FIGURE 1. TYPICAL H-100 SERIES INSTRUMENT

DIMENSIONS: 50" HIGH, 26-1/2" DEEP AND 50" HIGH WITH MUSIC RACK
WEIGHT: 445 LBS. WITH PEDALS AND BENCH
INPUT: 117 VOLTS, 60 CYCLE A. C. - 340 WATTS
POWER OUTPUT, 60 WATTS E. I. A.

GENERAL DESCRIPTION

H-100 SERIES

The Hammond H-100 series organ is a completely self-contained console, requiring no external tone cabinet. It has two manuals or keyboards of 61 keys each, a 25 note pedal keyboard, and an expression (or swell) pedal for controlling the volume. All tones are produced by electro-magnetic tone generators and electronically amplified, as in other models of the Hammond Organ. Selection of tone colors is made by adjusting 46 drawbars, 7 prevoiced tabs and 18 preset keys. Other characteristics of the music are adjusted by means of 21 other tabs. A switch on the expression pedal when operated turns off any vibrato effect set up on the tabs. A toggle switch located to the left of the console above the manual is used to turn on the organ. A pilot light shows when the organ is turned on.

Figure 1 shows the front of the console and Figure 2 is a rear view, with the back cover removed.

INSTALLATION AND MAINTENANCE

(See Back Cover)

A card, packed with the playing instructions, gives full information on installing the organ, oiling, and packing for moving or shipment. After reading this card, the owner may wish to attach it to the underside of the organ bench top for future reference.

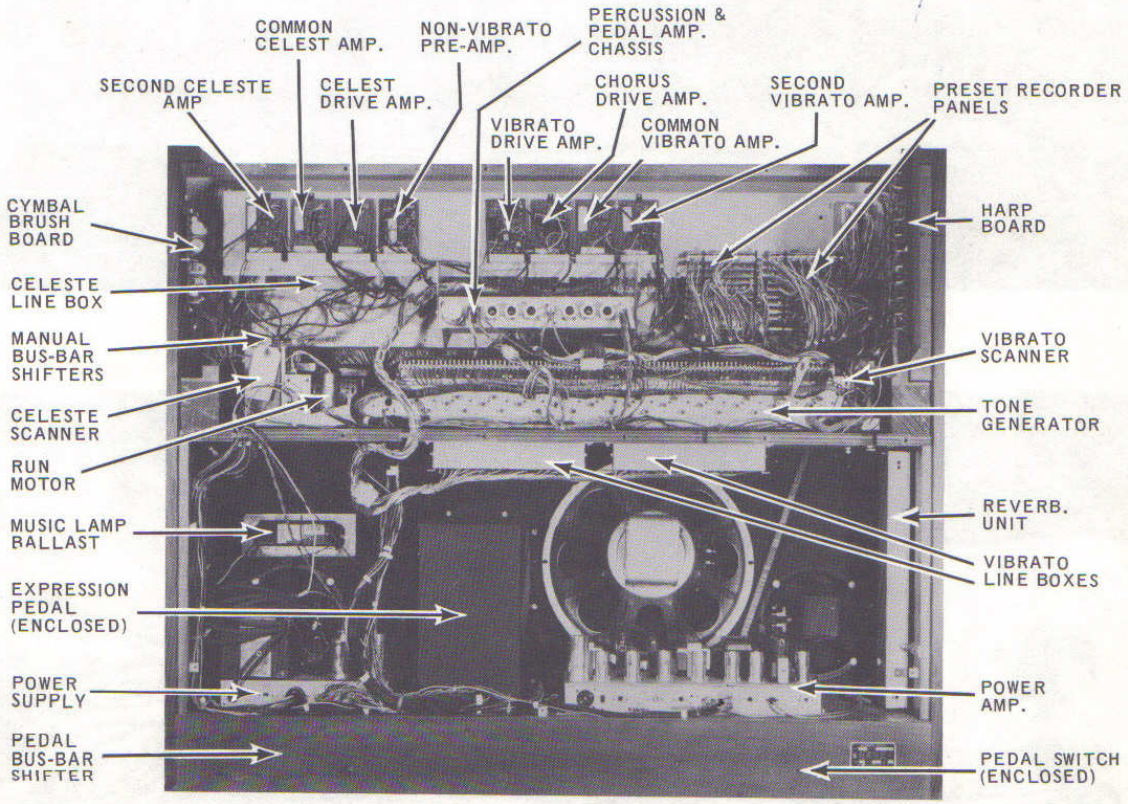


FIGURE 2. REAR VIEW WITH BACK COVER REMOVED

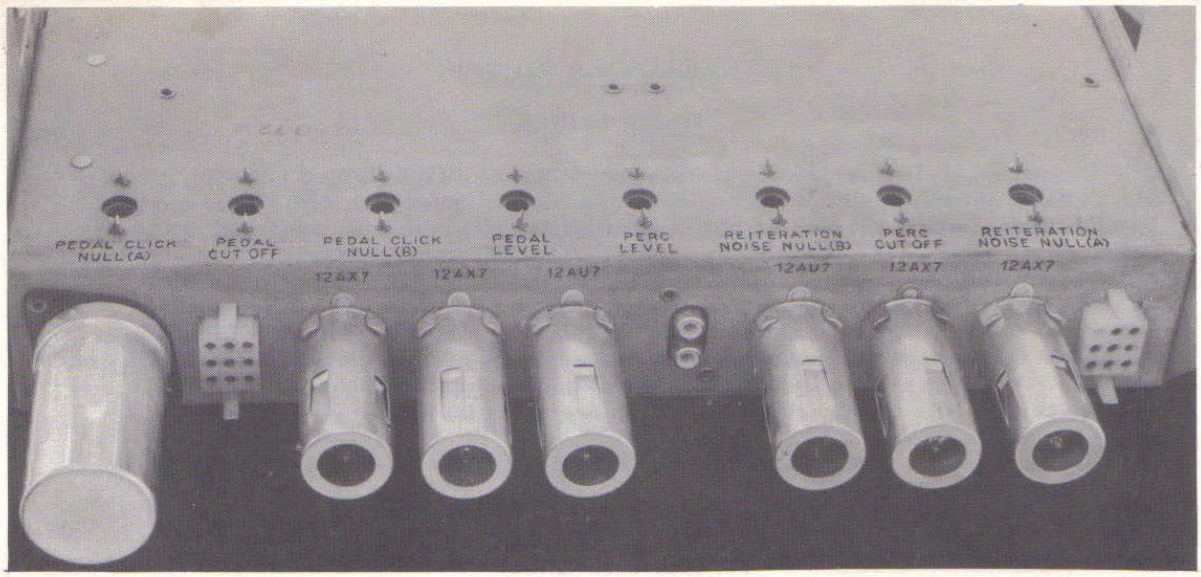


FIGURE 3. CONSOLE PREAMPLIFIER

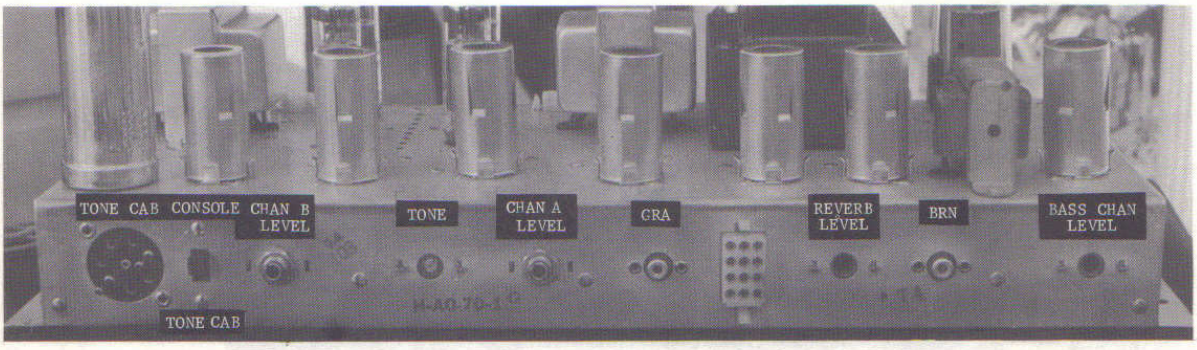


FIGURE 4. POWER AMPLIFIER

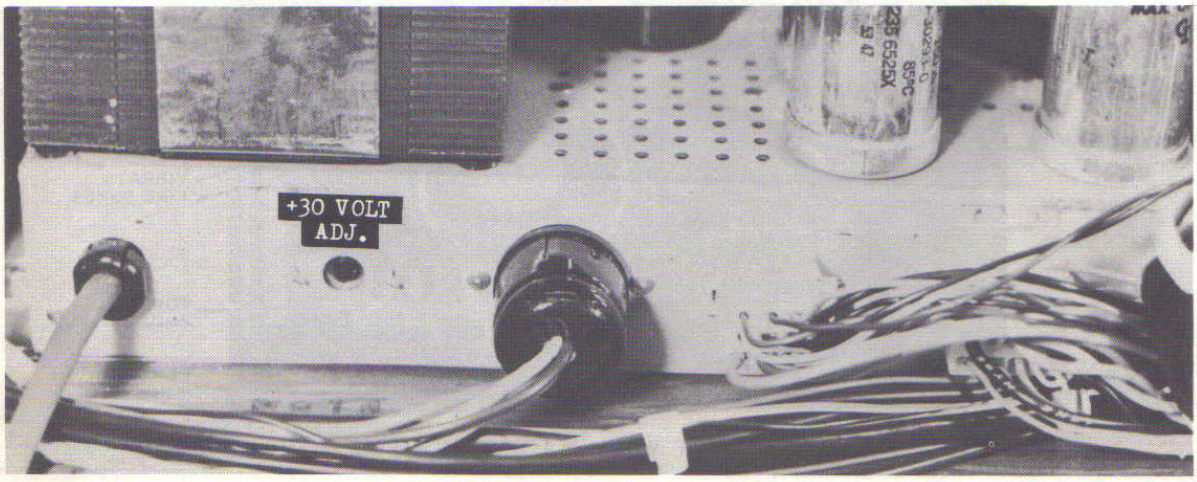


FIGURE 5. POWER SUPPLY CHASSIS

NOTICE: If tests indicate that an adjustment of the control settings is necessary, proceed as outlined on the following 3 pages. For control locations see figures 3, 4, and 5.

ADJUSTMENT PROCEDURES

To properly make the following adjustment settings, you should have the following equipment:

1. An AC VTVM such as Simpson Model 715 for $75.00, or a Heathkit Model IM-21 for $34.00 in "kit" form, or Model IMW-21 for $53.00 "Ready Built".
2. A Quality Volt OHM Meter, such as Simpson Model 260-5 for $58.00.

We have found a single meter, Heathkit Model IM-25, in "kit" form for $80.00 or Model IMW-25 "Ready Built" for $115.00 to be an acceptable substitute for both the above meters.

Before adjustments can be made it will be necessary to:

1. Remove console back cover.
2. Remove screw that secures Harp Assembly to preamplifier, and swing Harp Assembly out.
3. Remove console top.
4. Remove the two covers located on the rear of the Control Panel Assembly.
5. Remove the top cover of the Control Panel Assembly.

NOTE: Before making any AC output adjustment, make the following DC settings.

1. Check the collector voltage of the finned transistor on the vibrato drive board. The case of this transistor is the collector. If the collector voltage is not 70 volts, adjust the bias control near this transistor so that 70 volts is attained.

   Depress any STRING BASS tab. Press and release any pedal. Adjust +30 volt control on power pack so that +18 volts* appears between pin 6 of plug P-702 (positive) and ground. *On later series instruments (those which have additional contacts on lowest 8 notes when using 16' mellow drawbar) set control for 14 volts instead of 18 volts.

NOTE: Keys or pedals called by number are counted from low note end of the organ.

OUTPUT AND BALANCE SETTINGS

All of the following settings are made with: A. Swell Pedal wide open.

B. All tabs UP, except as specified.

Later model H-100 organs with power amplifiers coded G and above, incorporate Concentric Level controls for the A and B channels. The inner control is accessible by inserting a screwdriver through the hole in the outside Pot, and adjusts the level of the signal being fed to the tone cabinet outlet.

The outer controls adjust the level of the console speakers only. To adjust the tone cabinet level it will be necessary to connect an AC VTVM with a 47K resistor across its input terminals to pins 1 and 7 of the tone cabinet outlet. Pin 1 is the A channel and Pin 7 is the B channel. Proceed as in Step #1 below, in which case each pin should show a reading of .17 volts. Adjust proper control until this reading is attained.

For The Following Adjustments

An AC VTVM should be connected across specified speaker. The A speaker is mounted above the power supply. The B speaker is above the power amplifier. The Bass speaker is the large speaker above the power amplifier.

Before starting this procedure, set Precussion and Pedal Level and REITERATION RATE controls to a full clockwise position. Set Tone Control on Power Amplifier to midway position.

Controls to be set in Steps #1, 3, 4, 5 and 6 are located on Power Amplifier Chassis.

	Meter Across Speaker Indicated		
1.	B		Depress Upper Manual B Preset Key. Pull out 4th drawbar of upper manual B group. Depress Key 25 and adjust Channel B Level for a meter reading of .54 volts.
2.	B		Add ON UPPER tab to above registration and adjust Vibrato Gain control located on top of vibrato drive board for a reading of .54 volts. After adjusting lift ON UPPER tab.
3.	B		Push in 4th drawbar and pull out drawbar #9 of upper manual B group. Depress key 48 and adjust Tone Control for a meter reading of .14 volts.
4.	A		Push in 9th drawbar and pull out 4th drawbar of upper manual B group. Depress key 25 and adjust Channel A Level for a meter reading of .54 volts.
5.	Bass		Push in 4th drawbar and pull out 1st drawbar of upper manual B group. Depress key 25 and adjust Bass Level control for a meter reading of 1.5 volts.
6.	A	a.	Setup the following registration 00060708000, on the upper manual B group drawbars. Depress keys 13, 14, 15, 16, and 17 on the upper manual and note meter reading.
		b.	Depress both REVERBERATION tabs and adjust Reverberation Level control until reading is identical to that noted in Step 6a. After adjusting push in drawbars and lift REVERBERATION tabs.
7.	A	a.	Depress the upper manual A# preset and pull out drawbar #4 of that group. Depress keys 13, 15, and 17, and note meter reading.
		b.	Depress B preset and HARP SUSTAIN tab. Depress same keys and adjust Harp Level control on harp board until reading is identical to that noted in Step 7a. After adjusting push in drawbar and lift HARP SUSTAIN tab.

8.	A		Depress BANJO tab. Depress key 25 and adjust Percussion Cutoff control until note is barely audible.
9.	A	a.	Depress the upper manual A# preset and setup the following registration 00078888800 on the upper manual A# group. Depress key 25 through A# preset, and note meter reading.
		b.	Depress BANJO and SECOND VOICE tab. Play key 25 through B preset and adjust Percussion Level control until reading is identical to that noted in Step 9a.
10.	A	a.	Depress BANJO and SECOND VOICE tabs. Play the middle C E G chord percussively at about 5 strokes per second, and observe the maximum swings in the output of the A channel.
		b.	Lift SECOND VOICE tab and continue to play the chord percussively. Adjust the Reiteration Drive control, located on the rear of the reiterator chassis, until reading is identical to that noted in Step 10a.
11.	Bass		Depress BANJO and REITERATION tabs. Partially depress the highest key on the upper manual to the point where the reiteration thump is heard. Wedge key in this position. Adjust Reiteration Noise Nulls A and B for minimum audible keying thump and meter reading. After adjustment lift BANJO and REITERATION tabs.
12.	Bass		Pull out all pedal drawbars and depress either STRING BASS tab. Depress the highest pedal and release, adjust Pedal Cutoff control until note disappears.
13.	Bass		Pull out Pedal drawbar #1 and depress pedal #13. Adjust ~~Pedal Cutoff control until note disappears. After adjusting lift STRING BASS~~ tabs. Ped level for 6.0 V.
14.	Bass		With all drawbars IN, and all tabs UP, depress any pedal repeatedly and adjust Pedal Click Nulls A and B for minimum audible keying thump and meter reading.
15.	B		Set BRUSH-CYMBAL LEVEL control to full clockwise position. Depress CYMBAL PEDAL tab. Depress any pedal rapidly, observe fluctuating output reading. Adjust CYMBAL LEVEL control on brush and cymbal board for a reading of 2.5 volts.
16.	B		Depress BRUSH tabs. Play any three keys repeatedly and adjust Brush Level control to attain reading identical to that in Step 15.
17.	Bass	a.	With all controls properly set, all metal covers in place, and all keys and tabs up, hum and noise should be less than .040 volts.
	A or B	b.	Under same condition as stated above hum and noise should be less than .015 volts.

HOW THE ORGAN WORKS

To turn on the organ, lift the switch to "ON" position. To turn off the organ, push the switch downward to its "OFF" position.

Most tone sources, such as strings, reeds, or pipes, produce complex tones. The Hammond tone-producing mechanism, however, generates individual frequencies which can be combined by means of harmonic drawbars to produce any desired tone quality. The block diagram, (figure 41) shows the chief components of the instrument.

Electrical impulses of various frequencies are produced in the "tone generator assembly" which contains a number of "tone wheels" driven at predetermined speeds by a motor and gear arrangement. Each tone wheel is a steel disc similar to a gear, with high and low spots, or teeth, on its edge. As the wheel rotates, these teeth pass near a permanent magnet, and the resulting variations in the magnetic field induce a voltage in a coil wound on the magnet. This small voltage, when suitably filtered, produces one note of the musical scale, its pitch or frequency depending on the number of teeth passing the magnet each second.

A note played on either manual of the organ consists of a fundamental pitch and a number of harmonics, or multiples of the fundamental frequency. The fundamental and harmonics available on each playing key are controlled by means of drawbars. By suitable adjustment of these controls the player may vary the tone colors at will. Several pre-selected tones are also available by use of the preset keys: Various special effects are made available by use of the tabs.

Mixed tones from either the upper manual or the lower manual may go through either the "vibrato" portion or the "non-vibrato" portion of the preamplifier, depending on the position of the corresponding "Vibrato ON" tabs. The tones are then combined and pass through the expression control and additional stages of amplification before reaching the speakers.

A "Cymbal" effect is available through the foot pedals with the "Cymbal Pedal" tab depressed, while a "Brush" effect on both upper and lower manuals is available by depressing either, or both the "Brush Upper" and "Brush Lower" tabs.

Both of these effects are introduced into the overall signal at the power amplifier input.

At the left of each manual are twelve keys identical to the playing keys except reversed in color (figure 6). When a preset key is depressed it locks down and is released only when another is depressed. The exception to this is the cancel key at the extreme left, which serves only to release any key which may be locked down. Only one preset key is used at one time. If, by mistake, two are depressed and locked, they may be released by means of the cancel key. Each preset key, with the exception of the two "Adjust" keys at the extreme right of the group, makes available a different tone color which has been set up on the preset panel located inside the console. These tone colors are set up at the factory in accordance with a standard design which has been found to best meet the average organist's requirements. They may be changed, if desired, by removing the back of the console and changing the preset panel connections in accordance with instructions on a card located near the preset panel.

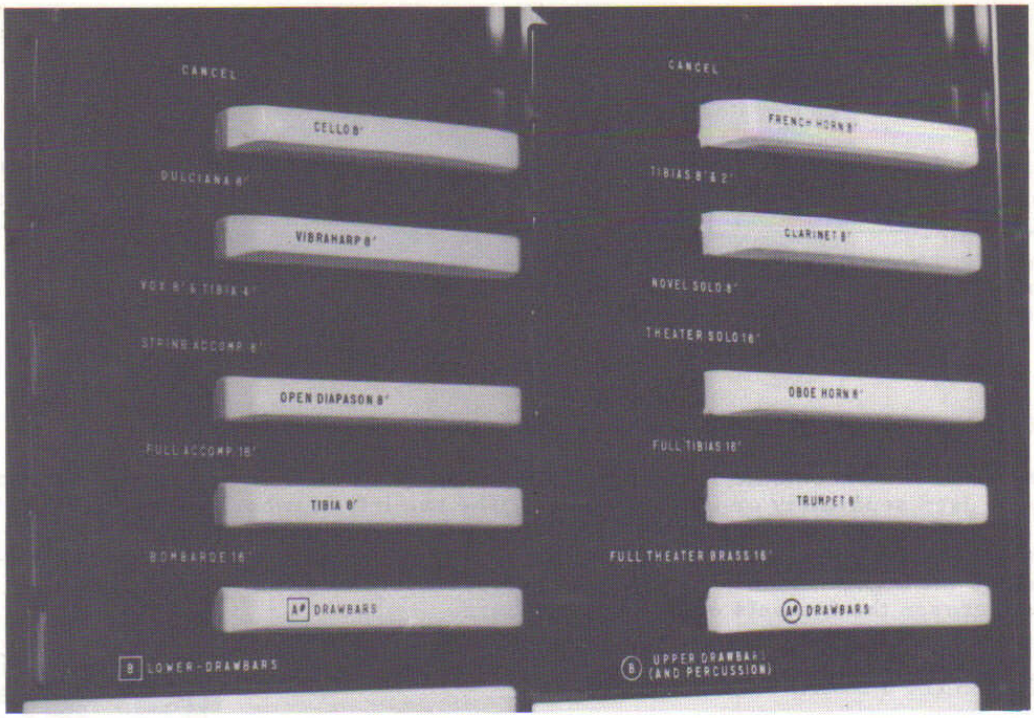


FIGURE 6. PRESET KEYS

When either "Adjust" key is depressed, the organ speaks with whatever tone color is set up on the harmonic drawbars associated with that key. The percussion voices can be used only when the upper manual "B" preset key is depressed. (See "Percussion Tabs" also).

Each console has four sets of harmonic drawbars, two for each manual, figure 7 shows one group of harmonic drawbars, by which the organist is enabled to mix the fundamental and any, or all, of twelve different harmonics in various proportions. (Note: The lower manual does not have the 10th. & 12th. harmonics.) The third bar from the left controls the fundamental, and each of the other bars except the two on the right, is associated with a separate harmonic. The second bar from the right combines the 7th. & 9th. harmonics, while the first bar on the right controls the 10th. & 12th. harmonics. If a drawbar is set all the way in, the harmonic it represents is not present in the mixture, each drawbar may be set in eight different positions by the organist in addition to the silent position. Each position, as marked on the drawbars, represents a different degree of intensity of the harmonic it controls. When drawn out to position 1, the harmonic it represents will be present with minimum intensity; when drawn out to position 2, with greater intensity; and so on up to position 8.

A tone color is logged by noting the numerical position of the various drawbars. For instance, the tone set up in figure 7 is known as Tone 33545124422. After a tone is logged it may be made available again by setting the harmonic drawbars to that number.

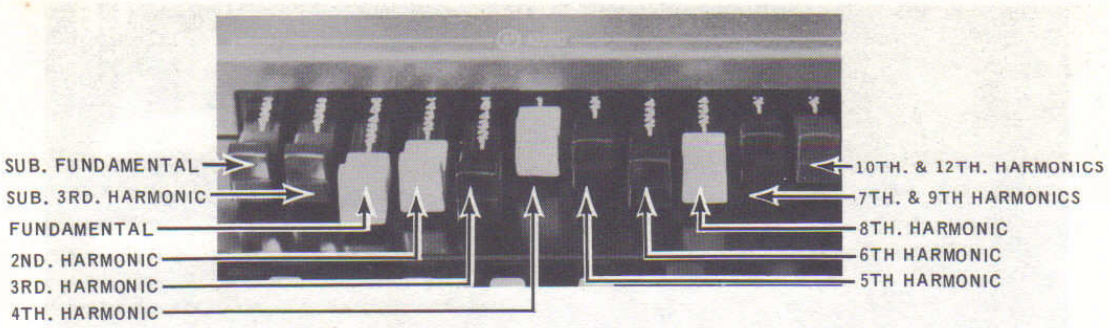


FIGURE 7. HARMONIC DRAWBARS

HARMONIC DRAWBARS FOR THE PEDALS

In the pedals the harmonic resources have been combined into four drawbars which may be used separately or in combination. The two left drawbars have a basic 16' pitch and the right two have an 8' pitch, for each pitch, the brown drawbar emphasizes the lower harmonics to give a mellow tone, while the black drawbar emphasizes the higher harmonics to give a bright tone. The pedal drawbars are located between the two sets of manual drawbars.

EXPRESSION PEDAL

The expression pedal, sometimes referred to as "Swell Pedal" (figure 8) is operated by the player's right foot to control the volume of the instrument. The pedal controls two channels simultaneously: One for the "BRUSH-CYMBAL" and organ "B" channel and the other for the organ "A" channel.

The volume is controlled by a variable shutter on the pedal moving between a light source and two photocells. The amount of light reaching the photocells is determined by the position of the shutter. Maximum light produces minimum resistance in the photocell; therefore, minimum volume.

FIGURE 8.
SWELL CONTROL

PERCUSSION TABS

There are 11 of these tabs (figure 9) plus a reiteration rate control. The first tab on the left "second voice", when depressed converts the percussion voices into sustained tones so that they will continue to sound as long as a key is held down. The second tab "Touch Control", when depressed, introduces the "Touch Response" percussion mode, in which the keys must be played in a detached manner to make the percussion voice operate. With this tab up, each note will sound as it is pressed, and repeat whatever other keys are depressed. The next six tabs are prevoiced percussive voices, each creating the effect associated with the instrument indicated on the: Individual tab. The next tab, when depressed, turns on the reiterator circuit, and it's rate is controlled by the reiteration rate control. The next tab produces a sustained harp voice which differs from the other percussion voices, in that it begins to decay after a key has been released. The last tab, when depressed, adds vibrato to any of the above mentioned percussion voices only. Operation of the electrical circuits associated with these features is described in subsequent paragraphs.

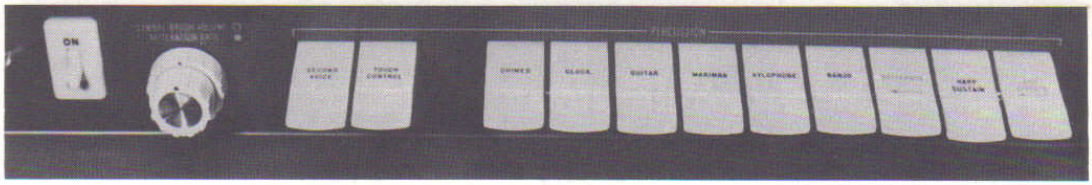


FIGURE 9. POWER SWITCH, CYMBAL-BRUSH, REITERATION RATE CONTROLS & PERCUSSION TABS

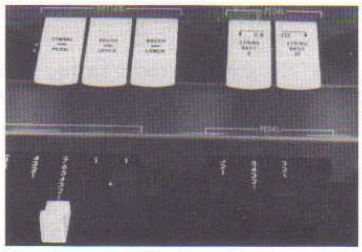


FIGURE 10. RHYTHM & PEDAL TABS

RHYTHM TABS

There are three tabs in this group (figure 10). The "Cymbal pedal" tab, when depressed, introduces a cymbal effect to the foot pedals in addition to the tones selected by the pedal drawbars. The "Brush Upper" tab, when depressed, introduces a brush effect to the upper manual in addition to any other tones selected by drawbars or preset keys. The "Brush Lower" tab performs the same function on the lower manual. Operation of the electrical circuits associated with these features is described in subsequent paragraphs.

Note: An overall level control for brush and cymbal is located at the left end of the control panel.

PEDAL TABS ("STRING BASS")

These two tabs (figure 10) when depressed, provide pedal decay in three degrees for a string bass effect. "String Bass I" provides a short decay, "String Bass II" provides a longer decay and a combination of the two provides an even longer decay period. Operation of the electrical circuits associated with this feature is described in subsequent paragraphs.

VIBRATO TABS

H-100 Series organs are equipped with selective vibrato, using five tabs to vary the vibrato effects. Two tabs relate to selectivity; depressing the "On Upper" tab introduces vibrato into the upper manual and depressing the "On Lower" tab introduces vibrato into the lower manual and pedals (figure 11).

"Vibrato I" tab, when depressed, produces the first degree of vibrato. A second or wider degree of vibrato is produced when "Vibrato II" tab is depressed, and a third degree of vibrato is produced when both tabs are in the "UP" position. Note: the above two tabs are mechanically interlocked so that both cannot be depressed at the same time.

The "Dual Vibrato" tab, when depressed, adds the second half of the vibrato scanner rotor, feeding it through a separate channel, creating an enriched, stereo vibrato.

The "Chorus" tab, when depressed, introduces some straight signal along with the vibrato, creating a chorus effect. The "Celeste" tab, when depressed, cuts out vibrato I, II and III and creates a slow wavering effect. "Dual Vibrato" can be added to it if desired. In addition, there is a spring loaded "Vibrato Cancel" switch on the expression pedal which, when operated, cancels all vibrato effects.

FIGURE 11. VIBRATO, REVERB., ECHO & VOLUME SOFT TABS

REVERBERATION TABS

The two reverberation tabs, when depressed, make available three degrees of reverberation. "Reverb. I" produces a small amount, "Reverb. II" a larger amount, and with both tabs depressed an even larger amount, entitled "Reverb. III". (figure 11).

ECHO TABS

The H-100 series organs have a built-in echo switch consisting of two tabs, "Echo Only" and "Main & Echo". When the "Echo Only" tab is depressed, the console speaker system does not sound, permitting only the tone cabinet or cabinets to sound. When the "Main & Echo" tab is depressed, the tone cabinet and the console speaker systems are activated. With both tabs "UP, only the console will sound. There is also a slide switch on the rear panel of the power amplifier which, when in the "UP" position, disables both of the echo tabs, if the organ is to be used alone.

VOLUME SOFT TAB

The "Volume Soft" tab, when depressed, reduces the overall volume level available, in order to permit playing at reduced volume while still maintaining the full dynamic range of the expression pedal.

AMPLIFICATION SYSTEM

The large chassis located on the right side of the lower console shelf (figure 2) contains the reverberation driver, reverberation pre-amplifier, channel "A" amplifier, channel "B" amplifier, bass amplifier, and tone cabinet drive amplifier.

The smaller chassis on the left side of the lower console shelf contains the power supply.

The large chassis mounted on the center rear of the manual chassis contains the percussion amplifier and the pedal amplifier.

Mounted on the rear cover of the control panel under two shielding covers, are eight printed circuit boards (figure 2). They are as follows; from left to right, second celeste amplifier, common celeste amplifier celeste drive amplifier, non-vibrato pre-amplifier, vibrato drive amplifier, chorus drive amplifier, common vibrato amplifier and second vibrato amplifier. Mounted on the upper end of the left inside console panel is a printed circuit board. It contains the cymbal-brush generator, keyers and shapers.

Hinged to the upper right of the console is a panel containing five printed circuit boards. The four boards from the left (figure 13) and a portion of the fifth board are keyers. The balance of the fifth board contains a two stage harp pre-amplifier.

Operation of the electrical circuits associated with the above systems are described in subsequent paragraphs.

FIGURE 12. TONE GENERATOR

CONSTRUCTION AND OPERATION OF COMPONENTS

In studying this section, refer to the schematic circuit of the entire organ, (figure 40 and 41). Connections between components are shown in the wiring diagram, (figure 43).

TONE GENERATOR

All tones of the organ except cymbal and brush effect originate as electrical signals in the tone generator assembly. It contains 96 tone wheels having various numbers of teeth, with suitable gears for driving them at various speeds from a main shaft extending along the center. Each pair of tone wheels is mounted on a shaft and between them is a bakelite gear held by a coil spring, forming a mechanical vibration filter. As the gear is not rigidly attached to the shaft, any pair of wheels which may be stopped accidentally will not interfere with the operation of the others.

The tone generator assembly is driven at constant speed by a self starting synchronous motor, operating at 1800 RPM, located at the left side as you look in at the back of the console (figure 2). (In 50 cycle organs, the generator speed is 1500 RPM.)

Adjacent to each tone wheel is a magnetized rod with a pick-up coil wound on it. These magnets extend through the front and back of the generator, and are held by set screws which can be loosened in case adjustment is ever necessary. Figure 15 shows where to find the magnet for any frequency number. In this drawing the dotted lines indicate frequencies whose tone wheels are on the same shaft.

On top of the tone generator assembly are small transformers and capacitors, forming tuned filters for the higher frequencies. They are not likely to need replacing. In case one filter becomes inoperative, both the transformer and condenser must be replaced with a matched set from the factory. Figure 14 shows the location of these filters. A few frequencies use untuned filters consisting of coils alone, and some use resistors and capacitors.

Wires from the various filter assemblies lead to the terminal strip on the long edge of the generator.

The output frequencies of the tone generators are numbered, for convenience, in order of increasing frequency. The lowest, number 1, is about 32 cycles per second, and the highest, number 96, is about 8000 cycles per second. Frequency numbers 1 to 68 are used by the manuals and pedals, while frequencies 69 thru 96 are used by the manuals only. Figure 14 showing filter locations also shows the termination point of each frequency, while (figure 40 and 41) shows typical tuned and untuned tone generators.

In case any generator frequency is weak or absent, refer to "Practical Service Suggestions" for the procedure to be used in locating and correcting the trouble.

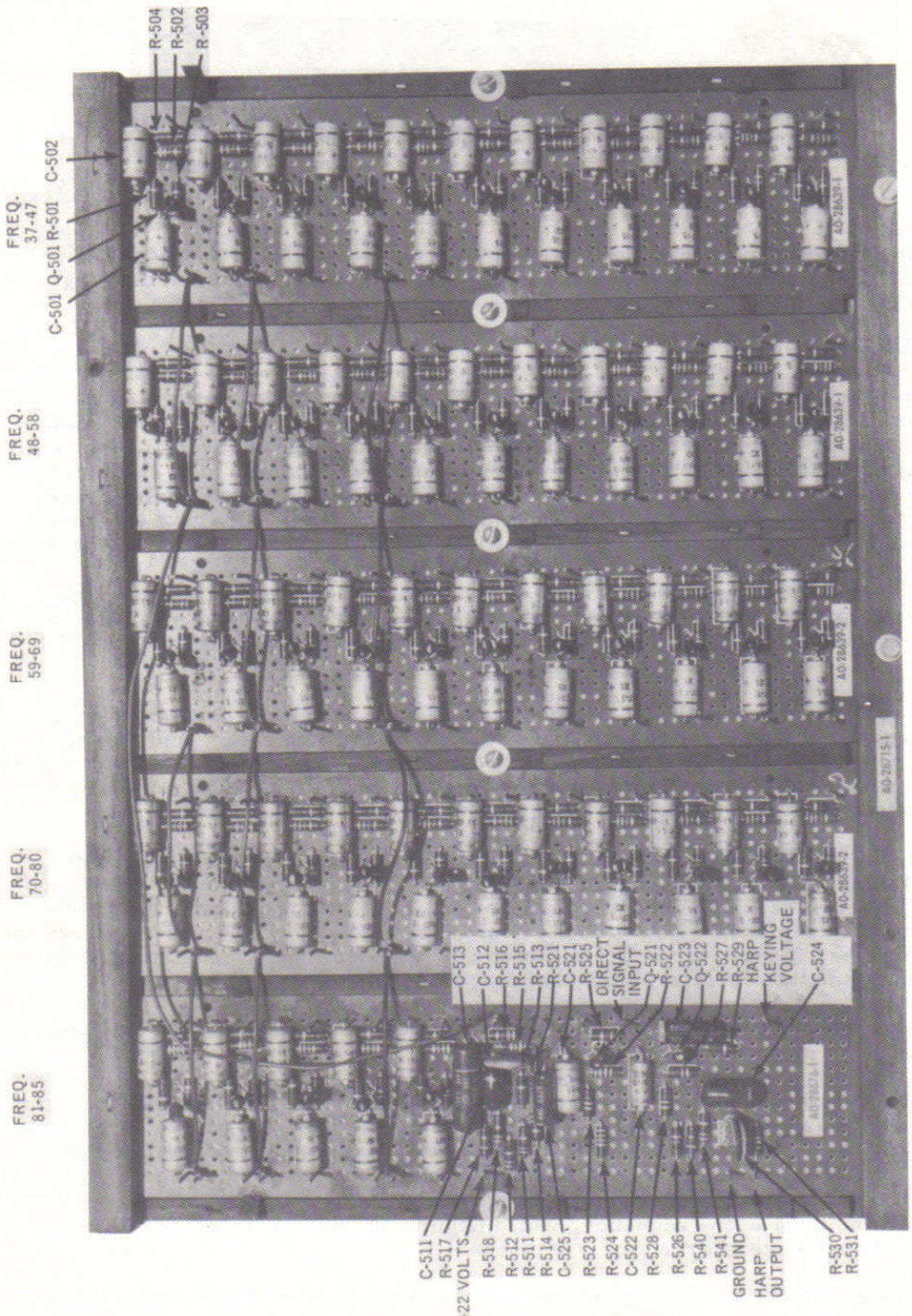


FIGURE 13. HARP SUSTAIN CHASSIS

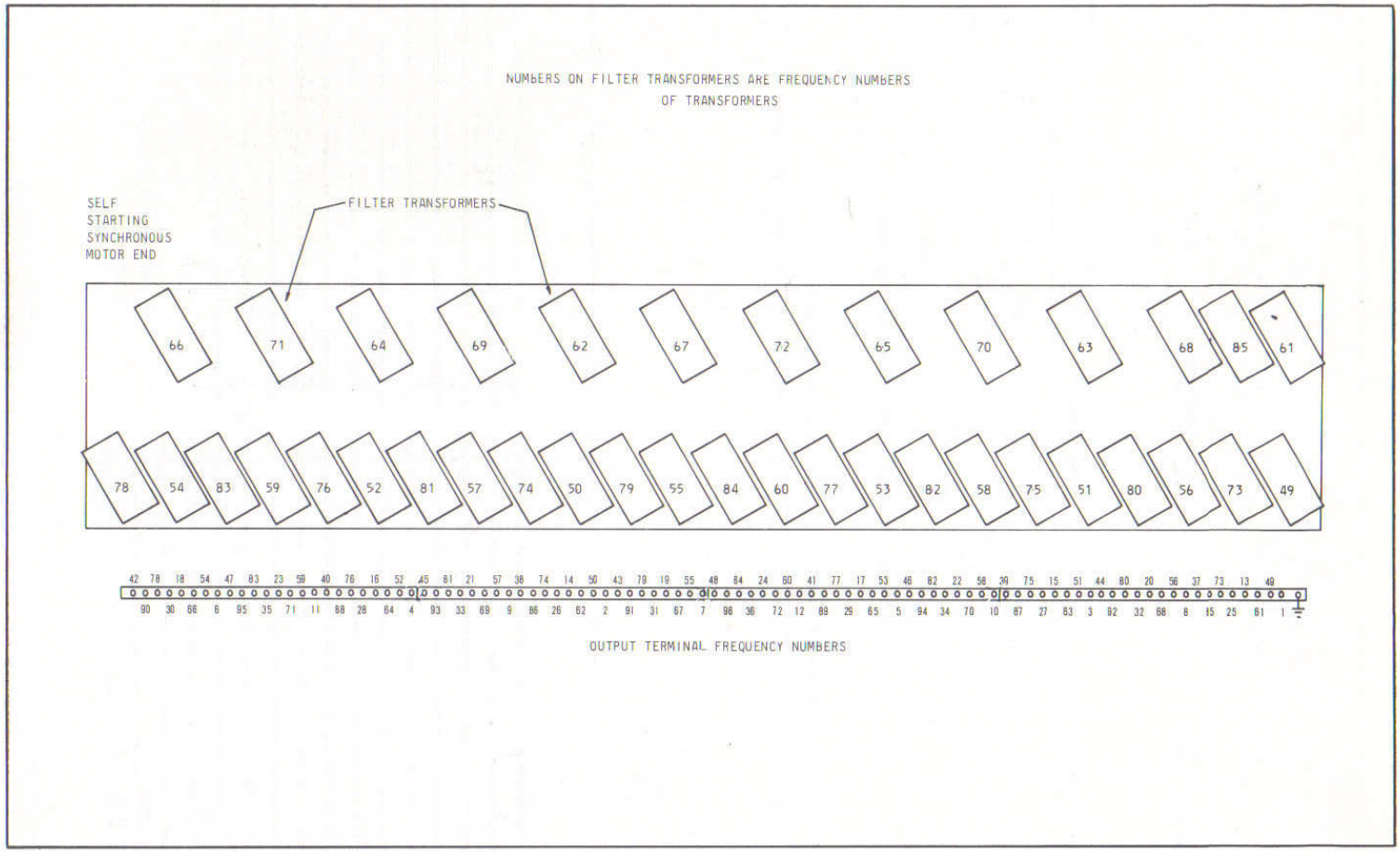


FIGURE 14. MAIN GENERATOR COVER & TERMINAL STRIP

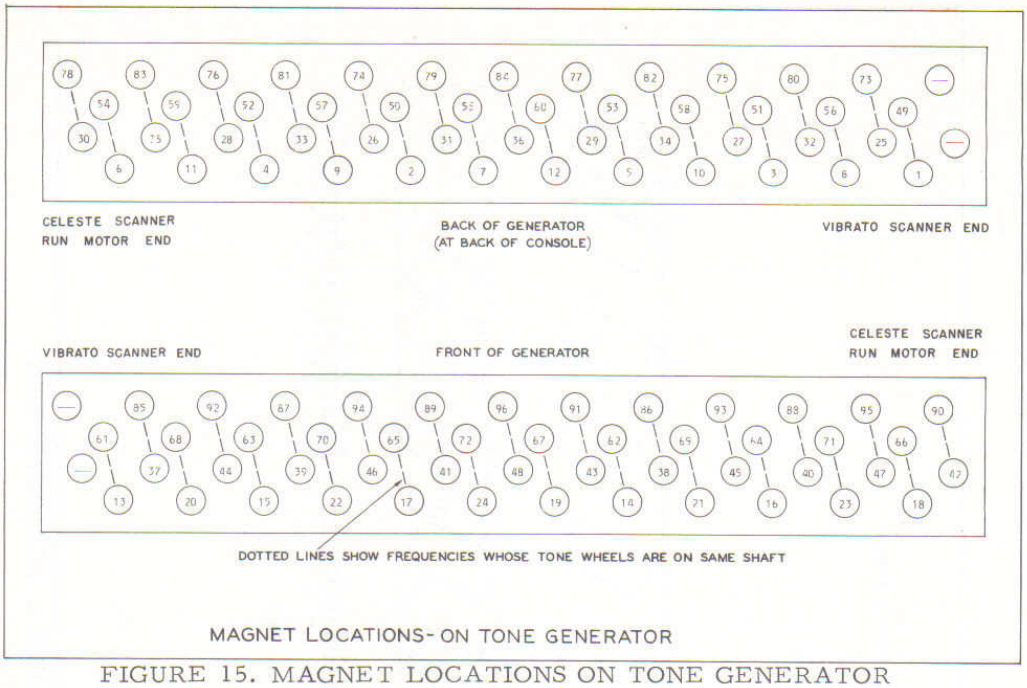


FIGURE 15. MAGNET LOCATIONS ON TONE GENERATOR

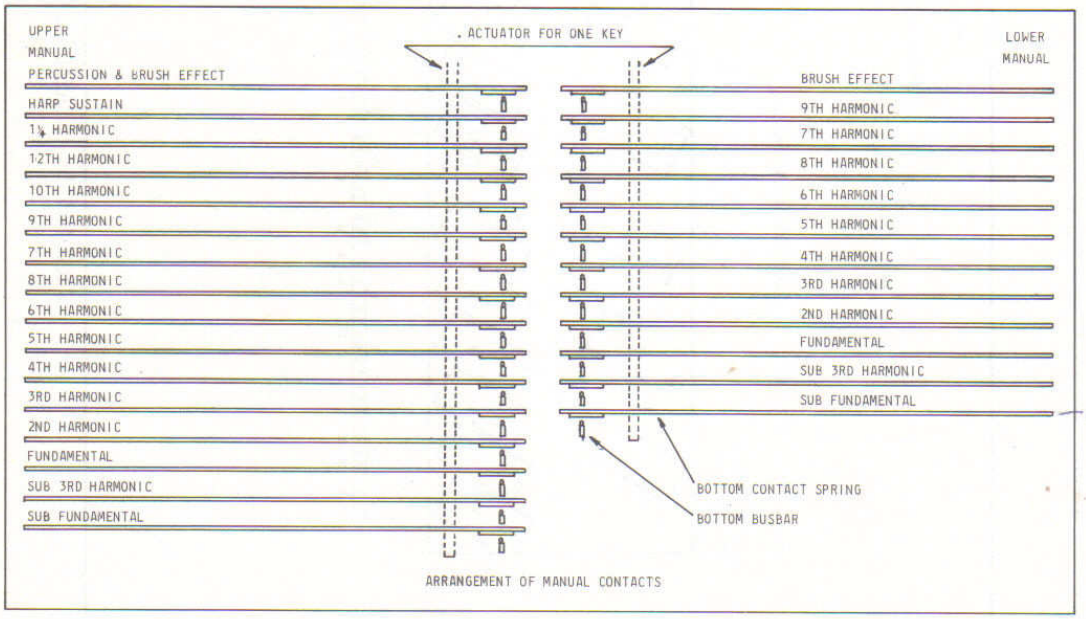


FIGURE 16. ARRANGEMENT OF MANUAL CONTACTS

MANUAL CHASSIS

The manual chassis assembly includes the upper and lower manuals, and preset panel. It has a terminal strip under each manual to accomodate the necessary frequency wires from the tone generator assembly.

UPPER MANUAL

This manual has 61 playing keys, 9 preset keys, and 2 adjust keys, each of which operates 16 small contact springs with precious metal points (see figure 16). When a key is pressed these points make contact with 16 busbars extending the entire length of the manual. The busbars also have precious metal contact surfaces.

When a playing key is depressed, 16 contacts (14 signal and 2 control) make contact with 16 busbars in the manual. The 14 signal contacts are impressed on the 14 signal busbars. Each contact carrying a single harmonic. The 7th and 9th harmonics are combined and fed to a single drawbar by connecting two busbars together inside the manual. The 10th and 12th harmonics are similarly combined.

The 1-1/4 Harmonic is used only in producing the "Chime" effect and is available only when the "B" adjust key is depressed. As there are no wires connected to these busbars, a preset or adjust key must be depressed before any circuit can be completed. Each adjust and preset key has 11 contacts ("B" adjust has 14) exactly like those of the playing keys. When an adjust or preset key is depressed, eleven harmonics are made available at either the recorder panel or the drawbars.

When the "B" adjust key is depressed, in addition to the 11 Harmonics made available at the drawbars, the "Harp" and percussion control contacts are connected to the proper circuits.

These keys have a locking and trip mechanism which locks down one key at a time. The key at the extreme left end of the manual is a cancel key, with no contacts, which releases any preset or adjust key that happens to be depressed.

The percussion control contacts also control the "Brush Upper" circuit. A wire attached to the control busbar connects it to ground through a zener diode D601.

LOWER MANUAL

This manual is identical to the upper manual with the following exceptions. There are 12 contacts; (11 signal and 1 brush keying contact) under each playing key. Each of the signal contacts carries a single harmonic. The 7th & 9th harmonics are carried to one drawbar by connecting two busbars together inside the manual. The remaining contact (brush keying) provides a path to ground each time a key is depressed.

Each adjust and preset key has 10 contacts exactly like those of the playing keys. When an adjust or preset key is depressed 10 harmonics are made available at either the recorder panel or the drawbars.

MANUAL BUSBAR SHIFTERS

The precious metal contact surfaces of the key contacts and busbars are not subject to corrosion, and the manuals are sealed to exclude dust as far as possible. In spite of these precautions an occasional particle of dust may lodge on a contact and cause the note to be scratchy, noisy, or silent, and for this reason a busbar shifting mechanism is provided on each manual to slide the busbars endwise and thus provide a fresh contact surface. The busbar shifter for each manual is a slotted stud near the left end of the manual as viewed from the back of the console (see rear view of console in (figure 2) for location).

Key Number	Note	Drawbar 1 Sub-Fund.	Drawbar 2 Sub-Third	Drawbar 3 Fund.	1⅓ Harm. Upper Manual Chime only	Drawbar 4 2nd Harm.	Drawbar 5 3rd Harm.	Drawbar 6 4th Harm.	Drawbar 7 5th Harm.	Drawbar 8 6th Harm.	Drawbar 9 8th. Harm.	Drawbar 10 7th Harm.	Drawbar 10 9th Harm.	Drawbar 11 10th Harm.	Drawbar 11 12th Harm. Upper Manual only
1	C	1	20	13	17	25	32	37	41	44	49	47	51	53	56
2	C#	2	21	14	18	26	33	38	42	45	50	48	52	54	57
3	D	3	22	15	19	27	34	39	43	46	51	49	53	55	58
4	D#	4	23	16	20	28	35	40	44	47	52	50	54	56	59
5	E	5	24	17	21	29	36	41	45	48	53	51	55	57	60
6	F	6	25	18	22	30	37	42	46	49	54	52	56	58	61
7	F#	7	26	19	23	31	38	43	47	50	55	53	57	59	62
8	G	8	27	20	24	32	39	44	48	51	56	54	58	60	63
9	G#	9	28	21	25	33	40	45	49	52	57	55	59	61	64
10	A	10	29	22	26	34	41	46	50	53	58	56	60	62	65
11	A#	11	30	23	27	35	42	47	51	54	59	57	61	63	66
12	B	12	31	24	28	36	43	48	52	55	60	58	62	64	67
13	C	13	32	25	29	37	44	49	53	56	61	59	63	65	68
14	C#	14	33	26	30	38	45	50	54	57	62	60	64	66	69
15	D	15	34	27	31	39	46	51	55	58	63	61	65	67	70
16	D#	16	35	28	32	40	47	52	56	59	64	62	66	68	71
17	E	17	36	29	33	41	48	53	57	60	65	63	67	69	72
18	F	18	37	30	34	42	49	54	58	61	66	64	68	70	73
19	F#	19	38	31	35	43	50	55	59	62	67	65	69	71	74
20	G	20	39	32	36	44	51	56	60	63	68	66	70	72	75
21	G#	21	40	33	37	45	52	57	61	64	69	67	71	73	76
22	A	22	41	34	38	46	53	58	62	65	70	68	72	74	77
23	A#	23	42	35	39	47	54	59	63	66	71	69	73	75	78
24	B	24	43	36	40	48	55	60	64	67	72	70	74	76	79
25	C	25	44	37	41	49	56	61	65	68	73	71	75	77	80
26	C#	26	45	38	42	50	57	62	66	69	74	72	76	78	81
27	D	27	46	39	43	51	58	63	67	70	75	73	77	79	82
28	D#	28	47	40	44	52	59	64	68	71	76	74	78	80	83
29	E	29	48	41	45	53	60	65	69	72	77	75	79	81	84
30	F	30	49	42	46	54	61	66	70	73	78	76	80	82	85
31	F#	31	50	43	47	55	62	67	71	74	79	77	81	83	86
32	G	32	51	44	48	56	63	68	72	75	80	78	82	84	87
33	G#	33	52	45	49	57	64	69	73	76	81	79	83	85	88
34	A	34	53	46	50	58	65	70	74	77	82	80	84	86	89
35	A#	35	54	47	51	59	66	71	75	78	83	81	85	87	90
36	B	36	55	48	52	60	67	72	76	79	84	82	86	88	91
37	C	37	56	49	53	61	68	73	77	80	85	83	87	89	92
38	C#	38	57	50	54	62	69	74	78	81	86	84	88	90	93
39	D	39	58	51	55	63	70	75	79	82	87	85	89	91	94
40	D#	40	59	52	56	64	71	76	80	83	88	86	90	92	95
41	E	41	60	53	57	65	72	77	81	84	89	87	91	93	96
42	F	42	61	54	58	66	73	78	82	85	90	88	92	94	nc
43	F#	43	62	55	59	67	74	79	83	86	91	89	93	95	nc
44	G	44	63	56	60	68	75	80	84	87	92	90	94	96	nc
45	G#	45	64	57	61	69	76	81	85	88	93	91	95	85	nc
46	A	46	65	58	62	70	77	82	86	89	94	92	96	86	nc
47	A#	47	66	59	63	71	78	83	87	90	95	93	nc	87	nc
48	B	48	67	60	64	72	79	84	88	91	96	94	nc	88	nc
49	C	49	68	61	65	73	80	85	89	92	85	95	nc	89	nc
50	C#	50	69	62	66	74	81	86	90	93	86	96	nc	90	nc
51	D	51	70	63	67	75	82	87	91	94	87	85	nc	91	nc
52	D#	52	71	64	68	76	83	88	92	95	88	86	nc	92	nc
53	E	53	72	65	69	77	84	89	93	96	89	87	nc	93	nc
54	F	54	73	66	70	78	85	90	94	85	90	88	nc	94	nc
55	F#	55	74	67	71	79	86	91	95	86	91	89	nc	95	nc
56	G	56	75	68	72	80	87	92	96	87	92	90	nc	96	nc
57	G#	57	76	69	73	81	88	93	85	88	93	91	nc	85	nc
58	A	58	77	70	74	82	89	94	86	89	94	92	nc	86	nc
59	A#	59	78	71	75	83	90	95	87	90	95	93	nc	87	nc
60	B	60	79	72	76	84	91	96	88	91	96	94	nc	88	nc
61	C	61	80	73	77	85	92	85	89	92	85	95	nc	89	nc
		Frequency Number													

FIGURE 17. MANUAL FREQUENCY CHART

If any note becomes scratchy or silent, it should first be struck 15 or 20 times in a rapid staccato manner to loosen the dirt. This will usually dislodge the particles and clear the note.

In case this procedure is not effective, the busbar shifter for that manual may be adjusted by turning the stud about two turns in either direction. It may sometimes be necessary to actuate the offending key while turning the busbar shifter, in order to wipe the busbar clean.

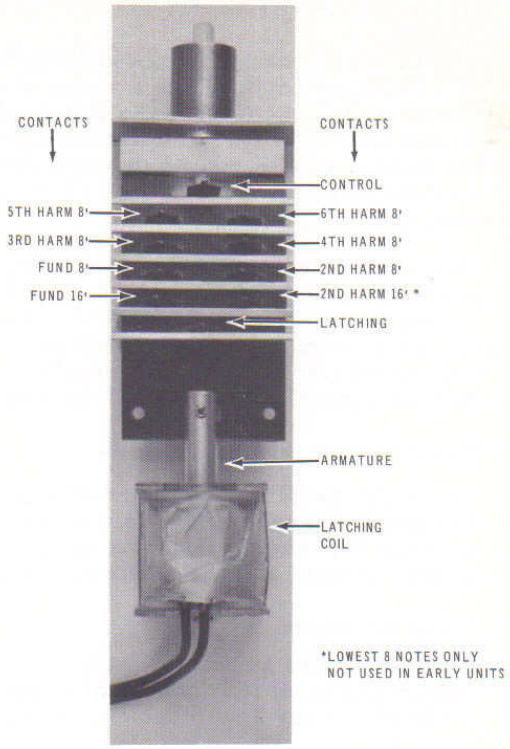


FIGURE 18. ARRANGEMENT OF PEDAL CONTACTS

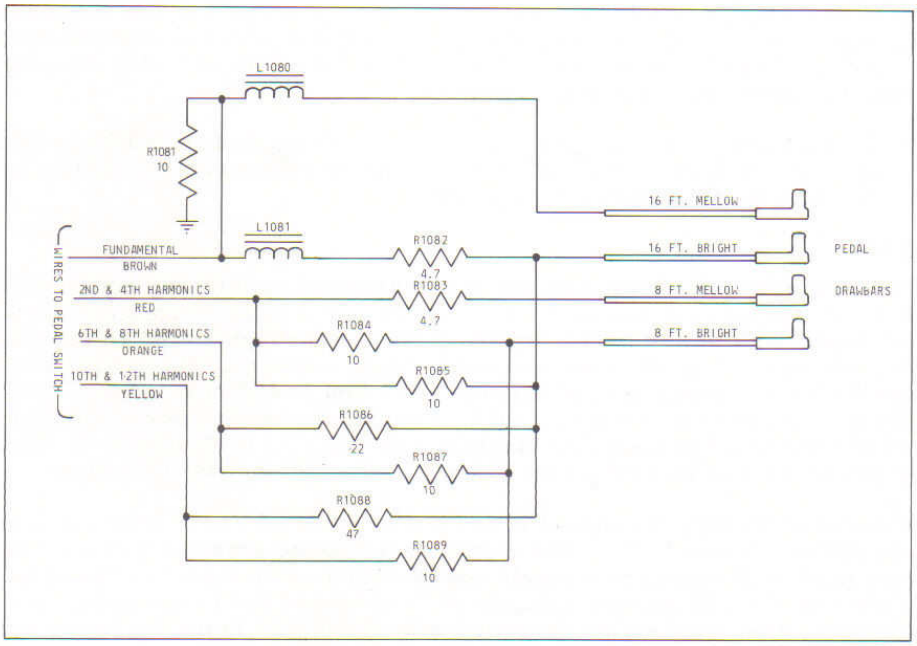


FIGURE 19. PEDAL CIRCUITS

PEDAL SWITCH

The pedal switch, which is actuated by the pedal keyboard, consists of 25 groups of 9 contacts each. When a pedal is depressed, 9 contacts (7 signal, 1 control or keying and 1 latching) make to 6 busbars (figure 18). The 4 signal busbars are routed through filter and mixing networks to the pedal drawbars. The signals from the drawbars are routed through the pedal percussion preamplifier. The control contact removes cut-off bias on the pedal control tube V-101, letting the pedal sound.

The latching contact comes into play when one or both "String Bass" tabs are depressed. Everytime a pedal is depressed this latching contact closes and provides a ground path for its latching solenoid. When the solenoid is energized it holds closed 8 contacts until the next pedal is played at which time it releases and the next pedal latches. In all instances, the control or keying contact is made only as long as a pedal is depressed; that is this contact does not latch.

Pedal Switch Busbar Shifters

The pedal switch is equipped with busbar shifters similar to those on the manuals. The pedal busbar shifter is a slotted stud on the near surface of the pedal switch, near the left end as you look in at the back. It should be adjusted as described under "Manual Busbar Shifters" on a previous page.

Pedal Keyboard

Pedal keys are set at the factory for average tension, but are adjusted to fit the requirements of the individual organist. Adjustment is accomplished by removal of the top cover at the back of the pedal keyboard and setting the tension as desired.

PEDAL SECTION

The signals from the pedal drawbars are blended and fed to the primary of T-101. The signal in the primary of T-101 are converted to push-pull in the secondary and fed to the grids of V-101, pedal control tube. Anytime a pedal is depressed, it's keying contact applies a positive 6 volt potential to the grids of V-101 causing it to conduct, thereby permitting the signal to pass.

The 6 volt keying voltage reaches the grids through diode D-101 and R-104 this keying voltage now charges C-102. When the pedal is released, the charge on C-102 discharges through R-104 and R-105 to ground.

STRING BASS

When either of the "String Bass" tablets are depressed, a latching action will take place whenever a pedal is depressed. The signal contacts will remain closed and a sustained signal will be fed to the drawbars and on through T-101 to the grids of V-101. The keying contact does not remain closed, however. The positive voltage, which turns V-101 on, feeds through diode D-101 and R-104, charging C-102, located in the secondary center tap of T-101. The pedal sustain time is controlled by the amount of time it takes C-102 to discharge through R-1010 and/or R-1011. These two resistors are located in the circuit of the "String Bass" tablets.

From the plates of V-101, the signal is fed to the grids of V-102 where the pedal signal is amplified. From V-102, the signal is fed to the grids of V-103. This tube converts the push-pull signal to a single ended output. The signal is taken off between the plate of V-103B and the cathode of V-103A and fed to the pedal level control. From here, the pedal signal is mixed with the signal from the lower manual and fed to the "ON-LOWER" vibrato switch.

Pedal No.	Note	Fund 16'	SEE NOTE 2nd Harm 16'	Fund 8'	2nd Harm 8'	3rd Harm 8'	4th Harm 8'	5th Harm 8'	6th Harm 8'
1	C	1	13	13	25	32	37	41	44
2	C#	2	14	14	26	33	38	42	45
3	D	3	15	15	27	34	39	43	46
4	D#	4	16	16	28	35	40	44	47
5	E,	5	17	17	29	36	41	45	48
6	F	6	18	18	30	37	42	46	49
7	F#	7	19	19	31	38	43	47	50
8	G	8	20	20	32	39	44	48	51
9	G#	9		21	33	40	45	49	52
10	A	10		22	34	41	46	50	53
11	A#	11		23	35	42	47	51	54
12	B	12		24	36	43	48	52	55
13	C	13	No Connection	25	37	44	49	53	56
14	C#	14		26	38	45	50	54	57
15	D	15		27	39	46	51	55	58
16	D#	16		28	40	47	52	56	59
17	E	17		29	41	48	53	57	60
18	F	18		30	42	49	54	58	61
19	F#	19		31	43	50	55	59	62
20	G	20		32	44	51	56	60	63
21	G#	21		33	45	52	57	61	64
22	A	22		34	46	53	58	62	65
23	A#	23		35	47	54	59	63	66
24	B	24		36	48	55	60	64	67
25	C	25		37	49	56	61	65	68
		Frequency Number							

FREQUENCIES USED IN PEDAL SWITCH

FIGURE 20.

NOTE: These frequencies omitted on early series instruments

PEDAL LATCHING SYSTEM

The latching and release system used in this organ is of the constant current type, and is entirely electronic in nature. Its operation and adjustment is as follows.

The Pedal latching power supply is a full wave type utilizing a winding of the power transformer T-701, and diodes D701 and D-702. The open circuit voltage of this supply (marked +30V) is approximately 32 volts. A portion of this supply is used to power the transistor preamplifiers and the brush and cymbal boards. The pedal latching supply uses two transistors. Q-701 is a control transistor, while Q-702 is a series current regulator.

THEORY OF OPERATION

With the string bass tabs up, no voltage drop will appear across R-712, R-713, R-714, or Zener diode D-704. Because no voltage drop takes place across this

resistor string, the base of Q-702 will be at the same potential as its emitter. When a "String Bass" tab is depressed, the low end of R-714 is routed to ground and the supply voltage less the Zener voltage (6 volts) is impressed across R-714. This means that approximately 25 volts will appear across R-714, while the Zener voltage, less the supply voltage, will appear across R-712, R-713, and between the emitter and collector of Q-701. Approximately 2-1/2 volts of this zener voltage will appear across R-712. With a pedal pressed, R-712 (the 30 volt adjust potentiometer is adjusted so that 125 ma, of current is drawn by one of the pedal latching coils. To measure this it will be necessary to open the pedal supply line, pin 6 of P-702, and insert a milliammeter. In practice, it has been shown that when a 125 ma, is drawn, the voltage across the coil is approximately 18 volts. Once a pedal is latched down, it will remain so until another pedal is depressed. When this occurs a voltage drop will take place, at the collector of Q-702 which shows up across C-708. This drop (negative pulse) is reflected back through diode D-705 to the base of Q-701. Q-701 will now conduct and short out zener diode D-704 so that the full supply voltage momentarily appears across resistor R-714. When this happens, no drop will take place across resistors R-712 and R-713 so that the base voltage of Q-702 is now the same as its emitter.

Under this condition no voltage will appear at the output of the latching supply. All this occurs very rapidly. With the supply momentarily off, the coil previously latched will be released, and when the supply is re-established, the pedal now depressed will be latched down. This pedal will remain latched until the next pedal is depressed, in which case the entire release and latch cycle is repeated. Diode D-707 is a protective device so that the collector of Q-702 can never exceed its base voltage, while diode D-706 passes any positive pulses from the latching supply back into the supply itself.

NOTE:

Because the "string bass" tabs introduce a "sustain" or "automatic pedal legato" mode in which a pedal note fades away after the pedal is released, it is necessary to have the signal contacts of the last-played pedal remain closed. This is accomplished by a solenoid under each pedal which is electrically held down through a locking contact.

The power supply to the pedal latching solenoids is marked + 30 V. for identification but is actually a constant current circuit which can furnish only enough current to hold down one solenoid. When a second pedal is pressed, there is not enough current to energize both solenoids, so the first one releases. The solenoid under the pedal which is pressed then locks down.

To insure greatest reliability in operation, a transistor circuit is provided to disable the constant current supply momentarily and insure that the first solenoid releases. Note, however, that this feature does not function in case a pedal is played before the previous one is released. The pedals are expected to operate satisfactorily when so played, but a more precise adjustment of the "+ 30 V. adjustment" may be required.

AMPLIFYING SYSTEM

The amplifying system of this organ is made up of ten individual units. Eight of these units are printed wiring boards, each containing the transistors and necessary components for its particular function. The remaining two units are tube type units; The one located on the rear of the control panel assembly contains the manual percussion and pedal control tubes with their associated amplifiers. The

large chassis on the lower shelf is the console power output amplifier. Also located on the bottom shelf of the organ is the organ power supply.

With the two shield covers removed from the printed wiring boards and looking at these boards from left to right from the rear of the organ, these boards perform the following functions; Second Celeste Amplifier, Common Celeste Amplifier, Celeste Drive Amplifier, Non-vibrato Preamplifier, Vibrato Drive Amplifier, Chorus Drive Amplifier, Common Vibrato Amplifier, and Second Vibrato Amplifier.

These printed wiring boards are held in position by clips on the rear of the control panel and are easily replaced.

The signal from the lower manual matching transformer is mixed with the pedal signal and routed to the "On-Lower" vibrato tablet. The signal from the upper manual is routed to the "On Upper" vibrato tablet. Depending upon the position of the vibrato tablets, the signal from the manual and pedals may be routed either into the vibrato or the non-vibrato channel of the amplifying system.

The output of the percussion amplifier is mixed with the output of the Harp preamplifier and these two signals are combined and routed to the "Add Vibrato" tablet in the percussion group. In this case, the percussion signals are likewise routed either into the vibrato or non-vibrato channel of the amplifying system.

VIBRATO SYSTEM

COMMON VIBRATO, SECOND VIBRATO, COMMON CELESTE AND SECOND CELESTE AMPLIFIERS.

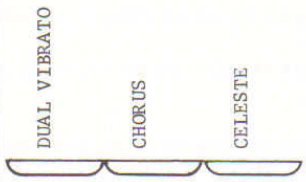
In the case of each of these amplifiers, the signal picked up by the scanner is capacity coupled to the base of Q807, which is direct-coupled to the base of Q808. The signal is taken from the emitter of Q808 and fed to the base of Q809. The collector output of Q-809 is now capacity coupled to the vibrato variation switches.

SIGNAL ROUTING THROUGH VIBRATO VARIATION SWITCHES

When these three variation switches, "Dual Vibrato", "Chorus" and "Celeste", are in the "Up" position, the signal from the common vibrato amplifier is fed into both the "A" and the "B" channels of the amplifying system. This gives the same vibrato effect on both channels. With the "Dual Vibrato" tablet depressed, the common vibrato amplifier signal now feeds into the "A" channel, while the second vibrato amplifier signal is routed into the "B" channel of the amplifying system. The common Vibrato Amplifier also feeds a signal to the base of Q-810, the Celeste Drive Amplifier. When the "Celeste" tab is depressed, the signal from the output of the common celeste amplifier is routed into the "B" signal channel, while the output of the second celeste amplifier is routed into the "A" signal channel. To provide a dual celeste effect, with this setting, vibrato tabs I and II have no effect.

With the "Dual Vibrato" and "Celeste" tabs up and the Chorus tablet depressed, the common vibrato amplifier signal is fed into the "A" signal channel, while the output of the chorus drive amplifier Q-810 is fed into the "B" signal channel. After the vibrato variations switches, the brush and cymbal signal is fed into the "B" signal channel. Both the "A" and "B" signal channels are mixed with the non-vibrato signal channel, and are routed to the expression pedal. The expression pedal now shunts more or less of each of these channels to ground, depending on it's setting. The remaining signal of both, the "A" and "B" channels is now fed through a resistor and condensor network to the "Volume Soft" tablet. For a pictorial breakdown of the above effects refer to figure 21.

H-100 ANIMATION TABS



EFFECT	AFFECTED BY VIB I AND VIB II TABS
Single phase vibrato in both speakers.	YES
Single phase vibrato in 1 speaker; opposite phase vibrato in other speaker.	YES
Same as above except vibrato line is mismatched.	YES
Single vibrato in 1 speaker and non-vibrato in other speaker.	YES
Single (slow scan) celeste in 1 speaker and opposite phase celeste in other speaker.	NO
Same dual celeste as above except previously treated with single phase vibrato.	YES
Same as above (single vibrato-dual celeste) with mis-matched vibrato line.	YES
Single phase vibrato in 1 speaker and single phase celeste in other speaker.	YES

FIGURE 21.

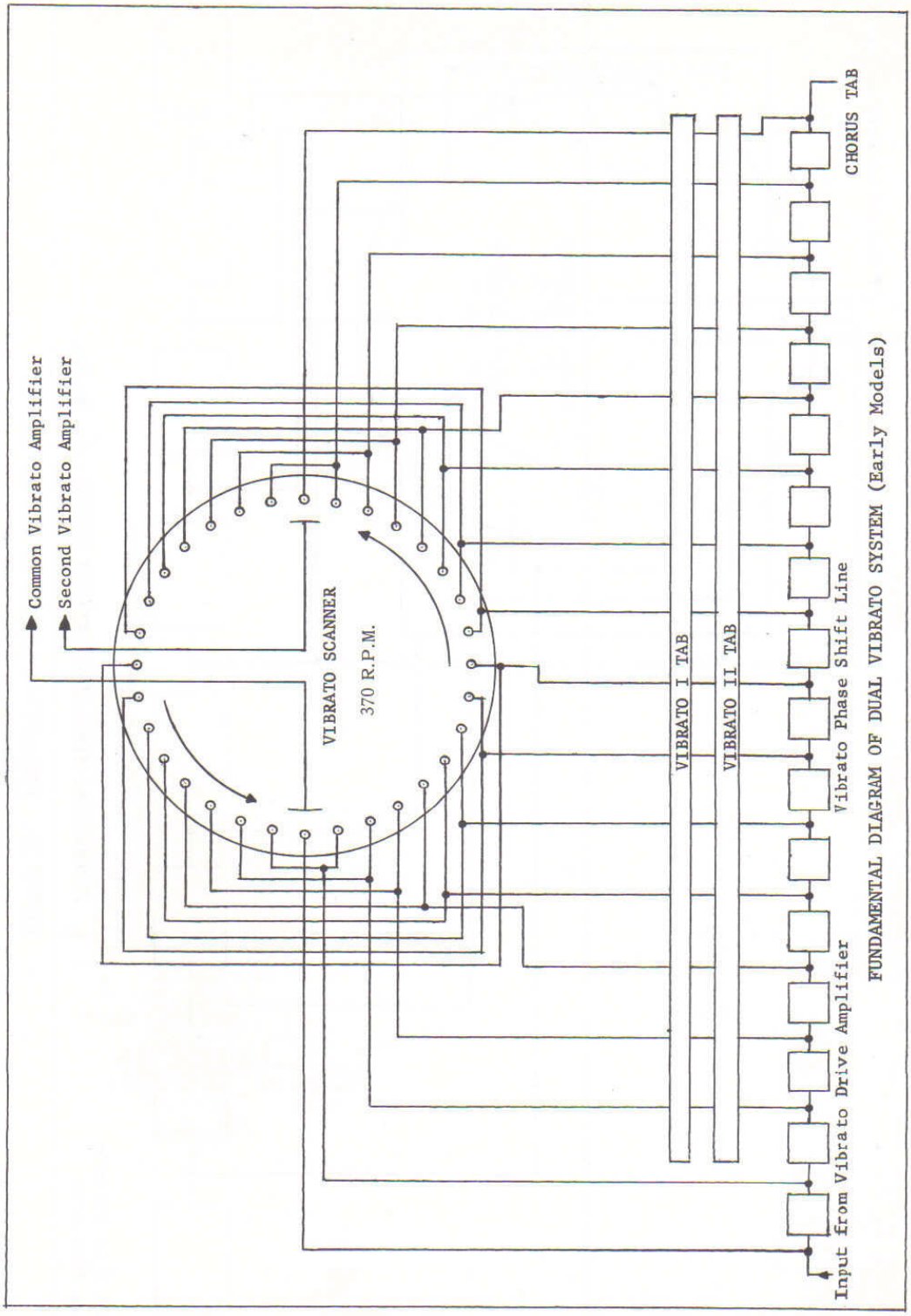

Common Vibrato Amplifier
Second Vibrato Amplifier
VIBRATO SCANNER
370 R.P.M.
VIBRATO I TAB
VIBRATO II TAB
CHORUS TAB
Vibrato Phase Shift Line
Input from Vibrato Drive Amplifier
FUNDAMENTAL DIAGRAM OF DUAL VIBRATO SYSTEM (Early Models)

FIGURE 22.

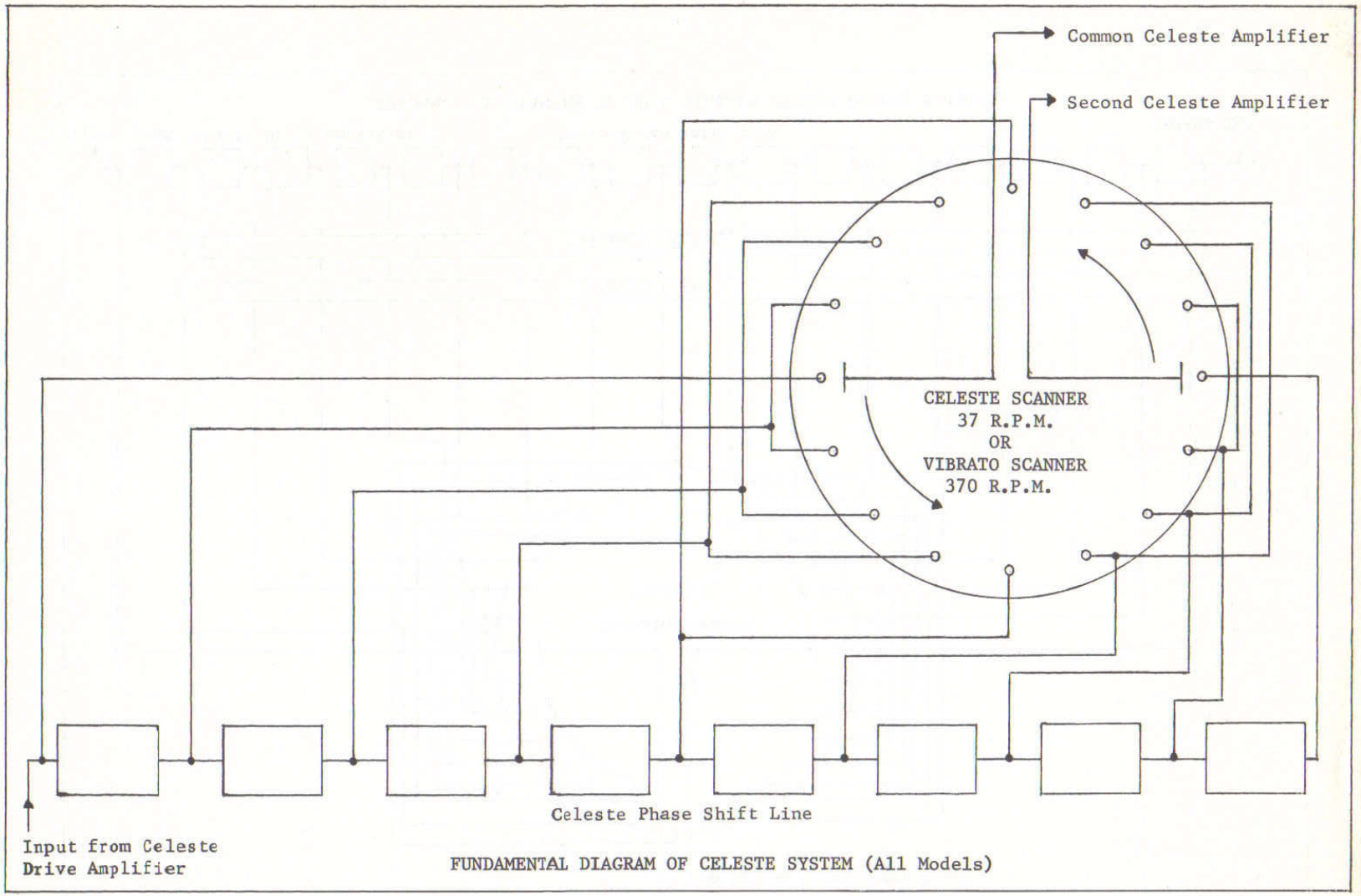


FIGURE 23. FUNDAMENTAL DIAGRAM OF VIBRATO SYSTEM
SERIAL NO. 15000 AND UP

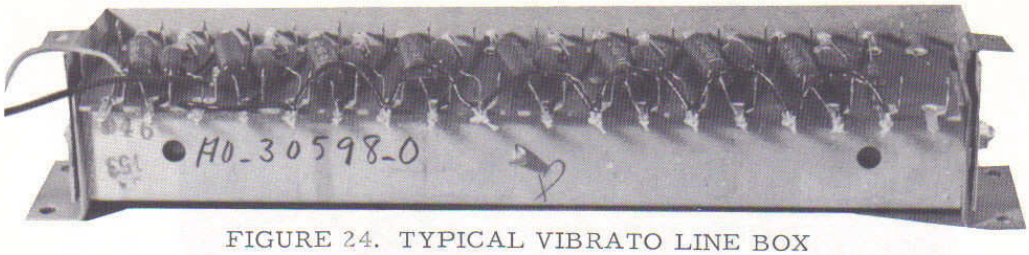


FIGURE 24. TYPICAL VIBRATO LINE BOX

NON-VIBRATO PREAMPLIFIER

Signals entering the non-vibrato channel of the amplifying system are capacity coupled to the base of Q-801. The output of Q801 is then capacity coupled to the base Q-802. The output of Q-802 is divided and forms a portion of both the "A" and "B" signal channels.

VIBRATO PREAMPLIFIER

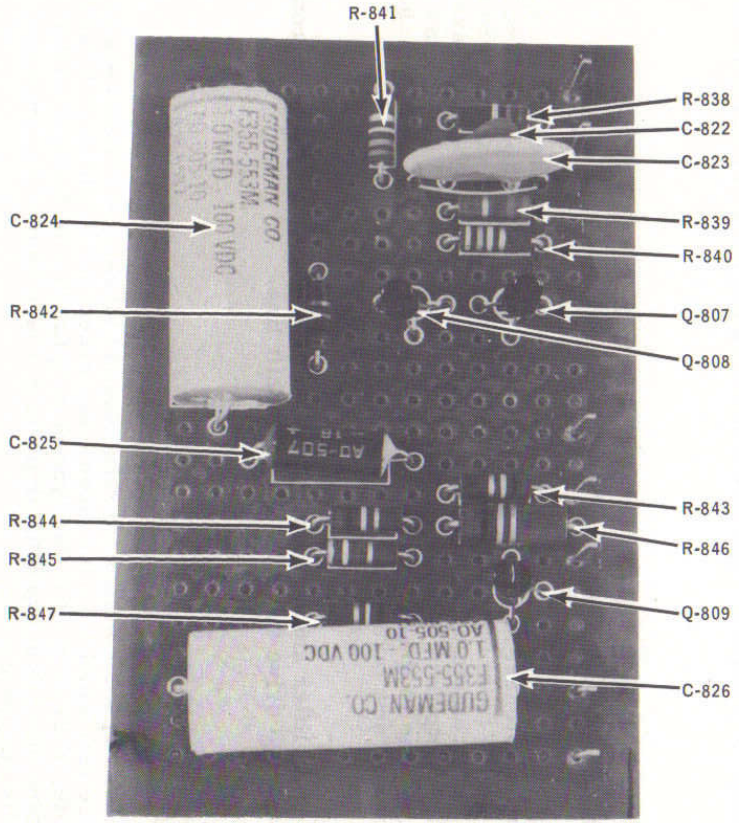
Signals entering the vibrato channel of the amplifying system are capacity coupled to the base of Q-804, which is direct coupled to the base of Q-805. The collector of Q-805 is capacity coupled to the base of Q-806. This signal is used for driving the line box assemblies. A portion of this signal is fed to the base of Q-810, chorus drive amplifier.

CHORUS AND CELESTE DRIVE AMPLIFIER

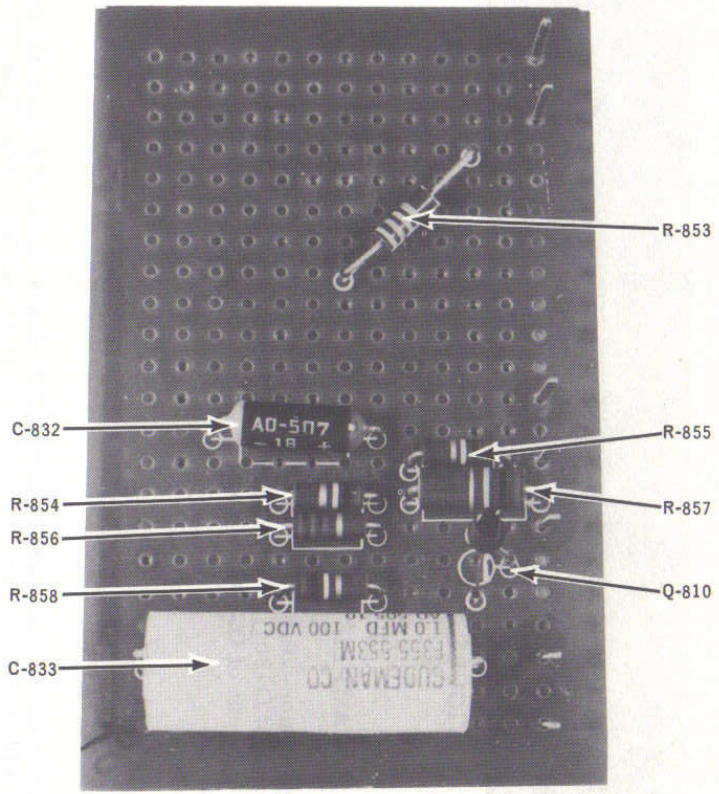
The signal amplified by Q810 is taken from the collector and routed to the "Chorus" and "Dual Vibrato" switches. When the "Chorus" and "Dual Vibrato" tabs are in the Up position, the signal from the chorus drive amplifier is fed through R-1050 to the base of Q-810 the celeste drive amplifier. With the "Chorus" tab depressed, this signal is routed into the "B" signal channel. When the "Dual Vibrato" tab is depressed, the signal line to the celeste drive amplifier is removed from the chorus drive amplifier and is now taken from the common vibrato amplifier.

The celeste drive amplifier amplifies the signal which is capacity coupled from the collector and is used to drive the celeste phase shift line.

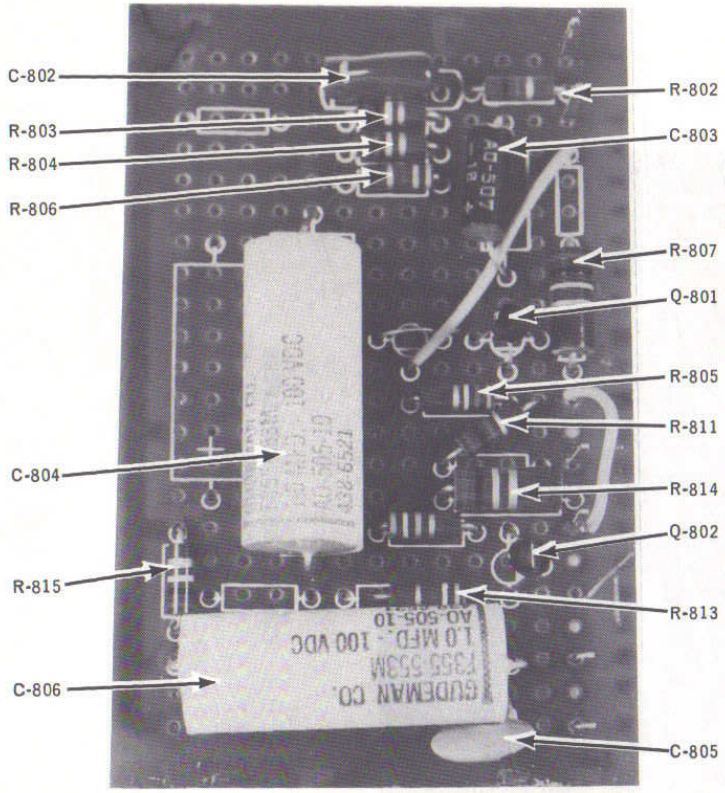
NOTE: The circuits of the common vibrato, second vibrato, common celeste and second celeste amplifiers are identical, except for slight variations at the inputs, with respect to the type of coupling used. Also, it will be helpful to know that the above four amplifiers share common component designation numbers.



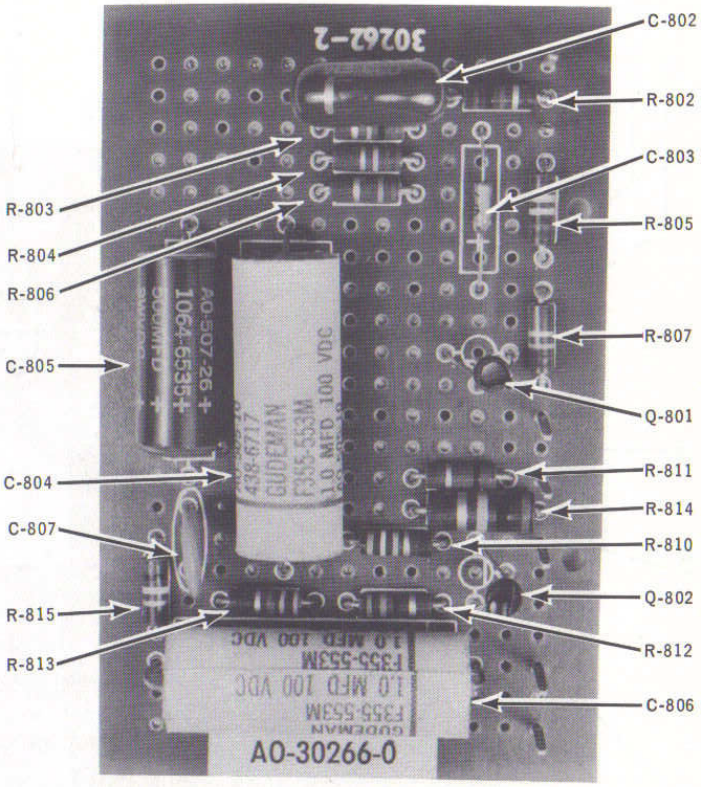
COMMON VIBRATO, SECOND VIBRATO
COMMON CELESTE, SECOND CELESTE
AMPLIFIER BOARDS
124-000074 (CELESTE)
124-000075 (VIBRATO)
SCHEMATIC FIGURES 40 & 41
FIGURE 25



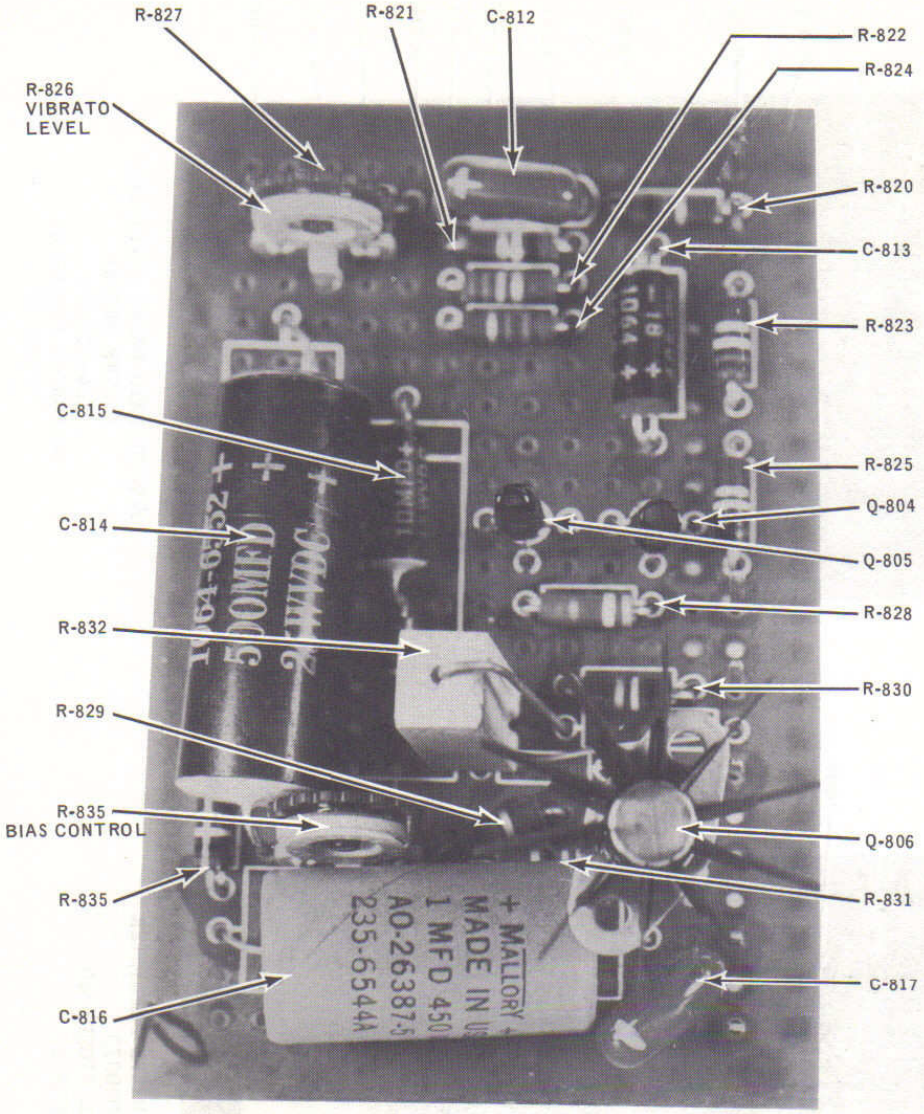
CELESTE DRIVE AMPLIFIER BOARD
124-000076
SCHEMATIC FIGURES 40 & 41
FIGURE 26



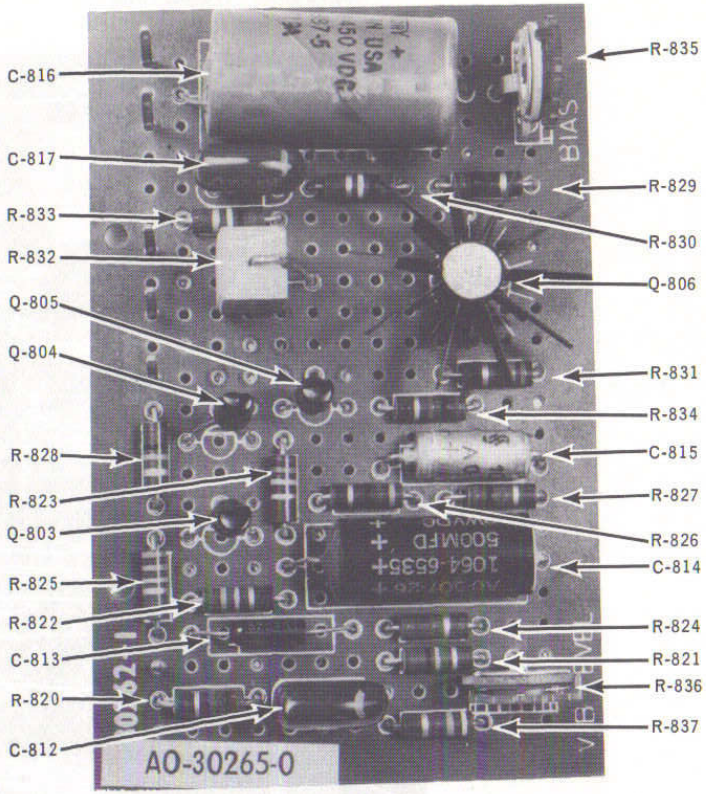
NON-VIBRATO DRIVE AMPLIFIER
124-000073
SCHEMATIC FIGURE 40
FIGURE 27



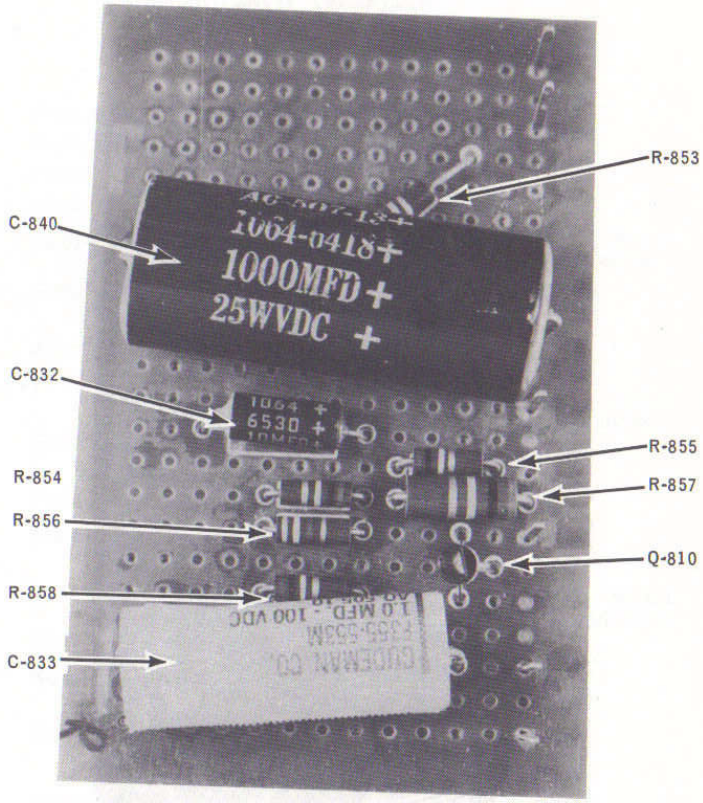
NON-VIBRATO DRIVE AMPLIFIER
(LATER UNITS)
124-000073
SCHEMATIC FIGURE 41
FIGURE 28



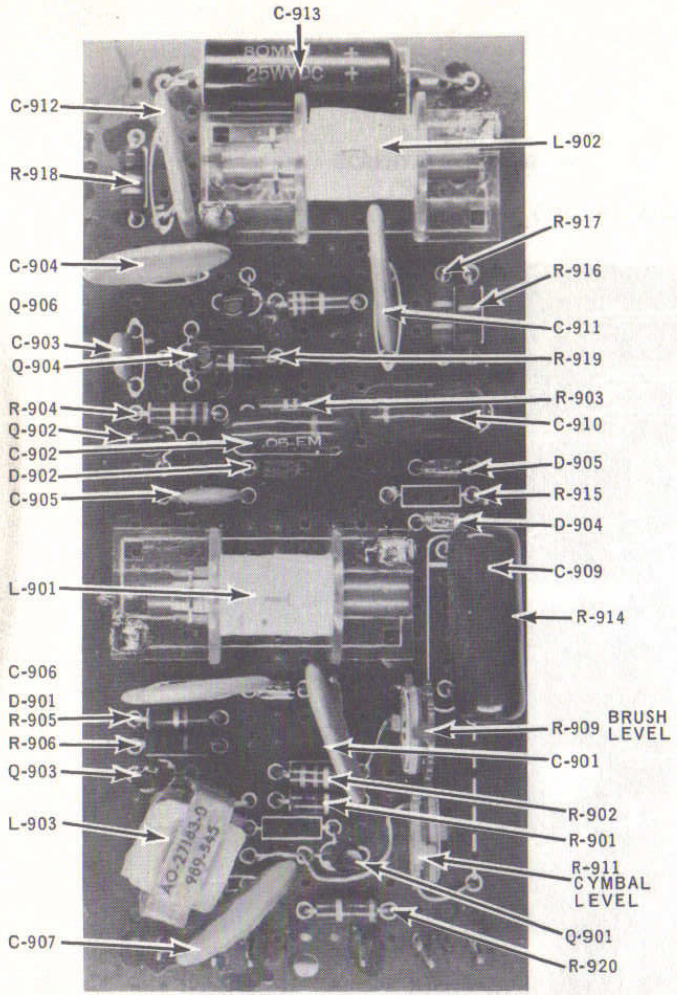
VIBRATO DRIVE AMPLIFIER
124-000072
SCHEMATIC FIGURE 40
FIGURE 29



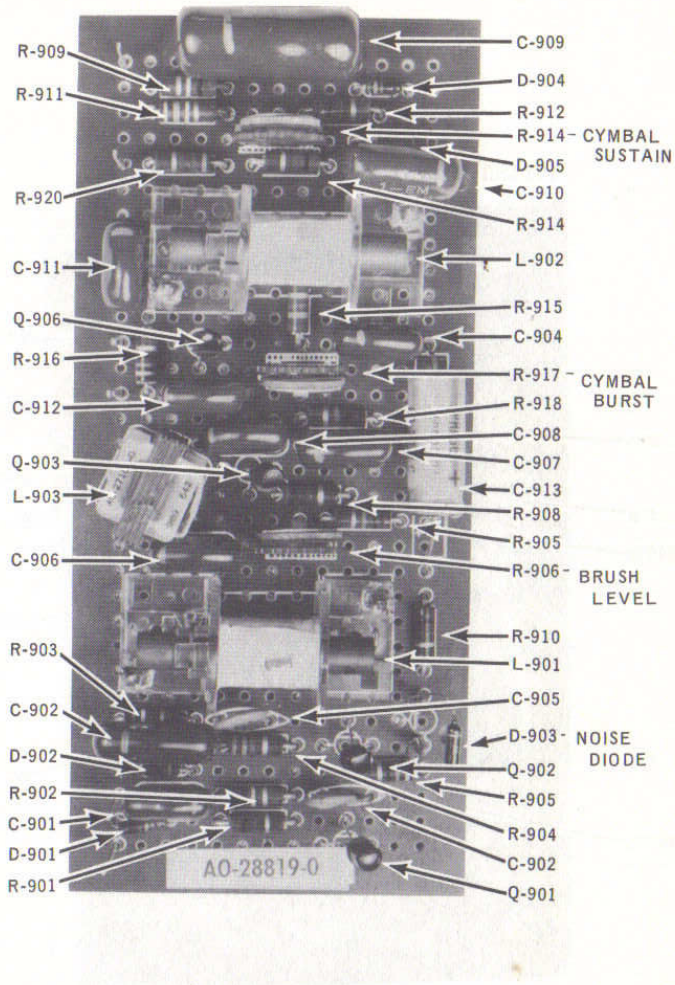
VIBRATO DRIVE AMPLIFIER (LATER UNITS)
124-000072
SCHEMATIC FIGURE 41
FIGURE 30



CHORUS DRIVE AMPLIFIER (LATER UNITS)
124-000077
SCHEMATIC FIGURE 54
FIGURE 31



BRUSH/CYMBAL GENERATOR
124-000020
SCHEMATIC FIGURE 40
FIGURE 32



BRUSH/CYMBAL GENERATOR
(LATER UNITS)
124-000020
SCHEMATIC FIGURE 41
FIGURE 32A

"A" CHANNEL AND REVERBERATION

The "A" channel signal from the "Volume Soft" switch is routed to the grid of V-301A and to the grid of V-303B. The signal which arrives at V-301A is amplified and capacity coupled to the grid of V-301B, and the output of this tube is capacity coupled to the driver coil of the reverberation unit. After the signal has been delayed, the reverberated signal is fed to the grid of V-302, where it is amplified and then capacity coupled to the top of the reverberation level control. The signal from this control is fed to the grid of V-303A. The reverberated signal is now taken from the cathode of V-303A and fed to the reverberation switches. The signal, which was fed to the grid of V-303B, is likewise taken from the cathode and fed to the reverberation switches. This signal completely bypasses the reverberation unit and provides the non-reverberated signal path when both reverberation switches are in the "Up" position.

The "A" channel signal, when routed through the "Main and Echo" switch, is divided into three signal channels. One signal is used to drive the grid of V-304A. The output of V-304A is capacity coupled to the tone cabinet outlet and provides the "A" channel drive signal for the tone cabinet.

Another leg of the "A" channel signal is routed through R-404 and into a low-pass filter and forms a portion of the bass channel of the power amplifier.

The third leg of the "A" channel signal is routed through a high-pass filter to the top of the channel "A" level control. The signal from channel "A" is fed to the tone control, from the tone control, the signal is routed to the grid of V-305A. V-305A amplifies the signal which is then capacity coupled to a split-phase type phase inverter. The signal from V-305B is used to drive a pair of 6BQ5 tubes in the output stage of the "A" channel amplifier. An 8" speaker is used in the "A" channel and is mounted above the power supply chassis.

ECHO SWITCHES

The "B" signal channel from the "Volume Soft" switch is routed directly to the "Main" and "Echo" tablets on the control panel. The "A" signal channel, with or without reverberation is also available at the "Main and Echo" and "Echo Only" switch terminals. These two tablets will route both the "A" and "B" channel signals, either to the organ power amplifier, the tone cabinet or both together, depending on the position of the tabs.

NOTE: A slide switch is located on the back of the power amplifier chassis, just to the right of the tone cabinet outlet. This switch, when in the "Up" position disables both echo switches when the organ is to be used without a tone cabinet.

"B" CHANNEL

The "B" channel signal routed through the "Main and Echo" switches is likewise divided into three signal channels. One signal is used to drive the grid of V-304B, the output of V-304B is capacity coupled to the tone cabinet outlet, and provides the "B" channel drive signal for the tone cabinet.

Another leg of the "B" channel is through R-403 to a low-pass filter, and together with the signal from the "A" channel, forms the bass channel of the power amplifier. The third leg of the "B" channel is routed through a high-pass filter to the top of the "B" level control. The signal from the "B" channel level control is fed to the tone control. From the tone control, the signal is routed to the grid of V-308A.

V-308A amplifies the signal which is then capacity coupled to a split-phase type phase inverter V-308B. The signal from V-308B is used to drive a pair of 6BQ5 tubes in the output stage of the "B" channel amplifier. An 8" speaker is used in the "B" channel and is mounted above the power amplifier chassis.

"BASS" CHANNEL

Signals of "A" and "B" signal channels are fed through R404 and R403 respectively, combined and fed to a low pass filter, and then to the top of the bass level control. From this control the signal is fed to the grid of V-311A, is amplified and direct coupled to the grid of V-311B; a split phase type phase inverter. The signals from this tube are used to drive a pair of 7591 tubes in the bass channel of the power amplifier. A 15" speaker is used in the bass channel and is mounted above the power amplifier.

PERCUSSION SECTION

When using the upper manual "B" adjust key, all of the busbars in the upper manual, with the exception of the sub-fundamental, sub-third 7th & 9th harmonics are routed through the percussion switch assembly and the primary windings of the percussion matching transformer T-102. The 1-1/4 harmonic is routed likewise, but is not available on the drawbars. It is used only in the harmonic structure of the "chime" effect. With the percussion switches in the "Off" position, the signals from the manual busbars are routed directly to the upper manual drawbars. Depending on which percussion effect is in use, the harmonics necessary to produce this effect will be routed, first through the primary windings of the percussion matching transformer, and then on to the drawbars. The signals induced in the primary windings of T-102 are converted to push-pull and fed to the grids of V-104, the percussion gate. The percussion keying pulses are supplied to the grids of V-104 from the percussion and reiteration driver, or the "second voice" tab. The percussion signal which appears on the plates of V-104 is passed on to the grids of V-105, where it is amplified. The signal from V-105 is fed to the grids of V-106. The signal is taken off between the plate of V-106B and the cathode of V-106A and is fed to the percussion level control.

At this point, the percussion signal is mixed with the harp signal and is routed to the "Add Vibrato" switch in the percussion group.

HARP SECTION

The signal input to the harp keyers comes directly from the tone generator (frequencies 37 through 85). These signals are applied to the emitter of the transistors Q-501 (there are 49 identical circuits, one for each frequency). A small bias voltage (. 3V) is applied to the base of all harp keyers through 10K resistors. With the "Harp Sustain" Tablet and the "B" preset on the upper manual depressed, a keying voltage is applied to the harp control busbar. When a key in the range between the second "C" and the top "C" of the upper manual is depressed, the harp control voltage is applied through R-504 and R-502 to the base of Q-501. At the same time, this control voltage is applied to condenser C-502. The application of this voltage causes the transistor to conduct. This conduction will continue as long as the keys are depressed, and will continue after the keys have been released for a time predetermined by the discharge time of C-502.

The signals from the collectors of Q-501 are then routed through Q-521 and Q-522.

In addition to the above functions, the following also takes place; when the "Harp Sustain" tablet is depressed, the second harmonic busbar signal is routed through a primary winding on T-1003. The result is that anytime a key is depressed, a signal is induced in the secondary of T-1003. This second harmonic signal (same pitch as Harp Signal) is introduced to the emitter of Q-521. The purpose of this signal is to enhance the harp effect by providing an instantaneous signal in the harp channel.

The output of Q-522 is routed through the harp level control (R-530) and is then mixed with the percussion signal and routed to the "Add Vibrato" switch. Depending on the position of the "Add Vibrato" tablet, the harp will sound either with or without vibrato.

CYMBAL AND BRUSH GENERATOR ASSEMBLY:

This assembly is basically a "White Noise" generator feeding two gating transistors, the outputs of which are shaped and fed to a common transistor amplifier. (Figure 31).

CYMBAL/PEDAL

With the "Cymbal/Pedal" tablet depressed, and a pedal depressed, a keying voltage is applied through R-911 to one plate of C-909. A like charge now appears on the opposite plate through Diode D-904. This voltage now passes through D-905 charging C-910 and applying the keying voltage to the base of Q-906. This voltage causes Q-906 to conduct, amplifying the "White Noise" from Q-904. This noise is coupled to the base of Q-906 through C-904. The setting of R-911 determines the amount of keying voltage, thereby controlling the "Cymbal" output level.

The collector circuit of Q-906 is a broadly tuned resonant circuit of approximately 8 kc. The output of this circuit is fed to the cymbal-brush amplifying transistor Q-903 and on to the expression control, and the "B" signal channel.

The decay time of the cymbal effect is governed by C-910 and R-916, while the shaping and keying are controlled by R-914 and C-909. The cymbal effect will occur each time a pedal is depressed.

BRUSH/UPPER & LOWER

With the "Brush/Lower," "Brush/Upper," or both tablets depressed, and a lower or upper manual key depressed, a small variation in D. C. voltage occurs at the base of Q-901. This small variation is amplified by Q-901 and appears as a larger varying potential on one plate of C-901. A like variation now appears on the opposite plate through Diode D-901. This voltage now passes through Diode D-902, charging C-902 and applying the voltage to the base of Q-902. This voltage causes Q-902 to conduct, amplifying the white noise from Q-904. This noise is coupled to the base of Q-902. The collector circuit of Q-902 is a broadly tuned resonant circuit of approximately 11 k. c. The output of this circuit is fed to the Cymbal-Brush amplifying transistor Q-903 and on to the expression control. R-909, a variable resistor on the collector of Q-901 controls the "Brush" output level.

The decay time of the brush effect is governed by C-902 and R-903.

BRUSH AND PERCUSSION KEYING CIRCUITRY:

In the following text points A, B, C etc. refer to circled points on the diagram.

Because of the new type circuitry being used in this instrument, a simplified schematic, figure 36, and the following description will be used to describe its functions.

Lower Manual Brush Keying

100 volts is supplied through R-1004 and R-1003 to point A. A stabilizing condenser, C-1004, is located at the junction of R-1004 and R-1003. With the "Brush Lower" tab depressed, 100 volts will appear at point D. Point D is a common supply line for the 61-220K 1/2 watt carbon resistors. The opposite ends of these resistors are connected to the 61 Brush Keying Contacts, one under each key of the lower manual.

When a key is depressed, the Brush Keying Contact under that key makes to the grounded Brush Keying Bus-bar. At this moment, a voltage divider is formed, made up of R-1004, R-1003 and the 220K resistor within the manual. A slight voltage drop (negative keying pulse) now takes place at point A. With the first key held down and another key depressed, a voltage divider is now formed, made up of R-1004, R-1003 and the two 220K resistors within the manual. Again, a slight voltage drop (negative keying pulse) takes place at point A and the top plate of C-1003. *This change will also appear on the opposite plate of C-1003 and the base of Q-901; point B. This keying pulse will be amplified by Q-901 and will appear at the collector as a positive-going voltage. This amplified positive pulse will appear on the collector side of condenser C-901, and the opposite side of C-901 will respond to this change in potential. D-901 provides a ground path for negative charges, while D-902 will pass this positive voltage to the brush gate Q-902. See the complete schematic for the continuation of Brush Keying Path.

Upper Manual Brush Keying

As you will note from the schematic, regardless of the position of the "Brush Upper" Tab, 100 volts will appear at point E. Point E is a common supply line for the 61-220K 1/2 watt resistors. The opposite ends of these resistors are connected to the 61 Brush Keying (percussion control) Contacts, one under each playing key in the Upper Manual.

With the "Brush Upper" Tab in the off position and a key depressed, a voltage divider is formed, made up of R-1004, a 220K resistor within the manual and D-601 (20V Zener). The function of D-601 is to maintain a fixed voltage in the low end of the voltage divider network regardless of the number of keys depressed. Refering back to the voltage divider formed with a single key depressed, a slight voltage drop will take place at point E (negative keying pulse). This will not produce a Brush Keying Pulse because of the stabilizing effect of C-1004. With the "Brush Upper" Tab in the on position, point E will be connected to point A. When a single key is depressed, the Brush Keying (percussion control) contact makes to the Upper Manual Brush and Percussion Keying Bus-bar. At this moment, a voltage divider is formed consisting of, R-1004, R-1003, the 220K resistor within the manual and D-601. A slight voltage drop (negative keying pulse) now takes place at point A, with the first key held down and another key depressed, a voltage divider is now formed, made up of R-1004, R-1003, two 220K resistors and D-601. Again, a slight voltage drop (negative keying pulse) takes place at point A and the top plate of C-1003, from this point on refer to text following asterisk (*) in "Lower Manual Brush Keying description".

Percussion Keying

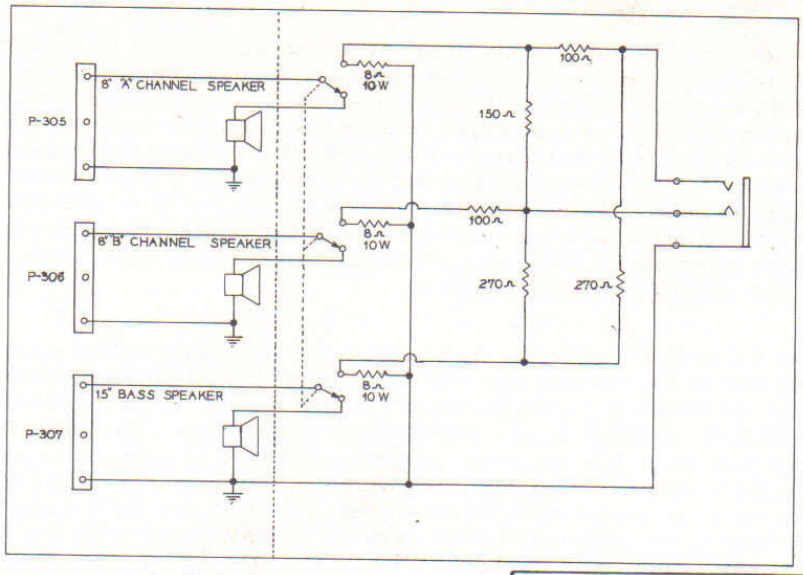
As noted previously, 100 volts is available at all times at point E. Anytime a key is depressed, this voltage is routed to the busbar, through one or more 220K resistors within the manual where it is clamped by D-601. In order to utilize any of the percussion voices it is necessary to depress the upper manual "B" adjust key. Anytime a playing key is depressed with the "B" adjust key latched, the clamped busbar voltage will appear at point F. Now, when a percussion voice is used the voltage at point F is routed through L-201 and D-202 to ground. D-202 is a 6 volt Zener and when a percussion voice is used it is electrically paralleled with D-601. Because of its lower break-over voltage, D-202 will now provide the clamping action on the busbar instead of D-601.

With the "Touch Control" tab in the up position, the following takes place anytime a playing key is depressed; the voltage at point E will be routed through a 220K resistor within the manual, to the busbar, through the "B" adjust contact, through a percussion switch, through L-201 and D-202. The voltage will cause D-202 to conduct. When this diode breaks-over, an inductive kick is induced across L-201. This provides the percussion keying pulse which is fed to Q-201 where it is amplified and fed to the percussion control tube. With the first key held down and another key depressed, an additional 220K resistor is paralleled with the 220K resistor under the first key. Additional current will now flow through the system creating a second inductive kick across L-201 which is again amplified by Q-201 and fed to the percussion control tube. This same cycle will be repeated for each additional key depressed. This effect is known as Legato Percussion, in that any previsouly held keys will repeat when another key is depressed

With the "Touch Control" Tab depressed, the input to the percussion pulse amplifier Q-201 is connected to the top of the Zener diode D-202. When a single key is depressed the voltage at point E will be routed through a 220K resistor within the manual, to the busbar, through the "B" adjust contact, through a percussion switch, through L-201 to D-202. This voltage will cause D-202 to conduct. The voltage now present at the top of the diode (percussion keying pulse) is now amplified by Q-201 and fed to the Percussion Control Tube. If any additional keys are depressed while the first key is held down, additional current will flow through the system, including D-202. Because of the regulating qualities of this diode, the voltage at the top of D-202 will remain constant regardless of the number of keys depressed. To generate another percussion keying pulse all keys must be released and another key, or group of keys depressed.

REITERATION DRIVER

With the "Reiterate" tab, and percussion tab, the "B" preset depressed and any playing key on the upper manual held down, voltage will be supplied for the operation of the reiterator circuit. Under these conditions 6 volts from the top of Diode D-202 will be applied to the base of the reiterator driver Q-202. This causes Q-202 to conduct and produces a large pulse at the collector which by the virtue of the blocking transformer T-201 immediately stops further conduction. At the same time, this pulse is taking place in the emitter circuit charging C-204 through D-201. The charge on C-204 is now dissipated through R-207 and R-208 (Reiteration Rate Control). The reiteration rate is variable from 4 to 20 cycles per second. The Reiterator Driver will not conduct again until the charge on C-204 has been dissipated thereby dropping the emitter voltage to a point where it will conduct again. As long as a key, or keys are depressed, the reiteration action will continue.



The above are recommended earphone connections for use with the Model H-100 organ. All parts to the right of the dotted line can be mounted in a small box on the front of the organ in easy reach of the organist. We recommend the use of a good quality earphone such as the Koss SP-3X, David Clark Model 200, or Telex Combo Model.

At the right is shown a recommended method of attaching a phonograph to the Model H-100.

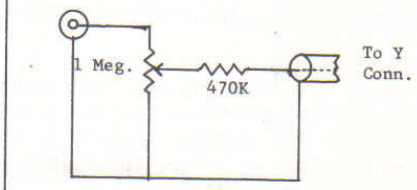


FIGURE 33 PHONO AND EARPHONE CONNECTION DIAGRAMS

SPECIAL EQUIPMENT

RADIO, PHONOGRAPH, OR MICROPHONE

A phonograph, radio, or microphone amplifier will play through the organ speakers if connected to the grid, pin 9 of V-302. This can be performed without going into the power amplifier, in the following manner. Purchase a Switchcraft type 330F "Y connector". Remove connector cable from GRA terminal on power amplifier. Insert "Y" connector", and reinsert connecting cable previously removed. The jack remaining open will now be a phono input. For diagram showing this connection see Figure 33 above.

The device (radio, phonograph, or microphone) should have an output level of about 10 to 20 millivolts maximum, and must have its own volume control, as neither the expression pedal nor the "Volume Soft" tablet will affect it. The reverberation tabs must be on to use the phono input. The organ may be played at the same time.

EARPHONE CONNECTIONS

Earphones can be added to the console for practice purposes so as not to disturb others. One method of attaching earphones is shown in Figure 33 above.

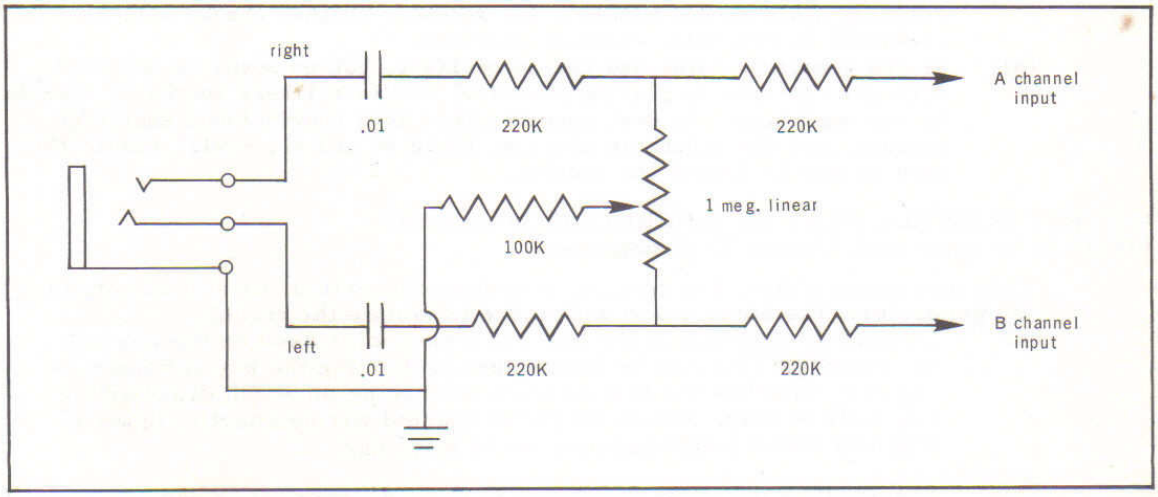
STEREO INPUT FOR H-100 ORGANS

Stereo tapes or other devices can be played through the H-100 organ, taking advantage of the reverberation and the three channel amplifying system. The system shown provides the necessary isolation and balance control for the stereo channels. The point of insertion in the signal line is such, that about 2.5 to 3 volts of program material is necessary at the input to achieve full output from the organ system. This signal level is generally available at the speaker voice coils of the tape or record player.

To tap into the organ signal lines it will be necessary to remove the back and top of the organ and the top cover of the control switch assembly. Locate the terminal board behind the main and echo tabs. This board has 8 lugs across the top. Looking from the rear of the console, the second lug from the left is the "A" channel input. The third lug from the right, is the "B" channel input. Solder a shielded lead assembly to each of these points and bring them out to a convenient location. Add circuit as shown below.

NOTES: The volume soft tab will effect this system.

The organ may be played simultaneously with the tape or record player.



If less bass response is desired reduce the value of the .01 condensers.

FIGURE 34.

EXTENSION SPEAKERS

Additional speakers of the permanent magnet type, may be attached to the organ if special circumstances make it desirable. They should be connected to the voice coil terminals of each of the console speakers. It is essential that the extension bass speaker be at least 12 inches in diameter and mounted in an adequate baffle to bring out the organ pedal notes properly.

Hammond Organ tone cabinets may be used as extension speakers. There is a seven pole receptacle located on the main power amplifier chassis for this purpose.

SPECIAL POWER SOURCES

The organ must always be connected to an alternating current source of the voltage and frequency specified on the name plate. If the only available power source is direct current or has a frequency different from that specified, it will be necessary to provide a converter or motor generator of at least 350 watts capacity.

If the frequency of the power source is not regulated (that is, if an electric clock will not keep correct time), the pitch of the organ will not be correct and may be irregular. In this case write to the factory service department for assistance, being sure to give all pertinent information.

PRACTICAL SERVICE SUGGESTIONS

ORGAN DOES NOT PLAY

(a) If the generator motor does not operate when the switch is "ON" and if the tubes do not light, check the power wiring, power switch, line cord, line cord plug, and wall outlet. On organs with Serial No. 15000 and up, check circuit breaker. If breaker is tripped, reset. If tripping again occurs within a few seconds, further checks will be necessary to determine cause of overload.

(b) If the generator turns and the tubes light, but no sound be obtained with all controls in playing position, the most likely source of trouble is the amplifier. In most respects this is a conventional amplifier circuit, and the schematic diagram, Figre 40 and 41, - will enable the service man to locate the trouble.

ONE KEY DOES NOT PLAY OR A HARMONIC IS MISSING

(Tests to be made with "Adjust Key" depressed)

This may mean a dirty key contact, a broken connection, or a dead note in the generator. The steps below will serve to isolate the trouble.

(a) Ordinarily only one of the several frequencies used on the key will be missing. This can be determined by holding the key and operating each drawbar for that manual, observing on which drawbar the key fails to play. Reference to the manual wiring chart, Figure 17 will tell which frequency number is missing.

(b) See whether the same frequency is missing where it is used on other keys of the same manual. The wiring chart will tell with what other key and what other drawbar you should get the same frequency. If it is missing on one key but not on others, a key contact is probably dirty. In some cases it may be cleared by striking the key 15 or 20 times in a rapid staccato manner to loosen the dirt. If this procedure is not effective, adjustment of the busbar shifter for that manual will clear it. (See "Manuals" section on prior page for location and manner of adjustment.) This will slide the busbars endwise so that they present a clean contact surface. In extreme cases, it may be necessary to hold down the faulty key while making the adjustment.

(c) Each magnet is set at the factory, with the set screw partially loosened, while observing an output meter. Experience has shown that the magnets seldom need adjustment and that setting them without proper equipment involves danger of damaging both magnet and wheel. Therefore, it is not recommended that the service man attempt this adjustment.

HUM

(a) A loud 60 cycle or 120 cycle hum in the speaker may come from some nearby electrical appliance. It may be picked up by the matching transformer, the vibrato line, or the console wiring.

It may be eliminated by moving either the console or the appliance.

(b) Any other hum must originate in the amplifier circuit, and can generally be cured by replacing one or more of the electrolytic condensers.

(c) In case hum originates in the amplifier but is not due to the electrolytic condensers, its source can be isolated by successively removing tubes or by grounding successive points in the signal circuit.

REPLACING TUBES

(a) The vacuum tubes are all standard radio types and can be tested in the usual way. Figure 40 shows the location of tubes in the amplifier.

(b) If tube V-104 is replaced, check percussion cutoff adjustment as explained under "Adjustments".

PROCEDURE FOR REMOVING PARTS IN NEED OF REPAIR OR REPLACEMENT

The following procedures require the removal of back and top. The back is removed by taking out the fifteen visible screws. Top removal is accomplished by taking out the two screws which secure it to the back stretcher. The front of the top has a snap fitting, released by pulling up.

NOTE: The music rack light cable must be disconnected before removing top.

TO REPLACE A BROKEN TAB OR REMOVE A TAB SWITCH ASSEMBLY

(a) Remove the Phillips screws from front of control panel that hold bank of switches associated with tab or switch to be replaced.

(b) To replace a tab, remove lock washer from either end of switch assembly, and pull rod out so it just clears broken tab. It may be necessary to tilt assembly so that free end of rod will clear adjacent switch assembly.

(c) Remove remains of broken tab and insert new piece.

TO REPLACE PILOT LIGHT OR POWER SWITCH (First pull out line plug)

(a) These items accessible with top removed.

(b) Replace bulb with No. 12 GE 6.3V, .15A miniature 2 pin.

(c) To replace power switch, remove two black leads from plug at generator.

(d) Compress springs on sides of switch and push through front of control panel.

TO REMOVE DRAWBAR ASSEMBLIES:

1. Remove rear panel and console top (unplug music rack light before removing top).

2. Remove eight 1/4" Hex Head Screws from control panel cover and remove cover.

3. Remove reiteration rate knob, cymbal-brush volume knob, and retaining nut and washer behind knobs.

4. Remove twelve phillips head screws holding tab switches and four phillips head screws holding face plate.

5. Pull all drawbars out, tilt control panel forward and lift out (make certain that wires leading from pilot light and On-Off switch have enough slack to clear end plate). Rest control panel plate on rear stretcher rail.

6. Tilt control switch assemblies up, and out of way. Note: It may be necessary to tie switches back.

7. Unsolder copper conductor strips from drawbar ends (handle conductor strips with care).

8. Remove eight 1/8" hex head screws holding stop switch assembly to base plate.

9. Transfer busbar leads from removed stop switch assembly to new assembly.

To reassemble, reverse above procedure.

TO REPLACE UPPER MANUAL KEY:

1. Remove rear panel and console top (be sure to unplug music rack light before removing top).

2. Remove eight 1/4" hex head screws from control panel cover and remove cover.

3. Remove the two 1/4" hex head screws holding percussion amplifier to the control panel base.

4. Remove two 1/4" hex head screws at center sides of cymbal-brush board and slide board toward front of organ and out of tracks.

5. Remove two 1/4" hex head screws and one phillips head screw at each end of stop switch base plate.

6. Tilt control panel assembly backwards to gain enough clearance to loosen the 1/4" hex head screws securing the key and channel assemblies.

7. Lift key channel up and toward rear. Note: Associated black keys must be removed before white keys can be removed. To reassemble, reverse above procedure.

TO REPLACE LOWER MANUAL KEY:

NOTE: To preform the following operations you will require the use of a ratcheting offset (yankee) screw driver with an extension handle. This handle may be a piece of flat steel stock taped to the tool so that its over all length is about 9 inches. Another helpful item is a 6 X 6 inch piece of 1/8" masonite.

1. Remove the upper manual front strip.

2. Remove the 4 hex head screws securing the front tabs the lower manual cover. Insert a screw driver between the cover and console front rail and push cover down.

3. By looking in the space between the bottom of the playing keys and the top of console front rail identify the key comb assembly associated with the key to be replaced.

4. Remove the two screws that secure the key comb to the manual bed. It may be necessary to tap key comb lightly to release it.

5. After keys are released remove key comb from channels.

6. Slide 6 X 6 inch piece of masonite under keys in area previously occupied by the key comb.

7. Setting ratchet so as to loosen, line up blade of offset screw driver with slot in screw of key to be removed.

8. After screw driver is positioned depress key against screw driver which is in turn backed up by the piece of masonite. Operate rachet until screw is removed.

9. Repeat this operation for other screw and reverse procedure to replace key.

CAUTION: Do not overtighten screws when installing new key.

HINT: When reinserting key comb leave all keys in their UP position being careful not to turn back the up stop felts located in key channels.

REPLACE CELESTE SCANNER:

1. Remove console rear panel

2. Remove console top (be sure to unplug music rack light).

3. Remove the left hand shield cover behind control panel.

4. Release all cable ties in upper half of console.

5. Remove the two black shielded leads, one from the common celeste amplifier (this lead is the longest one) and the other from the second celeste amplifier.

6. Remove four 7/16" hex head generator mounting bolts.

7. Move the left end of generator out as far as wiring will permit. NOTE: Right end will have to be moved some to accomplish this.

8. Remove Scanner Drive Belt.

9. Unsolder wires from celeste line box.

10. Remove the four 1/4" Scanner Bracket mounting bolts. NOTE: A short 1/4" box end wrench or spin-tite would be useful here.

11. Remove celeste scanner.

To install reverse above operations.

ROTOR ALIGNMENT - CELESTE & VIBRATO SCANNERS

To realign the Vibrato Scanner rotor, it is necessary to cock the generator in the console so that the cover of the scanner may be removed.

The scanner rotor is held in position on the shaft by a set screw which may occasionally work loose. Early scanners have only one set screw, while later scanners are equipped with two set screws. The procedure for the realignment of the rotor is the same in either case.

It will be noted that the stator plates of the scanner have a small notch located near the phenolic back plate. The set screws are of a Bristol socket head type. By looking down between the plates with a flashlight, it will be evident as to whether or not the scanner has one or two set screws. In either case, loosen set screw (or screws), securing the rotor on the shaft. To accomplish this you will require a long #6 Bristol Spline Wrench.

After loosening the set screw (or screws), leave the wrench engaged in the set screw; this will hold the rotor. With the rotor now immovable, rotate the shaft, in the direction which will place the rotor plates in the center of the stator plates. When this is accomplished, retighten the set screw to prevent any further movement.

CAUTION!!! Scanners with one set screw should not be tightened too securely. The set screws on these scanners provides a dual purpose. It not only locks the rotor on the shaft but also provides the ground path for two resistors which bleed off any charges built up on the rotor-condensor plates.

On scanners with two set screws, one set screw provides the grounding function, while the other provides the major locking tension.

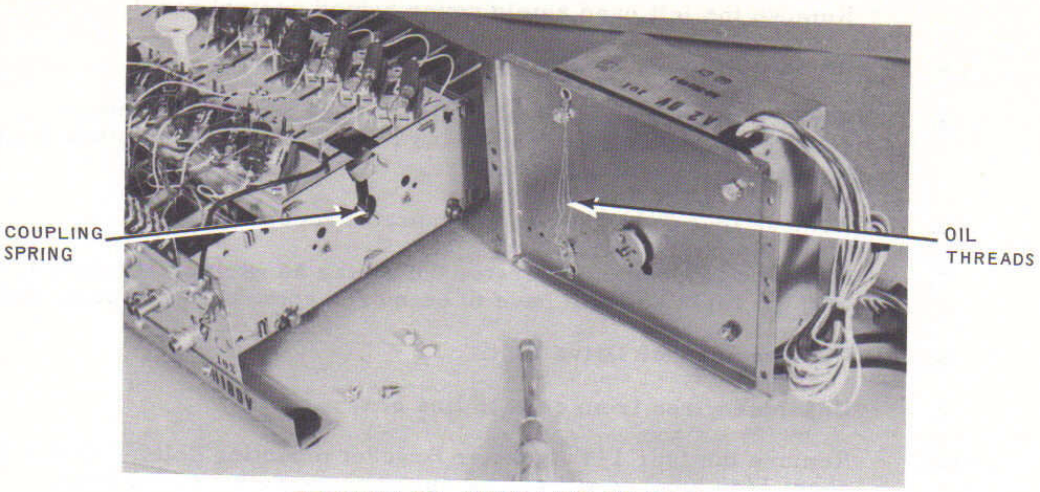


FIGURE 35. VIBRATO SCANNER

REPLACE VIBRATO SCANNER:

1. Follow procedures in steps 1 through 4 of Celeste Scanner replacement instructions.
2. Remove the right hand shield cover behind control panel.
3. Remove the two black shielded leads; one from the Common Vibrato Amplifier (This lead is the longest one), and one from the second Vibrato Amplifier.
4. Remove four 7/16" Hex Head Generator Mounting Bolts.
5. Remove Round Head Bolt and Nut holding Grounding Cables at extreme right end of Generator Terminal Strip.
6. Move the right end of generator out as far as wiring will permit. NOTE: Left end will have to be moved some to accomplish this.
7. Remove the four 1/4" Scanner Bracket Mounting Bolts. NOTE: A short 1/4" box end wrench or spin-tite would be useful here.
8. Move scanner away from generator end, taking care not to lose coupling spring.
9. Unplug green and white nine pin connectors leading from scanner to the vibrato switches.
10. Mount scanner on generator by reversing above procedure. NOTE: Extreme care will have to be taken to be certain that coupling spring is properly aligned and connected using the small hole. Be sure to insert the oil threads from the scanner into the generator oil trough.

TO REMOVE PEDAL SWITCH:

1. Remove console rear panel.

2. Release tie holding pedal cable to console base and feed excess cable through hole in base. This will provide the slack needed to pull pedal switch out.

3. Remove two 5/16' hex head bolts, one at each end of mounting bracket.

4. Slide pedal switch toward you and out of tracks.

5. If replacement of switch is necessary, pedal harness will have to be unsoldered at tone generator, green and violet wires will have to be removed from green 9 pin plug on percussion amplifier and white 6 pin plug containing balance of pedal wires will have to be unplugged.

6. Feed balance of pedal cable through hole in console base.

To install new pedal switch, reverse above procedure.

TO REMOVE PEDAL SWITCH COVER:

1. Remove nine self-tapping screws holding bottom of pedal cover to pedal mounting bracket.

2. Remove thirteen 1/4" hex head screws holding back of pedal cover to top pedal cover.

3. Remove four round head screws, two at each end holding pedal switch end brackets.

4. Remove cover by carefully sliding it over pedal cable harness.

To reinstall cover, reverse above procedure,

NOTE: Be sure to feed ground wire through cover and attach to cover with a 1/4" hex head cover screw.

TO REPLACE PEDAL SUSTAIN SOLENOID:

1. Remove pedal switch and switch cover.

2. Remove four round head screws holding pedal assembly end caps.

3. Unsolder the two solenoid leads from their respective terminals.

4. Draw out the two round solenoid bracket retaining rods until the correct solenoid has been freed. NOTE: Because the solenoids are riveted to the brackets, it will be necessary to replace both solenoids where there are two on one bracket.

To reassemble, reverse above procedure.

REMOVE EXPRESSION PEDAL:

1. Using a 1/4" ratchet drive with a long extension and 5/16" hex socket, remove the 4 screws securing the swell pedal to the console.

2. Slide pedal foward and by reaching around to the rear of the assembly unplug the connecting cables.

3. Remove swell pedal from organ.

To install, reverse above procedures.

VIBRATO CANCEL SWITCH:

The Vibrato Cancel Switch is an integral part of the Expression Control Pedal. Therefore, if replacement becomes necessary, the Pedal and Switch will have to be replaced as a unit.

REMOVE POWER SUPPLY CHASSIS:

1. Remove console rear panel.

2. Remove six pin, nine pin and twelve pin plugs (it is necessary to depress the locking clips on either side of the six and nine pin plugs to release them).

3. Remove four 5/16" hex head mounting screws. Chassis can now be removed.

To reinstall, reverse above procedure.

REMOVE REVERB. - POWER AMPLIFIER CHASSIS:

1. Remove console rear panel.

2. Remove associated cable ties.

3. Remove twelve pin plug P703 from power supply chassis.

4. Remove pins 5 and 8 from P703.

5. Remove twelve pin plug from power amplifier chassis. (It is necessary to depress the locking clips on either side of the twelve pin plugs to release them).

6. Remove gray and black shielded cables from power amplifier chassis.

7. Remove three speaker plugs from top of chassis.

8. Remove four 5/16" hex head mounting screws. Chassis can now be removed.

To reinstall, reverse above procedure.

OPERATION OF MECHANISM ON PRESET KEYS

In their basic construction the preset keys are identical to the playing keys. Each has a plastic key mounted on a metal channel, pivoted in the rear and with a guide toward the front to minimize side motion.

On the front edge of each channel of the 9 preset keys and 2 adjust keys, two flat springs are attached, one 3/8" long of rather stiff material, and another approximately 5/8" long of soft plastic. The softer long spring is sandwiched on top of the stiff spring, nearest to the key. The cancel key has only one heavy spring approximately 1" long.

When a preset key is depressed, the longer soft spring is forced downward and snaps under a tubular rod which is part of the cradle. The cradle is constructed of two tubes approximately 6" long and assembled 3/4" apart. One tube is used as a fulcrum, the entire assembly being mounted perpendicular to the preset keys. A spring and bumper hold the cradle at a 60° angle toward the front of the console.

Once a key has been depressed, the soft spring remains under the tube. It is backed by the short stiff spring to give it sufficient tension to hold the key down. When the next preset key is depressed, the cradle is forced down and outward, permitting the previously actuated key to come up, but again locking the one last depressed.

If two preset keys are depressed at once, both will lock down. The cancel key with its long stiff spring is then used and forces the cradle down, causing all preset keys depressed to return to their normal position. As there is no locking spring on the cancel key, it will immediately return to its normal position.

CRADLE ADJUSTMENT

If it is determined that adjustment is necessary for proper operation of preset keys, the left hand end block of the manual needing adjustment should be removed. The upper or lower manual assembly will have to be raised to gain access to the screws holding this block. After removal of this block, the end of the cradle will be visible. Also visible will be the stop felt and bracket assembly. This is a small angular bracket faced with a small piece of felt. This bracket is slotted and after loosening the retaining screws, can be moved either forward or backward to effect an adjustment. It should be moved forward to decrease holding tension and backward to increase tension. Additional movement in either direction can be obtained by loosening the two screws from underneath, holding the cradle assembly and moving it forward or backward.

REPRINT OF TECHNICAL BULLETINS.

SUBJECT: Transistor and diode commercial part Replacement recommendations

TECHNICAL BULLETIN 33

SYMBOL	HAMMOND PART NO	COMMERCIAL EQUIVALENT
Q702	01-1205-0P	2N1541
Q701	01-1201-0	2N1303
D704	01-2303-3	IN1766
D701, D702, D703	01-2405-1	IN2069
D707		
D705, D706	01-2601-0	IN3604
Q201, Q202	01-2101-0	2N2712
D202	01-2303-3	IN1766
D201	01-2601-0	IN3604
Q501	01-2101-0	2N3393
Q521	01-2101-0	2N3393
Q522	01-2101-0	2N3393
Q904	01-2106	2N3394
Q901, Q903	01-2104	2N3393
Q902, Q906	01-2108	2N3391
D101	01-2601-0	IN3604
Q810	01-2110	2N3416
Q810	01-2110	2N3416
Q801, Q802	01-2110	2N3416
Q803, Q804, Q805	01-2104	2N3393
Q806	01-2114	(Mot. 2N3501 (RCA 2N3440 (G.E. 2N3589
Q807	01-2109	2N3393
Q808	01-2104	2N3393
Q809	01-2110	2N3416
D903	01-2408	
D901, D904	01-2601-0	IN3604
D902, D905		
D102	01-2303-3	IN1767
D602	01-2601-0	IN3604
D601	01-2303-0	IN1779

TECHNICAL BULLETIN 35

The following changes are recommended to correct the percussion and reiteration thump on the H-100. To give the serviceman some flexibility in making the change we have listed two alternates. Alternate "A" change provides correction without requiring that the serviceman remove the AO-72 amplifier chassis. Alternate "B" change, which is identical to the change to be made in production, requires removing the amplifier chassis. It should be made clear that only one of the methods should be implemented.

METHOD A

1. Insert a .001 mfd. capacitor in series with the output lead of the percussion amplifier. This is the shielded lead which connects from plug P103 on the chassis to R1025 on the ADD VIBRATO switch on the control panel. This change can readily be made in the vicinity of the switch.

2. Add a .002 mfd. capacitor from the wiper arm of potentiometer R210 to ground. This capacitor can be added in the vicinity of the pot which is on the control panel.

METHOD B

1. Replace C118 (.047 mfd.) with a .0015 mfd. capacitor.

2. Replace C114 (.0039 mfd.) with a .0056 mfd. capacitor.

TECHNICAL BULLETIN 42

"ADD VIBRATO" TAB

To reduce "pop" when depressing "Add Vibrato" tab, change C-803 and C-813 to 2.2 MFD. tantalum capacitor. Our #AO 29615-3.

REITERATOR

To improve operation of reiteration circuit and prevent outplaying, a 12" violet wire has been added to the circuit in the following manner:

Facing the front of the organ, the violet wire is attached to the fourth terminal in on the reiterator chassis, and then to the last terminal in on the right side of the "Reiterate" switch.

The following Model and Serial Numbers indicate the point where this change has been incorporated in production:

H-110	#3998	H-143	#2765
H-111	#2129	H-182	#3108
H-112	#3687	H-195	#2498

It is suggested, this change be made on earlier H-100 instruments during the course of normal service.

TECHNICAL BULLETIN 46

To improve Bass response, substitute .082 MFD capacitors for C-650 and C-651. These capacitors are now .15 MFD, and are located on the Expression Control.

NEW CIRCUITS
SERIAL NO. 15000 AND UP

Following is a functional list of new circuit assemblies, their assembly numbers and, where applicable, the number of the assembly replaced.

NOTE:

Parts listed below are not interchangeable between earlier H-100 Series organs and those above Serial No. 15000.

	New Assembly No.	Replaces Assembly No.
Power supply	127-000025	127-000017
Vibrato Scanner Assembly	121-000067	121-000096
Pedal Gate Amplifier	117-000004	P/O 126-000039 (AO-72-0)
Percussion Gate and Amplifier	117-000001	P/O 126-000039 (AO-72-0)
Audio Delay Circuit	124-000019	
Percussion & Reiteration Driver	128-000001	125-000029 (AO-30223-0)
Power Amplifier	126-000050	126-000038 (AO-70-1)
Vibrato Recover Amplifier	124-000100	

THEORY OF OPERATION - NEW CIRCUITS

SOLENOID LATCHING CIRCUIT P/O 127-000025

(Schematic Fig. 52)

Transistor Q706 is a constant current supply providing 130 mA. d. c. for one pedal latching solenoid. The current is set to 130 mA by adjusting control R724 and in this way varying the impedance of transistor Q706.

When another solenoid is switched in parallel to the first one, the current divides equally between both solenoids and each one is drawing 65 mA. Because of tolerances, 65 mA per solenoid may be sufficient to keep both solenoids latched. It is necessary to release the first solenoid when another one is connected. To achieve this, the voltage level at the collector of transistor Q706 is sensed by transistor Q701. When one solenoid is connected, transistor Q701 is conducting and transistor Q702 is cut off.

When the second solenoid is connected, this condition is reversed. The resulting voltage drop at the collector of transistor Q706 causes transistor Q701 to cut off, and this in turn causes transistor Q702 to conduct. The produced voltage change at the collector of Q702 is amplified by transistors Q703 and Q704 and causes the impedance of transistor Q705 to increase. The voltage drop across resistor R722 increases, and this limits the current that transistor Q706 can now pass to 100 mA. The result is 50mA for each solenoid, which is insufficient for latching, and the solenoid which is not held down by an external force (pedal) will release.

PEDAL GATE AMPLIFIER 117-000004

(Schematic Fig. 46)

The purpose of this amplifier is to provide the pedal sustain effect in conjunction with the solenoid controlled pedal switch. It also provides amplification with or without the sustain effect.

NOTE:

Because the "string bass" tabs introduce a "sustain" or "automatic pedal legato" mode in which a pedal note fades away after the pedal is released, it is necessary to have the signal contacts of the last played pedal remain closed. This is accomplished by a solenoid under each pedal which is electrically held down through a locking contact.

The operation of this amplifier can be described in two parts; the Pedal Gate Driver and the Pedal Gate (the latter formed by transistors Q-151 through Q-155). With no pedal depressed, transistor Q-157 is not conducting because of no bias at the base. Zener diode D-151 is draining current through R-176 and maintains +15V at terminal 14. Condensor C-165 has also charged to +15V from terminal 14 via R-178 only, or R-21, R-22 or R-23 in series, depending on the position of the sustain switch.

The charge in condenser C-165 cannot rise above the +15V level of the Zener diode as this would forward bias diode D-152 and connect zener D-151 in parallel to the condenser. Because the base of Q-158 is forward biased, both transistors Q-158 and Q-159 are conducting with a resultant voltage on pin 1.

Depressing a pedal applies +6V through R-174 to the base of transistor Q-157 driving it into saturation. As a result, condenser C-165 discharges through diode D-152, transistor Q-157, and R-177. The voltage at terminal 1 drops to zero.

With the pedal released, Q-157 stops conducting, zener diode D-151 "fires", and reverse biases diode D-152, and C-165 now starts charging; the rate depending upon the setting of the sustain tabs which determine the resistors in series with the charging path. The voltage level at terminal 1 now rises following the level of C-165.

The audio signal is controlled by the pedal gate and more precisely, by the DC voltage developed across R-181 and available at terminal 1. This voltage is applied through R-181 to F.E.T. gate Q-153. This voltage is adjusted to the cut-off voltage of the F.E.T. used. Under this condition the drain to source resistance of Q-153 does not affect the operation of transistor Q-152.

An audio signal appearing in the secondary of T-151 is fed to the base of transistor Q-152 through R-151, C-152, and transistor Q-151. Q-152 splits the signal into two out-of-phase signals. Because of unequal emitter and collector loads. (R-156 and R-157) the signal across R-157 is much greater than that across R-156. Both signals are mixed and levels adjusted by means of R-159, R-160, R-161, and R-162, so that signal cancellation takes place at point 8. This is the condition when the gate is closed.
When the DC at the gate of Q-153 is removed, the drain to source resistance of Q-153 becomes very small (a few hundred ohms).

This connects C-155 in parallel to R-157 and removes the signal degeneration in R-157. The result is a signal level rise at the collector of Q-152. The signal cancelling described in the prior paragraph is offset and a maximum signal now appears at point 8. The gate is now open for maximum signal output conditions.
As the DC voltage at the gate of Q-153 varies (from pinch-off to zero), the signal output from the gate varies correspondingly.

Transistor Q-154 and Q-155 are conventional amplifiers to raise the output of the gate to proper level. R-164 serves as a pedal level adjustment.

PERCUSSION & REITERATION DRIVER 128-000001
(Schematic Fig. 48)

This unit operates in two modes; percussive and reiterative. Percussive can be "touch control" or legato. Reiteration is controlled by "reiteration" tab.

In the percussive mode in standby condition, transistors Q-201, Q-204, and Q-205 are not conducting, hence their collectors are at +25 volts for the three transistors. The +25V potential is a reverse bias for D-204, which is therefore not conducting. Condenser C-203 is charged to +10.5V via any one of the charge time determinant resistors.

When a key is depressed, the keyer contact applies +6V to terminal 3. The current which charges C-201, passes through R-203 and produces a positive pulse at the base of transistor Q-201. Transistor Q-201 saturates and its collector voltage drops momentarily below one volt. The resulting negative

pulse at the collector of Q-201 discharges condenser C-202. The discharge current of C-202 passes through resistor R-207 and effects a positive pulse at the base of transistor Q-204.

Diode D-202 eliminates a negative pulse at the base of Q-204, which would have resulted from releasing the key.

The positive pulse saturates Q-204 and this in turn saturates Q-205. The collector voltage of Q-205 drops below one volt and D-204 is at forward bias potential. Condenser C-203 discharges momentarily via diode D-204, transistor Q-205, and resistor R-209.

This condition is the starting point of percussion drive ramp signal.

After completion of the discharge pulse, C-203 charges again via one of the charge time determinant resistors.

The dual emitter follower stage, consisting of transistor Q-206 and Q-207, isolates output terminal 9 from the timing condenser C-203.

In the reiterative mode, in standby condition, condenser C-203 is charged to approximately +10.5V via resistors R-211 and R-212.

When a key is depressed, the keyer contact applies +6 volts to terminal 5. A forward bias is thereby placed on transistors Q-202 and Q-203. Q-203 saturates and connects diode D-205 to ground. Diode D-205 "fires" and condenser C-203 discharges through transistor Q-203. C-203 charges again through R-211 and R-212. The charge speed is adjusted by Reiteration Rate Control R-211.

When C-203 is charged to the "firing" voltage of D-205, another discharge follows. This cycling continues as long as a keyer contact is closed. The reiterative pulse is connected through isolation transistors Q-206 and Q-207 to terminal #9.

PERCUSSION GATE AMPLIFIER 117-000001
(Schematic Fig. 47)

A positive DC voltage from R-112 is applied through R-111 to the gate terminal of F.E.T. Q-102. This voltage is adjusted by means of R-112 to the pinch-off voltage of the Q-102 F.E.T. used. Under this condition the drain to source resistance of Q-102 is very high (tens of megohms) and Q-102 does not influence the operation of Q-101.

An audio signal from transformer T-101 is fed via C-101 to the base of transistor Q101. Because of uneqal emitter and collector loads (R-104 and R-105), the signal across R-105 is much greater than across R-104. The signal across R-105 is in phase with the signal at the base of Q-101 and the signal across R-104 is 180° shifted in phase. The signals from the collector and emitter of Q-101 are mixed via R-107 plus R-109, and via R-108 plus R-110 in such a way that they both appear at point 7 in equal level and out of phase. The result is that both signals cancel each other and there is no output from the gate. This is the condition when the gate is closed.

When the DC voltage from the F.E.T. gate Q-102 is removed, the drain to source resistance becomes very small (a few hundred ohms) and this virtually places C-104 in parallel with R-105. The result is that the signal at the collector of Q-101 increases, because C-104 decouples the signal current degeneration in R-105. This, in turn unbalances the signal null point at point 7 and gate has maximum output, or is "open."

A variable DC voltage impressed upon gate Q-102 will cause a variable signal output from the gate.

Transistors Q-103 and Q-104 perform as conventional amplifiers to raise the output from the gate to the proper level. R-113 adjusts the gain of the amplifier as required.

AUDIO DELAY CIRCUIT 124-000019
(Schematic Fig. 56)

With no voltage applied to terminal No. 1, Q-951 is not conducting, since there is no forward bias on its base. Accordingly, the junction of R957 and R958 is at ground potential, and no bias voltage is applied to the gates of FET's Q-952 through Q-955. In this condition, the D-to-S resistance of the FET's is relatively low, and audio signals reaching terminals 3 through 6 are shunted to ground.

When -24 volts is applied to terminal No. 1, C-951 begins to charge, and the potential drop at the top end of R-955 is slowly reduced. When the potential has reached approximately -9 volts, the difference across the Zener, D-952, is about 15 volts. The Zener "fires" or starts conducting, supplying current to the base of Q-951, which starts conducting, and about -12 volts appears at the junction of R-957 and R-958. This voltage exceeds the cut-off voltage of the FET's, and when applied to the gates of Q-952 through Q-955 causes their D-to-S resistance to become very high. Therefore, audio signals reaching terminals 3 through 6 are no longer shunted to ground, and pass to the amplifiers at their input terminals.

When power is removed from terminal No. 1, C-951 discharges. D-951 facilitates the discharge by bypassing R-955, thereby rapidly setting up the gate for another delay cycle. The function of C-952 is to inhibit the amplification by Q-951 of noise from D-952. R-956 provides a path for the starting voltage to D-952.