LOWREY REPAIR PROCEDURES MANUAL

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993-023140

Chapter 1

Parts Replacement

THE USE OF SUBSTITUTE PARTS

Official company policy is "WE DON'T RECOMMEND USING ANYTHING OTHER THAN FACTORY-SUPPLIED PARTS" — except standard resistors and capacitors. The Guarantee says the same thing more explicitly in that the manufacturer's guarantee shall become void in the event that non-factory-supplied parts are used.

In actual practice, however, many parts are standard electronic parts that can be purchased from the part manufacturer or his agents anywhere. So from a practical standpoint the following list of interchangeable parts is provided for those technicians who feel they need to use substitute parts.

IMPORTANT

Technicians using the following list of substitute parts do so at their own risk! The list is compiled from comments received from field technicians only and is not tested or assumed to work in all cases.

SOME PITFALLS OF PARTS SUBSTITUTION

1. Let us suppose a transistor is diagnosed as bad and is then replaced with a substitute. What if the substitute doesn't work? Then the technician assumes his trouble is elsewhere and is off on a wild chase costing time and money.
2. Let us assume a preamp transistor is diagnosed as bad and a substitute is used to replace it and it works. But, what if that transistor has high noise leakage that the technician doesn't notice and the owner does notice after the technician has gone.
3. How about long term durability? Suppose the substitute part works fine for a few weeks and then fails. Factory parts are all tested prior to use and in the field after use. The manufacturer monitors parts reliability constantly. If the part is improved, the technician ordering that part gets the improved part.
4. Certain parts, like speakers for instance, can - if substituted - completely change the character of the organ tone. The amount of highs, lows, resonance, volume and power handling capability all would be different and yet, everything would be all right electrically.

COMPONENT PARTS REPLACEMENT

NETWORKS

Keying, Voicing, Filter and Divider Networks can be replaced easiest by using either of the two following methods:

(1) Clip defective network leads about 1/8" from body of network then solder new network leads to old network leads. (See Figs. 1A & 1B.)

(2) Clip defective network leads about 1/8" from body of network, unsolder each lead one at a time from the printed circuit board, and then solder new network to printed circuit board.

NOTE: The 1/8" of lead left on the supposed defective network permits reuse of the network in case of error in diagnosis.

NETWORK REPLACEMENT

Fig.1A

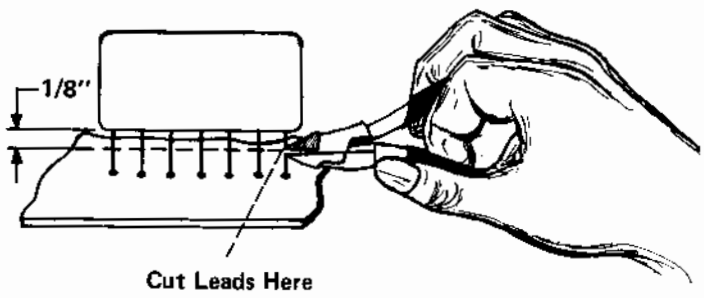
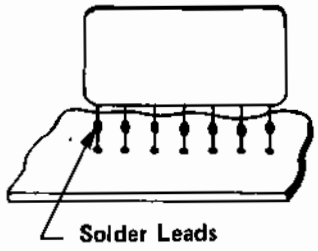


Fig.1B



PARTS SUBSTITUTION CHART

ZENER DIODES

Lowrey Part No.	Vendor Part No.	Nominal Volt
919-017406	IN5363A	30V
919-017406-1	IN5344A	8.2V
919-017406-2	IN5342A	6.8V
919-017406-3	IN5355A	18V
919-017406-4	IN5359A	24V
919-017406-5	IN5347A	10V
919-017406-6	IN5350A	13V
919-017406-7	IN5349B	12V
919-017406-8	IN5353A	16V
919-017406-9	IN5351A	14V
919-017406-10	IN5357A	20V
919-017406-11	IN5358A	22V
919-017406-12	IN5361A	27V
919-017406-13	IN5352A	15V
919-017406-14	IN5348A	11V
919-017406-15	IN5339A	5.6V
919-017406-16	IN5336A	4.3V
919-017406-17	IN5345A	8.7V
919-017406-18	IN5333A	3.3V
919-017406-19	IN5334A	3.6V
919-017406-20	IN5335A	3.9V
919-017406-21	IN5337A	4.7V
919-017406-22	IN5338A	5.1V
919-017406-23	IN5340A	6.0V
919-017406-24	IN5341A	6.2V
919-017406-25	IN5343A	7.5V
919-017406-26	IN5346A	9.1V
919-017406-27	IN5354A	17V
919-017406-28	IN5356A	19V
919-017406-29	IN5360A	25V
919-017406-30	IN5362A	28V
919-017406-31	IN5364A	33V
919-017406-32	IN5365A	36V
919-017406-33	IN5366A	39V
919-017406-34	IN5367A	43V
919-017406-35	IN5368A	47V
919-017406-36	IN5369A	51V
919-017406-37	IN5370A	56V
919-017406-38	IN5371A	60V
919-017406-39	IN5372A	62V
919-017406-40	IN5373A	68V
919-017406-41	IN5374A	75V
919-017406-42	IN5375A	82V
919-017406-43	IN5376A	87V
919-017406-44	IN5377A	91V
919-017406-45	IN5378A	100V
919-017406-46	IN5379A	110V
919-017406-47	IN5380A	120V
919-017406-48	IN5381A	130V
919-017406-49	IN5382A	140V
919-017406-50	IN5383A	150V
919-017406-51	IN5384A	160V
919-017406-52	IN5385A	170V
919-017406-53	IN5386A	180V
919-017406-54	IN5387A	190V
919-017406-55	IN5388A	200V
919-017406-56	IN5355B	18V
919-017406-57	IN5347B	10V
919-017406-58	IN5333B	5.1V
919-017406-59	IN *	4.5V
919-017406-60	IN5352B	15V

INTEGRATED CIRCUITS

Lowrey Part No.	Vendor Part No.
991-013182-1	GE470
991-015942-1	MFC6020
991-018494	SC18081L
991-018813-1	GEM555 or AIK7207BC
991-018813-2	GEM556 or AIK7207AV
991-019354	SN74107
991-019355	MC8311P or SN74154
991-019356	SN74193

TRANSISTORS

Lowrey Part No.	Vendor Part No.
991-002298	2N3391A
991-008393	2N2924
991-008394	2N2923
991-010098	2N3702
991-013544	2N5249A
991-015587	2N3414 or 2N3415
991-015663	2N5308
991-016274	2N2925
991-018238	2N6008
991-020425-1	RCA31 or TIP31
991-020425-3	RCA31B or TIP31B
991-020426-3	RCA32B or TIP32B
992-001192	2N555
992-008870	BENDIX B1717
992-020432	2N3055
992-003139	2N3055
992-017169	2N3055

* 919-017406-59 is a selected version of 919-017406-22.

TRANSFORMERS

The most important thing to remember when replacing a transformer is. . . replace it one lead at a time! This can be done easily by following the steps listed in order below:

(1) Clip old transformer leads 1/2" from their terminal connections. The 1/2" left at the terminal is for wire color identification.

(2) Remove old transformer, install new transformer and dress leads toward corresponding colored 1/2" clipped old transformer leads.

(3) Connect new transformer leads to terminals with corresponding 1/2" clipped leads from old transformer.

(4) Remove 1/2" old transformer leads.

CAN-TYPE ELECTROLYTICS

The following method permits quick and easy replacement of metal can-type electrolytic capacitors. Using a pliers, side cutter and standard soldering iron or gun:

1. Take a good firm hold on the can to be replaced, then push and pull it sideways until it breaks off - leaving just the bottom of the can with terminals and ground lugs still connected normally.
2. Unsolder or clip off wires connected to capacitor terminals. Clip off any wires connected to the can ground lugs. Make certain to note which wires are connected to which terminals.
3. Using a pliers, twist off can ground lugs and remove all that's left of can, terminals and lugs. Don't be delicate in your efforts - literally pull the ground lugs from their solder connections.
4. Insert new can in chassis and twist ground lugs with pliers. Solder wires to capacitor terminals and ground lugs.
5. Connect and solder a heavy ground wire from a ground lug on the can to a ground terminal located as close as possible to the new capacitor.

RECTIFIER AND ZENER DIODES

Replace rectifier and zener diodes by connecting as original part was installed. However, dress the diode away from any close-by power resistors. Since power resistors get hot, close placement of diodes can appreciably raise the diodes operating temperature and possibly cause thermal runaway failure.

POWER TRANSISTORS

Although power transistors are plug-in and easy to replace, there are some important basic considerations to observe:

1. The case of the transistor is one element of the transistor and therefore must make proper electrical connection to the circuit. This is accomplished by using the two mounting screws which connect the transistor case to the terminals on the transistor socket or chassis ground.
2. If the transistor case is connected to chassis ground, then a silicone grease is applied between the transistor case and chassis. This grease is non-conductive electrically but it is conductive thermally, thus it mechanically connects the transistor to its heat sink allowing high power operation without overheating. (See Fig. 2.)
3. If the transistor case is not connected to ground, then an insulator is mounted between the case of the transistor and the heat sink. Most often this insulator is transparent and sometimes it sticks to the transistor case when the transistor is removed. Whenever power transistors are removed, watch for this insulator and be certain it doesn't get omitted in the replacement of power transistors. Also silicone grease is used to insure good mechanical connection between heat sink, insulator and transistor case.
4. Power transistor leads should be carefully aligned with their clearance holes when they are inserted into the transistor socket to insure that a short circuit to chassis ground cannot occur. This is especially important when the transistor leads have to pass through both the chassis and heat sink because a slight misalignment of chassis to heat sink leaves even less clearance for transistor leads.

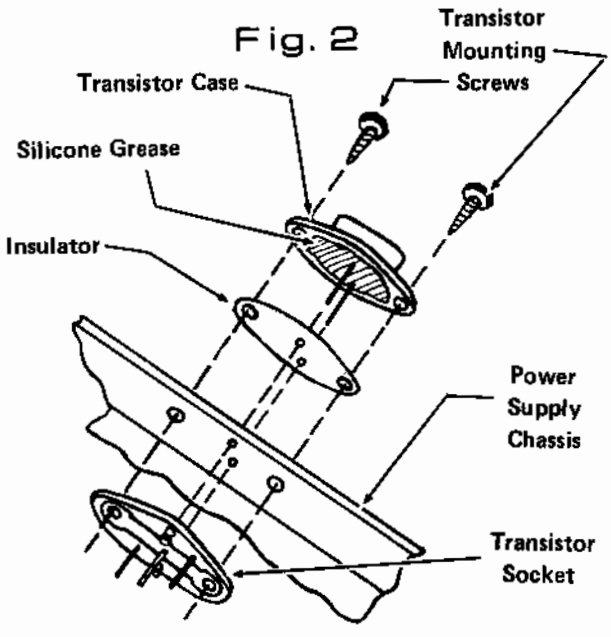
INTEGRATED CIRCUITS

Replacement of soldered-in IC's can be done several ways, depending upon their accessibility and the technician's desire to carry special IC unsoldering equipment. The various methods of IC replacement are listed below. Choose the one that suits your situation and tool inventory:

1. Clip the IC leads close to the old IC body and solder the new IC leads to the old IC leads. Be certain to solder carefully and quickly so as not to heat the IC unduly. Also, it's a good idea to solder in an alternating pattern around the IC with rest stops for IC cooling.
2. Clip the IC leads close to the old IC body and remove the IC, then unsolder each old lead one at a time and pull out. Then solder in the new IC in the original fashion.
3. Use a multi-connection IC unsoldering tip in your soldering iron. This will allow unsoldering of all IC leads at one time, permitting the easy removal of the complete IC. Then solder in the new IC in the original fashion.

POWER TRANSISTOR MOUNTING

Fig. 2



IMPORTANT

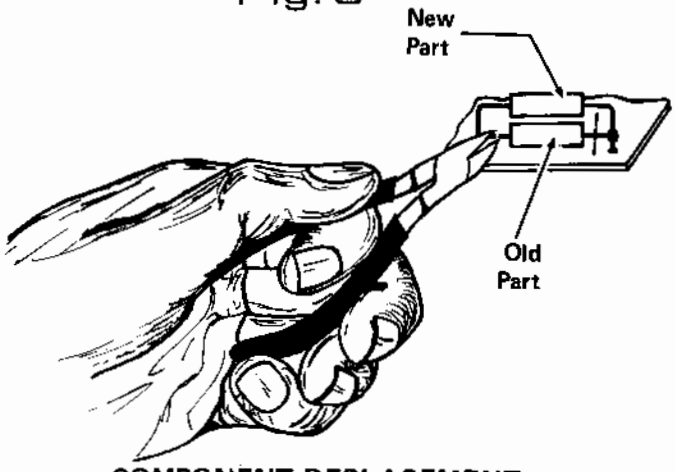
IC's should be soldered using a **low heat** soldering iron. When soldering, allow cooling time between connections to prevent thermal damage. Also, store and handle IC's **carefully** to prevent accidental static voltage damage.

MISCELLANEOUS COMPONENTS

Transistors, diodes, resistors, capacitors, photocells and other components should be replaced as originally installed where time and accessibility permit. Where necessary, most parts can be cut out leaving enough lead length to solder the new part to the old leads. It is best to do this, however, using a light-weight, low-heat iron so as not to overheat the old leads causing them to become unsoldered at their original connections. Also, it is helpful to leave the new part leads long until soldered and then, if necessary, clip them off. This gives added heat sink protection and something to hold onto while soldering.

As shown in Fig. 3, new component parts can also be soldered to the old part, then afterwards can be clipped out.

Fig. 3



COMPONENT REPLACEMENT

UPSTOP REPLACEMENT

A combination foam and plastic material is used as a white key upstop cushion on most wood keyboards. This upstop material can be replaced, in the event of damage or deterioration, as follows:

Upper Keyboard

1. Remove the small Phillips-head screws located across the front of the upper keyboard upstop rail.
2. Remove upstop rail and pull off upstop material and replace with new material.
3. Replace upstop rail and small Phillips-head screws. Be certain to replace screws in rail according to markings from original installation so that key adjustment is unchanged.

Lower Keyboard

1. Same as upper keyboard except lower keyboard must be raised to gain access to small Phillips-head screws.
   (a) On metal framework models remove organ top, two bolts under the front of the lower keyboard and two bolts under the rear of the lower keyboard, then raise entire upper and lower keyboard assembly.
   (b) On wood framework models raise upper keyboard by removing organ top, upper endblocks and four keyboard hold-down screws (two at each side of upper keyboard). Raise lower keyboard by removing lower endblocks and removing screws from under keyboard.

SPINET PEDAL CAP REPLACEMENT

BLACK, TAN, MAROON AND WOOD PEDAL CAPS

Broken, damaged or worn pedal caps are easily replaced. When ordering replacement pedal caps, order quantity needed and specify color or wood. All black pedal caps are identical. Tan, maroon or wood pedal caps should not be interchanged on the same organ. Maroon pedal caps may, however, be used to replace a complete set of tan pedal caps where more resistance to abrasive wear is desired. To replace either a black, tan, maroon or wood pedal cap, simply remove the two screws located one at the top back and one at the middle underneath. To gain access to the screw under the pedal, either tilt the organ back at approximately 45 degrees or stand the organ on its right side. (See Fig. 4.)

KEY CAP REPLACEMENT

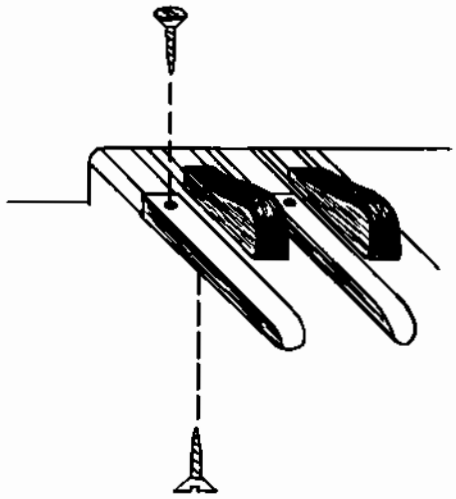
STANDARD WOOD KEYBOARD BLACK OR WHITE KEY CAPS

Damaged or broken plastic key caps can be replaced using the following procedure:

1. Remove damaged or broken key from organ.
   (a) Standard Upstop Keyboard
   White keys - disconnect keyswitch actuator from wire form at back of key and lift out complete key.
   Black keys - disconnect keyswitch actuator from wire form at back of key, remove upstop screw from center of key and lift out complete key.

Fig. 4

SPINET PEDAL CAP REPLACEMENT



(b) Non-Upstop Keyboard

White keys - disconnect keyswitch actuator from wire form at back of key and adjacent keys. Remove adjacent keys where they interlock with damaged key. Remove damaged key.

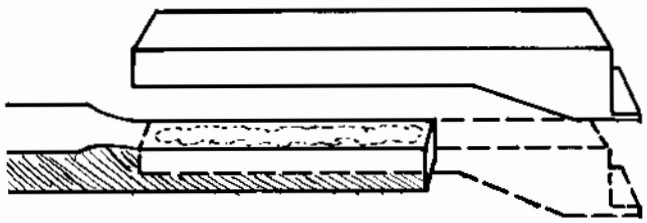
Black keys - disconnect keyswitch actuator from wire form at back of key and lift out complete key.

2. Using a screwdriver, chisel or knife blade, pry plastic key cap off wood key. Use caution so as not to break wood key.
3. Remove any extraneous plastic, wood or glue material that may interfere with correct placement of new key cap.
4. Apply white glue or other non-plastic dissolving glue to key where old plastic cap was removed.
5. Position new key cap on wood key, insert key in organ and check front to rear alignment as compared to adjacent keys.
6. Let glue set before reassembling key to keyswitch actuator on white keys only since the plastic cap also is the upstop. (See Fig. 5).

NOTE: When ordering white key caps from the Service Department, specify key name C, D, E, etc. Also, top C should be specified when needed. Black key caps are all identical. Be sure to include that they are for wood keys!

Also, replacement white key caps have an upstop lip. If replacement is used on a non-upstop keyboard, the upstop lip will have to be cut off.

Fig. 5



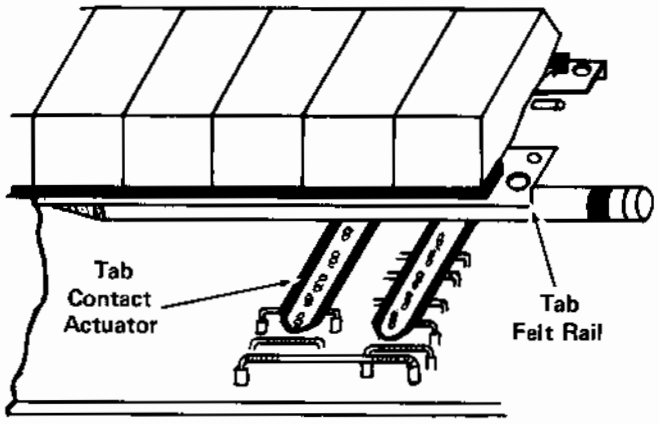
KEY CAP REPLACEMENT

METAL KEYBOARD BLACK OR WHITE KEY CAPS

The method for replacing plastic key caps on metal keys is essentially the same as in wood keys with the following exceptions:

1. Remove key return spring instead of keyswitch actuator.
2. Adjacent keys will have to be removed to allow removal of damaged key due to key comb construction.
3. Black and white key caps screw on rather than glue on, using one screw at the back of the key cap.
4. When ordering key caps specify letter name as in wood key caps, but state that they are for metal keys.

Fig. 6



TAB REPLACEMENT

ROCKER-TYPE TABS

Replacement of one tab or a complete set can be done according to the following procedure:

1. Remove endblock plate (two Phillips-head screws).
2. Be certain all tabs are in their off or level position.
3. Install a long wood pencil or 5/16" diameter wood, plastic or metal dowel between the tab contact actuators and the back tab felt rail. (See Fig.6.)
4. Using a pliers, pull out the tab pivot rod.
5. Carefully lift out tab or tabs needing replacement and carefully set in new tab or tabs.
6. Carefully slide tab pivot rod back through tabs.
7. Carefully slide out pencil or dowel.
8. Check each tab for normal operation both mechanically and electrically.

IMPORTANT

In the event that a tab contact spring gets removed from its proper location in the tab actuator, it can be replaced in the actuator using one of the following methods:

1. Long nose pliers, steady hand and patience.
2. Release the tab actuator wire form guide to raise actuator. Then use long nose pliers and, with slight movement of tab to align actuator hole with contact spring, lower actuator onto contacts and connect wire form guide.
3. Unsolder contact spring, pull out slightly, align hole in tab actuator and solder. Make certain contact spring doesn't "solder freeze".

LIP-TYPE TABS

Replacement of lip-type tabs is essentially the same as the replacement of rocker-type tabs; however, there are these two important differences. First, a larger diameter (5/8") dowel to hold the actuator when the tab pivot rod is pulled. Second, a greater amount of organ disassembly is needed to gain access to the lip-type assembly. In some instances, the entire lip-type assembly or assemblies will need to be moved.

Chapter 2

Adjustments

TUNING ADJUSTMENT

The following three types of tunable oscillator circuits have been used in transistor and IC tone generators:

1. 12 adjustable coils
2. 12 adjustable potentiometers
3. 1 adjustable coil

Each tone generator system, whether 12 adjustment or single adjustment type, controls the pitch for the entire organ including bass pedals. Adjustment of tuning coils, coil or potentiometers may be accomplished using any of the systems listed below:

(a) Stroboscopic (Conn Strobo tuner) Visual identification of tuning condition that is highly accurate and easy to use.

(b) Set of 12 tuning forks. Zero beat any 12 organ notes to corresponding forks. A convenient, easy to use and highly accurate tuning method.

(c) Single tuning fork. For single oscillator organs, zero beat note on organ to corresponding tuning fork. To tune organs using 12 oscillators with one fork requires listening for proper 4th and 5th beat patterns. Tuning one note using a tuning fork is easy and accurate; however, the 4th and 5th beat pattern system is for those who have an ear for it. (See Single Tuning Fork Instructions.)

(d) Another musical instrument, pitch pipes, frequency counters, calibrated audio oscillators and other devices can be used for tuning when convenient or necessary. However, be certain of the accuracy of the device.

IMPORTANT

Coil-type oscillators must be tuned only with a non-conductive tuning wand. A suitable tuning wand is available from the Service Department by ordering Part No. 964-009816. When tuning, be certain Vibrato, Tremolo and fractional voices are off. Fans, air conditioners and other devices with moving parts should be shut off when tuning by ear to prevent extraneous beats.

SINGLE TUNING FORK INSTRUCTIONS

From a strict mathematical view point, in tuning the tempered scale each interval should be tuned to a precise speed of beat. In general, the fourths should have a slightly faster beat than the fifths, but no two intervals are precisely alike. However, the tempered scale is a compromise made necessary on any keyboard instrument by the limitation to twelve notes in the octave. Tuning by this method will produce results very similar to, and musically as good as, a mathematically exact tempered scale.

For maximum beat clarity, all tuning should be done using a bright voice such as Clarinet, Trombone or Trumpet.

Sound a C fork (523.3 Hz Int. Pitch) and adjust the C tone generator control until no roll or beat is heard between the organ note and the fork tone. In other words, until the C tone generator and the C fork are in exact tune with each other.

Now, hold down C (one octave above middle C) along with G. Adjust the G tone generator control until it is flat – about three beats in five seconds.

Next, release C and hold down D along with G. This constitutes a fourth down. Adjust D control in the same way until it is flat – about three beats in five seconds.

Release G and hold A along with D. Tune A on the flat side likewise. Repeat this process of a fifth up and a fourth down until F# is tuned to B.

Hold C# a fourth below F#. Tune C# to the same beat then proceed to G# a fifth above C#, D# a fourth down, A# a fifth up and then F a fourth down. For a final check, sound F and C together. The number of beats should be about the same as G and C, or three per five seconds.

NOTE: When the control is in the center position, or exactly dead on the pitch, no beat is heard. Turning the control clockwise (sharp side), will increase the number of beats per second, turning the control counterclockwise (flat side), the beats will again increase. The tuning must all be on the flat side, or counterclockwise from the no beat position. The three beats per five seconds needed will occur very close to the no-beat position. This is a critical adjustment and must be listened for carefully. The control should be turned in the counterclockwise direction until a fast beat is obtained and then slowly turned toward the center position, or clockwise direction, until the slow beat is heard.

The entire tuning procedure is shown in the following two charts. (See Fig. 1.)

Fig.1

TUNING CHART (44-Note Keyboard)		
REFERENCE NOTE	KEYBOARD NOTE (8' Voice)	COIL OSCILLATOR ADJUSTMENT
C2 (Tuning Fork 523 Hz)	C2	Tune to exact pitch.
C1	G2	Tune G counterclockwise (3 beats in 5 sec.)
G2	D1	Tune D counterclockwise (3 beats in 5 sec.)
D1	A2	Tune A counterclockwise (3 beats in 5 sec.)
A2	E1	Tune E counterclockwise (3 beats in 5 sec.)
E1	B2	Tune B counterclockwise (3 beats in 5 sec.)
B2	F#2	Tune F# counterclockwise (3 beats in 5 sec.)
F#2	C#1	Tune C# counterclockwise (3 beats in 5 sec.)
C#1	G#2	Tune G# counterclockwise (3 beats in 5 sec.)
G#2	D#1	Tune D# counterclockwise (3 beats in 5 sec.)
D#1	A#2	Tune A# counterclockwise (3 beats in 5 sec.)
A#2	F2	Tune F counterclockwise (3 beats in 5 sec.)
F2	C2	Check – Do not tune.*

TUNING CHART (61-Note Keyboard)		
REFERENCE NOTE	KEYBOARD NOTE (8' Voice)	COIL OSCILLATOR ADJUSTMENT
C4 (Tuning Fork 523 Hz)	C4	Tune to exact pitch.
C3	G3	Tune G counterclockwise (3 beats in 5 sec.)
G3	D3	Tune D counterclockwise (3 beats in 5 sec.)
D3	A3	Tune A counterclockwise (3 beats in 5 sec.)
A3	E3	Tune E counterclockwise (3 beats in 5 sec.)
E3	B3	Tune B counterclockwise (3 beats in 5 sec.)
B3	F#3	Tune F# counterclockwise (3 beats in 5 sec.)
F#3	C#3	Tune C# counterclockwise (3 beats in 5 sec.)
C#3	G#3	Tune G# counterclockwise (3 beats in 5 sec.)
G#3	D#3	Tune D# counterclockwise (3 beats in 5 sec.)
D#3	A#3	Tune A# counterclockwise (3 beats in 5 sec.)
A#3	F3	Tune F counterclockwise (3 beats in 5 sec.)
F3	C4	Check – Do not tune.*

* Fast beats indicate the need to recheck all tuning steps.

BLACK & WHITE KEY TRAVEL ADJUSTMENT

IMPORTANT

Adjustment of key travel may necessitate readjustment of keyswitch contacts.

WHITE KEYS – White key travel is adjustable only on wood keyboards where the front rail is also the white key upstop rail. The correct white key up and down travel should be 5/16" to 7/16" as measured at the front edge of the key. (See Fig. 2.) To adjust:

(a) loosen the small Phillips-head screws located across the front of the upstop rail

(b) reposition the entire rail up or down. Make certain to check for uniform key travel across keyboard

(c) retighten screws

BLACK KEYS – Black key travel is adjustable only on wood keyboards where the black keys are provided with an adjustable upstop screw. Proper black key travel is 5/16" to 7/16" as measured at the front edge of the key. (See Fig. 3.) To adjust:

(a) tighten or loosen each black key adjusting screw to set key travel

(b) use a straight edge or sight across the tops of the black keys to be certain of uniform key adjustment.

NOTE: Sluggish black key operation can be caused by the black key adjustment screws not being centered within the key clearance holes.

BASS PEDAL SWITCH ADJUSTMENT

13 PEDAL (Spinets)

Spinet pedal switch adjustment is accomplished by bending the small metal tab located at the top rear of each bass pedal. Bend the tab up to cause the pedal to play earlier or down to play later. Proper adjustment is achieved when there is 1/16" to 1/8" clearance between the pedal switch and the cushion on the adjustment tab. (See Fig. 4.)

Fig. 2

KEY TRAVEL ADJUSTMENTS

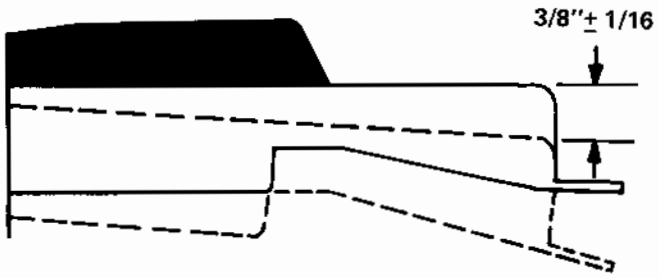
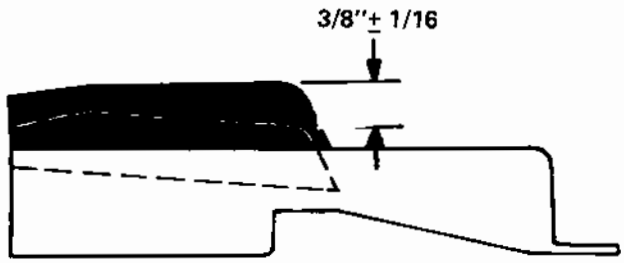


Fig. 3



25 & 32 PEDAL (Consoles)

Two types of pedal switches have been used on console models. The plunger-type mounted on the pedal clavier and the finger-type mounted in the console. Both switch types should be adjusted for 1/16" to 1/8" clearance between the actuator and the switch plunger or fingers. Plunger-type pedals are adjustable by bending the actuator up or down. Finger-type switches have actuators on the pedals that are adjustable by loosening their mounting screw.

NOTE: Insufficient pedal switch to actuator clearance may result in one or more of the following conditions:

(a) Loss of pedals above the misadjusted pedal. However, the misadjusted pedal will play. This is due to the series wiring of most pedals. (See Fig. 4A).

Fig. 4

SPINET BASS PEDAL SWITCH ADJUSTMENT

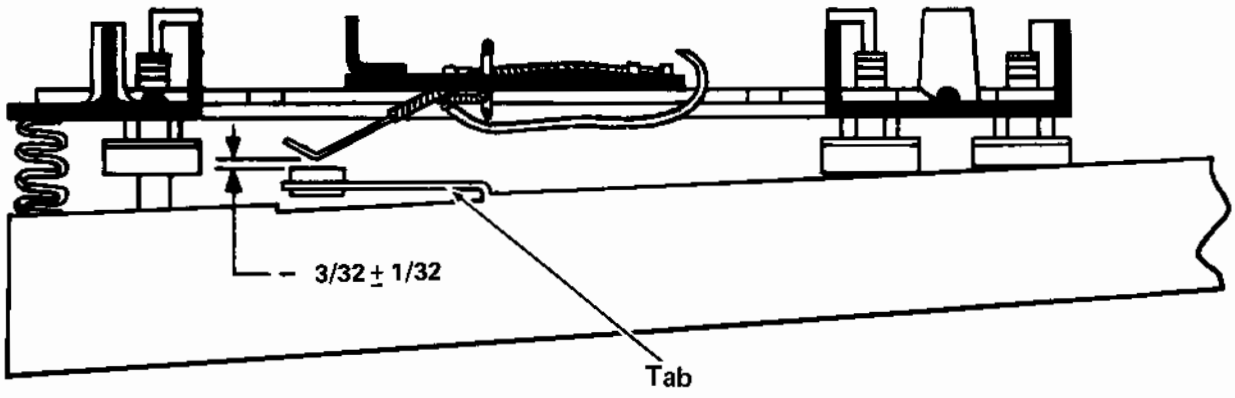
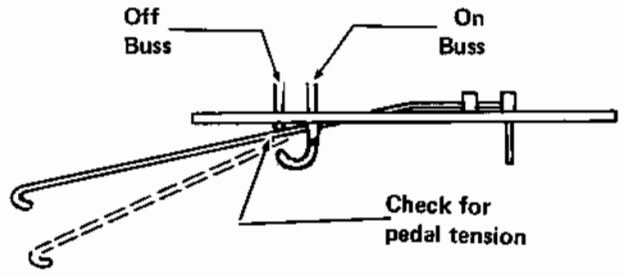


Fig. 4A



CONSOLE BASS PEDAL SWITCH ADJUSTMENT

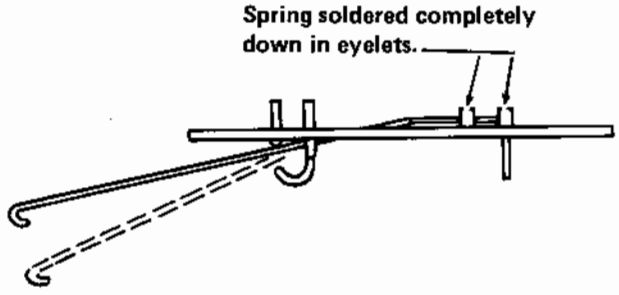
(b) Erratic canceling of pedal sustain on the misadjusted pedal during faster pedal playing. This is due to pedal bounce causing the pedal contact to momentarily re-touch its on buss retriggering the sustain cancel circuit. On console organs, also check pedal tension.

(c) Double pedal keying. This is due to strong pedal bounce which is usually the result of loose pedal tension and insufficient actuator to switch clearance.

IMPORTANT

Check for proper switch solder construction when servicing pedals. Fig. 5 shows the correct construction.

Fig. 5



AMPLIFIER BIAS ADJUSTMENT

TWIN BIAS POTENTIOMETER AMPLIFIERS
(Germanium or Silicone)

Test Equipment Required:

Milliamp Meter

Amplifier bias may be checked and adjusted by either of the following two methods:

Meter Method

(a) With organ off, turn bias potentiometers back and forth several times to clean.

(b) Set bias potentiometers at their mid-points.

(c) Connect a milliamp meter in series with the amplifier high voltage supply. Set meter to highest current scale (250 milliamps minimum).

(d) Turn organ on. Adjust both potentiometers, keeping as close to their mid-point as possible, for a meter reading of 90 to 120 milliamps.

(e) Play chords on the organ using Flute voices, listen for proper Flute quality. If a slight buzz or distortion is heard, slightly touch up adjustment of either or both potentiometers.

Touch and Sound Method

This method is suggested in lieu of the meter method where time or equipment is not available.

(a) Turn organ on. After a few minutes carefully touch the amplifier heat sink. If the heat sink is slightly warm to fairly warm, bias is O.K. providing organ has proper Flute tonality.

(b) In the event that the heat sink is hot or the Flute tone is not proper, turn off the organ, turn bias potentiometer back and forth a few times then set at their mid-points.

(c) Turn organ on. Play chords using Flutes. Adjust bias potentiometers while listening for proper Flute tone and keeping as close to the potentiometer mid-point setting as possible.

FIXED BIAS AMPLIFIERS
(Factory-Tailored)

Upon replacing output transistors, the amplifier bias should be checked and retailored if necessary as follows:

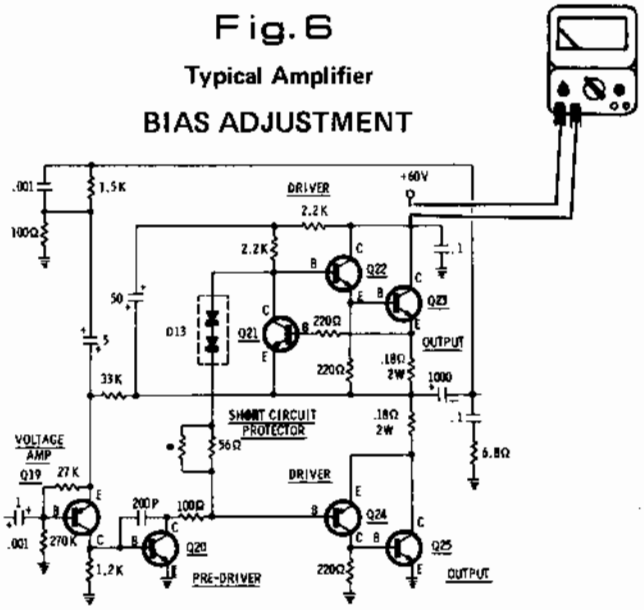
(a) With the organ off and the amplifier cool, connect a milliamp meter in series with the amplifier high voltage supply. Set meter to highest current scale (250 milliamps minimum). (See Fig. 6.)

(b) Turn organ on, meter should read 35 to 45 milliamps during the first few minutes of operation only, there after current should rise to between 75 and 150 milliamps and stabilize. If current is less than 35 milliamps or more than 45 during the first few minutes of operation, bias should be tailored.

Fig. 6

Typical Amplifier

BIAS ADJUSTMENT



(c) Tailoring the amplifier for correct bias is accomplished by selecting the right value for the resistor wired in series with the dual diode connected between the two amplifier transistors. Either of the following methods can be used to select the right bias resistor value:

1. Resistor substitution box
2. Substitution of a potentiometer which can then be measured and replaced with a fixed value resistor.

NOTE: Make certain bias is adjusted only during the first few minutes of amplifier operation. Too little bias current will result in distortion; too much bias current will cause hot amplifier operation and possible destruction of output transistors.

EXPRESSION PEDAL PHOTOCELL SHUTTER ADJUSTMENT

Expression pedals with a fixed position photocell and bulb, and movable shutter attached to the expression shoe, are adjustable for range as follows: (See Fig. 7.)

(a) Tape or wedge down the top key of the upper keyboard and depress any voice tab.
(b) Loosen the two screws on the expression pedal shutter.
(c) Set expression pedal shoe at minimum volume position.
(d) Adjust movable shutter element to a point just past where volume ceases to diminish.
(e) Tighten the two screws.

NOTE: Adjustment of photocell shutter too far towards minimum volume will cause loss of maximum volume. Conversely, adjustment too far toward maximum will result in too much minimum volume.

IMPORTANT

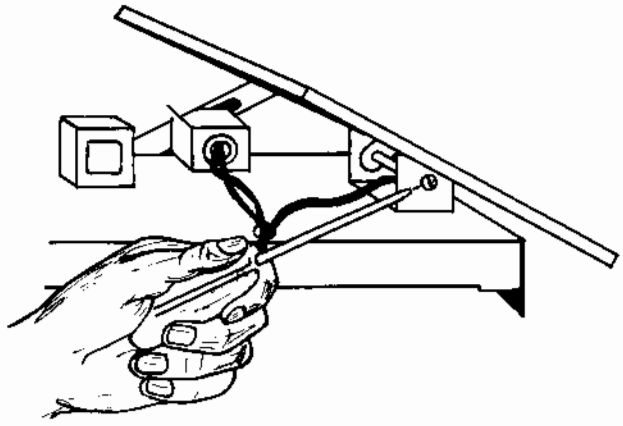
If the light diffuser disc has been removed or inadvertently left out of the photocell assembly during repair, the shutter adjustment will have little or no effect.

EXPRESSION PEDAL TENSION ADJUSTMENT

PIVOT BEARING TYPE

Adjusting either or both 5/16" bolts located on each side of the expression pedal assembly at the pivot point controls shoe tension. (See Fig. 8.)

Fig. 8
PEDAL TENSION ADJUSTMENT



CLUTCH BEARING TYPE

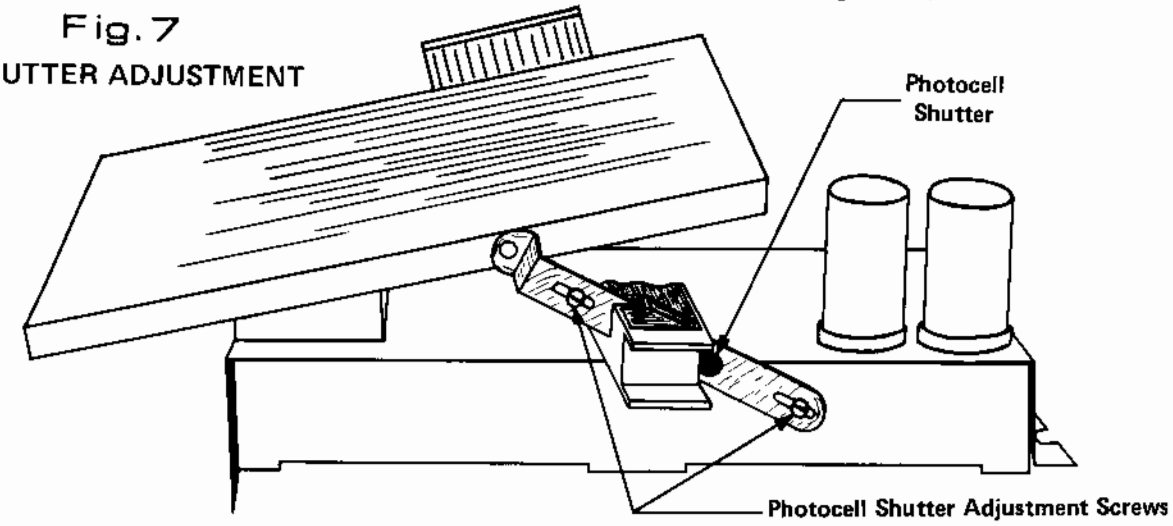
Adjusting the slotted screw located on the left side of expression pedal assembly at the pivot controls shoe tension.

Proper setting of either type of expression pedal assembly is achieved when:

(a) Expression shoe does not fall by its own weight.
(b) Expression shoe moves over its range smoothly without jerkiness* or squeak*.
(c) Pressure required to move expression pedal is acceptable to organist.

* Oiling or greasing the expression pedal pivot bearing or clutch plates sometimes will remove jerkiness or squeaks. In some cases removing oil from the pivot bearing may remove squeak or jerkiness. Squeaking clutch type expression pedal assemblies that do not respond to oil should be disassembled and checked for overspray of paint on metalwork contacting clutch plates.

Fig. 7
SHUTTER ADJUSTMENT



DOUBLER COIL ADJUSTMENT

Test Instruments Required:

Volt/Ohmmeter Signal Generator

Since doubler coil tuning frequency varies somewhat between models, doubler coils should be tuned for resonance at the frequencies specified in the service manuals. Tune the doubler coils by adjusting the two tuning controls on each doubler coil as follows:

1. Connect signal generator to input of doubler coil to be tuned.
2. Set signal generator at frequency to which doubler coil is to be tuned.
3. Connect volt/ohmmeter, set at AC volts, to the amplifier output or speaker leads.
4. Adjust doubler coil for maximum AC voltage. This indicates resonance of coil at input frequency is in tune.

After tuning doublers to their correct frequency check by ear for minimum tonality change from non-doubled notes to doubled notes and between the two groups of doubled notes. Slight re-adjustment of the doubler coils by ear may be desirable to minimize tonality change.

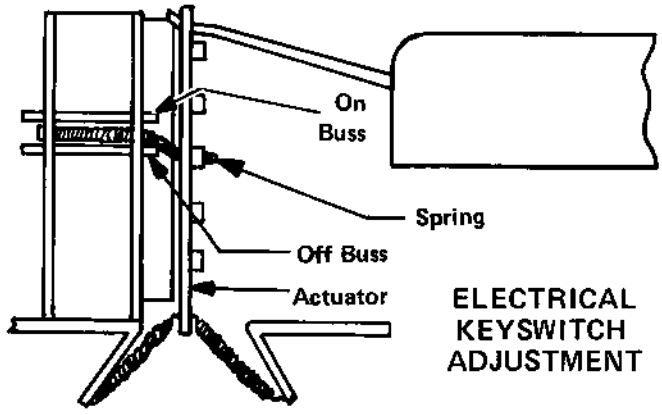
VOLUME LIMITER ADJUSTMENT

On certain models (LC98K for instance) a potentiometer is wired in series with the expression pedal bulb. This potentiometer is accessible from the outside of the expression pedal/amplifier chassis and may be adjusted using a small regular or Phillips-head screwdriver. Proper adjustment of the limiter potentiometer is achieved by:

1. Depressing expression pedal fully.
2. Depressing a full range of Flute voices on both keyboards and full pedal volume.
3. Playing chords on both keyboards and pressing a pedal.

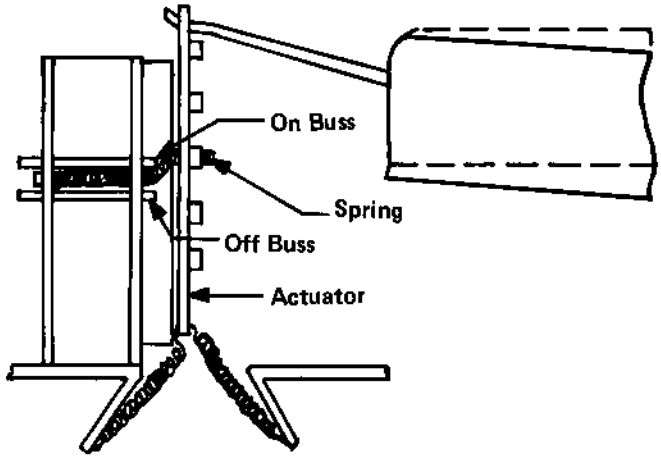
Then set limiter for maximum volume with little or no distortion. Take into account customer preference; some may use mainly solo voices permitting a higher volume setting than would otherwise be practical.

Fig. 9A



ELECTRICAL KEYSWITCH ADJUSTMENT

Fig. 9B



BASS PEDAL TENSION ADJUSTMENT

(25 and 32 Note Pedals)

Each individual pedal has a spring tension adjustment bolt located at the rear of the pedal board assembly. To gain access to the pedal adjustment, remove the wood cover at the rear of the pedal board. To adjust use a nut driver or socket wrench and loosen or tighten the adjustment bolt. Proper adjustment is obtained when 2-1/4 to 3-1/4 lbs. of pressure is required to depress the pedal at its front edge (closest to organ).

NOTE: A loose pedal tension adjustment will cause pedal bounce resulting in double pedal tones or erratic pedal sustain. Too tight a pedal tension will cause difficulty in playing and noisy operation.

ELECTRICAL KEYSWITCH ADJUSTMENT

Test Instruments Required:

None.

Keyswitch adjustment on all Lowrey models using wood keyboards is correct when the following conditions are met:

(a) All keyswitch actuators should be as close as possible to the keyswitch buss bar mounting posts. This insures proper on and off contact pressure.

(b) When a key is pressed it should play slightly before it reaches its midpoint of travel. This provides proper keyswitch wiping action and is correct key action for the organist. (See Figs. 9A & B.) On keyswitches containing several contacts, the points of play should average above and below the mid-point of key travel favoring the on side.

To adjust the keyswitch actuators according to (a) above, the entire keyswitch assembly must be moved. To do this, the screws that mount the keyswitch assembly need only to be loosened, then the assembly can be moved forward or backward so that proper adjustment is achieved. Then, retighten the mounting screws. The location of the keyswitch assembly mounting screws is either directly behind the keyswitches in a row about 5" apart or under the keyboard toward the back in a row about 5" apart.

To adjust the keyswitch actuators according to (b) above, use a long nose pliers and bend the wire form attached to the end of the key. Bend up to play sooner or down to play later.

CONTACT SPRAY

All switch contacts are treated with Tarniban prior to assembly in the organ. In the event of switch contact difficulties* retreatment with Tarniban usually will restore normal operation. Tarniban is not a contact cleaner, although it accomplishes the same result. What is Tarniban? It is a contact improver and preservative. The way it improves contacts is a complex molecular-chemical process which effectively removes surface resistance from the contact metal.

Tarniban is available in spray cans from the service department and may be ordered as needed. Contact sprays other than Tarniban are not recommended! This is due to the possibility of their containing petroleum distilates which may leave an oily residue. This residue can cause carbonizing on the switch contacts resulting in large-scale contact failure. Also, dust and other foreign material will tend to collect, causing additional contact difficulties.

In the event that actual cleaning of contact surfaces is deemed necessary, use denatured alcohol. Apply with a small art brush or pipe cleaner.

NOTE: When spraying contacts with Tarniban, normal organ operation may be temporarily upset until volatile agents fully evaporate.

* Improper adjustment is the most common cause of contact difficulties. See Adjustment of Keyswitches and/or Pedal Switches.

IMPORTANT

Tarniban is flammable — use in a well ventilated area and keep away from fire or flame.

MULTI-CHANNEL CHORUS ADJUSTMENT

Test Instruments Required:

Volt/Ohmmeter and Oscilloscope

Turn on 8' Flute and Multi-channel Chorus tabswitches. Tape or weigh down E3 key (Spinets) or E5 key (Consoles). Using a clip lead, ground the Multi-channel Chorus Oscillator output. (Collector of oscillator transistor.)

MAIN PHASER ADJUSTMENT

1. Connect oscilloscope vertical input probe to Multi-channel Chorus Main channel output. This point is at the emitter follower output after the emitter capacitor. (Refer to Service Manual for transistor location.)
2. Connect oscilloscope horizontal input probe to Multi-channel Chorus Main channel input. This point is at the Main Phaser input ahead of the input capacitor. (Refer to Service Manual for transistor location.)
3. Connect voltmeter to collector of Main Phaser Lamp Driver transistor. (Set meter to read maximum of 25 volts.)
4. Set Main Phaser Adjustment as follows:
   (a) Turn adjustment full in direction of highest voltmeter reading.
   (b) Oscilloscope should now read a straight line or ellipse at a 45 degree angle to the right. (See Fig. 10A.)
   NOTE: Failure to reach a straight line or ellipse at a 45 degree angle to the right may be caused by a Main Phaser Lamp Driver transistor with too high a 'beta'. To cure, replace transistor.
   (c) Slowly back off the Main Phaser Adjustment while watching scope pattern. Stop as soon as 45 degree line changes to a circle. (See Fig. 10B.)
5. This completes Main Phaser adjustment.

LESLIE PHASER ADJUSTMENT

6. Connect oscilloscope vertical input probe to Multi-channel Chorus Leslie channel output. This point is at the emitter follower output after the emitter capacitor. (Refer to Service Manual for transistor location.)
7. Connect oscilloscope horizontal input probe to Multi-channel Chorus Leslie channel input. This point is at the Leslie Phaser input ahead of the input capacitor. (Refer to Service Manual for transistor location.)
8. Connect voltmeter to collector of Leslie Phaser Lamp Driver transistor. (Set meter to read maximum of 25 volts.)
9. Set Leslie Phaser adjustment as follows:
   (a) Turn adjustment full in direction of lowest voltmeter reading.
   (b) Oscilloscope should now read a straight line or ellipse at a 45 degree angle to the right. (See Fig. 10A.)
   NOTE: Failure to reach a straight line or ellipse at a 45 degree angle to the right may be caused by a Leslie Phaser Lamp Driver transistor with too high a 'beta'. To cure, replace transistor.
   (c) Slowly back off the Leslie Phaser adjustment while watching scope pattern. Stop as soon as 45 degree line changes to a circle. (See Fig. 10B.)
10. This completes Multi-channel Chorus adjustment.
11. To insure adjustment stability, use a small dab of paint or glue to secure potentiometers.

Fig. 10A

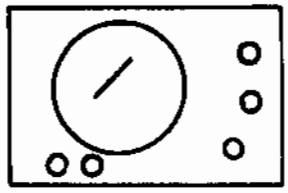
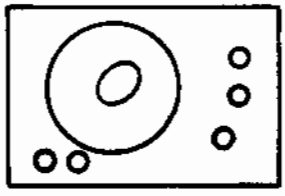


Fig. 10B



MULTI–CHANNEL CHORUS ADJ.

Chapter 3

Troubleshooting

ELECTRICAL INTERFERENCE

WHAT CAN CAUSE INTERFERENCE

Common causes of electrical interference:

High Frequency Transmitting. . . Commercial broadcast radio AM or FM, Amateur radio (Hams), CB radio, Police and business radio, TV and even Radar.

Commercial/Industrial Equipment. . . Arc welders, Neon advertising signs, Saws, Drills and other power tools.

Household appliances. . . Furnaces, Freezers, Air conditioners, Irons, Sewing machines, Refrigerators, Washers & Dryers, Clocks, Fluorescent lights and Light dimmers.

SYMPTOMS OF INTERFERENCE

Interference symptoms vary widely, depending upon the cause, the way it is being introduced and how strong the interference is. Typical interference symptoms are listed below:

High Frequency Transmitting. . . Voice and/or music can be heard coming from the organ. Sometimes it can be heard plainly, although usually it will be garbled and accompanied by a constant undertone or hum. In the case of radar, short repetitive beeps or pinging sounds can be heard.

Commercial/Industrial Equipment & Household Appliances. . . Buzz, Hum, Ticks, Pops, Static or Crackling sounds. In cases where heavy current appliances come on and cause a momentary power drop, volume may be affected or the organ may momentarily do something strange. This type of interference is almost always introduced into the organ through the AC line.

INTERFERENCE SUPPRESSION

High Frequency Transmitting. . . This type of interference can be removed by:

1. Moving the instrument. Sometimes just a slight difference in room location can make a great difference.
2. Installing an RF filter capacitor. To determine where to install the capacitor, locate where the RF signal is being introduced into the organ circuits as follows:
   (a) Depress expression pedal. If RF volume doesn't change, the RF is being introduced into the organ amplifier. If RF volume gets louder, then it is being introduced ahead of the expression pedal.
   (b) Try all tabs and controls, especially volume type. If any affect the RF volume this will give a clue to which circuit the RF is getting into.
   (c) Use a good sized capacitor (.1 or so) and a clip lead in series, ground out the organ signal and RF starting at the expression pedal and working toward preamp and voicing circuits. At the first point where signal can be grounded out but not RF pin-points the circuit where RF is being introduced.

Once the circuit where RF is being detected is determined, then connect a small ceramic capacitor – .001, for example, to ground wherever it will remove the RF but not upset normal organ operation. In circuits where .001 capacitors upset normal organ operation, capacitors smaller than .001 can be used providing they still remove the RF. Generally speaking, a .001 from collector to emitter and base to collector will remove all RF in a preamp transistor.

Commercial/Industrial Equipment & Household Appliances. . . This type of interference usually can be removed by one or more of the following methods:

1. Reverse the organ AC plug in the wall outlet. It's a minor thing but sometimes it's all that is necessary.
2. Plug the organ into a different AC outlet - preferably one with infrequently used or no appliances. This may require the use of an extension cord or moving of the organ.
3. Connect the organ AC line cord to commercially available AC power regulator (where voltage drop is encountered) or filter device (where ticks, pops, static, crackling or buzz is a problem).
4. Fluorescent lights and clocks are two AC powered devices commonly placed upon an organ that can cause interference. Generally, Hum or Buzz is introduced into the organ preamp circuits due to their close physical location at the top of the organ. To cure this type of interference, aluminum foil should be placed under the organ top between the device and the organ preamps and grounded to the organ framework.

NOTE: A pop or tick or any one-time unexplainable occurrence many times can be some form of rare electrical happening that could cause owner concern and questioning. It should be explained as a normal electrical phenomenon - that it should not be worried about and that if it were to be serious, the organ is fuse-protected.

TONE GENERATORS

What They Do

As their name implies tone generators produce or generate all the tones or sounds of the entire organ. All the tones are created constantly as long as the organ is on. Technically, tone generator tones are referred to as signals. Specifically, a signal is AC voltage - usually small AC voltage. Tone generation can therefore be thought of as the creation of many (several dozen) AC voltages. All these AC voltages are of the same amount or power but each is at a different frequency or speed (pitch). In other words, a tone generator AC voltage is a voltage that alternates on and off at a speed of, let us say for example in the case of Mid A, 440 times in one second.

Types of Tone Generators

Two main types of tone generators have been used:

1. 12 oscillator type. . . 12 individual oscillator circuits are used to produce the twelve highest frequency notes or tones of the organ. Each of these twelve tones is connected to a series of divider circuits that produce all the lower octave tones.
2. Single oscillator type. . . One oscillator circuit produces a high frequency tone that is above the range of the organ. This tone is then divided down by IC divider circuits to the twelve highest frequency notes or tones used on the organ. Each of these twelve tones is then connected to a series of divider circuits that produce all the lower octave tones.

In addition to the two main types of tone generators, some physically different but functionally similar divider and oscillator circuit configurations have been used:

(a) 12 RC oscillators with MOS or TTL Integrated Circuit dividers
(b) 12 LC oscillators with transistor or TTL Integrated Circuit dividers
(c) Single high frequency oscillator with MOS Integrated Circuit top octave dividers and either MOS or TTL integrated circuit lower octave dividers.

How to Recognize Tone Generator Failure

The most common indications are:

(a) 12 oscillator type. . . All, some or most keys of a given note name (F's for example) are dead, weak, garbled, wrong in octave or pitch, weak in vibrato or otherwise similarly defective.
(b) Single oscillator type. . . All, many or some keys of different note names (B's, E's and C#'s for example) or—all, some or most keys of a given note name (F's for example) are dead, weak, garbled, wrong octave or pitch or otherwise similarly defective.

NOTE: In certain cases, it is possible for only one or two upper octave notes to be dead or weak due to tone generator buffer circuit failure.

Servicing Tone Generators (12 oscillator type)

How to determine which circuit has failed:

(a) Determine notes that have failed. . . are they C's, F's, G's, A#'s or what.
(b) If the defective notes are F's, for example, locate the F tone generator. . . Look for the letter F stamped on the tone generator circuit board, tuning coil or potentiometer.
(c) Signal test the suspected tone generator as follows:
    1. Using one hand touch any preamp or filter circuit at a point where loud hum can be caused.
    2. Using your other hand touch the various circuit components of the suspected bad tone generator. This connects tone generator signals through you to the organ amplifier and speakers. Then touch the same point on a known good tone generator for comparison.
    3. Since tone generator signals are created in series from highest tone to lowest tone, failure of the oscillator tone will result in no tones. Failure of subsequent divider tones will allow higher tones to continue functioning normally and only lower tones to be defective.

Servicing Tone Generators (Single oscillator type)

The single oscillator type tone generators can be signal traced in the same manner as the 12 oscillator type. The repair of the high frequency oscillator circuit itself should be done by checking individual components and B+ voltage. To determine if the high frequency oscillator is oscillating, use an oscilloscope with at least a 5 megahertz capability.

LOCATING NOISY TRANSISTORS

Static or crackling noise can be caused by a noisy transistor. Many times locating the particular transistor causing the noise can be difficult due to the intermittent nature of noisy transistors. Two methods are commonly used to locate noisy transistors. The most common method is to follow the circuit signal flow backwards, grounding the output and input of each individual transistor circuit until a transistor is reached where grounding the output kills the noise and grounding the input does not.

IMPORTANT

Always use extreme caution when grounding transistors! Do not ground transistor leads connected directly to power supply voltage!

The second and fastest way to locate noisy transistors is to use a freon freeze spray. To use, simply spray each preamp transistor one by one while listening to the noise. When the noisy transistor is sprayed, the noise will diminish or even go away completely. Once the noisy transistor has been pinpointed by using the freeze spray, replace the transistor.

NOTE: Freeze sprays are available from most electronic parts supply companies. Make certain the spray used is a freon spray, not merely an evaporative liquid.

LOCATING BAD DIODES

All Lowrey Service Manuals contain Diode Keying Charts to aid in locating a suspected bad diode. Once the diode you suspect to be bad is located, refer to Testing Diodes, Chapter 4 in this manual.

AMPLIFIERS

TYPES OF AMPLIFIERS

1. Germanium output transistors (P-8870) with bias potentiometers and transformer coupled.
2. Silicone output transistors (P-3139) with bias potentiometers and transformer coupled.
3. Silicone output transistors (P-3139) or (P-020432) with factory-tailored bias resistor and direct coupled.

TYPICAL AMPLIFIER FAILURE CHARACTERISTICS

1. Dead organ. . . may or may not blow fuse.
2. Distortion. . . on multi-amplifier models, only one channel may be affected.
3. Low power. . . on multi-amplifier models, only one channel may be affected.
4. Static or other extraneous noise. . . on multi-amplifier models, only one channel may be affected.
5. Loss of Main, Leslie or Bass channel. . . multi-amplifier models only.

TROUBLESHOOTING AMPLIFIER USING A VOM

Refer to "Component Testing" for specific component tests.

1. Check visually. Connections, components, circuit boards, etc.
2. Check power supply voltages. Mainly power transistor supply voltage.
3. Check power transistors. Many technicians do this first.
4. Check driver transistor or transistors. Especially on direct coupled amplifiers.
5. Check power supply rectifier diodes and zeners.
6. Check components in general. Preamp transistors, electrolytic capacitors, power resistors and bias potentiometers.

NOTE: Power transistor failure in direct coupled amplifiers will many times cause failure of associated transistors. Check all to be sure.

Component and circuit failure that can make it appear as if the amplifier has failed.

1. Speakers or their wiring.
2. Crossover capacitor.
3. Speaker switch contacts.
4. Leslie Mercotac.
5. Expression pedal potentiometer, bulb or photocell.
6. Missing or wrong B+ to reverb or preamps.
7. Plug and socket pin to wire crimp connections or poor pin gripping action.
8. Misadjusted or defective bias potentiometer.

NOTE: Refer to "Adjustments" for amplifier bias setting.

Chapter 4
Component Testing

TESTING SPEAKERS

Speakers usually fail in one of two ways - either they work and sound bad due to an internal defect, in which case the faulty speaker is relatively easy to find (see "Touch Test") or, the speaker quits completely (opens internally) and one has to prove the speaker has failed.

VOM TEST:

To test for an open speaker connect a VOM as follows:
(a) Set VOM to high resistance range.
(b) Remove speaker leads.
(c) Intermittently touch meter test leads to speaker terminals.

Clicking sound when connecting ohmmeter indicates speaker is not dead. However, a click doesn't indicate a speaker will produce good sound. . . the ear is always the best judge.

TOUCH TEST:

Speakers that work but sound bad can be tested by lightly touching around the back edge of the speaker cone while the speaker is in operation. When touched, a bad speaker will nearly always change the sound tonality for better or worse. Any appreciable tonality change indicates the speaker should be replaced.

TESTING PHOTOCELLS (LDR'S)

A photocell is essentially a variable resistor that varies its internal resistance with the application of light. To test, connect an ohmmeter across the photocell. With zero light on, the photocell meter should read high resistance (megohms); with light on, photocell meter should read low resistance. (Hundreds of ohms).

Photocells which are packaged with their light source can be tested like other photocells. However, it is necessary to find out if the light source works since failure of either the light source or photocell requires replacement of the entire packaged unit. To test for the operation of the light source in packaged photocells proceed as follows:

Test incandescent-type photocell light source by connecting ohmmeter across light source. Incandescent light source should read low resistance (hundreds of ohms or less) if filament is O.K.

Test neon-type photocell light source by scraping away some of the neon bulb light-shielding paint, then observe whether neon lights or not. Neon bulbs can be erratic and light only when ambient light is allowed to reach them or they may light only when your hand is near.

NOTE: The neon-type photocell assembly may be replaced as a complete unit or the neon may be crushed with a pliers and replaced with a new NE23 neon bulb and covered with black tape.

TESTING CAPACITORS

To test for an open capacitor parallel the suspected capacitor with a capacitor of similar or identical value —

1. If circuit now functions normally, suspected capacitor was open.
2. If no change in circuit operation capacitor is either shorted or O.K.

To test for a shorted capacitor test with ohmmeter as follows:

1. If meter registers open or high resistance, capacitor is O.K.
2. If meter registers short or low resistance, then clip one lead of the capacitor and re-measure. If capacitor still tests short or low resistance, capacitor should be replaced.

NOTE: Electrolytic capacitors will usually test shorted when an ohmmeter is first connected. Only after the capacitor is charged will the capacitor test high resistance or open.

LED PHOTOCELLS

Photocells using an LED (Light Emitting Diode) light source can be tested for light source function with an ohmmeter as if one were testing a standard diode (see "Testing Diodes").

IMPORTANT

Use caution when handling photocells. Excess stress on leads can break the hermetic seal resulting in intermittent or gradual deterioration of performance.

TESTING DIODES (Rectifier, Signal or Keying)

Test with ohmmeter across diode — it should indicate high resistance megohms with meter leads one way and low resistance (hundreds of ohms) with leads reversed.

If meter reads high both ways or low both ways, retest with one diode lead clipped from circuit. Resolder if diode tests O.K.!

TESTING ZENER DIODES

Zener diodes can be tested for open or short circuits like regular diodes by using an ohmmeter (see Testing Diodes). However, zener diodes can also be tested by touch. Since zener diodes drop a certain amount of current when operating normally, they therefore get warm or even hot. To test, lightly touch the zener with a moistened fingertip to lessen the chance of burn in case the zener is dropping too much current and is running super hot. A warm or slightly hot zener is a good zener; a cold zener is either open or not receiving sufficient voltage to regulate. A super hot zener is either leaky or receiving too much voltage which usually indicates lack of normal circuit load.

TESTING PNP AND NPN TRANSISTORS

Transistors (small signal or power type) may be tested for an open or short using an ohmmeter as follows:

(a) Cut or otherwise remove at least two (2) transistor leads from the circuit to prevent possible misleading meter reading due to circuit components.

(b) Connect ohmmeter to base and emitter leads. Meter should read either high or low resistance. Reverse meter lead and re-measure. Meter should read opposite of first reading; i.e. high resistance (megohm) first test then low resistance (hundreds or thousands of ohms) with meter leads reversed.

(c) Repeat step by using base and collector transistor leads.

(d) Connect ohmmeter to emitter and collector leads. Meter should read high resistance (megohms). Reverse meter leads and meter should also read high resistance (megohms).

IMPORTANT

Testing transistors with an ohmmeter will reliably indicate gross transistor failure. It will not, however, indicate other types of transistor failure such as:

1. Voltage breakdown.
2. Noise (see Locating Noisy Transistors).
3. Low Beta.
4. Leakage.

To further test transistors, use a transistor tester or substitute a new transistor. Substitution is the most positive test.

Chapter 5

Connecting Accessories

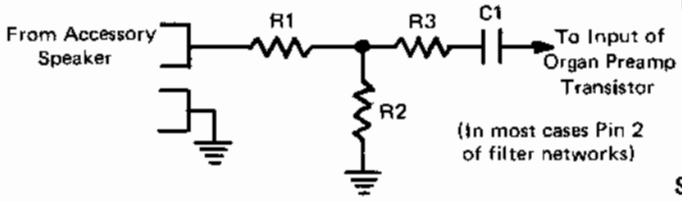
Various electronic devices and accessories can be attached to an organ so that they can play through the organ amplifier/speaker system. Whenever any type of device is connected, be sure to check for any deterioration of normal organ performance. Usually a connection that loads the organ circuitry will cause the organ to exhibit one or more of the following conditions.

1. Loss of organ volume
2. Distortion
3. Lack of brightness

Improper grounding or shielding of accessory connecting wires will result in hum or noise.

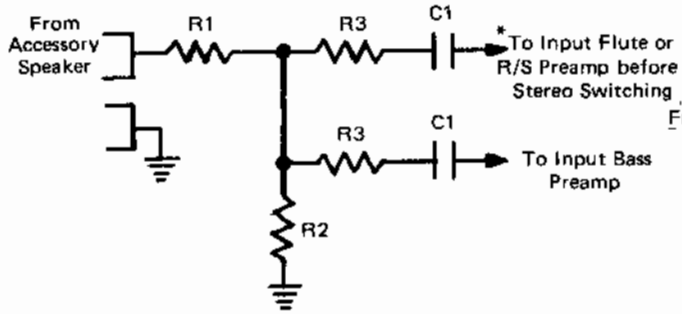
The following are circuit schematics showing the accessory hookups for various situations. These circuits can be used to connect phonographs, stereos, rhythm units and recorders to the organ amplifier/speaker system.

MONAURAL ACCESSORY TO PLAY THROUGH A MONAURAL ORGAN



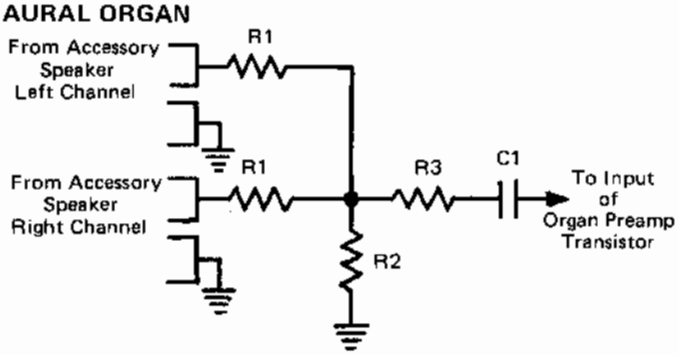
NOTE: When connecting a monaural accessory to play thru a 2-amplifier stereo organ, connect capacitor C1 to the input of either the Flute or R/S preamp before the stereo switching. This allows the signal from the accessory to be switched to the Main or Leslie speaker systems.

MONAURAL ACCESSORY TO PLAY THROUGH A STEREO ORGAN (3 amplifiers)

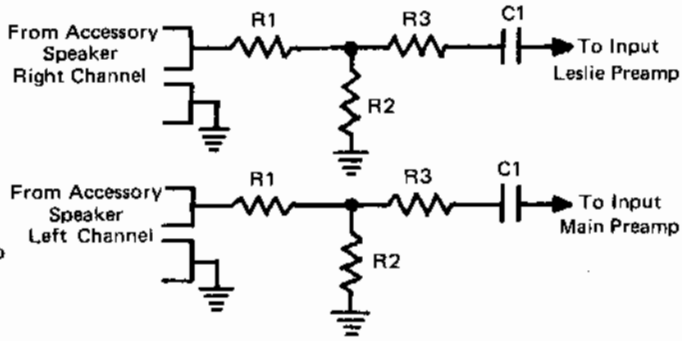


* This allows accessory to play through Main or Leslie, depending on stereo tabswitch settings

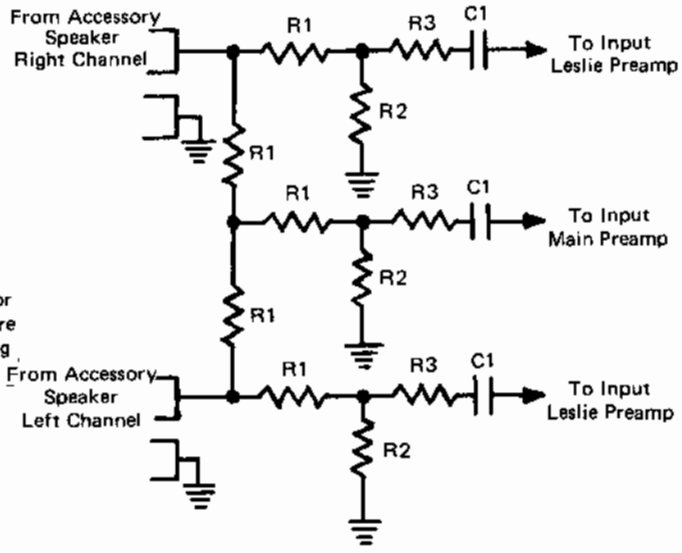
STEREO ACCESSORY TO PLAY THROUGH A MONAURAL ORGAN



STEREO ACCESSORY TO PLAY THROUGH A STEREO ORGAN (2 amplifiers)



STEREO ACCESSORY TO PLAY THROUGH A STEREO ORGAN (3 amplifiers)



After choosing the circuit which best applies to your situation, refer to the following instructions.

NOTE: Resistors R1 & R2 transform the low impedance output signal from the accessory speaker to a high impedance signal suitable for driving organ preamp. If the accessory you are attaching is designed to play through the organ speaker system and has no self-contained speaker, then resistors R1 & R2 may be eliminated in the preceding schematics. Shielded wire should also be used in an installation of this kind.

COMPONENT VALUE SELECTION

Step 1

Select R1 & R2 values to prevent overdriving organ preamps. Typical values might be R1=10K & R2=1K.

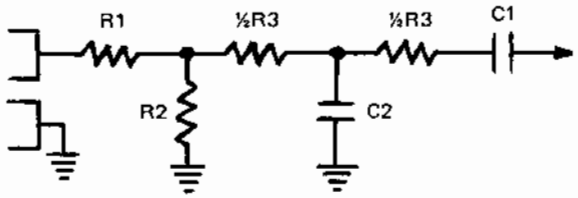
Step 2

Select R3 so as to be large enough to prevent loading the organ preamp and small enough to allow sufficient volume for the accessory being attached. Typical value may be 100K. (See Note below.)

Step 3

Select capacitor C1 for desired bass response. Larger values give full bass, smaller values reduce bass. Typical full bass value is a .047. C1 also blocks any DC voltage from being applied to the preamp transistor, upsetting its bias and causing distortion.

NOTE: Excess highs can be reduced by changing resistor R3 to two resistors of half the value. (For example, if R3=100K, replace it with two 47K's in series.) Then from the junction of these two resistors connect a small capacitor to ground. The larger capacitor C2, the less highs. (See Schematic below.)



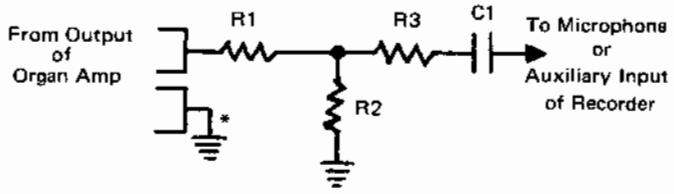
Typical Treble Roll-Off Schematic

TO RECORD DIRECTLY FROM ORGAN

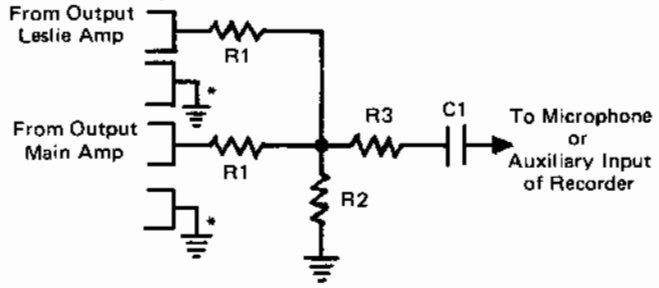
The following are circuit schematics which allow recording directly from the organ speaker system. Choose the schematic which best suits your situation.

NOTE: The Leslie tremolo effect is a mechanical effect created after the speaker and cannot be recorded when recording directly from the organ. In order to obtain this effect, the tape must either be played back through the Leslie channel or an external microphone must be used for recording.

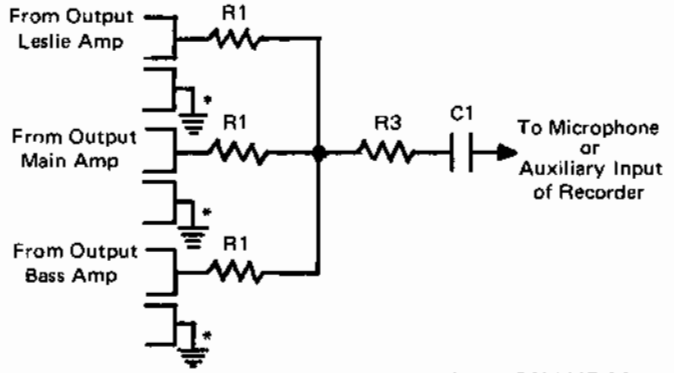
MONAURAL RECORDER TO RECORD FROM MONAURAL ORGAN



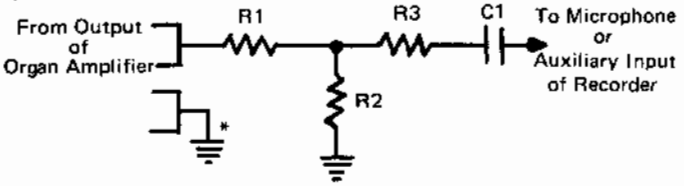
MONAURAL RECORDER TO RECORD FROM STEREO ORGAN (2 amplifiers)



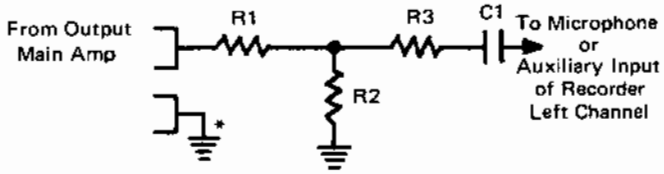
MONAURAL RECORDER TO RECORD FROM STEREO ORGAN (3 amplifiers)

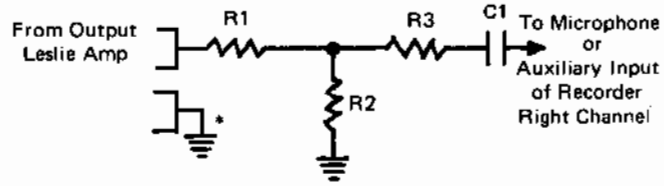


STEREO RECORDER TO RECORD FROM MONAURAL ORGAN

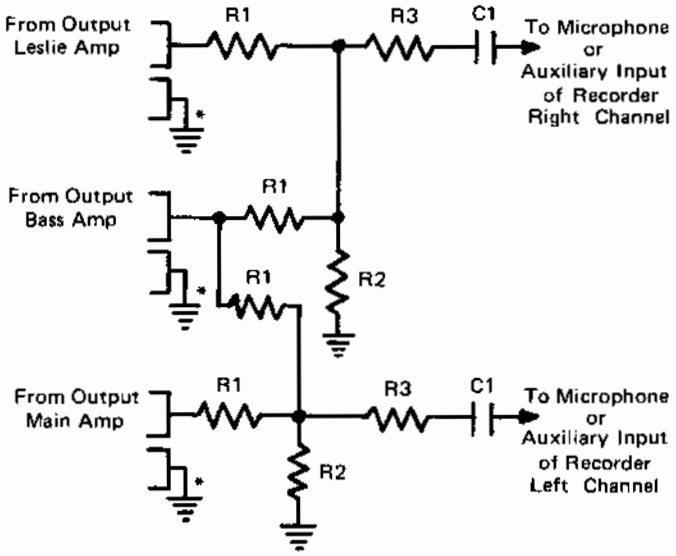


STEREO RECORDER TO RECORD FROM STEREO ORGAN (2 amplifiers)





STEREO RECORDER TO RECORD FROM STEREO ORGAN (3 amplifiers)



* When connecting recorders to an organ, only one ground should be used. More than one ground will cause feedback or oscillations. The recommended ground to use is a ground near the speaker ground.

After choosing circuit which best suits your situation, refer to the following instructions.

COMPONENT VALUE SELECTION

Step 1

Select R1 & R2 values to prevent overdriving the recorder. Typical values might be R1=10 K, R2=1K.

Step 2

Select R3 so as to be large enough to prevent loading the recorder and small enough to allow sufficient organ volume. Typical value may be 100K.

Step 3

Select capacitor C1 for desired bass response. Larger values give full bass, smaller values reduce bass. Typical full bass value is a .047. C1 also blocks any DC voltage from being applied to the recorder input causing distortion.

MICROPHONES

Generally microphones do not have enough gain to sufficiently drive the organ preamps without causing severe loading (loss of organ volume and or distortion). Also a microphone should have its own volume control. The best way to connect in microphone is to buy a microphone preamp which many electronics stores sell (Allied Radio).
Connect the microphone to the preamp and connect the preamp to either the auxiliary jack or wire it in using Resistor R3 and Capacitor C1 (refer to previous schematics) to Pin 2 of the filter networks or the input of the organ preamp. When using a microphone with the organ, if at all possible stay behind the organ to prevent excessive feedback.

EXTRA SPEAKERS (No amplifier)

The connection of the organ amplifier output to additional speakers or speaker is generally undesirable for the following reasons:

1. The organ is voiced using the characteristics of the built-in speakers. Adding a speaker with different characteristics can change the tonality of the organ quite drastically.
2. Additional speakers represent additional load on the organ amplifier. This can result in distortion or possible damage to the amplifier components.
3. Adding a speaker to a multi-speaker or multi-channel (stereo) organ, will sometimes result in an unbalanced speaker system. For instance, the Leslie channel may be weak or strong in relation to the Main channel.
4. Phase relationships on speakers are an important tonal consideration. Unless one is skilled in determining proper speaker phasing in multi-speaker organs, especially where crossover circuits are employed. Less sound quality will result, rather than more.

EXTRA SPEAKERS (Amplified)

Leslie tone cabinets and other speaker systems specifically manufactured for organs must be connected, using directions supplied by the speaker system manufacturer. Larger model organs are equipped with tone cabinet "plug-in" sockets specifically designed for a Leslie Model 147 and Lowrey tone cabinet.

Chapter 6
Soldering

SOLDERING

Soldering is a simple and efficient way of joining two or more metal parts. Even though the process is fairly easy, there are certain preparations and steps that should be followed to make good solder connections.

The technique may be broken down into three simple steps:

1. Preparing the metallic surfaces to be soldered.
2. Proper mechanical connection.
3. Application of heat, solder and flux.

Heat is used to melt the solder; flux is used to clean the connection so the melted solder will flow evenly and harden properly around the connection.

Generally, solder used in electrical or electronic wiring is made with rosin flux in it. This type of solder is commonly referred to as rosin-core solder. The solder itself is like a tube with the rosin inside. Some solders have more than one core of rosin and are referred to as multicore solder. When the solder is heated, the flux melts quickly, flows out of the solder core and cleans the metal as the solder flows on right behind it.

CHOOSING THE RIGHT SOLDER

Since solder comes in many types, be sure to get the one best suited to your application. Solder is classified by the metals it contains and the amounts of each metal. For example, a 60-40 grade solder is 60 percent tin and 40 percent lead. This is a typical combination used in electronic wiring. This type of solder melts at 371 degrees F. This temperature is normally safe because the solder melting point is low enough that the heat will not normally damage electronic parts.

Solder with a 50-50 tin-to-lead ration melts at 425 degrees and may be used where heat is not a problem. However, for general electrical work, 60-40 rosin-core solder is the best choice. In all cases of electronic wiring, a rosin-core solder should be used. Never use an acid-core type. Acid-core solder is corrosive to electric wiring and will not provide the right kind of connection needed for proper current flow.

SELECTING THE RIGHT IRON

Soldering irons and soldering guns come in many sizes, shapes and styles. To make the selection easier, consider the various types and when they are used.

Soldering irons and soldering guns are rated by the amount of heat they provide. This is given in watts. Electrical soldering which consists of soldering wires, terminals and other metal which will not be damaged by heat may be done with soldering irons or guns rated as high as 150 watts. Electrical or electronic wiring on printed circuit boards and the like should be done with a low-wattage iron. This may be a 25-watt, 30-watt or 40-watt iron or an iron rated even a little lower. A low-wattage iron is needed to prevent damage to transistors, diodes and other parts. Low-wattage irons are light and easy to handle. They are often called "pencil-type" irons because of their size. Most irons are equipped with either tips or elements which are easy and inexpensive to replace.

SOLDERING AIDS

There are a number of handy tools to use when soldering. Some of these you may already have in your tool box. Needle-nose pliers and a side-cutter (called dikes) are a must for soldering electronic equipment. Needle-nose pliers are useful for handling small parts and making lead connections in crowded spaces. The side-cutter is used to trim wires and leads on components.

A wire stripper is also useful for quick and safe removal of insulation from hook-up wire. Another very handy tool is a solder siphon (or solder sipper). This tool is a suction device which is used to remove the solder as it is melted. It is especially helpful when removing parts from a printed circuit board. A small vise or a surgeon's forceps are great aids as a third hand for holding parts during soldering. Even an ordinary household item, such as a clothespin, may be used to hold small parts for soldering.

Soldering-iron holders will prevent burns. Another inexpensive aid is a small damp sponge to keep the tip of the iron clean. Some soldering-iron holders include a special sponge as part of the base. Wiping the iron tip on this sponge after each application of solder will keep the iron tip clean and shiny and allow it to transfer heat to the soldered connection more quickly.

SOLDERING TECHNIQUES

Having the right tools for the job is the best start. Proper use of the tools gives the greatest satisfaction. The first step in soldering is to have a clean, tinned tip on the soldering iron. A new iron tip should be "tinned" by melting solder

on the heated tip and wiping off the excess with a damp sponge or rag. Badly worn tips should be filed down to their original shape and retinned to keep them shiny and free from corrosion. Worn-out tips should be replaced.

There are two ways to apply solder — a right way and a wrong way. The right way to solder is to heat the connection with the iron. When the connection is hot enough to melt the solder, the solder will flow in evenly. Then remove the iron and solder without moving the connection and let the melted solder harden by itself. Don't use too much solder! Many people think a big blob of solder makes a good connection. . . it doesn't! Heat the connection and let just enough solder flow into it to fill around the connection. That's all you need.

The wrong way to solder is to heat the solder with the iron and melt it onto the connection. This causes a "cold solder joint." A cold solder joint is simply one in which the connection was not heated to let the solder flow into it and this kind of connection can cause poor operation or no operation at all. When a good solder connection hardens, it is silver colored. A "cold solder" connection is usually much duller in appearance. If you get too much solder on a connection, reheat it and use the iron to pick up the excess solder. Wipe the excess solder from the iron tip on a damp sponge or rag. If the connection was moved before the solder had time to harden and looks like a cold solder joint, reheat the connection and apply new solder — but not too much.

HELPFUL HINTS

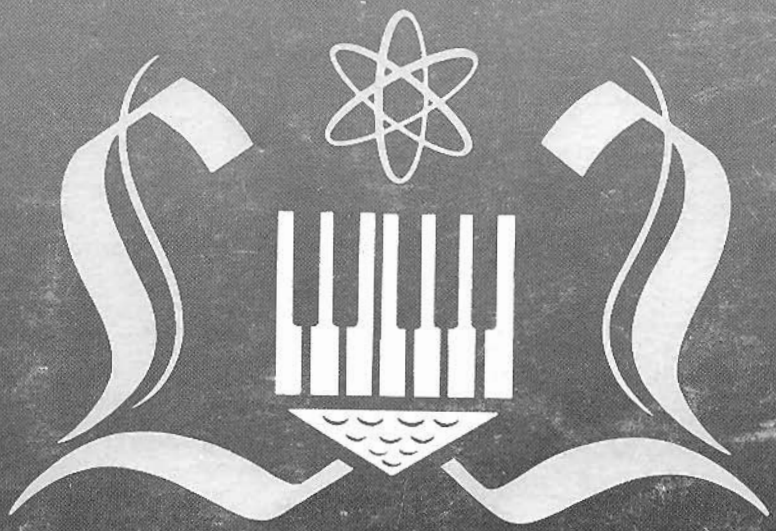
There are a number of little "tricks" or hints that can and should be used when soldering electronic parts — especially when working with delicate transistors and diodes. Even low-wattage irons can cause possible damage to some parts if too much heat is transferred into the device. Many manufacturers' service instructions mention using caution when soldering transistors. There is no problem if you are reasonably careful of the amount of heat you apply.

The best way to solder any delicate part, such as a transistor, is to use a "heat sink" of some type. This "heat sink" can be any metal tool clipped to the transistor lead which is being soldered. Use needle-nose pliers, or even handier, an alligator clip.

Before soldering each transistor lead to a circuit, connect the alligator clip to the transistor lead below the transistor — in other words, between the transistor and the connection to be soldered. The alligator clip also lets you have both hands free to solder. Heat from the connection will go up the lead and be soaked up by the alligator clip without reaching the transistor. Do this on each lead as it is soldered and you will not have to worry about damaged transistors. Use the same procedure when soldering diodes or other delicate parts.

Another trick is one you will find very useful if you have to replace a resistor or capacitor on a printed circuit board and want to save the effort of having to remove the board. Cut the defective part off the board with your dikes right next to the body of the part so that you leave as much of the old lead as possible still on the top of the board. Then simply put the new part in place, wrap the new leads around the old ones, trim off the excess length and solder.

One more hint when working with an iron on any electronic equipment: Always be sure the power plug is disconnected.



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