

STEREOPHONIC PREAMPLIFIER

MODEL
HF-85



EICO

INSTRUCTION

MANUAL
HF 85-1



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

EICO

MODEL HF-85

STEREOPHONIC PREAMPLIFIER

general description

GENERAL

The EICO Model HF-85 is a complete high fidelity stereophonic control center. It offers practically every control and switching facility anyone could want in a physical design adaptable to any type of installation. With it you can select, preamplify and control accurately, any stereophonic source, whether it be from tape, discs or broadcasts. Every control facility is both useful and effective.

Extremely low distortion, bordering on the immeasurable (even at high output levels), precludes any degradation of quality from the best modern program sources.

The HF-85 is self-powered, utilizing a full-wave rectifier tube power supply. It works in conjunction with any two high quality power amplifiers, such as the EICO HF-14, HF-22, HF-30, HF-35, HF-50, and HF-60.

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 tuner, FM tuner, 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 the other, or FM tuner to one channel and FM Multiplex adapter output to the other.
3. Independent level controls that may be operated separately or together with a built-in clutch.
4. Distortionless, 3-stage, independent bass and treble tone control circuits in each channel. Each tone control circuit consists of a feedback amplifier pair (30 db of feedback) driving a true variable crossover, feedback tone control stage. Bass and treble controls do not interact with each other or affect the level. Bass controls in both channels and treble controls in both channels are concentric. Controls may be operated individually or together with a built-in clutch.
5. Fletcher-Munson loudness compensation for low level listening which may be disabled by front panel slide switch.
6. Extremely versatile function selector permits listening to each channel separately for checking purposes; on stereo listening, to reverse the channel connections; on monophonic record playing with a stereo cartridge, to mix the two channels for cancellation of vertical rumble; on monophonic tuner, to have the channels unmixed so as not to introduce extraneous noise from the unused input.
7. Low impedance output to tape recorder, useful on all inputs. Output to main amplifier impedance permits use of up to 40 ft. of 25 mmfd/ft. shielded audio cable before response at 20,000 c is affected.
8. Hum balance control, pilot lamp, convenience outlets.
9. New "low-silhouette" construction matches EICO tuner. Very attractive when placed on a shelf or out in the open, yet permits easy console installation with full shielding and adaptability to any panel thickness. Employs one piece horizontal chassis (cadmium plated steel) attached to the centers of two side pieces (brown enameled steel). Unit is self-supporting for easy servicing top or bottom. Perforated steel cover (metallic-gold painted) slides in and out on rails in the side pieces. A bottom plate and front bezel (both brown enameled steel) plus a solid brushed brass control plate complete the assembly. Controls may be used as either concentric or ganged with built-in clutch mechanisms.

SPECIFICATIONS

Frequency Response: ± 0.3 db 5-200,000 c at any level up to 3 V RMS out. (Measured from high level inputs with level controls set at maximum and tone controls electrically flat.)

Sensitivity (Input for 2 V RMS output at 1000 cps: Mag. Phono-1 mv; Microphone-1 mv; Tape-Head-0.5 mv; High Level Inputs -0.17 V.

Hum & Noise: Mag. Phono -60 db; Microphone-60 db; Tape Head -50 db; High level inputs -75 db. (For low level inputs, values given are equivalent noise input in db down from 10 mv input level. For high level inputs, value given is equivalent noise input in db down from 0.5 V input level.)

Im Distortion (60 and 7000 cps at 4 : 1):

<u>IM DIST.</u>	<u>V RMS OUT</u>
0.02%	0.5 V
0.03%	1.0 V
0.04%	2.0 V
0.07%	3.0 V
0.11%	4.0 V
0.17%	5.0 V

Harmonic Distortion (20-20,000 cps): 0.1% at 3 V RMS out; 0.15% at 5 V RMS out.

Tone Control Range: At 10 kc: 15 db boost, 15 db cut; at 50 cps: 15 db boost, 15 db cut.

Equalization: Phono -RIAA; Tape Head -NARTB for 15 ips and 7 1/2 ips, 3 3/4 ips.

Output to Tape Recorder Impedance: 1,400 ohms.

Output to Main Amplifier Impedance: 8,000 ohms.

Tubes: 5- 12AX7/ECC83, 1- 6X4

Size: 3 5/8" high, 12" wide, 8 1/2" deep.

Weight: 9 1/2 lbs.

mechanical installation

GENERAL

a) **HEAT DISSIPATION (VENTILATION):** In common with other electronic equipment, the HF-85 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 reduced.

Adequate ventilation will be provided if the HF-85 is installed in an open-back console provided that the top of the unit is spaced at least two inches below any shelf mounted above it. If the cabinet is enclosed at the rear, provide several large holes or slots as low down and as high up in the cabinet back as possible. As an alternative, holes may be provided in the sides, bottom, or top of the cabinet. The important thing to remember is that effective ventilation requires provision for cool air to enter at the bottom and hot air to leave at the top.

If the HF-85 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 it will not mar the surface of furniture on which it is placed.

b) **EASY ACCESS TO CONTROLS:** Mount the preamplifier at a height which will permit easy manipulation of the controls.

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

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

CONSOLE MOUNTING

a) Operations on console front panel preliminary to pre-

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 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) Preamplifier 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 brackets are up against the panel and both slide switches 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

GENERAL

a) **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 SELECTOR switch. At the TUNER, AUX, position of the MODE switch, AM only is selected at the AM-FM position of the SELECTOR switch, and FM only is selected at the FM-FM MULTI. position of the SELECTOR switch.

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. Four-terminal cartridges (each sensing element brought out to a separate pair of terminals) are generally advantageous as compared to three-terminal cartridges (one terminal of each sensing element brought out to a common terminal) because the possibility of increased hum due to a ground loop can be avoided. The correct method for wiring a four-terminal cartridge is shown in Fig. 1. (If the cartridge is a three-terminal type, the two inside contacts of the cartridge shown in Fig. 1 are effectively replaced by a common terminal.) 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. 1. The value of each of the two shunt resistors (R_s) can be determined from the desired loading resistance (R_l) by this formula

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

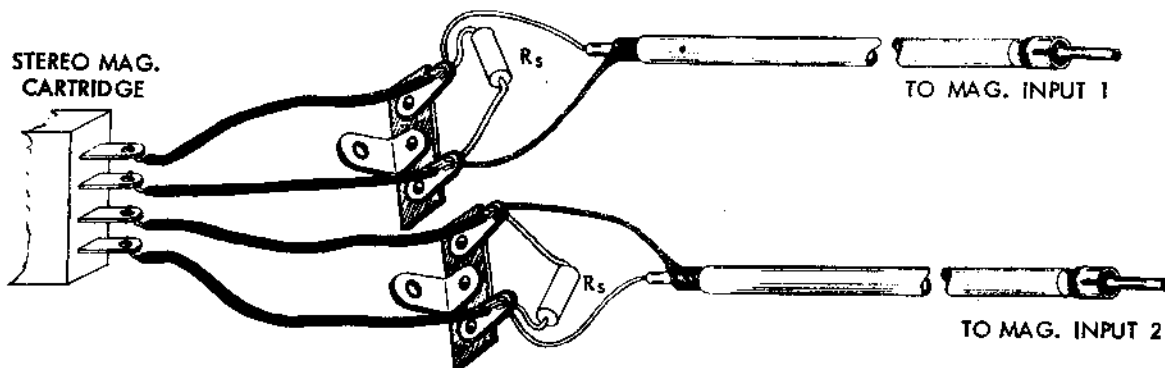


FIG. 1

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 to 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 maybe 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 stacked stereo playback heads. The tape heads can be either two-track or the new four-track type. A front panel slide switch permits choice of NARTB tape head equalization either for 7 1/2 ips or 3 3/4 tape speeds. Note that the equalization required for the new four-track type at the standard 3 3/4 ips tape speed for four-track is the same as for the older two-track at 7 1/2 ips. The TAPE speed switch is therefore set at 7 1/2 for both two-track at 7 1/2 ips and four-track at 3 3/4 ips. The 3 3/4 position of the TAPE speed selector is set at 3 3/4 for playback of 3 3/4 ips two-track tapes on two-track machines. The loading resistance presented by each tape head input is 1 megohm. Appropriate shunting resistors can be installed in the tape deck if the loading resistance specified for the particular heads is substantially lower.

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.

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. Also the main carrier or equivalent 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 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).

b) **OUTPUTS TO TAPE RECORDER:** The TAPE OUT CH. 1 and CH. 2 jacks permit feeding the channel 1 and channel 2 signals to a stereo tape recorder. With a monophonic source connected to a channel 1 input, the TAPE OUT CH. 1 jack is used for feeding out to a monaural tape recorder. Low-capacity shield audio cables with RCA-type phono connectors at the end may be used in lengths up to 50 ft. to connect each jack to the tape recorder inputs. Note that any inputs chosen by the SELECTOR switch feed out through these jacks. All inputs are affected by the LEVEL control and the LOUDNESS compensation switch, but not the tone controls.

c) **SIGNAL CONNECTIONS TO MAIN POWER AMPLIFIERS:** The PREAMP OUT CH. 1 and CH. 2 jacks are each connected to the input of a basic power amplifier*. The two basic power amplifiers may be separate or combined on one chassis. Low capacity shielded audio cables with RCA-type phono connectors at the ends should be used in lengths up to 10 feet normally. If the cable capacity is as low as 25 mmfd per foot, lengths up to 40 feet may be used if necessary. However, the shortest possible cable length should always be used.

* **NOTE:** If the user already has an integrated amplifier from his original monophonic system, it may be used as a basic power amplifier by connecting to one of its high level inputs (tuner, radio, auxiliary), setting its tone controls to the "flat" positions, its loudness compensation control or switch (if any) to where it has no affect, and

its level control to maximum. In the case of the EICO HF12, HF20, or HF32 integrated amplifiers, a more direct connection to the power amplifier sections may be made by connecting to the TAPE OUT jacks of these units, setting the LEVEL control and LOUDNESS control (if any) to maximum. In the case of the EICO HF52 integrated amplifier, connect to the ELECTRONIC CROSS-OVER OUTPUT jack and snip the connection between the ELECTRONIC CROSSOVER INPUT & OUTPUT jacks inside the chassis; the control settings on the HF52 are then immaterial. EICO now offers a complete line of basic power amplifiers which may be used in pairs for stereo. Included are the HF60 (60 watts rated), HF50 (50 watts rated), HF35 (35 watts rated), HF22 (22 watts rated), and the HF14 (14 watts rated).

d) **POWER CONNECTIONS:** The power cords of the basic power amplifiers, the turntable, and the tuner may be inserted in the convenience outlets provided on the rear chassis apron. The receptacle marked 117VAC is intended for use primarily with a phonograph and provides 117VAC regardless of whether the power switch of the amplifier is turned on or off in order to protect the phonograph mechanism. The receptacle marked 117VAC SWITCHED is "live" or "dead" depending on whether the preamplifier power switch is turned on or off and is intended primarily for use with the basic power amplifiers. The recommended method is to plug the line cord of one basic power amplifier into the 117VAC SWITCHED receptacle of the HF85 and the line cord of the other basic power amplifier into either convenience receptacle on the first power amplifier. Tuners and other devices which may be turned on and off with the preamplifier power switch should be plugged into the remaining receptacles on the basic power amplifiers.

HUM ADJUSTMENT

After checking the preamplifier for proper operation, remove all input cables to the preamplifier and make the following control settings which hold throughout the process of hum adjustment: SELECTOR switch at PHONO, MODE switch at STEREO NORM., both LEVEL controls at 10, LOUDNESS compensation switch at OFF, both BASS controls at 0, both TREBLE controls at -5. The preamplifier should be connected to the two basic power amplifiers which must in turn be connected to the two speaker systems. The two speaker system must be in phase and placed near one another for this adjustment. Connect the line cords of the two basic power amplifiers as recommended in POWER CONNECTIONS above. Plug the preamplifier line cord into a 117VAC wall outlet. Touch one end of a length of hook-up wire to the preamp chassis and check for a spark when the other end is touched to an unpainted chassis point on both power amplifiers. If a spark occurs in either case, reverse the prong position of the line cord plug for that power amplifier. Now place your ear close to both loudspeakers and listen to the hum level. Reverse the prong position of the preamplifier line cord plug in the wall outlet and listen again. Choose the prong position giving the least hum. Now connect the

tuner input connector to the appropriate input jack on the preamplifier and with the tuner set in between stations and the tuner volume control set at minimum, find the prong position of the tuner line cord in one of the convenience receptacles on the basic power amplifiers that gives the least hum. Finally, connect the phono input connectors to the PHONO CH. 1 and CH. 2 inputs (stereo mag. cartridge), or through the recommended adaptors to

these inputs (stereo ceramic cartridge), or to one set of auxiliary A or B inputs (stereo crystal cartridge) and do the same with the power plug of the turntable (turntable off and pickup arm at rest position) using the 117VAC convenience receptacle on the preamplifier. When all of this is completed, adjust the hum balance control on top of the preamplifier chassis for least hum.

operation

PRELIMINARY: Be sure all tubes are firmly seated in their sockets and that the tubeshields are making good contact with their bases. As initial adjustments, set these controls as follows: LEVEL controls 1 & 2 at 0, BASS controls 1 & 2 at 0, TREBLE controls 1 & 2 at 0, LOUDNESS compensation switch at OFF. Turn the system on by setting the POWER switch at ON. Please note that in the instructions that follow, it is assumed that a stereo pickup and/or a stereo tape head is being employed in the system.

LEVEL, BASS, & TREBLE controls: The LEVEL, BASS, and TREBLE controls each consist of two concentrically mounted controls, one in each channel. A built-in clutching device is effective when the smaller diameter inner knob (Amplifier 2 control) is pressed in against the larger diameter outer knob (Amplifier 1 control). At the in (clutched) position, turning either knob will cause both knobs to turn together, to make the same adjustments in both channels simultaneously. The clutching device is disengaged when the smaller inner knob is pulled out, making it possible to turn and adjust each of the controls independently. Please note that the clutching mechanism is designed to permit slipping, so that either the inner or outer control can always be turned to either minimum or maximum even if the other control is engaged to it in a more advanced position in the desired direction of turning. The optional clutching arrangement just described is intended to be used in the following manner: to adjust level balance, bass balance, and treble balance between the two channels (to accommodate the inevitable gain differences between channels due to tolerances and aging of components, loudspeaker response differences, room acoustics), the controls are disengaged for independent adjustment; once balance has been achieved, the controls are engaged to permit simultaneous adjustments of level, bass and treble in both channels for different records, program material, and desires as to listening level.

SELECTOR Switch: The SELECTOR switch selects corresponding pairs of inputs to both channels. The program source being fed to any of these pairs of inputs may be either stereophonic or monophonic. The MODE switch takes care of setting up the preamplifier according to the type of the program source (stereophonic or monophonic, tuner or phono, etc.) and also performs other functions detailed in the description of the MODE switch. The AUX A, AUX B, AM-FM and FM-MULTI are all high

level pairs of inputs suitable for stereophonic or monophonic crystal cartridges, AM or FM tuners, AM-FM stereo, FM-FM Multiplex stereo, pre-amplified equalized tape playback, tv sound, etc. As to monophonic tuner, use the AM-FM position for AM tuner selection, and FM-MULTI for FM tuner selection. When independent AM and FM tuners are used, and/or an FM Multiplex adaptor is used in conjunction with or is incorporated in the FM tuner, the same two positions can be used for AM-FM or FM-FM Multiplex stereo broadcast selection. The MIC, PHONO, and TAPE positions of the SELECTOR switch are all low level pairs of inputs; the MIC pair provide straight amplification for microphones, the PHONO pair RIAA standard equalization and amplification suitable for magnetic cartridges or ceramic cartridges with appropriate adaptors, the TAPE pair NARTB tape equalization and amplification for tape heads.

TAPE Switch: Adjusts the equalization at the TAPE (head) position of the SELECTOR switch according to the NARTB standard for the 7 1/2 (& 15) ips tape speeds and the 3 3/4 ips tape speed.

MODE Switch: 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 amplifier 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. The internal arrangements of the HF-85 at each of the positions of the MODE switch are shown in Fig. 2.

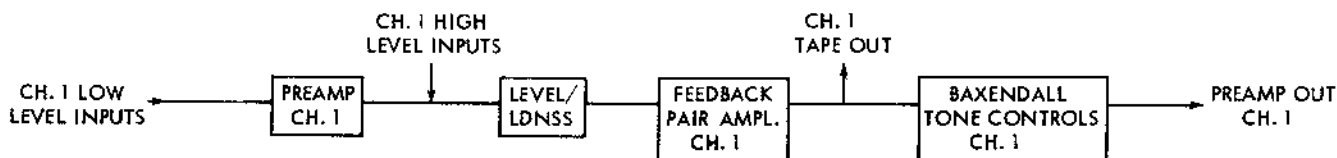


FIG. 2A. CHECK AMPLIFIER 1

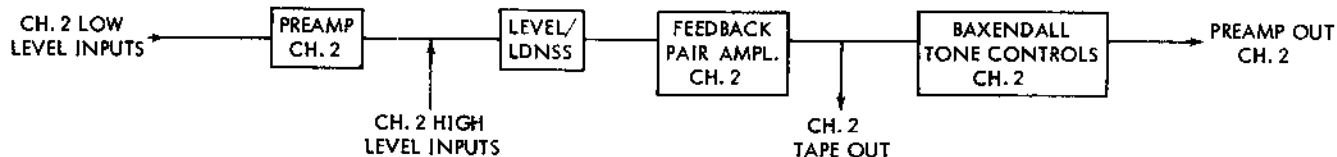


FIG. 2B. CHECK AMPLIFIER 2

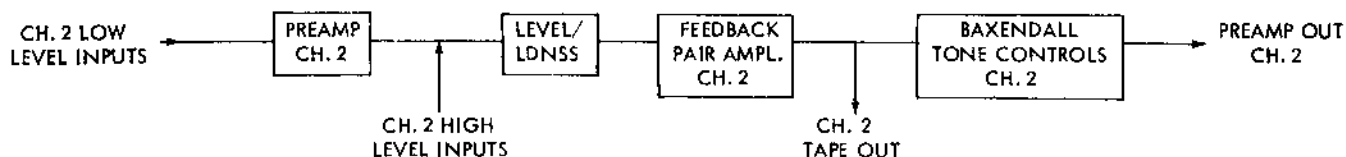
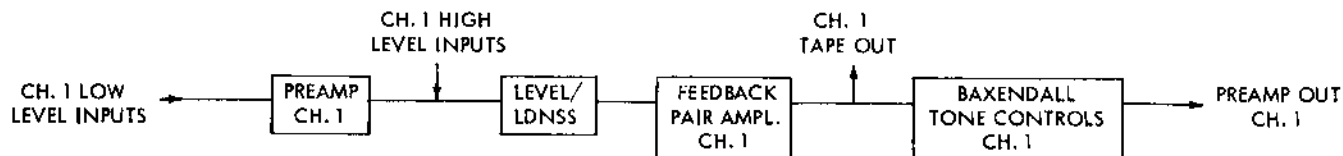


FIG. 2C. STEREO NORMAL

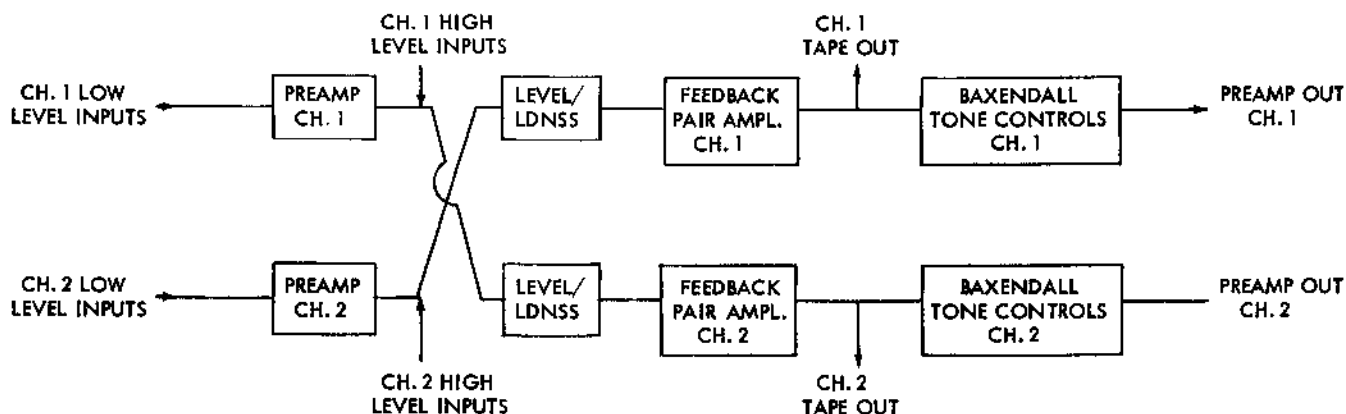


FIG. 2D. STEREO REVERSE

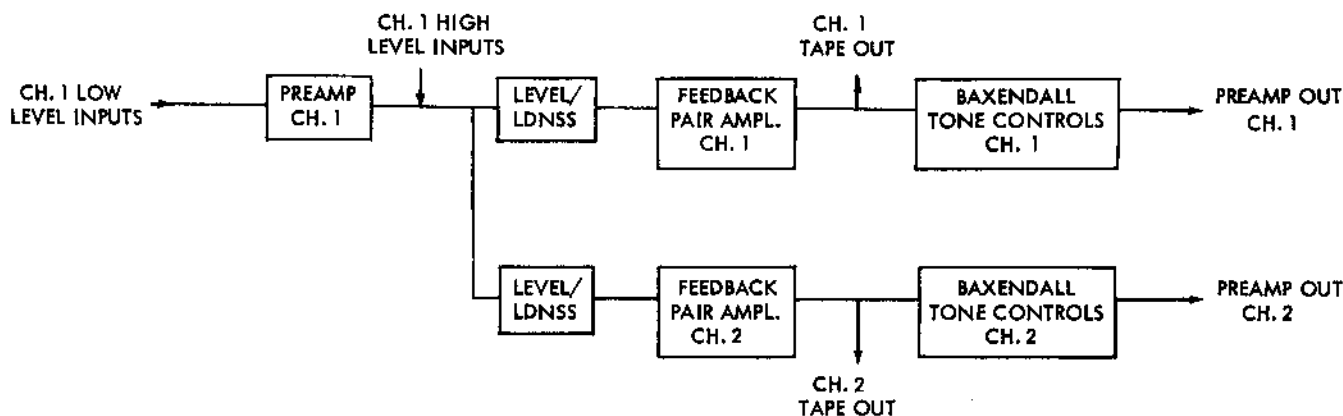


FIG. 2E. MONOPHONIC TUNER, AUX.

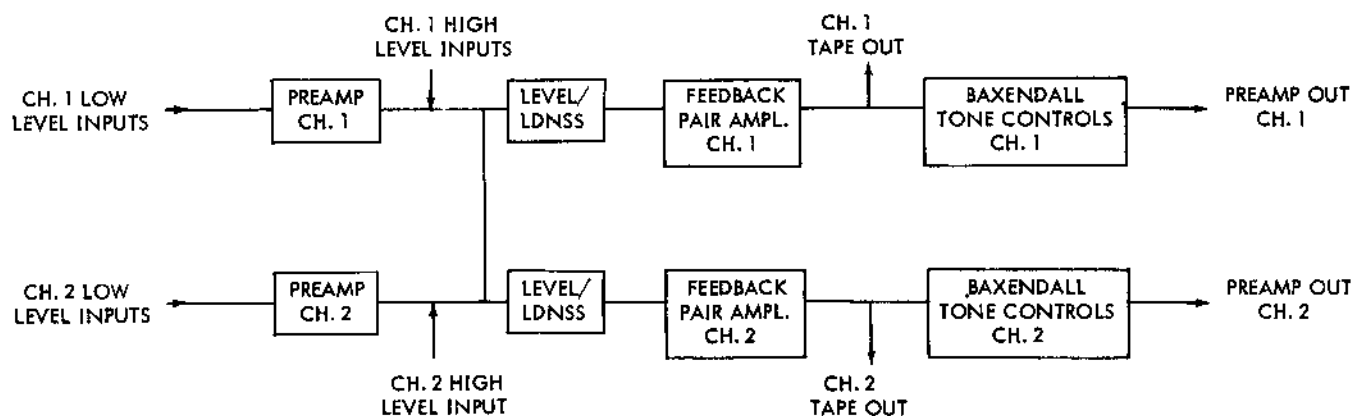


FIG. 2F MONOPHONIC PHONO

LEVEL BALANCE BETWEEN CHANNELS: The use of individual level controls in each channel, concentrically mounted and with an optional clutching arrangement, eliminates the need for a separate "balance" control and is indeed preferable as to electrical performance. During the balancing procedure, always set the MODE switch to one of the MONOPHONIC positions (appropriate to the program source) in order to ensure that the same signal level appears at the inputs to both LEVEL controls. Start with both LEVEL controls turned down to 0 and disengaged (smaller inner knob pulled out). Next, turn up one LEVEL control until you have obtained normal room volume from the corresponding speaker. Then turn up the other LEVEL control until the sound source is apparently mid-way between the two speakers, indicating proper balance. (It is assumed that the two speaker systems are connected in phase as they always should be. See note on "Speaker Phasing" for clarification.) When this has been achieved, push the smaller inner knob inward to engage the two controls, which will then move together, should either be turned, to maintain the balance over normal level adjustments. (Please note the "slipping" feature described in an earlier paragraph.) After balancing, the MODE switch can be set to one of the STEREPHONIC positions for stereo listening.

AMPLIFIER 1 BASS CONTROL, AMPLIFIER 2 BASS CONTROL (CONCENTRIC WITH CLUTCH): 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 in that channel; the minus sign on the left side indicates that counter-clockwise rotation from the mid-point decreases (cuts) bass response in that channel. These controls have no effect on the treble or the volume. Start by pulling the smaller inner knob out to disengage the two controls, and then set both at the mid-point (0), which is called the "flat" position since bass response is neither cut nor boosted at this position. If dissimilar loudspeakers are used and one provides somewhat thinner bass, or if location in the room seems to favor a little the bass response of one speaker over the other, turn up the bass in the less favored channel (within reason) until a more satisfactory balance is achieved, leaving the bass control for the more favored channel at the 0 or "flat" position.

If the discrepancy is great, turn down the bass in the more favored channel as well as turning up the bass in the less favored channel in order not to use excessive bass boost in the less favored channel. (Note that excessive boost in the less favored channel will usually increase distortion considerably in that channel because the speaker is being forced beyond its natural capabilities.) When satisfactory balance is achieved, press in the smaller inner bass knob to engage the two bass controls. They may be then turned in tandem to provide the varying degree of bass boost or cut that seems to be required by different program material (Please note the "slipping" feature described in an earlier paragraph.)

AMPLIFIER 1 TREBLE CONTROL, AMPLIFIER 2 TREBLE CONTROL (CONCENTRIC WITH CLUTCH): The plus sign on the right side of the dial indicates clockwise rotation from the mid-point (0) of either control increases (boosts) treble response in that channel; the minus sign indicates that counter-clockwise rotation from the mid-point decreases (cuts) treble response in that channel. These controls have no effect on the bass or the volume. Start by pulling the smaller inner knob out to disengage the two controls and then set both at the mid-point (0), which is called the "flat" position since treble is neither cut nor boosted at this position. If dissimilar loudspeakers are used, or position in the room favors the treble response of one loudspeaker over the other, turn up the control for the less favored speaker and turn down the control for the more favored speaker (or both) until a more satisfactory balance is achieved. When this is done, press in the smaller inner treble knob to engage the two treble controls. They may be then turned in tandem to adjust the treble for room acoustics as a whole and to provide the varying degree of treble boost or cut that seems to be required by different program material.

LOUDNESS Switch: The LOUDNESS switch is used to insert, when desired, compensation for the inefficiency of the human ear in hearing bass and treble at a low volume level. Compensation is inserted at the IN position and is effective over the range below 5 on the LEVEL control dial; compensation is removed at the OUT position. We recommend no compensation (OUT position) for any situation

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. The color code of each component is printed each time the component is referred to in the book.

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 sol-

dering close to a part, hold the lead between the part and the joint being soldered 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 lengths. The recommended lengths, as well as the required lengths of all wires, are indicated in the wiring steps.

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 many of the resistors and capacitors for which color coding is given, may not be color coded, but have their values are ratings printed. To aid in rapid identification 10% and 20% resistors are almost always color coded, while all 1%, 5% resistors and all capacitors usually have their values printed. Printed numbers may appear with the letter "K", indicating that the number is to be multiplied by 1000. The letter "M" indicates a multiplication by 1,000,000. "mf" indicates microfarads or $1/1,000,000$ farad. "mmf" indicates micromicrofarads or $1/1,000,000$ of a microfarad. The alternate way of writing capacitor values are indicated in the construction book when the component is used. Please note the following examples of relationship between units.

$$\begin{aligned} 1,000,000 \text{ micro-microfarads (mmf)} &= 1 \text{ microfarad (mf)} \\ 10,000 \text{ mmf} &= 10K \text{ mmf} = .01 \text{ mf} \\ 1,000,000 \text{ ohms } (\Omega) &= 1000 \text{ kilohms} = 1 \text{ megohm (M}\Omega) \\ 2,700,000 \Omega &= 2,700K\Omega = 2.7M\Omega \\ 470,000 \Omega &= 470K\Omega = 0.47M\Omega \\ 2,700 \Omega &= 2.7K\Omega \end{aligned}$$

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. The number after "(S)" indicates the number of connections to be soldered to the terminal. You can also check if you have made the proper number of connections to the terminal. Bend the ground lug tabs on the sockets toward the chassis to prevent accidental shorting to the socket pins.

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. 1. Cut all leads on two .025mfd (25K or 25,000mmf) disc capacitors, C15 and C16, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect C15 from S1B-6 (C) to S1B-7 (S1). Connect C16 from S1H-7 (Q) to S1H-8 (S1).

2. () Fig. 1. Cut all leads on two 90K Ω (white, black, orange, gold) 5% resistors, R15 and R16, to 1/2". Connect R15 from S1B-3 (Q) to S1B-1 (C). Connect R16 from S1G-2 (C) to S1G-4 (C).

3. () Fig. 1. Cut all leads on two 850mmf disc capacitors, C9 and C10, to 3/4". Connect C9 from S1B-3 (S2) to S1B-1 (Q). Connect C10 from S1G-2 (Q) to S1G-4 (S2).

4. () Fig. 1. Cut all leads on two 2.2M Ω (red, red, green, silver) 10% resistors, R21 and R22, to 1/2". Connect R21 from S1B-1 (C) to S1C-1 (C). Connect R22 from S1F-2 (C) to S1G-2 (C).

5. () Fig. 1. Cut all leads on two .0027mfd (2.7K or 2700mmf) 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. 1. Cut all leads on two 100K Ω (brown, black, yellow, silver) 10% resistors, R17 and R18, to 1/2". Connect R17 from S1B-12 (Q) to S1C-12 (Q). Connect R18 from S1F-1 (C) to S1G-1 (C).

7. () Fig. 1. Cut all leads on two 47mmf disc capacitors, C33 and C34, to 3/4". Connect C33 from S1B-12 (S2) to S1C-12 (S2). Connect C34 from S1F-1 (S2) to S1G-1 (S2).

8. () Fig. 1. Cut all leads on two 600mmf disc capacitors, C13 and C14, to 3/4". Connect C13 from S1B-4 (S1) to S1C-4 (Q). Connect C14 from

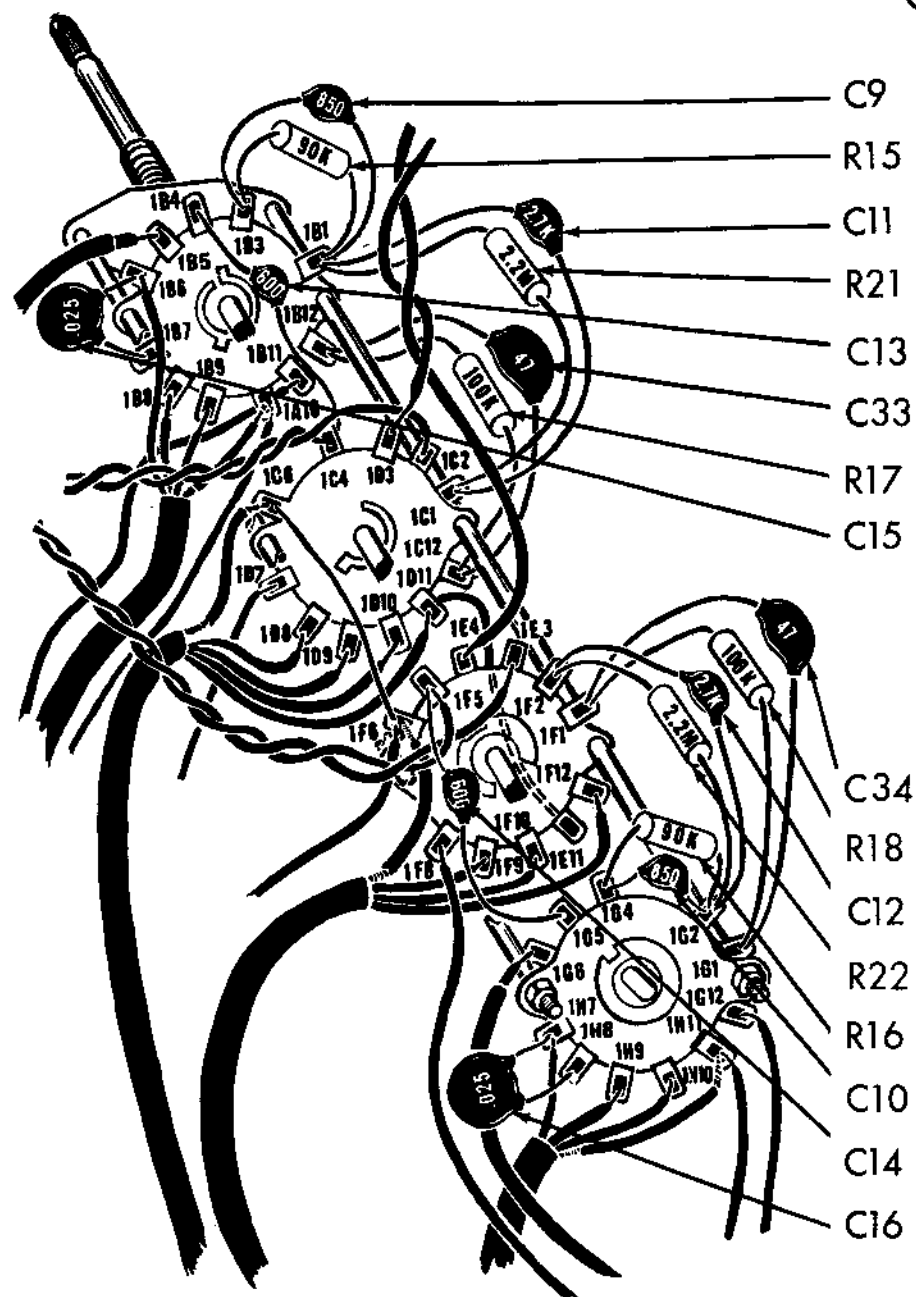


Fig. 1

9. () Fig. 1. Strip back the outer insulation 1 1/2" from one end of an 8" 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 S1B-6 (S2), the red lead to S1B-8 (S1), the orange lead to S1B-9 (S1) and the twisted shield strands to S1A-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. 1. Connect one end of a 3 1/2" piece of black wire to S1A-10 (S2).

11. () Fig. 1. Strip back the outer insulation 1 3/4" from one end of an 8" 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 S1D-8 (S1), the red lead to S1D-9 (S1), the orange lead to S1D-10 (S1) and the yellow lead to S1D-11 (C). Connect a 1" piece of bare wire from S1D-11 (S2) to S1E-11 (S1). Connect the twisted shield strands to S1C-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 to 3/4" and cover with 1/2" piece of spaghetti. Cut the red, brown, orange, and yellow leads 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.

12. () Fig. 1. Strip back the insulation 1 3/4" from one end of a 6 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 S1F-12 (S1), the red lead to S1F-10 (S1), the brown lead to S1F-9 (S1) and the twisted shield strands to S1F-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". Cover shield strands with 1/2" piece of spaghetti. 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. 1. Connect one end of a 4 1/2" piece of black wire to S1F-6 (C).

14. (✓) Fig. 1. Connect a 1 1/2" piece of bare wire from S1C-6 (S2) to S1F-6 (S2).

15. (✓) Fig. 1. Strip back the outer insulation 1 1/4" from one end of a 6 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 S1H-10 (S1), the red lead to S1H-9 (S1), the brown lead to S1H-7 (S2) and the shield strands to S1H-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. 1. Connect one end of a 4" piece of black wire to S1H-11 (S2).

17. (✓) Fig. 1. Connect one end of a 2 1/2" piece of grey wire to S1B-11 (S1).

18. (✓) Fig. 1. On one end of a 4" 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 S1B-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. 1. Connect one end of a 4" piece of brown wire to S1D-7 (S1).

20. (✓) Fig. 1. Connect one end of a 3" piece of brown wire to S1F-8 (S1).

21. (✓) Fig. 1. On one of a 3" 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 S1G-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. 1. Connect one end of a 3" piece of grey wire to S1G-12 (S1).

23. (✓) Fig. 1. Connect one end of a 5" piece of grey wire to S1D-3 (S1) and one end of a 5" piece of yellow wire to S1E-4 (S1). Twist the two leads together loosely.

24. (✓) Fig. 1. Connect one end of a 4 1/2" piece of green wire to S1C-2 (S1) and one end of a 4 1/2" piece of blue wire to S1C-4 (S2). Twist the two leads together.

25. (✓) Fig. 1. Connect one end of a 5 1/2" piece of violet wire to S1E-3 (S1) and one end of a 5 1/2" piece of white wire to S1F-5 (S2). Twist the two leads together.

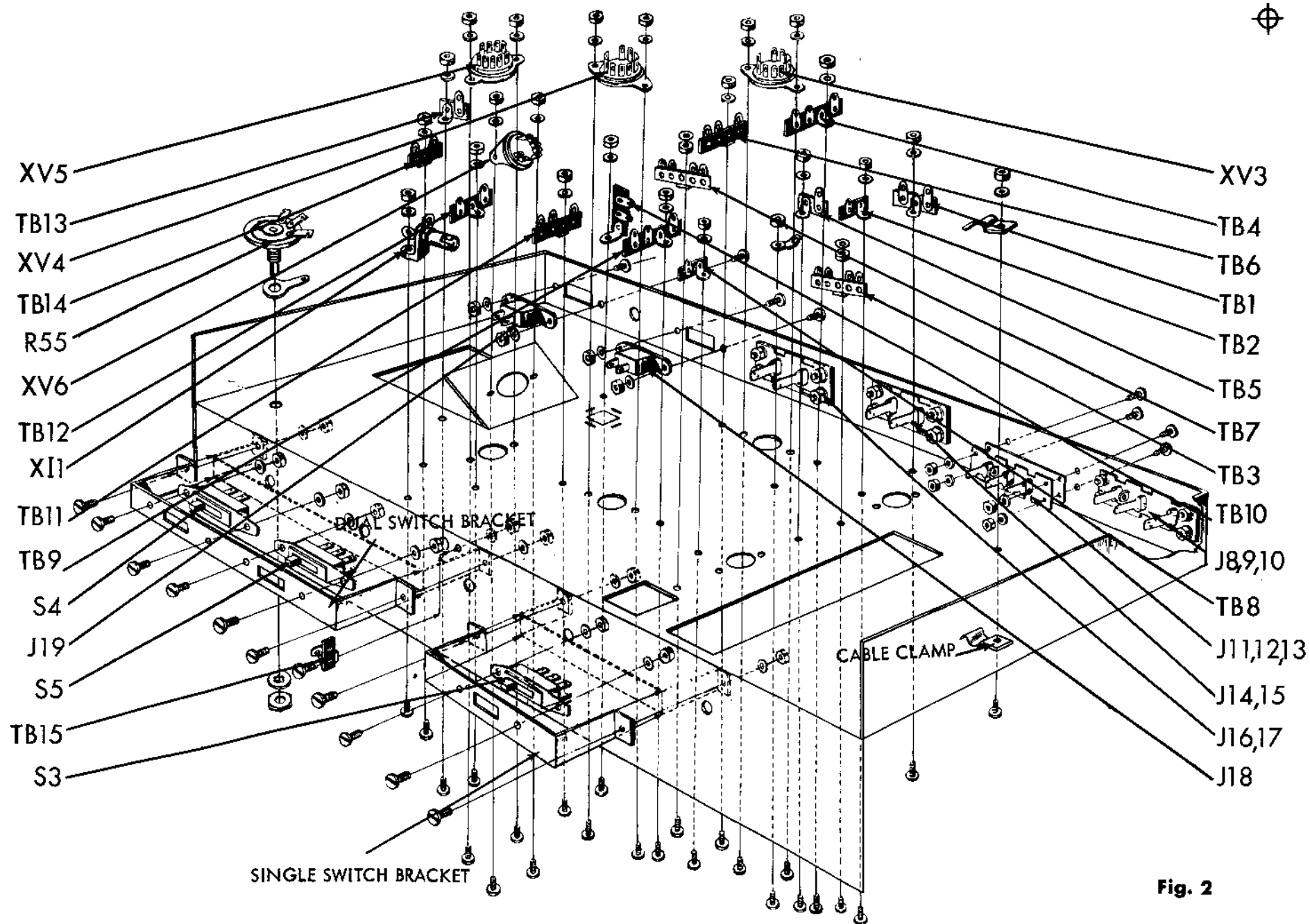


Fig. 2

BOTTOM CHASSIS MOUNTING

1. () Fig. 2. Mount the one post left terminal strip, TB15, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.

2. () Fig. 2. Note that the mounting holes for the single switch bracket and the dual switch bracket are not at the center of the bracket. The bracket must be mounted so that a larger part of the bracket is below the mounting hole than above it. When mounted properly, the brackets will protrude 1/8" below the bottom of the chassis. Mount both brackets as shown, using two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts on each.

3. () Fig. 2. On the single switch bracket mount the double pole double throw slide switch, S3 as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

4. () Fig. 2. On the double switch bracket mount the double pole double throw slide switch, S5, as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

5. () Fig. 2. Mount the single pole single throw slide switch, S4, as shown. Note direction in figure 6. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

6. () Fig. 2. Mount the hum bucking pot, R55, as shown (see Fig. 5). Use pot grounding lug, a 3/8 lockwasher and a 3/8 hex nut. When tightening grounding lug should be under center terminal to which it will eventually be soldered.

7. () Fig. 2. Mount the two convenience outlets, J18 and J19 as shown. Use two #6-32 screw, two #6 lockwashers and two #6-32 hex nuts on each.

8. () Fig. 2. Mount the triple jack, J11, 12, 13 as shown. Use a bakelite insulator between the jack strip and the chassis. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts. (See Fig. 5)

9. () Fig. 2. In a similar manner, mount the triple jack, J8, 9, 10, the dual jack J14, 15 and the dual jack, J16, 17. Use a bakelite insulator between each jack strip and the chassis. Use four #6-32 screws, four #6 lockwashers and four #6-32 hex nuts on each. (See Fig. 5)

10. () Fig. 2. Between the two convenience outlets, push a rubber grommet into the 3/8" hole.

11. () Fig. 2. Mount the pilot lite socket, X11, as shown (see figure 5). Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.

12. () Fig. 2. Mount seven pin miniature tube socket, XV6 as shown. (see figure 5). Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.

13. () Fig. 2. Mount nine pin miniature tube sockets, XV3, XV4 and XV5 (without shield support) as shown. (see figure 5) Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts on each.

14. () Fig. 2. Near J8, 9, 10, mount one cable clamp below the chassis. Use one #8-32 screw, one #8 lockwasher and one #8-32 hex nut. On the same screw, mount another identical cable clamp above the chassis. Do not tighten the nut as yet.

15. () Fig. 2. Mount two post terminal board, TB1/ one post left terminal board, TB2/ four post terminal board, TB3/ three post two left terminal board, TB4/ one post right terminal board, TB5/ three post two right terminal board, TB6/ four post terminal board, TB7/ one post left terminal board, TB8/ three post two left terminal board, TB9/ two post upright - right terminal board, TB10/ three post two right terminal board, TB11/ two post terminal board, TB12/ one post right terminal board TB13/ and two post terminal board, TB14/ as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut on each.

16. () Fig. 2. In the hole next to terminal board, TB3, mount a #6 ground lug. Use one #6-32 screw and one #6-32 hex nut.

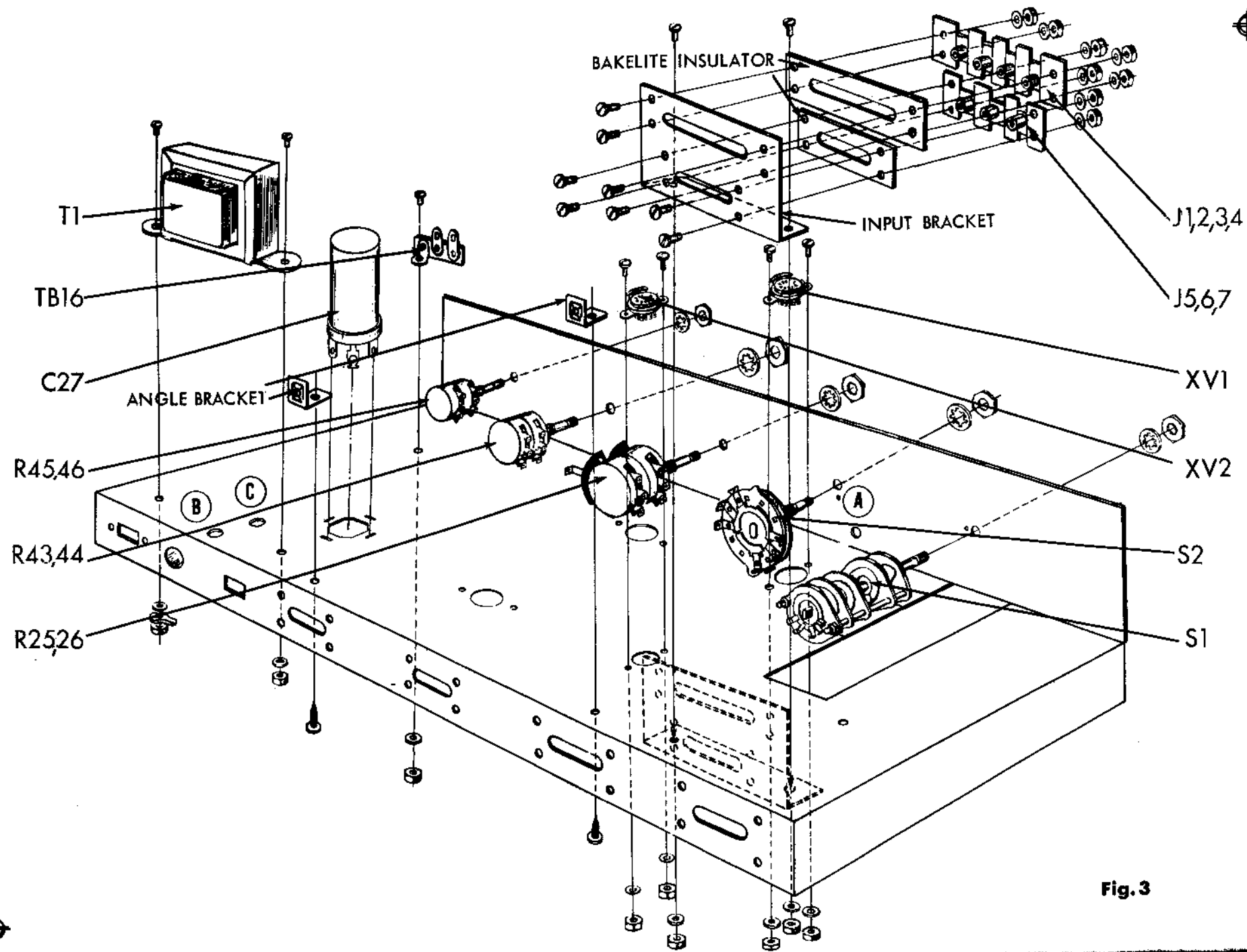


Fig. 3

TOP OF CHASSIS ASSEMBLY

1. () Fig. 3. Mount the four wafer input selector switch, S1, as shown (see figure 4). Push all leads except the twisted violet-white pair, the blue-green pair and the yellow-grey pair, to the bottom of the chassis, through the rectangular hole below the switch. Push the twisted white-violet pair and the twisted green blue pair through hole "A" in the front apron of the chassis. Use a 3/8 lockwasher and a 3/8 hex nut.

2. () Fig. 3. Mount the mode switch, S2, as shown (see figure 4). Use one 3/8 lockwasher and one 3/8 hex nut.

3. () Fig. 3. Mount the concentric level control pot (with center tap lug stock # 18053) R25, 26 as shown. Use one 3/8 lockwasher and one 3/8 hex nut.

4. () Fig. 3. Mount the concentric bass control pot (stock # 18054) R43, 44 as shown. Use one 3/8 lockwasher and one 3/8 hex nut.

5. () Fig. 3. Mount the concentric treble control pot (stock # 18052) R45, 46 as shown. Use one 3/8 lockwasher and one 3/8 hex nuts.

6. () Fig. 3. Mount the input bracket as shown. Use two #6-32 screws, two #6 lockwashers and two #6-32 hex nuts.

7. () Fig. 3. Mount the four input jack strips, J1, 2, 3, 4 and the three input jack strips, J5, 6, 7 as shown on the input bracket. Use four #6-32 screws, four

#6 lockwashers and four #6-32 hex nuts on each. Between each jack strip and the input bracket, place a bakelite insulator.

8. () Fig. 3. Mount the electrolytic can capacitor, C27, as shown. Note half moon, square and triangle near the lugs to determine the direction for mounting (figure 6). 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 any one of the tabs to the chassis at its slot.

9. () Fig. 3. Mount the two angle brackets at the rear of the chassis as shown. Use one #8 P. K. - type Z screw for each.

* 10. () Fig. 3. On the power transformer, T1, cut the two black leads, the two yellow leads and the red-yellow leads to 2 1/2". Cut both red leads to 3 1/2". Push both black leads through hole "B" and all the remaining leads through hole "C". Mount the transformer as shown, using two #6-32 screws and two #6-32 hex nuts. Under one of the hex nuts, use a #6 lockwasher. Under the second hex nut, use a #6 ground lug.

11. () Fig. 3. Mount the two post right terminal strip, TB16, as shown. Use one #6-32 screw, one #6 lockwasher and one #6-32 hex nut.

12. () Fig. 3. Mount the two nine pin miniature tube sockets with shield support, XV1 and XV2 as shown. See figure 6 for orientation. Use two #4-40 screws, two #4 lockwashers and two #4-40 hex nuts.

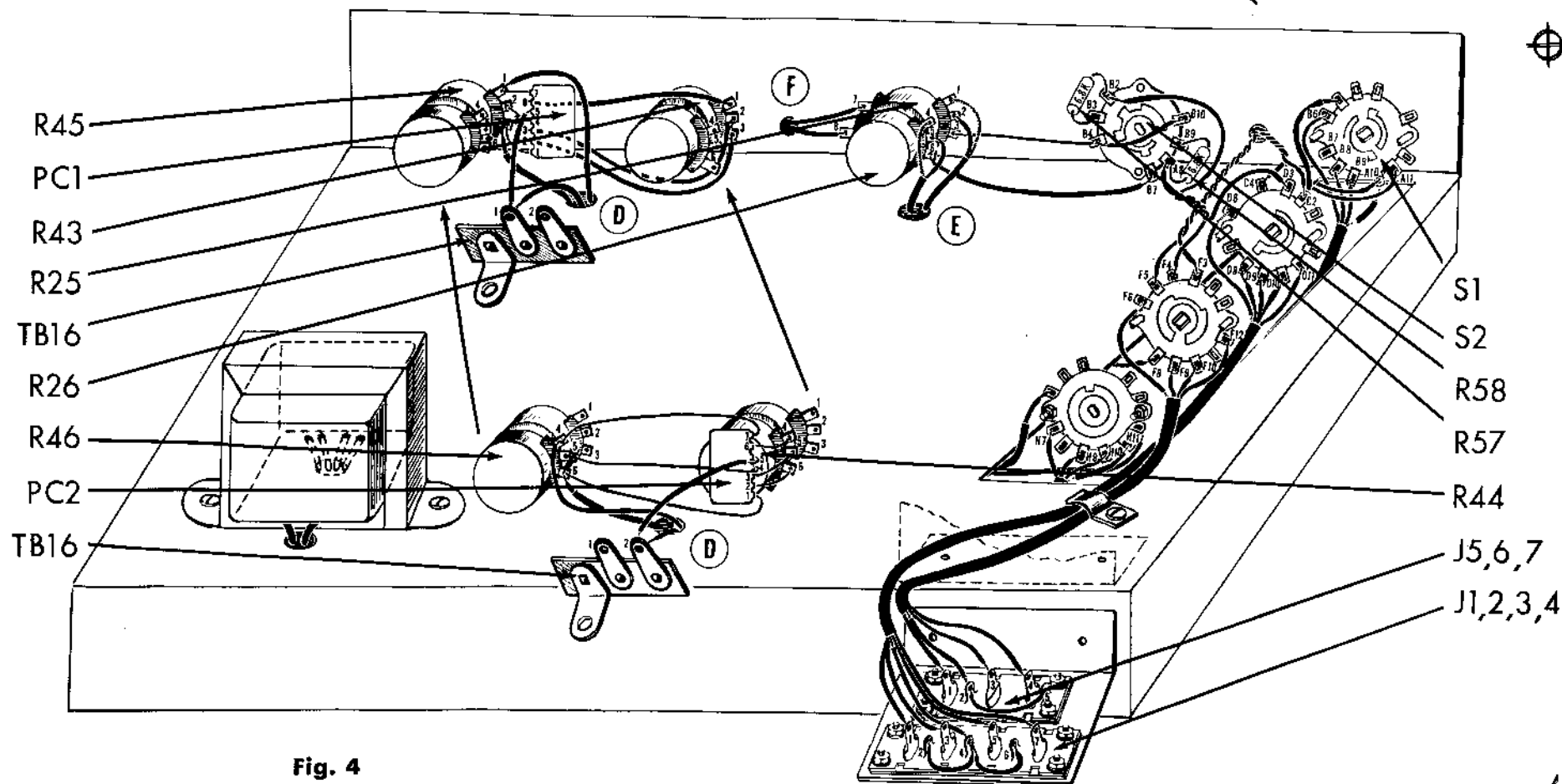


Fig. 4

- ✓ 1. (✓) Fig. 4. Run the three conductor shielded cable (previously connected to wafer "F" on input selector switch S1) along the chassis as shown under the cable clamp. Connect the red lead to J5, 6, 7-3 (S), the orange lead to J5, 6, 7-4 (S), the spaghetti covered shield strands to J5, 6, 7-2 (C) and the brown lead to J5, 6, 7-1 (S). Note that the input bracket is shown bent out, away from the chassis to better show the connections in the drawing. The bracket actually remains mounted vertically on the chassis and is not removed for this or any of the following steps.
- ✓ 2. (✓) Fig. 4. Connect a 1 3/4" piece of black wire from J5, 6, 7-5 (S) to J5, 6, 7-2 (S).
- ✓ 3. (✓) Fig. 4. Connect a 1" piece of black wire from J1, 2, 3, 4-2 (S) to J1, 2, 3, 4-4 (C).
- ✓ 4. (✓) Fig. 4. Connect a 1" piece of black wire from J1, 2, 3, 4-4 (C) to J1, 2, 3, 4-6 (S).
- ✓ 5. (✓) Fig. 4. Run the four conductor shielded cable (previously connected to wafer "D" on S1) along the chassis as shown under the cable clamp. Connect the spaghetti covered shield strands to J1, 2, 3, 4-4 (S), the red lead to J1, 2, 3, 4-3 (S), the orange lead to J1, 2, 3, 4-5 (S), the brown lead to J1, 2, 3, 4-1 (S) and the yellow lead to J1, 2, 3, 4-7 (S).
- ✓ 6. (✓) Fig. 4. Cut all leads on two 6.8KΩ (blue, grey, red, silver) resistors, R57 and R58, to 1/2". Connect R57 from S2B-2 (C) to S2B-3 (S) and R58 from S2B-9 (S) to S2A-8 (C).
- ✓ 7. (✓) Fig. 4. Connect a 1 3/4" piece of grey wire from S2B-10 (S) to S2B-4 (C).

- ✓ 8. (✓) Fig. 4. Connect a 1 1/2" piece of grey wire from S2B-4 (S) to R25-3 (S).
- ✓ 9. (✓) Fig. 4. Connect a 2 1/2" piece of yellow wire from S2B-7 (S) to R26-6 (S).
- ✓ 10. (✓) Fig. 4. A twisted yellow and grey pair of leads has previously been connected to S1. Connect the other end of the yellow lead to S2A-8 (S) and the other end of the grey lead to S2B-2 (S).
- ✓ 11. (✓) Fig. 4. On one end of a 7" piece of single conductor shielded wire, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation back 1/4" on the inner conductor and connect to R25-2 (S). Connect the twisted shield strands to R25-1 (S).
On the other end of the same piece of shielded wire, strip the outer insulation back 3/4". Twist the shield strands together and cover with a 1/2" piece of thick spaghetti. Strip the insulation back 1/4" on the inner conductor. Push this end through hole "E" to bottom of the chassis.
- ✓ 12. (✓) Fig. 4. On one end of a 4" piece of single conductor shielded wire, strip the outer insulation back 1/2". Twist the shield strands together. Strip the insulation back 1/4" on the inner conductor and connect to R26-5 (S). Connect the twisted shield strands to R26-4 (S).
On the other end of the same piece of shielded wire, strip the outer insulation back 3/4". Twist the shield strands together and cover with a 1/2" piece of thick spaghetti. Strip the insulation back 1/4" on the inner conductor. Push this end through hole "E" to the bottom of the chassis.

Two printed circuit plates are soldered to the dual potentiometers. One printed circuit plate, PC1, gets connected to the potentiometers R43 and R45 nearest the front apron. The other printed circuit plate, PC2, gets connected to the potentiometers R44 and R46, 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 potentiometers are just shown, but not wired.

Below this drawing, the second plate PC2, is mounted and wired in the circuit with its associated connections. In this drawings, the front potentiometers, R43 and R45 are shown. 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.

- ✓ 13. (✓) Fig. 4. Strip the outer insulation back 1/2" on one end of an 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 of R45-3 (S). On the other end of the same piece of cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the inner insulation back 1/4". Push this end of the cable through hole "D" to the bottom of the chassis.

- ✓ 14. (✓) Fig. 4. Connect one end of a 3" piece of ^{violet} purple wire to R45-1 (S). Push the other end through hole "D".
- ✓ 15. (✓) Fig. 4. Connect one end of a 2 1/2" piece of blue wire to TB16-1 (S). Push the other end through hole "D".
- ✓ 16. (✓) Fig. 4. On printed circuit plate PC1, cut leads #1, #4 and #7 to 1/2". Cut leads #2, #3 and #6 to 2 1/2". Cut lead #5 to 1 1/2". Cover each of leads #2, #3 and #6 with a 2 1/4" piece of spaghetti. Cover lead #5 with a 1 1/4" piece of spaghetti. Board mounted with numbers facing away from you. Connect lead #6 to R43-1 (S), lead #2 to R43-3 (S), lead #3 to R43-2 (S), lead #1 to R45-3 (S), lead #4 to R45-2 (S), lead #7 to R45-1 (S) and lead #5 to TB16-1 (S).
- ✓ 17. (✓) Fig. 4. Strip the outer insulation back 1/2" on one end of a 5" piece of single conductor shield cable. Twist the shield strands together and cut off. Strip the inner insulation back 1/4". Connect this end to R46-6 (S). On the other end of the same piece of cable, strip the outer insulation back 1/2". Twist the shield strands together. Strip the inner insulation back 1/4". Push this end of the cable through hole "D" to the bottom of the chassis.
- ✓ 18. (✓) Fig. 4. Connect one end of a 3" piece of green wire to R46-4 (S). Push the other end through hole "D".
- ✓ 19. (✓) Fig. 4. Connect one end of a 3" piece of white wire to TB16-2 (S). Push the other through hole "D".
- ✓ 20. (✓) Fig. 4. On printed circuit plate PC2, cut leads #2, #3 and #6 to 1/2". Cut leads #1, #4, #5 and #7 to 2 1/4". Cover lead #5 with a 2" piece of spaghetti. Board is mounted with numbers facing towards you. Connect lead #2 to R44-6 (S), lead #3 to R44-5 (S), lead #6 to R44-4 (S), lead #1 to R46-6 (S), lead #4 to R46-5 (S), lead #7 to R46-4 (S) and lead #5 to TB16-2 (S).
- ✓ 21. (✓) Fig. 4. Connect one end of one 2" piece of blue wire to R25-7 (S), and one end of a second 2" piece of blue wire to R26-8 (S). Push the other end of both leads through hole "F" to the front of the chassis.

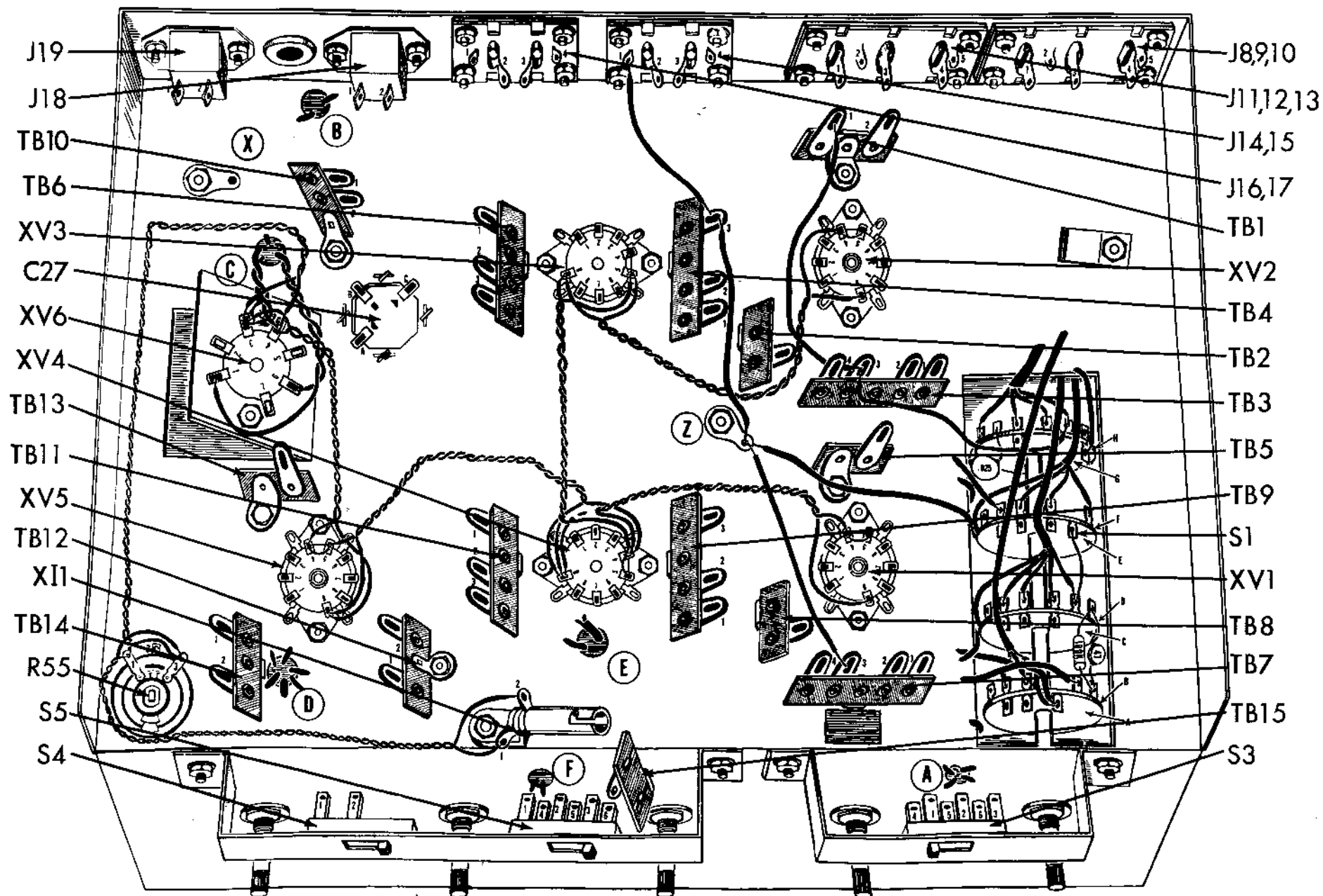


Fig. 5

BELOW CHASSIS WIRING

- ✓ 1. (✓) Fig. 5. From hole "C", twist the two yellow leads together. Connect one yellow lead to XV6-3 (C) and the second yellow lead to XV6-4 (C).
- ✓ 2. (✓) Fig. 5. From hole "C", twist the two red leads together. Connect the shorter red lead to XV6-6 (S1) and the longer red lead to XV6-1 (S1).
- ✓ 3. (✓) Fig. 5. Connect one end of a 3" piece of yellow wire to XV6-4 (C) and one end of a 4" piece of brown wire to XV6-3 (C). ✓ Twist both leads together and run along the chassis as shown. Connect the other end of the yellow lead to XV5-4 (C) and the other end of the brown lead to XV5-9 (C).
- ✓ 4. (✓) Fig. 5. Fold the pot grounding lug over the center lug on R55 and solder to this lug, R55-2 (S1).
- ✓ 5. (✓) Fig. 5. Connect one end of a 8" piece of yellow wire to XV6-4 (S3) ✓ and one end of a 8" piece of brown wire to XV6-3 (S3). ✓ Twist both leads together and run along the chassis as shown. Connect the other end of the yellow lead to R55-3 (C) and the other end of the brown lead to R55-1 (C).
- ✓ 6. (✓) Fig. 5. Connect one end of a 7" piece of yellow wire to R55-3 (S2) ✓ and one end of a 7" piece of brown wire to R55-1 (S2). ✓ Run along the chassis as shown. Connect the other end of the yellow lead to X11-1 (S1) and the other end of the brown lead to X11-2 (S1).
- ✓ 7. (✓) Fig. 5. Connect one end of a 6" piece of yellow wire to XV5-5 (C) ✓ and one end of a 6" piece of brown wire to XV5-9 (S2). ✓ Twist both leads together and run along the chassis as shown. Connect the other end of the yellow lead to XV4-4 (C) and the other end of the brown lead to XV4-9 (C). ✓
- ✓ 8. (✓) Fig. 5. Connect a 1/2" piece of bare wire from XV5-4 (S2) to XV5-5 (S2).
- ✓ 9. (✓) Fig. 5. Connect a 1/2" piece of bare wire from XV4-4 (C) to XV4-5 (S1).
- ✓ 10. (✓) Fig. 5. Connect one end of a 5" piece of yellow wire to XV4-4 (C) ✓ and one end of a 5" piece of brown wire to XV4-9 (C). ✓ Twist both leads to-

gether and run along the chassis as shown. Connect the other end of the yellow lead to XV1-4 (C) and the other end of the brown lead to XV1-9 (S1).

- ✓ 11. (✓) Fig. 5. Connect a 1/2" piece of bare wire from XV1-4 (S2) to XV1-5 (S1).
- ✓ 12. (✓) Fig. 5. Connect one end of a 4" piece of yellow wire to XV4-4 (S4) ✓ and one end of a 4" piece of brown wire to XV4-9 (S3). ✓ Twist both leads together and run along the chassis as shown. Connect the other end of the yellow lead to XV3-5 (C) and the other end of the brown lead to XV3-9 (C).
- ✓ 13. (✓) Fig. 5. Connect a 1/2" piece of bare wire from XV3-4 (S1) to XV3-5 (C).
- ✓ 14. (✓) Fig. 5. Connect one end of a 5" piece of yellow wire to XV3-5 (S3) ✓ and one end of a 5" piece of brown wire to XV3-9 (S2). ✓ Twist both leads together and run along the chassis as shown. Connect the other end of the yellow lead to XV2-4 (C) and the other end of the brown lead to XV2-9 (S1).
- ✓ 15. (✓) Fig. 5. Connect a 1/2" piece of bare wire from XV2-4 (S2) to XV2-5 (S1).
- ✓ 16. (✓) Fig. 5. Connect a 3 1/2" piece of black wire from TB1-1 (C) to TB3-3 (C).
- ✓ 17. (✓) Fig. 5. Connect the black lead from the "H" wafer of input selector switch, S1, to TB3-3 (C).
- ✓ 18. (✓) Fig. 5. Connect the black lead from the "F" wafer of S1 to ground lug "Z" (C).
- ✓ 19. (✓) Fig. 5. Connect a 3 1/2" piece of black wire from TB7-3 (C) to ground lug "Z" (C).
- ✓ 20. (✓) Fig. 5. Connect a 3 1/2" piece of black wire from TB4-3 (C) to ground lug "Z" (C).
- ✓ 21. (✓) Fig. 5. Connect a 2" piece of black wire from TB4-3 (C) to J14, J15-1 (C).

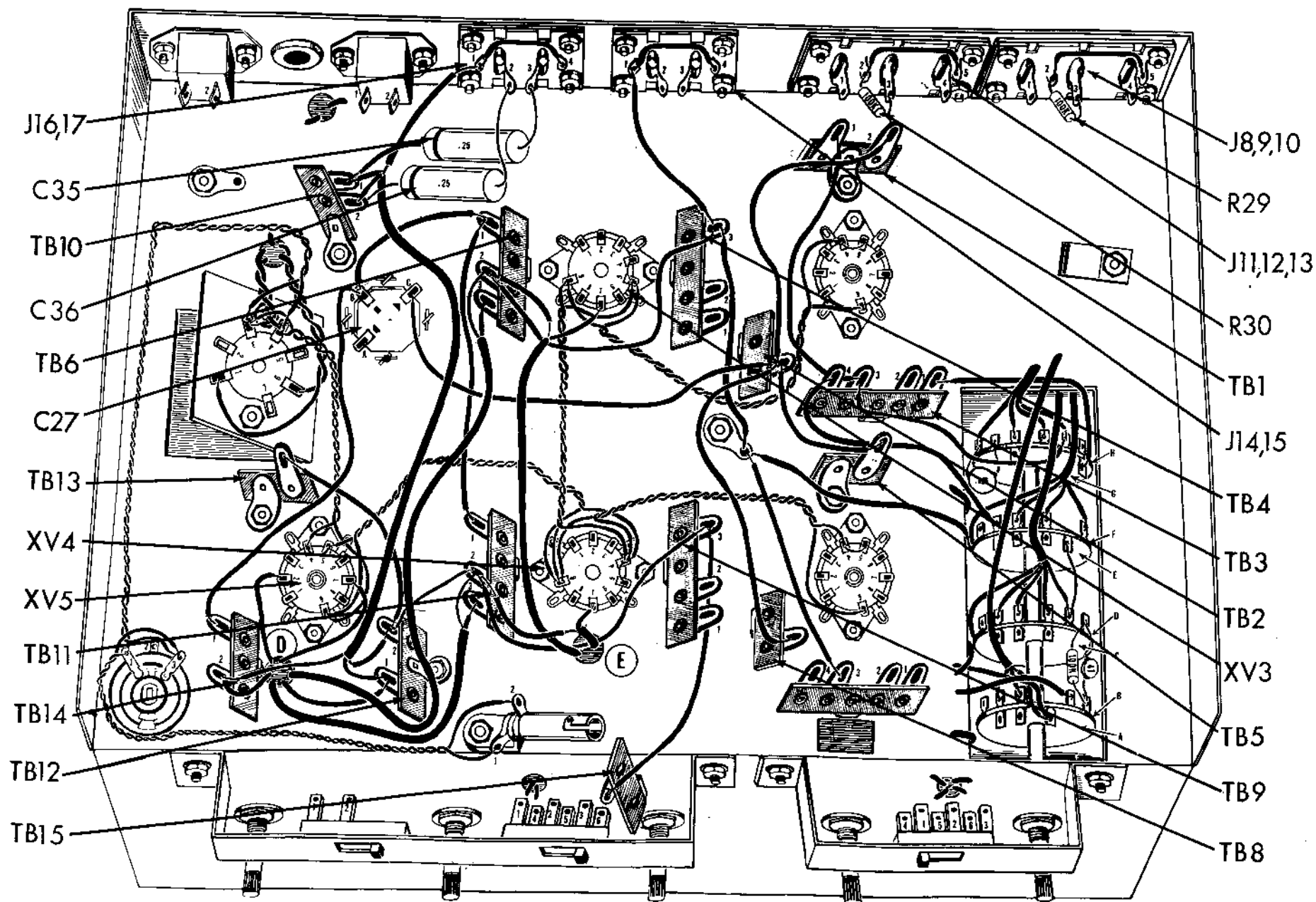


Fig. 6

- ✓ 1. (✓) Fig. 6. Connect a 4" piece of black wire from TB4-3 (C) to TB6-2 (C).
- ✓ 2. (✓) Fig. 6. Connect a 4" piece of black wire from TB9-3 (C) to TB11-2 (C).
- ✓ 3. (✓) Fig. 6. Connect a 2" piece of black wire from TB11-2 (C) to TB12-2 (C).
- ✓ 4. (✓) Fig. 6. Connect a 3" piece of black wire from TB12-2 (C) to TB13 (C).
- ✓ 5. (✓) Fig. 6. Connect a 5" piece of black wire from TB9-3 (C) to TB15 (C).
- ✓ 6. (✓) Fig. 6. Connect a 1 1/2" piece of black wire from J8, 9, 10-2 (C) to J8, 9, 10-5 (C).
- ✓ 7. (✓) Fig. 6. Connect a 1 1/2" piece of black wire from J11, 12, 13-2 (C) to J11, 12, 13-5 (C).
- ✓ 8. (✓) Fig. 6. Cut all leads on two 100KΩ (brown, black, yellow, silver) resistors, R29 and R30 to 1/2". Connect R29 from J8, 9, 10-2 (S2) to J8, 9, 10-3 (C) and R30 from J11, 12, 13-2 (S2) to J11, 12, 13-3 (C).
- 13 ✓ 9. (✓) Fig. 6. Connect a 1 1/2" piece of black wire from J14, 15-1 (C) to J14, 15-4 (S1).
- ✓ 10. (✓) Fig. 6. Connect a 1 1/2" piece of black wire from J16, 17-1 (C) to J16, 17-4 (S1).
- ✓ 11. (✓) Fig. 6. Connect a 3" piece of red wire from C27B (C) to TB6-1 (C).
- ✓ 12. (✓) Fig. 6. Connect a 4" piece of red wire from TB6-1 (C) to TB11-1 (C).
- ✓ 13. (✓) Fig. 6. Connect a 6" piece of red wire from C27C (C) to TB2 (C).
- ✓ 14. (✓) Fig. 6. Connect a 5" piece of red wire from TB2 (C) to TB8 (C).
- ✓ 15. (✓) Fig. 6. Connect a 4" piece of red wire from TB2 (C) to TB1-2 (C).
- ✓ 16. (✓) Fig. 6. Connect a 3" piece of red wire from TB2 (C) to TB5 (C).
- ✓ 17. (✓) Fig. 6. Connect a 5 1/2" piece of red wire from TB14-1 (C) to C27B (C).

- ✓ 18. (✓) Fig. 6. From hole "D" connect the blue lead to XV5-2 (C), the violet lead to TB14-2 (C), the white lead to XV5-7 (C) and the green lead to TB12-1 (C).
- ✓ 19. (✓) Fig. 6. From hole "D", connect the inner conductor of the longer shielded cable to TB6-3 (C) and the outer shield to TB6-2 (C). Connect the inner conductor of the shorter shielded cable to TB11-3 (C) and the outer shield to TB11-2 (C).
- ✓ 20. (✓) Fig. 6. On one end of a 9" piece of two conductor shielded cable, strip the outer insulation back 1 1/4". Twist the shield strands together and cover with a 1 1/2" piece of thick spaghetti. Connect these shield strands to TB12-2 (C). Strip the insulation back 1/4" on both inner conductors. Connect the red lead to TB14-2 (C) and the brown lead to TB12-1 (C). On the other end of the same cable, strip the outer insulation back 1 1/2". Twist the shield strands together, cover with a 1 1/4" piece of thick spaghetti and connect lead to J16, 17-1 (S2). Strip the insulation back 1/4" on both inner conductors. Connect the red lead to TB10-1 (C) and the brown lead to TB10-2 (C).
- ✓ 21. (✓) Fig. 6. Cut one lead on a .25mfd (red, green, yellow, white, red) paper capacitor, C35 to 1 1/4". Cover this lead with a 1" piece of spaghetti and connect to TB10-1 (S2). Cut the second lead to 3/4" and connect to J16, 17-3 (S1).
- ✓ 22. (✓) Fig. 6. Cut one lead on a .25mfd (red, green, yellow, white, red) paper capacitor, C36 to 1 1/4". Connect this lead to J16, 17-2 (S1). Cut the second lead to 3/4" and connect to TB10-2 (S2).
- ✓ 23. (✓) Fig. 6. From hole "E", connect the inner conductor of the longer shielded lead to XV3-7 (S1). Connect the spaghetti covered shield strands to TB6-2 (C). Connect the inner conductor of the shorter lead to XV4-7 (S1) and the spaghetti covered shield strands to TB11-2 (C).
- ✓ 24. (✓) Fig. 6. Connect the brown lead from wafer "F" on switch, S1, to TB3-4 (C).
- ✓ 25. (✓) Fig. 6. Connect the grey lead from wafer "G" on S1 to TB3-1 (C).

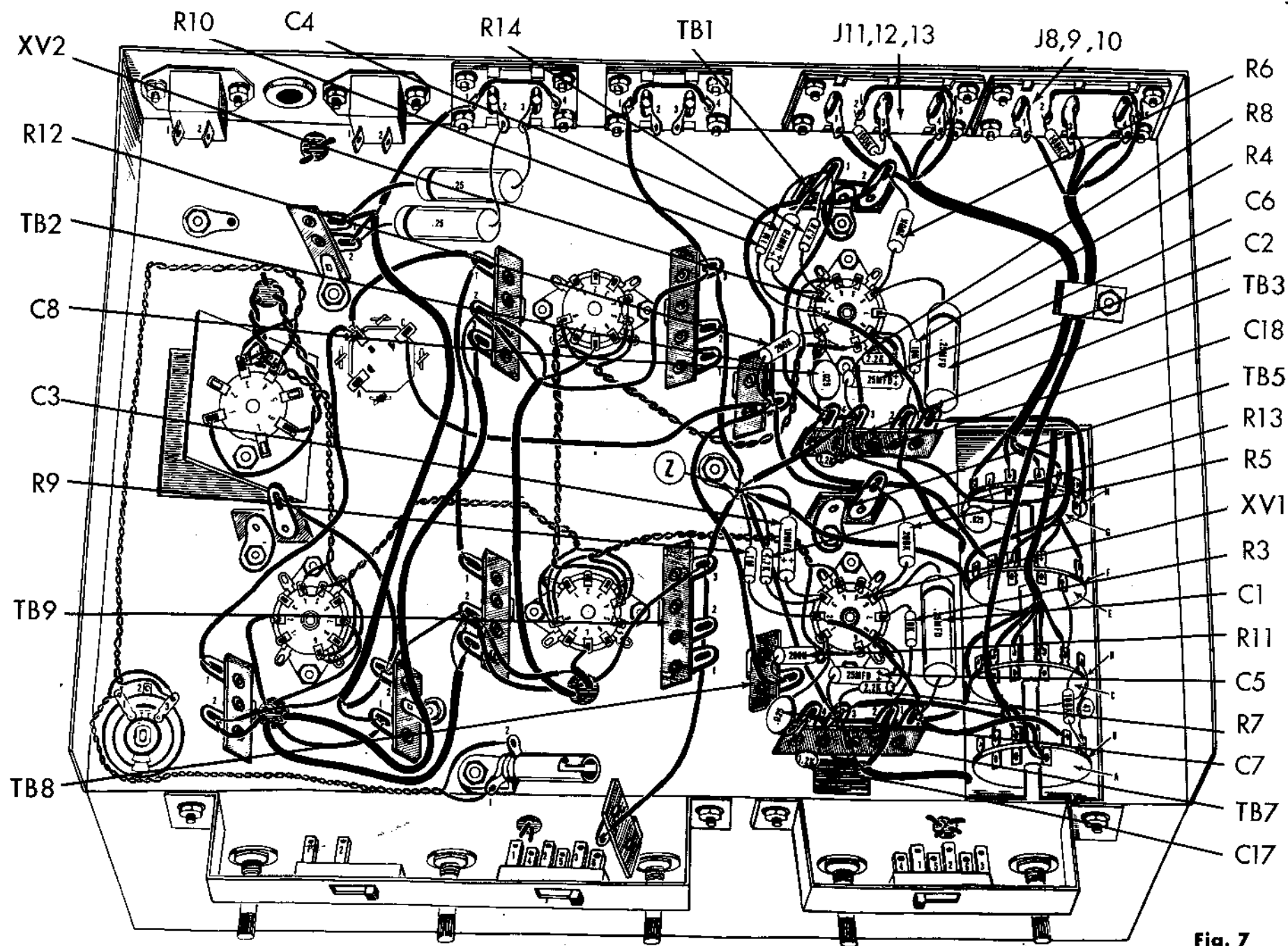


Fig. 7

- ✓ 1. (✓) Fig. 7. Connect the inner conductor from the shielded wire (from wafer "G" on S1) to TB3-2 (C). Connect the shield strands to TB3-3 (C).
- ✓ 2. (✓) Fig. 7. Connect the brown lead from wafer "D" on switch, S1 to TB7-4 (C).
- ✓ 3. (✓) Fig. 7. Connect the inner conductor from the shielded wire (from wafer "B" on S1) to TB7-2 (C) and the shield strands to TB7-3 (C).
- ✓ 4. (✓) Fig. 7. Run the three conductor cable from wafer "H" of switch S1, under the cable clamp and along the chassis as shown. Connect the red lead to J11, 12, 13-3 (S2) the brown lead to J11, 12, 13-1 (S1) the orange lead to J11, 12, 13-4 (S1) and the spaghetti covered shield strands to J11, 12, 13-5 (S2).
- ✓ 5. (✓) Fig. 7. Run the three conductor shielded cable from wafer "A" and "B" of switch S1, under the cable clamp and along the chassis as shown. Tighten the screw holding the cable clamp. Connect the spaghetti covered shield strands to J8, 9, 10-5 (S2) the orange lead to J8, 9, 10-4 (S1), the red lead to J8, 9, 10-3 (S2) and the brown lead to J8, 9, 10-1 (S1).
- 13C ✓ 6. (✓) Fig. 7. Connect the black lead from wafer "A" on input selector switch, S1 to TB7-3 (C).
- ✓ 7. (✓) Fig. 7. Connect the grey lead from wafer "B" on switch S1 to TB7-1 (C).
- ✓ 8. (✓) Fig. 7. Connect a 2" piece of black wire from TB3-3 (C) to ground lug "Z" (C).
- ✓ 9. (✓) Fig. 7. Connect a 1 1/2" piece of black wire from TB9-3 (C) to ground lug "Z" (C).
- ✓ 10. (✓) Fig. 7. Cut all leads on four 200K Ω (red, black, yellow, gold) 5% resistors, R5, 6, 11 and 12 to 1/2". Connect R5 from XV1-6 (C) to TB5 (S2) R6 from XV2-6 (C) to TB1-2 (S2) R11 from XV1-1 (C) to TB8 (S2) and R12 from XV2-1 (C) to TB2 (S5).
- ✓ 11. (✓) Fig. 7. Cut all leads on two 25mfd, 6 volt electrolytic capacitors, C5 and C6, to 3/4". Cover all leads with a 1/2" piece of spaghetti. Connect the positive (+) end of C5 to XV1-8 (C) and the negative (-) end to TB7-3 (C). Connect the positive (+) end of C6 to XV2-8 (C) and the negative (-) end to TB3-3 (C).

- ✓ 12. (✓) Fig. 7. Cut all leads on two 2.2K Ω (red, red, red, silver) resistors, R7 and R8, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect R7 from XV1-8 (S2) to TB7-3 (C) and R8 from XV2-8 (S2) to TB3-3 (C).
- ✓ 13. (✓) Fig. 7. Cut one lead on each of two 10K Ω (brown, black, orange, silver) resistors, R3 and R4, to 1" and the second lead on each resistor to 1/2". Connect the shorter lead of R3 to XV1-7 (S) and the longer lead to TB7-2 (C). Connect the shorter lead of R4 to XV2-7 (S) and the longer lead to TB3-2 (C).
- ✓ 14. (✓) Fig. 7. Cut all leads on two .25mfd (red, green, yellow, white, red) 200 volt paper capacitors, C1 and C2, to 1/2". Connect C1 from XV1-6 (S2) to TB7-1 (C) and C2 from XV2-6 (S2) to TB3-1 (C).
- ✓ 15. (✓) Fig. 7. Cut all leads on two 10mfd, 6 volt electrolytic capacitors, C3 and C4, to 1/2". Connect the positive (+) end of C3 to XV1-3 (C) and the negative (-) end to ground lug "Z" (C). Connect the positive (+) end of C4 to XV2-3 (C) and the negative (-) end to TB1-1 (C).
- ✓ 16. (✓) Fig. 7. Cut all leads on two 4.7K Ω (yellow, violet, red, silver) resistors, R13 and R14, to 3/4". Connect R13 from XV1-3 (S2) to ground lug "Z" (C) and R14 from XV2-3 (S2) to TB1-1 (C).
- ✓ 17. (✓) Fig. 7. Cut all leads on two 1M Ω (brown, black, green, silver) resistors, R9 and R10 to 3/4". Connect R9 from XV1-2 (C) to ground lug "Z" (S8) and R10 from XV2-2 (C) to TB1-1 (S4).
- ✓ 18. (✓) Fig. 7. Connect a 2 1/4" piece of green wire from XV1-2 (S2) to TB7-1 (S3).
- ✓ 19. (✓) Fig. 7. Connect a 2 1/4" piece of green wire from XV2-2 (S2) to TB3-1 (S3).
- ✓ 20. (✓) Fig. 7. Cut all leads on two .025mfd (25K or 25,000mmf) disc capacitors, C7 and C8, to 3/4". Connect C7 from XV1-1 (S2) to TB7-4 (C) and C8 from XV2-1 (S2) to TB3-4 (C).
- ✓ 21. (✓) Fig. 7. Cut all leads on two .0012mfd (1.2K or 1200mmf) disc capacitors, C17 and C18, to 1/2". Connect C17 from TB7-3 (C) to TB7-4 (S3) and C18 from TB3-4 (S3) to TB3-3 (C).

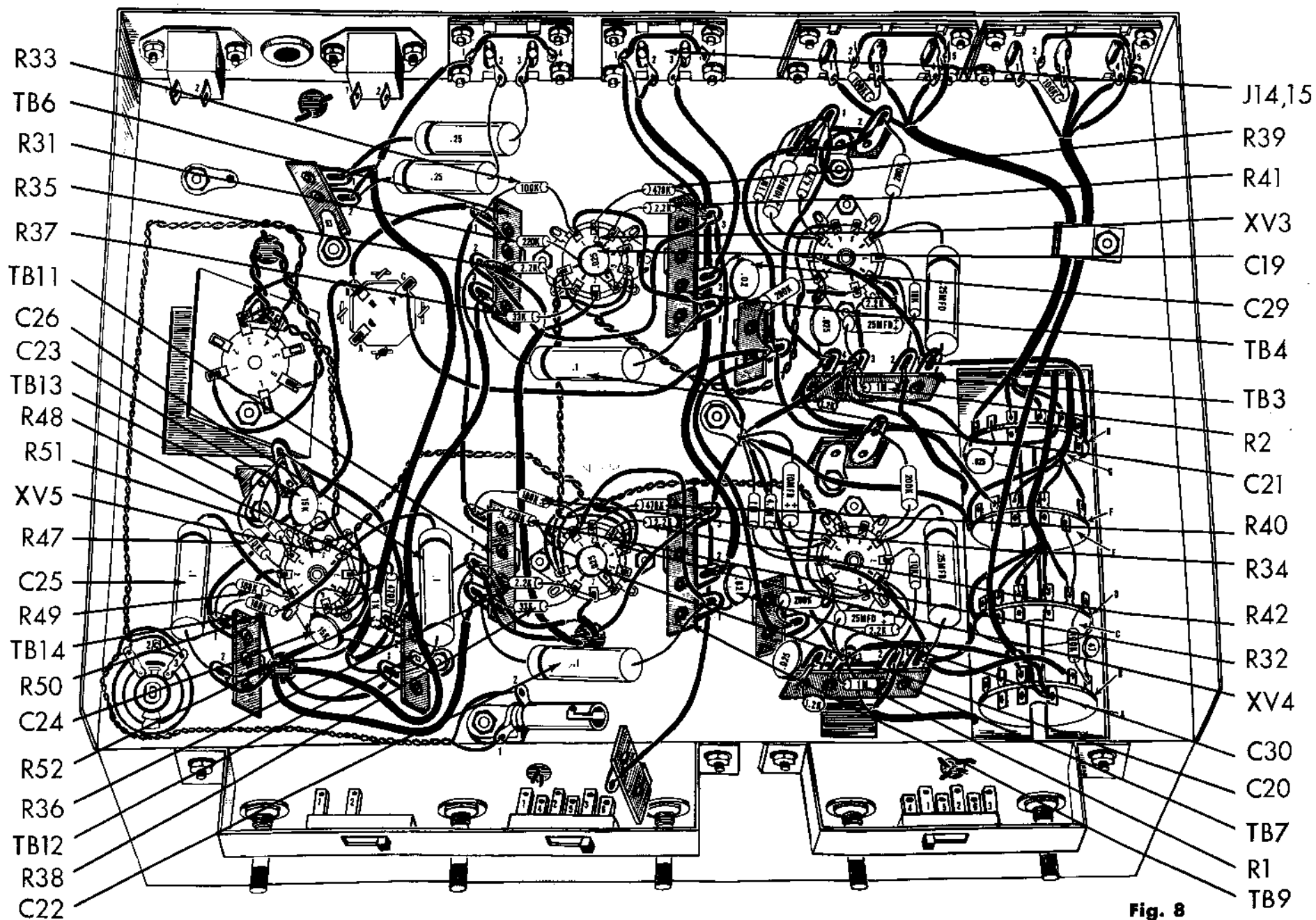


Fig. 8

- ✓ 1. (✓) Fig. 8. Cut both leads on two 1M Ω (brown, black, green, silver) resistors, R1 and R2, to 1/2". Connect R1 from TB7-2 (S3) to TB7-3 (S7) and R2 from TB3-2 (S3) to TB3-3 (S8).
- ✓ 2. (✓) Fig. 8. On one of a 6 1/2" piece of single conductor shielded cable, strip the insulation back 1/2". Twist the shield strands together and cut them off. Strip back for 1/4" the insulation on the inner conductor. Connect this lead to TB9-2 (C).
On the other end of the same piece of cable, strip the insulation back 1/2". Strip back for 1/4" the insulation on the inner conductor and connect to J14, 15-2 (S1). Twist the shield strands together and connect to J14, 15-1 (S3).
- ✓ 3. (✓) Fig. 8. Connect a 2 1/2" piece of brown wire from TB4-2 (C) to J14, 15-3 (S1).
- ✓ 4. (✓) Fig. 8. Cut all leads on two .02mfd (20K or 20,000mmf) disc capacitors, C29 and C30, to 1/2". Connect C29 from TB4-1 (C) to TB4-2 (S2) and C30 from TB9-1 (C) to TB9-2 (S2).
- ✓ 5. (✓) Fig. 8. Connect a 3" piece of blue wire from XV4-1 (C) to TB9-1 (C).
- ✓ 6. (✓) Fig. 8. Connect a 3" piece of blue wire from XV3-1 (C) to TB4-1 (C).
- ✓ 7. (✓) Fig. 8. Cut all leads on four 2.2K Ω (red, red, red, silver) resistors, R35, R36, R41 and R42, to 1/2". Connect R35 from XV3-8 (C) to TB6-2 (S4), R36 from TB11-2 (S5) to XV4-8 (C), R41 from XV3-3 (S1) to TB4-3 (C) and R42 from XV4-3 (S1) to TB9-3 (C).
- ✓ 8. (✓) Fig. 8. Cut all leads on two 33K Ω (orange, orange, orange, silver) resistors, R37 and R38, to 1/2". Connect R37 from XV3-8 (S2) to TB6-3 (C) and R38 from TB11-3 (C) to XV4-8 (S2).
- ✓ 9. (✓) Fig. 8. Cut all leads on two 100K Ω (brown, black, yellow, silver) resistors, R33 and R34, to 1/2". Connect R33 from TB6-1 (C) to XV3-1 (S2) and R34 from TB11-1 (C) to XV4-1 (S2).
- ✓ 10. (✓) Fig. 8. Cut all leads on two 220K Ω (red, red, yellow, silver) resistors,

- ✓ R31 and R32, to 3/4". Connect R31 from TB6-1 (S4) to XV3-6 (C) and R32 from TB11-1 (S3) to XV4-6 (C). Dress resistors so that leads do not short against pins 1 or 9 of XV3 and XV4.
- ✓ 11. (✓) Fig. 8. Cut all leads on two .025mfd (25K or 25,000mmf) disc capacitors, C19 and C20, to 1/2". Connect C19 from XV3-6 (S2) to XV3-2 (C) and C20 from XV4-6 (S2) to XV4-2 (C).
- ✓ 12. (✓) Fig. 8. Cut all leads on four 470K Ω (yellow, violet, yellow, silver) resistors, R39, R40, R47 and R48, to 5/8". Connect R39 from XV3-2 (S2) to TB4-3 (S5), R40 from XV4-2 (S2) to TB9-3 (S5), R47 from XV5-2 (S2) to TB13 (C) and R48 from XV5-7 (S2) to TB12-2 (C).
- ✓ 13. (✓) Fig. 8. Cut all leads on two .1mfd (brown, black, yellow, silver, yellow) 400 volts, molded capacitors, C21 and C22, to 3/4". Connect C21 from TB6-3 (S3) to TB4-1 (S3) and C22 from TB11-3 (S3) to TB9-1 (S3).
- ✓ 14. (✓) Fig. 8. On two .1mfd (brown, black, yellow, silver, yellow) 400 volts, molded capacitors, C25 and C26, cut one lead on each capacitor to 1 1/4" and cover with a 1" piece of spaghetti. Cut the other lead on each capacitor to 3/4". Connect the longer lead of C25 to XV5-1 (C) and the shorter lead to TB14-2 (S3). Connect the longer lead of C26 to XV5-6 (C) and the shorter lead to TB12-1 (S3).
15. () Fig. 8. Cut all leads on two 1K Ω (brown, black, red, silver) resistors, R51 and R52, to 1/2". Connect R51 from XV5-3 (C) to TB13 (C), and R52 from XV5-8 (C) to TB12-2 (C).
- ✓ 16. (✓) Fig. 8. Cut all leads on two .015mfd (15K or 15,000mmf) disc capacitors, C23 and C24, to 1/2". Connect C23 from TB13 (S4) to XV5-3 (S2) and C24 from XV5-8 (S2) to TB12-2 (S6).
- ✓ 17. (✓) Fig. 8. Cut both leads on a 100K Ω (brown, black, yellow, silver) resistor, R49, to 1/2". Connect from XV5-1 (S2) to TB14-1 (C).
- ✓ 18. (✓) Fig. 8. Cut both leads on a 100K Ω (brown, black, yellow, silver) resistor, R50, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect from XV5-6 (S2) to TB14-1 (S3).

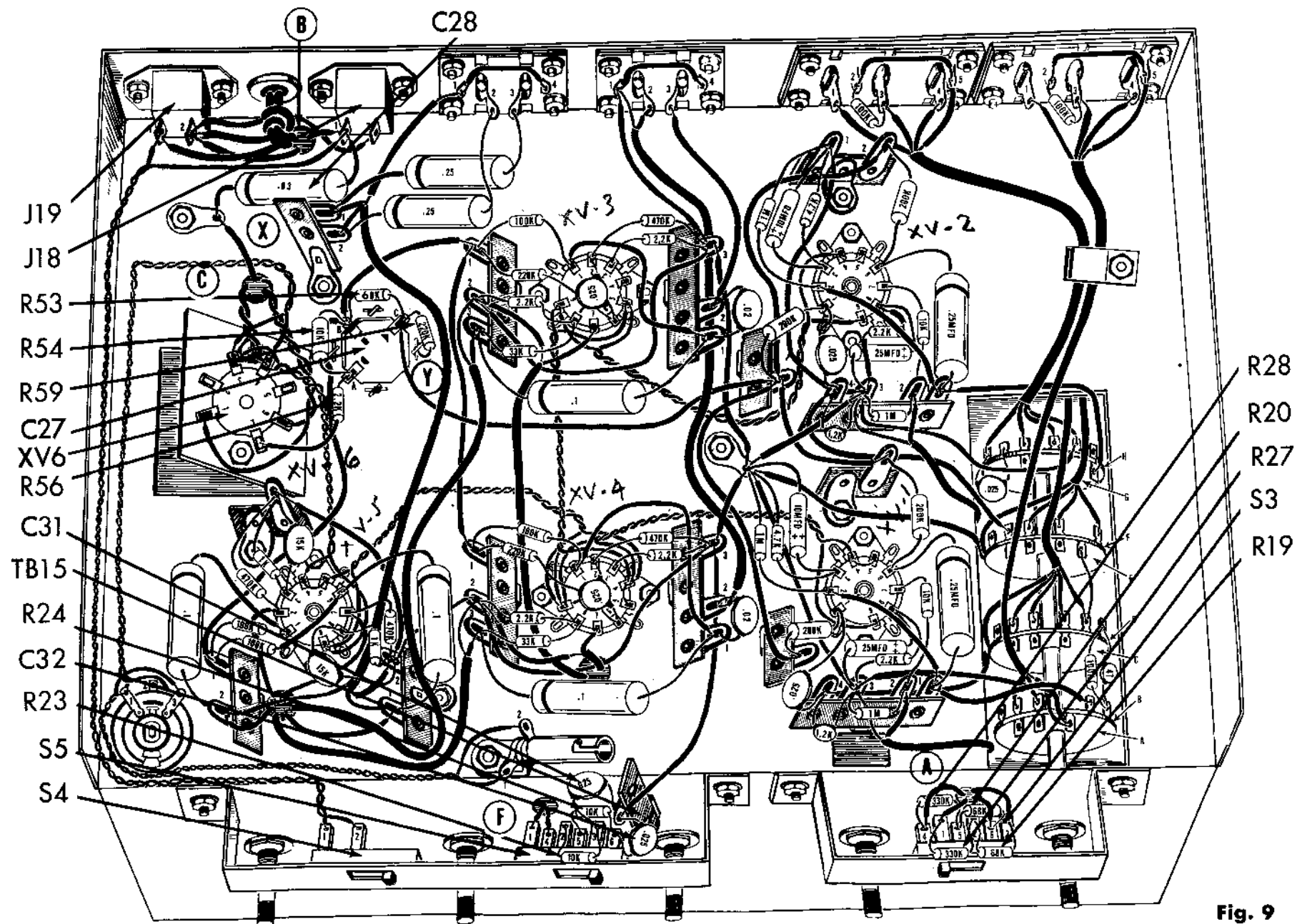


Fig. 9

- ✓ 1. (✓) Fig. 9. On slide switch S3, terminal 1, 2, and 3 are toward the bottom of the chassis (facing the wirer) and 4, 5, and 6 are towards the top of the chassis. From hole "A" in the front of the chassis, connect the violet lead to S3-4 (C), the white lead to S3-6 (C), the blue lead to S3-3 (C) and the green lead to S3-1 (C).
- ✓ 2. (✓) Fig. 9. Cut both leads on two 68K Ω (blue, grey, orange, silver) resistors, R19 and R20, to 1/2". Connect R19 from S3-2 (C) to S3-3 (S2) and R20 from S3-5 (C) to S3-6 (S2).
- ✓ 3. (✓) Fig. 9. Cut both leads on two 330K Ω (orange, orange, yellow, silver) resistors, R27 and R28, to 1/2". Connect R27 from S3-1 (S2) to S3-2 (S2) and R28 from S3-4 (S2) to S3-5 (S2).
- ✓ 4. (✓) Fig. 9. On slide switch S5, terminals 1, 2, and 3 are toward the bottom of the chassis (facing the wirer) and 4, 5, and 6 are towards the top of the chassis. From hole "F", connect one blue wire to S5-1 (S1) and the second blue wire to S5-4 (S1).
- ✓ 5. (✓) Fig. 9. Cut both leads on two 10K Ω (brown, black, orange, silver) resistors, R23 and R24, to 1/2". Connect R23 from S5-2 (S1) to S5-3 (C), and R24 from S5-5 (S1) to S5-6 (C).
- ✓ 6. (✓) Fig. 9. Cut all leads on two .025mfd (25K or 25,000mmf) disc capacitors, C31 and C32, to 1/2". Connect C31 from S5-3 (S2) to TB15 (C) and C32 from S5-6 (S2) to TB15 (S2).
- ✓ 7. (✓) Fig. 9. Cut both leads on a 2.2K Ω (red, red, red, silver) resistor, R56, to 3/4". Cover each lead with a 1/2" piece of spaghetti. Connect from XV6-7 (S1) to C27A (C).
- ✓ 8. (✓) Fig. 9. Cut both leads on a 10K Ω (brown, black, orange, silver) 1 watt resistor, R54, to 1/2". Connect from C27A (S2) to C27B (C).

- ✓ 9. (✓) Fig. 9. Cut both leads on a 68K Ω (blue, grey, orange, silver) resistor, R53, to 1/2". Connect from C27B (S4) to C27C (C).
- ✓ 10. (✓) Fig. 9. Cut both leads on a 220K Ω (red, red, yellow, silver) resistor, R59, to 1/2". Connect from C27C (S2) to ground lug "Y" (S1) at C27.
- ✓ 11. (✓) Fig. 9. Connect a 3" piece of black wire from J18-2 (S1) to J19-2 (C).
- ✓ 12. (✓) Fig. 9. From hole "B", connect one black lead to J18-1 (C) and the second black lead to J19-2 (C).
- ✓ 13. (✓) Fig. 9. Connect one end of a 13" piece of black wire to J18-1 (C) and one end of an 11" piece of grey wire to J19-1 (C). Twist the two leads together and run along the chassis as shown. Connect the grey lead to S4-1 (S1) and the black lead to S4-2 (S1).
- ✓ 14. (✓) Fig. 9. Cut both leads on a .03mfd (orange, black, orange, white, blue) 600 volt, molded capacitor, C28, to 3/4". Cover one lead with a 1/2" piece of spaghetti and connect to J18-1 (S3). Connect the second lead to ground lug "X" (C).
- ✓ 15. (✓) Fig. 9. Connect the red-yellow lead from hole "C" to ground lug "X" (S2).
- ✓ 16. (✓) Fig. 9. Push the line cord through the grommet between the two convenience outlets, J18 and J19. Tie a knot inside the chassis 3" from the end of the cord to be soldered. Connect one lead to J19-2 (S2) and the other lead to J19-1 (S2).

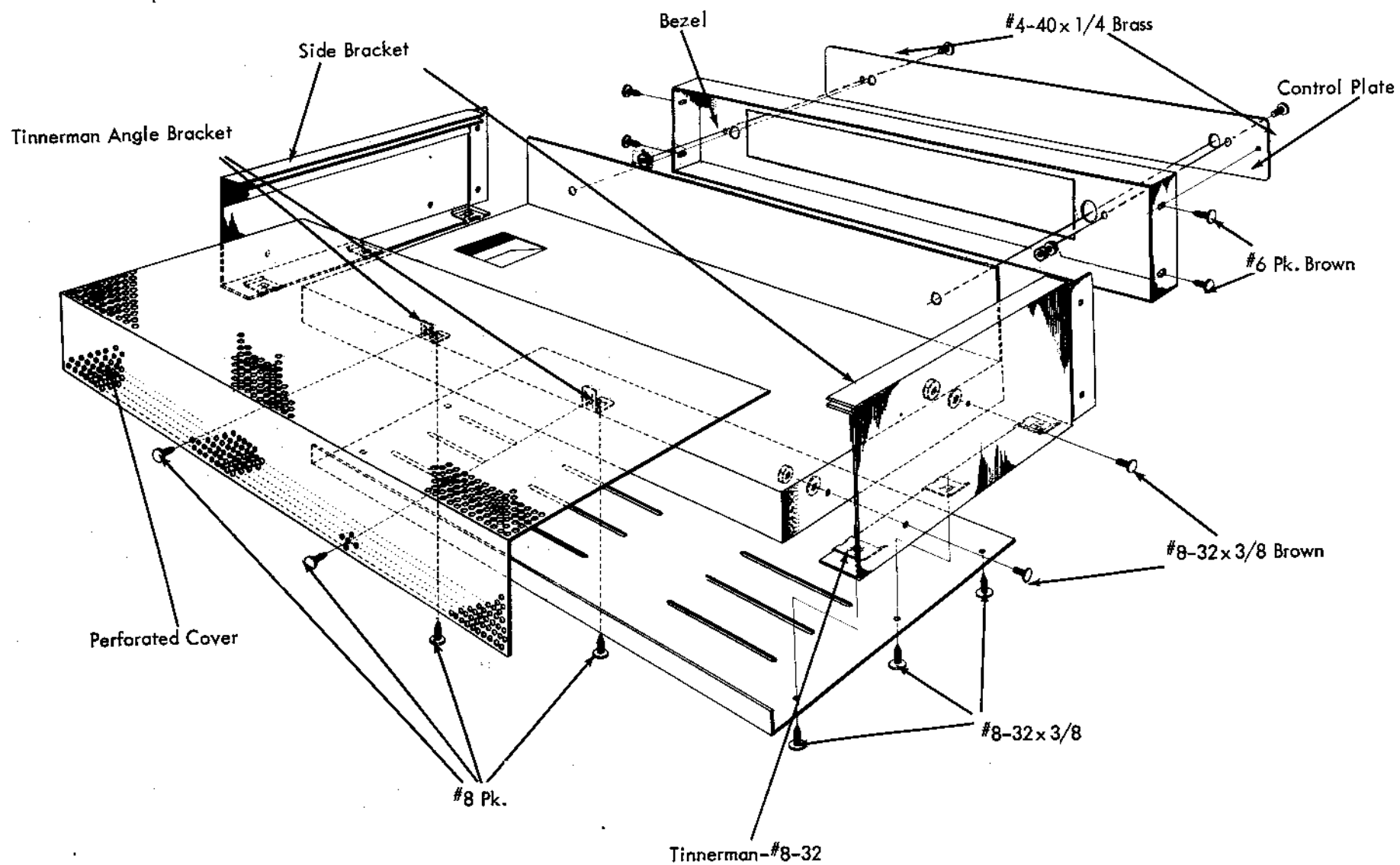


Fig. 10

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 tubes V1 through V6 into their sockets. Be sure to insert the correct tube in each socket. Place a shield over tubes V1 and V2. See tube layout in instruction section. Insert the pilot light, 11, into its socket.

3) If you have a VTVM or VOM, make the following resistance checks before connecting to the a-c line: Check for a cold minimum d-c resistance of 20 ohms across the a-c line plug with the a-c power switch turned on; check for a resistance of at least 450 ohms between ground and pins 1 and 6 of XV6; check for a resistance of at least 100KΩ between pin 7 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. 10. 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. 10. 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.

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

7. () Fig. 10. Install the rubber feet in the openings provided in the bottom plate. The method is to work the rounded portion of each foot into the interior of the cabinet from the outside, using a small screwdriver. The flat surface of the bottom plate is the outside and the surface with the two flanges is the inside. When finally mounted, the flat surface will be seen while the sur-

face with the flanges will be facing the inside of the chassis. The rubber feet are mounted so that when the amplifier sits on a table, the flat portion of the rubber feet will rest on the table.

8. (✓) Fig. 10. Insert the perforated cover into the "rails" on the side pieces and slide it forward fully.

9. () Fig. 10. Mount the control plate on the bezel using two each #4-40 x 1/4 screws, #4 lockwashers and #4 hex nuts to fasten it to the bezel. Note that the narrower portion of the cutout in the bezel is at the top. Press the plastic pilot jewel into place on the control plate.

10. () Fig. 10. 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.

11. () Fig. 10. 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.

12. () Fig. 10. 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 A; MODE knob to AMPL. 1; LEVEL knob at 0, BASS and TREBLE knobs to -5. Note that all clutch controls are at their maximum counter-clockwise position.

13. 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 power amplifiers, phonograph, and tuner to the preamplifier 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 and RESISTANCE chart to discover and remedy the difficulty. As the Trouble Shooting Chart presumes a properly wired preamplifier, which may not be the case, re-check the wiring for errors or reversed connections and continuity.

14. If the preamplifier is to be mounted in a console, read carefully the "Mechanical Installation" section of the instructions and follow the procedures outlined.

15. Detailed information as to connection of phonograph, tuner, etc., to the preamplifier inputs and power amplifier to the preamplifier output, 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 large label supplied and place it on the outside surface of the bottom plate.

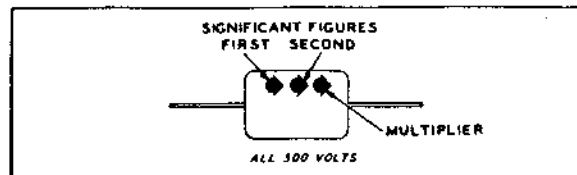
SERVICE

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 \$8.00 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-

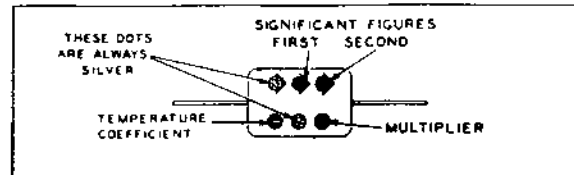
cepted for repair. Instruments that show evidence of acid core solder or paste fluxes will be returned not repaired. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in 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.

CAPACITOR COLOR CODES

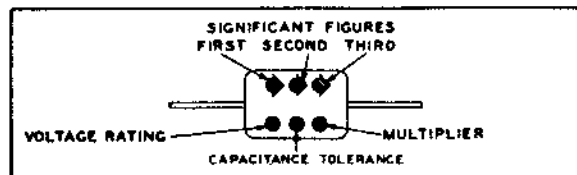
RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



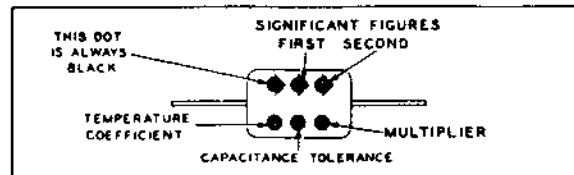
JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



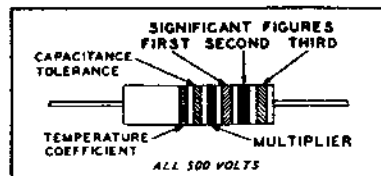
RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



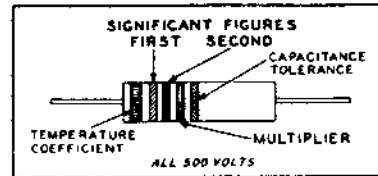
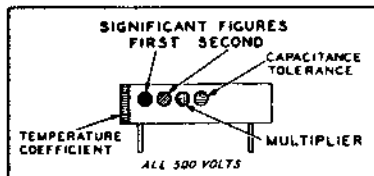
JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS



JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS

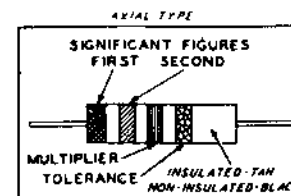


RMA: RADIO MANUFACTURERS ASSOCIATION
JAN: JOINT ARMY-NAVY

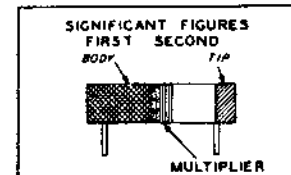
RESISTORS				CAPACITORS				
TOLERANCE	MULTIPLIER	SIGNIFICANT FIGURE	COLOR	MULTIPLIER			VOLTAGE RATING	TEMPERATURE COEFFICIENT
	1	0	BLACK	RMA MICA AND CERAMIC-DIELECTRIC	JAN MICA AND PAPER-DIELECTRIC	JAN CERAMIC DIELECTRIC		A
	10	1	BROWN	1	10	10	100	B
	100	2	RED	10	100	100	200	C
	1000	3	ORANGE	100	1000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

RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS

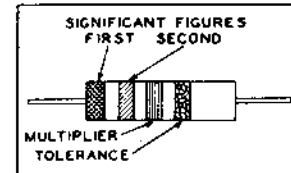


RADIAL TYPE

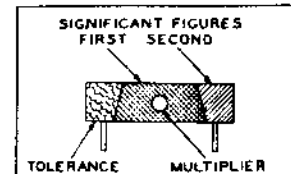


JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS

AXIAL TYPE INSULATED



RADIAL TYPE NON-INSULATED



where you can enjoy a normal volume level and are actually listening. When the situation requires a very soft level, or you are simply providing background music, insertion of loudness compensation (IN position) will eliminate a thin "tinny" sound quality by boosting lower bass tones to a more audible level. The reason we prefer that you limit the use of loudness compensation is that compensation tends to create the impression that you are sitting close to an orchestra that is playing softly. This carries over to what would normally be loud orchestral passages and may therefore be grossly contradictory to the sense of the music. When no compensation is used for soft listening levels, it seems merely that you are sitting at a greater distance from the orchestra, but the sense of the music is not disturbed except for the loss of audibility mainly at the extreme low frequencies. However, many people prefer the pleasure of hearing the full frequency range even at very low listening levels and they will employ loudness compensation more often.

LISTENING TO PHONOGRAPH: Set the SELECTOR switch 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 SELECTOR switch to AUX A or AUX B if you are using a stereophonic crystal cartridge (Ronette) connected to either AUX A or AUX B inputs. To play a stereophonic record, initially set the MODE switch to MONOPHONIC PHONO and balance the two channels as described above in "LEVEL BALANCE BETWEEN CHANNELS". When this is done, set the MODE switch to one of the STEREO PHONIC positions for stereo listening. To play a monophonic record, the procedure is exactly the same, only the MODE switch remains set at the MONOPHONIC PHONO position, providing the identical signal in both channels with mixing

of the inputs for vertical rumble cancellation. If it is desired to listen to the monophonic record on one channel alone, set the MODE switch to the CHECK AMPLIFIER 1 or CHECK AMPLIFIER 2 position depending on which channel is desired. Note that in the latter case there is no mixing of the inputs and vertical rumble is not cancelled. The use of the LOUDNESS switch, and the BASS and TREBLE controls, is described above.

LISTENING TO TAPE DECK (direct connection to tape head): Set the SELECTOR to TAPE. NARTB tape 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 ips tapes and the other for 3 3/4 ips tapes. These equalizations are the industry standard for pre-recorded stereophonic and monophonic tapes. The remainder of the procedure is the same as "Listening to Phonograph" described above.

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

LISTENING TO A STEREO PHONIC SOURCE CONNECTED TO AUXILIARY A1 and A2, AUXILIARY B1 and B2, AM and FM, FM and FM MULTIPLEX: Set the SELECTOR to AUX A, AUX B, AM-FM, or FM-MULTI respectively. Set the MODE switch at STEREO NORMAL or STEREO REVERSE. The LEVEL, 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. Please note that recordings cannot be made on tape decks unless those decks are equipped with the electronics required for recording.

maintenance

Your preamplifier should require little service except for normal tube replacement.

To facilitate servicing, remedial and trouble-shooting procedures have been provided in the TROUBLE SHOOTING CHART that follows. VOLTAGE and RESISTANCE CHARTS are also provided as an aid to locating defective components. On the schematic diagram, AC mid-frequency (1 kc) voltage sensitivities are shown at most of the grids for full 2 volt output in order to permit a careful, stage-by-stage check of the operation.

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 Installation". Set

the SELECTOR switch at PHONO and the MODE switch at STEREO NORMAL or REVERSE. 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. Each channel can be dealt with separately by setting the MODE switch to CHECK AMPLIFIER 1 or 2 as desired.

The cause of phonograph hum may be a metal pick-up arm or motor not grounded to the preamplifier chassis (run these ground leads directly to the preamplifier chassis, not to

the outer braid conductors of the phono input cables), 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 LEVEL controls to maximum (10), the BASS and TREBLE controls to their mid-points (0), the SELECTOR switch to PHONO and the MODE switch to STEREO NORMAL or REVERSE. Use a 1000 cycle sinewave 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 0.004 volt fed into MAG. PHONO from an audio generator output of 0.4 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 resistance and voltage chart. Disconnect the pre-amplifier from the power line and discharge capacitors prior to making any resistance check.

SERVICE

If trouble develops in your instrument which you can not remedy yourself, write to our service department listing all possible indications that might be helpful. If desired you may return the instrument to our factory where it will be placed in operating condition for \$8.00 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.

MODEL HF-85 SPECIAL NOTE

The high gain of the Model HF-85 low level inputs (MIC, MAG. PHONO, TAPE HEAD) requires that shorted RCA-type phono plugs be inserted into all unused low level input jacks. A number of RCA-type phono plugs are supplied with every unit, and it remains only to short out each of the plugs required for this use.

VOLTAGE AND RESISTANCE CHART

TUBE	PIN#	OPERATING VOLTS (DC UNLESS NOTED)	SIGNAL VOLTS (1 kc) at 3V OUT	OHMS (UNIT DISCONNECTED FROM POWER)
V1 (ECC83/12AX7)	✓ 1	87 - 100	.44	280KΩ
	✓ 2	0	.046	1MΩ
	✓ 3	1.2	0	4.7KΩ
	4&5	fil. (0VDC; 6.3VAC to pin 9)		
	✓ 6	72 - 50	.046	280KΩ
	✓ 7	0	.004	91KΩ
	✓ 8	0.75	0	2.2KΩ
	9	fil.		
V2 (ECC83/12AX7)	✓ 1	87 - 100	.082	280KΩ
	✓ 2	0	.026	1MΩ
	✓ 3	1.2	0	4.7KΩ
	✓ 4&5	fil. (0VDC; 6.3VAC to pin 9)		
	✓ 6	72 - 50	.026	280KΩ
	✓ 7	0	-	91KΩ
	✓ 8	0.75	0	2.2KΩ
	9	fil.		
V3, V4 (both ECC83/12AX7)	✓ 1	180 - 190 - 195	4	112KΩ
	✓ 2	0	0.6	470KΩ
	✓ 3	1.5	0.4	2.2KΩ
	4&5	fil. (0VDC; 6.3VAC to pin 9)		-
	✓ 6	140 - 145 - 155	0.6	232KΩ
	✓ 7	0 V-3 V-4	0.24	225KΩ
	✓ 8	1.15 1.18 1.23 V-2	0.24	2.2KΩ
	✓ 9	fil.		
V5 (ECC83/12AX7)	1	140 - 155	3	112KΩ
	2	0.4 - .1	0.16	260KΩ
	3	1.25 1.28	0.075	1KΩ
	4&5	fil. (0VDC; 6.3VAC to pin 9)		
	6	140 - 155	3	112KΩ
	7	0.4 - .1	0.16	260KΩ
	8	1.25 - 1.26	0.075	1KΩ
	9	filament		
V6 6X4	✓ 1	275VAC *		500Ω
	2			-
	3&4	fil. (0VDC; 6.3VAC between pins 3&4)		-
	5			-
	✓ 6	275VAC *		500Ω
	✓ 7	340		over 100KΩ

* = 60 cycles

All resistance measurements, except from pin 7 of V6 (6X4 rectifier) are made with pin 7 of V6 grounded. All voltage and resistance measurements are measured to chassis with controls set as follows: SELECTOR Switch to PHONO, MODE switch to MONOPHONIC PHONO, LEVEL 1 & 2 controls both at 10, LOUDNESS switch to OUT, BASS 1 & 2 and TREBLE 1 & 2 controls all at 0. Note that at the MONOPHONIC PHONO position there is a loss of sensitivity from that at the other positions of the MODE switch due to losses in the mixing network inserted at this position. This accounts for the apparent sensitivity in the chart of .004v (4mv) in at 1kc for 3v out at the PHONO position, instead of .0015 (1.5mv) for 3v out on phono that can be expected at the other MODE positions. For voltage measurements as they appear in this chart, feed 0.004 volt (4mv) 1kc signal into the MAG. PHONO 1 input only, shorting out the MAG. PHONO 2 input. Voltage measurements are made with a VTVM. Operating line voltage at which voltage measurements are made is 117VAC, 60cps. NOTE: ALL VOLTAGE & RESISTANCE VALUES MAY NORMALLY BY ±15%.

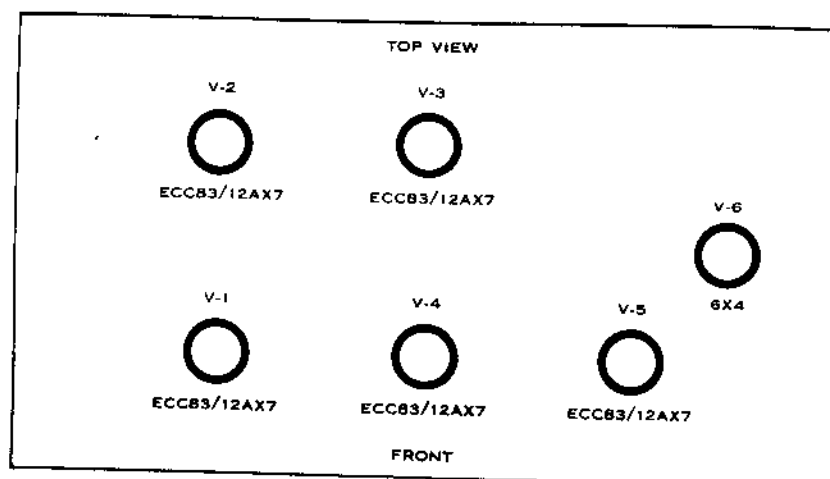
TROUBLE-SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
Preamplifier causes power line fuse to blow.	Line cord, J18, J19, primary or high voltage secondary windings of T1 incorrectly wired.	Repair
	Pri./h.v. sec. windings of T1 shorted.	Replace
Any tube filament not lit.	Open lead from 6.3V winding of T1.	Repair
	6.3V winding of T1 open.	Replace
DC voltage at V6 cathode (pin 7) is incorrect as specified below.		
a) No voltage.	Defective V6 C27A shorted internally or externally. Open R58 Connection to center-tap of high voltage winding of T1 is open.	Replace Replace (or repair) Replace Repair
b) Low voltage.	C27A O. K. but C27B or C shorted. C27 open or no connection. Excessive current drain in amplifier	Replace Replace (or repair) Repair
c) High voltage.	Tubes V1-V4 defective or over-biased and not drawing normal current.	Repair (or replace)
	Open R53 or R54.	Replace

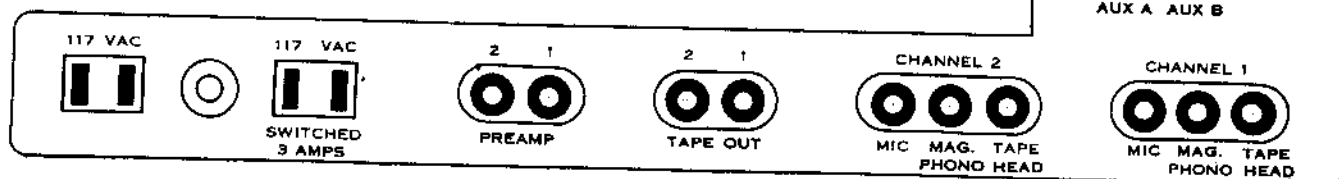
INPUT SELECTOR SWITCH S1	SECTION	AUX A	AUX B	AM-FM	FM-MULTI	MIC	PHONO	TAPE
	A	7-8-9-10	7-8-9-10	7-8-9-10	7-8-9-10	8-9-10	7-9-10	7-8-10
	B	3-11 5-8	9-11	11-12		5-7 11-12	5-8 3-11	5-9 4-11
	C	1-2-6-7-9- 10-11-12	1-2-6-7-8- 10-11-12	1-2-6-7-8- 9-12	1-2-6-7-8- 9-10-12	1-2-6- 8-9-10-11	2-6-8- 9-10-11-12	1-6-8-9-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

MODE 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.

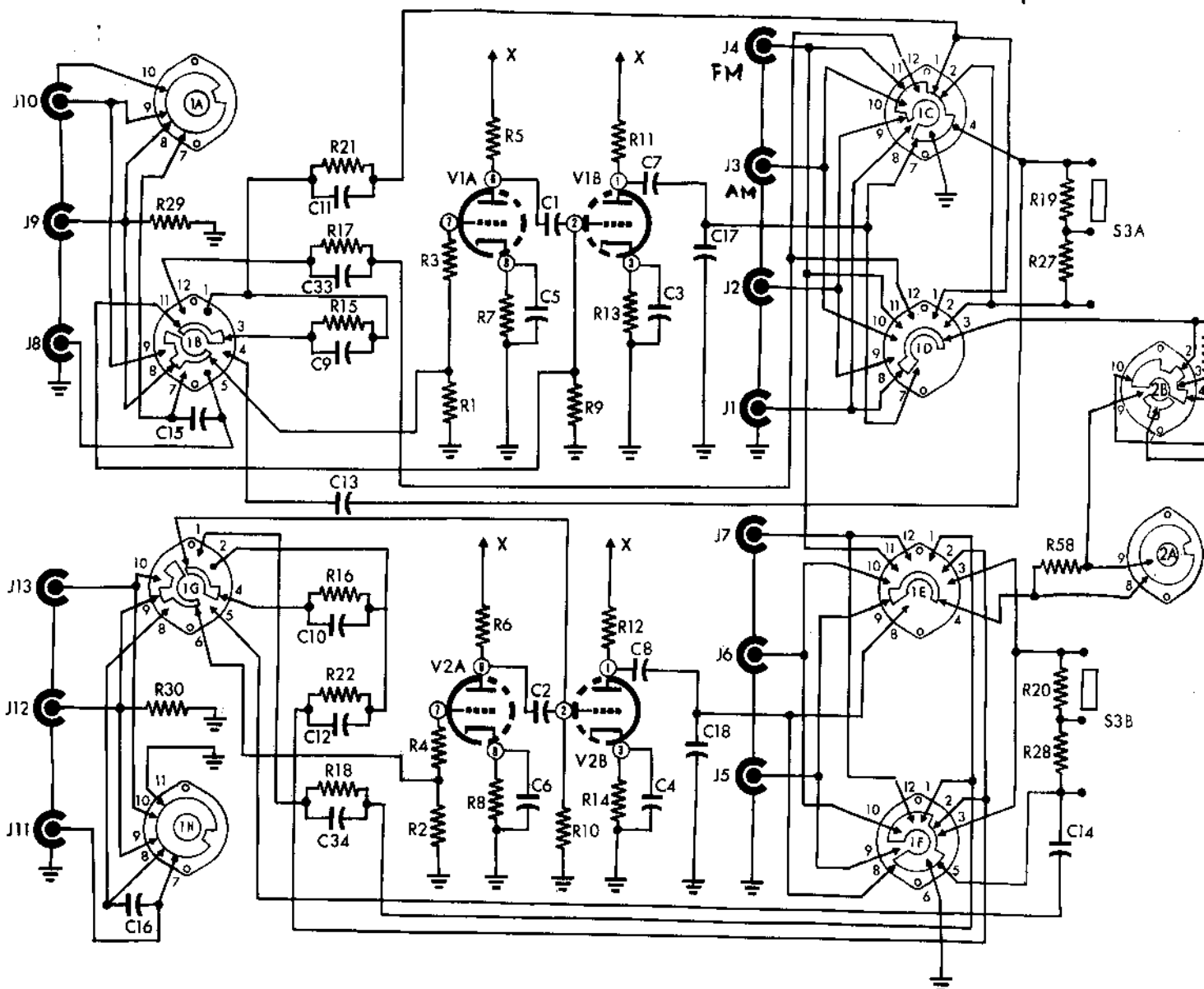


EICO
MODEL HF-85
STEREOPHONIC PREAMPLIFIER
OPERATES FROM 117V 60 CYCLE AC LINE
POWER CONSUMPTION: 20 WATTS
ELECTRONIC INSTRUMENT CO., INC.
33-00 NORTHERN BLVD., L.I. CITY 1, N. Y.



REPLACEMENT PARTS LIST

Stock #	Symbol	Description	Am't.	Stock #	Symbol	Description	Am't.
✓ 20050	C1, 2, 35, 36	cap., paper, .25mfd - 200V	4 ✓	✓ 97712	X11	pilot light assembly	1 ✓
✓ 23014	C3, 4	cap., elec., 10mfd - 6V	2 ✓	✓ 97027	XV1, 2	socket, 9 pin min. w/shield	2 ✓
✓ 23020	C5, 6	cap., elec., 25mfd - 6V	2 ✓	✓ 97025	XV3, 4, 5	socket, 9 pin min.	3 ✓
✓ 22517	C7, 8, 15, 16	cap., disc., .025mfd, GMV (25K or 25,000)	8 ✓	✓ 97024	XV6	socket, 7 pin	1 ✓
	19, 20, 31, 32			40000		nut, hex, #6-32	59
✓ 22514	C9, 10	cap., disc., .850mfd, ±10%	2 ✓	40001		nut, hex, 3/8-32	6
✓ 22518	C11, 12	cap., disc., .0027mfd, ±10% (2.7K or 2700)	2 ✓	40007		nut, hex, #4-40	14
✓ 22550	C13, 14	cap., disc., 600mfd, ±10%	2 ✓	40008		nut, hex, #8-32	5
✓ 22520	C17, 18	cap., disc., .0012mfd, ±10% (1.2K or 1200)	2 ✓	40026		nut, tinnerman, #8-32	6
✓ 20039	C21, 22, 25, 26	cap., molded, .1mfd, - 400V	4 ✓	40027		nut, tinnerman, bracket	2
✓ 22547	C23, 24	cap., disc., .015mfd, ±20% (15K or 15,000)	2 ✓	41000		screw, #6-32 x 1/4	60
✓ 22533	C27	cap., elec., 20 - 40 - 40mfd, 400 - 350 - 350V	1 ✓	41003		screw, #8-32 x 3/8	6
✓ 20043	C28	cap., molded, .03mfd - 600V	1 ✓	41016		screw, #4-40 x 1/4	14
✓ 22506	C29, 30	cap., disc., .02mfd, ±20% (20K or 20,000)	2 ✓	41027		screw, #4 wood	2
✓ 22533	C33, 34	cap., disc., 47mfd, ±10%	2 ✓	41028		screw, #8-32 x 1	2
✓ 92000	I1	pilot lite	1 ✓	41045		screw, #6 P.K., brown	4
✓ 50020	J1-2, 3-4	jack, input, quadruple	1 ✓	41046		screw, #8-32 x 3/8 brown	4
✓ 50018	J5-6-7, 8-	jack, input, triple	3 ✓	41047		screw, #8 P.K.	4
	9-10, 11-12-13			42000		washer, lock, 3/8	6
✓ 50011	J14-15, 16-17	jack, input, dual	2 ✓	42002		washer, lock, #6	58
✓ 50016	J18, 19	outlet, convenience	2 ✓	42007		washer, lock, #4	14
✓ 29571	PC1, 2	printed circuit	2 ✓	42008		washer, lock, #8	5
✓ 10407	R1, 2, 9, 10	res., 1MΩ, 1/2W, ±10% (brown, black, green, silver)	4 ✓	42032		washer, flat metal #8, 7/16 O.D.	2
✓ 10400	R3, 4, 23, 24	res., 10KΩ, 1/2W, ±10% (brown, black, orange, silver)	4 ✓	43000		lug, #6	2
✓ 11526	R5, 6, 11, 12	res., 200KΩ, 1/2W, ± 5% (red, black, yellow, gold)	4 ✓	43001		pot ground lug, 3/8	1
✓ 10423	R7, 8, 35, 36	res., 2.2KΩ, 1/2W, ±10% (red, red, red, silver)	7 ✓	✓ 46000		grammet, 3/8	1
	41, 42, 56			✓ 46006		bumpers, rubber	4
✓ 10430	R13, 14	res., 4.7KΩ, 1/2W, ±10% (yellow, violet, red, silver)	2 ✓	✓ 50012		insulator dual	2
✓ 11504	R15, 16	res., 90KΩ, 1/2W, ± 5% (white, black, yellow, gold)	2 ✓	✓ 50019		insulator triple	3
✓ 10410	R17, 18, 29,	res., 100KΩ, 1/2W, ±10% (brown, black, yellow, silver)	8 ✓	✓ 50021		insulator quadruple	1
	30, 33, 34, 49, 50			✓ 51006		plugs, RCA	17
✓ 10422	R19, 20, 53	res., 68KΩ, 1/2W, ±10% (blue, grey, orange, silver)	3 ✓	✓ 53016		knob, outer concentric	3
✓ 10434	R21, 22	res., 2.2MΩ, 1/2W, ±10% (red, red, green, silver)	2 ✓	✓ 53018		knob, dual	2
✓ 18053	R25, 26	pot., dual 500KΩ, and 50K tap	1 ✓	✓ 53022		knob, inner concentric with screw	3
✓ 10412	R27, 28	res., 330KΩ, 1/2W, ±10% (orange, orange, yellow, silver)	2 ✓	✓ 57000		line cord	1
✓ 10417	R31, 32, 59	res., 220KΩ, 1/2W, ±10% (red, red, yellow, silver)	3 ✓	✓ 58004		wire, hook-up	length
✓ 10426	R37, 38	res., 33KΩ, 1/2W, ±10% (orange, orange, orange, silver)	2 ✓	✓ 58300		spaghetti, small diam.	length
✓ 10431	R39, 40, 47, 48	res., 470KΩ, 1/2W, ±10% (yellow, violet, yellow, silver)	4 ✓	✓ 58303		spaghetti, large diam.	length
✓ 18054	R43, 44	pot., dual, 1MΩ, linear	1 ✓	✓ 58408		wire, single conductor	length
✓ 18052	R45, 46	pot., dual, 500KΩ, linear	1 ✓	✓ 58410		wire, four conductor	length
✓ 10432	R51, 52	res., 1KΩ, 1/2W, ±10% (brown, black, red, silver)	2 ✓	✓ 58412		wire, three conductor	length
✓ 10853	R54	res., 10KΩ, 1W, ±10% (brown, black, orange, silver)	1 ✓	✓ 58413		wire, two conductor	length
✓ 19009	R55	pot., 100Ω, w.w.	1 ✓	✓ 58501		wire, bare	length
✓ 10421	R57, 58	res., 6.8KΩ, 1/2W, ±10% (blue, grey, red, silver)	2 ✓	✓ 80062		panel	1
✓ 60057	S1	switch, input selector	1 ✓	✓ 81092		bottom plate	1
✓ 60065	S2	switch, mode selector tor	1 ✓	✓ 81103		bracket, left	1
✓ 62000	S3, S5	switch, slide, DPDT - .5A AC-DC	2 ✓	✓ 81104		bracket, right	1
✓ 62001	S4	switch, slide, SPST - 4A AC.	1 ✓	✓ 81132		bezel	1
✓ 30027	T1	transformer, power	1 ✓	✓ 81151		chassis	1
✓ 54003	TB1, 12, 14	terminal strip, 2 post	3 ✓	✓ 81152		bracket, input	1
✓ 54000	TB2, 8, 15	terminal strip, 1 post left	3 ✓	✓ 81153		perforated screen	1
✓ 54008	TB3, 7	terminal strip, 4 post	2 ✓	✓ 81171		switch bracket, single	1
✓ 54014	TB4, 9	terminal strip, 3 post, 2 left	2 ✓	✓ 81172		switch bracket, dual	1
✓ 54001	TB5, 13	terminal strip, 1 post right	2 ✓	✓ 81903		cable clamp	2
✓ 54006	TB6, 11	terminal strip, 3 post, 2 right	2 ✓	✓ 89220		label, rear	1
✓ 54010	TB10	terminal strip, 2 post upright	1 ✓	✓ 97300		tube shield	2
✓ 54019	TB16	terminal strip, 2 post right	1 ✓	✓ 97710		jewel	1
✓ 90034	V1, 2, 3, 4, 5	tube, 12AX7	5 ✓	✓ 66321		manual of instruction (wired)	1
✓ 90036	V6	tube, 6X4	1 ✓	✓ 66320		manual of instruction (kit)	1



Sym. Description

C1	cap., paper, .25mfd-200V
C2	cap., paper, .25mfd-200V
C3	cap., elec., 10mfd-6V
C4	cap., elec., 10mfd-6V
C5	cap., elec., 25mfd-6V
C6	cap., elec., 25mfd-6V
C7	cap., disc., .025mfd, GMV
C8	cap., disc., .025mfd, GMV
C9	cap., disc., .850mmf, ±10%
C10	cap., disc., .850mmf, ±10%
C11	cap., disc., .0027mfd, ±10%
C12	cap., disc., .0027mfd, ±10%
C13	cap., disc., .600mmf, ±10%
C14	cap., disc., .600mmf, ±10%
C15	cap., disc., .025mfd, GMV
C16	cap., disc., .025mfd, GMV
C17	cap., disc., .0012mfd, ±10%
C18	cap., disc., .0012mfd, ±10%
C19	cap., disc., .025mfd, GMV
C20	cap., disc., .025mfd, GMV
C21	cap., molded, 1mfd-400V
C22	cap., molded, 1mfd-400V
C23	cap., disc., .015mfd, ±20%
C24	cap., disc., .015mfd, ±20%
C25	cap., molded, 1mfd-400V
C26	cap., molded, 1mfd-400V

Sym. Description

C27	cap., elec., 20-40-40mfd at 400-350-350V
C28	cap., molded, .03mfd-600V
C29	cap., disc., .02mfd, ±20%
C30	cap., disc., .02mfd, ±20%
C31	cap., disc., .025mfd, GMV
C32	cap., disc., .025mfd, GMV
C33	cap., disc., .47mmf, ±10%
C34	cap., disc., .47mmf, ±10%
C35	cap., paper, .25mfd-200V
C36	cap., paper, .25mfd-200V
J1	input, AUX A-1
J2	input, AUX B-1
J3	input, FM
J4	input, FM
J5	input, AUX A-2
J6	input, AUX B-2
J7	input, MULTI
J8	input, MIC-1
J9	input, MAG. PHONO-1
J10	input, TAPE HEAD-1
J11	input, MIC-2
J12	input, MAG. PHONO-2
J13	input, TAPE HEAD-2
J14	output, TAPE OUT-2

Sym. Description

J15	output, TAPE OUT-1
J16	output, PREAMP-2
J17	output, PREAMP-1
J18	outlet, convenience
J19	outlet, convenience
PC1	printed circuit
PC2	printed circuit
R1	res., 1MΩ, 1/2W, ±10%
R2	res., 1MΩ, 1/2W, ±10%
R3	res., 10KΩ, 1/2W, ±10%
R4	res., 10KΩ, 1/2W, ±10%
R5	res., 200KΩ, 1/2W, ±5%
R6	res., 200KΩ, 1/2W, ±5%
R7	res., 2.2KΩ, 1/2W, ±10%
R8	res., 2.2KΩ, 1/2W, ±10%
R9	res., 1MΩ, 1/2W, ±10%
R10	res., 1MΩ, 1/2W, ±10%
R11	res., 200KΩ, 1/2W, ±5%
R12	res., 200KΩ, 1/2W, ±5%
R13	res., 4.7KΩ, 1/2W, ±10%
R14	res., 4.7KΩ, 1/2W, ±10%
R15	res., 90KΩ, 1/2W, ±5%
R16	res., 90KΩ, 1/2W, ±5%
R17	res., 100KΩ, 1/2W, ±10%
R18	res., 100KΩ, 1/2W, ±10%
R19	res., 68KΩ, 1/2W, ±10%

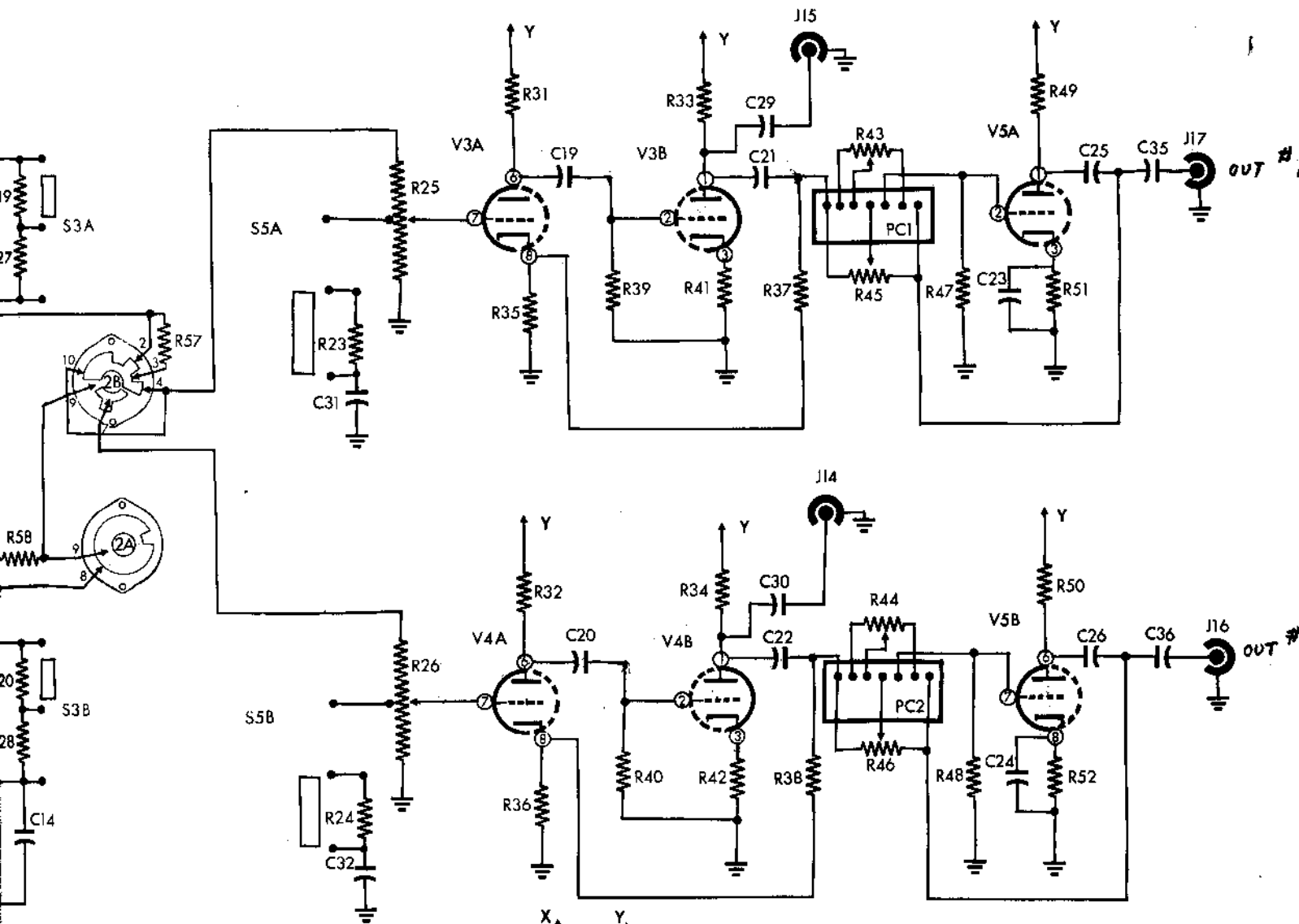
Sym. Description

R20	res., 68KΩ, 1/2W, ±10%
R21	res., 2.2MΩ, 1/2W, ±10%
R22	res., 2.2MΩ, 1/2W, ±10%
R23	res., 10KΩ, 1/2W, ±10%
R24	res., 10KΩ, 1/2W, ±10%
R25	pot., 500KΩ and 50KΩ tap dual
R26	pot., 500KΩ and 50KΩ tap dual
R27	res., 330KΩ, 1/2W, ±10%
R28	res., 330KΩ, 1/2W, ±10%
R29	res., 100KΩ, 1/2W, ±10%
R30	res., 100KΩ, 1/2W, ±10%
R31	res., 220KΩ, 1/2W, ±10%
R32	res., 220KΩ, 1/2W, ±10%
R33	res., 100KΩ, 1/2W, ±10%
R34	res., 100KΩ, 1/2W, ±10%
R35	res., 2.2KΩ, 1/2W, ±10%
R36	res., 2.2KΩ, 1/2W, ±10%
R37	res., 33KΩ, 1/2W, ±10%
R38	res., 33KΩ, 1/2W, ±10%
R39	res., 470KΩ, 1/2W, ±10%
R40	res., 470KΩ, 1/2W, ±10%
R41	res., 2.2KΩ, 1/2W, ±10%
R42	res., 2.2KΩ, 1/2W, ±10%
R43	pot., 1MΩ, linear
R44	pot., 1MΩ, linear
R45	pot., 500KΩ, linear

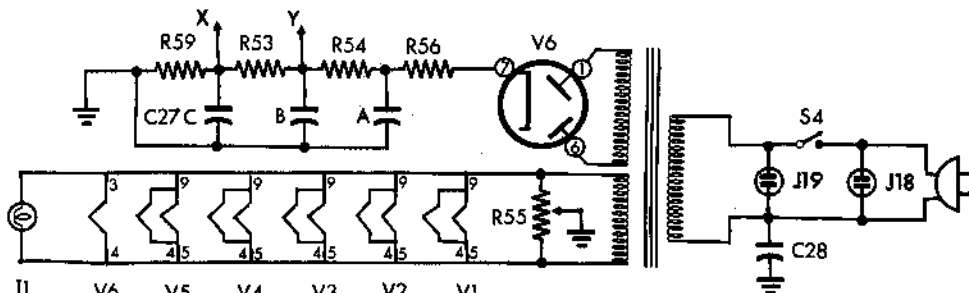
E/C

MODEL HF-85

STEREOPHONIC



Description	Sym.	Description
68K Ω , 1/2W, $\pm 10\%$	R46	pot., 500K Ω , linear
2.2M Ω , 1/2W, $\pm 10\%$	R47	res., 470K Ω , 1/2W, $\pm 10\%$
2.2M Ω , 1/2W, $\pm 10\%$	R48	res., 470K Ω , 1/2W, $\pm 10\%$
10K Ω , 1/2W, $\pm 10\%$	R49	res., 100K Ω , 1/2W, $\pm 10\%$
10K Ω , 1/2W, $\pm 10\%$	R50	res., 100K Ω , 1/2W, $\pm 10\%$
500K Ω and 50K Ω tap dual	R51	res., 1K Ω , 1/2W, $\pm 10\%$
500K Ω and 50K Ω tap dual	R52	res., 1K Ω , 1/2W, $\pm 10\%$
330K Ω , 1/2W, $\pm 10\%$	R53	res., 68K Ω , 1/2W, $\pm 10\%$
330K Ω , 1/2W, $\pm 10\%$	R54	res., 10K Ω , 1W, $\pm 10\%$
100K Ω , 1/2W, $\pm 10\%$	R55	pot., 100 Ω
100K Ω , 1/2W, $\pm 10\%$	R56	res., 2.2K Ω , 1/2W, $\pm 10\%$
220K Ω , 1/2W, $\pm 10\%$	R57	res., 6.8K Ω , 1/2W, $\pm 10\%$
220K Ω , 1/2W, $\pm 10\%$	R58	res., 6.8K Ω , 1/2W, $\pm 10\%$
100K Ω , 1/2W, $\pm 10\%$	R59	res., 220K Ω , 1/2W, $\pm 10\%$
100K Ω , 1/2W, $\pm 10\%$	S1	switch, input selector
2.2K Ω , 1/2W, $\pm 10\%$	S2	switch, mode
2.2K Ω , 1/2W, $\pm 10\%$	S3	switch, slide, DPDT
33K Ω , 1/2W, $\pm 10\%$	S4	switch, slide, SPST
33K Ω , 1/2W, $\pm 10\%$	S5	switch, slide, DPDT
470K Ω , 1/2W, $\pm 10\%$	T1	transformer, power
470K Ω , 1/2W, $\pm 10\%$	V1	tube, 12AX7
2.2K Ω , 1/2W, $\pm 10\%$	V2	tube, 12AX7
2.2K Ω , 1/2W, $\pm 10\%$	V3	tube, 12AX7
1M Ω , linear	V4	tube, 12AX7
1M Ω , linear	V5	tube, 12AX7
500K Ω , linear	V6	tube, 6X4



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PHONIC PREAMPLIFIER