

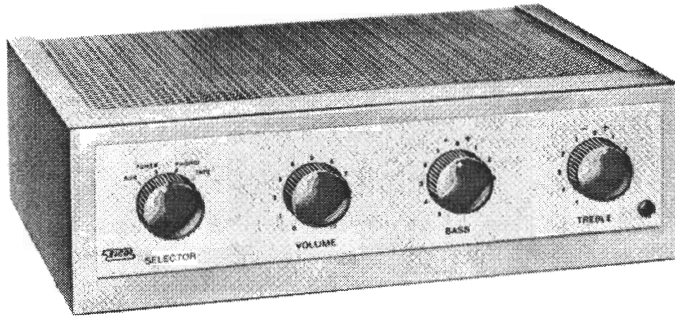
12 WATT INTEGRATED HIGH FIDELITY AMPLIFIER

MODEL
HF-12



ELECTRONIC INSTRUMENT CO. INC.
3300 NORTHERN BLVD., L. I. CITY 1, N. Y.





MODEL HF 12

**12 WATT INTEGRATED
HIGH FIDELITY AMPLIFIER**

general description

GENERAL

The HF12 is a true high fidelity 12-watt integrated amplifier absolutely free of the "gimmicks" sometimes used in low-priced amplifiers. It provides complete "front end" facilities and true high fidelity performance of such excellence that we can recommend it unreservedly for any medium-power high fidelity application. Two HF 12's may be used for stereo tape reproduction, each amplifier connecting directly to a tape head with no other electronic equipment required.

FEATURES

1. Two low level inputs for magnetic phono (RIAA) and tape head (NARTB). Low noise dual triode preamplifier with accurate, low distortion equalization for either input.

2. Two high level inputs for tv, tuner, and crystal or ceramic cartridge.

3. Unused inputs are shorted at every position of the input selector switch for zero cross-talk.

4. DC superimposed on all tube filaments to eliminate cathode-heater leakage as a source of hum.

5. Low-noise dual triode used exclusively for separate bass and treble tone controls. Extremely low distortion, variable crossover, feedback-type circuit.

6. Highly stable Williamson-type power amplifier circuit.

7. Newly-designed "flat" construction, utilizing horizontal chassis to permit proper layout and component separation necessary for long component life. Extremely flexible design permits easy console installation with complete shielding and adaptability to any panel thickness.

SPECIFICATIONS

Output Power: 12 watts continuous, 25 watts peak.

* IM Distortion (60 & 6000 cps at 4 : 1): 1.3% at 12 W; 0.55% at 6 W; 0.3% at 4 W.

* Frequency Response: 1 W : ± 0.5 db 12 cps — 75 kc; 12 W : ± 0.5 db 25 cps — 20 kc.

* Harmonic Distortion: 20 cps: 2% at 4.2 W; 1/2% at 2.5 W; 30 cps: 2% at 11 W; 1/2% at 6.3 W; 40 cps: 1% at 12 W; 1/2% at 9.3 W; 2000 cps: 1/2% at 12 W; 10 kc: 1% at 10 W; 1/2% at 6 W.

* 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.

Speaker Connections: 4, 8, and 16 ohms.

Sensitivity (input for 12 W): mag. phono — 5 mv; tape head — 2 mv; tuner, auxiliary — 0.5 v.

Hum & Noise Level (below 12 W): mag. phono — **60 db; tape head — **50 db; tuner, auxiliary — 75 db.

Tone Control Range: at 10 kc, ± 13 db; at 50 cps, ± 16 db.

Tubes: 3- ECC83/12AX7, 2- EL84, 1- EZ81.

Size: 3 5/8" high, 12" wide, 8 1/4" deep.

Weight: 13 lbs.

* Measured from high level inputs with tone controls set at "flat" positions.

** Includes effect of compensation.

mechanical installation

a) **HEAT DISSIPATION (VENTILATION):** In common with other electronic equipment, the HF-12 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 two EL84 output tubes and the EZ81 rectifier tube.) 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) **ACCESSABILITY 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. (2) Use an awl or a nail to pierce the centers of the four 5/8" diameter holes for the controls, the 3/8" hole for the viewing of the pilot lamp, and the two small holes for mounting the control plate, to transfer their locations to the console panel beneath. (3) Remove the panel template. (4) Drill the holes for the panel controls and the pilot viewing hole (the two small holes which have been marked are for wood screws).

b) Amplifier mounting in console: (1) Pull off the control knobs. (2) Remove the control plate, which is attached to the bezel by two screws. (These may be discarded since they are unsuitable for attaching the control plate to the console panel and two #4 X 3/8 wood screws have been supplied for this purpose.) (3) Fasten the control plate to the console panel with the 2 #4 X 3/8 wood screws. (4) If the rubber feet have been inserted in the bottom plate, remove them. (They may be pried out with a thin screwdriver.) (5) Remove the four screws that fasten the bezel to the side pieces and remove the bezel, which is not used in console mounting. (6) Place the unit on the mounting shelf and slide it as far forward as possible, so that the controls penetrate the panel holes as far as possible. (7) Place a knob on each control, pressing each knob toward the chassis firmly so that each control shaft enters fully into its knob. (8) Draw the chassis back evenly and carefully until the back rims of all the knobs are equally spaced from the control plate about 1/8". (9) 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. (10) Now remove the knobs and take the chassis off the shelf. (11) Remove the 6 screws which fasten the bottom plate to the chassis. (12) 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. (13) Remove the bottom plate and drill each of the marked holes on the shelf to a diameter of 1/4". (14) 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. (15) 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. (16) 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

GENERAL

a) **SPEAKER CONNECTIONS:** To connect your speaker to the amplifier properly, you must know its rated impedance. This may be read off the speaker nameplate. Connect one speaker lead to the "G" terminal on the rear apron and the other speaker lead to the nearby terminal corresponding to the rated speaker impedance (4, 8, or 16 ohms). Plastic-covered lamp cord may be used for distances up to 50 ft. with little power loss. For shorter distances, TV antenna lead can be used, particularly if it is desired to run the speaker lead under a rug.

If it is desired to use two similar or identical full-range speakers of the same rated impedance (either 8 or 16 ohms only) for better sound distribution, connect one speaker lead of each pair to "G" and the two remaining leads to the terminal with a number equal to half of one of the speaker's rated impedance. (It may be necessary to "phase" the two speakers by reversing both of the leads from one of the speakers.) This may not be done if each of the speakers is designed for reproduction of a different part of the audio spectrum (woofer-tweeter combinations) in which case a cross-over network is required which connects to the amplifier with only one pair of leads.

b) **MAG. PHONO INPUT:** This input is intended for use with phonographs having magnetic cartridges. The shielded lead from your phonograph should be provided with a shielded plug. The loading resistance presented to the cartridge at the input is 47,000 ohms, which is the most generally suitable loading resistance for magnetic cartridges.

c) **TAPE HEAD INPUT:** This input is intended for receiving the output signal directly from the playback head of a tape deck. NARTB tape head equalization for 7 1/2 and 15 i.p.s. tape speeds is applied to signals fed in at this input. The loading resistance presented to the tape head is 100,000 ohms.

d) **HIGH LEVEL INPUTS:** Two high level input jacks designated as Tuner and Auxiliary are provided for connection of tuners, tv receivers, equalized and pre-amplified tape recorder playback, and ordinary or RIAA equalizing crystal or ceramic phono cartridges without adaptor. A shielded cable with a shielded "phono-type" plug should be used to connect each of these sources to the corresponding amplifier input jack. Unless the source has a low-impedance output such as a cathode follower (with which up to 50 ft. of cable can be used), use the shortest possible connection

and low capacity shielded cable (cable having as low as 25 mmfd capacitance per foot is available).

If the tuner employed has a volume control to adjust the output, set this control to give about the same sound level for any given setting of the amplifier VOLUME control as obtained from an average orchestral recording played on your phonograph. If you do this, there will not be any extreme change in sound level when switching from phonograph to tuner or vice versa.

e) **TAPE OUTPUT:** A shielded cable (up to 30 ft. may be used) with a shielded "phono-type" plug should be used to connect from the TAPE OUTPUT jack to the input of the tape recorder. Any input chosen by the SELECTOR is fed out to the tape recorder through this jack. Phono inputs fed in at MAG. PHONO are of course equalized according to the RIAA characteristic and all the inputs are affected by the level and tone controls.

f) **POWER CONNECTIONS:** The 117 VAC, 250W receptacle is "live" or "dead" depending on whether the amplifier power switch is turned on or off. By plugging into it the line cords of associated equipment (tuner, tape recorder, etc.) it is possible to turn these components on or off with the amplifier. Use a cube tap if it is desired to connect more than one device. Record changers and turntables should be plugged into a wall outlet as a protection to the mechanisms of these units.

HUM ADJUSTMENT

a) 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: SELECTOR at PHONO, LEVEL to 10, TREBLE control at -5, BASS control at 0. Next, proceed as follows: With your ear held close to the speaker, insert the amplifier power plug into the wall outlet and listen to the hum level. Now pull out the plug and reinsert it with the prongs reversed and listen again. Choose the prong position which gives the least hum. Now connect the tuner input connector to the amplifier input jack, and with tuner set between stations and the tuner volume control set at minimum, do the same with the power plug of the tuner, using the 117VAC convenience outlet on the amplifier if desired. Finally connect the phono input connector to the amplifier MAG. PHONO or AUX. Input (as required) and find the lowest hum position for the power plug of the phonograph in a wall outlet. Do this with the phonograph off and the pickup arm at rest position.

operation

PRELIMINARY: Be sure all tubes are firmly seated in their sockets and that the V1 tube shield is making good contact with its base. As initial adjustments, set these controls as follows: VOLUME at zero, BASS at zero. Turn the amplifier on by turning the TREBLE control clockwise from OFF and set it at zero initially. Note that the VOLUME, BASS, and TREBLE controls all affect the TAPE OUTPUT.

LISTENING TO PHONOGRAPH: Set the SELECTOR to PHONO if you have a magnetic cartridge or AUXILIARY if you have a ceramic or crystal cartridge. The RIAA equalization provided for magnetic phono cartridges is now the standard in the recording industry and is also a very good compromise for the most important of the older characteristics. The better ceramic cartridges are also self-equalizing according to the RIAA characteristic. Use the separate bass and treble tone controls to compensate for inexact matching of the actual recording characteristic as well as the over-all characteristics of your audio system (including room acoustics).

LISTENING TO TAPE DECK (direct connection to tape head): Set the SELECTOR to TAPE HEAD. NARTB tape equalization for the 7 1/2 and 15 i.p.s. speeds is provided by the preamplifier-equalizer at this position. This equalization is the industry standard for pre-recorded stereo and monaural tapes. The bass and treble tone controls can be used to compensate for inexact matching of the actual recording characteristic.

LISTENING TO TUNER, TV, TAPE RECORDER HAVING BUILT-IN PLAYBACK PREAMPLIFIER-EQUALIZER: Set the SELECTOR to TUN or AUX depending on the input

desired. The corresponding high level input will feed through the amplifier. Adjustment of the level control on each source is discussed in the "ELECTRICAL INSTALLATION" section under "High Level Inputs".

MAKING RECORDINGS: Tape recordings may be made by connecting the recorder to the TAPE OUTPUT jack. See "Tape Output" under "ELECTRICAL INSTALLATION". Please note that recordings cannot be made on tape decks intended only for stereo or monaural tape playback. Recordings can only be made on tape machines having recording facilities including the necessary electronic equipment, which may be either built-in or supplied separately by the tape deck manufacturer.

BASS CONTROL: The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) 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 setting.

TREBLE CONTROL: The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) increases (boosts) treble response; the minus sign on the left side 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

TROUBLE SHOOTING & OPERATING NOTES

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 50 watts output, as well as the corresponding 1 kc signal voltages.

TROUBLE-SHOOTING PROCEDURES

Connect a phonograph and speaker to the amplifier as described in "Electrical Connections" and set controls for phono listening. Play a known high quality LP 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.

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.

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 working step-by-step toward the output. Set the VOLUME control to maximum (10), and the BASS and TREBLE controls to their mid-points (0). 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 0.01 volt fed into MAG. PHONO from an audio generator output of 1.0 volt, 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 (such as the EICO 232, 249, 221, or 214) and a VTVM or 20,000 Ω /volt VOM for DC voltage 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 either or both of the EL84 output tubes V4 and V5. Do not turn the amplifier on with either of the output tubes removed.

TROUBLE-SHOOTING A TYPICAL TUBE STAGE

1. Check tube.
2. Check plate and cathode resistors.
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 R18, R31, R32, R33 and filter capacitor C17 or C18.
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 R18, R31, R32, R33.

Suspected trouble in the equalization, tone, 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, vtvm, and scope.

SERVICE

If trouble develops in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. Note number appearing in red under the word "Manual" on the front cover. If there is no number, state this. If desired, you may return the instrument to our factory where it will be placed in operating condition for \$7.50 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is 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, N.Y. 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 V6 out of socket.	Line cord, J6, primary or high voltage secondary windings of T2 shorted internally or externally (wiring).	Replace or repair.
Amplifier causes power line fuse to blow. Power line fuse does not blow again with V6 out of socket.	V6, C17, V4, V5, or T1 primary shorted internally or externally.	Replace or repair.
Any or all tube filaments not lit.	Open lead from 6.3V winding of T2. 6.3V winding of T2 open.	Repair Replace
DC voltage at V6 cathode (pin 9) is incorrect as specified below.		
a) No voltage	Defective V6 C17 shorted internally or externally.	Replace Replace or repair.
b) High voltage.	Connection from C17 to pin 9 of V6 broken. Connection to center tap of h.v. secondary winding of T2 open. Output tubes V4 & V5 over-biased or not drawing current.	Repair Repair See trouble-shooting typical tube stage.
c) Low voltage.	Excessive current drain in amplifier. Defective V6	See trouble-shooting typical tube stage. Replace
Excessive hum on mag. phono or tape head.	V1 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 and tape head	V1 socket and contacts dirty.	Clean thoroughly with carbon tetrachloride.
Sustained oscillations.	Poor dress of output transformer T1 leads	Dress all input leads and T1 leads away from each other. Keep T1 leads away from input jacks.
Sustained microphonics on mag. phono and tape head.	V1 defective.	Replace
Hum on all inputs	V2 defective, not properly shielded, or dirty sockets and contacts. Dress of power transformer T2 leads.	Replace, correct, or clean. Correct

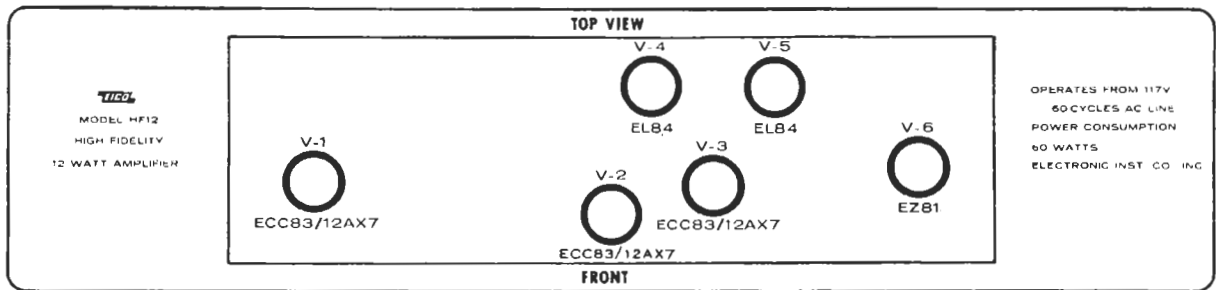
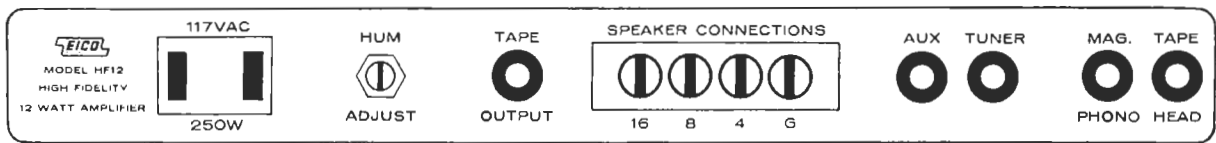
VOLTAGE AND RESISTANCE CHART

TUBE	PIN#	DC VOLTS NO SIGNAL	DC VOLTS 12 W OUT	AC VOLTS (1 kc) 12 W OUT	RESISTANCE UNIT OFF
ECC83/12AX7 V1	1	108	108	0.52	300K Ω
	2	0	0	0.028	1M Ω
	3	1.2	1.2	0	4.7K Ω
	4 & 5	filament (12 - 14 DC; 6.3 VAC to pin 9)			165-190 Ω
	6	68	68	0.028	300K Ω
	7	0	0	0.005	480K Ω
	8	0.6	0.6	0.009	2.2K Ω
	9	filament			165-190 Ω
	ECC83/12AX7 V2	1	185	185	2
2		0	0	0.5	500K Ω
3		1.4	1.4	0.265	1.2K Ω
4, 5		filament (12 - 14 VDC; 6.3 VAC to pin 9)			165-190 Ω
6		180	180	1.38	130K Ω
7		0	0	0.26	400K Ω
8		1.6	1.6	0.135	3.3K Ω
9		filament			165 - 190 Ω
ECC83/12AX7 V3		1	190	190	7.7
	2	91	90	8	480K Ω
	3	93	92	7.7	100K Ω
	4 & 5	filament (12 - 14 VDC; 6.3 VAC to pin 9)			165-190 Ω
	6	91	90	8	480K Ω
	7	0	0	1.37	210K Ω
	8	0.85	0.8	1.25	1.8K Ω
	9	filament			165-190 Ω
	EL 84 V4	1	-	-	-
2		0	0	7.7	340K Ω
3		12	14.2	0.05	165-190 Ω
4 & 5		filament (12 - 14 VDC; 6.3 VAC between)			165-190 Ω
6		-	-	-	-
7		330	324	176	160 Ω
8		-	-	-	-
9		336	330	3.9	0
EL 84 V5		1	-	-	-
	2	0	0	7.7	340K Ω
	3	12	14.2	.05	165-190 Ω
	4 & 5	filament (12 - 14 VDC; 6.3 VAC between)			165-190 Ω
	6	-	-	-	-
	7	330	324	176	200 Ω
	8	-	-	-	-
	9	336	330	3.9	0
	EZ 81 V6	1-	-	-	280
2		-	-	-	-
3		336	330	-	160K Ω
4 & 5		filament (12 - 14 VDC; 6.3 VAC between)			165-190 Ω
6		-	-	-	-
7		-	-	280	95 Ω
8		-	-	-	-
9		336	330	-	160K Ω

All resistance measurements, except those made from pins 3 and 9 of the EZ81, are made with pins 3 and 9 of the EZ81 grounded. All voltages and resistances are measured to chassis with the volume control set to 10 on the dial, the TREBLE and BASS controls set to 0 and the SELECTOR SWITCH set to AUX. For voltage measurements at 12W output, set the input selector to the PHONO position and feed a 0.010 volt (10mv) 1 kc signal to the mag. phono input jack; connect a resistive (preferably non-inductive) load of equal resistance to the tap selected ($\pm 20\%$) and capable of handling 25 watts. Voltage measurements are made with a VTVM. Operating line voltage at which voltage measurements are made is 117 VAC, 60 cps. NOTE: ALL VOLTAGE AND RESISTANCE VALUES MAY VARY NORMALLY BY $\pm 15\%$.

	Section	AUX	TUNER	PHONO	TAPE HEAD
Selector Switch	A	1 - 11, 3 - 4	2 - 11, 4 - 5	3 - 10 - 11, 5 - 6	3 - 4 - 11, 6 - 7
	B	11 - 12, 2 - 3 - 5	1 - 11 - 12, 3 - 5, 8 - 9	1 - 2 - 11 - 12, 8 - 9	1 - 2 - 12, 5 - 8, 9 - 11

Entries are numbers of those switch contacts which are connected together by the rotors at the particular position.



TRANSFORMER TEMPERATURE

The temperature of the transformers used in the HF-12 run at less than 195° despite the fact that the safety limit is at a much higher 221°F. Although 195°F is cool for a transformer, it is very hot to the touch. Transformers which seem too hot when touched with the hand, are usually good and are actually not overheating.

Output transformers usually run cooler than power transformers. Some output transformers may appear hotter than others due to being located near hot components such as output and power tubes and power transformers.

OUTPUT TRANSFORMER LOAD

The output transformer and the output tubes of any amplifier are subjected to severe stress when the amplifier is operated at a high signal level without a load. To protect these components against possible damage, always have either a speaker or resistive load connected to the output terminals of the amplifier while it is being operated.

REPLACEMENT PARTS LIST

Stock #	Sym.	Description	Am't.	Stock #	Sym.	Description	Am't.
20050	C1	cap., paper, .25mfd - 200V * *	1	54003	TB8, 3	terminal strip, 2 post	2
22517	C2,12,13	cap., disc., .025mfd (25K or 25,000)	3	54013	TB10	terminal strip, 1 post left w/gnd	1
22549	C3	cap., disc., .003mfd (3K or 3000)	1	90034	V1, 2, 3	tube, 12AX7	3
22514	C4,6	cap., disc., 850mmf, 10%	2	90039	V4, 5	tube, EL84	2
23020	C5	cap., elec., 25mfd - 6V * *	1	90038	V6	tube, EZ81	1
20044	C7	cap., molded, .25mfd - 400V *	1	97712	X11	pilot assembly	1
20039	C8	cap., molded, .1mfd - 400V * *	1	97027	XV1	socket, 9 pin min. top mount	1
22529	C9	cap., disc., 150mmf, 10%	1	97025	XV2-6	socket, 9 pin min. bottom mount	5
22539	C10,11	cap., disc., 200mmf, 10%	2	40000		nut, hex, #6-32	25
22533	C14	cap., disc., 47mmf, 10%	1	40001		nut, hex, #3/8	5
23007	C15	cap., elec., 50mfd - 25V * *	1	40007		nut, hex, #4-40	16
20043	C16	cap., molded, .03mfd - 600V * *	1	40008		nut, hex, #8-32	12
23016	C17	cap., elec., 30mfd - 400V *	1	40026		nut, tin, #8-32	6
24005	C18	cap., elec., 20-40-40mfd-400-350-350V	1	40027		nut, angle tin dual #8	2
22507	C19	cap., disc., .0022mfd, 10% (2.2K or 2200)	1	41000		screw, #6-32 x 1/4	25
22523	C20	cap., disc., .0068mfd, 10% (6.8K or 6800)	1	41003		screw, #8-32 x 3/8	6
23014	C21	cap., elec., 10mfd - 6V * *	1	41016		screw, #4-40 x 1/4	12
92000	I1	pilot light	1	41026		screw, #4-40 x 1/4 brass	2
50011	J1-2,3-4	jack, dual phono	2	41027		screw, #4 wood	2
50014	J5	jack, single phono	1	41028		screw, #8-32 x 1	2
50016	J6	outlet, convenience	1	41045		screw, #6 P. K. brown finish	4
29751	PC1	printed circuit	1	41046		screw, #8-32 x 3/8 brown finish	4
10410	R1,15	res., 100KΩ, 1/2W, ±10%	2	41047		screw, #8 P. K.	4
10431	R2,19,36	res., 470KΩ, 1/2W, ±10%	3	42000		washer, lock, #3/8	5
11526	R3,4	res., 200KΩ, 1/2W, ± 5%	2	42001		washer, flat, #3/8	1
10423	R5	res., 2.2KΩ, 1/2W, ±10%	1	42002		washer, lock, #6	22
10430	R6	res., 4.7KΩ, 1/2W, ±10%	1	42007		washer, lock, #4	14
10407	R7,8	res., 1MΩ, 1/2W, ±10%	2	42008		washer, lock, #8	12
11504	R9	res., 90KΩ, 1/2W, ± 5%	1	42032		washer, flat, #8	2
10400	R10,21,26,27	res., 10KΩ, 1/2W, ±10%	4	43000		lug, #6	2
18038	R11	pot., 500KΩ, audio taper (volume)	1	43004		lug, #8	1
18033	R12	pot., 1MΩ, linear taper (bass)	1	46000		grommet, 3/8	1
18034	R13, S2	pot., 500KΩ, linear taper, CT (treble)	1	46006		feet, rubber	4
10426	R14,32	res., 33KΩ, 1/2W, ±10%	2	50012		insulator for 50011	2
10427	R16	res., 1.2KΩ, 1/2W, ±10%	1	51006		plug, phono	5
10420	R17	res., 3.3KΩ, 1/2W, ±10%	1	53007		knobs	4
10853	R18	res., 10KΩ, 1W, ±10%	1	57000		line cord	1
11543	R20	res., 1.8KΩ, 1/2W, ± 5%	1	58004		wire, hook-up	length
11527	R22,23	res., 100KΩ, 1/2W, ± 5%	2	58300		spaghetti	length
10412	R24,25	res., 330KΩ, 1/2W, ±10%	2	58408		cable, single conductor	length
14600	R28	res., 165Ω, 5W, ± 5%	1	58410		cable, 4 conductor	length
11538	R29	res., 22KΩ, 1/2W, ± 5%	1	58501		wire, bare #22	length
19009	R30	pot., 100Ω, (hum adjust)	1	80049		control plate	1
10422	R31	res., 68KΩ, 1/2W, ±10%	1	81084		chassis	1
10520	R33	res., 68KΩ, 1/2W, ± 5%	1	81091		bezel	1
10425	R34	res., 56KΩ, 1/2W, ±10%	1	81092		bottom plate	1
10419	R35	res., 270KΩ, 1/2W, ±10%	1	81103		bracket, left	1
60049	S1	switch, selector	1	81104		bracket, right	1
32005	T1	transformer, output	1	81105		perforated screen	1
30019	T2	transformer, power	1	89204		label, rear apron	1
54017	TB1	terminal strip, 1 post upright	1	89205		label, tube layout	1
54500	TB2	terminal board, 4 post	1	97300		tube shield	1
54002	TB5	terminal strip, 1 post right w/gnd	1	97710		jewel, red	1
54004	TB4,9	terminal strip, 2 post w/gnd	2	66052		manual of instruction (wired)	1
54015	TB6	terminal strip, 3 post, 2 left w/gnd	1	66304		manual of instruction (kit)	1
54000	TB7,11,12	terminal strip, 1 post left	3				

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

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

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

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

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

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

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

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

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

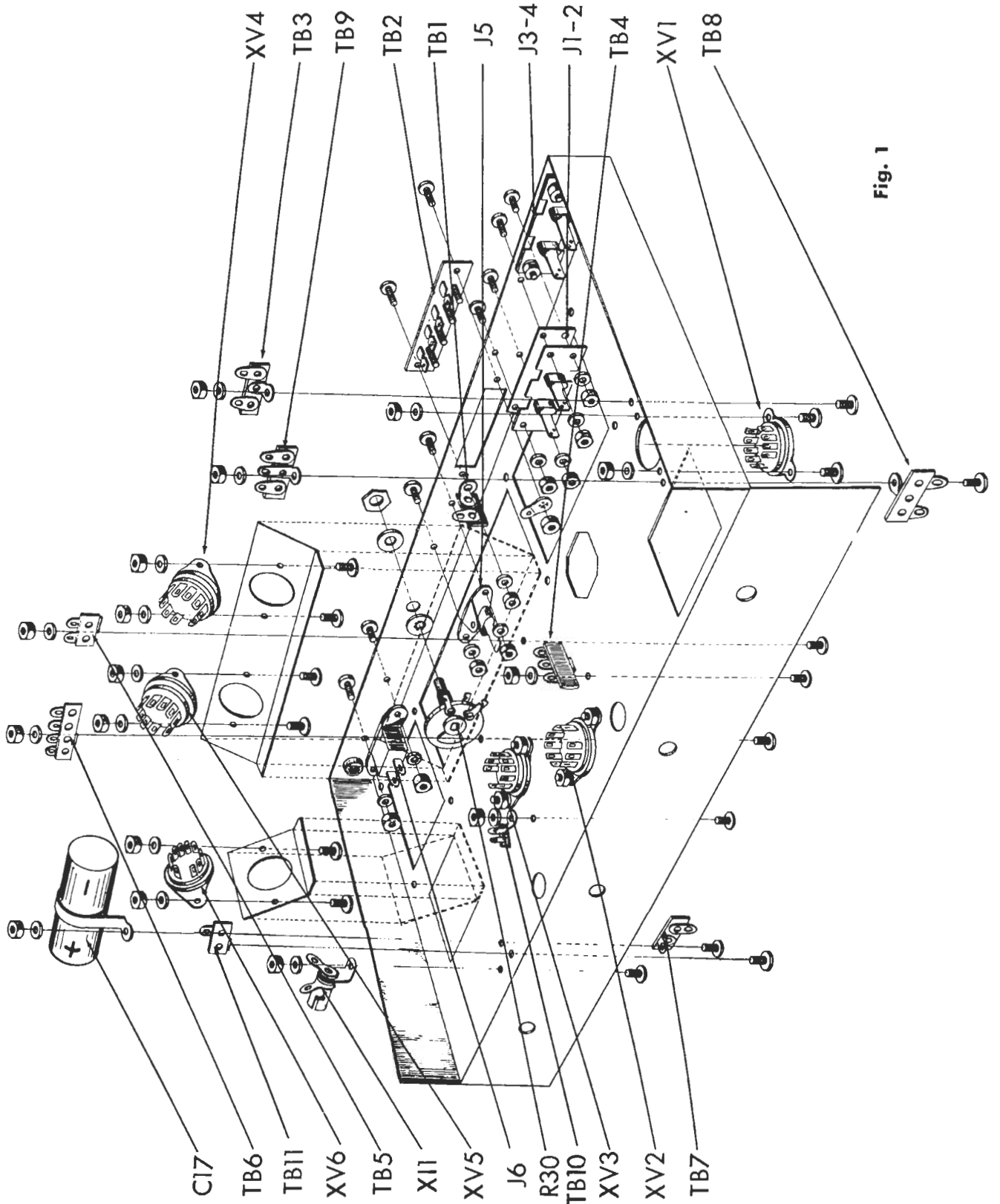


Fig. 1

MOUNTING INSTRUCTIONS

NOTE: The chassis in Fig. 1 appears in exploded view. The angles on which the tube sockets are mounted are actually part of the chassis, but has been moved up, out of the chassis, to make component mountings more obvious. Refer to Fig. 3 for proper orientation of all components.

1. (✓) Fig. 1. Mount the 9 pin miniature tube socket with shield base XV1 as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.
2. (✓) Fig. 1. Mount the 9 pin miniature tube socket XV6 as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.
3. (✓) Fig. 1. Similar to the above, mount the 9 pin miniature tube sockets XV2, XV3, XV4 and XV5 as shown. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts for each socket.
4. (✓) Fig. 1. Mount the 4 screw terminal board, TB2 from the outside of the chassis as shown. Use two #6-32 screws and two #6-32 hex nuts. Under one #6-32 hex nut, mount a #6 ground lug. Under the other #6-32 hex nut, add a 1 post upright terminal strip, TB1, and a #6 lockwasher.
5. (✓) Fig. 1. Mount a 2 post terminal strip, TB3, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.
6. (✓) Fig. 1. Using the same mounting hole, mount a two post with ground terminal strip, TB9, from the bottom and a two post terminal strip, TB8, from the top. Use one #6-32 screw, one #6-32 lockwasher and one #6-32 hex nut.
7. (✓) Fig. 1. Mount a 2 post with ground terminal strip, TB4, as shown. Use one #6-32 screw, one #6-32 lockwasher and one #6-32 hex nut.
8. (✓) Fig. 1. Mount a 1 post right with ground terminal strip, TB5, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.

9. () Fig. 1. Mount a 3 post, 2 left with ground terminal strip, TB6, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.
10. () Fig. 1. Using the same hole, mount a 1 post left terminal strip, TB7, from the top and 30 mfd electrolytic capacitor, C17, as shown. Observe the polarity on the capacitor. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.
11. () Fig. 1. Mount the pilot light socket, X11, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.
12. () Fig. 1. Mount a 1 post left with a ground terminal strip, TB10, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.
13. () Fig. 1. Mount input jack board, J1-2 as shown. Use a bakelite insulator between the board and the chassis. Use four #6-32 screws, four #6-32 lockwashers and four #6-32 hex nuts.
14. () Fig. 1. Mount the input jack board, J3-4 as above. Use bakelite insulator as above. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts.
15. () Fig. 1. Mount tape output jack, J5, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.
16. () Fig. 1. Mount the hum adjustment pot, R30 as shown. Use one 3/8 flatwasher, one 3/8 lockwasher and one 3/8 hex nut. Bend upper and lower lugs so that they neither protrude over bottom of chassis or touch the chassis proper.
17. () Fig. 1. Mount the convenience outlet, J6 as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.
18. () Fig. 1. Push the grommet through the remaining 3/8 hole in the rear of the chassis.
19. () Fig. 1. Mount #6 ground lug "1". Use a #6-32 screw and a #6-32 hex nut. See Fig. 5.
20. () Fig. 1. Mount a 1 post left terminal strip, TB11, as shown. Use one #6-32 screw, one #6-32 lockwasher and one #6-32 hex nut.

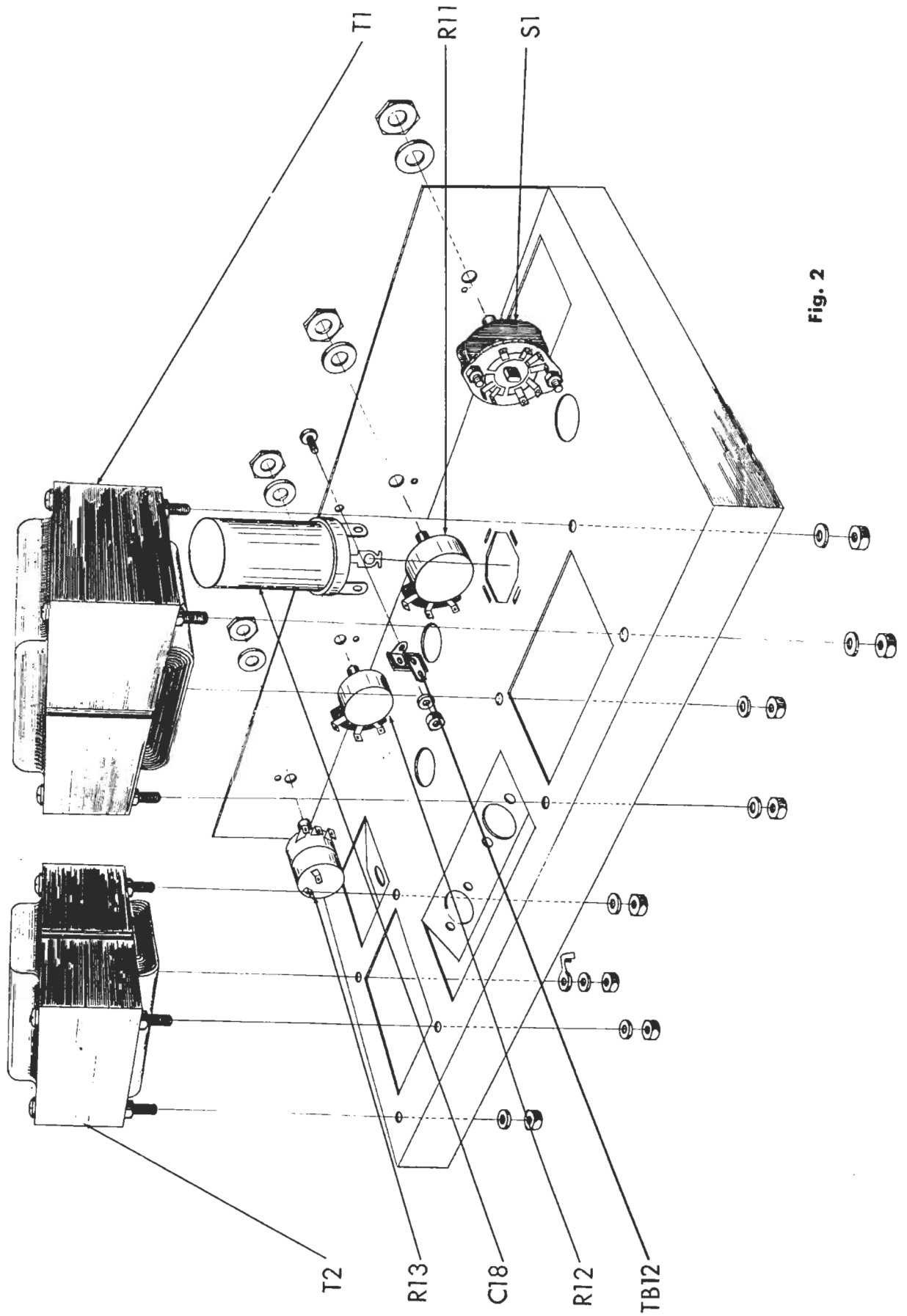


Fig. 2

MOUNTING INSTRUCTIONS CONT'D.

1. () Fig. 2. Mount the switch, S1, as shown. Note that the switch is in the maximum counter-clockwise position. Use one 3/8" lockwasher and one 3/8" hex nut as shown. Note that tab on switch slides into small hole adjacent to mounting hole.
2. () Fig. 2. Mount the pot, R11 (18038) as shown. Use one 3/8" lockwasher and one 3/8" hex nut. Note that the tab on pot slides into small hole adjacent to mounting hole.
3. () Fig. 2. Similar to the above, mount the pot R12 (18033) and the pot with the switch, R13 and S2 as shown. Note that in each case, the tab on the pot slides into small hole adjacent to mounting hole. Use one 3/8" lockwasher and one 3/8" hex nut in mounting each pot.

4. () Fig. 2. Mount the output transformer, T1 (32005) as shown. Use four #8-32 hex nuts and four #8 lockwashers. Note that the yellow lead and the brown lead face the rear of the chassis toward TB2.
5. () Fig. 2. Mount the power transformer, T2 (30019) as shown. Use four #8-32 hex nuts and four #8 lockwashers. Add a #8 ground lug under one of the lockwashers as shown. Note that the green leads face the center of the chassis and the tube sockets XV4 and XV5.
6. () Fig. 2. Mount the electrolytic can capacitor, C18 as shown. Note the mounting in Fig. 3 as to direction of triangle, semi-circle and square, next to the prongs on the capacitor. 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 one tab to the chassis at its slot.
7. () Fig. 2. Mount a 1 post left terminal strip, TB12, as shown. Use one #6-32 screw, one #6-32 lockwasher and one #6-32 hex nut.

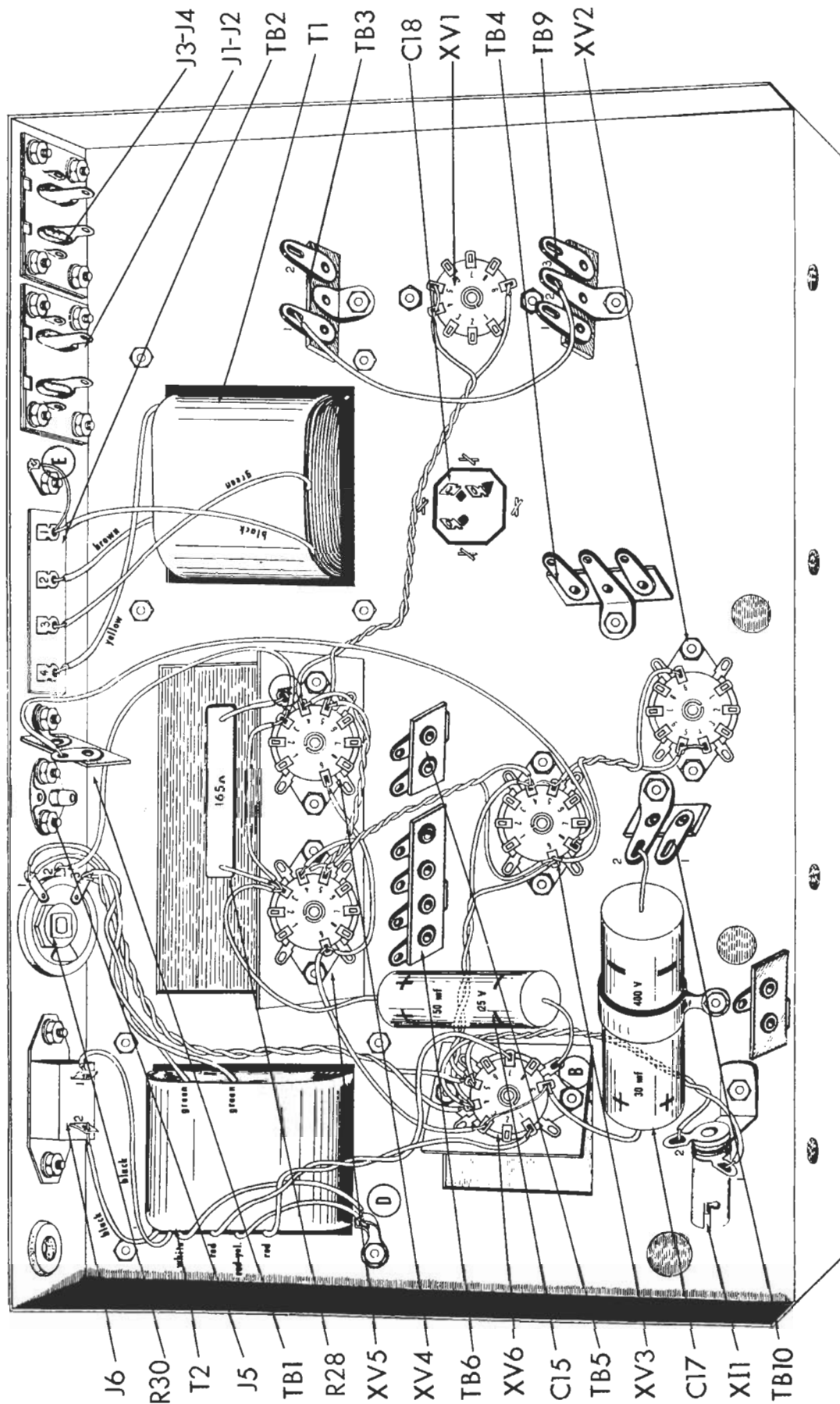


Fig. 3

WIRING INSTRUCTIONS

1. () Fig. 3. Cut a 6" length of black wire and 6" length of brown wire. Connect one end of the brown wire to XV1-9(S) and one end of the black wire to XV1-4(S) through XV1-5(S). Twist the two wires and run along the chassis as shown. Connect the other end of the black wire to XV4-4(C) and the other end of the brown wire to XV4-5(C).
2. () Fig. 3. Following the above procedure, cut a 4" length of black wire and a 4" length of brown wire. Connect one end of the black wire to XV4-4(S) and one end of the brown wire to XV4-5(S). Twist the two wires and run along the chassis as shown. Connect the black wire to XV5-4(C) and the brown lead to XV5-5(C).
3. () Fig. 3. Following the above procedure, cut a 4" length of black wire and a 4" length of brown wire. Connect one end of the black wire to XV5-4(S) and one end of the brown wire to XV5-5(S). Twist the two wires and run along the chassis as shown. Connect the black wire to XV3-5(C) through XV3-4(C) and the brown wire to XV3-9(C).
4. () Fig. 3. Following the above procedure, cut a 3" length of black wire and a 3" length of brown wire. Connect one end of the black wire to XV3-5(S) and one end of the brown wire to XV3-9(C). Twist the two wires and run along the chassis as shown. Connect the black wire to XV2-4(S) through XV2-5(S) and the brown wire to XV2-9(S).
5. () Fig. 3. Following the above procedure, cut a 4" length of black wire and a 4" length of brown wire. Connect one end of the black wire to XV3-4(S) and one end of the brown wire to XV3-9(S). Twist the two wires and run along the chassis as shown. Connect the black wire to XV6-5(C) and the brown wire to XV6-4(C).
6. () Fig. 3. Following the above procedure, cut a 6" length of black wire and a 6" length of brown wire. Connect one end of the black wire to XV6-5(C) and one end of the brown wire to XV6-4(C). Twist the two wires and run along the chassis as shown. Connect the black wire to X11-1(S) and the brown wire to X11-2(S).
7. () Fig. 3. Following the above procedure, cut a 6" length of black wire and a 6" length of brown wire. Connect one end of the black wire to XV6-5(S) and one end of the brown wire to XV6-4(S). Twist the two wires and run along the chassis as shown. Connect the black wire to R30-1(C) and the brown wire to R30-3(C).
8. () Fig. 3. Twist the two green leads from the power transformer, T2, and run along the chassis as shown. Connect one green lead to R30-3(S) and the other green lead to R30-1(S).

9. () Fig. 3. Connect a 6" piece of yellow wire from XV4-3(C) to R30-2(S).
10. () Fig. 3. Connect a 3" piece of yellow wire from XV4-3(S) to XV5-3(C).
11. () Fig. 3. Cut both leads of the 165Ω, 5W resistor, R28, to 1". Put 3/4" of spaghetti on one lead and leave the other lead bare. Connect the lead with the spaghetti to XV5-3(C) and the other lead to ground lug "A" (S) on XV4.
12. () Fig. 3. Cut the lead on the positive end (+) of the 50 mfd, 25 volt electrolytic capacitor, C15, to 1 1/2" and the lead on the negative (-) to 1 1/4". Put 1 1/4" spaghetti on the lead of the positive end and connect to XV5-3(S). Connect the negative lead to ground lug "B" (S) on XV6.
13. () Fig. 3. Cut the lead on the positive (+) end of the 30 mfd capacitor, C17, to 2 1/2" and the lead on the negative (-) end to 3/4". Put 2 1/4" spaghetti on the positive lead and connect to XV6-9(C). Connect the lead on the negative end to TB10-2(C).
14. () Fig. 3. Connect a 1" piece of bare wire from XV6-9(S) to XV6-3(C).
15. () Fig. 3. Twist the red leads from the power transformer, T2. Run the leads along the chassis as shown. Connect one red lead XV6-1(S) and the other red lead to XV6-7(S).
16. () Fig. 3. Twist the red-yellow and the white leads from the power transformer T2. Connect to ground lug "D" (S).
17. () Fig. 3. Connect one black lead from the power transformer, T2, to J6-1(C) and the other black lead to J6-2(C).
18. () Fig. 3. Connect an 8 1/2" black wire from TB1(C) to XV3-8(C).
19. () Fig. 3. Connect the following leads from the output transformer T1, to the output terminal board TB2:
 - Green lead to TB2-3(S)
 - Yellow lead to TB2-4(C)
 - Brown lead to TB2-2(S)
 - Black lead to TB2-1(C).
20. () Fig. 3. Connect a 3 1/2" red lead from XV6-3(S) to XV5-9(C).
21. () Fig. 3. Connect a 3 1/2" red lead from XV5-9(S) to XV4-9(C).
22. () Fig. 3. Connect a 1" piece of bare wire from TB2-1(S) to ground "E" (S).
23. () Fig. 3. Connect a 4" piece of black wire from TB3-1(C) to TB9-2(C).

1. () Fig. 4. Cut both leads on the 22K Ω (red,red,orange,gold) 5% resistor, R29, to 3/4". Connect from TB2-4 (C) to TB1 (C).
2. () Fig. 4. Cut both leads on a 47mmf, 10% disc ceramic capacitor, C14, to 3/4". Connect from TB2-4 (S) to TB1 (S).
3. () Fig. 4. Connect a 4" red lead from TB3-2 (C) to C18-3 (C).
4. () Fig. 4. Connect a 4 1/2" red lead from C18-2 (C) to TB4-3 (C).
5. () Fig. 4. Connect a 4.7K Ω (yellow,violet,red,silver) resistor, R6, from XV1-3 (C) to TB3-1 (C). Cut both leads to 3/4".
6. () Fig. 4. Connect a 10mfd, 6V elec capacitor C21 from XV1-3 (S) to TB3-1 (C). Cut both leads to 3/4". Use 1/2" piece of spaghetti on (+) side. The (+) side goes to XV1.
7. () Fig. 4. Connect a 1M Ω (brown,black,green,silver) resistor, R7, from XV1-2 (C) to TB3-1 (S). Cut both leads to 3/4".
8. () Fig. 4. Connect a 200K Ω (red,black,yellow,gold) resistor, R4, from XV1-1 (C) to C18-3 (C). Cut both leads to 1/2".
9. () Fig. 4. Connect a 200K Ω (red,black,yellow,gold) resistor, R3, from XV1-6 (C) to TB3-2 (S). Cut both leads to 1".
10. () Fig. 4. Connect a 68K Ω (blue,grey,orange,silver) resistor, R31, from C18-2 (C) to C18-3 (S). Cut both leads to 3/4".
11. () Fig. 4. Connect a 33K Ω (orange,orange,silver) 10% resistor, R32, from C18-2 (S) to C18-1 (C). Cut both leads to 3/4".
12. () Fig. 4. Connect a 10K Ω (brown,black,orange,silver) 1 watt resistor, R18, from C18-1 (C) to TB4-1 (C). Cut both leads to 3/4".
13. () Fig. 4. Connect a 4" red lead from XV4-9 (C) to TB4-1 (S).
14. () Fig. 4. Connect a 2.2K Ω (red,red,red,silver) resistor, R5, from XV1-8 (C) to TB9-2 (C). Cut both leads to 3/4".
15. () Fig. 4. Connect a 10K Ω (brown,black,orange,silver) resistor, R10, from XV1-7 (S) to TB9-3 (C). Cut both leads to 1/2".
16. () Fig. 4. Connect a .25mfd paper capacitor, C1, from XV1-2 (C) to XV1-6 (S). Cut both leads to 3/4". Be careful not to short lead to center lug of socket.

17. () Fig. 4. Connect a .025mfd disc ceramic capacitor, C2, from XV1-1 (S) to TB9-1 (C). Cut both leads to 3/4".
18. () Fig. 4. Connect a 5" red lead from C18-1 (S) to TB6-2 (C).
19. () Fig. 4. Twist the red,brown-yellow and blue leads on the output transformer, T1. Connect the brown-yellow lead to XV4-7 (S), the red lead to XV4-9 (S) and the blue lead to XV5-7 (S).
20. () Fig. 4. Connect a 33K Ω (orange,orange,orange,silver) resistor, R14, from TB4-3 (C) to XV2-1 (C). Cut both leads to 3/4".
21. () Fig. 4. Connect a 100K Ω (brown,black,yellow,silver) resistor, R15, from TB4-3 (S) to XV2-6 (C). Cut both leads to 1".
22. () Fig. 4. Connect a 3.3K Ω (orange,orange,red,silver) resistor, R17, from TB4-2 (C) to XV2-8 (S). Cut both leads to 3/4".
23. () Fig. 4. Connect a 4" piece of black wire from TB10-1 (C) to TB4-2 (C).
24. () Fig. 4. Cut one lead on the .25mfd capacitor, C7, to 3/4" and the other lead to 1". Cover the shorter lead with 1/2" spaghetti and connect to XV2-1 (S). Running the capacitor along the chassis as shown, connect the longer lead to TB11 (C).
25. () Fig. 4. Connect a 1.2K Ω (brown,red,red,silver) resistor, R16, from XV2-3 (C) to TB10-1 (C). Cut both leads to 3/4".
26. () Fig. 4. Connect a 6800mmf disc ceramic capacitor, C20, from XV2-3 (S) to TB10-1 (S). Cut both leads to 1".
27. () Fig. 4. Cut one lead on the .1mfd capacitor, C8, to 3/4" and the other lead to 1 1/2". Cover the shorter lead with 1/2" spaghetti on the longer lead with 1 1/4" of spaghetti. Connect the longer lead to XV2-6 (S) and the shorter lead to XV3-7 (C).
28. () Fig. 4. Cut an 8" piece of single conductor shielded cable. Strip the outer rubber insulation back 3/4". Unwrap the metal shield. Cut off the metal braid on one end of the cable while twisting together all strands of the metal braid on the other end of the cable. Strip the inner insulation back 1/4" on both ends of the cable. Connect the metal braid to ground lug "H" (S) on socket XV3. Connect the inner lead on the same end of the cable to XV3-7 (C). Run the cable along the chassis as shown and connect the other end of the inner lead to J5 (S).
29. () Fig. 4. Connect a 1.8K Ω (brown,grey,red,gold) 5% resistor, R20, from XV3-8 (S) to TB10-2 (S). Cut both leads to 3/4".
30. () Fig. 4. Cut the plus (+) lead of the 25mfd -6V elec. capacitor, C5, to 1", and the minus (-) lead to 1 1/2". Cover the 1" lead with a 3/4" piece of spaghetti and connect to XV1-8 (S). Cover the 1 1/2" lead with a 1 1/4" piece of spaghetti and connect to TB9-2 (C).
31. () Fig. 4. Connect one end of a 4 1/2" piece of black wire to TB11 (C). Push the other end through hole "Y".

TOP CHASSIS WIRING

1. () Fig. 5. Strip the outer insulation of one end of the 4 conductor cable back 1 3/4". Unwrap the outer shield and twist shield strands. Cut the outer shield to 1/2", the brown lead to 3/4", the red lead to 1" and the yellow lead to 1 1/4". Connect the shield wire to S1-7B (C), the brown lead to S1-6AB (S), the red lead to S1-5AB (S), the orange lead to S1-11B (S) and the yellow lead to S1-8B (S). Push the remainder of the shielded lead through the rectangular hole under the switch to the bottom of the chassis.
2. () Fig. 5. Strip the outer insulation of one end of a 3 1/2" piece of single conductor shielded wire back 1". Unwrap the outer shield and twist shield strands. Cut the outer shield to 1/2". Connect the shield wire to S1-7B (C) and the inner conductor to S1-10B (S). Push the remainder of the shielded lead through the rectangular hole under the switch to the bottom of the chassis.
3. () Fig. 5. Connect a 2" piece of bare wire covered with 1 1/2" of spaghetti from S1-7B (S) to S1-2B (S).
4. () Fig. 5. Strip the outer insulation of one end of a 4 1/2" piece of single conductor shielded wire back 1/2". Unwrap the shield and cut off. Strip the insulation of the inner conductor back 1/4" and connect to S1-8A (S). Strip the outer insulation on the other end back 3/4". Unwrap the outer shield and twist shield strands. Strip the insulation of the inner conductor back 1/4" and connect to TB12 (C). Cut the shield strands to 1/2" and connect to R11-3 (C).
5. () Fig. 5. Connect a 3" piece of black wire to R11-3 (S). Push the remainder through hole "X".
6. () Fig. 5. Connect one end of a 2" piece of green wire to S1-4AB (S). Push the rest of the lead through the rectangular cutout under the switch to the bottom of the chassis.
7. () Fig. 5. Connect one end of a 4" piece of yellow wire to S1-1A (S). Running lead as shown, push the rest of the lead through the rectangular cutout under the switch to the bottom of the chassis.
8. () Fig. 5. Connect a 850mmf disc ceramic capacitor, C6, from S1-3A (S) to TB8-1 (C). Cut both leads to 1".
9. () Fig. 5. Connect a 68KΩ (blue, grey, orange, gold) 5% resistor, R33, from S1-12A (S) to TB8-1 (S). Cut both leads to 1" and cover each with a 3/4" piece of spaghetti.
10. () Fig. 5. Connect a 90KΩ (white, black, orange, gold) 5% resistor, R9, and an 850mmf disc ceramic capacitor, C4, from S1-2A (S) to TB8-2 (C). Cut all leads to 1".
11. () Fig. 5. Connect a 1MΩ (brown, black, green, silver) 10% resistor, R8, and a 3000mmf disc ceramic capacitor, C3, from S1-9A (S) to TB8-2 (S). Cut all leads to 1".
12. () Fig. 5. Connect one end of a 2 1/2" piece of green wire to R11-2 (S). Push the remainder of the wire through hole "X" near R11 to the bottom of the chassis.
13. () Fig. 5. Connect one end of a 4" piece of green wire to TB7 (C). Push the remainder of the wire through hole "Y" near R12 to the bottom of the chassis.
14. () Fig. 5. Connect one end of a 5" piece of yellow wire to R13-1 (C). Push the remainder of the wire through hole "Y" near R12 to the bottom of the chassis.
15. () Fig. 5. Connect the black lead that passes through hole "Y" to R13-3 (C).
16. () Fig. 5. Cut and connect the leads on the printed circuit board PC1, in the prescribed sequence as follows. Put 2 1/4" of spaghetti on lead 1; 1 1/2" of spaghetti on lead 4; 1" of spaghetti on lead 5 and 2" of spaghetti on lead 7.

#6 (1/2") to R12-3 (S)	#1 (2 1/2") to R13-3 (S)
#3 (3/4") to R12-2 (S)	#7 (2 1/4") to R13-1 (S)
#2 (1/2") to R12-1 (S)	#4 (1 3/4") to R13-2 (S)
	#5 (1 1/4") to TB7 (S)
17. () Fig. 5. Connect the .03mfd molded capacitor, C16, from S2-1 (C) to ground lug "1" (S). Cut both leads to 1 1/2". Cover the lead going to S2-1 with 1 1/4" spaghetti.
18. () Fig. 5. Cut both leads on a 56KΩ (green, blue, orange, silver) resistor, R34, to 1/2". Connect from TB12 (S) to R11-1 (S).

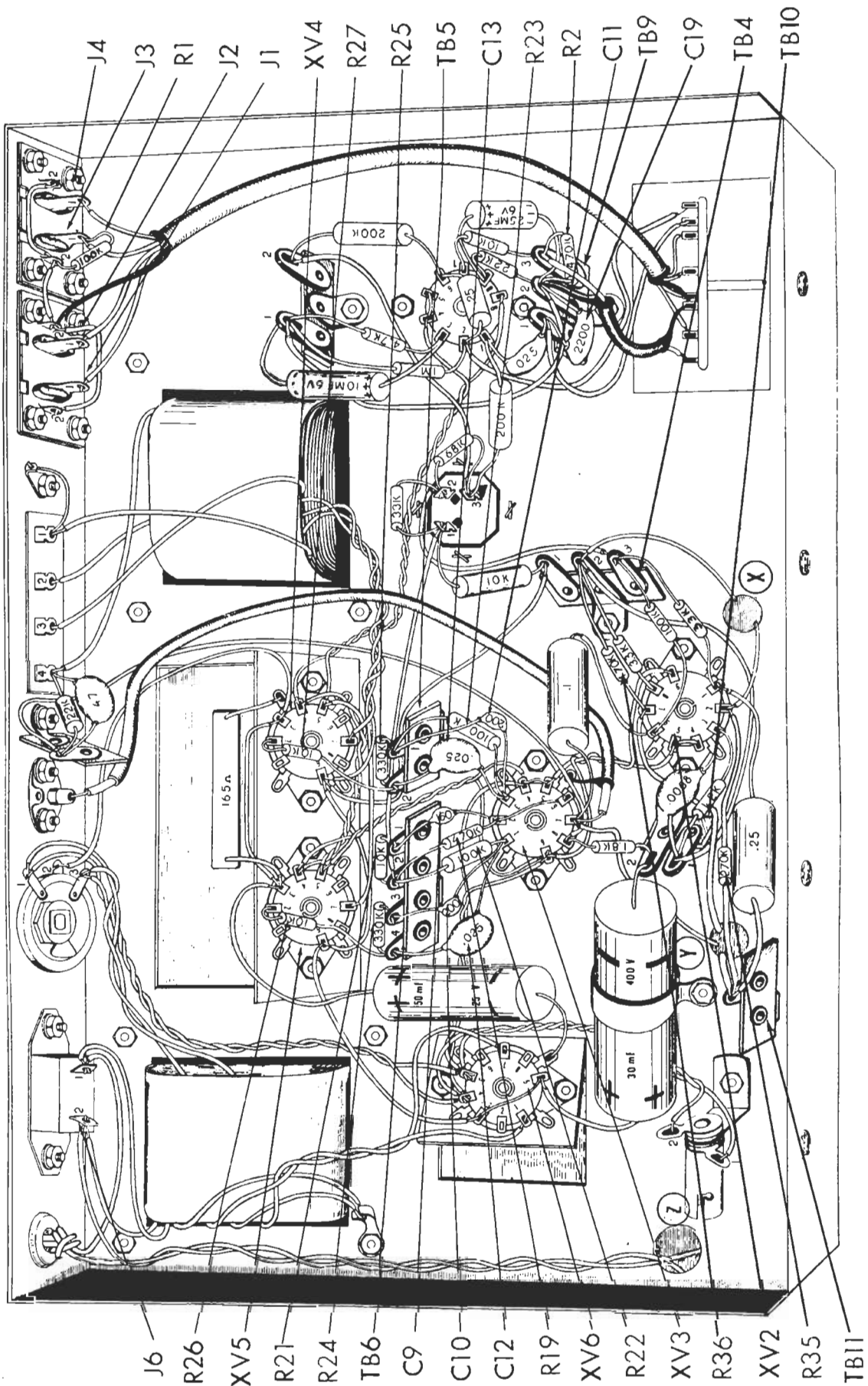


Fig. 6

1. () Fig. 6. Connect a 1" piece of bare wire from XV3-6 (S) to XV3-2 (C).
2. () Fig. 6. Connect a 100K Ω (brown, black, yellow, gold) 5% resistor, R23, from XV3-3 (C) to TB5-1 (C). Cut both leads to 3/4".
3. () Fig. 6. Connect a 200 mfd disc ceramic capacitor, C11, from XV3-3 (C) to TB5-1 (C). Cut both leads to 1".
4. () Fig. 6. Connect a .025 mfd disc ceramic capacitor, C13, from XV3-3 (S) to TB5-2 (C). Cut both leads to 3/4".
5. () Fig. 6. Connect a 470K Ω (yellow, violet, yellow, silver) resistor, R19, from XV3-2 (C) to TB6-2 (C). Cut both leads to 3/4".
6. () Fig. 6. Connect a 100K Ω (brown, black, yellow, gold) 5% resistor, R22, from XV3-1 (C) to TB6-2 (C). Cut both leads to 3/4".
7. () Fig. 6. Connect a 150 mfd disc ceramic capacitor, C9, from XV3-2 (S) to TB6-1 (C). Cut both leads to 3/4".
8. () Fig. 6. Connect a .025 mfd disc ceramic capacitor, C12, from XV3-1 (C) to TB6-4 (C). Cut both leads to 3/4".
9. () Fig. 6. Connect a 200 mfd disc ceramic capacitor, C10, from XV3-1 (S) to TB6-3 (C). Cut both leads to 3/4".
10. () Fig. 6. Connect a 330K Ω (orange, orange, yellow, silver) resistor, R25, from TB5-1 (S) to TB5-2 (C). Cut both leads to 1/2". Push the resistor down towards the chassis.
11. () Fig. 6. Connect a 330K Ω (orange, orange, yellow, silver) resistor, R24, from TB6-3 (S) to TB6-4 (C). Cut both leads to 1/2". Push the resistor down towards the chassis.
12. () Fig. 6. Connect a 10K Ω (brown, black, orange, silver) resistor, R21, from TB6-1 (S) to TB6-2 (S). Cut both leads to 1/2". Push the resistor down towards the chassis.
13. () Fig. 6. Connect a 10K Ω (brown, black, orange, silver) resistor, R26, from TB6-4 (S) to XV5-2 (S). Cut both leads to 3/4". Run resistor over pin 8 of XV5 without touching pin.
14. () Fig. 6. Connect a 10K Ω (brown, black, orange, silver) resistor, R27, from TB5-2 (S) to XV4-2 (S). Cut both leads to 3/4". Run resistor over pin 8 of XV4 without touching pin.

15. () Fig. 6. Run a 1 1/2" piece of bare wire covered with 1" of spaghetti from J1-2 (S) to J2-2 (C). Run an identical wire from J3-2 (C) to J4-2 (S). Run a 1" piece of bare wire covered with 1/2" of spaghetti from J3-2 (C) to J2-2 (C). Be careful not to touch any mounting screw or the bare chassis with the bare wire.
16. () Fig. 6. Connect a 100K Ω (brown, black, yellow, silver) resistor, R1, from J3-1 (C) to J3-2 (S).
17. () Fig. 6. Run the four conductor shielded cable from rectangular hole under S1 along the chassis as shown. Cut the outer insulation back 1 1/2". Unwrap the metal shield and twist the shielded strands. Cut the metal shield to 3/4" and the red and orange leads to 1". Connect the brown lead to J1-1 (S), the red lead to J2-1 (S), the orange lead to J3-1 (S) and the yellow lead to J4-1 (S). Connect shield to J2-2 (S).
18. () Fig. 6. Strip the outer insulation of the single conductor cable (passing through the rectangular hole under S1) back 3/4". Unwrap the shield strands and twist shield strands together. Strip the inner conductor back 1/4". Connect the inner conductor to TB9-3 (C) and the outer shield to TB9-2 (C).
19. () Fig. 6. Connect the yellow lead from the rectangular hole under S1 to XV1-2 (S) and the green lead from the same hole to TB9-1 (C).
20. () Fig. 6. Connect a 470K Ω (yellow, violet, yellow, silver) resistor, R2, from TB9-3 (S) to TB9-2 (C).
21. () Fig. 6. Connect a 2200 mfd disc capacitor, C19, from TB9-2 (S) to TB9-1 (S). Cut both leads to 3/4".
22. () Fig. 6. Connect the green lead from hole "X" to XV2-2 (C) and the black lead to TB4-2 (C).
23. () Fig. 6. Connect the green lead from hole "Y" to XV2-7 (C) and the yellow lead from hole "Y" to XV3-7 (S).
24. () Fig. 6. Push the line cord through the grommet near J6 at the rear of the chassis. Tie a knot on the inside of the chassis 8" from the tinned end of the line cord. Split the two leads apart until the knot. Cut one lead to 3" and connect to J6-1 (S).
25. () Fig. 6. Connect one end of a 10" brown lead to J6-2 (S). Twist this lead with the remaining lead from the line cord and dress as shown. Push both leads through hole "Z".
26. () Fig. 6. Connect the line cord lead from hole "Z" to S2-2 (S) and the brown lead to S2-1 (S). See Fig. 5.
27. () Fig. 6. Cut both leads on a 470K Ω (yellow, violet, yellow, silver) resistor, R36, to 3/4". Connect from XV2-7 (S) to TB4-2 (S).
28. () Fig. 6. Cut both leads on a 270K Ω (red, violet, yellow, silver) resistor, R35, to 1 1/4" and cover each with a 1" piece of spaghetti. Connect from TB11 (S) to XV2-2 (S).

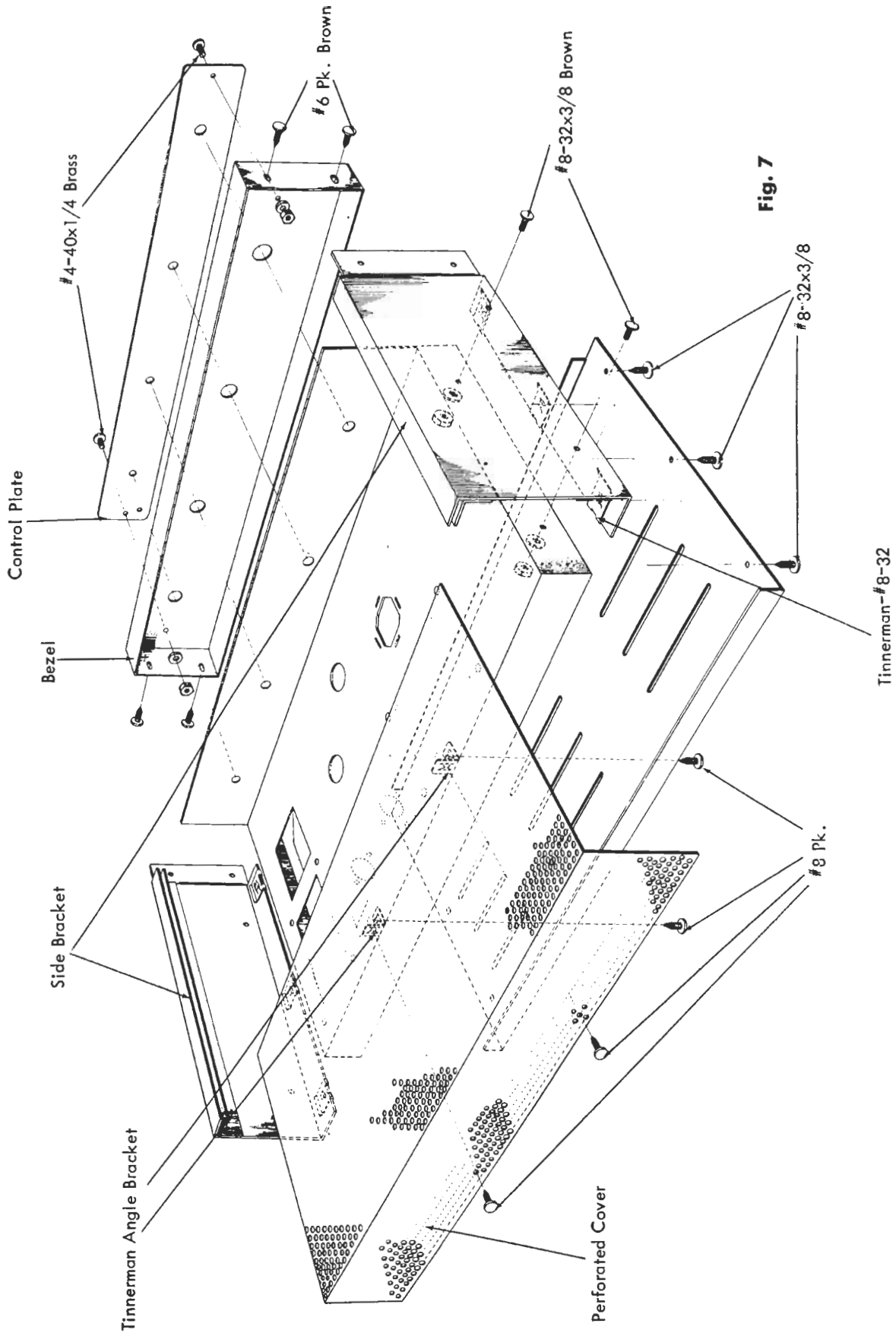


Fig. 7

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 lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts (remove with a stiff brush dipped in carbon tetrachloride, being careful not to spring contacts when cleaning switches).
- 2) Insert the pilot lamp in its socket and tubes V1 through V6 in their sockets. Be sure to insert the correct tube in each socket. Place a shield over tube V1. See tube layout in instruction section (Fig. A).
- 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 2 ohms across the a-c line plug; check for a resistance of at least 65 ohms between ground and pins 1 and 7 of XV6; check for a resistance of at least 40KΩ between pins 3 & 9 of XV6 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. 7. 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. 7. On the rear edge of the chassis surface, mount the two Tinnerman speed nut angle brackets, using a #8 P.K. - Type Z screw for each.
6. () Fig. 7. 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.
7. () Fig. 7. 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. 7. 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. 7. Insert the perforated cover into the "rails" on the side pieces and slide it forward fully.
10. () Fig. 7. Mount the control plate on the bezel (locating the hole for the plastic pilot jewel in the lower right-hand corner of the control plate 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. 7. Fit the bezel and control plate over the projecting control 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. 7. Fasten the perforated cover to the two Tinnerman angle brackets (previously mounted on the rear edge of the chassis surface), using two #8 P.K. Type Z screws.
13. () Fig. 7. Set all controls to the furthest counter-clockwise position. Mount the knobs on the shafts with the indicating dots pointing as follows: SELECTOR knob at AUX; VOLUME knob at 0; BASS knob at -5; TREBLE knob at OFF.
- 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 speaker, phonograph, and tuner 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 phonograph, tuner, etc., to the amplifier inputs and speaker systems to the amplifier output, as well as a-c line plug connections and use of the hum adjustment control, is given in the "Electrical Installation" section.

SERVICE

If you are still having difficulty, write to our service department listing all possible indications that might be helpful. Note the code number appearing in red under the word "Manual" on the front cover. If there is no number, state this. If desired, you may return the instrument to our factory where it will be placed in operating condition for \$7.50 plus the cost of parts replaced due to their being damaged in the course of construction. This service policy applies only to completed instruments constructed in accordance with the instructions as stated in the manual. Instruments that are not completed or instruments that are modified will not be accepted for repair. Instruments that show evidence of acid core solder or paste fluxes will be returned not repaired.

NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to the Electronic Instrument Co., Inc., 33-00 Northern Blvd., L. I. C. I., 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.

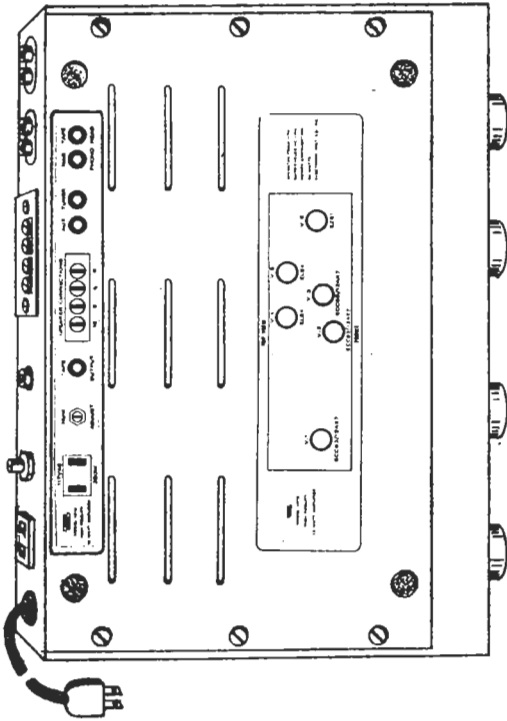


Fig. 8

1. () Fig. 8. Remove the backings from the two labels supplied and place them on the outside surface of the bottom plate as shown.