INTRODUCTION

The purpose of this manual is to give the service engineer the technical information needed to understand the operation of the ELECTRONIC ORGAN, so that in the event of a fault developing it can be readily diagnosed and cleared.
The manual is divided into sections which broadly correspond to the various sub-assemblies used in the construction.

CONTENTS

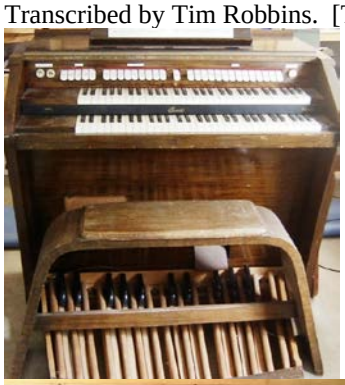
ILLUSTRATIONS

Issue 2 October 1957 To be inserted after Figure 29

MINSTER ORGAN - MODEL CC

CONTENTS

Transcribed by Tim Robbins. [Transcriber's additional notes/items are inserted in square brackets]





Transcribers Introduction

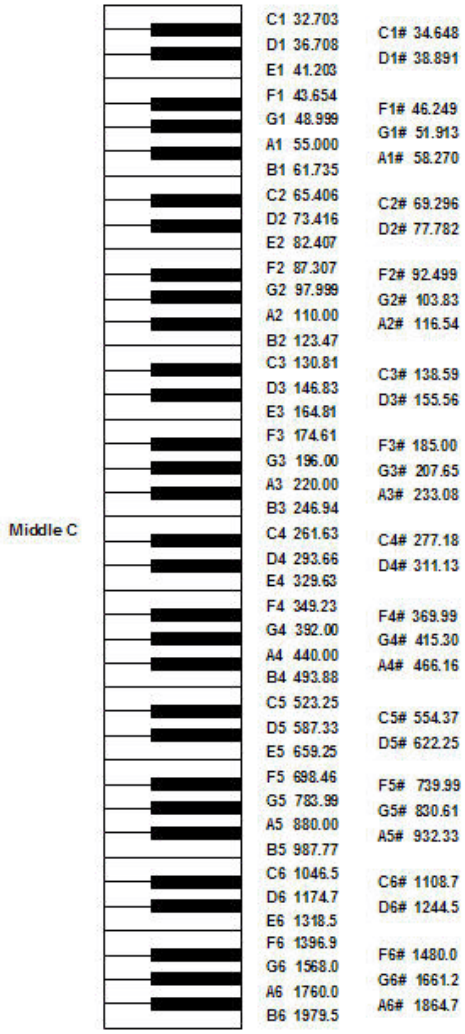
This manual is compiled from a photocopied manual and an original manual, and details from a Concert Model, S.N. 2389, built about 1958. Some Figures have been augmented with extra detail.

Although called a concert organ, the style is of a well appointed spinet with 2 full-range manuals and a wide variety of stops, vibrato and expression pedal. The model has two manual 60 note keyboards (upper Solo, lower Accompaniment) from C^2 to B^6, and a 25 note pedalboard from C^2 to C^4 (8') or C^1 to C^3 (16'). The two-octave pedalboard is radiated and concave and allows both feet to play in heel-and-toe fashion, but only provides one note output. The in-board speaker is a quality Goodmans Audiom 60 bass unit, and the amplifier is a KT66 push-pull low distortion configuration. The frame is almost entirely from solid English Oak. The Stop Tabs available are:

Pedal	**Solo**	**Accompaniment**
Bourdon 16'	Tibia 16'	Bass Flute 16'
Dulciana 16'	Dulciano 16'	
Bassoon 16'	Cello 16'	
	Trumpet 8'	Horn 8'
Clarinet 8'	Clarinet 8'	Melodia 8'
Flute 8'	Orch. Horn 8'	Flute 8'
	Oboe 8'	String 8'
	Tibia 8'	
	Dulcet 8'	
	Viol 8'	
	Tibia 4'	Clarion 4'
	Piccolo 4'	Flute 4'
	Viol 4'	String 4'
	Salicet 2'	Salicet 2'

This organ uses 12 note oscillators and four frequency dividers per note to cover the 5 octave keyboards, and an additional divider section for the pedals in 16'. A series-feed Hartley oscillator and buffer amp generates each note in the top octave, and a relaxation long-tail pair amplifier in each divider stage generates near saw-tooth like waveform outputs for use with the subtractive synthesis registration filters (formant filters). A high impedance key contact circuit is used to minimise keying noise clicks.

The 8' pitch tabs play the keyboard notes at the natural pitch. The 16' pitch tabs play the keyboard notes at an octave lower than the natural pitch. The 4' pitch tabs play the keyboard notes at an octave higher than the natural pitch. However, the top octave of keys passes the natural pitch also through the 4' pitch tabs, rather than an octave higher. Likewise, the bottom octave of keys passes the natural pitch also through the 16' pitch tabs, rather than an octave lower, although the pedal board allows an octave lower note to be played when a 16' pitch tab is selected. The service manual designates note numbering from the leftmost C note as C^1, whereas this key is actually C^2, and the middle C at the centre of the organ (ie. in line with the lock and akin to a piano) is C^4 = 261Hz with the key played at the 8' pitch although this manual refers to it as C3. This may cause confusion on reading this manual.



Restoration of this organ has required all the resistor values to be checked, as a few needed replacing. All paper and mica foil capacitors were replaced. Electrolytic capacitors were either replaced or bypassed. AC wiring was reconfigured with an auto 1 minute heater on phase. Oscillator circuit R4 was optimised. A 300V regulator was placed in parallel with the 0A2 tubes to allow tighter regulation if the tubes are not in place. Higher levels of HT rail filtering were used.

Additional modifications included send-return for external effects; half-semitone dip; tremolo; external speaker connection; additional amplifier protection.

1 General Description

The Electronic Organ comprises 5 main sections as follows:-

1.1 The Manuals:-

Two similarly constructed manual assemblies each carrying keying contacts are arranged so that the upper (Solo) manual is pivoted to give access to the lower (Accompaniment) manual which is fixed.

1.2 The Generator Units:-

Twelve separate chassis are employed each generating 5 similarly designated notes throughout the 5 octave compass (e.g.) C^1, C^2, C^3, C^4, C^5. The oscillator divider system is in continuous operation and as one valve supplies one note a total of 60 valves is employed for tone generation.

1.3 The Tab Box:-

The Tab Box contains 6 valves and associated components, together with the Tab operated switches which control the function of the Organ. Three valves are employed as Buffer Amplifiers drawing the input signals from the 4', 8' and 16' bus bars of each manual, while the remaining three valves operate in the main amplifier chain

1.4 The Power Amplifier:-

This unit comprises all Power Supplies, Power Amplification, Vibrato Generation and Pedal Note Divider circuits. A total of 8 valves are employed for these purposes.

1.5 The Expression Pedal:-

A balanced pedal system operates a special type of control unit which coupled to the Amplifier, gives a variation of volume between pre-set limits.

1.6 The Pedal Board:-

This unit comprises only the mechanical parts of the 25 note Pedal Board, and is readily detachable from the Console. The associated contacts and wiring are mounted within the Console.

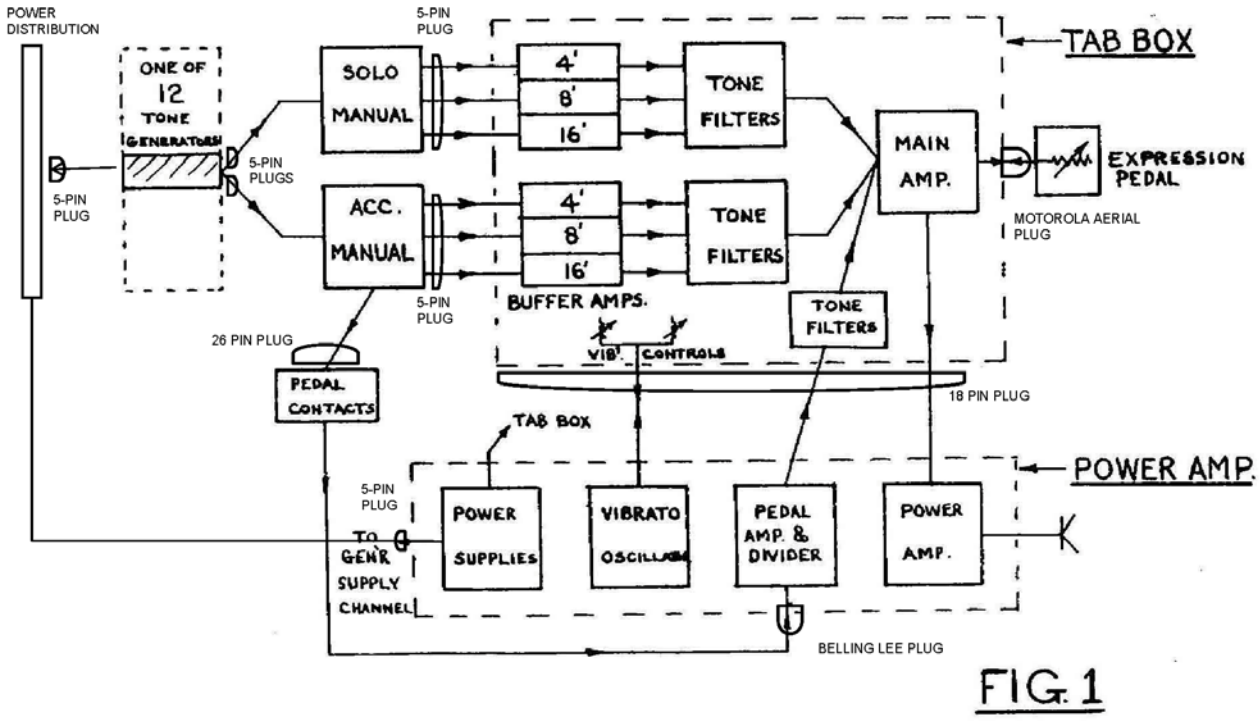


Figure 1. Main Sections of Organ [with Connections shown]

2 The Manuals

Each manual assembly is mechanically and electrically identical, but in the lower manual additional wiring is necessary for feeding tones to the Pedal Section.

2.1 Operation:-

Figure 2 shows a sectional view of the assembly. With the key at rest the Return Spring (3) causes the front end of the key to be lifted against the Level Adjust Button (1). The rear end of the key is therefore in its lowest position and the Contact Button (5) presses springy comb (6) against the Wire (7).

Signal input is taken from the appropriate Generator Chassis via one of the leads of the 5 way plug to one end of Keying Resistor Rb which is mounted upon Resistor Panel (11). The other end of the resistor is connected to the Contact Wire (7).

The Comb (6) is earthed and thus when the key is at rest the input signal is shorted out. When the key is depressed the Comb (6) is allowed to lift clear of the Wire (7).

The signal is now able to pass through Ra, which is connected to the junction of Rb and the Wire (7), to the appropriate Bus Bar, either 4', 8' or 16'.

In the complete assembly there are three Contact Wires (7) each simultaneously operated by the Comb (6) which is controlled by one key. Thus when a key is depressed, signals of 4', 8' and 16' pitch pass simultaneously to their respective Bus Bars.

The Rear View inset drawing figure 2 shows three adjacent keys B^2, C^3 and $C\#^3$. Key C^3 is pressed and the Button (5) has moved upwards followed by contact Comb (6), which breaks clear of the three wires mounted in the vertical slots. Thus notes C^2, C^3 and $C\#^4$ are passed to the respective bus-bars 16', 8' and 4'.

Note that the Panels (11) are arranged in a set of five, each covering one octave. The bus-bars are continuous throughout the length of the Manual. The Cover may be removed for contact inspection.

Figure 3 shows the schematic of the keying circuits. [The resistance presented to each oscillator/divider output is normally 10MΩ/3/2 = 1.7MΩ with no keys depressed. With a key depressed, each 10M passes through 2M7 effectively to ground (47k grid leak plus all other bus/manual keys and their 2M7 to ground). The signal attenuation from oscillator output to buffer amplifier grid is effectively about 34k / 12M7 = 0.0027, which is then amplified by about 100.]

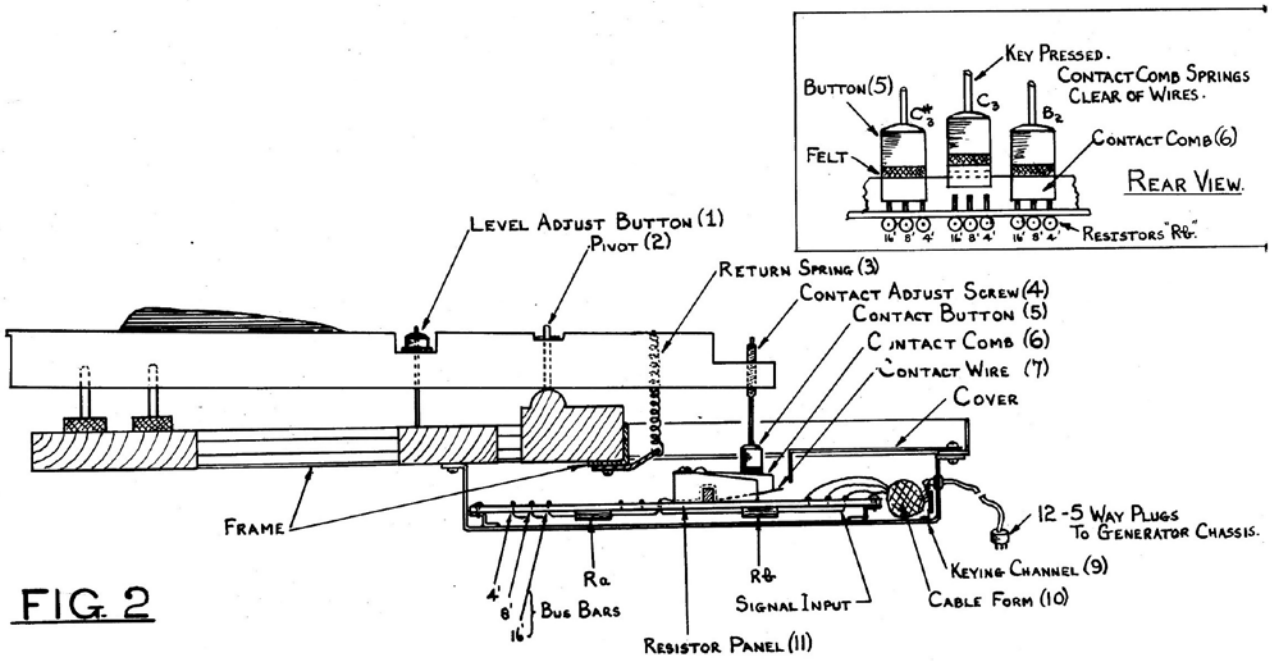


Figure 2. Key Assembly

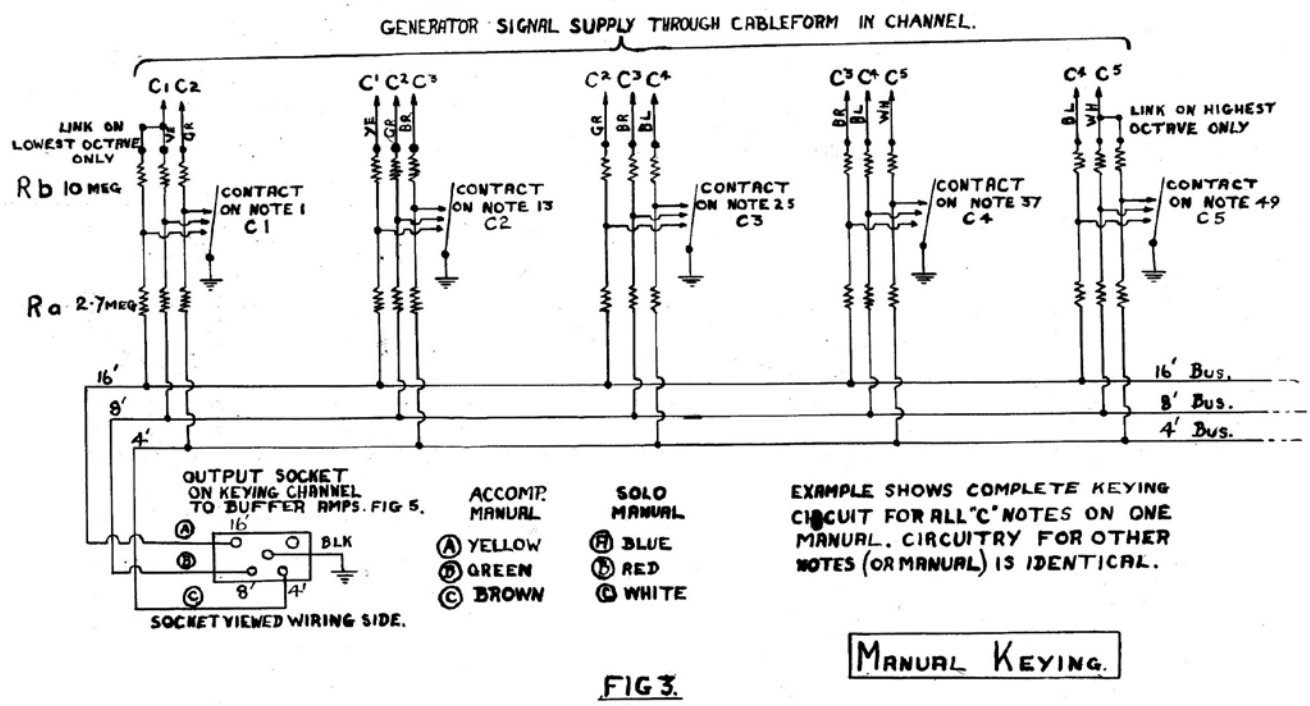
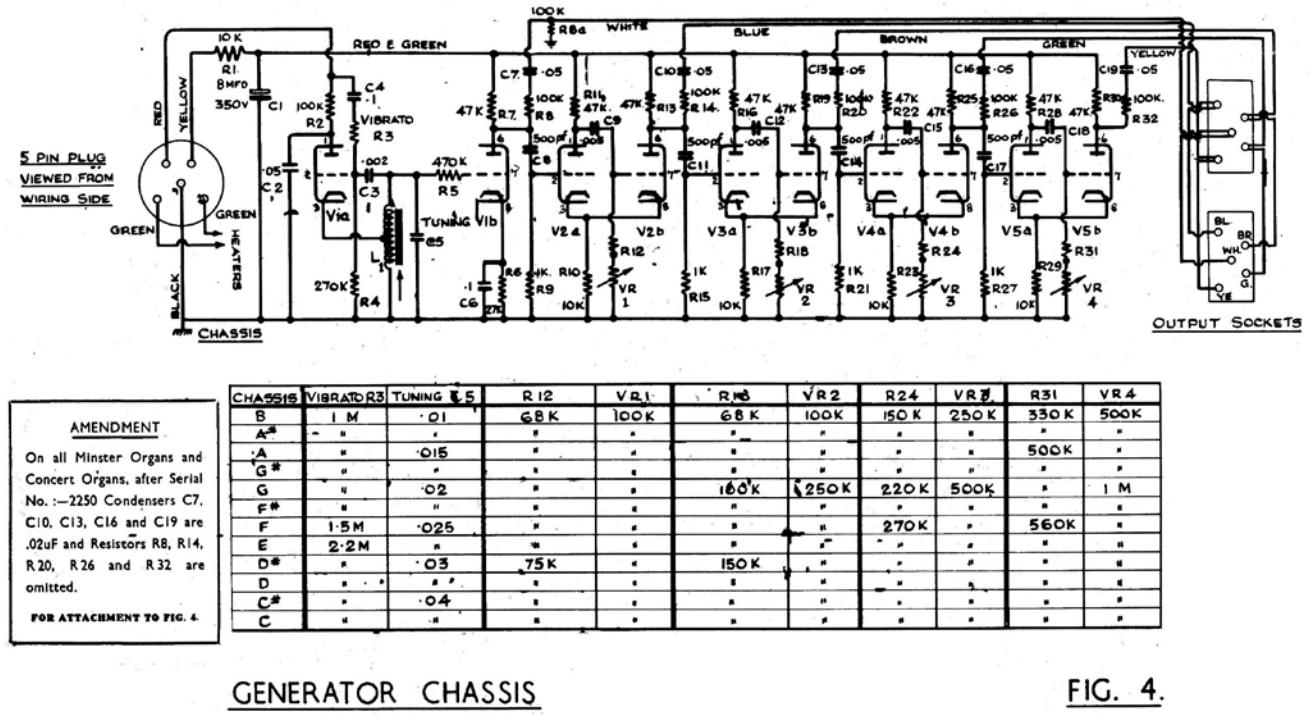


Figure 3. Manual Keying



CHASSIS	VIBRATO R3	TUNING C5	R12	VR1	R13	VR2	R24	VR3	R31	VR4
B	1 M	·01	68K	100K	68 K	100K	150 K	250 K	330 K	500K
A#	"	"	"	"	"	"	"	"	"	"
A	"	·015	"	"	"	"	"	"	500K	"
G#	"	"	"	"	"	"	"	"	"	"
G	"	·02	"	"	160K	250K	220 K	500K	"	1 M
F#	"	"	"	"	"	"	"	"	"	"
F	1·5M	·025	"	"	"	"	270K	"	560K	"
E	2·2M	"	"	"	"	"	"	"	"	"
D#	"	·03	75K	"	150K	"	"	"	"	"
D	"	"	"	"	"	"	"	"	"	"
C#	"	·04	"	"	"	"	"	"	"	"
C	"	"	"	"	"	"	"	"	"	"

GENERATOR CHASSIS FIG. 4.

Figure 4. Generator Chassis

3 The Generators

There are 12 Generator Chassis, each corresponding to a note of the musical scale. Each chassis gives an output of 5 octavely related frequencies and thus the 12 chassis encompass a musical range of 5 octavos (i.e.) 60 notes.

It will therefore be apparent that when tuning the instrument an adjustment of the Master Oscillator on any one chassis will automatically adjust the frequency of the 5 notes provided by that chassis. (SEE TUNING INSTRUCTIONS 7.1).

Except for minor component changes the 12 chassis are identical in all respects and the following description will therefore apply to all.

Figure 4 refers. [Note generators are: C, C#, D, D#, E, F, F#, G, G#, A, A#, B.]

3.1 Operation:-

One half of a double triode valve V1A, type ECC83, operates as an oscillator in an inverted Hartley Circuit. The frequency is controlled by the position of the slug Ll in the tuning coil.

While the oscillator is exceptionally stable in frequency, a dynamic change of HT supply causes a dynamic shift in frequency and this feature is used for introducing Vibrato effect.

Thus the 300v supply to the oscillator anode circuit can be modulated at sub-audio frequency by the Vibrato Oscillator which is built into the Power Amplifier.

The depth of frequency modulation so obtained is determined by the value of R3 which is in series with the blocking condenser C4.

Oscillator output is taken from the tuned circuit Ll, C5 through R5 to the grid of V1B which operates as a buffer amplifier.

Output from the Buffer Amplifier is taken via C7 to one pin of each of the pair of 5 way signal output sockets on the Generator Chassis. This output is of the same frequency as the Oscillator and is the highest frequency supplied by the Generator Chassis. (e.g.) C5.

The output from the Buffer is also fed to the differentiating Circuit comprising C8 and R9. Thus sharp negative and positive pulses are supplied to the grid (a) of the double-triode valve V2 which operates as a frequency divider.

A brief description of the divider operation is as follows:-

A negative pulse applied to grid of V2a causes a positive pulse to appear at the anode which is applied to the grid of V2b via C9. The cathode current through R10 rises and since R10 is common to both triode sections the grid of V2a is effectively driven more negative. Thus anode current of V2a is reduced and anode voltage rises towards H.T. line voltage.

C9 charges at a rate determined by the variable resistor VR1 and the grid voltage V2b falls. The cathode voltage will also fall and thus grid voltage V2a becomes less negative and the anode voltage falls.

C9 is discharged at a rate dependent upon the value of VR1 and R12.

The application of a further negative input pulse to the grid of V2a causes a repetition of the cycle of operation.

While V2a is either cut off or heavily conductive, incoming pulses have no effect. Thus adjustment of VRl enables the divider to lock in at sub-multiples or multiples of the input frequency.

In the organ each divider on the one Generator Chassis is adjusted to lock-in at half the input frequency, thus supplying a series of 5 octavely related notes (e.g.) C^{5}, C^{4}, C^{3}, C^{2}, C^{l}.

The output from each divider is taken in each case through a blocking condenser to appropriate pins on the parallel connected 5 way output sockets.

[Oscillator output level can be maximised by using an optimum R4, which varied from about 240k up to 470k].

4 The TAB Box

The three bus-bar outputs from each Keying Channel (Figure 3) are taken via plug socket connectors to the TAB Box and applied direct to the grids of the Buffer Amplifiers V6, 7 & 8, double triodes, type ECC83 - Figure 5.

Each triode section operates as a voltage amplifier and the output from each anode is taken via a coupling condenser to the Registration or Tone forming circuits (Figure 7 and Figure 8). [C20, C21, C23, C24 are 0.02uF, and C22, C25 are 1nF in S.N.2389. C22 and C25 effectively replace the use of C40A in Accompaniment Registration Figure 7, and C63 in Solo Registration Figure 8.]

The Registration or Stop Tabs which control the signal outputs derived from the upper (Solo) manual are placed in a group to the right hand side of the Control Panel, while the Stop Tabs relative to the lower (Accompaniment) manual are placed to left hand side.

The operation of either group is similar in principle, but component values differ to produce the required waveform shaping for the various tones.

When the Stop Tabs are in the off (upward) position all the signal outputs are earthed through the Tab switch contacts.

If now, for example, the 8' Horn Stop on the Accompaniment Registration is drawn, signal on the 8' bus input from the Buffer Amplifier V6b will pass via R49, 47K and R50, 100K to the output busbar. A resonant circuit comprising L2 and C29 is connected in parallel with the junction of R49 and R50. Wave shaping will occur by the action of the tuned circuit and the characteristic sound of the 8' Horn is obtained. (Figure 7)

The signal on the output bus-bar is applied via the resistance pad R72 and R73 to the input of the Main Amplifier. (Figure 8)

Similarly, outputs from the 4', 8', 16' Buffer Amplifier with Solo manual are shaped, controlled and passed via resistance pad R74 and R 75 to the Main Amplifier. (Figure 8)

The 8' and 16' outputs from the Pedal Generator, which is situated on the Power Amplifier chassis, are brought up to the TAB Box and also shaped and controlled before being passed to the Pedal Balance control VCl which is connected between grid and earth on the Main Amplifier input valve V11a (Figure 12).

Thus tones from the Solo and Accompaniment Manuals, and from the Pedal Divider, are selected by the Tabs and combined at the grid of V11a which operates as a Voltage Amplifier, feedback being provided by R149.

The output is passed to the grid of V11b, amplitude of the signal being controlled by the shunt circuit C91, R153 and the Expression Control [120kΩ max to 6k8 min '12 position' slider pot formed by fixed resistors].

V11b also operates as a Voltage Amplifier, negative feedback from the secondary of the output transformer being applied via R157. [V11 is mounted on a vibration isolation platform in S.N.2389 – to reduce microphony.]

Output from V1lb is applied via preset volume Control VC2 to the grid circuit of V12a. This valve V12, operates as a cathode coupled phase splitter thus enabling the grid of V12b to be used for an auxiliary input if required.

The anti-phase outputs from the anodes of V12a and b are amplified by V13a and b. Negative feedback is applied via R169, C98 and R170, C99 respectively and the outputs are passed via plug and socket connectors to the Power Amplifier chassis.

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The TAB Box also carries a Tab which controls Vibrato (On and Off) together with potentiometers VC4 and VC3 which control Vibrato Speed and Amplitude.

The Mains switch and Pilot lamp are mounted at the extreme right hand side of the TAB Box.

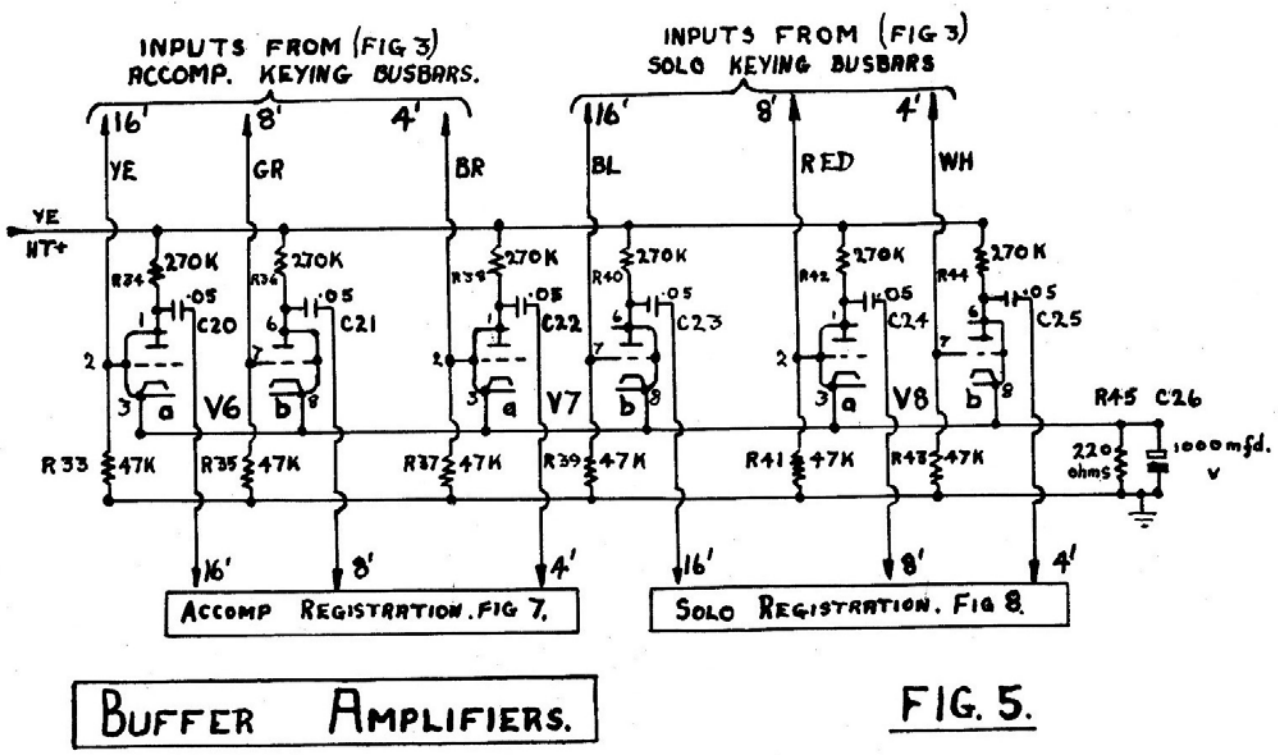
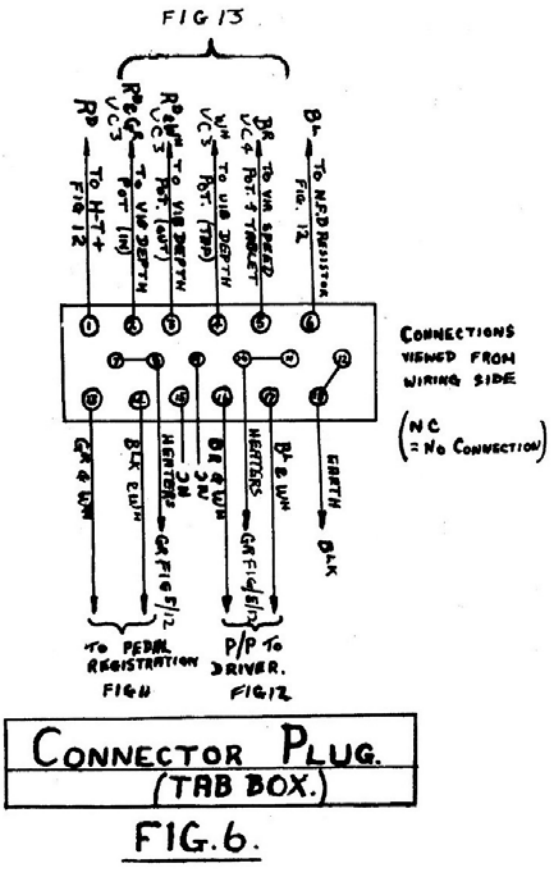


Figure 5. Buffer Amplifiers



Connector Plug Pin Assignment

Pin	Colour	Description
1	RD	390V HT via R176
2	RD/GRN	300V reg to VIB Depth Pot VC3
3	RD/WH	From VIB Depth Pot VC3 to OSC socket
4	WH	To VIB Depth Pot VC3 wiper
5	BR	To VIB Speed Pot VC4 from LFO V19b grid
6	BLK	NFB from OPT to Main Amp pre stage
7	GRN	To heaters in TAB Box
8	GRN	Parallel with pin 7
9	-	Not connected
10	GRN	To heaters in TAB Box
11	GRN	Parallel with pin 10
12	BLK	Earth (shield to Pins 16,17)
13	GRN/WH	8' Pedal output from Generator to Registration (shielded)
14	BLK/WH	16' Pedal output from Generator to Registration (shielded)
15	-	Not connected
16	BR/WH	From V13a driver stage to V16 (shielded)
17	BLK/WH	From V13b driver stage to V15 (shielded)
18	BLK	Earth (shield to Pins 13,14) - parallel with Pin 12

This connector plug connects to socket on TAB Box. The connector plug is at the end of a cableform that originates within Power Amp Chassis - terminating to a terminal strip. It includes two shielded cableforms. McMURDO plug.

Figure 6. Connector Plug – TAB Box [and Connector Pin assignment]

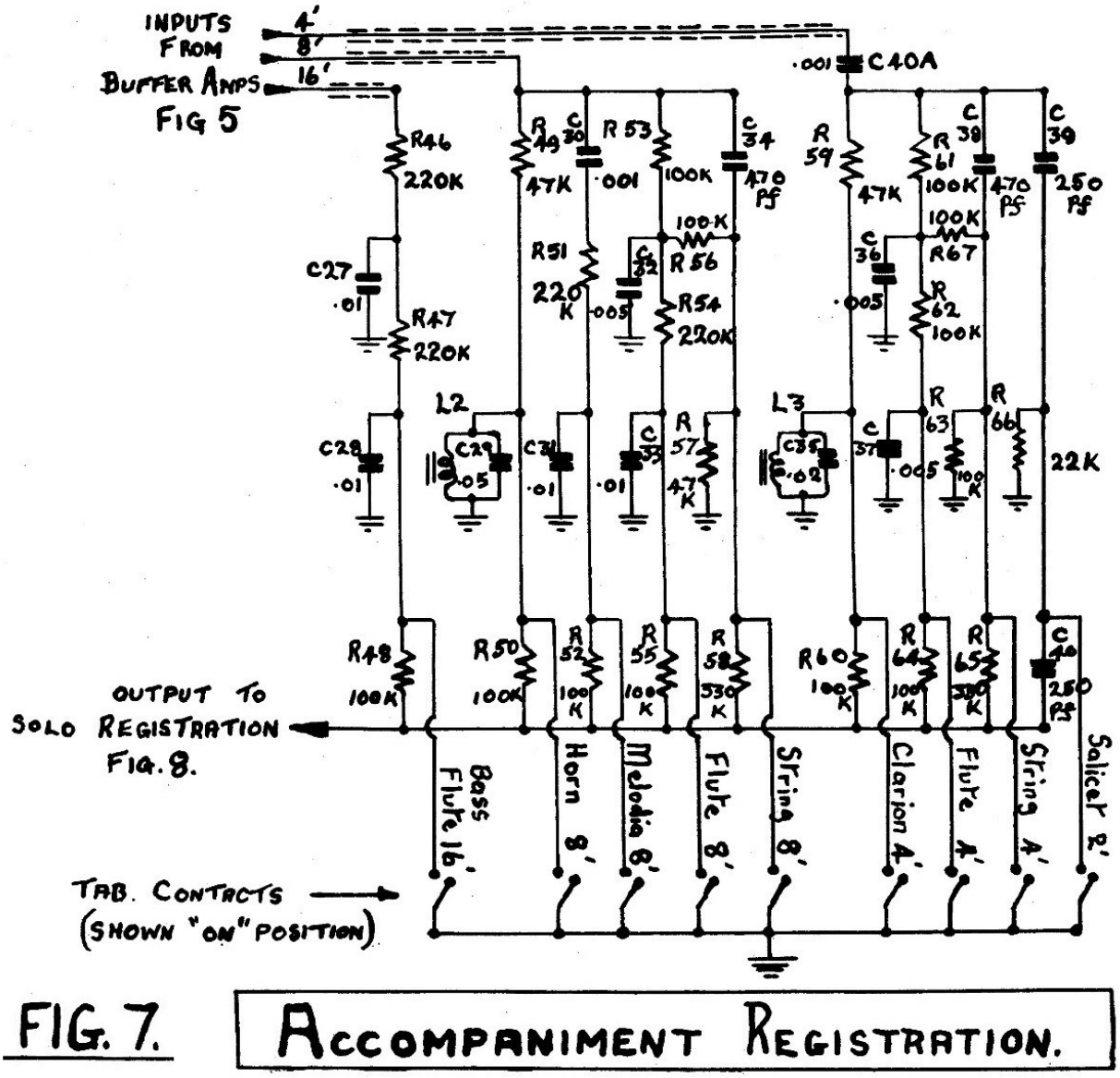
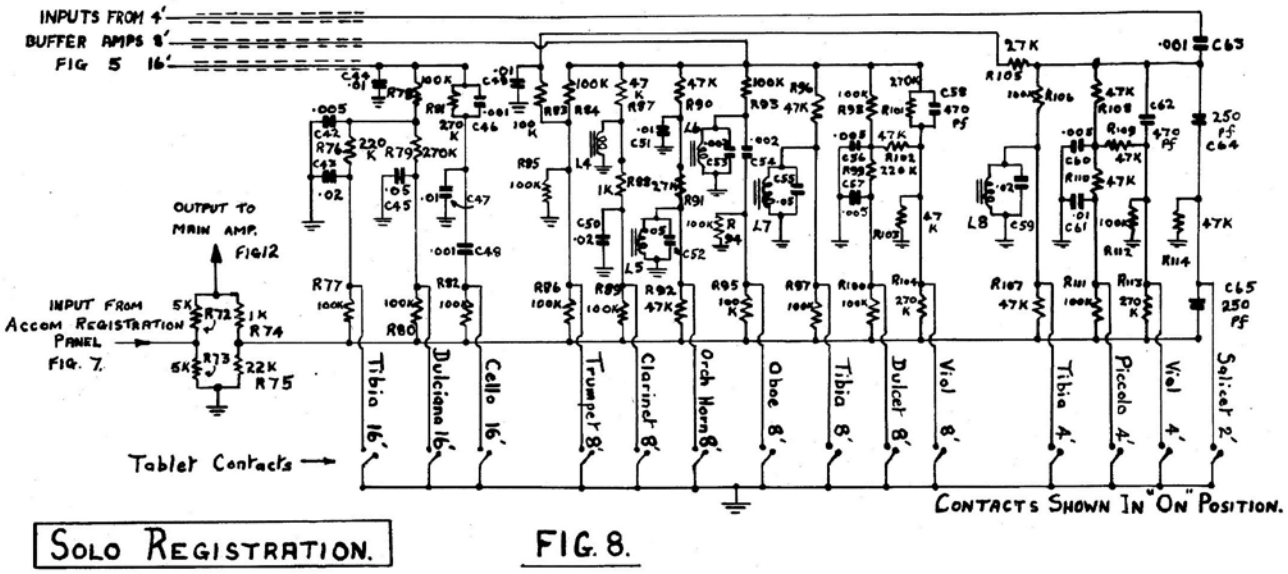


FIG. 7. ACCOMPANIMENT REGISTRATION.

Figure 7. Accompaniment Registration



SOLO REGISTRATION. FIG. 8.

Figure 8. Solo Registration

5 The Power Amplifier

Output from the Main Amplifier situated in the Tab Box is applied to the grids of the power amplifier comprising two KT 66 valves, V15 and V16 in push-pull. The input signal is also connected to the Booster Amplifier socket.

The power pack is conventional with V14 operating as the rectifier and smoothing being provided by C100, L9 and C101.

5.1 Stabilisers.

Main HT voltage (375v) is supplied to the Tab Box via R176 and to voltage stabiliser network via R18l and the connecting link which is situated within the five way plug which feeds the Generator supply channel. The stabilisers V17 and V18 are thus protected from overload in the event of the plug being withdrawn.

The stabilised HT at 300V is supplied via the Vibrato Amplitude control VC3 to the Tone Oscillators in the twelve Generator Chasses. The slider of the control feeds HT to the anode circuit of Vibrato Oscillator valve V19.

5.2 Vibrato Oscillator.

This valve V19 operates as an oscillator by virtue of the cathode resistance R187, which is common to both triode sections. Frequency is controlled by condenser C109 which is shunted by Vibrato Speed control VC4. The Vibrato Tab shorts VC4 when the Tab is up.

The sub-audio frequency output from the Vibrato Oscillator modulates the otherwise stabilised HT supply to the Tone Oscillators. Depth of modulation is adjusted by the Amplitude Control VR.

Stabilised HT at l50V approximately is taken via decoupling Circuit R185 and C107 to the Generator Dividers and to the Pedal Divider.

5.3 Pedal Generator.

The lowest 25 notes from the Accompaniment (lower) manual are wired to the changeover contacts which are operated by the Pedal Board. When a pedal is depressed a tone is passed to the input network associated with the grid circuits of V9a and b. (Figure 9). Amplified output at 8' pitch is passed to the Pedal Central Tabs within the Tab Box via associated filter circuits. [R117 is 270k in S.N.2389.]

The amplified and shaped output from V9a is passed to the grid circuits of the Divider valve V10 which is arranged in a conventional divider circuit. The divided output at 16' pitch is also fed to the appropriate control circuits and Tabs. (Figure 11)

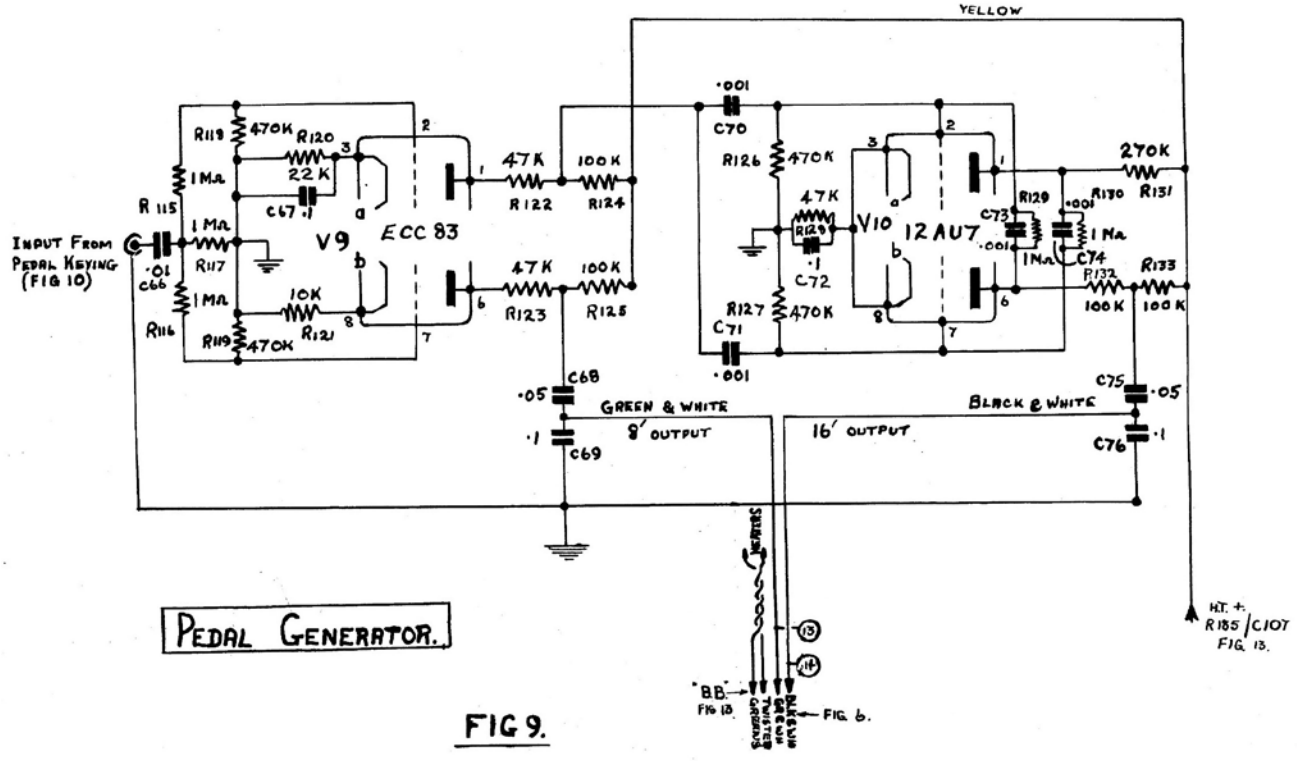


Figure 9. Pedal Generator

6 The Pedal Board

The mechanics of the 25 Note Pedal Board are extremely simple:-

Each pedal is mounted on a flat steel spring at the pivot end and is free to move at the other end in a vertical direction. The free end is controlled laterally by a fixed steel pin which engages with a felt lined slot in the underside of the pedal.

As the pedal board carries no contacts it can be readily attached or detached. The free end of each pedal carries a thin steel spring which registers with the contact plunger.

Each contact is a change-over switch and the set of 25 is mounted on a metal panel which is attached to two concave carrying rails located in the floor of the console. [The closest depressed pedal to C1 is the only pedal not passed to the Pedal Generator section, and only 8' and 16' versions of that note are played depending on Tab Stop selection.]

To remove the contact system withdraw the eight hexagon headed screws which pass through the metal panel into the rear carrying rail and withdraw also the six woodscrews which fasten the three metal brackets to the floor of the console.

The contact assembly together with front carrying rail may now be removed as a unit. (Figure 10).

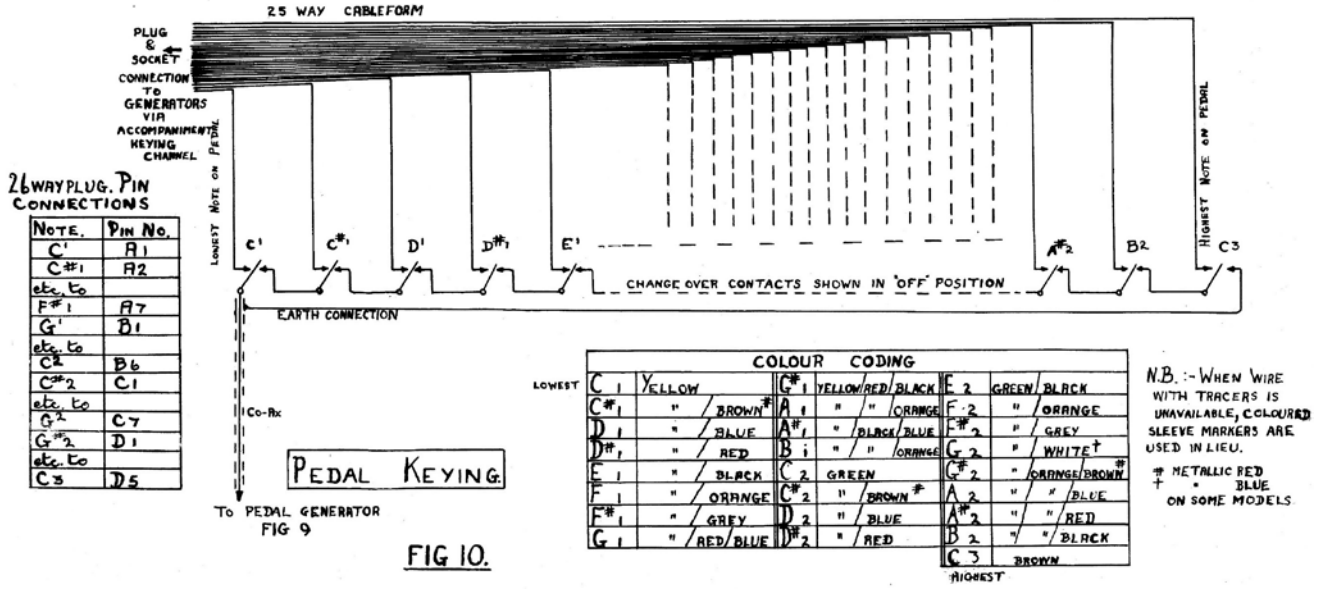


Figure 10. Pedal Keying

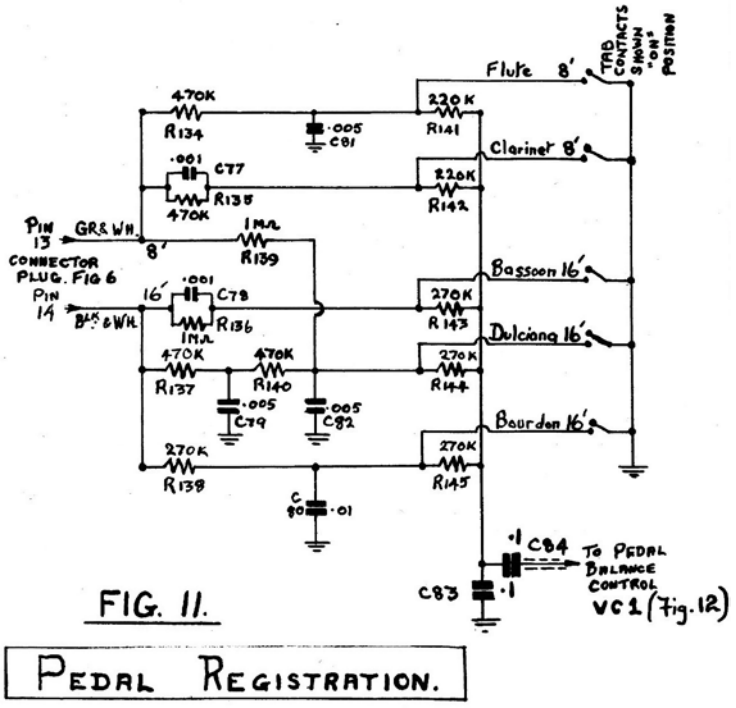


Figure 11. Pedal Registration

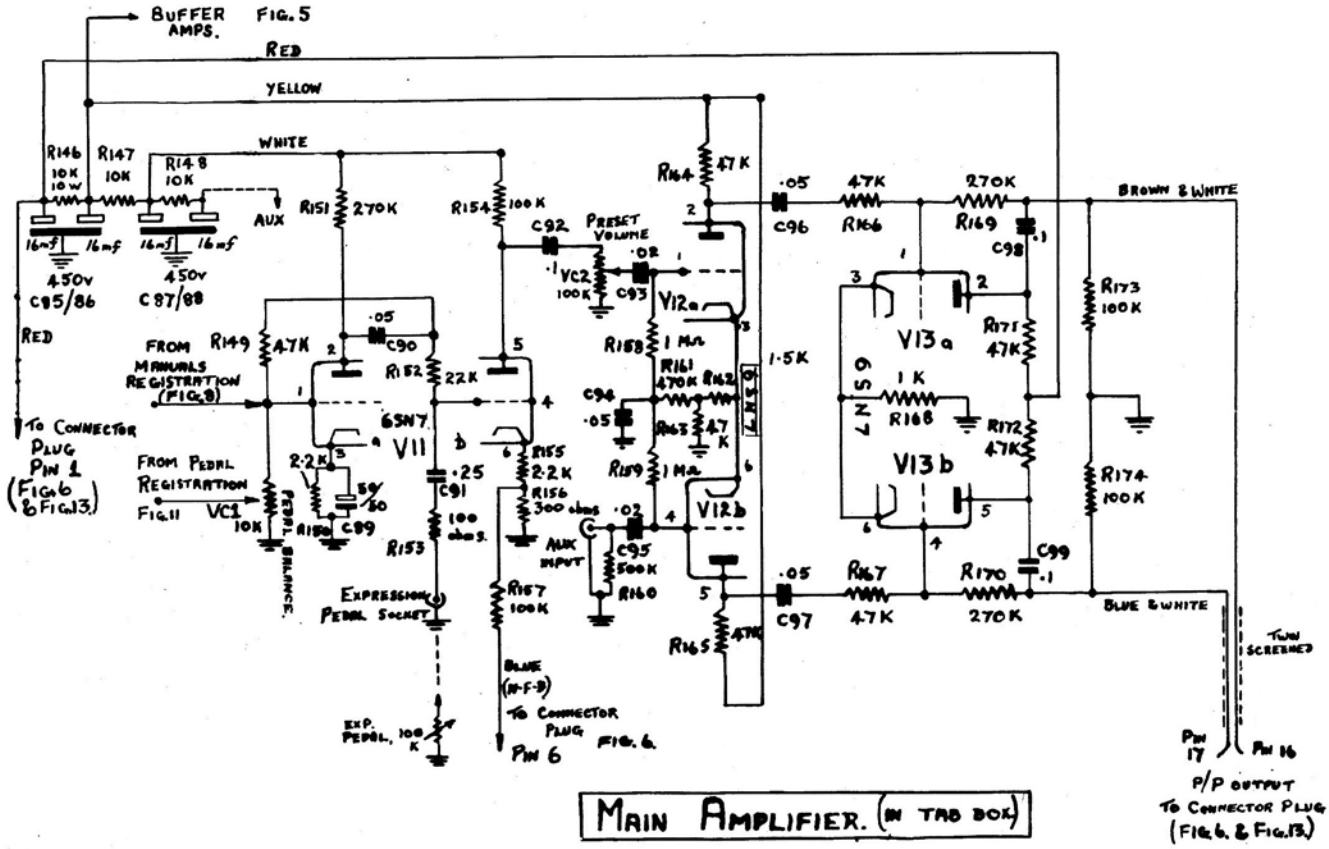


Figure 12. Main Amplifier in TAB Box

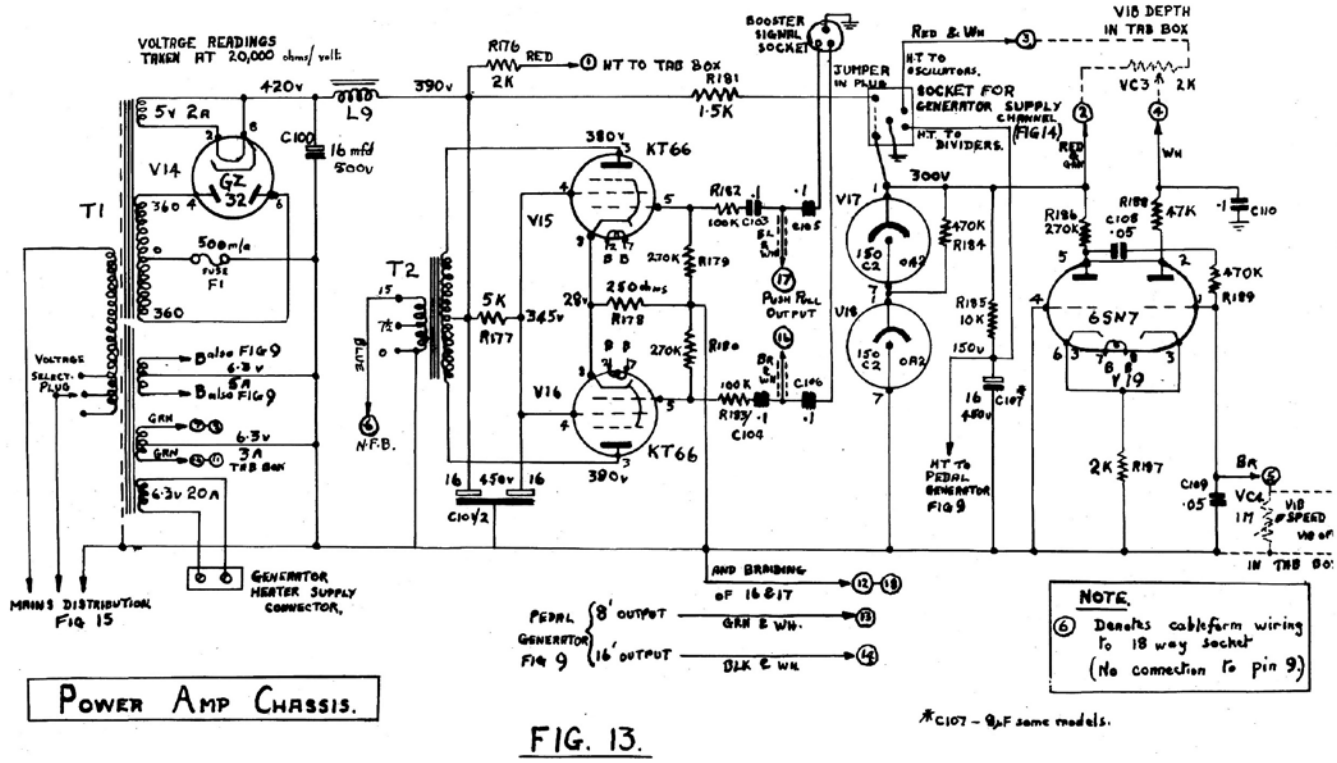


Figure 13 Power Amp Chassis

7 Tuning

Since each generator chassis produces a series of five octavely-related notes, tuning is made relatively simple; because it is only necessary to make one adjustment to each chassis to tune the twelve notes of the musical scale.

Tuning will usually be carried out by someone skilled in the art and the method of tuning is a matter of preference. However, there may be occasions when a service engineer without this experience and musical knowledge may find it necessary to make adjustments to tuning. The tuning sequence which follows is intended for his guidance.

It should be pointed out that in tuning a keyboard instrument in which the octave is divided into twelve semitones, it is necessary to 'temper' the scale in order that music may sound equally pleasing in all keys. To arrive at this, intervals e.g. fifths, are tuned to a 'flat beat' instead of being mathematically accurate (i.e. 'beatless'). The corresponding lower fourth in the octave tunes to the same beat, the speed of these increasing gradually in ascending the scale; a similar beat in the next octave up being at twice the rate.

NOTE: In the following paragraphs, octaves are numbered from 1 (bass end) to 5 (treble end).
[C^5 523.25 ; $C\#^5$ 554.37 ; D^5 587.33 ; $D\#^5$ 622.25 ; E^5 659.26 ; F^5 698.46 ; $F\#^5$ 739.99 ; G^5 783.99 ; $G\#^5$ 830.61 ; A^5 880.00 ; $A\#^5$ 932.33 ; B^5 987.77.
C^6 1046.5 ; $C\#^6$ 1108.7 ; D^6 1174.7 ; $D\#^6$ 1244.5 ; E^6 1318.5 ; F^6 1396.9 ; $F\#^6$ 1480.0 ; G^6 1568.0 ; $G\#^6$ 1661.2 ; A^6 1760.0 ; $A\#^6$ 1864.7 ; B^6 1979.5.]

7.1 Tuning Procedure.

(1) All stops should be in the 'up' (off) position except the 8' Horn stop on Solo manual.
(2) Commencing with B^5 (highest note) play in turn each B down to B^1. Listen carefully to ensure that each note heard is one octave below the preceding note. If a false note occurs, adjust the appropriate divider control.
(3) Repeat octave checks on all notes from B. downward to C. adjusting dividers where necessary.
(4) The tuning proper may now commence:-

Sound A.440 on a tuning fork with key A^3 wedged down, and adjust tuning slug on the A chassis until no 'beat' is heard between the fork and organ note.

Hold A^2 and E^3 (one fifth above) and adjust E^3 tuning slug until it beats flat with A^3 about three beats in five seconds.

NOTE: (a) With tuning slug set to 'no-beat' position, tuning turning counter-clockwise will flatten note.
(b) The above-mentioned beat rate will occur very close to the 'no-beat' position and care must be taken in setting this very critical adjustment.

The subsequent tuning procedure, with beat rates, is given hereunder. Since the rates in cycles per second are decimals it will be seen that a closer approximation will be attained by counting over ten seconds than over five.

Hold	Tune	Beat. Rates in 5 seconds	Beat, rates in 10 seconds
A^2	E^3	3	7
E^3	B^3	5+	11
B^2	$F\#^3$	4	8
$F\#^3$	$C\#^4$	6	12
$C\#^3$	$G\#^3$	4+	9
$G\#^3$	$D\#^4$	7	14
$D\#^3$	$A\#^3$	5	10
$A\#^2$	F^3	4	7.8 (8)
F^3	C^4	5+	11.7 (12)
C^3	G^3	4+	8.8 (9)
G^3	D^4	6+	13
D^3	A^3 check but do not tune	5	9.8 (10)

If the beat D^3 - A^3 does not come out reasonably accurate some error has occurred in working the above procedure.

Whilst tuning, the oscillator valve should be tapped lightly to determine if loose elements are liable to cause tuning drift. If this condition obtains, substitute by another valve on same chassis.

If the original tuning was badly out, it may be found that divider slip occurs as tuning adjustments are made. Such slip, if in second or third octave, will be evident during tuning; and the divider affected should be re-adjusted before

continuing with tuning. After tuning is complete check the other dividers on octaves one, two and three to ensure that no slip has occurred.

Finally, depress Vibrato tab and set Vibrato amplitude control to give maximum swing. Now repeat divider check on all notes in each octave as in notes (2) and (3) above. If it is found that a poor tone is obtained or a 'burble' occurs, it means that the divider corresponding to the faulty note is on the verge of slipping at the extreme excursion of the frequency swing. Adjustment should therefore be made so that the divider control is midway between the two points where slip occurs.

[Alternatively, use a modern digital oscilloscope with frequency measurement. Note that the organ uses no stretching between octaves, as found in a normal modern piano or keyboard.]

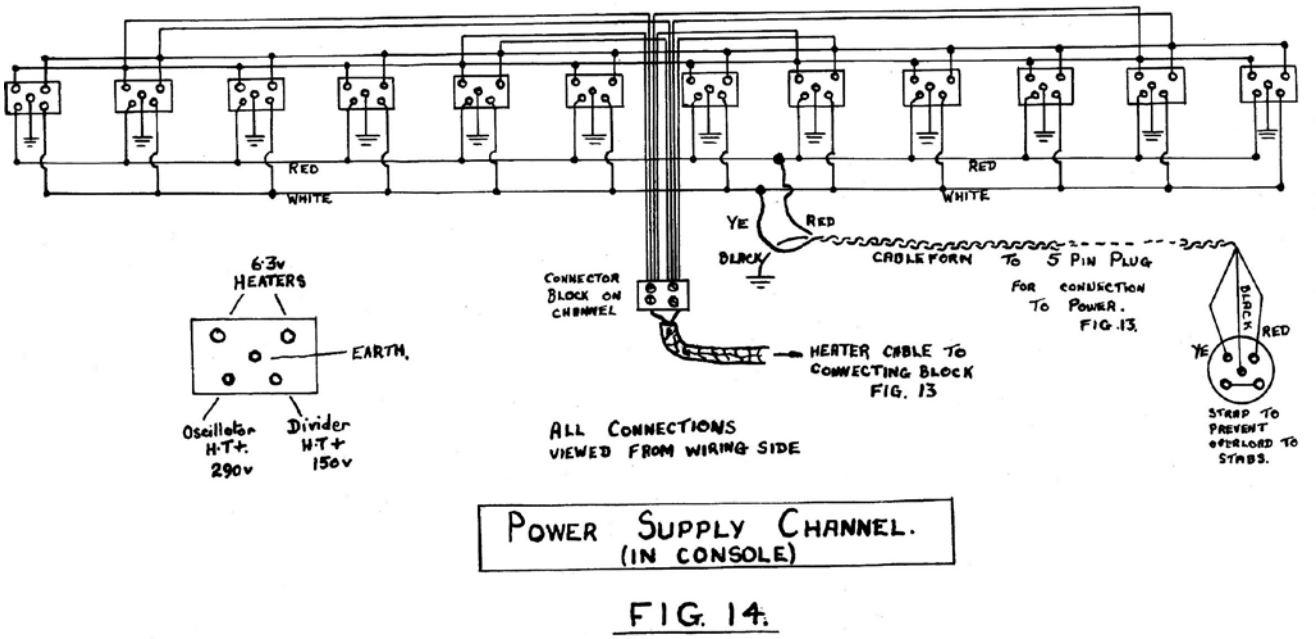


Figure 14. Power Supply Channel in Console

8 The Expression Pedal

The Expression Pedal is a mechanical assembly in which the rocking action of the pedal is transmitted by a rack and pinion to the Control element.

This Control is a potentiometer so constructed that it will withstand extensive use without the development of noise. The assembly is designed so that the Control may easily be replaced if and when the need arises.

The Control is 100 K-ohms Log-Law (Part No. P22l). [Pot in SN. 2389 replaced by a slider arm and 13 fixed resistors of measure 140kΩ max to 27k min – the slider arm progressively connects to spring wires. Fixed resistors from min setting are: 27k, 18k, 18k, 15k, 15k, 6k8, 4k7, 2k7, 2k7, 2k2, 1k5, 1k, 6k8.]

Two accurately machined castings are pivoted together at one end. The base casting carries the control element, the upward limit and friction adjustments, while the upper casting carries the swell pedal and downward limit adjustment.

The free end of the upper casting is machined to form a toothed quadrant or gear sector which engages with a pinion which is locked to the potentiometer shaft by means of two grub screws. This shaft rotates in nylon bearings.

The arc through which the pedal can swing is set by two limit adjustments and the stiffness of operation is controlled by a friction adjustment which consists of a spring loaded leather plunger bearing on either side of the toothed quadrant. Each plunger is retained in a threaded cup which screws into the casting.

8.1 Control Replacement:-

Set pedal so that the pinion grub screws can be slackened off.

Slacken retaining screw at bottom of fixing bracket. Swing bracket clear and withdraw potentiometer, at the same time catching the pinion which is now free.

Renew control and replace assembly in reverse order.

N.B. Be careful that the nylon bearings are not pushed out or deformed.

It is important that restriction of the pedal at either end of its travel is controlled by the limit adjustments and <u>not</u> by the potentiometer. To check this, proceed as follows:-

Slacken off lock nuts and then rotate milled edge limit screws so that pedal travel is limited only by the maximum rotation of the potentiometer.

Depress pedal and adjust downward limit screw until the potentiometer is turned back about 5° from its maximum position.

Tighten lock nut.

Repeat with pedal in upward position, this time adjusting the upward limit screw which is behind the pivot point of the castings.

Drop a spot of light machine oil into oil-hole.

8.2 Friction Adjustment:-

The stiffness of the pedal action is largely a matter of organist’s preference, but always ensure that sufficient friction is applied to prevent a sloppy action when the pedal is foot operated.

To adjust the stiffness the milled edge friction adjustment screws are turned clockwise to increase friction and counter clockwise to reduce friction.

9 The Booster

This consists of a Tone Cabinet containing two 12" loudspeakers and an amplifier with built-in power supply.

[See Figure 24] The output stage consists of two KT66 valves, V2l and V22, operated in push-pull. The driver is V20, a double triode valve type 6SN7GT which receives its push-pull input from the Power Amplifier chassis in the Organ Console via a twin screened line terminated at either end by a 3 pin plug.

Two three pin signal sockets are fitted; one to receive the signal input from the Console, while the second which is in parallel, may be used to feed a second Booster if required.

The H.T. rectifier is a 5V4G valve, V23, connected in a full wave circuit.

In the usual condition of operation, the mains supply will be taken from the separately fused terminal blocks mounted within the Console and the Booster will be controlled by the Console On-Off switch. For this reason no switch or mains fuse is fitted to the Booster.

A H.T. fuse is included, however, and this is readily accessible from the rear of the Booster Unit.

When more than one Booster is to be used mains supply should not be drawn through the Console Switch, but should be obtained from a separately switched and fused outlet.

The Chassis of the Booster Amplifier is rigidly fastened to the rear panel of the Tone Cabinet by means of four 1/4" screws. All valves, however, are on floating mounts to offset transmission of mechanical vibration.

Access to the Amplifier is gained by removing the top of the Cabinet which is retained by screws situated immediately beneath the beading lip.

The loudspeakers can be reached through the base of the Cabinet, the floor of which is also removeable.

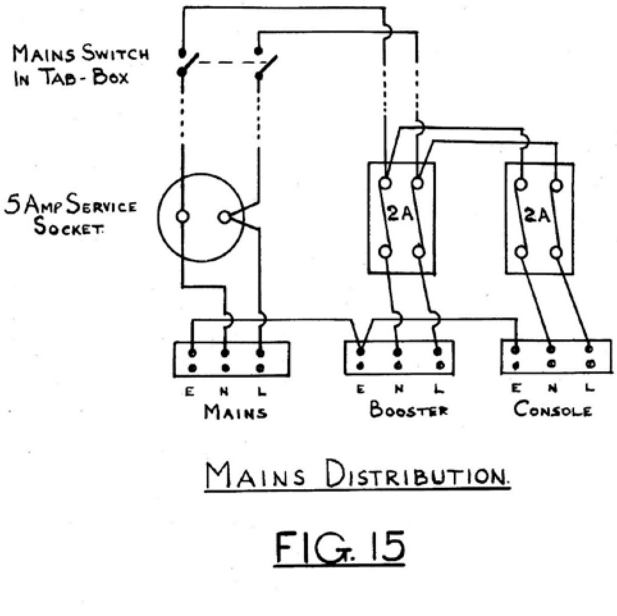


Figure 15. Mains Distribution

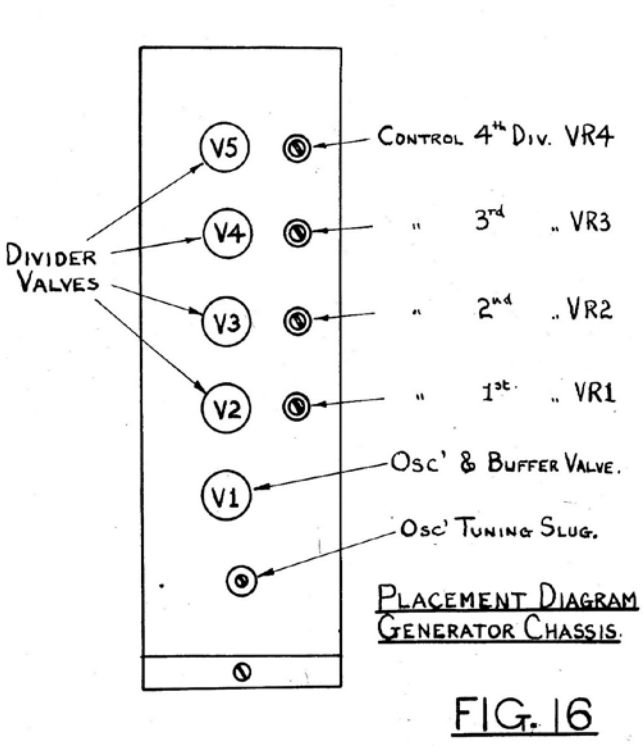


Figure 16. Placement Diagram Generator Chassis

10 Parts List

The majority of components used in the Organ are commonly used in the radio trade and are therefore readily available from any good stockists.

In the following parts list only these items are shown which are either "specials" or otherwise not easily obtainable from usual sources.

When requesting spares please indicate clearly the "description" and the "part number".

FIG REF	CIRCUIT REF	DESCRIPTION	PART NO
2		Return Spring (3) Sharp	S380
2		Return Spring(3) Natural	S381
2		Contact Comb (4)	C344
2		Contact Wire (6)	C381
2/3	Ra	Keying Resistor 2.7 meg ohms	R371
2/3	Rb	" " " " 10 meg ohms	R365
4	L1	Oscillator Tuning Coil	C351
4		Tuning Slug for above	S366
4	VR1/2	Potentiometer 100K	P205
4	VR2/3	" " " " 250K	P206
4	VR3/4	" " " " 500K	P207
4	VR4	" " " " 1M	P208
5	C26	Condenser 1000 mf, 25 V	C345
6		Plug 18 way, Chassis Mounting	P203
		Socket 18 way, Cable End	S369
7	L2/3	Choke, Tone	C347
8	L4 to 8	Choke, Tone	C347
10		Switch, Change – over	S386
10		Socket, 26way, Chassis Mounting	S370
		Plug, 26 way, Cable End P204	P204
12	Rl46	Resistor 10K-ohms, Wire Wound	S190
12	C85/86	Condenser 16+16 mf, 450v	C39
12	C87/88	Condenser 16+16 mf, 450v	C39
12	C89	Condenser 50 mf, 50v	C52
13	Tl	Transformer, Mains	T80
13	T2	" " , Output	Tl3
13	L9	Choke, Smoothing	C173
13	C100	Condenser 16 mf, 500v	C3
13	C101/2	" " 16+16 mf, 450v	C39
13	Rl76	Resistor 2K-ohms, Wire Wound	R384
13	Rl77	" " 5K- ohms " "	R385
13	R178	" 250-ohms " "	R386
13	R181	" 1.5K ohms Wire Wound	R387
13	Rl85	" " 10K ohms Wire "	Rl90
13	VC3	Potentiometer 2K ohms, " "	P230
24	R214	Resistor 250 ohms Wire Wound	R386
24	R215/6	" 10K ohms Wire Wound	R190
24	C205/6/7	Condenser 16mf 500v	C378
24	C208	" " 16 mf 500v	C3
24	L10	Choke, Smoothing	C173
24	T3	Transformer, Output	Tl3
24	T4	Transformer, Mains	* T109
		Pot 'n Exp, Control	P22l

* T3 Early Models

11 Voltage Analysis & Fault Finding:-

11.1 Voltage Analysis

The figures given in the table below are average readings taken over a number of Organs. The meter had a sensitivity of 20,000 ohms/volt, the mains input was 230v and the voltage selector tap set to the 230v position. No keys were pressed and the Vibrato tab was off (up).

		Anode (a)	Anode (b)	Screen	Cath (a)	Cath (b)
V1	ECC83	(1) 170	(6) 114		(3) 0.73	(8) 10-5*
V2	"	(1) 124	(6) 120		(3) 2.2	
V3	"	(1) "	"		2.3	
V4	"	(1) "	"		2.5	
V5	"	(1) "	"		2.6	
V6	ECC83	(1) 108	(6) 108		(3) 0.83	
V7	"	(1) "	"		"	
V8	"	(1) "	"		"	
V9	"	(1) 123	(6) 113		(3) 1.75	(8) 1.55
V10	"	(1) 25.5	(6) 31.5		(3) 23.3	
V11	6SN7	(2) 41.5	(5) 85		(3) 1.68	(6) 3.55
V12	"	(2) 207	(5) 207		(3) 113	
V13	"	(2) 185	(5) 185		(3) 6.7	
V14	GZ32	(4) 360AC	(6) 360AC		(8) 411	
V15	KT66	(3) 364		(4) 342	(8) 27.5	
V16	"	(3) 364		(4) 342	(8) 27.5	
V17	15OC2	(1) 300±6			(7) 150	
V18	"	(1) 150±3			0	
V19	6SN7	(5) 139	(2) 165-175 #		(3) 6.37	

* Left hand figure refers to "B" Chassis and right hand figure to "C" Chassis. Intermediate Chassis give intermediate readings.

Dependent upon setting VC3.

Figure in brackets gives valve pin number.

OTHER READINGS:

	Ref. or Check Point.	Volts.
Gen. Chassis -	HT to Osc.	276
	HT to Div.R1/C1	127
Tab Box -	HT1 R146/C85	342
	HT2 R146/R147	268
	HT3 R147/R148	240
Power Pack -	HT Smoothed L9/C101	375
	HT Ped. Gen. R185/C107	144

11.2 Fault Finding

To those engineers not conversant with Organ terminology, the terms 4', 8' and 16' are sometimes confusing and we know from past experience that valuable time, is often lost in fault diagnosis because of unfamiliarity with both the terms used and the relative circuitry involved.

Therefore we ask both the unfamiliar and the unmusical to always keep the following in mind when tracing faults :-
(a) All keys are numbered from the bass or left hand end of the manual or keyboard. Thus C^3, which is in line with the lock on the Console, is the third C from the left hand end and is therefore the C of the third octave.

All keys are similarly designated. Thus B^5, which is the extreme right hand note, is the B of the fifth octave.

Now in the case of a piano the C nearest the lock is known as middle C and sounds at a frequency of approximately 261 cycles per second.

In the Organ this same key C^3 may or may not sound at this same pitch depending upon the organist's choice of stops. This now leads us to the three footages 4', 8' and 16' mentioned above.

(b) The 8' Pitch. When any stop so marked is depressed a note played will sound at what might be termed its natural pitch. Thus C^3 would sound at the frequency of 261 c/s approx.

The 4' Pitch. Playing the key C^3 with a 4' stop engaged will result in a sound of double the frequency, 522 c/s approx. (i.e.) the sound is one octave higher than the natural pitch of the key played and is the same note as C^4 played in the 8' pitch.

The 16' Pitch. This is the reverse of the 4' pitch. With a 16' stop engaged, playing the key C^3 will result in a sound of 130.5 c/s approx. (i.e.) one octave lower than the natural pitch associated with the key played and is the same note as C^2 played in the 8' pitch.

Note that when the organ is played the three footages may be used singly or in any combination. (e.g.) if a 16', 8', and 4' are engaged, playing key C^3 will result in the three octavely related notes C^2, C^3 and C^4 respectively being heard together. Therefore, when fault finding or tuning, avoid confusion by restoring all stops to the up or off position and then depress only one 8' stop for initial checking.

Note also that changing from one stop to another within any one bank (e.g.) 8', does not change the pitch of the note heard , but only its sound (i.e.) timbre or quality.

The following chart will assist in establishing a fault tracing routine.

11.2.1 Manuals

FAULT	TEST	REMEDY
Anyone note silent.	(1) Test corresponding note on other manual.	If O.K. proceed to 2. If no output, proceed to 4.
	(2) Test 1 octave higher using 4' stop. Test 1 octave lower using 16' stop.	If O.K. adjust contact on faulty key. If no output, proceed to 3.
	(3) No noise present.	Test for O/C in keying resistor panel and bus bar connection.
	If noise output (breakthrough of adjacent notes) only.	Test for O/C lead from Generator Chassis, Plug & manual cableform.
	(4)	(a) If no output on either manual, remove each output plug (5 pin) from corresponding generator chassis in turn, testing for output on manual still connected. If output appears on one manual, test other manual for S/C in plug, 5-way lead & inter-octave cableform. (b) If fault not revealed by 4(a), remove generator chassis & test as under 10 - 14. (c) If noise output only on both manuals, remove generator chassis & test as under 10-14.
One note Cyphering.	(5)	Adjust contact operating screw on unison, octave & sub-octave keys to give 1/6" movement at front of key to sound note.
One manual silent	(6) If upper (solo) manual silent.	Remove 5-pin plug in keying channel & replace with plug from lower (acc.) manual.

FAULT	TEST	REMEDY
	If lower (Acc.) manual silent.	(a) Play notes on solo manual using ace manual stop. If o.k. proceed to test 18-19 (control box). If no output; test socket, bus bars etc. in keying channel. (b) Lift control box. Remove 5-pin plug in keying channel & replace with plug from upper (solo) manual. Play notes on Acc. Manual stops. If o.k. proceed to test 18-19 (control box) If no output, test socket, bus bars etc. in keying channel.
Both manuals silent.	(7) Test generator unit 10-14 & Control box 17-19.	
Notes not in tune.	(8)	Retune master oscillators & reset dividers if necessary, as per tuning instructions. If tuning unstable, proceed on 9.
	(9) Test voltage of stabilised 300V line.	If deviation greater than +/- 9 volts, test main H.T. If O.K. test load on stabilizers & replace if necessary.
Severe key click.	Test heater voltage.	Tighten heater block terminal screws.
	Dividers not stable.	Test 150v Line decoupling capacitor C107.
	(10)	Replace output capacitor from appropriate osc/divider on generator chassis.

11.2.2 Generators

FAULT	TEST	REMEDY
No top note.	Test voltage of Osc. Anode & Cathode, & buffer anode & Cathode. Visually inspect all Resistors & Capacitors for possibility of S/C between components, tags etc. Check connections to 5-way sockets.	Very low Osc. Anode voltage, Vib. Blocking capacitor C4 s/c. High Osc. Anode voltage. O/C Anode connection, i.e. dry joint, Valve pin not connecting with valve socket. Placing a S/C across Osc. Grid/earth will cause Osc. Anode Va to fall, if Osc. is working. If component values correct & voltage readings substantially different from correct values, replace valve.
No note from divided octave.	(12)	Test voltages of anodes & cathode. Replace valve. Measure component values. Check connections to 5-way sockets.
Note poor musical quality.	(13)	Adjust divider potentiometer. It may be necessary to adjust the divider above and/or divider below.
No output from one or all chassis.	(14) Test 300v line, 150v line, & heaters, ensuring that meter neg. Is clipped to chassis & not to power pack chassis.	If no H.T. check safety link in supply (5-pin) plug in power pack, otherwise check P/P. 14 & 15.

11.2.3 Power Supply

FAULT	TEST	REMEDY
No H.T.	(15) Test 500mA fuse. Test rect. Valve.	Replace if blown, checking H.T. current. Replace if faulty.
No H.T. on generators.	(16) Stabiliser will show pink glow when operating.	Check link on 5-pin plug. Check W.W. resistors panel. (1.5K & 10K). Check 2K W.W. pot. (Vib. Depth) & leads in multiway cable.

11.2.4 Vibrato

FAULT	TEST	REMEDY
No Vibrato.	(17) Test voltages.	Check Vib. Tab., Vib Depth & Speed, & leads in mulitway cable. Change valve.

11.2.5 Control Box

FAULT	TEST	REMEDY
Organ silent. No stops operating.	(18) Check heaters & stabilisers (P.P.14)	
	Place Ex. Pedal at Max.	Tap V11, microphonic noise will result if Amp working. If no output, test all voltages & replace valve. Sell also 14.
One of both manuals silent. Pedal stops operating.	(19) Test 16', 8' & 4' stops.	Test bus amp. V6-8, & replace valves. Check registration panels and signal leads from manuals.
16', 8' or 4' stops silent.	(20) Test other stops in group.	Test 19.
One stop silent or ciphering.	Test stop switches.	Adjust as necessary.

11.2.6 Pedal

FAULT	TEST	REMEDY
Faulty pedal note. i.e. incorrect or intermittent in pitch.	(21) Test 8' stops only.	If O.K. adjust appropriate divider on manuals to obtain correct output for pedal unit. If limits or divide adjustment do not effect cure, test H.T voltage to pedal unit, change V.10. Test voltages on divider unit. If 8' tones faulty, test lowest two octaves on manual & adjust octave divider. Also test for shorting of two or more cables in 26-way plug.
Pedal not cipher (8' & 16') (16' only)	(22) Remove 26-way socket.	If. O.K. remove micro-switch unit complete, test, rectify. Change V10. Test voltages.
Hum & noise on 8' stops. One note silent.	(23) Remove Coax plug & place s/c on centre pin/chassis of socket.	If O.K. test continuity of earth connection through all micro-switches, switch locating rails & coax cable.
No pedal notes. 8' or 16'	(24) Test appropriate note on panel.	If O.K. test cable in 26 way plug/socket, micro-switch & connections. If manual note faulty, rectify as under (1-4).
	(25) Disconnect coax plug. Link output from 1 manual note (lower two octaves) to coax socket.	If pedal O.K., test coax cable & 26-way cables, plug, socket & switching unit. If no signal, test V9. Replace if necessary.

12 General Notes

Since the introduction of the "Minster Organ" (without coupling - Type C) changes have been made to the voicing, and on later it will be observed that the component values as shown in figures 25, 26, 27 & 28, differ from those actually used.

In this case, reference should be made to figures 25a, 26a, 27a & 28a, but extra connections applicable to the coupling (as used on Minster Organ – Type CC) should be ignored.

To ensure perfect tuning stability it is essential that the mains voltage selector plug is correctly set. Provision is made for 210, 230 or 250V A.C.. In cases where the mains voltage is 220 or 240 it is advisable to use the 210 or 230 tap respectively. This will ensure that the stabilisers remain ignited and will provide stability over normal mains voltage fluctuations.

In exceptional cases where the mains voltage fluctuates between such wide limits that the stabilisers cannot function correctly, it is advisable to supply the organ via a "constant voltage transformer".

Where the mains voltage is below 200V A.C., but reasonably constant, an auto-transformer may be used.

Technical advise or information will be gladly given by letter or telephone, but please quote the model and serial number when in communication with the company.

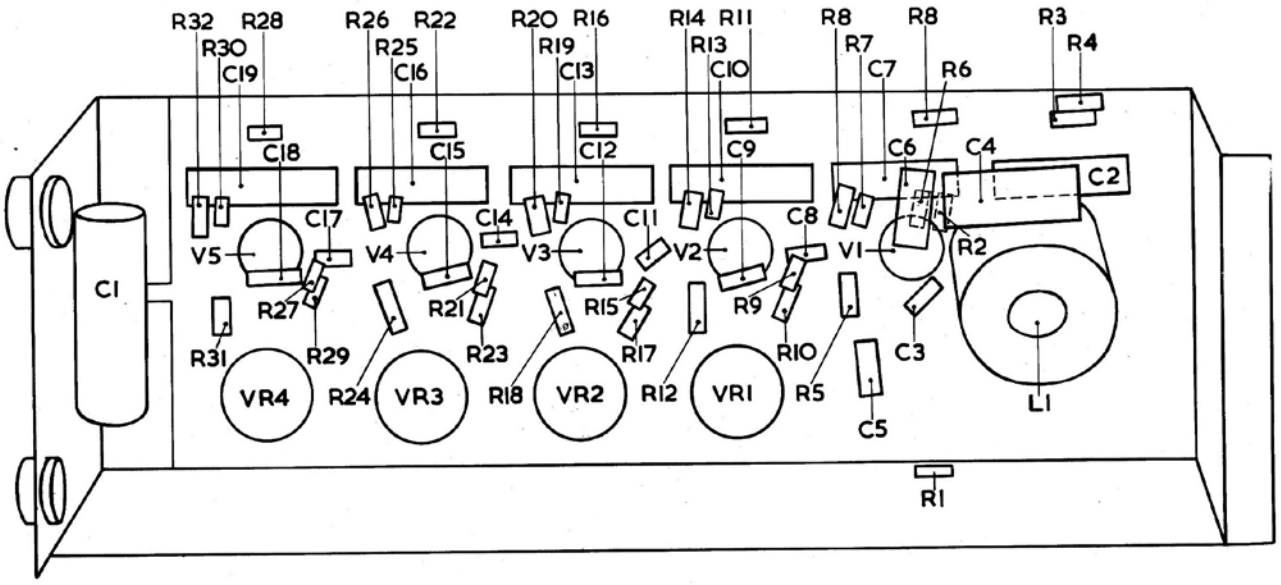


FIG. 17. PLACEMENT – GENERATOR CHASSIS

Figure 17. Placement – Generator Chassis

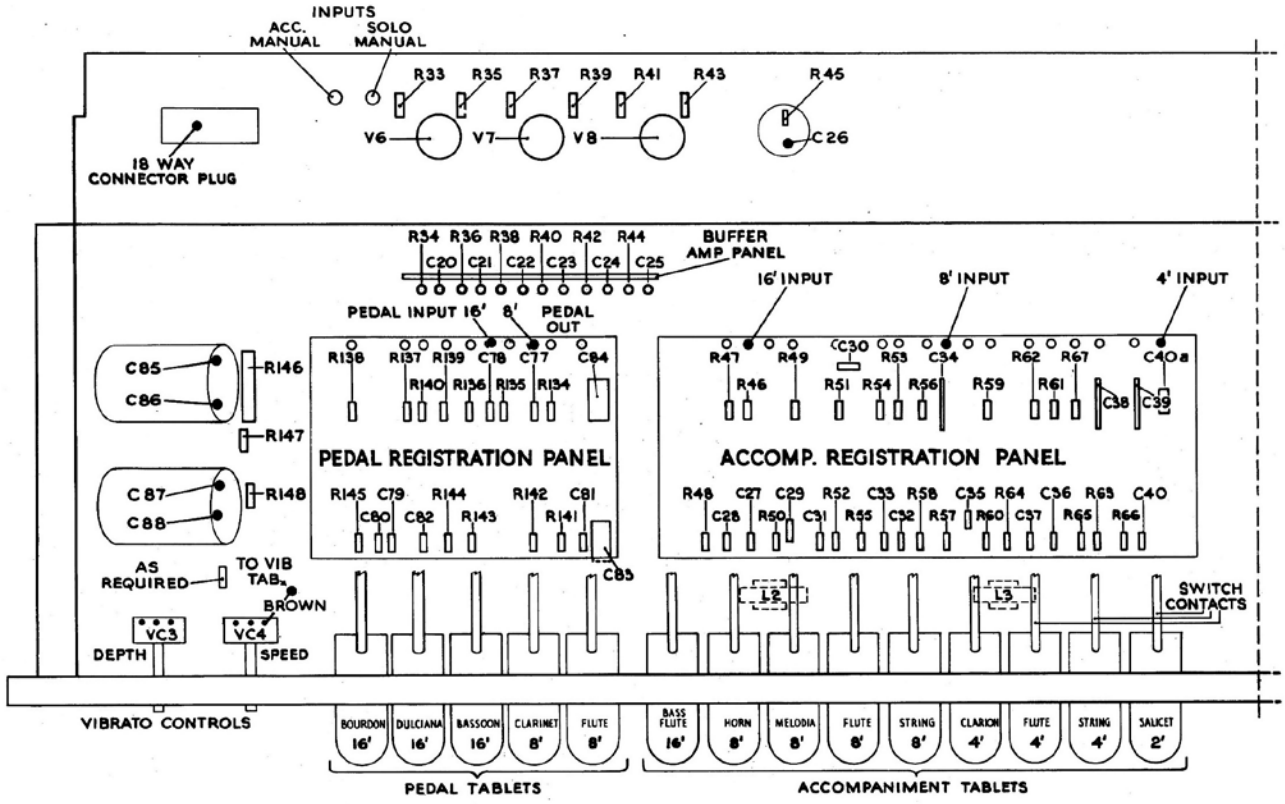


FIG. 18. **PLACEMENT – TAB BOX [LEFT HAND SIDE]**

Figure 18. Placement – TAB Box (Left Hand Side)

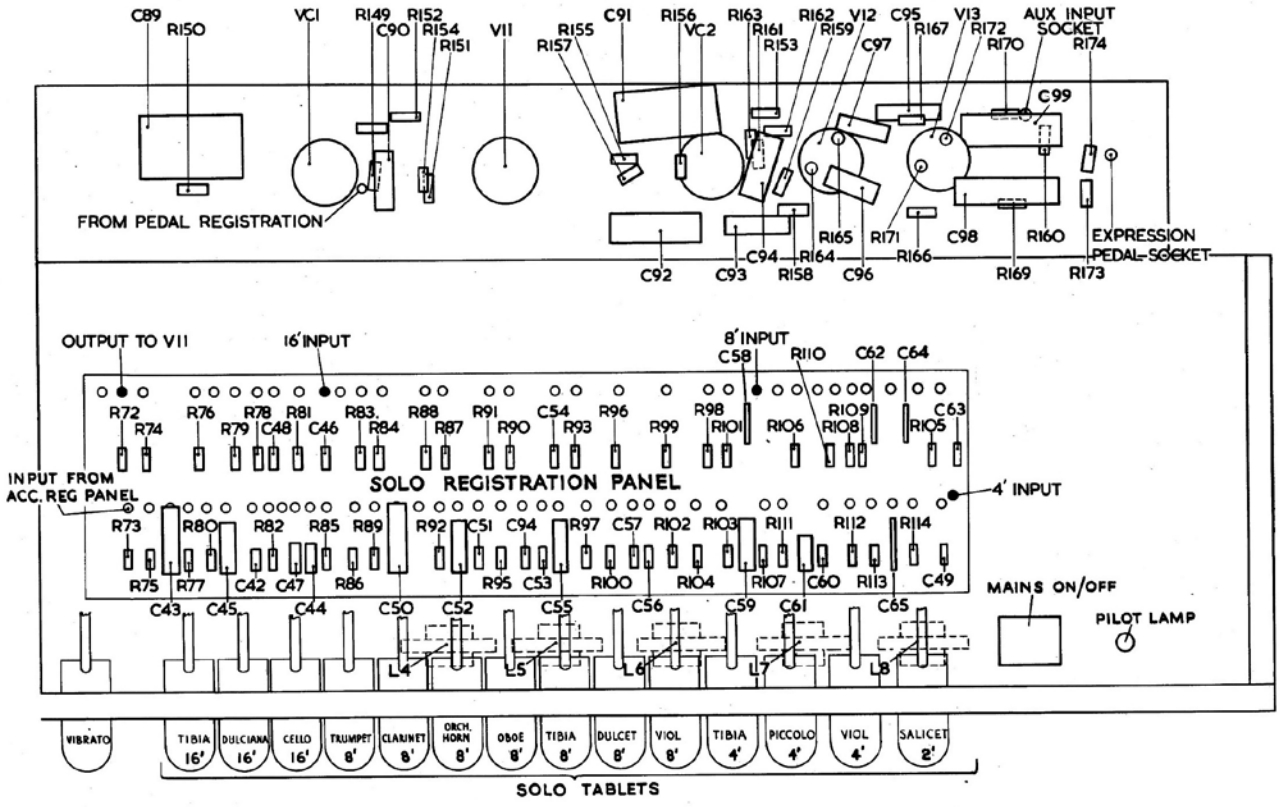


FIG. 19. **PLACEMENT – TAB BOX [RIGHT HAND SIDE]**

Figure 19. Placement – TAB Box (Right Hand Side)

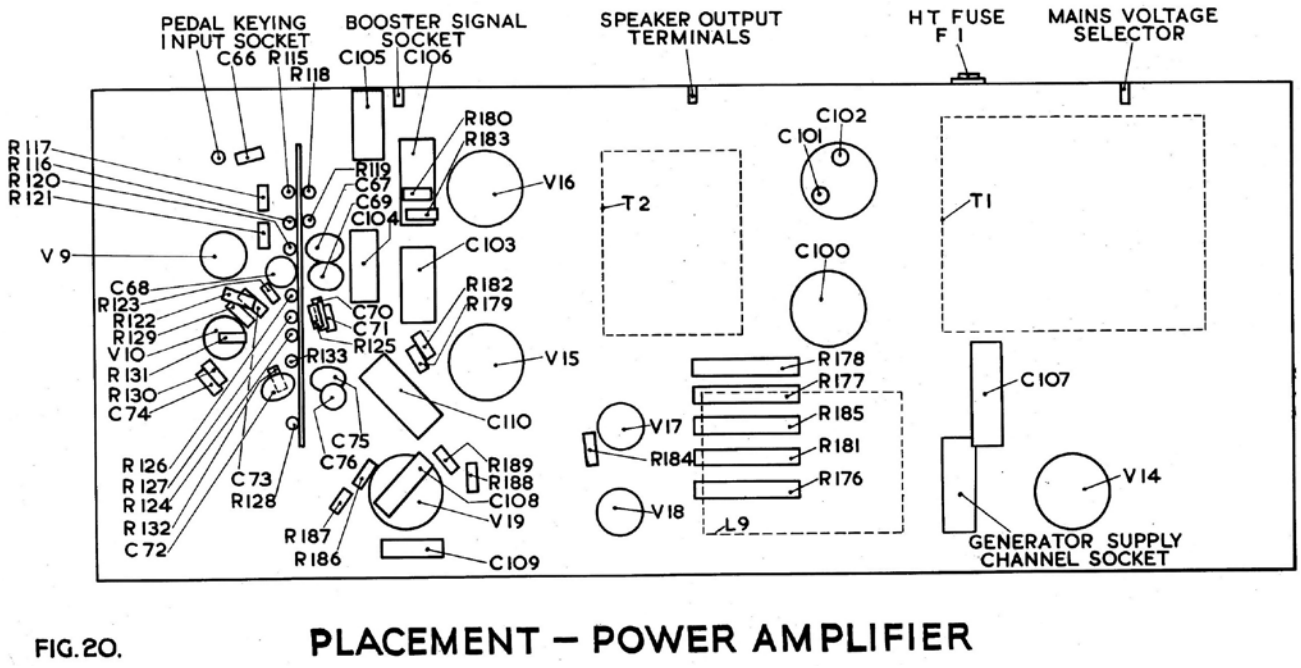


Figure 20. Placement – Power Amplifier

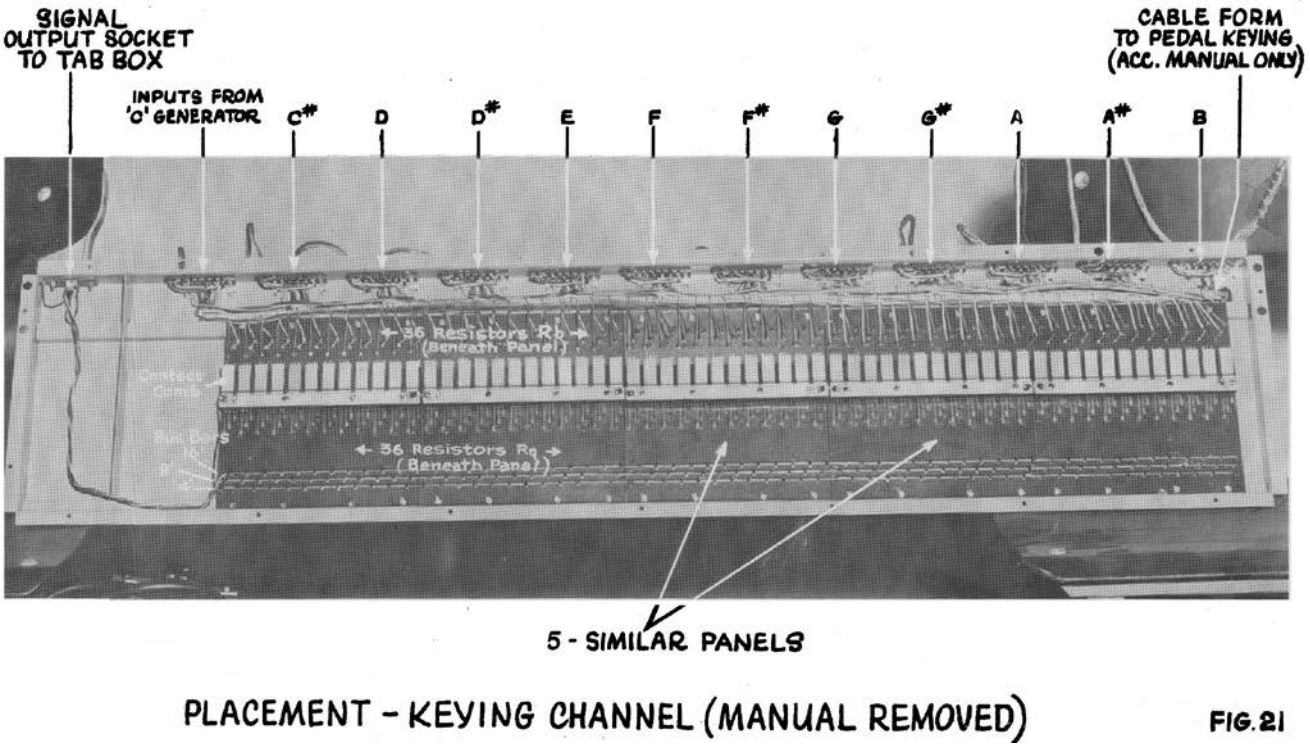


Figure 21. Placement – Keying Channel

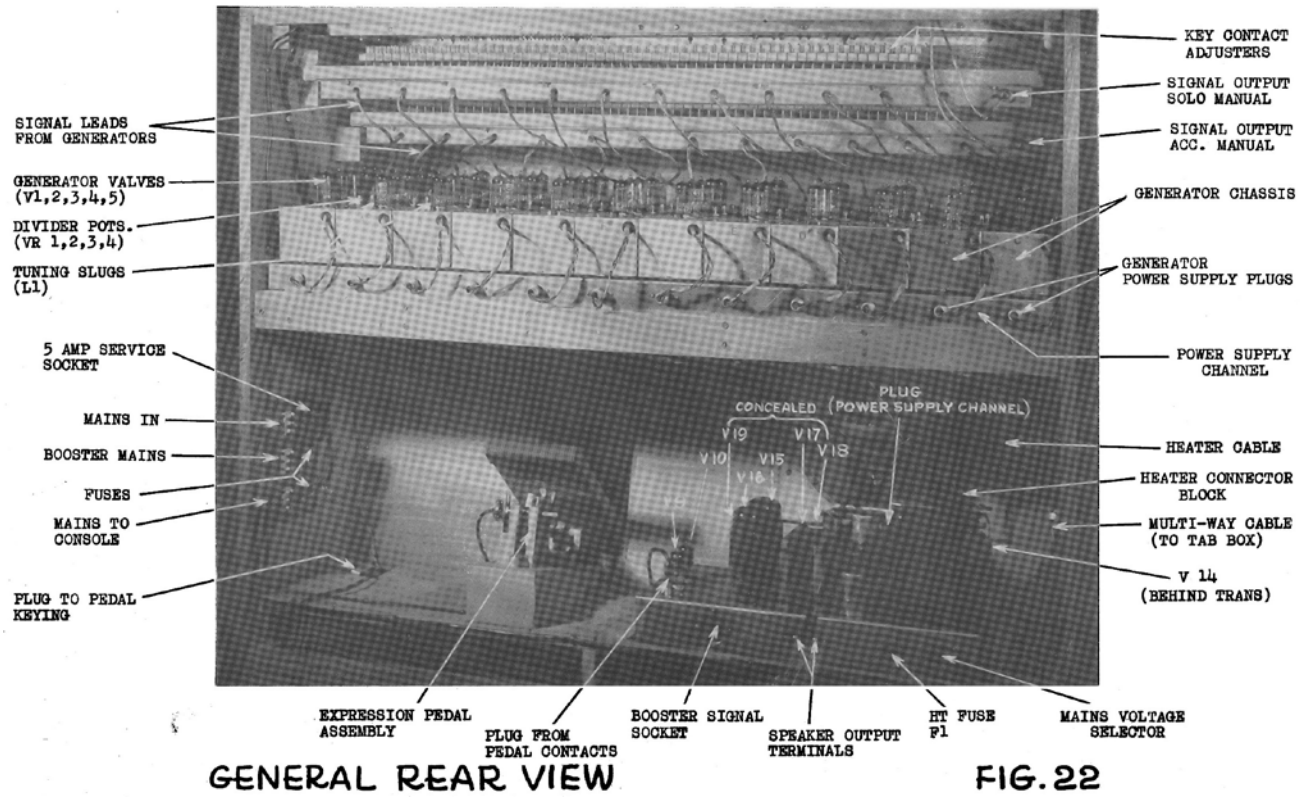


Figure 22. General Rear View

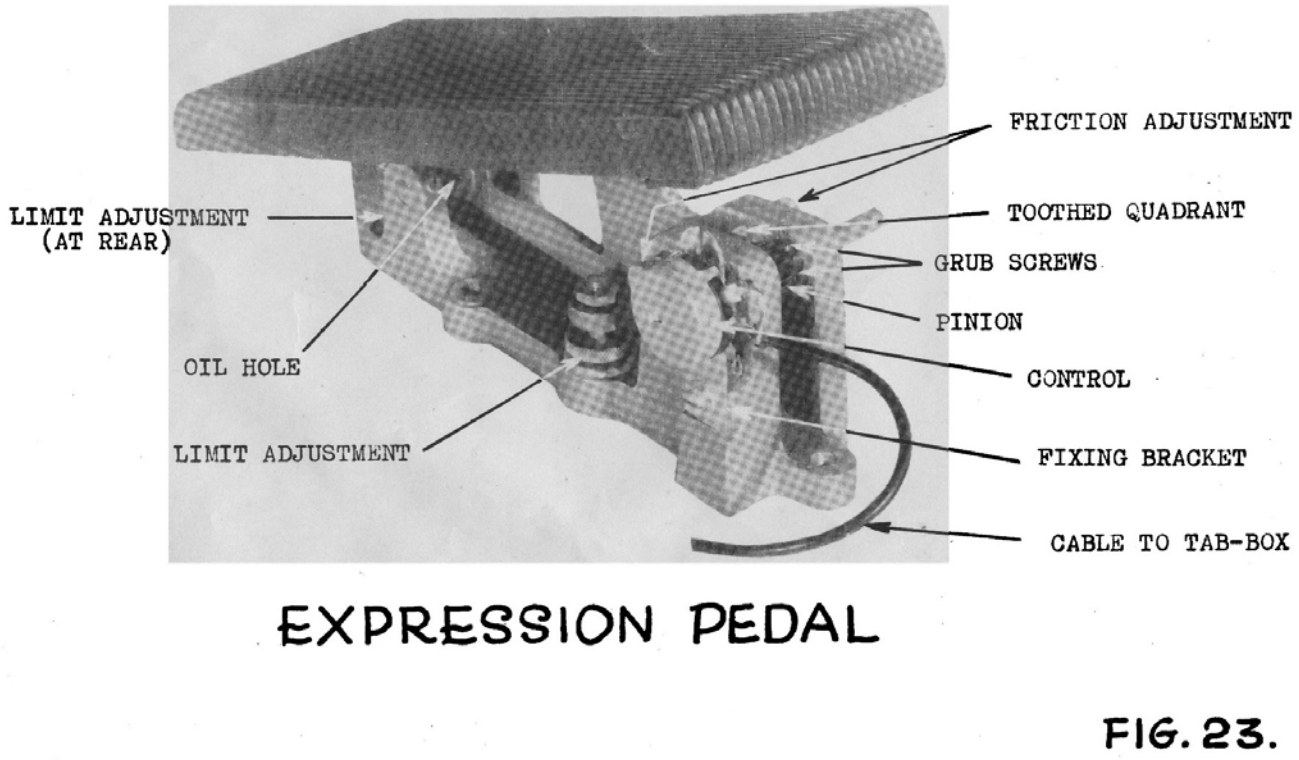


Figure 23. Expression Pedal

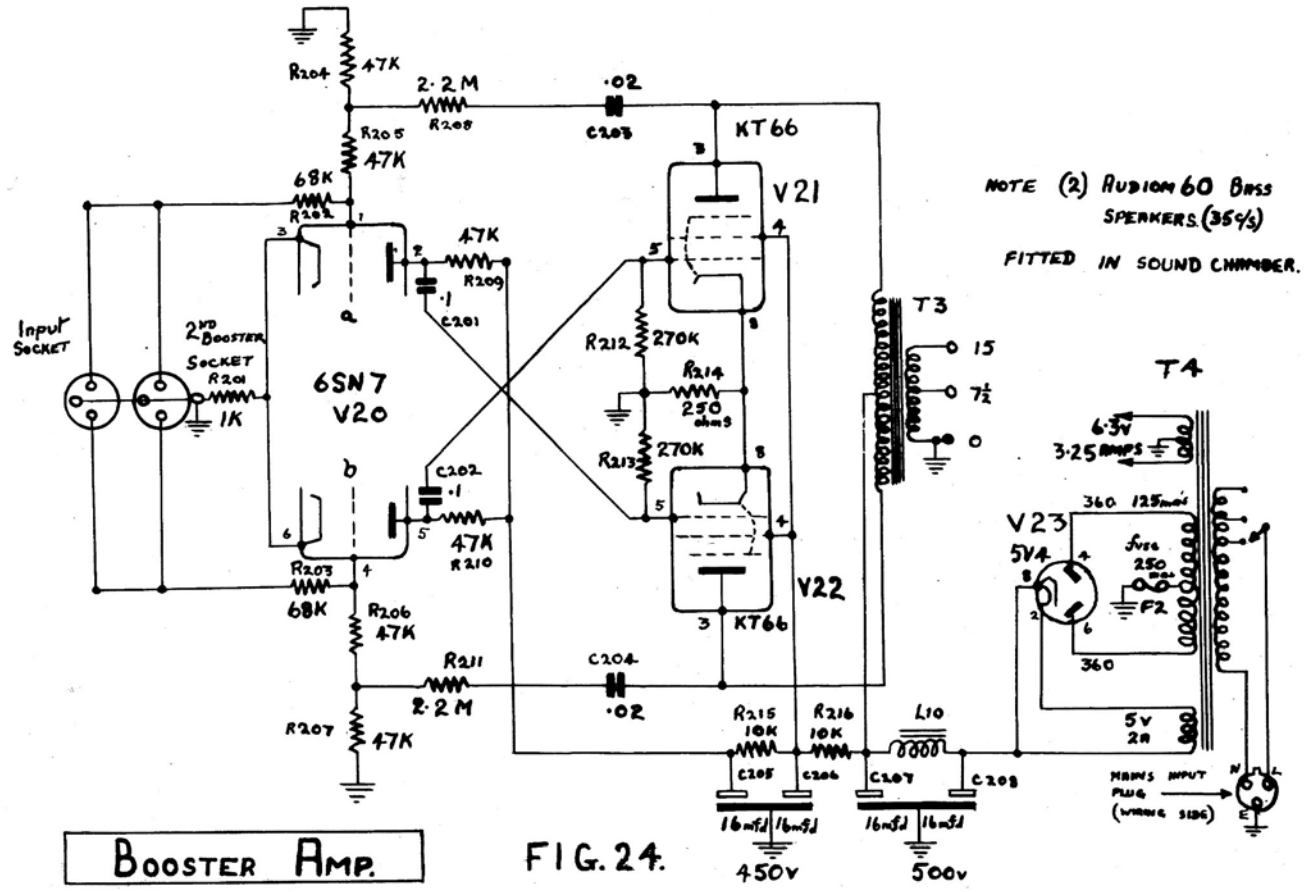


Figure 24. Booster Amp

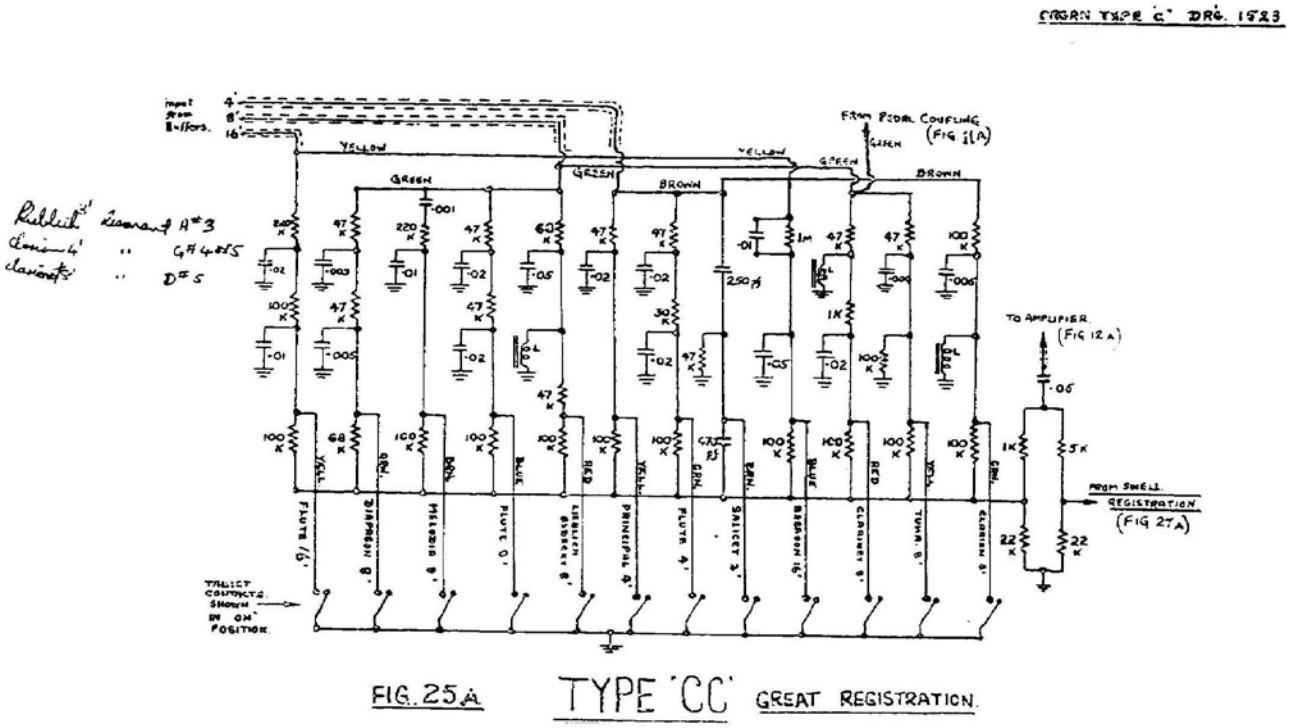


Figure 25A. Great Registration – Type 'CC'

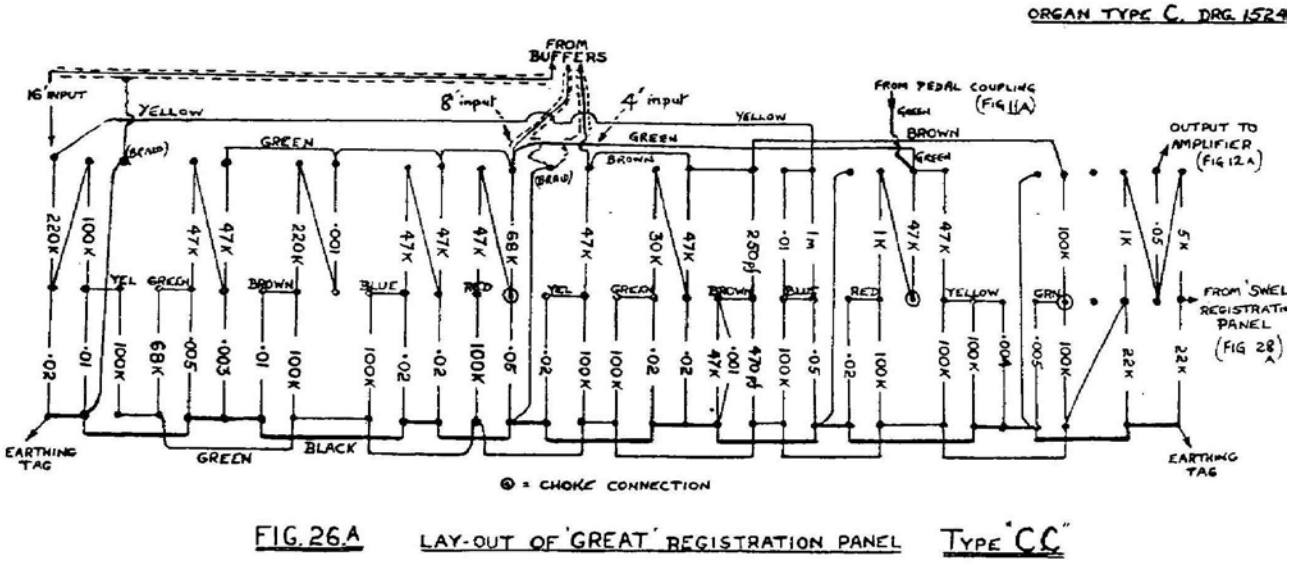


Figure 26A. Lay-out of Great Registration Panel – Type 'CC'

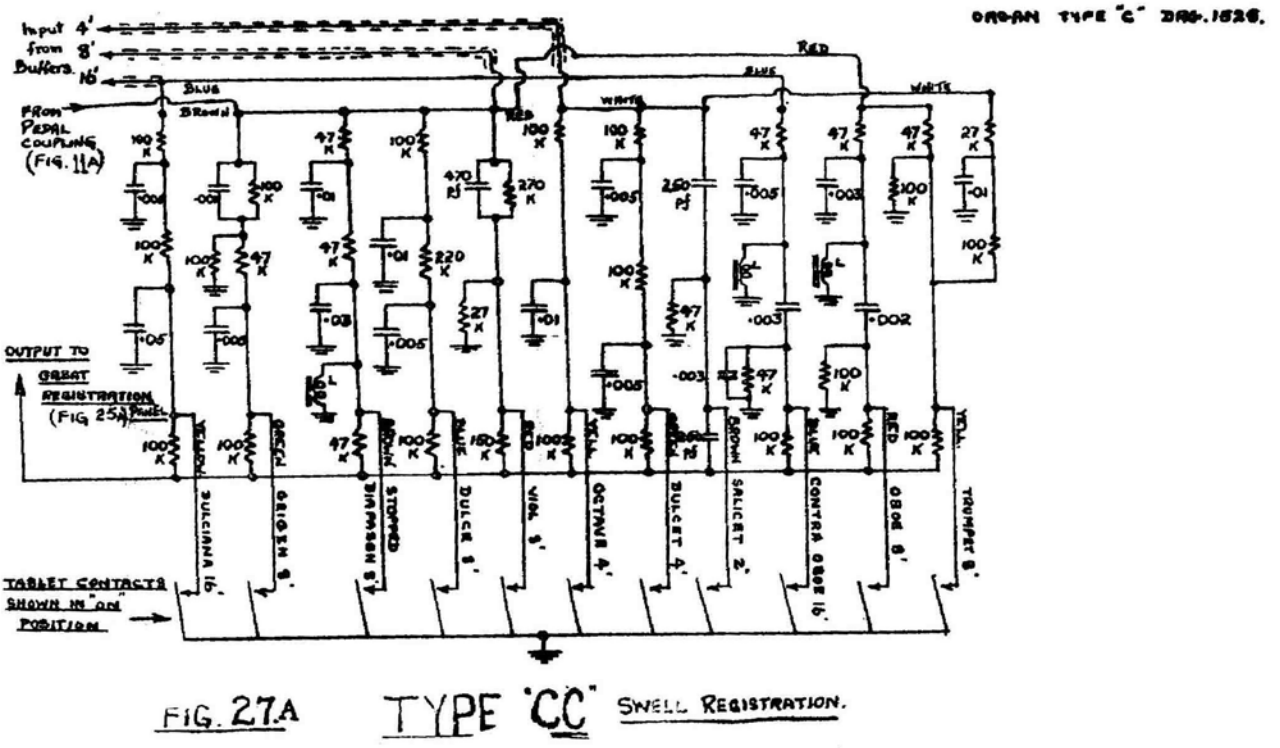


Figure 27A. Swell Registration – Type 'CC'

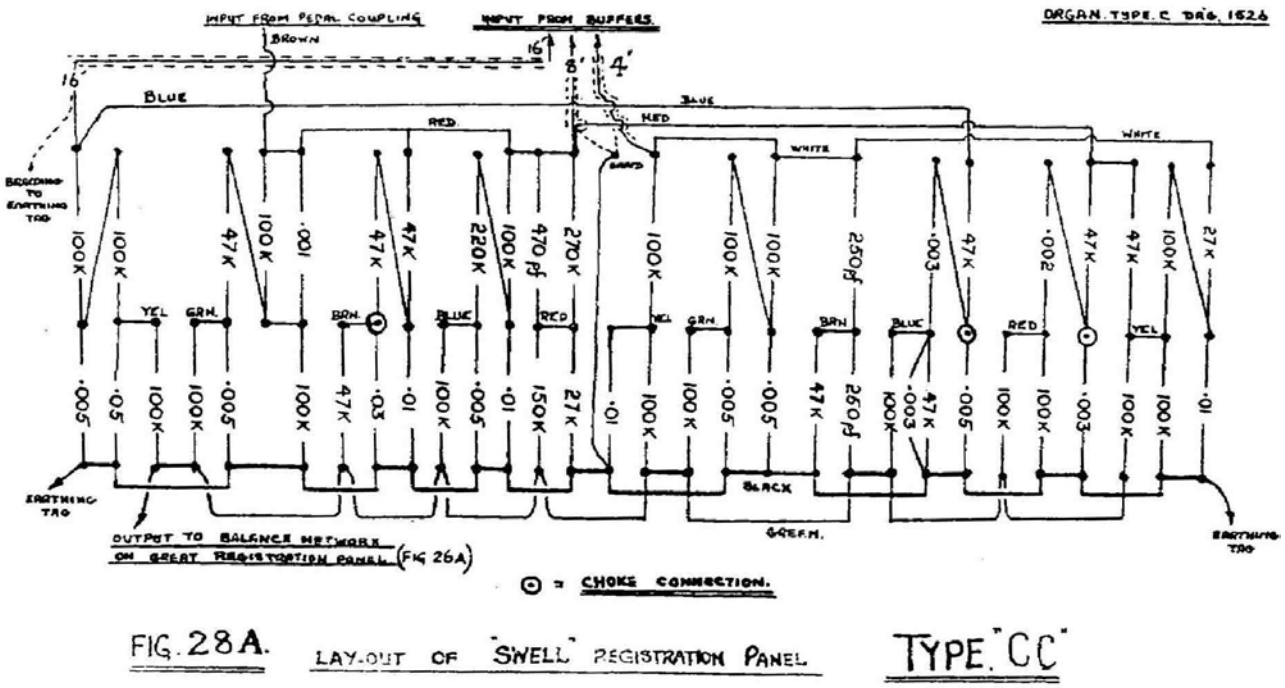


Figure 28A. Lay-out of Swell Registration Panel – Type 'CC'