
INSTRUCTION MANUAL

BILOO

ST 70

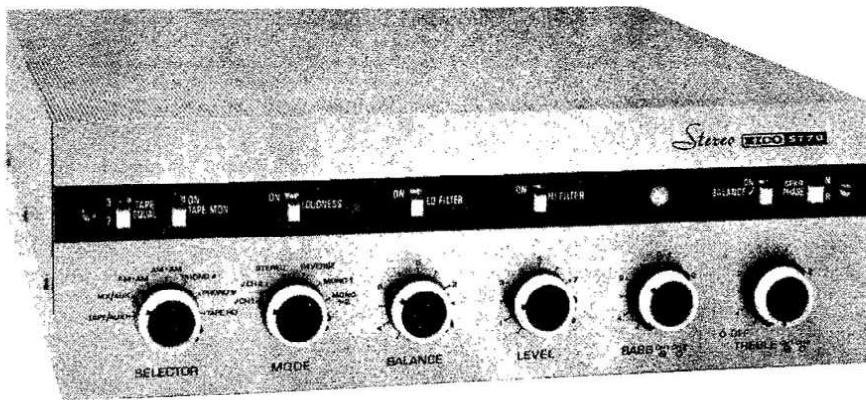
**70 WATT INTEGRATED
STEREO AMPLIFIER**

ST 70-1

EICO

131-01 39th Ave., Flushing, N. Y. 11352

70 WATT INTEGRATED STEREO AMPLIFIER



GENERAL DESCRIPTION

The EICO Model ST-70 is a complete high fidelity stereophonic control center and a pair of 35-watt amplifiers, all on one chassis. With it, you can select, preamplify, and control any stereophonic or monophonic source and feed it through the self-contained dual 35 watt amplifiers to a stereo pair of speaker systems. Provision is made for operating a center speaker directly from the ST-70.

FEATURES

1. Provision for two stereo phono cartridges to be connected. Permits the use of both a turntable and a record changer in the installation. One pair presents 47K Ω load and the other pair 100K Ω load, to cover most popular cartridges. RIAA equalization.
2. Provision for connecting stereo tape heads. Either NARTB equalization for 7 1/2 ips, or standard equalization for 3 3/4 ips can be selected on the front panel.
3. High level input pairs for multiplex adaptor, preamplified and equalized tape, FM tuner, and AM tuner.
4. Separate level and balance controls. Null-type balance checking circuit.
5. Switched high and low frequency filter circuits permit elimination of rumble or scratch.
6. Switched loudness compensation.
7. Tape monitor switch.
8. Speaker phase selector switch.
9. Feedback equalization, with feedback around both preamplifier stages. High overload point.
10. Bass and treble tone controls are of the variable inflection point, feedback type, for exceptionally low distortion and the most desirable control characteristics. These controls do not affect the volume or interact with each other, and boost or cut at the extremes of the audio range do not affect the mid-range.
11. Separate filament windings and hum balance controls for each channel permit an optimum hum balance for each channel, rather than a compromise for both channels.
12. Unused inputs grounded by SELECTOR switch to eliminate cross-talk — except for TAPE inputs, since some tape machines are adversely affected if playback outputs are grounded during recording.
13. Provision for feeding a center speaker directly from the ST-70.
14. Power amplifier circuit incorporates a triode voltage amplifier direct-coupled to a dual triode cathode-coupled phase inverter.
15. 7591 output pentodes, conservatively operated in push-pull output stages with fixed bias. DC balance controls, and controls for adjusting the fixed bias are provided.

SPECIFICATIONS

POWER OUTPUT: 70 watts total; 35 watts each channel continuous sine wave power

IM DISTORTION (60 & 7000 CPS at 4:1): 1% at 35W each channel

HARMONIC DISTORTION: Less than 1% 25-20,000 cps within 1db of 35 watts each channel

FREQUENCY RESPONSE: ± 0.5 db 18-43,000 cps at 35 watts each channel, ± 1 db 9-60,000 cps at 1 watt each channel

<u>INPUT</u>	<u>SENSITIVITY</u>	<u>INPUT IMPEDANCE</u>
Phono A	4Mv	100K Ω
Phono B	4Mv	47K Ω
Tape Head 3 3/4	1.4Mv	1M Ω
Tape Head 7 1/2	2.15Mv	1M Ω
FM	480Mv	500K Ω
AM	480Mv	500K Ω
Multiplex	480Mv	500K Ω
Tape	480Mv	500K Ω

TONE CONTROL RANGE: ± 15 db at 50 cps and 10kc

DAMPING FACTOR: above 6

SPEAKER CONNECTIONS: 4, 8, 16 Ω

TAPE OUTPUT IMPEDANCE: 400 Ω at 20kc when using low level inputs; same as the output impedance of the source when using high level inputs

TUBES: 3-12AX7, 2-12DW7, 2-6SN7GTB, 4-7591, 1-GZ34 rectifier

POWER SOURCE: 117V, 60 cps

POWER CONSUMPTION: 125 watts

CONVENIENCE OUTLETS: 1 controlled by power switch, 1 not switched

FUSE: 3 amperes

SIZE (HWD): 5 1/8" x 15 7/8" x 15"

WEIGHT: 40 lbs.

CABINET INSTALLATION**GENERAL**

1. Mount horizontally on a well-braced shelf. The stock thickness of the wood panel may not exceed 3/4".
2. Do not remove feet for mounting. Air must be allowed to enter through the perforations in the bottom plate to avoid overheating.
3. Any shelf above the unit must be spaced away at least 3 inches. Allow at least a 1 1/2" clearance on each side of the unit.
4. Leave the back of the cabinet entirely open.

PREPARATION OF UNIT

1. Turn unit over and loosen the front and rear pairs of screws (4 in all) that fasten the bottom plate to the side pieces. Remove the center pair entirely. Then turn the unit back right side up.
2. Remove the 6 screws, one on each side, that fasten the cover to the side pieces. Remove the cover and set aside.
3. On the top side of the chassis, loosen all 6 screws (3 on each side) that fasten the chassis to the side pieces.
4. Push both side pieces back as far as they will go. The screws that have been loosened will move from the front to the rear ends of the slots in the chassis and the bottom plate. Then re-tighten all the screws that have been loosened. Check to see that all the tubes are properly seated in their sockets, and then replace and re-fasten the cover to the side extrusions.
5. Remove all the knobs from the control shafts, and then remove the 4 screws, (2 previously concealed by knobs and 2 in the recessed area) that fasten the panel to the chassis. Lift the panel out over the control shafts and set it aside. The unit is now prepared for cabinet installation.

PREPARATION OF CABINET

1. Two templates are provided, one for the cabinet shelf and the other for the cabinet panel. The shelf template is used to locate exactly two holes that are to be drilled in the shelf. The panel template is used to locate exactly the required rectangular cut-out. The two templates must be used together as indicated, as there is an exact relationship between the locations of the shelf holes and panel cut-out.

2. To use the shelf template, cut it or fold it back exactly along the dashed line that corresponds to the panel thickness. Remove the shelf from the cabinet and line up this dashed line on the template with the front edge of the shelf, positioning it also along the edge to leave at least 1 1/2" clearance on each side. Tape the template in position and use a center punch to mark the centers of the two holes to be drilled. If the shelf can not be removed, place the template in a similar manner on the top side of the shelf if there is room to drill from the top side, or on the under side of shelf if there is only room to drill from the under side. If the template is used on the underside of the shelf, mark the rear edge of the shelf at the points where the extended heavy lines on the template hit the rear shelf edge. After the holes are center-punched, remove the template and drill carefully through the punched centers to a diameter of 1/4". If the shelf has been removed for the drilling operation, now re-mount it. Finally, replace the shelf-template in exactly its former position on the top-side of the shelf and tape it down. If the shelf template had been used on the underside of a stationary shelf, now place it on the top-side of the shelf using the marks on the rear edge of the shelf previously made. (In the latter case, accuracy may be improved by cutting the two holes out of the shelf-template with a razor blade and then lining up the holes in the shelf template with the holes in the shelf).

3. To use the panel template, cut it or fold it back exactly along the dashed line. This dashed line corresponds to the junction of the top side of the cabinet shelf and the interior side of the wood panel. Position the panel template against the interior side of the wood panel so that the dashed line rests against the shelf and the two heavy vertical lines in the panel template meet with the two heavy horizontal lines in the shelf templates. Tape the panel template down and use a center-punch to make the centers of the four 3/8" holes in the four corners of the rectangular cut-out shown on the template. Now remove both templates and drill carefully through each of the four punched centers to a

hole diameter of 3/8". On the front side of the wood panel scribe a rectangle externally tangential to the four drilled holes. Check the height and width of the rectangle against the panel template dimensions. These dimensions should not be exceeded. Now carefully cut out the rectangle with a sabre saw, using a small blade to start accurately in the 3/8" holes. After the cutting operation, any rough spots or excess material along the edges of the cut-out may be removed with a file. Finally, brush or blow out all chips and sawdust.

MOUNTING THE UNIT

1. Insert the unit from the rear of the cabinet, carefully guiding the controls through the panel cut-out. Center the unit in the cut-out and re-mount the panel with the four screws previously removed.

2. From the rear of the cabinet, pull the amplifier toward you gently, until the front panel is flush against the wood panel.

3. Now place 5/8" flat washers against the heads of the two #8 x 1 3/4" screws provided and insert them from the bottom side of the shelf into the two holes drilled previously. It may be necessary to shift the unit slightly to the left or right in order to afford clear access for the screws. When both screws have caught, tighten them to secure the unit to the shelf.

4. Replace the knobs previously removed on the control shafts.

INPUT CONNECTIONS

Channel 1 has 7 inputs and channel 2 has 6 inputs, one of which there is no use for at the present time (AM 2).*

The channel 1 inputs are identified by the suffix "1" and are as follows:

<u>CH. 1 Low Level Inputs</u>	<u>CH. 1 High Level Inputs</u>
PHONO A 1	FM 1
PHONO B 1	AM 1
TAPE HEAD 1	Multiplex 1
	TAPE 1

The channel 2 inputs are identified by the suffix "2" and are as follows:

CH. 2 Low Level Inputs CH. 2 High Level Inputs

PHONO A 2	AM 2* (See note)
PHONO B 2	Multiplex 2
TAPE HEAD 2	TAPE 2

All high level inputs are provided the same gain and flat frequency response. Low level inputs are provided much higher gain and the prescribed gain-frequency characteristics of RIAA for phono and NARTB for tape head.

Monophonic sources, such as FM tuner, AM tuner, or monophonic phono cartridge, are plugged into Channel 1 inputs. Stereophonic sources, such as stereo phono cartridge, stereo tape heads, or FM, Multiplex (MX) adaptor, are plugged in as follows: left channel into channel 1 inputs; right channel into channel 2 inputs.

*Input AM 2 has been provided due to the possibility of AM-AM stereo. AM 1 is the normal AM tuner input.

Setting the SELECTOR switch to FM-AM and the MODE switch to STEREO or REVERSE takes care of feeding two normally monophonic channel 1 inputs (FM tuner and AM tuner) one to channel 1 and the other to channel 2 for FM-AM simulcast stereo.

PHONO

The PH. A input jacks 1 & 2 and the PH. B input jacks 1 & 2 permit the use of two magnetic cartridges in your system. One cartridge can be a stereo type and the other monophonic, or both can be stereo. One cartridge can be in a turntable, and the other in a record changer or an inexpensive phono for children's use. A monophonic cartridge is plugged into the channel 1 input only.

When playing a monophonic record with a stereo cartridge, set the MODE switch to the MONO 1-2 position, specifically intended for this purpose. In the MONO 1-2 position, the channel 1 and 2 inputs are fully blended internally, and the blend is fed to both amplifiers. The purpose here is to cancel extraneous vertical noise components in the cartridge output.

When playing a monophonic record with a monophonic cartridge, set the MODE switch to MONO 1, the normal monophonic position at which the channel 1 input is fed to both amplifiers.

The load presented to the cartridge by the PHONO A

inputs is 100K Ω . The load presented to the cartridge by the PHONO B inputs is 47K Ω . The choice of load impedance permits accommodation of most popular cartridges. Most popular cartridges, including all Shure and the Pickering 381A require 47K Ω load. The Pickering 380A, however, requires 100K Ω load.

If the Weathers C501-D cartridge is used, connect a 180K Ω resistor in series followed by a 33K Ω resistor in shunt, across each output. Plug into PHONO A inputs. This network avoids overloading the pre-amplifier inputs.

TAPE HEAD

The TAPE HEAD 1 & TAPE HEAD 2 input jacks permit the connection of a tape deck having no playback pre-amplifiers to the unit. The tape head should be the conventional high impedance, high output type normally supplied in decks without playback electronics. If the head is of the stereo type, connect the upper track output to TAPE HEAD 1, and the lower track output to TAPE HEAD 2. If the head is of the monophonic type, connect the output to TAPE HEAD 1. The load presented to the tape head by each input is 1 megohm. Choose the proper equalization for the tape playing speed, using the TAPE EQUAL switch on the front panel.

FM TUNER

The FM 1 input jack is for connection of an FM tuner.

AM TUNER

The AM 1 input jack is for connection of an AM tuner. Do not use AM 2 for this purpose.

FM MULTIPLEX ADAPTOR

The MX 1 and MX 2 input jacks permit the connection of an FM Multiplex adaptor. Any adaptor will provide a left channel output and a right channel output. The left channel output is connected to MX 1 and the right channel output to MX 2.

TAPE

The TAPE 1 and TAPE 2 input jacks permit the connection of a tape machine complete with playback pre-amplifiers. If the machine provides stereo playback, connect the upper track output to TAPE 1, and the lower track output to TAPE 2. If the machine is of the monophonic type, connect the output to TAPE 1.

OUTPUT CONNECTIONS

TAPE RECORDER

The TAPE OUT 1 & TAPE OUT 2 jacks are intended for feeding signals out to the "line" recording inputs of a tape recorder. These are independent outputs for channel 1 and channel 2, respectively. They are unaffected by the LEVEL, BALANCE, BASS, TREBLE, HI FILTER, and LO FILTER controls.

SPEAKER CONNECTIONS

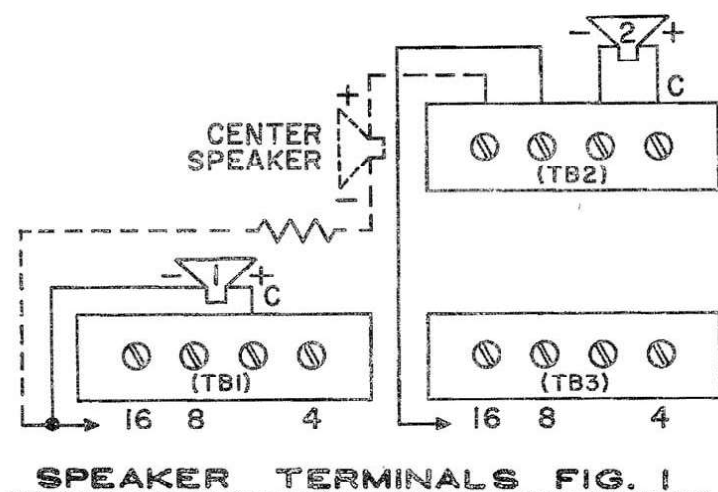
WARNING: Do not operate the amplifier without first connecting speakers to the speaker connection terminals, exactly as described below.

Every speaker has a rated impedance, which may be 16, 8, or 4 ohms. For an amplifier to provide rated power output with rated distortion, the speaker used with it must be connected to the output transformer tap corresponding to its impedance.

On the rear apron of the unit, there are three 4-connection Terminal Boards (TB). Imprinted on the apron is a diagram for connecting up to three speakers, one each for channels 1 and 2, and an optional center channel speaker.

To agree with the established conventions of stereo, connect the left speaker to the channel 1 output, and the right speaker to the channel 2 output, after reading the connection information below.

The board at the left, TB1, carries the impedance taps for channel 1. The board at the lower right, TB3, carries the impedance taps for channel 2.



The left board, TB1, carrying the channel 1 impedance taps (16, 8, 4 Ω), also includes the common terminal (C) for channel 1. The channel 1 speaker is connected to this common terminal C and the appropriate channel 1 impedance tap, as shown.

The lower right board, TB3, carrying the channel 2 impedance taps (16, 8, 4 Ω), must not be used for connecting the channel 2 speaker. The upper right board, TB2, provides the connection terminals for the channel 2 speaker. As the diagram shows, the channel 2 speaker is to be connected between the right-hand pair of terminals on board TB2. Note that the terminal at the extreme right is marked "C", this being the common terminal for channel 2.

To complete the connection of the channel 2 speaker, a jumper wire must be connected between the third terminal from the right on the upper right board, TB2, and the appropriate impedance tap on the lower right board, TB3, as shown in the diagram.

There is a third speaker shown in the diagram, labelled CENTER SPKR. (OPTIONAL). A resistance symbol is shown in series with this speaker, as well. This resistance symbol stands for an attenuator to reduce the level of the center speaker appreciably below that of the channel 1 and 2 speakers so as to produce "center fill" without markedly diminishing the stereo effect. For this purpose we recommend an adjustable 50 ohm, 25 watt wire-wound dropping resistor such as the Ohmite "Dividohm", mounted on the rear panel of the center channel speaker adjacent to the speaker terminals. Connect the sliding divider on the resistor to one of the speaker terminals, allowing enough slack to permit the slider to be moved along the body of the resistor. Now connect the other speaker terminal to the extreme left-hand terminal on the upper right board, TB2, on the amplifier, and then connect one end terminal of the dividing resistor to the same impedance tap on the left board, TB1, used for the channel 1 speaker. These connections are shown in the diagram.

The speaker connection diagram imprinted on the rear apron of the amplifier is reproduced in Figure 1, with additional polarity indications which will assist in phasing the speakers properly if your speakers are marked as to polarity. A physical representation of the speaker connections is given in Fig. 2. If your speakers are not marked as to polarity, use the phasing method given below. Have the SPKR PHASE switch set at N through-out.

Set the speakers together, including the center speaker if you are using one. Listen to a monophonic source with plenty of bass material through both channels, and all speakers, at once. Temporarily disconnect one lead going to the center speaker. Now reverse the connections to one outside speaker. If the bass is fuller, the two outside speakers are now in phase. If the bass is thinner, restore the original connections to this outside speaker. Now re-connect the lead previously removed from the center speaker. If the bass is fuller, the center speaker is in phase with the outside speakers. If the bass is thinner, reverse the connections to the center speaker.

NOTE: We do not mean to give the impression that a center channel speaker is normally necessary in a stereo installation. We consider it, rather, to be a convenient facility in the case that the channel 1 and 2 speakers have to be spread apart more than the normal 8 to 10 feet, or that, with normal spacing, listening at close quarters is often necessary. Under these circumstances the sound from the channel 1 and 2 speakers may become disassociated, resulting in a phenomenon

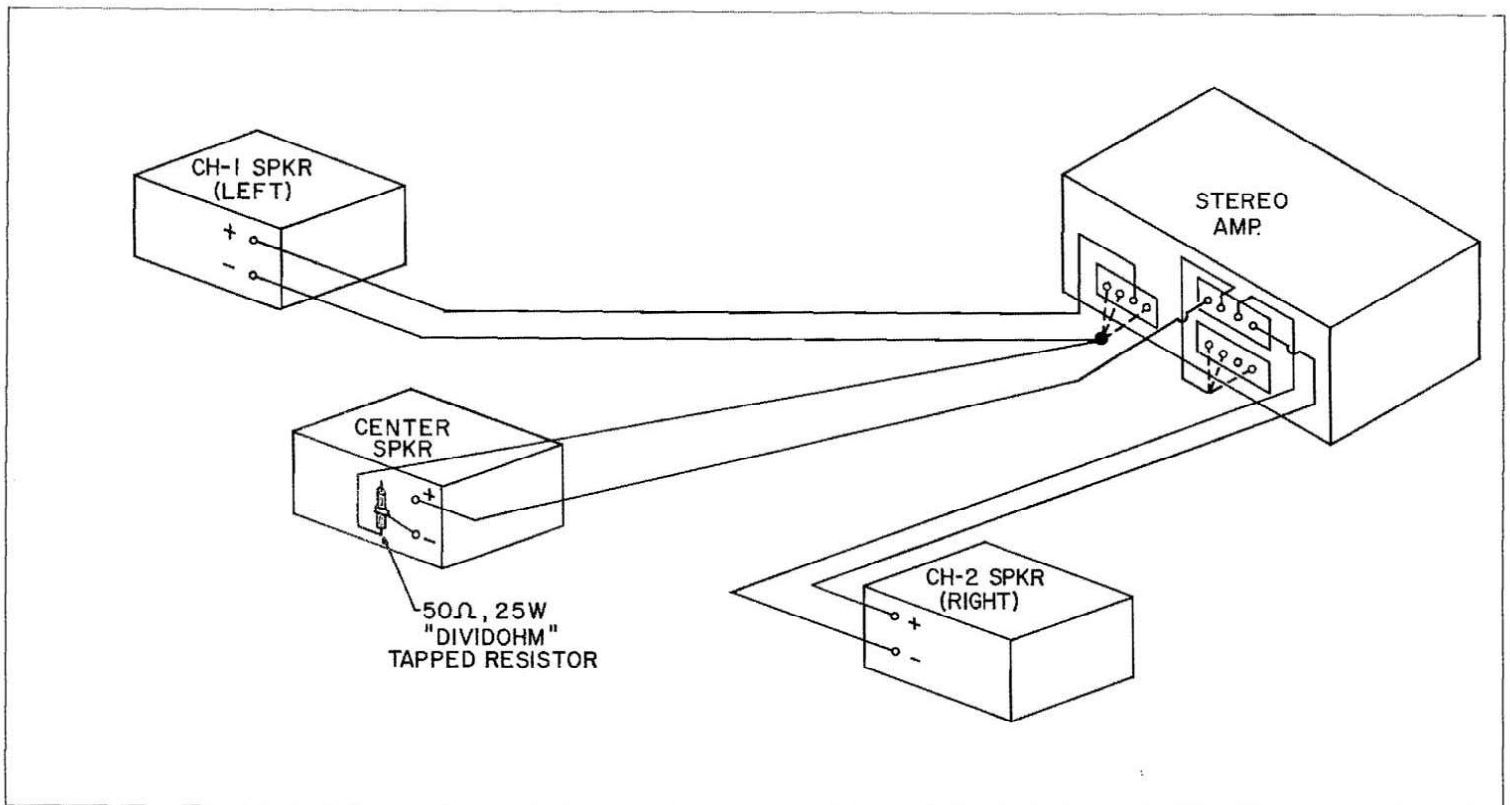
known as "hole-in-the-middle". The center channel speaker is a remedy for this situation.

AC POWER CONNECTIONS

Plug the line cord into a 117VAC, 60 cps power line outlet only. A DC power source will cause severe damage to the unit.

Two convenience outlets are provided on the rear apron, one switched and one unswitched. The unswitched outlet should be used with record changers, turntables, or tape decks (devices which can sometimes be harmed if turned off simply by removing power), if it is not convenient to plug them directly into the power line. The switched outlet is for use with tuners. A cube tap may be used if more than one connection is to be made to an outlet.

A 3 amp fuse is provided on an extractor post mounting on the rear apron. This fuse protects only the amplifier, not any equipment plugged into the switched convenience outlet.



SPEAKER CONNECTIONS FIGURE 2

OPERATION OF CONTROLS

SELECTOR Switch: Used to select any input or pair of inputs as follows:

POSITION	SOURCE	INPUTS	COMMENTS
TAPE/AUX.	Pre-amplified tape	TAPE 1 & TAPE 2	
MX/AUX.	FM Multiplex Stereo	MX 1 & MX 2	
FM-AM	FM tuner & AM tuner	FM 1 & AM 1	FM only with MODE Sw at MONO 1
AM-AM*	AM tuner	AM 1	Set MODE Sw at MONO 1
PHONO A	Stereo mag. phono cartridge	PH. A 1 & PH. A 2	Set MODE Sw at MONO 1-2 to play mono record
PHONO B	Stereo mag. phono cartridge	PH. B 1 & PH. B 2	Set MODE Sw at MONO 1-2 to play mono record
TAPE HD.	Stereo tape head in deck without preamplifiers	TAPE HD. 1 & TAPE HD. 2	

MODE Switch: Used to select mode of operation

POSITION	OPERATION	COMMENTS
✓CH. 1	CH. 1 input out CH. 1 speaker	For checking left side of stereo program
✓CH. 2	CH. 2 input out CH. 2 speaker	For checking right side of stereo program
STEREO	CH. 1 input out CH. 1 speaker CH. 2 input out CH. 2 speaker	Should normally give left side of program out of left speaker, and right side of program out of right speaker
REVERSE	CH. 1 input out CH. 2 speaker CH. 2 input out CH. 1 speaker	Use if left side of program is coming out of right speaker when set at STEREO
MONO 1	CH. 1 Input out CH. 1 & 2 speakers	Use for all mono listening except when playing mono record. Used also for checking balance in Stereo. See BALANCE ✓ operation.
MONO 1-2	CH. 1 plus CH. 2 inputs blended, out CH. 1 & 2 speakers	Used only when playing mono record (with stereo cartridge)

*See note on use of AM 2 in INPUT CONNECTIONS.

TAPE EQUAL slide switch: Used to provide the proper playback equalization for the tape speed used, when a tape deck without playback pre-amplifiers is connected to the TAPE HEAD inputs of the amplifier. The 7 1/2 ips equalization is in accordance with the NARTB standard. The 3 3/4 ips equalization is in accordance with industry standards. The tape speed equalization selected is in effect only when the SELECTOR switch is set at the TAPE HD. position.

BALANCE Control: Used to achieve equal left and right side program levels in stereo. Effective in mono to center the apparent source between the speakers. Neither channel amplifier is favored (as to gain) at the zero setting (mid-rotation). As the control is turned clockwise from zero, the channel 2 (right) speaker is made louder and the channel 1 (left) speaker is made softer, while the overall level remains about the same. As the control is turned counter-clockwise from zero, the channel 1 (left) speaker is made louder and the channel 2 (right) speaker is made softer, while the overall level remains about the same.

BALANCE ✓ (CHECK) Slide Switch: If you have identical left and right speakers (or dissimilar speakers of nearly equal efficiency), the BALANCE control can be set properly by means of the BALANCE ✓ (CHECK) slide switch as follows:

1. Set BALANCE control to zero.
2. Adjust LEVEL control for desired listening level.
3. Set BALANCE ✓ (CHECK) slide switch to ON.
4. Set MODE switch to MONO 1.
5. Adjust BALANCE control for minimum sound (null) from the left (CH. 1) speaker. There will be no sound from the right (CH. 2) speaker. If the BALANCE control is turned either direction from the proper setting (null), the sound level from the left speaker will increase.
6. Return the MODE switch to STEREO or REVERSE if the source is stereo.

NOTE:

In the "null" method of balancing just described, this is what is being done. An identical signal is fed to the channel 1 and 2 amplifiers at the high level input points (setting MODE switch to MONO 1). A dummy load is internally substituted for the channel 2 (right) speaker, and the channel 2 output signal is fed back through a precision dividing network to the input of the channel 1 power amplifier (setting BALANCE ✓ switch to ON). The channel 2 output signal is out-of-phase with the input signal to channel 1, and tends to cancel or nullify it. When the BALANCE control is

set so that the portion of the channel 2 output signal fed to the channel 1 power amplifier input is equal to the channel 1 signal at this point, almost complete cancellation (null) occurs and the output from the channel 1 speaker is at a minimum.

This method of balancing achieves equality of gain in the channel 1 and 2 amplifiers from the high level inputs to the speaker outputs. The preamplifiers, which are ahead of the high level input, are audibly nearly equal in gain because of feedback. If, upon returning the MODE switch to STEREO or REVERSE after setting the BALANCE control by this method, audible balance is not achieved, the indication is that the sources feeding the amplifier are not equal. If the sources have their own level controls, such as FM or AM tuners or Multiplex adaptors, then these level controls should be set to equal output by successively setting the MODE switch at ✓CH. 1 and ✓CH. 2 while adjusting the source level controls for equal output from each speaker. Once the source levels have been adjusted, the null balancing method described previously will work effectively.

If one speaker is a little more efficient than the other, you may pad down the more efficient speaker by a series resistor up to half the rated speaker impedance (more will unduly deteriorate speaker damping), in order to make the convenient null balancing method effective. If the speakers are grossly different in efficiency, you will have to adjust the BALANCE control by successively setting the MODE switch at ✓CH. 1 and ✓CH. 2, while finding the BALANCE control setting that produces about equal output from each speaker.

If a stereo phono cartridge has a marked difference in output between the two sides, you will have to adjust the BALANCE control setting until audible balance is achieved, while successively setting the MODE switch to ✓CH. 1 and ✓CH. 2, when this input is selected.

LEVEL control: Used to adjust the listening level in both channels. The BALANCE control is adjusted after setting the LEVEL control. Substantial changes in LEVEL control setting may require re-setting the BALANCE control. Adjust the output level controls in tuners, multiplex adaptor, and tape machines with pre-amplifiers, to match the sound level obtained on phono, if possible. If any of the high level sources can not provide high enough output to match phono, simply set this source to maximum output.

LOUDNESS slide switch: A characteristic of human hearing is that sensitivity to bass tones diminishes more rapidly, as the listening level is lowered, than sensitivity to middle and high frequency tones. Many people find the audible loss of bass at low listening levels unsatisfying. Setting the **LOUDNESS** slide switch to **ON** provides a compensating amount of bass boost at low listening levels. Do not leave the **LOUDNESS** switch at **ON** when listening at normal volume, since the amount of bass boost provided will usually be excessive and unmusical. Some people prefer not to use loudness compensation at all, because it does not correspond to any natural listening condition at a live performance.

BASS CONTROL CH. 1, BASS CONTROL CH. 2 (CONCENTRIC): The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) bass response; the minus sign on the left side indicates that counter-clockwise rotation from the mid-point decreases (cuts) bass response. There is no interaction with the **TREBLE** control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since bass response is neither cut nor boosted at this position.

TREBLE CONTROL CH. 1, TREBLE CONTROL CH. 2 (CONCENTRIC): The plus sign on the right side of the dial indicates that clockwise rotation from the mid-point (0) of either control increases (boosts) treble response; the minus sign indicates that counter-clockwise rotation from the mid-point decreases (cuts) treble response. There is no interaction with the **BASS** control. Start all adjustments with this control set at the mid-point (0), which is called the "flat" position since treble response is neither cut nor boosted at this position.

The amplifier **ON-OFF** power switch is ganged with the **CH. 2 TREBLE** control. Note the word "OFF" on the panel just beyond full-counter-clockwise rotation. The plain circle symbol preceding it indicates that the power switch is ganged with the **CH. 2** control. Turn the amplifier off by turning the **CH. 2 TREBLE** control beyond full counter-clockwise rotation until the power switch clicks to **OFF**. Turn the amplifier on by turning the **CH. 2 TREBLE** control clockwise from **OFF** and setting it at the mid-point (0) or some customary setting of the **CH. 2 TREBLE** control you may use.

SPEAKER PHASE slide switch: Used to correct for an out-of-phase condition between the left and right channel signals. Has two positions: **N** (normal) and **R**

(reverse). When the switch is set at **R**, the polarity of the channel 2 output signal is internally reversed, which will restore the in-phase relationship between the left and right signals regardless of how the out-of-phase condition was caused. However, if the speakers are connected and phased with the **SPKR PHASE** switch set at **N** as described in **SPEAKER CONNECTIONS**, and no auxiliary equipment is normally feeding out-of-phase stereo signals to the amplifier, then the left and right signals should normally be in phase (with the **SPKR PHASE** switch set at **N**), unless the stereo recording or broadcast material is accidentally out-of-phase. To determine whether or not stereo signals are in phase, you may use the following criteria. Out-of-phase signals tend to be heard separately from each speaker, rather than forming a distinct stereophonic sound image spread between the speakers. Also, in-phase signals tend to produce stronger bass, whereas out-of-phase signals produce thinner bass.

LO FILTER slide switch: Set to **ON** when it is desired to cut low frequency response below 100 cps because of rumble in a phonograph or even in broadcast program material. Phonograph rumble is usually at about 29 cps and may well not be directly audible. Sometimes it can be at a much lower frequency, which is definitely not directly audible. However, the effect of rumble can be heard even the rumble itself is not. It manifests itself by using up amplifier power at low frequencies and can even overload the amplifier. If, at normal listening levels on phonograph, setting the **LO FILTER** to **ON** definitely results in "cleaner", less-distorted sound, the indication is that your phonograph suffers from excessive rumble. Whether it is worth doing anything about it, depends on the installation. If you have inexpensive speaker systems that do not produce substantial undistorted sound below 80 cycles, you may just as well live with the rumble and eliminate its bad effects by using the **LO FILTER**. If you have made a considerable investment in speakers, partly in order to obtain full, undistorted response below 80 cycles, you may not want to forego full bass response. In the latter cases, have the phonograph examined by a qualified service man to see if the rumble is caused by a defect that can be remedied.

HI FILTER slide switch: Set to **ON** when it is desired to cut high frequency response above 5000 cps. Useful for minimizing extraneous noise when listening to narrow range AM broadcasting, for listening to noisy or worn records, and for reducing the annoyance of excessive distortion from any source.

TAPE MONITOR slide switch: Useful with complete tape machines (including record and playback electronics) that provide off-the-tape monitoring facilities while recording. In this situation, setting the TAPE MONITOR slide switch to ON permits you to hear the program being recorded directly from the tape.

MAINTENANCE

INSTALLATION PROCEDURES FOR MINIMUM HUM

AC LINE CORDS: Hum can usually be reduced by the following procedure, after all the equipment used with the amplifier is connected to it and plugged in.

1. Turn on all the equipment used.
2. Reverse the amplifiers's AC line cord plug in the wall outlet to see if hum is reduced. Leave it in the position that results in least hum.
3. With the SELECTOR switch, select a particular piece of equipment, and determine the insertion position of its AC line cord plug that results in least hum.
4. Repeat step 3 for every piece of equipment used with the amplifier.

When this is done, proceed to HUM BALANCE adjustments.

HUM BALANCE: Separate filament windings and hum-balance controls are provided for the two channels, so that an optimum hum balance setting can be found for each channel, rather than a compromise setting for both channels. Connect the phonograph and leave it shut-off with the tone arm at rest. Set the SELECTOR to the PH. A or PH. B position depending on which inputs are used. Set the MODE switch at \checkmark CH. 1, BALANCE at 0, LEVEL at 10, BASS 1 & 2 at 0, TREBLE 1 & 2 at 0 (amplifier turned on). Set all slide switches at "off" (down). Adjust the channel 1 hum-balance control (R-107) with a screw-driver until the hum heard from the channel 1 speaker is at a minimum. Now set the MODE switch at \checkmark CH. 2, and adjust the channel 2 hum-balance control (R-106) until the hum heard from the channel 2 speaker is at a minimum. See Figure 2 for these locations of R-106 and R-107.

GROUNDING: The cause of phonograph hum may be a metal pick-up arm not grounded to the cable shield (try a good single ground connection to the cable shield

from turntable frame, pick-up arm, and cartridge case), direct hum pick-up by the magnetic cartridge from the record player motor (try using a rubber mat on the turntable to increase the separation of the pick-up from the motor), or pick-up from a power transformer or other magnetic field in the vicinity (try moving phonograph away from suspected source). Check also that the phono input cable shielding is grounded to the amplifier chassis at one point only, through the skirt of the input connector where it plugs into the amplifier. Finally, try a good building ground such as a connection from a cold water pipe terminated under the channel 2, 4 Ω impedance tap (ground) on the rear apron of 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.

BIAS & BALANCE ADJUSTMENTS

In the ST-70, fixed bias is employed in the output stages. Each of the two amplifiers is provided with a BIAS ADJ. potentiometer and a BALANCE ADJ. potentiometer. It is essential that these controls be adjusted exactly as instructed before putting a completed kit amplifier into use, or at any time thereafter when any of the output tubes are replaced, or it is suspected that a dc unbalance in the output tubes has occurred in the course of use.

In the Final Steps of the Construction section, it is instructed that both BALANCE ADJ. pots R79 and R80, and both BIAS ADJ. pots, R103 and R104, be set to mid-rotation before connecting the unit to the AC line. Be sure this is done. Then connect speakers to the amplifiers exactly as described in speaker connections.

Next, turn the amplifier on and set the LEVEL control down to zero. Immediately after the unit is turned on, perform bias and balance adjustment in each amplifier according to the methods and schedule given below.

Instrument Required: VOM or VTVM of at least $\pm 3\%$ accuracy on DC voltage measurement, with a lowest DC voltage range not exceeding 3 volts full scale.

a) **BALANCE ADJUST METHOD.** (Use the BALANCE ADJ. pot and METER jacks for the particular amplifier, 1 or 2, being adjusted. See Fig. 3) Set the VOM or VTVM to the lowest DC voltage range and at either

the plus or minus DC voltage function. Connect the meter leads to the pair of METER pin jacks for amplifier 1 or amplifier 2 on the chassis. If the meter deflects to the left of zero, switch the function to the opposite sign or reverse the leads. Adjust the corresponding BALANCE ADJ. control for a zero or minimum reading. This completes the balance adjustment, whereupon the meter leads can be removed from the meter pin jacks.

b) BIAS ADJUST METHOD. (Use the BIAS ADJ. pot and a METER jack of the pair for the particular amplifier, 1 or 2, being adjusted.) Set the VOM or VTVM at the plug DC voltage function and the lowest DC voltage range (not exceeding 3 volts full scale). Insert the "hot" meter lead into either one of the pair of METER pin jacks for the particular amplifier (1 or 2) being adjusted, and connect the common or ground meter lead to a convenient chassis ground point. Set the corresponding BIAS ADJ. control for a meter reading of 0.38 volt. This completes the bias adjustment, whereupon the meter leads can be removed.

NOTE:	CH. 1	CH. 2
METER JACKS	J19 & J21	J18 & J20
BALANCE ADJ. control	R79	R80
BIAS ADJ. control	R103	R104

BALANCE & BIAS ADJUSTMENT SCHEDULE

Immediately upon turning amplifier on for the first time (either after completing the kit or after replacing output tubes):

1. Adjust BALANCE amplifier 1
 2. Adjust BIAS amplifier 1
 3. Adjust BALANCE amplifier 2
 4. Adjust BIAS amplifier 2
- Repeat steps 1, 2, 3 and 4

15 minutes later - Repeat steps 1, 2, 3 and 4

2 hours later - Repeat steps 1, 2, 3 and 4

2 weeks later - Repeat steps 1, 2, 3 and 4

SERVICING

Your amplifier should require little service except for normal tube replacement. We recommend no substitutions for the tube types used in this amplifier except as

stated. All the tube types used are distributed nationally, but replacements can be obtained directly from EICO if desired.

To facilitate servicing, remedial and trouble-shooting procedures have been provided in the TROUBLE-SHOOTING CHART that follows. A VOLTAGE AND RESISTANCE CHART is also provided as an aid in locating defective components. DC operating voltages are given both at no signal and signals developing 30 watts output, as well as the corresponding 1kc signal voltages.

TROUBLE SHOOTING PROCEDURES

Connect a stereo phono and a pair of speakers to the amplifier as described in INPUT CONNECTIONS and OUTPUT CONNECTIONS. Do not operate the amplifier without speakers or equivalent loads connected exactly as described. Set the SELECTOR switch to the corresponding phono position (PH. A or PH. B) and the MODE switch to STEREO. Play a known high quality stereo recording on the phonograph. If there is no output to the speaker, or if the output is low or audibly distorted, proceed to the checks for those symptoms. If there is excessive hum in the output, disconnect the phono input cable from the amplifier and short the phono input jack to chassis. If the hum disappears, the trouble is not in the amplifier but in the phonograph or in the connection to the amplifier. In each case, check for the trouble in the amplifier which seems defective. If both amplifiers are defective, check the power supply.

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 symptoms listed in the TROUBLE-SHOOTING CHART 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, low output, or distorted output, in either or both amplifiers, check for a tube that does not warm up (replace), or test the tubes (one at a time) on a tube tester or by substitution. Do not turn the amplifier on with the 7591 output tubes removed. If the tubes appear to be good, proceed to

the VOLTAGE and RESISTANCE chart and check the troublesome amplifier, or both amplifiers, by the procedures given. Study the chart and the accompanying notes thoroughly before you begin. The 1kc signal required may be obtained from an audio generator and a 100:1 attenuator (for best signal-to-noise ratio).

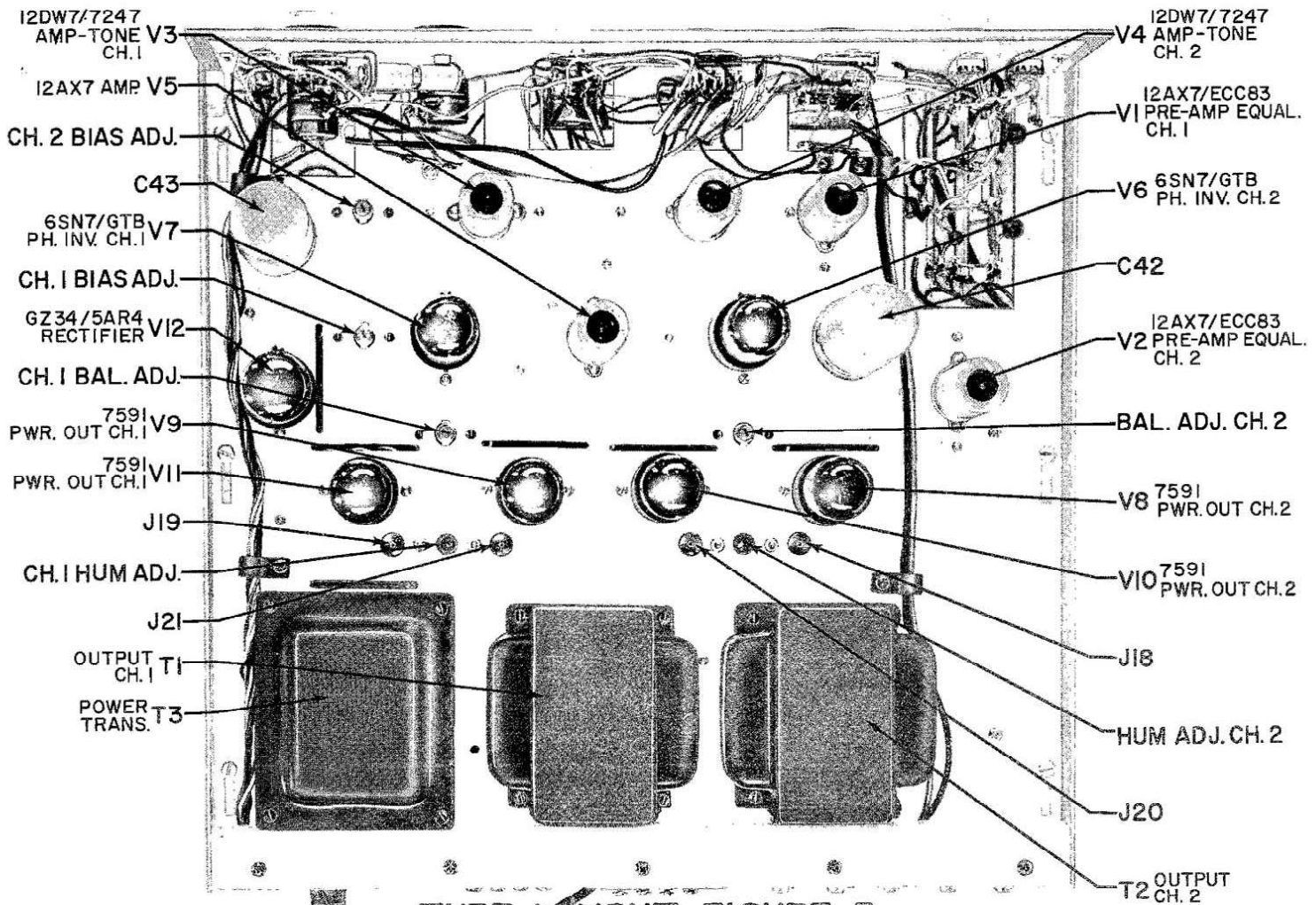
TRANSFORMER TEMPERATURE

The transformers used in this unit run at a temperature less than 195°F despite the fact that the safety limit is at a much higher 221°F. Although 195°F is cool for a transformer, it is very hot to the touch. Transformers which seem too hot when touched are usually good and Output transformers usually run cooler than power transformers. Some output transformers may appear hotter than others due to being located near hot components such as output and power tubes and power transformers.

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. List, also, any code numbers in red under the words INSTRUCTION MANUAL on the cover. If desired, you may return the instrument to our factory where it will be placed in operating condition for \$13.50 plus the cost of parts replaced due to their being damaged in the course of construction. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material inserted to keep the instrument immovable. Ship by prepaid Railway Express, if possible, to Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, New York. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.



TUBE LAYOUT FIGURE 3

TROUBLE - SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
Amplifier causes power line fuse to blow. Power line fuse blows again with V12 out of its socket.	Line cord, J16, J17, primary or high voltage secondary windings of T3 shorted internally or externally (wiring).	Replace or repair.
Amplifier causes power line fuse to blow. Power line fuse does not blow again with V12 out of its socket.	Defective V12, C43, V8, V9, V10, V11; T1 or T2 primary shorted internally or externally.	Replace or repair.
Any or half of tube filaments not lit.	Open tube filament. Open lead from one of the 6.3V windings of T3. One 6.3V winding of T3 open.	Replace or repair.
DC voltage at V12, cathode (pin 8) is incorrect as specified below. a) No voltage. b) High voltage. c) Low voltage.	 Defective V12. C43 shorted internally or externally. Connection to center tap of h.v. secondary winding of T3 open. Output tubes, V8, V9, V10, V11 over-biased or not drawing current. Excessive current drain in amplifier. Defective V12	 Replace Replace or repair. Check possible causes and replace or repair. Check possible causes and repair. Readjust bias and DC balance controls. Adjust bias and DC balance controls. Replace
Excessive hum on mag. phono tape head or mic.	V1 or V2 defective. Filament leads dressed too close to grid lead. Tube shield not making electrical contact to base or base not making electrical contact to chassis. Shielding and grounding of wiring to input jacks not exactly as instructed and shown in drawings.	Replace Dress filament leads away from grid lead. Check and correct. Correct
Excessive noise on mag. phono or tape head.	V1 and V2 and contacts dirty. Poor solder-flux connection	Clean thoroughly with carbon tetrachloride. Resolder
Sustained oscillations.	Poor dress of output transformer T1 or T2 leads.	Dress all input leads and T1, T2 leads away from each other. Keep T1, T2 leads away from input jacks.
Sustained microphonics on mag. phono, tape head or mic.	V1 or V2 defective.	Replace
Hum on all inputs	V3 or V4 defective, not properly shielded, or dirty sockets and contacts. Dress of power transformer T3 leads.	Replace, correct, or clean. Correct.

REPLACEMENT PARTS LIST

SYM. #	STOCK #	AM'T.	DESCRIPTION	STOCK #	AM'T.	DESCRIPTION
C1, 2	22538	2	capacitor, disc, 400mmf, 10%	40000	51	nut, hex, #6-32
C3, 4	22520	2	capacitor, disc, .0012mfd (1.2K or 1200mmf), 10%	40001	6	nut, hex, #4-40
C5, 6	22522	2	capacitor, disc, 330mmf, 10%	40007	50	nut, hex, #8-40
C7, 8, 9, 10	22517	4	capacitor, disc, .025mfd, CMV	40008	12	nut, hex, #8-32
C11, 12	22534	2	capacitor, disc, 68mmf, 10%	40016	1	nut, 1/2" fuseholder
C13, 14	22580	2	capacitor, disc, .2mfd, +80%, -20%	41035	5	screw, #6 x 1/4, self tapping
C15, 16, 17, 18, 19, 20, 21, 22	20039	8	capacitor, molded, .1mfd, 400V	41047	7	screw, #8, self tapping
C23, 24	22547	2	capacitor, disc, .015mfd (15K or 15,000mmf), 20%	41086	51	screw, #6-32 x 5/16
C25, 26	22511	2	capacitor, disc, .005mfd (5K or 5000mmf), 20%	41090	34	screw, #4-40 x 5/16
C27, 28	22523	2	capacitor, disc, .0068mfd (6.8K or 6800mmf), 10%	41091	16	screw, #4-40 x 1/4, flat head
C29, 30	22548	2	capacitor, disc, .009mfd (9K or 9000mmf), 10%	41026	2	screw, #4-40 x 1/4, brass
C31, 32	22547	2	capacitor, disc, .015mfd (15K or 15,000mmf), 20%	41097	2	screw, #6-32 x 5/16, brown oxide
C33, 34	23020	2	capacitor, elec., 25mfd, 6V	41099	18	screw, #8-32 x 3/8, Type F, brown oxide
C35, 36	22545	2	capacitor, disc, 125mmf, 10%	41100	2	screw, #8-32 x 1 3/4
C37, 38	20044	2	capacitor, molded, .25mfd, 400V	42000	6	washer, lock, 3/8
C39, 40	23011	2	capacitor, elec., 50mfd, 50V	42002	50	washer, lock, #6
C41	23015	1	capacitor, elec., 50mfd, 150V	42007	50	washer, lock, #4
C42	24012	1	capacitor, elec., 40/20/20/20mfd, 450V	42005	2	washer, #6, flat
C43	24008	1	capacitor, elec., 40/20mfd, 500V	42008	12	washer, lock #8
C44	23041	1	capacitor, elec., 30mfd, 400V	42029	1	washer, rubber, 1/2" for fuseholder
C45	23003	1	capacitor, elec., 16mfd, 350V	42032	2	washer, flat #8, 7/16" OD
C46	23001	1	capacitor, elec., 10mfd, 25V	43000	2	lug, ground, #6
C47	20043	1	capacitor, molded, .03mfd, 600V	43004	4	lug, ground, #8
CR1	93005	1	rectifier, 200ma/380 PIV	46000	1	grommet, rubber, 3/8
F1	91005	1	fuse, 3Amp	46011	4	plastic feet
I1	92000	1	bulb, #47	50019	5	insulator for 50018
J1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	50018	5	jack, phono, triple	53047	2	knob, concentric, inner
J16, 17	50009	2	A. C. receptacle	53048	2	knob, concentric, outer
J18, 19, 20, 21	50007	4	jack, pin	53049	4	knob, dual, split knurl
PC1, 2	29751	2	printed circuit	57003	1	line cord
R1, 2	10428	2	resistor, 47K, 1/2W, 10% (yellow, violet, orange, silver)	58004	length	wire, hook-up, black
R3, 4	10410	2	resistor, 100K, 1/2W, 10% (brown, black, yellow, silver)	58005	length	wire, hook-up, brown
R5, 6, 7, 8	11526	4	resistor, 200K, 1/2W, 5% (red, black, yellow, gold)	58006	length	wire, hook-up, red
R9, 10	11532	2	resistor, 4M, 1/2W, 5% (yellow, black, green, gold)	58007	length	wire, hook-up, orange
R11, 12	10407	2	resistor, 1M, 1/2W, 10% (brown, black, green, silver)	58008	length	wire, hook-up, yellow
R13, 14	10424	2	resistor, 22K, 1/2W, 10% (red, red, orange, silver)	58009	length	wire, hook-up, green
R15, 16	11512	2	resistor, 2.4K, 1/2W, 5% (red, yellow, red, gold)	58010	length	wire, hook-up, blue
R17, 18	10455	2	resistor, 1.5M, 1/2W, 10% (brown, green, green, silver)	58011	length	wire, hook-up, violet
R19, 20	11520	2	resistor, 40K, 1/2W, 5% (yellow, black, orange, gold)	58012	length	wire, hook-up, grey
R21, 22	11533	2	resistor, 1.2K, 1/2W, 5% (brown, red, red, gold)	58013	length	wire, hook-up, white
R23, 24	10435	2	resistor, 150K, 1/2W, 10% (brown, green, yellow, silver)	58300	length	spaghetti, small
R25, 26	10408	2	resistor, 680K, 1/2W, 10% (blue, grey, yellow, silver)	58303	length	spaghetti, large
R27, 28	11523	2	resistor, 68K, 1/2W, 5% (blue, grey, orange, gold)	58408	length	cable, 1 conductor black
R29, 30	10421	2	resistor, 6.8K, 1/2W, 10% (blue, grey, red, silver)	58412	length	cable, 3 conductor
R31-32	18068	1	pot., 750K, dual	58414	length	cable, 1 conductor grey
R33-34	18069	1	pot., 250K, dual	58501	length	wire, bare
R35, 36	10413	2	resistor, 2.7K, 1/2W, 10% (red, violet, red, silver)	80091	1	panel
R37, 38, 39, 40	11546	4	resistor, 33K, 1/2W, 5% (orange, orange, orange, gold)	81175	2	cable clamp, plastic
R41, 42	10417	2	resistor, 220K, 1/2W, 10% (red, red, yellow, silver)	81269	1	chassis
R43, 44	10442	2	resistor, 1.5K, 1/2W, 10% (brown, green, red, silver)	81270	1	rear panel
R45-46	18071	1	pot., 1M, concentric	81271	1	bottom plate
R47-48-510	18070	1	pot., 50K, concentric, with SPST switch	81272	1	hood
R49, 50, 51, 52	10431	4	resistor, 470K, 1/2W, 10% (yellow, violet, yellow, silver)	81920	6	cable clamp
R53, 54	11526	2	resistor, 200K, 1/2W, 5% (red, black, yellow, gold)	81924	1	bracket, extrusion, left side rail
R55, 56	10432	2	resistor, 1K, 1/2W, 10% (brown, black, red, silver)	81925	1	bracket, extrusion, right side rail
R57, 58	11505	2	resistor, 100Ω, 1/2W, 5% (brown, black, brown, gold)	89537	1	pilot light shield
				97300	5	shield for 9 pin socket
				97717	1	jewel for pilot light
				66349	1	manual of instruction (kit)
				66096	1	manual of instruction (wired)
				89627	1	glue capsule

REPLACEMENT PARTS LIST (CONTINUED)

SYM. #	STOCK#	AM'T.	DESCRIPTION
R59, 60	10407	2	resistor, 1M, 1/2W, 10% (brown, black, green, silver)
R61, 62	11601	2	resistor, 28.75K, 1W, 5%
R63, 64	11602	2	resistor, 33K, 1W, 5% (orange, orange, orange, gold)
R65, 66	11600	2	resistor, 18K, 1W, 5% (brown, grey, orange, gold)
R67, 68, 69, 70	10435	4	resistor, 150K, 1/2W, 10% (brown, green, yellow, silver)
R71, 72, 73, 74	10430	4	resistor, 4.7K, 1/2W, 10% (yellow, violet, red, silver)
R75, 76, 77, 78	11527	4	resistor, 100K, 1/2W, 5% (brown, black, yellow, gold)
R79, 80	18029	2	pot., 50K, snap-in
R81, 82, 83, 84	11703	4	resistor, 10 Ω , 1W, 1%
R85, 86	11557	2	resistor, 6K, 1/2W, 5% (blue, black, red, gold)
R87, 88	10432	2	resistor, 1K, 1/2W, 10% (brown, black, red, silver)
R89	11558	1	resistor, 5.3K, 1/2W, 5% (green, orange, red, gold)
R90	14850	1	resistor, 16 Ω , 20W, 5%, W.W.
R91, 92, 93	10956	3	resistor, 10K, 2W, 10% (brown, black, orange, silver)
R94, 95	10444	2	resistor, 120K, 1/2W, 10% (brown, red, yellow, silver)
R96	14308	1	resistor, 1800 Ω , 10W, 10%, W.W.
R97	10950	1	resistor, 2200 Ω , 2W, 10% (red, red, red, silver)
R98, 99	10422	2	resistor, 68K, 1/2W, 10% (blue, grey, orange, silver)
R100, 101	10426	2	resistor, 33K, 1/2W, 10% (orange, orange, orange, silver)
R102, 103	18029	2	pot., 50K, snap-in
R104	10407	1	resistor, 1M, 1/2W, 10% (brown, black, green, silver)
R105	10410	1	resistor, 100K, 1/2W, 10% (brown, black, yellow, silver)
R106, 107	19016	2	pot., 100 Ω , W.W.
S1	60074	1	switch, rotary, 4 section
S2	60083	1	switch, rotary, 1 section
S3, 4	62012	2	switch, slide, DPDT
S5, 6, 7, 8	62014	4	switch, slide, 4PDT
S9	62012	1	switch, slide, DPDT
S10		1	switch, SPST mounted on R47-48
T1, 2	32021	2	transformer, output
T3	30048	1	transformer, power
TB1, 2, 3	54500	3	terminal board, 4 screw
TB4	54002	1	terminal strip, 1 post right with ground
TB5, 6, 7, 8, 9, 10, 11, 12, 13	54003	9	terminal strip, 2 post
TB14, 15, 16	54006	3	terminal strip, 3 post 2 right
TB17, 18, 19	54001	3	terminal strip, 1 post right
TB20, 21	54000	2	terminal strip, 1 post left
TB22	54019	1	terminal strip, 2 post right
TB23	54015	1	terminal strip, 3 post 2 left with ground
TB24	54023	1	terminal strip, 2 post left with ground
TB25	54008	1	terminal strip, 4 post
TB26	54014	1	terminal strip, 3 post 2 left
TB27	54003	1	terminal strip, 2 post
V1, 2	90034	2	tube, 12AX7/ECC83/7025
V3, 4	90061	2	tube, 12DW7/7247
V5	90034	1	tube, 12AX7/ECC83/7025
V6, 7	90041	2	tube, 6SN7GTB
V8, 9, 10, 11	90073	4	tube, 7591
V12	90044	1	tube, GZ-34
X11	97712	1	pilot light assembly
XF1	97800	1	fuseholder
XV1, 2, 3, 4, 5	97027	5	socket, 9 pin min. with shield support
XV6, 7, 8, 9, 10, 11, 12	97032	7	socket, octal

VOLTAGE AND RESISTANCE CHART

	Pin#	Column 1 DC volts at 30 watts ea. chan- nel	Column 2 DC volts at no signal	Column 3 AC volts (signal) at 35 watts one channel at a time	Column 4 Resistance in ohms Pin 8 of XV12 grounded
V1, 2	1	182	200	.48	60K
	2	0	0	.032	1.5Meg
	3	1.25	1.38	.018	1200
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	75	80	.032	325K
	7	0	0	.0041	1.2M
	8	0.7	0.75	.0037	2400
	9	12.5	13.8		100K
V3, 4	1	95	105	.28	62K
	2	0	0	.05	250K
	3	3.4	3.7	.023	1500
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	138	150	.24	62K
	7	0	0	.022	280K
	8	.85	.95	.0125	1K
	9	12.5	13.8		100K
V5	1	77	97	2.6***	320K
	2	0	0	.24***	240K
	3	.55	.70	.2***	1100
	4	12.5	13.8		100K
	5	12.5	13.8		100K
	6	77	97	0***	320K
	7	0	0	0***	240K
	8	.55	.70	0***	1100
	9	12.5	13.8		100K
V6, 7	1	77	97	2.6	320K
	2	234	300	18	33K
	3	80	100	1.24	18K
	4	234	75	<.001	1.3M
	5	80	280	18	37K
	6	80	100	1.24	18K
	7	12.5	13.8		100K
	8	12.5	13.8		100K
V8, 9 V10, 11	1	-18	-19	18	190K
	2	12.5	13.8		100K
	3	400	450	270	80-110
	4	320	400	.25	1800
	5	.7	.38	1	10
	6	-18	-19	18	195K
	7	12.5	13.8		100K
	8	320	400	.25	1800
V12	1				
	2	405	455		>30K**
	3				
	4	360*	360*		15-25
	5				
	6	360*	360*		15-25
	7				
	8	405	455		30K**

Column 1:

Both amplifiers are fed a 1kc signal through a high level input to produce 30 watts output from each amplifier. A dummy load must be connected to each amplifier output. Feed a 1kc signal to the TAPE 1 input and set the SELECTOR switch to TAPE/AUX. Set the MODE switch to MONO 1, the BASS and TREBLE controls for both channels to zero and all slide switches to the down position. Then set the audio generator output, and the LEVEL and BALANCE controls, to obtain the appropriate 1kc signal voltage corresponding to 30 watts output (from the table) across the speaker output terminals of each channel to which the dummy loads are connected. If a defect in either or both amplifiers makes it impossible to obtain the required signal voltage across the speaker output terminals, feed a 480mv, 1kc signal to the TAPE 1 input and proceed to the measurements.

Column 2:

Same as for Column 1 but remove input signal.

Column 3:

One channel amplifier at a time is fed a 1kc signal through the appropriate PH. A Input to produce 35 watts output. A dummy load must be connected to each amplifier output. To check the channel 1 amplifier, feed a 1kc signal to the PH. A1 input, and set the MODE switch to ✓CH. 1. Set the SELECTOR switch to PHONO, the BALANCE control to zero, the BASS and TREBLE controls for both channels to zero, and all slide switches to the down position. Then set the audio generator output and the LEVEL control to obtain the appropriate 1kc signal voltage corresponding to 35 watts output (from the table) across the CH. 1 speaker output terminals to which the dummy load is connected. To check the channel 2 amplifier, feed a 1kc signal to the PH. A2 input, and set the MODE switch to ✓CH. 2. All other controls remain set as before. Then set the audio generator output and the LEVEL control to obtain the appropriate 1kc signal voltage corresponding to 35 watts output (from the table) across the CH. 2 speaker output terminals to which the dummy load is connected. Note that the entries for V5, as given are for the channel 1 amplifier test. In checking the channel 2 amplifier, pins 6, 7 and 8 of V5 should give the readings entered above for pins 1, 2 and 3, respectively, whereas pins 1, 2 and 3 should read zero. If a defect in either amplifier makes it impossible to obtain the required signal voltage across the speaker output terminals, feed a 4mv, 1kc signal to the PH. A input for that amplifier and proceed to the measurements.

Column 4:

Set controls as in Column 1. Disconnect unit from AC line and remove all input and output connections. Short pin 8 of XV12 (rectifier) to chassis ground with a jumper throughout resistance measurements, except when pins 2 and 8 of XV12 are being checked.

*AC 60 cycles

**Short from pin 8 of XV12 to ground removed.

***Correct as given, only for the Channel 1 amplifier test. In checking the channel 2 amplifier, pins 6, 7 and 8 of V5 should give the readings entered for pins 1, 2, and 3, respectively, whereas pins 1, 2 and 3 should read zero.

Load R (Ω)	$V_{AC} \text{ for } P_{OUT} = \frac{V_{AC}^2}{R} = 30W$	$V_{AC} \text{ for } P_{OUT} = \frac{V_{AC}^2}{R} = 35W$
16	21.9	23.6
8	15.5	16.7
4	10.9	11.8

