



ACOUSTICAL SYSTEM

"Pipe Voice of the Electric Organ"

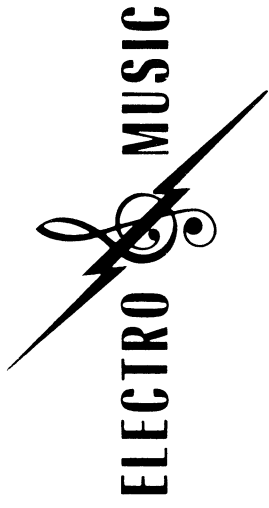
MODEL 101

OWNER'S MANUAL

INSTRUCTIONS, SERVICE INFORMATION

AND

PARTS LIST



PASADENA

CALIFORNIA

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INTRODUCTION

The Leslie ISOMONIC is in many ways an "ideal" organ sound system. It is a unique, multi-channel system, which divides the organ output into several components, then handles each one of these on a completely separate basis. The final musical result achieves a quality of realism that is otherwise unobtainable. Need for the ISOMONIC system becomes quite apparent in the performance of most single-channel systems; beats and upper harmonic interference are unavoidable in those cases where all frequencies are compressed into a single channel of amplification. Nor do multiple loudspeakers solve the problem where all the speakers are supplied with the same signal.

The ISOMONIC system divides the keyboard chromatically into two channels, so that notes adjacent to each other (in the chromatic scale) are not in the same channel, although alternate notes *are* in the same channel. For example, one channel will contain C, D, E, F#, G#, A#, C, etc. — this is designated as the "C" channel. The other channel, appropriately designated as the C# channel, contains C#, D#, F, G, A, B, C#, etc. The net effect of this separation is to prevent musical intervals of the fourth and the fifth from mixing in the amplifier or in the speaker, permitting them to mix only acoustically, thus following the pattern of the orchestra, the choir, and the pipe organ.

The ISOMONIC channelling is applied only to the organ's MAIN section, since the complex tones produced there are rich in harmonics and thus must be separated in order to avoid beats and interference. The TIBIA tone, being pure fundamental, is devoid of the upper harmonics that produce the previously-mentioned beats and interference. Hence, the ISOMONIC separation is not required for the TIBIA; its entire output is handled by a single sound channel.

PEDAL tones, isolated electrically from the other sections of the organ, are directed to a separate amplifier channel. The PEDAL speaker is isolated in a separate compartment of the 101 cabinet, thereby preventing modulation and distortion of the manual speakers.

SPECIFICATIONS

Cabinet: Selected hardwood veneers with quality lacquer finish to match consoles.

Dimensions: 29" wide, 20½" deep, 41" high

Speakers: Cabinet contains seven individual loudspeakers — one heavy-duty 15-inch unit for the Pedal output, and six broad-range 6 x 9 speakers for the manuals. Three of these speakers are mounted in stationary positions behind louvers at the top of the cabinet, while the other three are mounted in the rotating drum in the lower part of the cabinet. The six 6 x 9 speakers are grouped electrically into three pairs, each pair consisting of one stationary and one rotating speaker. These three pairs of speakers are powered by the three amplifier channels which receive the output from the organ manuals.

Amplifier: Four separate channels with combined output power of 65 watts. Individual etched-circuit boards hold the components for each channel. Boards are compact and are easily replaced. There are individual volume controls (screwdriver-adjustable) for each channel. The four amplifier channels are designated by number, and relate to the organ output channels as follows:

- Amplifier Channel 1 — Organ PEDAL Channel
- Amplifier Channel 2 — Organ MAIN C Channel
- Amplifier Channel 3 — Organ MAIN C# Channel
- Amplifier Channel 4 — Organ TIBIA Channel

Tremolo System and Control: The unique Leslie tremolo effect is produced in the Model 101 by a system of rotating loudspeakers. The 101 also includes stationary speakers, which of themselves produce no tremolo. Tremolo control then is merely a matter of selecting the speakers to which the amplifier's output is to be routed. Tremolo control for the TIBIA channel is separate from that of the two MAIN channels. The control circuit for the TIBIA channel routes this output to the rotary speaker for Tremolo "ON", or to the stationary speaker for Tremolo "OFF". The control circuits for the two MAIN channels are operated together by a single tablet, although they remain separate electrically. When the MAIN tremolo is "OFF" signal is routed only to the assigned stationary speakers. When the MAIN tremolo is "ON", an electronic tremulant is added to the signal, and this signal is routed to two of the rotating loudspeakers, as well as to two of the stationary speakers. Thus, the stationary speakers for the MAIN channels operate when the MAIN tremolo is ON or OFF. Further details will be found later in this manual.

Power Supply: 117 Volt, 60 Cycle A. C.

Power Consumption: 220 Watts, 2.3 Amps

Weight: 154 pounds net, 172 pounds boxed for shipment

Guarantee: One year from date of purchase, generally covering defective workmanship and materials. See guarantee card for details.

INSTALLATION

Unpacking and Preparing the Speaker for Operation

1. Remove the Leslie Speaker from its shipping carton, and detach the shipping skid from the bottom of the cabinet.
2. Remove the lower back cover panel, and take out the shipping blocks which hold the motor, rotor, and the amplifier. Save the wood blocks for possible future use in shipping the cabinet. Do not replace the back until installation is complete, as belt tension and amplifier volume levels may require adjustments. (See subsequent sections of manual.)
3. Remove cable from the upper compartment and attach it to the 9-pole plug on the 101 amplifier chassis.
4. Place the speaker cabinet so that it rests solidly on the floor, using wedges as necessary to prevent "rocking" where the floor is uneven.

Making the Connection at the Console

A simple plug-in connection is all that is required at the console, since the tremolo controls are already incorporated in the console's mechanism. Sockets are provided in the Gulbrandsen Model J and K consoles for connecting the Leslie Speaker. Two such sockets are provided in the Model K, and one such socket is provided in the Model J organ. The sockets are readily accessible when the back of the console has been removed.

Since the two sockets in the Model K are identical in function, either one may be used where just a single speaker is involved. The second socket is for a second speaker.

Although two sockets are provided in the Model J console, one of them is intended for the use of the built-in speaker system. Thus, only one socket is available for connecting the Leslie. Installations involving the Model J organ, and requiring two or more speakers, will be described later.

The 9-conductor cable from the speaker is connected to the socket in the organ console. The back to the console may then be replaced, as the installation is now complete.

Volume Control Setting — at the Leslie Speaker

Four volume controls are incorporated in the Leslie amplifier — one for each of the four channels. These screwdriver-type controls are adjusted at the factory to maximum levels for normal usage. However, individual taste or acoustic conditions may necessitate further adjustments. The controls are located on the etched circuit boards and are readily accessible. The individual channels are identified at the Leslie amplifier by numbers, arranged in sequence starting at the plug end of the amplifier. The relationship between console and speaker channels is as follows:

Amplifier channel number	Organ channel name
1	Pedal
2	Main "C"
3	Main "C#"
4	Tibia

Volume settings for the Tibia and Pedal channels may be adjusted independently of all the other channels, purely on the basis of individual taste. On the other hand, the settings for the two Main channels (Nos. 2 and 3) should be very carefully co-ordinated. If one of these channels is adjusted, the other should be brought into exact balance with it. In this way all the notes will be kept at the same sound level.

Belt Tension

Tension on the rotor drive belt should be sufficient to bring the rotor up to full speed within ten seconds after it is started. Yet this tension should not be so great that it causes noise and vibration. If it appears that the belt tension is not correct it should be adjusted. First, disconnect the motor plug from the amplifier, and allow the rotor to come to a complete stop.

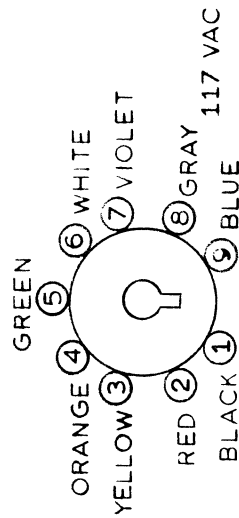
Tension is adjusted by means of the motor support wing nut nearest the back of the cabinet. Loosen this wing nut and move the entire motor assembly to the left until the belt is stretched. Release the assembly and it will automatically move to a position of equilibrium which provides approximately the correct amount of tension. Usually it requires only a slight increase in tension to produce the desired operating condition. Once the correct tension has apparently been obtained, the adjusting wing nut should be tightened securely. The motor should be plugged in and the starting and stopping of the rotor observed, to make certain that the tension is correct. Further adjustments should be made if necessary to achieve the desired operating condition.

Connecting Cable

The 9-conductor connecting cable is supplied in a standard 30-foot length, complete with plug and socket. This assembly is Leslie Part No. 100-60.

For longer console-to-speaker runs, two or more of these standard 30-foot cable assemblies may be connected together in series.

In certain installations a length of cable is required other than 30 feet. In such cases bulk cable should be ordered, along with the necessary connectors, as specified in the parts list. In attaching the connectors to the cable the color coding should be followed exactly, with special care being given to the handling of all connections involving AC. The sketch below shows the color coding.



Connector Color Coding

Special Installations with Early Model J and K Organs

The Model 101 Leslie Speaker may be connected to early Model J and K Organs, but some special steps need to be taken, and it is also necessary to use the connecting kit which is available for such installations. (Model J and K organs which are of earlier manufacture may be readily recognized as such since they do not have the "Main Tremolo Chorus" control, and the serial numbers will be below 20,000.)

The connecting kit consists of an adapter (No. 101-80) which, in effect, re-channels the various outputs from the console, so that the individual components of the 101 will be supplied with the correct signal. The organ's "Main Tremolo" control will now perform the same essential functions as the "Main Tremolo Chorus" control on the newer J and K consoles — that is, the Main channels' electronic tremolo will be switched On and Off simultaneously with the Leslie Tremulant. An additional control is necessary to enable the Main electronic tremulant to be used by itself; this is the function of the switch assembly which is supplied as a part of the special adapter kit.

A. Early Model J Installation using 101-80 Adapter

1. Remove the back of the organ, and plug the interceptor into the external speaker socket.
2. Mount the supplementary control under the keyboard shelf, fasten it in place with the two screws which are provided. Position the control so that it will be visible and accessible to the organist. The preferred location is to the left of the keyboard, although there is sufficient lead length to permit installation to the right of the keyboard, should this location seem preferable.
3. Route the cable from the control down along the corner where the knee panel and the end of the console are joined, then through the bass end of the panel switch assembly, and into the console.
4. Connect the two leads from the switch to the two (brown covered) wires from the interceptor plug, using wire nuts which are furnished. NOTE: When using wire nuts be sure to hold the wire ends parallel and together but do not twist them. Insert these ends into the opening of the nut, pushing firmly and turning clockwise direction until the connection is securely made.
5. Next, take out the two mounting screws near the top of the generator rack. Swing the generator rack away from the console, and place it on a suitably cushioned support.
6. Locate the Tremolo-vibrato "card" in the generator rack, and Terminal No. 2 in the contact strip for this card. Route the red wire from the interceptor plug up to this terminal, and solder it in place, along with the orange-and-black wire which is already connected there.
7. Return the generator rack to operating position and replace the two mounting screws at the top. Attach the 9-conductor speaker cable to the socket in the interceptor plug, and replace the back of the console. This completes the installation.

B. Early Model K Installation using 101-80 Adapter

1. Remove the back of the organ console, also the knee panel. Plug the interceptor into the external speaker socket to which the Model 101 Speaker is to be connected.
2. Mount the supplementary control under the keyboard shelf, fastening it in place with the two screws which are provided. Position the control so that it will be visible and accessible to the organist. The preferred location is to the left of the keyboard, although there is sufficient lead length to permit it to be located to the right of the keyboard, should this location seem preferable.
3. Route the cable from the control up through the slot in the keyboard shelf, then down inside the console to the interceptor plug.
4. Connect the two leads from the switch to the two (brown covered) wires from the interceptor plug, using wire nuts which are furnished. NOTE: When using wire nuts be sure to hold the wire ends parallel and together but do not twist them. Insert these ends into the opening of the nut, pushing firmly and turning in a clockwise direction until the connection is securely made.
5. Locate the Tremolo-vibrato "card" near the bottom of the generator rack, and terminal No. 10 in the contact strip for this card. Route the red wire from the interceptor plug up to this terminal, and solder it in place, along with the brown and white wire which is already connected there.
6. Attach the 9-conductor speaker cable to the socket in the interceptor plug. Replace the console back and knee panel. The installation is now complete.

Multiple Speaker Installations

When greater volume is required than can be obtained without distortion from a single Leslie Speaker, one or more additional Leslies may be utilized. Moreover, even where no additional sound volume is needed, the use of a second Leslie cabinet normally enhances any installation, adding fullness and still more of a pipe-like quality to the sound. In these latter cases, although the relative location of the two cabinets is not critical, it is usually possible to obtain a very interesting overall musical effect by placing the two speakers 15 to 20 feet apart. In making any installation involving more than one Leslie Speaker, some rather exact procedures must usually be followed, particularly in handling the AC supply, as is explained in the following paragraphs.

Power Requirements

A limited amount of AC power may be drawn from the organ console for external use, and it is dangerous to exceed this limitation. In the case of the Model K console, power is available for *two* of the Model 101 Speakers. In the Model J organ, however, power is available for only one of the Model 101 Speakers. Where it becomes necessary to exceed these maximums, the added speakers must be provided with a source of AC power which is separate from the organ console. This is accomplished through use of the No. 100-70 Extra Speaker Adapter, which draws its power from a source other than the console, yet is fully controlled from the console AC switch by means of a power relay which is incorporated in the adapter.

A No. 100-70 Extra Speaker Adapter must be used for each cabinet in excess of two on the Model K organs, for each cabinet in excess of one on the Model J organs. The procedure for connecting a Model 101 Speaker using the No. 100-70 Adapter is as follows:

1. Remove the lower back from the cabinet which is connected directly to the console. (Where two cabinets are connected, use either one.) Detach the connecting cable from the amplifier.
2. Connect the No. 100-70 Extra Speaker Adapter to the amplifier by means of the socket on the adapter's short extension cable.
3. Connect the 9-contact socket on the console cable to the 9-pole plug on the adapter.
4. Connect the cable for the speaker which is being added to the remaining socket on the adapter.
5. Plug the line cord into a convenient 117-volt AC outlet.

NOTE: The chassis of the No. 100-70 Extra Speaker Adapter may be permitted to rest on the floor behind the cabinet, in those cases where only a temporary installation is being made. For more permanence, however, it is suggested that the adapter chassis be fastened either to the back of the cabinet, or to the bottom shelf of the cabinet. In the latter case the chassis must be positioned near the back of the shelf so as to fully clear the rotor.

Pedal Loudness

When two or more speakers are being used together and are adjacent, they should be phased so that with individual pedal notes the speakers reinforce rather than cancel each other.

If improper phasing is suspected, try reversing the green and black wires in the plug on the 15-inch speaker in one of the cabinets. If louder pedal output results from this change it should be made permanent. However, if the pedal level is instead reduced, the original connection should be restored, and it may safely be concluded that the problem is acoustical rather than one of phasing. Phasing is comparatively unimportant where speakers are separated from each other by a considerable distance.

RECOMMENDED PERIODIC MAINTENANCE

Oiling

Remove lower compartment back to gain access to the oil pan on top of the motor. Place 20 to 30 drops of the oil which is furnished (or sewing machine oil) in this pan. Be very careful to prevent oil from getting onto the pulley grooves or the drive belt.

Generally it will be satisfactory if the motor is oiled every six months. Yet, in cases of active professional or commercial usage, it is suggested that the motor be oiled as often as every three months.

Belts

Belts will normally last for several years. They should, however, be inspected periodically for fraying which can cause noise. A frayed or badly worn belt should be replaced. The procedure for belt replacement will be found on page 17 of this manual. Once the belt has been replaced the tension should be adjusted according to the instructions given on page 4.

Tubes

Check periodically to see that all the tubes on the amplifier are illuminated and are functioning properly. The weakening of tubes with long use is such a gradual process that the resulting sub-standard performance may not at first be noticed. New tubes, if carefully checked, will restore the speaker to its original efficiency. For best results it is recommended that tubes be replaced when deterioration is first noticed.

SPECIAL USES OF THE LESLIE SPEAKER

Broadcasting and Recording

Limitations of the microphone — any microphone — must be taken into consideration in planning a set-up for broadcasting or recording. It may not be assumed that the microphone will pick up exactly the same sound and the same effects that are heard within the studio itself. The ideal set-up can only be arrived at experimentally. Among the few general principles that should be followed, are these:

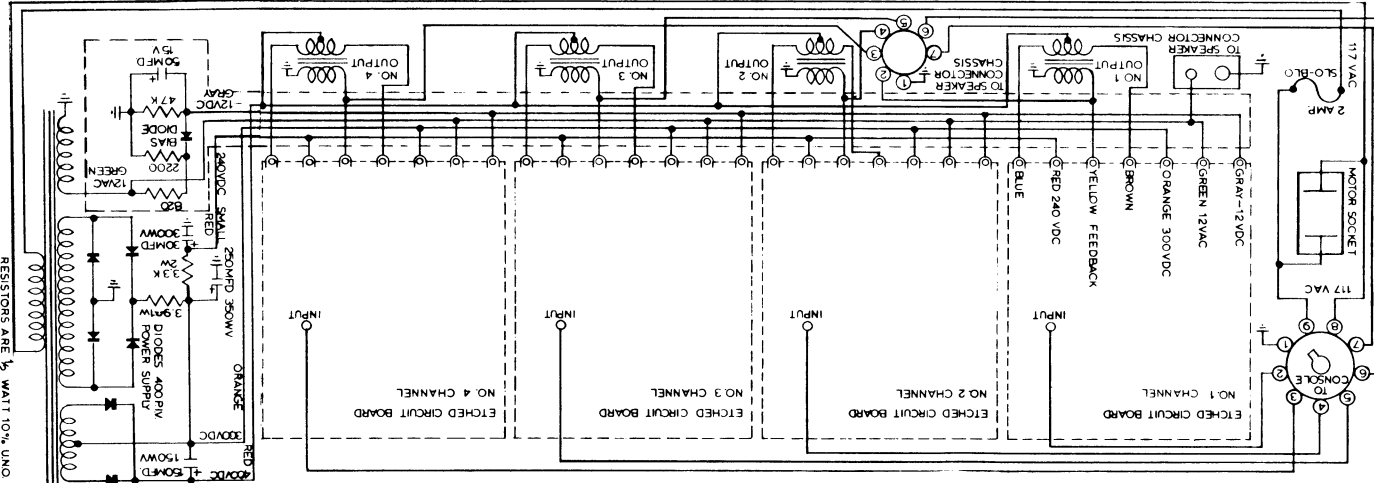
1. If possible, select a fairly "live" studio.
2. Play the organ at medium to full volume level.
3. Place the microphone ten to fifteen feet from the Leslie, and usually *not* in direct line with the upper speaker louvers.

Non-Organ Use of the Leslie Speaker

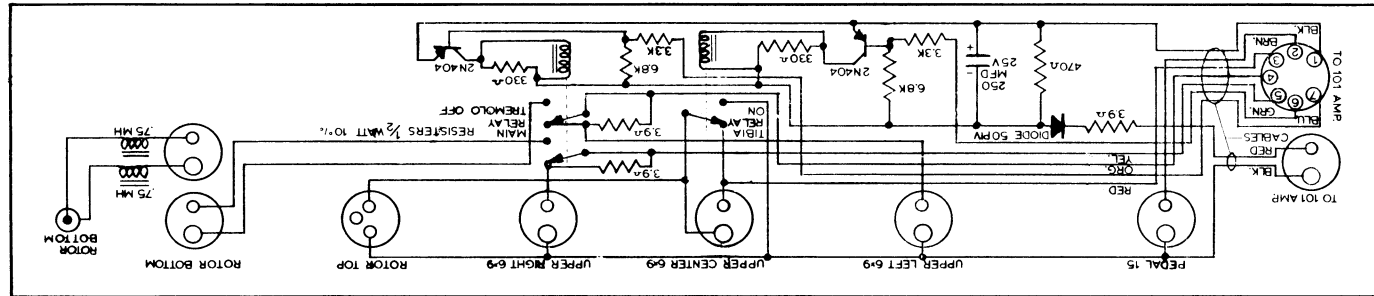
The Leslie Speaker is a high-quality product, designed solely and specifically for use with the electric organ. It does not function satisfactorily in other applications. The unique musical characteristics of the speaker result from electrical and acoustical properties which are totally different from those found in "high fidelity" sound equipment. This specialized concept of the Leslie Speaker restricts its recommended usage to the electric organ.

SHIPPING

The Leslie Speaker may be moved or carried in any position without special preparation. However, if it is to be shipped, the cabinet should be in an upright position, with shipping blocks in place to protect the motor, rotor, and the power amplifier.



ABOVE: Type 101 Four-channel amplifier—general schematic.
BELOW: Signal Junction Chassis detail—Part No. 101-20



TECHNICAL SERVICE INFORMATION

For servicing it is usually necessary to remove the back of the Model 101 cabinet. Because of its weight and inertia, the rotor — when spinning — can be dangerous. Thus, care should be taken to avoid personal injury or damage to equipment.

Replacement Parts Procurement

Replacement transformers, filter chokes, etched circuit boards, tremolo relays, and loud speakers should be obtained from Electro Music. Standard type parts such as fuses, sockets, resistors and condensers, can be obtained from local electronic supply houses. The detailed parts list in this manual gives complete parts replacement information.

THE AMPLIFIER

(Refer to pages 9 and 10 for schematics)

The Type 101 Amplifier is skillfully engineered for long, trouble-free operation. The power supply is designed around three silicon rectifier circuits, with a resulting stabilized screen supply that enhances the amplifier's operation. The four-channel design is made possible by the use of individual etched-circuit boards for each channel. Each circuit board consists of an insulating panel with copper conducting lines on one side and all of the amplifier components (including volume control and tube sockets) on the other. One board is used for each channel — Pedal, Main-C, Main-C#, and Tibia — and is connected to its individual output transformer and to the power supply by means of connecting clips. Each amplifier channel receives its input from the organ through the nine-pin plug on the front of the chassis by means of a wire soldered to the etched side of the circuit board.

A non-fused AC power outlet is provided on the chassis front for the motor which drives the tremolo rotor. Due to the type circuitry involved, the power consumption of the amplifier varies from 170 watts — with no signal, to 220 watts — with full signal on all channels.

Amplifier Removal and Replacement

The amplifier is removed from the cabinet by taking out the one screw that holds the front end of its chassis to the bottom of the cabinet. The connecting cable (from the console) and the motor plug should be removed from the amplifier, which should then be partially withdrawn from the cabinet. Next, disconnect the two plugs on the left side of the amplifier. Finally, the amplifier may be completely withdrawn.

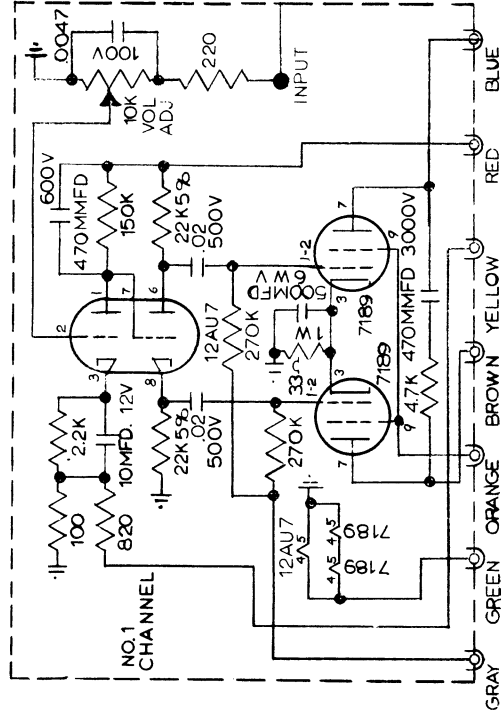
When replacing the amplifier, be sure to align the back end of the chassis so that it will engage the hold-down clamp in the cabinet. The amplifier should be pushed securely into position, and the front holding screw replaced.

Fuse

The amplifier uses a replaceable "Slo-Blo" 2-amp fuse for protection against overloads. When a fuse fails it should not be replaced until the cause of failure has been determined and eliminated. Replacement fuses whose current rating is higher than specified should never be used.

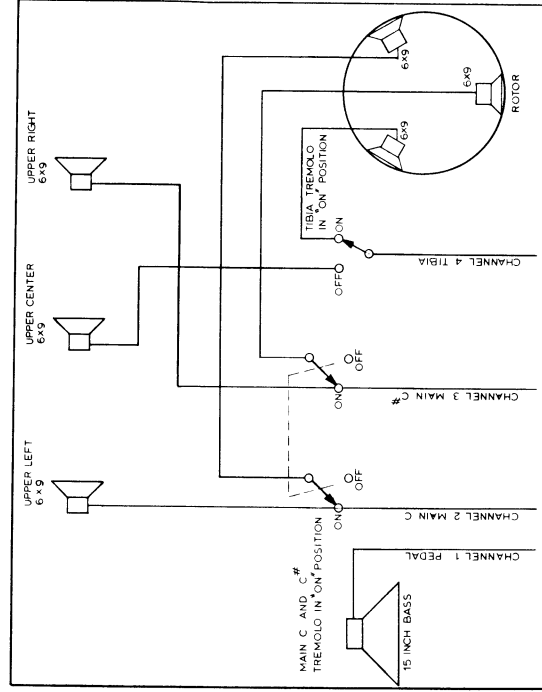
Distortion

Distorted sound may occasionally result from volume control settings which are too high. The four channels are set at "full" volume at the factory, with the expectation that one or more of the settings may need



ABOVE: Detailed schematic of individual amplifier channel. Etched circuit board, part No. 100-13. See previous page for general amplifier schematic.

BELOW: Channelling system for loudspeakers



to be attenuated at the time of installation, in order to balance the channels, or to compensate for acoustic problems. It may at times also be necessary to reduce the volume of a given channel in order to eliminate an overload condition in either the speaker or the amplifier.

As was previously pointed out, the Pedal and Tibia channels must be set independently of the others, while the settings for the two Main channels must be carefully co-ordinated. Before considering any of the volume levels to be finally "set" make a listening test for overload, using a full registration, and with the expression pedal at its maximum position.

Line Voltage

Line voltage that is lower than 100 volts, or higher than 130 volts will adversely affect the operation of the amplifier. While the low condition will result merely in poor performance, the high voltage condition will cause overheating and possible component damage. Some sort of voltage-regulating device should be used in those instances where the condition cannot otherwise be eliminated.

Line voltage at the electrical outlet may be in the proper range, and yet read lower at the amplifier. A drop here may be due to faulty cable contacts.

Tubes

Tubes are a common source of amplifier difficulties, although it must first be recognized that certain malfunctions which at first appear to be caused by tubes are actually the result of other conditions.

The tube tester will reveal certain tubes to be defective. Moreover, replacement is also recommended for tubes which have been in service for a considerable period of time, as their performance will have deteriorated and the amplifier will not operate efficiently.

Voltage Readings

If the amplifier malfunctions, or fails completely, the tubes and the electrolytic condenser should be checked first. If it appears that the difficulty lies elsewhere, the faulty component, or components, may be detected by checking the voltages at various points in the amplifier circuitry. Readings should be similar to those shown on the circuit diagram, although reasonable allowances should be made for meter resistance, line voltage variations, and normal tolerances. The voltages in the diagram were obtained by using a 20,000 ohms-per-volt multimeter.

An unusually high or low voltage reading (with respect to values shown in the circuit diagram) usually indicates a defective component in that particular part of the circuit.

Etched Circuit Board Replacement

If the cause of trouble is traced to one of the parts on an etched circuit board, that part may be replaced by using a pencil-tip soldering iron. Much time and expense can be saved, however, by replacing the whole circuit board with a new one, rather than to attempt to repair the defect.

The etched circuit board is easily removed, as follows:

1. Remove the tubes from the etched circuit board, and turn the entire amplifier upside down.
2. Remove the seven wire connectors from the end of the etched circuit board.

3. Using a pencil soldering iron, unsolder and remove the input lead from the etched circuit board. (This is the lead which comes from the 9-contact plug to a point on the etched circuit board near the screwdriver-adjustable volume control.)

4. Remove the four nuts, lockwashers, and flatwashers holding the etched circuit board in place; the board may now be removed from the amplifier.

5. After checking for proper alignment of the mounting screws with the mounting holes in the circuit board (if it is a new unit) the board is replaced, then the flatwashers, lockwashers, and finally the nuts to secure it in position.

6. Attach and re-solder the input lead to the new board.

7. Connect the seven wires, by means of their connectors, to the terminals on the circuit board. Each terminal is identified by either the color or the function of the wire which is to be connected to it. The relationship is as follows:

gray wire — bias supply
green wire — filament
orange wire — screen
brown (output transformer) wire — plate
yellow wire — feedback
red wire — 200 volt B+ for 12AU7 tube
blue (output transformer) wire — plate

8. Replace the tubes and check the amplifier for proper operation.
9. Adjust the volume control with a screwdriver to balance channel with others, as described previously.

Bias and Terminal Strip Board Removal and Replacement

1. Remove the four etched circuit boards. (See previous section.)

2. Unsolder the following wires:

From the high voltage section: two red wires, one orange wire
From the board itself: two green wires, four yellow wires from the output socket, four red output transformer wires, four green output transformer wires.

3. Loosen nut on the fuse holder, and slide the holder through the hole in the chassis until the nut on the bias board is accessible.
4. Remove mounting nuts on the bias board and remove it from the chassis.

5. Install replacement board, reversing the above procedure.

Transformer Replacement

If an output or power transformer is to be replaced, the colors must be noted and the new transformer wired with the same color identification. Replacement transformers should be obtained from Electro Music and they will be provided with correct lead lengths and with any necessary connectors.

Replacement of any of the output transformers first necessitates the removal of the etched circuit board for that particular channel. One or both of the mounting bolts for the bias and terminal strip board should also be loosened as necessary to permit the board to be tilted, thus to facilitate the exchange of transformers. Reassembly should follow in careful reverse order those same steps which were employed in disassembly.

SIGNAL JUNCTION CHASSIS

Output from the amplifier's three channels which serve the organ's manuals may be directed to different loudspeakers within the 101 cabinet, depending on the effect that is desired. All signal output from the amplifier is fed into the Signal Junction Chassis (Leslie Speaker Connector Chassis, No. 101-20) and is then routed out to one or more of the 6 x 9 speakers by means of a switching system which is controlled at the console. The actual switching within the junction chassis is accomplished by two relays. One of the relays functions only for the Tibia channel, directing its output either to the stationary speaker (Tibia tremolo "off"), or to the assigned speaker in the tremolo rotor (Tibia tremolo "on"). The other relay switches the output from the two Main channels, routing these signals into the assigned rotating speakers whenever the "Main Tremolo Chorus" is on. The two stationary speakers for the Main channels are in the circuit at all times; use of the "Main Tremolo Chorus" activates the two rotary speakers in addition. Signal output from the amplifier's Pedal channel passes through the Junction Chassis, but it is not in any way affected by the switching of the other channels.

Output from the two Main channels may be routed to just the two stationary speakers, or to a total of four speakers (two stationary and two rotary), depending on whether the "Main Tremolo Chorus" is off or on, as was explained previously. In order to equalize the sound level of these two conditions, filter chokes have been used in the supply circuit for the rotary speakers, and resistors are introduced into the supply circuit for the stationary speakers when the "Main Tremolo Chorus" is switched on. Thus, the four speakers produce no greater sound volume than the two.

Contact between the signal junction chassis and the three speakers in the rotor is effected through the use of patented rotary contacts. (These are discussed in detail in the "Mechanical Maintenance" section.) Each of these contacts handles two completely independent circuits. Thus, with two of the contacts in use, a total of four circuits is available. With one of these circuits common to all three of the rotary speakers, there remains an individual circuit for each of the speakers, thereby making each one completely independent of the other two speakers in the rotor.

The diagram on page 10 shows the system of connections to the speakers.

LOUDSPEAKERS

The Pedal Speaker

A 15-inch speaker handles output from the organ's Pedal channel. The speaker is mounted in a bass-reflex enclosure whose size is carefully calculated to provide correct "loading". Thus, for proper bass response, the upper back panel of the cabinet must be in place and securely fastened.

Should the 15-inch speaker malfunction or fail, it must be replaced. Field repair, involving disassembly of the speaker, cone replacement, etc., is not recommended; the speaker should be returned to Electro Music for any such major repair.

Disconnect the speaker by withdrawing its plug from the connection at the signal junction chassis. Remove the screws in the rim of the speaker, and it may then be lifted out.

The Stationary (Manual) Speakers

Should any of the three stationary 6 x 9 speakers malfunction or fail, replacement is necessary. The procedure is as follows:

1. Disconnect the speaker at the signal junction chassis, and pull the lead wires up into the top compartment, after first removing the cork which is inserted in the hole between the two compartments.
2. Remove the four nuts from the mounting screws around the rim of the speaker, and pull the speaker straight back until it is free of these screws. The speaker must then be turned with the magnet down in order to remove it from the cabinet.
3. In replacing the speaker, fit it carefully over the mounting screws as these could seriously damage the speaker cone.

The Rotary (Manual) Speakers

Replacement of any one of the three rotary speakers (for reasons of malfunction or failure) is a simple process. First it is necessary to remove the complete rotor from the cabinet, as described on page 18. The remaining steps, then, are as follows:

1. Turn the complete rotor assembly upside down, to expose the speaker access opening in the bottom of the rotor drum.
2. Take out the four mounting screws; the speaker can now be removed from the rotor drum.
3. In replacing the speaker, be sure to use a unit whose magnetic structure is identical to that of the speaker which was removed.

MECHANICAL MAINTENANCE

(Refer to page 19 for mechanical diagram)

MOTOR

After several years of typical service, or a reasonably long period in commercial use, the motor might accumulate lint and dust. This accumulation interferes with proper ventilation and oiling, therefore can adversely affect the operating life of the motor. At this point it is recommended that the motor be thoroughly cleaned. The motor may be quite easily removed and disassembled for this purpose.

Motor Removal and Replacement

Remove the motor power plug from the socket on the amplifier, and remove the two wing nuts that hold it to the shelf. The motor will drop down for removal. When replacing the motor, first position the belt on the pulley before it is lifted into place on the mounting screws. The wing nut nearest the back of the cabinet controls belt tension, and this therefore must be re-set after the motor has been replaced. (See "Belt Tension", page 4.)

Motor Disassembly and Cleaning

1. Remove the pulley, pulley support ring, and oil tube assembly.
2. Note, or mark, the position of the top and bottom end covers in relation to the laminations, to insure correct assembly of the motor.
3. Remove the four screws holding the end covers, and disassemble the motor.
4. Clean all parts with solvent and allow them to dry.

5. Oil the felt bearing pads located inside the two end covers.
6. Reassemble the motor. If it is then noisy in operation, the bearings are probably unseated. To correct this tap the motor on the side with a fairly heavy tool. This will cause the bearing to align itself with the shaft, and the noise should thus be eliminated.

NOTE: The mounting brackets for the motor should measure $5\frac{3}{4}$ " between centers of the mounting holes. If the brackets are bent they should be straightened as necessary to obtain this dimension.

ROTARY CONTACT MECHANISM

Output from the amplifier is channelled to the speakers in the tremolo rotor by means of special rotary contacts. Two such contacts are used — one at the top of the rotor shaft, and the other at the bottom. These contact units are of patented design, and incorporate pools of mercury as the inner contact vehicle.

Rotary Contact Removal and Replacement — Upper

In case of apparent malfunction, the rotary contact should be removed and checked:

1. Remove the fibre cap assembly, pulling it straight up with one hand, while the contact itself is being held in position on the shaft end with the other hand.
2. Remove the rotary contact from the shaft by pulling it straight up, turning the contact back and forth to loosen it on the shaft end.
3. Check the contact for malfunctions according to instructions given in a subsequent section of this manual. See "Rotary Contact Malfunctions."
4. Replace the contact on the rotor shaft by pushing straight down, carefully avoiding damage to the contact pin in the center of the shaft.
5. Replace the fibre cap assembly on the top of the contact, again carefully protecting the delicate contact pin in the center of the cap.

Rotary Contact Removal and Replacement — Lower

To gain access to the lower rotary contact the Leslie cabinet should be laid on its back, and the metal bottom cover plate taken off. Then:

1. Hold the contact with one hand, and pull off the fibre cap assembly with the other hand, pulling straight out to avoid damaging the center contact pin.
2. Remove the rotary contact, pulling it straight away from the shaft until there is a complete separation.
3. Check the contact for malfunctions. See instructions below.
4. Reassemble in the reverse sequence, first connecting the rotary contact to the shaft end, making sure to connect the upper end of the contact, so that the "UP" arrow points in the proper direction. Make the connection carefully, pushing the contact end straight into the shaft so as to avoid damaging the delicate contact pin.
5. Finally, replace the fibre cap assembly on the lower end of the contact pushing it straight on.

Rotary Contact Malfunctions

Interruptions of the signal, or "static" noises from any of the speakers in the tremolo rotor usually means that there is an intermittent condition in one or more of the signal supply circuits. The cause may be found in one or both of the rotary contacts; at least these units should be checked whenever the above malfunction is encountered. After the rotary contact has been removed from the cabinet, proceed as follows:

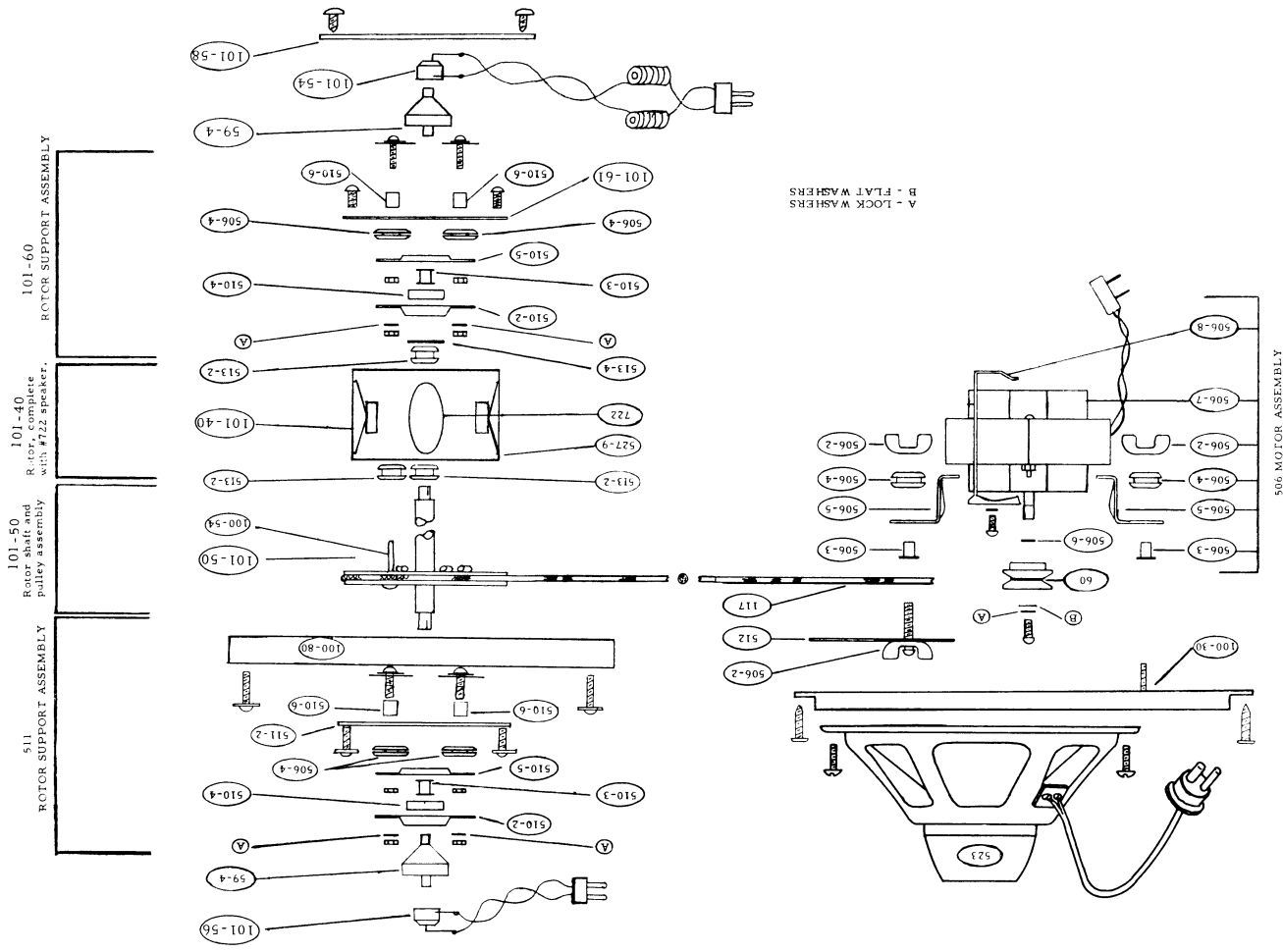
1. Hold the mercury contact in an upright position and spin the top center section with the fingers three or four times.
2. Use an ohm meter to check internal continuity of the mercury contact. The meter reading should be less than one ohm between the following:
 Top center terminal to bottom center terminal
 Top outside terminal to bottom outside terminal
3. Check to make sure there is *no* continuity between the inside and the outside circuits in the mercury contact. If there is continuity between inside and outside circuits, repeat step number one. If the continuity between the two circuits then disappears, the mercury contact may be considered "clear" and thus can be reinstalled.
4. If continuity between the inside and outside circuits still cannot be broken, it is possible that the mercury within the contact needs to be re-seated. This is accomplished through the same technique of centrifugal force as is used to reduce a fever thermometer. Hold the mercury contact with the fingertips, with the funnel-shaped end pointing away from the palm of the hand. Then apply centrifugal force by combining a smooth downward swing of the arm with a final wrist-snap motion. If this does not clear the contact it is probably defective and should be replaced.

Belt Replacement

A worn or frayed belt should be replaced. The procedure is as follows:

1. Remove the rotary contact assembly from the top of the rotor shaft, according to the procedure given previously.
2. Remove the four black screws from the upper bearing mounting block and lift the block up and off the rotor shaft. (There are two guide pins in the block to insure its being located properly.)
3. Loosen the motor support wing nut nearest the back of the cabinet, remove the old belt from the motor pulley, and pull it up and off from the rotor pulley.
4. Place the new belt over the rotor shaft. Feed the belt under the speaker, position it on the motor pulley, and hold it in place. Slip belt onto rotor pulley and push motor left to prevent belt from slipping off the pulleys.
5. Replace the upper bearing mounting block over shaft end, aligning the guide pins with their proper holes. Fasten the block in place with the four black screws which were previously removed.
6. Replace the rotary contact on the shaft by pushing down carefully to prevent damage to the contact pin in the center of the shaft.
7. Adjust the belt tension, following the instructions given previously.

PARTS IDENTIFICATION



Upper Rotor Bearing Replacement

1. Remove rotary contact assembly from the top of the rotor shaft, according to instructions given previously.
2. Remove upper half of bearing clamp. Ball bearing can now be lifted out and replaced.
3. Reassemble the new bearing in the bearing clamp.
4. Replace the rotary contact on the shaft by pushing down carefully to prevent damage to the contact pin in the center of the shaft.

Lower Rotor Bearing Replacement

1. Lay cabinet on the floor face down so that the bottom is fully accessible. Remove metal cover plate in bottom of cabinet.
2. Remove the rotary contact assembly from the rotor shaft, following the procedure given previously.
3. Remove the screws at both ends of the lower bearing support assembly; the entire bearing assembly can now be pulled from the shaft. Be sure to hold the rotor assembly in its normal position to relieve weight on the bearing and to facilitate disassembly.
4. Remove upper half of the bearing clamp; ball bearing can now be lifted out and replaced.
5. Reassemble the new bearing and bearing clamp.
6. Replace the bearing support assembly on the rotor shaft, making certain that the flat washer is included between the rotor and bearing grommets with the smooth side of the washer against the shaft shoulder.
7. Replace the rotary contact assembly, and the metal cover plate.

Tremolo Rotor Removal and Replacement

1. Lay the cabinet on the floor face down so that the bottom is fully accessible. Remove the metal cover plate, and the rotary contact assembly. Return the cabinet to upright position.
2. Remove the upper rotary contact assembly, the 15-inch speaker, and the upper bearing mounting block, following previous instructions.
3. Remove the drive belt from the rotor pulley, and unplug the rotor speaker leads from the terminals on the rotor shaft.
4. Grasp the rotor pulley and pull straight up for several inches so as to clear the rotor drive pin; continue pulling upward, at the same time rotating the pulley back and forth until the shaft is completely withdrawn from the rotor. The rotor can now be slid out of the cabinet. (Be sure to save flat metal washer which separates bearing and rotor grommets.)
5. When reassembling, be sure the rotor shaft enters the "solid" end of the drum. The rotor drive pin must fit into the grommetted drive hole, and the flat metal washer must be included between the rotor and lower bearing grommet, with smooth side of the washer against the shaft shoulder. (When replacing shaft in the rotor, a little oil or vaseline may be used as a lubricant; grommets are made of neoprene and will not be damaged.)
6. Replace the rotor drive belt, the upper bearing mounting block, the 15-inch speaker, and the upper rotary contact assembly, according to previous instructions.
7. Lay cabinet on the floor face down so that bottom is fully accessible. Replace lower rotary contact assembly, and metal cover plate.

PARTS LIST

TO AVOID ERRORS, orders should include serial number(s) of the Leslie Speaker(s) on which the parts will be used. Also, PARTS SHOULD BE ORDERED BY NUMBER. Be sure to state color when ordering switch cases or complete switch assemblies. Sockets, connectors, and standard value components (resistors, condensers) are available through local electronic supply houses. Most of the "hardware" items (bolts, nuts, screws) are also locally available. Parts listed below are mainly non-standard items, or components with close tolerances which should be obtained from Electro Music.

101	Four-Channel Amplifier
100-14	Bias and terminal strip board
525-6	Bushing, shoulder, neoprene, for chassis mounting strip (4 used)
525-7	Bushing, metal, for mounting strip (4 used)
525-5	Chassis mounting strip (2 used)
100-13	Etched circuit board, amplifier channel (4 used)
100-18	Filter condenser, plug-in type, 30-30-30-10 mfd., 350 volt
100-19	Filter condenser, 150 mfd., 150 volt
100-110	Filter condenser, plug-in type, 100-100 mfd., 350 volt
525-17	Fuse holder
100-12	Output transformer (4 used)
100-11	Power transformer
25-5	Silicon diode, power supply (6 used)
100-15	Silicon diode, bias supply
525-21	Socket, filter condenser
525-13	Socket, motor outlet
101-20	Signal Junction Chassis, complete
100-16	Relay
101-26	Relay
730-3	Socket, speaker, 2-contact (5 used)
101-22	Socket, speaker, 3-contact
100-15	Silicon diode
201-15	Transistor (2 used)
101-40	Rotor Assembly, complete
513-2	Grommets, rubber, for rotor (3 used)
513-4	Washer, metal
722	Speaker, 6 x 9, PM-type (3 used)
101-50	Shaft and Pulley Assembly, complete
101-51	Shaft and pulley only
100-54	Drive pin for pulley
101-54	Rotor connector assembly, lower
59-5	Fibre connecting cap
101-56	Rotor connector assembly, upper
59-5	Fibre connecting cap
59-4	Rotary contact, mercury type (2 used)

506	Motor Assembly, complete less pulley
506-2	Wing nut (2 used)
506-3	Bushing, shoulder, metal (2 used)
506-4	Grommet, neoprene, motor mounting (2 used)
506-5	Bracket, motor mounting (2 used)
506-6	Ring, wire, pulley support
506-7	Motor only
60	Pulley, for motor
100-30	Rail, for motor mount
511	Rotor Support Assembly (2 used)
510-2	Bearing clamp, large hole
510-3	Grommet, neoprene, for bearing
510-4	Ball bearing
510-5	Bearing clamp, small hole
511-2	Mounting plate, rotor support
506-4	Grommet, neoprene, for mounting plate (2 used)
510-6	Bushing, metal, for grommet (2 used)
100-80	Mounting Block, upper bearing
117	Belt, Rotor Drive
523	Speaker, 15-inch PM type
722	Speaker, 6 x 9, PM type (3 used, in addition to 3 in the rotor)
100-60	INSTALLATION ACCESSORIES
100-61	Cable Assembly, 9-conductor, 30-foot length, with connector plugs installed
100-62	Nine-conductor bulk cable, less connectors, to specified lengths
100-63	Nine-pole plug and cap, for 100-61 cable
100-70	Nine-contact socket and cap, for 100-61 cable
101-80	Power Relay, Extra Speaker Adapter
530	Special Adapter, for early J and K consoles
	Lubricating Oil, in container

MISCELLANEOUS SCREWS

Thread & Length	Quantity and Usage
10-24 x 7/8" Sems with lockwasher	(1) Fasten amplifier to cabinet (1) In slot of adjustable motor mount — used with #506-2 wing nut
10-24 x 1 1/2" Sems with washer	(1) Rear motor mount (2) Fasten upper bearing assembly (10) Fasten backs to cabinet (4) Fasten bearing mount to shelf
8-32 x 3/8" Sems with washer	(1) Fasten pulley to motor
8-32 x 3/8" Sems with lockwasher and flat washer	(4) Fasten bearing clamps to mounting plates
#6 special washer	(16) Used under nuts fastening circuit boards in the amplifier chassis