. (✓) Fig. 6. Connect one end of a 2 1/2" piece of yellow wire to XV4-4 (C) and one end of a 5 1/2" piece of brown wire to XV4-9 (S2). Twist the wires and run along the chassis as shown. Connect the other end of the brown wire to XV1-9 (S1) and the other end of the yellow wire to XV1-4 (C).
18. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV1-4 (S2) to XV1-5 (S1).
19. (✓) Fig. 6. Connect a 1/2" piece of bare wire from XV4-4 (S3) to XV4-5 (S1).
20. (✓) Fig. 6. Connect one end of one 3 1/2" piece of yellow wire to XV12 4 (C) and one end of a second 3 1/2" piece of yellow wire to XV12-5 (S1). Twist the wires and run along the chassis as shown. Connect the other end of one of the yellow wires to XV11-4 (C) and the other end of the remaining yellow wire to XV11-5 (C).
21. (✓) Fig. 6. From the power transformer, T1, twist the yellow leads and run along the chassis as shown. Connect one lead to XV11-4 (S2) and the other lead to XV11-5 (S2).

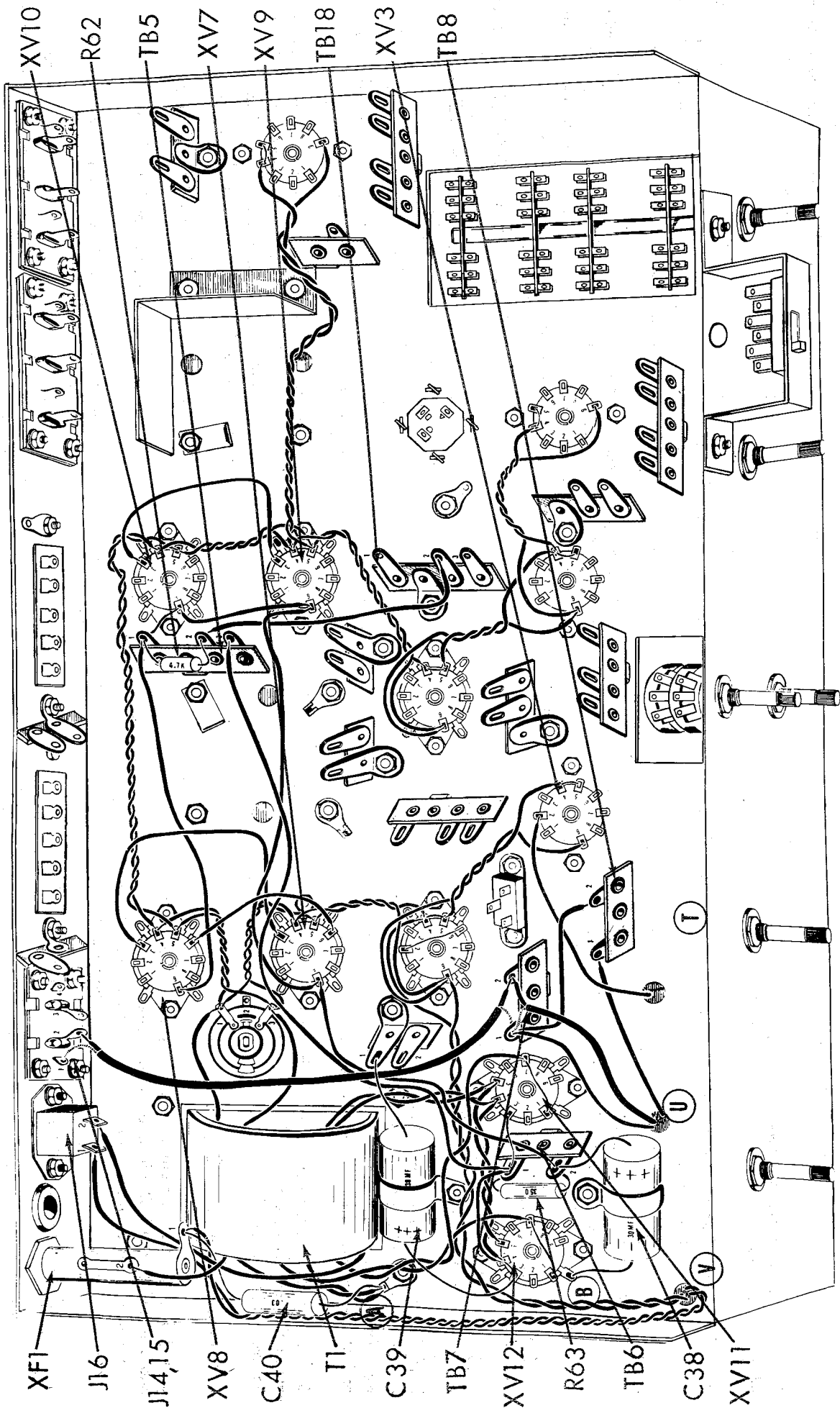


Fig. 7



1. (✓) Fig. 7. From the power transformer, T1, connect the red-yellow and white leads to ground lug "A" (C) at the power transformer.
2. (✓) Fig. 7. From the power transformer, T1, twist the two red leads and run along the chassis as shown. Connect one red lead to XV12-7 (C) and the other red lead to XV11-7 (C).
3. (✓) Fig. 7. Connect a 1" piece of bare wire from XV11-1 (S1) to XV11-7 (S2).
4. (✓) Fig. 7. Connect a 1" piece of bare wire from XV12-1 (S1) to XV12-7 (S2).
5. (✓) Fig. 7. Run the twisted pair of grey and black leads from hole "V" along the chassis as shown. Connect the grey lead to XFI-1 (C) and the black lead to J16-1 (C).
6. (✓) Fig. 7. Cut both leads on a .03mfd molded capacitor, C40, to 1" and cover each with a 3/4" piece of spaghetti. Connect one lead to XFI-1 (S2) and the other lead to ground lug "A" (S3). Be careful not to burn the leads running near ground lug "A".
7. (✓) Fig. 7. From the power transformer T1, connect the black lead (nearest ground lug "A") to J16-2 (C).
8. (✓) Fig. 7. Connect remaining black lead on power transformer, T1, to XFI-2 (S1).
9. (✓) Fig. 7. Connect the 350 Ω , 10 watt resistor, R63, from TB6-1 (C) to TB6-2 (C). Cut both leads to 1 1/4" and cover each with a 1" piece of spaghetti.
10. (✓) Fig. 7. Cut both leads on the 30mfd electrolytic capacitor, C38, to 1 1/2". Cover the positive (+) lead with 1 1/4" piece of spaghetti and connect to TB6-2 (C). Connect the negative lead to ground lug "B" (S1) on XV12.
11. (✓) Fig. 7. Connect a 1/2" piece of bare wire from XV12-3 (C) to XV12-4 (C).
12. (✓) Fig. 7. Connect a 3" piece of red wire from XV12-4 (S3) to TB6-1 (C).
13. (✓) Fig. 7. Cut the positive (+) lead on the 30mfd electrolytic capacitor, C39, to 1 1/2". Cover with a 1 1/4" piece of spaghetti and connect to XV12-3 (S2). The other lead will be connected later.
14. (✓) Fig. 7. Connect a 6" piece of orange wire from TB6-2 (S3) to XV7-9 (C).

15. (✓) Fig. 7. Connect a 3/4" piece of bare wire from TB6-1 (C) to XV11-3 (S1).
16. (✓) Fig. 7. Connect a 7" piece of orange wire from XV7-9 (S2) to XV9-9 (C).
17. (✓) Fig. 7. Connect a 6" piece of orange wire from XV8-9 (S1) to TB5-1 (C).
18. (✓) Fig. 7. Connect a 3" piece of orange wire from XV10-9 (C) to XV9-9 (S2).
19. (✓) Fig. 7. Connect a 1" piece of bare wire from TB5-1 (C) to XV10-9 (S2).
20. (✓) Fig. 7. Connect a 4 1/2" piece of orange wire from TB5-2 (C) to TB18-2 (C).
21. (✓) Fig. 7. Cut both leads on a 4.7K Ω (yellow, violet, red, silver) 2 watt resistor, R62, to 3/4". Connect from TB5-1 (S3) to TB5-2 (S2).
22. (✓) Fig. 7. Connect a 3 1/2" piece of yellow wire from XV8-3 (C) to XV7-3 (C).
23. (✓) Fig. 7. Connect a 3 1/2" piece of yellow wire from XV10-3 (C) to XV9-3 (C).
24. (✓) Fig. 7. Connect an 8 1/2" piece of red wire from TB5-3 (C) to TB6-1 (S4).
25. (✓) Fig. 7. Connect the black wire from hole "U" to TB7-1 (C).
26. (✓) Fig. 7. Connect the green wire from hole "T" to XV3-2 (S1).
27. (✓) Fig. 7. Connect the yellow wire from hole "U" to TB8-1 (C).
28. (✓) Fig. 7. Connect a 3 1/2" piece of black wire from TB7-1 (C) to TB8-2 (C).
29. (✓) Fig. 7. Connect the outer shield from the single conductor shielded cable (from hole "U") to TB7-1 (C) and the inner conductor of the same cable to TB7-2 (C).
30. (✓) Fig. 7. Strip back the outer insulation 3/4" from one end of a 8" piece of single conductor shielded cable. Twist the shield strands together. Strip the insulation on the inner conductor back 1/4". Connect the shield to TB7-1 (C) and the inner conductor to TB7-2 (C). On the other end of the same cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation on the inner conductor back 1/4". Connect the shield to J14, 15-1 (S1) and the inner conductor to J14, 15-2 (S1).

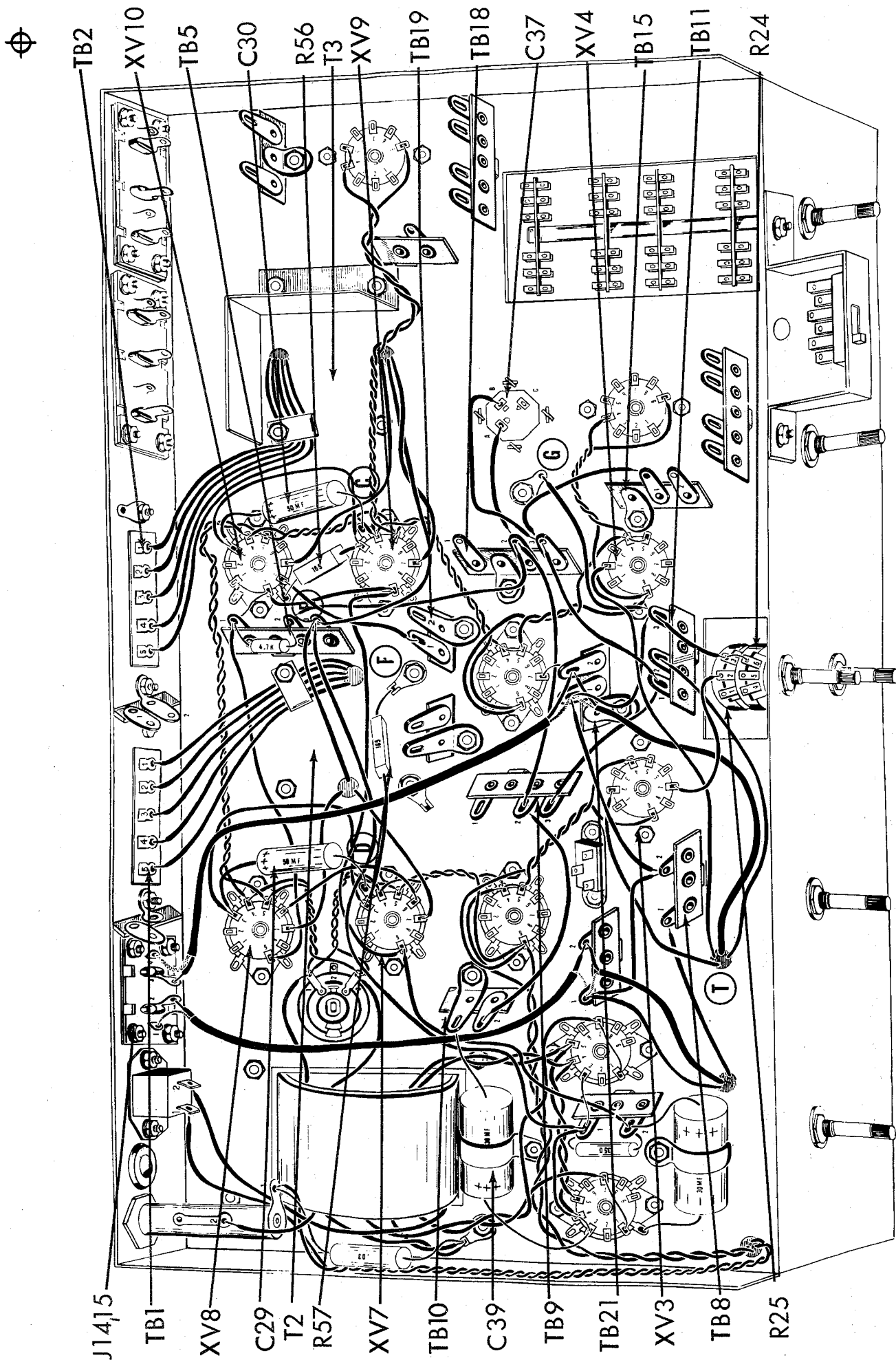


Fig. 8

1. (✓) Fig. 8. Cut the negative (-) lead on the 30 mfd electrolytic capacitor, C39, to 1 1/4". Connect to TB10-1 (C).
2. (✓) Fig. 8. From the output transformer, T2, connect the yellow lead to TB1-4 (C), the green lead to TB1-3 (S1), the brown lead to TB1-2 (S1), the black lead to TB1-1 (C), the red lead to TB5-3 (C), the blue lead to XV7-7 (S1), the brown-yellow lead to XV8-7 (S1), and the orange lead to TB1-5 (S1).
3. (✓) Fig. 8. Connect a 3 1/2" piece of green wire from XV7-6 (C) to XV8-6 (C).
4. (✓) Fig. 8. Connect a 3 1/2" piece of green wire from XV10-8 (C) to TB19-1 (C).
5. (✓) Fig. 8. Cut all leads on two 50 mfd, 25V, electrolytic capacitors, C29, and C30, to 1". Cover the positive (+) leads on both capacitors with a 3/4" piece of spaghetti. Connect the positive lead of one capacitor to XV10-3 (S2) and the negative (-) lead to ground lug "C" (S1) at XV9. Connect the positive (+) lead of the second capacitor to XV8-3 (S2) and the negative (-) lead to ground lug "D" (S1) at XV7.
6. (✓) Fig. 8. Cut both leads on a 165Ω, 5 watt resistor, R56, to 3/4". Cover one lead with a 1/2" piece of spaghetti and connect XV9-3 (S2). Connect the other lead to ground lug "E" (S1) at XV10. Dress resistor away from surrounding wires.
7. (✓) Fig. 8. From the output transformer, T3, connect the yellow lead to TB2-4 (C), the green lead to TB2-3 (S1), the brown lead to TB2-2 (S1), the black lead to TB2-1 (C), the red lead to TB5-3 (S3), the blue lead to XV9-7 (S1), the brown-yellow lead to XV10-7 (S1) and the orange lead to TB2-5 (S1).
8. (✓) Fig. 8. Connect the brown lead from hole "T" to TB11-2 (C).
9. (✓) Fig. 8. Connect a 2 1/2" piece of red wire from TB9-3 (C) to TB11-1 (C).
10. (✓) Fig. 8. Connect the outer shield from the single conductor cable (from hole "T") to TB21-1 (C) and the inner conductor to TB21-2 (C).
11. (✓) Fig. 8. Connect a 3 1/2" piece of orange wire from TB9-2 (C) to TB18-2 (C).
12. (✓) Fig. 8. Strip back the outer insulation 3/4" from one end of an 8"

- piece of single conductor shielded cable. Twist the shield strands together. Strip the insulation on the inner conductor back 1/4". Connect the shield to TB21-1 (C) and the inner conductor to TB21-2 (C). On the other end of the same cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation on the inner conductor back 1/4". Connect the shield to J14, 15-4 (S1) and the inner conductor to J14, 15-3 (S1).
13. (✓) Fig. 8. Cut one lead on the 165Ω, 5 watt resistor, R57, to 1 1/2" and cover with a 1 1/4" piece of spaghetti. Connect this lead to XV7-3 (S2). Cut the other lead to 1/2" and connect to ground lug "F" (S1). Dress away from the surrounding wires.
 14. (✓) Fig. 8. Connect a 3 1/2" piece of black wire from TB8-2 (C) to TB21-1 (C).
 15. (✓) Fig. 8. Connect a 3" piece of black wire from TB21-1 (C) to TB11-3 (C).
 16. (✓) Fig. 8. Connect a 3 1/2" piece of black wire from TB11-3 (C) to ground lug "G" (C).
 17. (✓) Fig. 8. Connect the grey lead from hole "T" to XV4-2 (S1).
 18. (✓) Fig. 8. Connect a 4" piece of orange wire from TB10-2 (C) to TB9-2 (C).
 19. (✓) Fig. 8. Connect a 3 1/2" piece of red wire from TB11-1 (C) to TB18-3 (C).
 20. (✓) Fig. 8. Connect a 4 1/2" piece of red wire from TB18-3 (C) to C37-B (C).
 21. (✓) Fig. 8. Connect a 3" piece of red wire from TB18-3 (C) to TB15-1 (C).
 22. (✓) Fig. 8. Connect a 3 1/2" piece of orange wire from TB18-2 (C) to C37-A (C).
 23. (✓) Fig. 8. Connect a 1" piece of bare wire to the dual concentric pots in the rectangular hole at the middle-front of the chassis. Connect from R24-6 (S1) to R25-3 (C).
 24. (✓) Fig. 8. Connect a 2" piece of black wire from R25-3 (S2) to TB11-3 (C).
 25. (✓) Fig. 8. Connect a 1 3/4" piece of green wire from R25-2 (S1) to XV3-7 (S1).

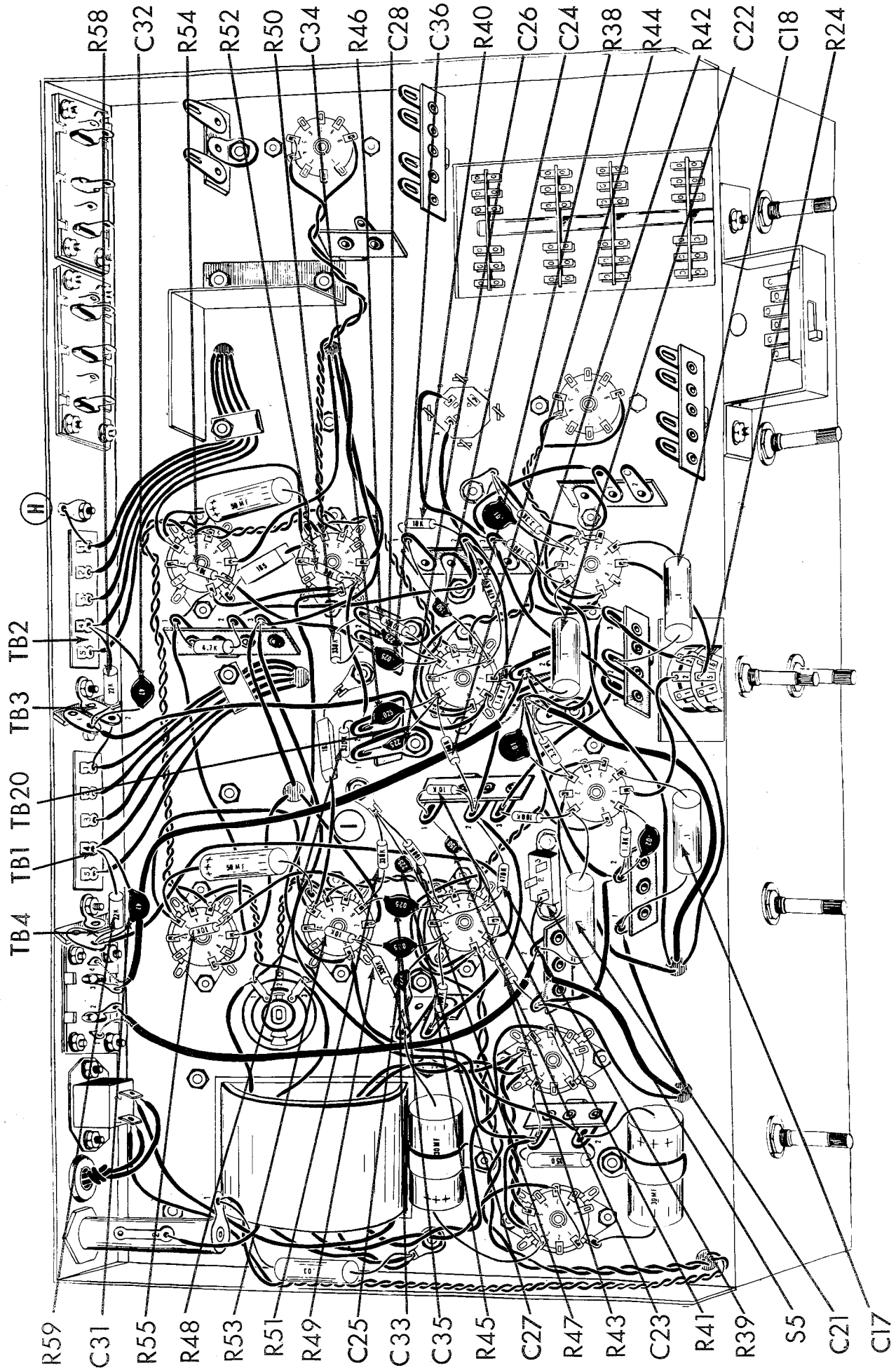


Fig. 9



1. (✓) Fig. 9. Connect a 2 1/2" piece of green wire from R24-5(S1) to XV4-7(S1).
2. (✓) Fig. 9. Connect a 9" piece of black wire from XV5-8(C) to TB4(C).
3. () Fig. 9. Connect a 9" piece of black wire from XV6-8(C) to TB3-1(C).
4. (✓) Fig. 9. Cut all leads on two 47mmf, 10% disc capacitors, C31 and C32, to 3/4". Connect C32 from TB2-4(C) to TB3-1(C) and the other capacitor, C31, from TB1-4(C) to TB4(C). Each lead is to be covered with a 1/2" piece of spaghetti.
5. (✓) Fig. 9. Connect a 1" piece of bare wire from TB1-1(S2) to TB3-2(S1).
6. () Fig. 9. Connect a 1" piece of bare wire from TB2-1(S2) to ground lug "H" (S1).
7. (✓) Fig. 9. Cut all leads on the two 22KΩ (red, red, orange, gold) 5% resistors, R58 and R59, to 3/4". Connect R58 from TB2-4(S3) to TB3-1(S3) and R59 from TB1-4(S3) to TB4(S3). Each lead is to be covered with a 1/2" piece of spaghetti.
8. (✓) Fig. 9. Cut all leads on the six 10KΩ (brown, black, orange, silver) resistors, R40, R41, R52, R53, R54, and R55, to 1/2". Connect R55 from XV8-6(S2) to XV8-2(S1). Connect R53 resistor from XV7-8(C) to XV7-2(S1). Connect R54 from XV10-8(S2) to XV10-2(S1). Connect R52 from XV9-8(C) to XV9-2(S1). Connect R41 from TB9-1(C) to TB9-2(C). Connect R40 from TB18-1(C) to TB18-2(C).
9. (✓) Fig. 9. Connect a 3" piece of grey wire from TB20-2(C) to XV9-8(S2).
10. (✓) Fig. 9. Cut all leads on the two 330KΩ (orange, orange, yellow, silver) resistors, R48 and R50 to 1/2". Connect R50 from TB19-2(C) to TB19-1(C). Connect R48 from TB20-1(C) to TB20-2(C).
11. (✓) Fig. 9. Cut all leads on the two 330KΩ (orange, orange, yellow, silver) resistors, R49 and R51 to 3/4". Connect R49 from TB10-1(C) to XV7-8(C). Connect R51 from XV7-6(C) to ground lug "I" (C).
12. (✓) Fig. 9. Cut all leads on the four .025mfd (25K or 25,000mmf) disc capacitors, C33, C34, C35, and C36, to 3/4". Connect C33 from XV5-1(C) to XV7-8(S3). Connect C35 from XV5-3(C) to XV7-6(S3). Connect C34 from XV6-1(C) to TB20-2(S3). Connect C36 from XV6-3(C) to TB19-1(S3).
13. (✓) Fig. 9. Cut all leads on the two 100KΩ (brown, black, yellow, gold) 5% resistors, R45 and R46, to 1/2". Connect R45 from XV5-1(C) to TB10-2(S2). Connect R46 from XV6-3(C) to TB19-2(C).
14. (✓) Fig. 9. Cut all leads on the two 100KΩ (brown, black, yellow, gold) 5% resistors, R44 and R47, to 3/4". Connect R47 from XV5-3(C) to ground lug "I" (C). Connect R44 from XV6-1(C) to TB9-2(C).
15. (✓) Fig. 9. Cut all leads on the two 225mmf disc capacitors, C25 and C28 to 3/4". Connect C25 from XV5-1(S3) to TB10-1(S3). Connect C28 from XV6-3(S3) to TB19-2(S3).
16. (✓) Fig. 9. Cut all leads on the two 225mmf disc capacitors, C26 and C27, to 1". Connect C27 from XV5-3(S3) to ground lug "I" (S3). Connect C26 from XV6-1(S3) to TB20-1(S2).
17. (✓) Fig. 9. Cut all leads on two 1.8KΩ (brown, grey, red, gold) 5% resistors, R42 and R43, to 3/4". Connect R43 from XV5-8(S2) to TB7-1(S5). Connect R42 from XV6-8(S2) to TB21-1(C).
18. (✓) Fig. 9. Cut all leads on two 470KΩ (yellow, violet, yellow, silver) resistors, R38 and R39, to 3/4". Connect R39 from XV5-6(C) to TB9-2(S5). Connect R38 from XV6-6(C) to TB18-2(S5).
19. (✓) Fig. 9. Cut all leads on two 150mmf disc capacitors, C23 and C24, to 1". Connect C23 from XV5-6(C) to TB9-1(S2). Connect C24 from XV6-6(C) to TB18-1(S2).
20. () Fig. 9. Connect a 1 1/4" piece of bare wire from TB7-2(C) to S5-1(S1).
21. (✓) Fig. 9. Connect a 3/4" piece of bare wire from TB21-2(C) to XV6-7(S1).
22. (✓) Fig. 9. Connect a 1" piece of bare wire from XV5-2(S1) to XV5-6(S3).
23. (✓) Fig. 9. Cut a 1" piece of bare wire from XV6-2(S1) to XV6-6(S3).
24. (✓) Fig. 9. Cut all leads on four .1mfd (brown, black, yellow, yellow) molded capacitors, C17, C18, C21 and C22, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect C17 from XV3-6(C) to TB8-1(S2). Connect C18 from XV4-6(C) to TB11-2(S2). Connect C21 from XV3-1(C) to TB7-2(S4). Connect C22 from XV4-1(C) to TB21-2(C). Dress the leads as shown and push all capacitors flat against the chassis.

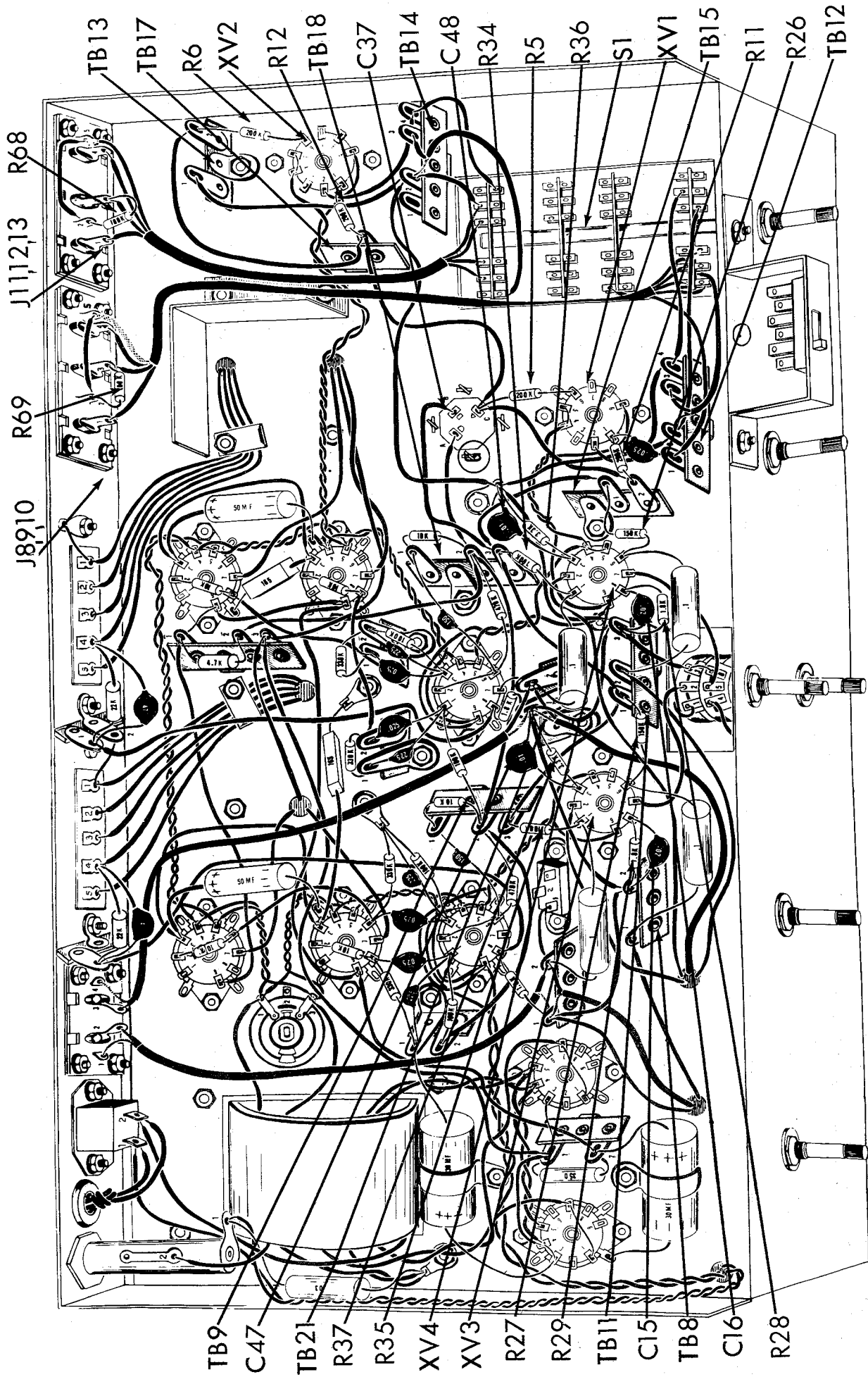


Fig. 10



1. (✓) Fig. 10. Cut all leads on two 100KΩ (brown, black, yellow, silver) resistors, R34 and R35, to 1/2". Connect R34 from XV4-1 (S2) to TB18-3 (S4). Connect R35 from XV3-1 (S2) to TB9-3 (S2).
2. (✓) Fig. 10. Cut all leads on two 150KΩ (brown, green, yellow, silver) resistors, R26 and R27, to 1/2". Connect R26 from XV4-6 (S2) to TB15-1 (S2). Connect R27 from XV3-6 (S2) to TB11-1 (S3).
3. (✓) Fig. 10. Cut all leads on two 1.8KΩ (brown, grey, red, silver) 10% resistors, R28 and R29, to 1/2". Connect R28 from XV4-8 (C) to TB11-3 (C). Connect R29 from XV3-8 (C) to TB8-2 (C).
4. (✓) Fig. 10. Cut all leads on two .02 mfd (20K or 20,000 mmf) disc capacitors, C15 and C16, to 1/2". Connect C15 from XV3-8 (S2) to TB8-2 (S4). Connect C16 from XV4-8 (S2) to TB11-3 (S5).
5. (✓) Fig. 10. Cut all leads on two 3.3KΩ (orange, orange, red, silver) resistors, R36 and R37, to 5/8". Connect R36 from XV4-3 (C) to ground lug "G" (C). Connect R37 from XV3-3 (C) to TB21-1 (C).
6. (✓) Fig. 10. Cut all leads on two .01 mfd (10K or 10,000 mmf) disc capacitors, C47 and C48, to 3/4". Connect C47 from XV3-3 (S2) to TB21-1 (C). Connect C48 from XV4-3 (S2) to ground lug "G" (C).
7. (✓) Fig. 10. Connect a 4" piece of orange wire from C37-C (C) to TB15-2 (C).
8. (✓) Fig. 10. Connect a 3 1/2" piece of black wire from ground lug "G" (C) to TB12-2 (C).
9. (✓) Fig. 10. Connect a 4" piece of orange wire from TB17 (C) to C37-C (C).
10. (✓) Fig. 10. Connect a 4 1/2" piece of black wire from ground lug "G" (C) to TB14-2 (C).
11. (✓) Fig. 10. Connect a 4" piece of orange wire from TB17 (C) to TB13-2 (C).
12. (✓) Fig. 10. Connect a 3 1/2" piece of black wire from TB14-2 (C) to TB13-1 (C).
13. (✓) Fig. 10. Connect the black lead from S1A-10 to TB12-2 (C).
14. (✓) Fig. 10. Connect the brown lead from S1D-7 to TB12-1 (C).
15. (✓) Fig. 10. Connect the shield from the single conductor shielded cable

- from S1B-5) to TB12-2 (C). Connect the inner conductor to TB12-3 (C).
16. (✓) Fig. 10. Connect the grey lead from S1B-11 to TB12-4 (C).
17. (✓) Fig. 10. Connect the grey lead from S1G-12 to TB14-4 (C).
18. (✓) Fig. 10. Connect the shield from the single conductor shielded cable (from S1G-6) to TB14-2 (C). Connect the inner conductor to TB14-3 (C).
19. (✓) Fig. 10. Connect the black lead from S1H-11 to TB14-2 (C).
20. (✓) Fig. 10. Connect a 1 1/2" piece of bare wire covered with a 1/4" piece of spaghetti from J8, 9, 10-2 (C) to J8, 9, 10-5 (C).
21. (✓) Fig. 10. Connect a 1 1/2" piece of bare wire covered with a 1/4" piece of spaghetti from J11, 12, 13-2 (C) to J11, 12, 13-5 (C).
22. (✓) Fig. 10. Cut all leads on two 100KΩ (brown, black, yellow, silver) resistors, R68 and R69, to 1/2". Connect R68 from J11, 12, 13-2 (S2) to J11, 12, 13-3 (C). Connect R69 from J8, 9, 10-2 (S2) to J8, 9, 10-3 (C).
23. (✓) Fig. 10. Run the three conductor shielded cable from switch wafer S1B along the chassis as shown. Connect the shield to J8, 9, 10-5 (S2); connect the brown lead to J8, 9, 10-1 (S1), connect the red lead to J8, 9, 10-3 (S2); and connect the orange lead to J8, 9, 10-4 (S1).
24. (✓) Fig. 10. Run the three conductor shielded cable from switch wafer S1H along the chassis as shown. Connect the shield to J11, 12, 13-5 (S2); connect the brown lead to J11, 12, 13-1 (S1); connect the red lead to J11, 12, 13-3 (S2); and connect the orange lead to J11, 12, 13-4 (S1).
25. (✓) Fig. 10. Connect a 2" piece of grey wire from TB12-4 (C) to XV1-2 (C).
26. (✓) Fig. 10. Connect a 3" piece of grey wire from TB14-4 (C) to XV2-2 (C).
27. (✓) Fig. 10. Cut all leads on four 200KΩ (red, black, yellow, gold) 5% resistors, R5, R6, R11 and R12 to 5/8". Connect R5 from C37-C (C) to XV1-6 (C). Connect R6 from TB13-2 (S2) to XV2-6 (C). Connect R11 from TB15-2 (S2) to XV1-1 (C). Connect R12 from TB17 (S3) to XV2-1 (C).

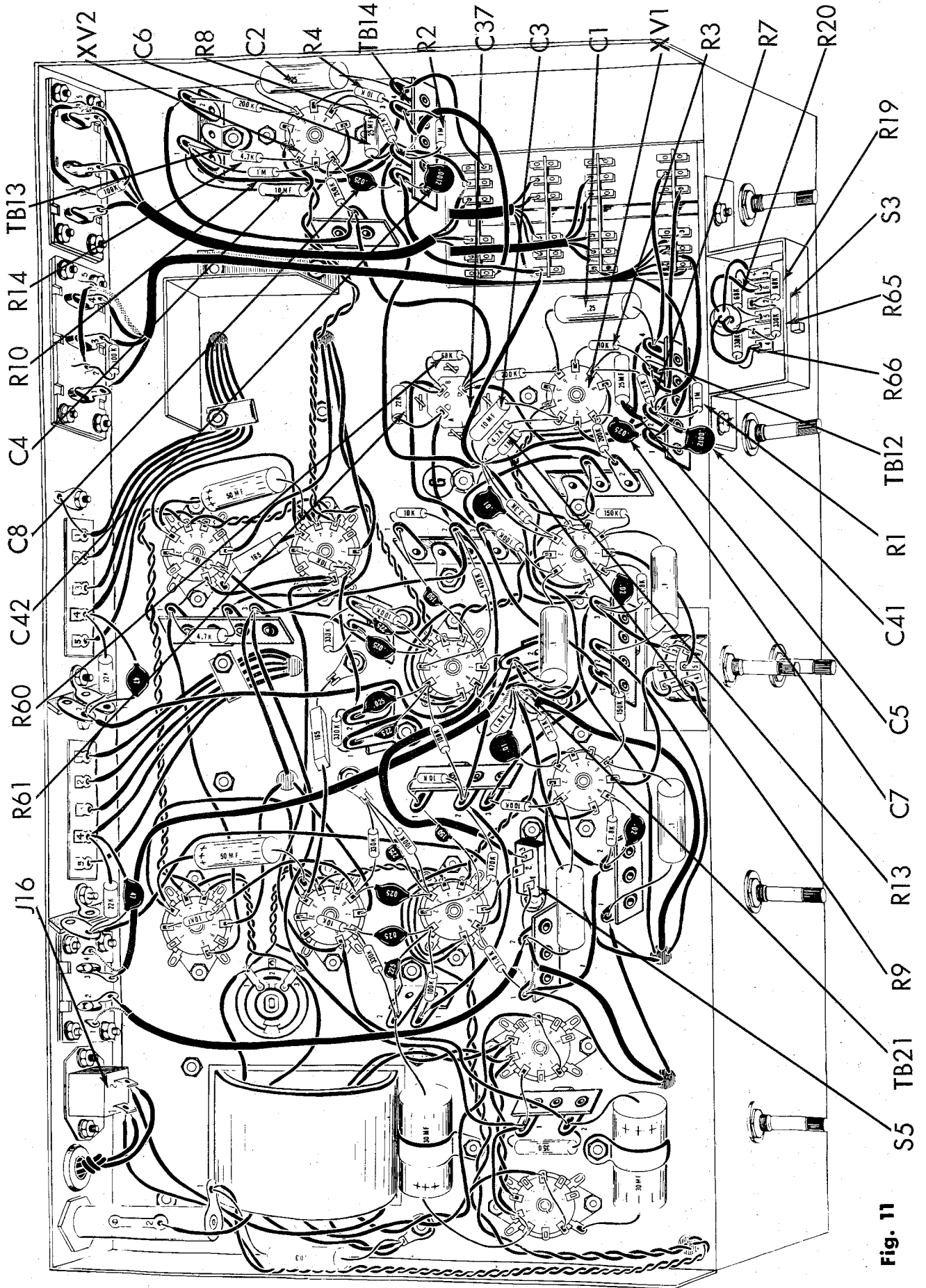


Fig. 11



1. (✓) Fig. 11. Cut all leads on two 25 mfd electrolytic capacitors, C5 and C6, to 1" and cover each with a 3/4" piece of spaghetti. Connect the positive (+) end of C5 to XV1-8 (C) and the negative (-) end to TB12-2 (C). Connect the positive (+) end of C6 to XV2-8 (C) and the negative (-) end to TB14-2 (C).
2. (✓) Fig. 11. Cut all leads on two 2.2KΩ (red, red, silver) resistors, R7 and R8, to 3/4" and cover each lead with a 1/2" piece of spaghetti. Connect R7 from XV1-8 (S2) to TB12-2 (C). Connect R8 from XV2-8 (S2) to TB14-2 (C).
3. (✓) Fig. 11. Cut the ground end (if the capacitor is so marked with a line) of two .25 mfd paper capacitors, C1 and C2, to 1". (If it is not marked, cut either end to 1".) Connect this end of C1 to XV1-6 (S2) and this end of C2 to XV2-6 (S2). Cut the other end of both capacitors to 3/4". Connect this end of C1 to TB12-4 (S3) and this end of C2 to TB14-4 (S3).
4. (✓) Fig. 11. On two 10KΩ (brown, black, orange, silver) resistors, R3 and R4, cut one lead to 1/2" and the other lead to 3/4". Connect the 1/2" lead of R3 to XV1-7 (S1) and the 3/4" lead to TB12-3 (C). Connect the 1/2" lead of R4 to XV2-7 (S1) and the 3/4" lead to TB14-3 (C).
5. (✓) Fig. 11. Cut both leads on two 1MΩ (brown, black, green, silver) resistors, R1 and R2, to 1/2". Connect R1 from TB12-3 (S3) to TB12-2 (C). Connect R2 from TB14-3 (S3) to TB14-2 (C).
6. (✓) Fig. 11. Cut all leads on two .0012 mfd (1.2K or 1200 mmf) disc capacitors, C41 and C42 to 1/2". Connect C41 from TB12-1 (C) to TB12-2 (S7). Connect C42 from TB14-1 (C) to TB14-2 (S8).
7. (✓) Fig. 11. Cut all leads on two .025 mfd (25K or 25,000 mmf) disc capacitors, C7 and C8, to 3/4". Connect C7 from XV1-1 (S2) to TB12-1 (S3). Connect C8 from XV2-1 (S2) to TB14-1 (C).
8. (✓) Fig. 11. Cut all leads on two 10 mfd, 6 volt electrolytic capacitors, C3 and C4, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect the positive (+) end of C3 to XV1-3 (C) and the negative (-) lead to ground lug "G" (C). Connect the positive (+) end of C4 to XV2-3 (C) and the negative (-) lead to TB13-1 (C).
9. (✓) Fig. 11. Cut both leads on one 4.7KΩ (yellow, violet, red, silver) resistor, R14 to 1/2" and both leads on a second 4.7KΩ resistor, R13, to 3/4". Connect R14, (with the shorter leads) from XV2-3 (S2) to TB13-1 (C). Connect R13 (with the longer leads) from XV1-3 (S2) to ground lug "G" (C).

10. (✓) Fig. 11. Cut all leads on two 1MΩ (brown, black, green, silver) resistors, R9 and R10, to 3/4". Cover both leads with a 1/2" piece of spaghetti. Connect R9 from XV1-2 (S2) to ground lug "G" (C). Connect R10 from XV2-2 (S2) to TB13-1 (S4).
11. (✓) Fig. 11. Cut both leads on a 22KΩ (red, red, orange, silver) 1 watt resistor, R61 to 3/4". Connect from C37-A (S2) to C37-B (C).
12. (✓) Fig. 11. Cut both leads on a 68KΩ (blue, grey, orange, silver) resistor, R60, to 1/2". Connect from C37B (S3) to C37C (S4).
13. () Fig. 11. Cut all leads on two 68KΩ (blue, grey, orange, silver) resistor, R19 and R20 to 1/2". Connect R19 from S3-2 (C) to S3-3 (C). Connect R20 from S3-5 (C) to S3-6 (C).
14. (✓) Fig. 1. Cut all leads on two 330KΩ (orange, orange, yellow, silver) resistors, R65 and R66 to 1/2". Connect R65 from S3-2 (S2) to S3-1 (C). Connect R66 from S3-5 (S2) to S3-4 (C).
15. (✓) Fig. 11. From hole "S" connect the white lead to S3-6 (S2), the brown lead to S3-4 (S2), the blue lead to S3-3 (S2) and the green lead to S3-1 (S2).
16. (✓) Fig. 1. Push the line cord through the grommet at the rear of the chassis, near the fuseholder. Tie a knot inside the chassis, 3" from the solder lugs. Connect one lead to J16-1 (S2) and the other lead to J16-2 (S2).
17. (✓) Fig. 11. Connect the brown lead from S1F-8 to TB14-1 (S3).
18. (✓) Fig. 11. Connect the black lead from S1F-6 to ground lug "G" (S9).
19. (✓) Fig. 11. Connect a 1" piece of bare wire from S5-2 (S1) to XV5-7 (S1).
20. () Fig. 11. Strip back the outer insulation on both ends of a 5" piece of single-conductor cable 1/2". Twist the shield strands. Strip back the insulation on the inner conductor on both ends 1/4". On one end, cut the shield strands and connect the inner conductor to S5-3 (S1). On the other end, connect the twisted shield strands to TB21-1 (S8) and the inner conductor on the same end to TB21-2 (S5).
21. () Fig. 11. Mount the top shield as shown in insert on figure 4. Use two #6 lockwashers and two #6-32 hex nuts.



#4-40x1/4 Screws

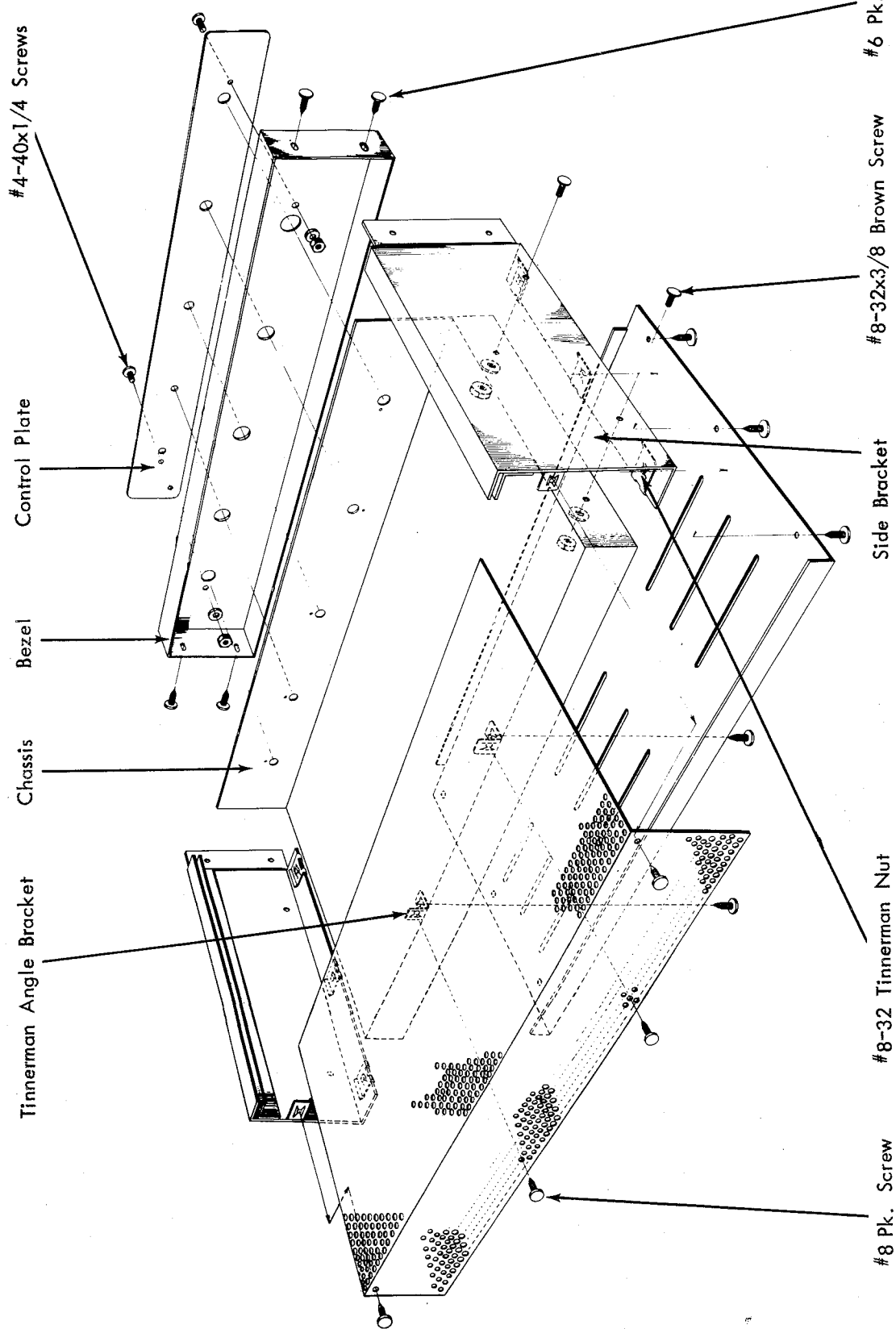
Control Plate

Bezel

Chassis

Tinnerman Angle Bracket

Fig. 12



#6 Pk. Brown Screw

#8-32x3/8 Brown Screw

Side Bracket

#8-32 Tinnerman Nut

#8 Pk. Screw



FINAL STEPS

You have now completed the assembly and wiring of your amplifier. When you have completed the following steps your amplifier 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 leads dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts (remove with a stiff brush dipped in carbon tetrachloride, being careful not to spring contacts when cleaning switches).
- 2) Insert tubes V1 through V12 in their sockets. Be sure to insert the correct tube in each socket. Place a shield over tubes V1, V2, V3, and V4. See tube layout in instruction. Insert fuse F1, in fuse holder.
- 3) If you have a VTVM or VOM, make the following resistance checks before connecting to the a-c line: Check for a cold d-c resistance of at least 1/2 ohm across the a-c line plug; check for a resistance of at least 40 ohms between ground and pins 1 of XV11 and XV12; check for a resistance of at least 200KΩ between pin 3 of XV11, XV12 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 check 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. 12. Assemble the left and right side pieces to the chassis. Each side piece is mounted with two #8-32 x 3/8 brown colored screws, two #8-32 hex nuts, and two #8 lockwashers.
5. () Fig. 12. On the rear edge of the chassis surface, mount the two innerman speed nut angle brackets, using a #8 P. K. - Type Z screw for each.
6. () Fig. 12. On the bottom flange of each side piece, press a tinnerman #8-32 - Type J speed nut in place over each of the three holes. The shorter length of the nuts face up towards you.
7. () Fig. 12. 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.
8. () Fig. 12. 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.

9. () Fig. 12. Insert the perforated cover into the "rails" on the side pieces and slide it forward fully.
10. () Fig. 12. Mount the control plate on the bezel (locating the hole for the plastic pilot jewel, above and between the focus and bass controls, over the corresponding hole in the bezel), using two each #4-40 x 1/4 brass screws, #4 lockwashers and #4 hex nuts to fasten it to the bezel. Press the plastic pilot jewel into place on the control plate.
11. () Fig. 12. Fit the bezel and control plate over the projecting control and slide switch shafts, onto the ends of the side pieces and the perforated cover. Assemble the bezel to the side pieces with four #6 x 1/4 brown colored P. K. screws. Before tightening the screws finally, be sure there is adequate play to slide the perforated cover out.
12. () Fig. 12. Fasten the perforated cover to the two tinnerman angle brackets (previously mounted on the rear edge of the chassis surface) and the two angle brackets on the side brackets using four #8 P. K. Type Z screws.
13. () Fig. 12. Set all controls to the furthest counter-clockwise position. Mount the knobs on the shafts with the indicating dots pointing as follows: INPUT SELECTOR knob at AUX; a FUNCTION SELECTOR at STEREO; FOCUS at -5; LEVEL at 0; BASS knobs at -5; TREBLE knobs at -5.
- 14) 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 speakers, phonograph, and tuners to the amplifier in accordance with the instructions given. Then read the section titled "Operating Instructions" and operate all the controls, checking aurally for the results described. If the amplifier does not operate at all or operates incorrectly, use the TROUBLE-SHOOTING chart and the VOLTAGE & RESISTANCE chart to discover and remedy the difficulty. As the Trouble Shooting Chart presumes a properly wired amplifier, which may not be the case, recheck the wiring for errors or reversed connections and continuity.
- 15) If the amplifier is to be mounted in a console, read carefully the "Mechanical Installation" section of the instructions and follow the procedures outlined.
- 16) Detailed information as to connection of phonographs, tuners, etc., to the amplifier inputs and speaker systems to the amplifier outputs, as well as a-c line plug connections and use of the hum adjustment control, is given in the "Electrical Installation" section.

Remove the backings from the two large labels supplied and place them on the outside surface of the bottom plate. See figure 4 for placement of small label.

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 \$12.50 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 ac-

cepted 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.

MODEL HF81-2 ADDENDA

Please make the following corrections to your HF81-2 book:

Page 7C, Step 7.

Page 16, Symbol #R22, 23 Stock #18045

Schematic R22 and R23.

"Part supplied may be dual 500K Ω instead of 750K Ω . This is a direct replacement. It does not impair the performance of the amplifier in any way."

Page 13. V8, Pin 7 should read 150 Ω instead of 330K Ω

I.E. 1209 Electronic Instrument Co., Inc., Long Island City 1, New York