MELLOTRON MARK II
SERVICE MANUAL

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MKII No. 210

T H E

"M E L L O T R O N"

SERVICE MANUAL.

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1 - 1 APPLICATION TO TAPE TO MUSICAL INSTRUMENT.

Hitherto, there have been many attempts to apply the principles of magnetically recorded tape to supply the basic tones needed for electronic organs. These have usually been variants of the endless loop system, and have met with varying degrees of success. However, the continuously driven endless loop has serious drawbacks if the full possibilities of recorded tape are to be exploited.

One of the attractive features of the recorded tape system is that the sound of a musician playing a note on an instrument is available and not an electronic synthesis of the same tone. It is obvious, however, that a musical sound is identified not only by the pitch and timbre of the sound but also by the way in which it starts, or is "attacked". On the continuous loop system, this characteristic start is not available since there is no way of knowing at what point of the loop playing will commence when the key is depressed. Thus it would not be feasible to try to reproduce a piano or guitar by this system.

This objection is even more serious when we consider the reproduction of recorded rhythmic patterns, that is, a group of instrumentalists playing bars of rhythm accompaniments which can be used in conjunction with the other recorded instruments. In this case, it would be impossible to know at what point in a bar the rhythm would start and one would not be able to play in time with oneself.

From the foregoing, it can be seen that what is required is a system where the playing of the tape can be commenced from a known point, the tape returning rapidly to that point after the key is released. The MELLOTRON has been designed to meet these requirements.

1.2 THE MELLOTRON SYSTEM. FIG: D.1.

The diagram shows the general layout of the way in which the requirements of section 1-1 have been met. The front and rear storage rollers are prevented from moving by being coupled together by a chain drive, which also is coupled to the drive motor and the synchronised switch. The rollers can only move when driven by the motor.

A magnetically recorded tape is slung between the two storage rollers in such a way that about 6 ft more tape is allowed to hang than is required to stretch simply between the storage rollers. This slack is taken up in two loops passing round a system of pulleys formed by the top roller and the front and rear bottom rollers. The bottom rollers are pulled down by the tape return spring and thus the tape is kept tight.

Mounted above the tape is a key which carries on its underside a pinch roller. When the key is pressed, the tape is squeezed or pinched between the pinch roller and the capstan. The capstan is a round bar which is made to rotate in the direction of the arrow at a constant speed. Thus the tape is made to travel towards the rear of the machine at a constant speed by the action of the capstan. Since the rear and front storage rollers are not allowed to move, the tape falls in free folds into the tape storage box, whilst at the same time the length of tape absorbed by the pulley system is reduced. This means that the bottom rollers rise as the tape is used up until finally, when the rollers reach the limit at the top of their permitted travel a length of about 6 ft of tape has been played into the tape storage box. The dotted line shows the tape in a position near to the end of the playing action. If at this point the key is released removing the driving force on the tape, the pull of the tape return spring acting on the lower rollers will remove the tape from the tape storage box and pull the loops downwards until the tape is tight again.

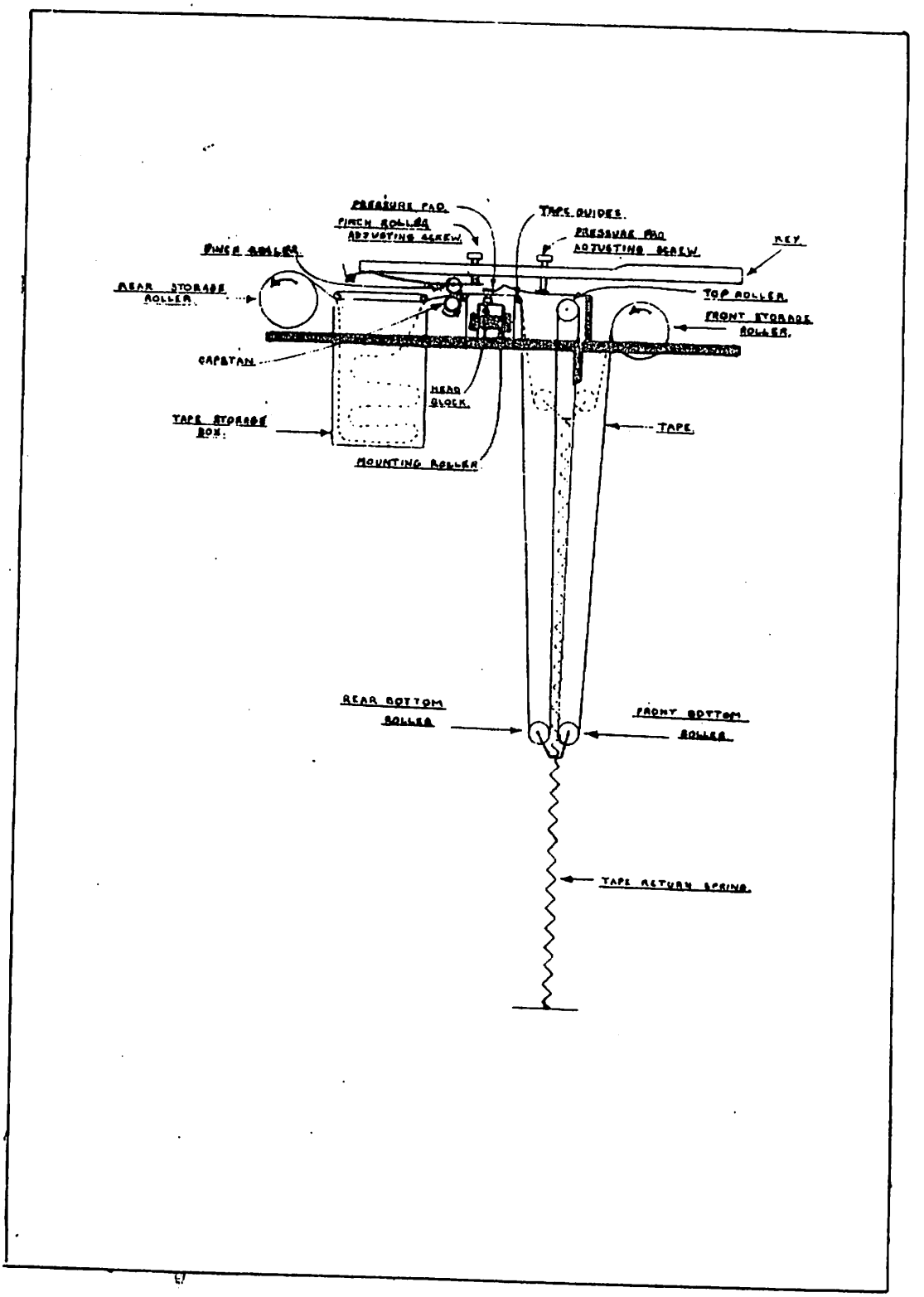
Since the rear roller has not moved throughout this action, it is clear that the part of the tape that was over the capstan when the key was first pressed, is now back exactly where it was before, ready to be played again.

Also operated by the pressing of the key is a pressure pad which forces the tape into contact with the tape reproducing head. Thus when the above action is considered, it can be seen that the signal on the tape can be played from a selected point, this point being returned to as soon as the key is released. This fulfils the main requirements as suggested in 1.1. Since, as we have said, the slack tape taken up by the spring loaded loops is some six feet in length, then this is the length of tape available for playing. At the tape playing speed of $7\frac{1}{2}$ inches per second, the time for playing is about 8 seconds which is adequate for most purposes. When 8 seconds is up the key is released, the tape returning immediately to its starting position, after which the full 8 seconds is possible again.

In order to increase the number of different sounds which are available, two things have been done. Firstly, three tracks have been recorded side by side on the tape and provision made for the head to be moved sideways to play the desired track. Secondly, the tape has been divided longtitudinally into six sections and a system arranged whereby the actual piece of tape stored in the spring loaded loops can be selected. This process is known as CYCLING and will now be explained.

MELLOTRON SYSTEM (Side View)

FIG. D1
Section 1.2.



CYCLING.

By referring to Fig D.1. we can see that if both the front and rear storage rollers are rotated in the direction of the arrow, tape will be wound off the front roller into the loops while tape is wound out of the loops into the rear roller. If the amount by which each roller is turned is exactly the same, the position of the bottom tensioning rollers will remain constant because the actual length of tape hanging between the two storage rollers will stay the same. (Note - In the MELLOTRON this situation is not exactly met because since the diameters of the storage rollers vary as tape is transferred from one to the other, the length of tape hanging between them varies slightly and it can be observed that the length of the loops increases to a maximum when the diameters of the rollers are equal between selections 3 and 4.)

This means that if we wish to change the six feet of tape which we have been playing, then all that is necessary to do is to rotate both the rollers in the same direction, and at the same rate until the start of a different six feet of tape is positioned in the loops with its start over the reproducing head.

In the MELLOTRON there are six positions or STATIONS to which the tapes can be set and taken together with the three tracks on each tape, and this means that there are eighteen different sounds that can be replayed from each tape.

It can be seen that this system gives a wide degree of flexibility because the exact instant on which a sound will start is available. So it is possible to play the tape from a point just as the hammer strikes the string of a piano or just as the guitarist releases the string. Similarly a tape can be played starting exactly "on the beat" at the beginning of a rhythmic phrase.

The MELLOTRON uses two keyboards of 35 keys each placed side by side. The right hand one is a normal chromatic keyboard which can play $2\frac{3}{4}$ octaves of 18 different sounding instruments. A few examples are Clarinet, Flute, Piano, Guitar and so forth.

The left hand keyboard controls the rhythms and orchestral backgrounds or fills which are used to accompany the theme played by the right hand. There are 17 different chords which underlie each rhythm, the chords chosen being those most commonly used, by popular music. For example, if we make a selection to play a waltz, then any rhythm key which we press will commence to play a 3/4 temp beginning on the first beat of a bar, but with different underlying harmonies, depending on the actual key pressed. In this way we can alter the harmony played by the rhythm section to satisfy the requirements of the melody being played, while maintaining a steady rhythm.

The fills, which for the most part are played in octaves with the rhythm section, match the rhythm in harmony and tempo.

Instructions for the use of the keyboards are contained in the Players Manual while the function of the controls is detailed in 1-5.

1.3 a) GENERAL ARRANGEMENT.

From Fig P.1. it can be seen that the instrument is built in two halves on a basic metal framework. The top portion of the framework carries the major components while the vertical member holds the tape separators and tape return springs.

There are two similar keyboards, the right hand one being used for the lead or solo instruments while the left hand one is used for the rhythm accompaniment and fill section. Except for the split head block on the left hand side, both sides are identical.

b) STORAGE ROLLER. FIG. P.13.

This roller is constructed of spirally wound paper and thus must be treated with a certain amount of care. At the factory it is impregnated with a shellac varnish which protects it from the effects of moisture in the air. Damage can result from the careless use of screwdrivers when fastening down the tape clamps for instance. See Section 3.2

c) TAPE STORAGE LOOPS. FIG. P.1.

The function of the tape storage loops as described above in Section 1.2 is to return the tape to its original position after playing. Following the path of the tape through the loops, the tape after leaving the front storage roller passes over the front tape support and drops to the frontmost bottom roller. It then rises and passes over the top roller after which it falls again to pass round the rear bottom roller. Finally it rises and enters the tape guide passing over a support on the way. The bottom rollers are both freely mounted on a 'V' shaped link which is secured to the horizontal rail by a spring and a cotter pin.

To prevent adjacent tapes from interfering with each other, the vertical tape separators have been incorporated. These are shaped sections of plastic material tensioned between two rows of pins. One set of pins is knurled and forced into the bar which supports the top rollers while the other row is pressed through the wooden bar which spans the down frame.

d) THE TAPE HEADS. FIG P.12.

As has been said above, the tape crosses the reproducing heads immediately after leaving the storage loops. The tape is correctly positioned with respect to the heads by the front and rear tape guides. The slots in the guides are only approximately .005" wider than the tape and so care must be taken to see that no damage occurs to them when performing service operations.

The tape heads are mounted in channel section aluminium alloy called "the head block" which is supported by rollers on the lower alloy channel. To prevent excessive side movement of these support rollers, they are retained by a bracket rivetted to the lower channel. The rollers are made of an insulating material as it is essential that no electrical contact exists between the head block and the metal frame. It is for this reason that the W shaped spring which holds the head block down is insulated from the lower channel by insulating washers. The reason for the free mounting as has been explained before, is to allow the whole bank of heads to be moved sideways to reproduce the sound from any of three tracks recorded on each tape.

The lateral motion of the head block is controlled by the TRACK SELECTION SWITCH.

The track selection mechanism is mounted on a standard self-cancelling push button frame, which is screwed to the rear of the control panel on rubber grommets. The position selected by the individual buttons are determined by the angle to which an adjustable plate, mounted on the track selector arm, is set. The "track" selector arm is freely mounted on a cotter pin which passed through the top and bottom bearing plates. The cotter pin is placed in line with the push button shaft into which is cut a slot to clear the pin.

When the button is depressed the Track selector arm moves on its pin until the adjustable plate is parallel to the flat rear end of the push button shaft. Thus the track selector arm will take up a position determined by the adjustable plate.

On later models the system of adjustable plate and three screws has been replaced by a simpler arrangement involving two 4 BA screws only. The screws are positioned so that they bear on the end of the push button shaft one on each side of the slot. The angle to which the track selector sets when the button is pressed depends on the relative position of the two screws, because the final position of the arm is with the ends of the screws just nearly touching the end of the shaft. Into the end of the track selector arm is formed a slot which engages with a pin mounted in the actuating rod. The actuating rod is supported by two pillars mounted on the bottom bearing plate. The mounting is such that it is free to move parallel to the control panel and this the lateral position of the rod is determined by the angle to which the track selector arm is set.

This lateral movement is transferred by the adjustable linkage to the head block.

As has been said before, there are three tracks on the tape and for the lead instruments we may wish to select any of the three tracks or mixtures of two of them. The same is true of the fill section of the left hand side, but we never can mix rhythms. It can be seen that the system used for setting the position of the head block is infinitely variable and thus the number of positions to which a head block can be set depends only on the number of buttons on the switch frame.

For the reasons outlined before therefore, we use five button frames for Lead and Fill, and a three button frame for Rhythms.

To press the tape into contact with the reproducing head a pressure pad mounted above the tape is used. This consists (see Fig: P.10) of a felt pad mounted on a shaped arm which is rivetted to a light spring. The spring is secured to the Pressure Pad Support Bar by a 4 BA screw the hole in the spring being slotted to allow adjustment. The Damping Bars have been introduced to prevent the pad arm from vibrating vertically after being released from contact with the tape.

e) THE CAPSTAN. FIGS P.13.

This is in the form of a round bar running the whole length of the instrument and is the means by which the tapes are driven at constant speed over the reproducing heads. The bar is ground to very close limits on diameter and is straightened by a special process at the factory so that the speed of all tapes should be the same. This is essential if the instrument is to play in tune and not to exhibit speed variation such as "WOW".

The Capstan runs in ball races which are mounted to the frame in special housings, and it is driven at the left hand end by the flywheel. The flywheel is in its turn driven by a belt from the capstan motor, mounted below the frame on the motor mounting board.

f) TAPE STORAGE BOX. FIG P.6.

This is constructed of wood and is supported behind the capstan on blocks screwed to the motor mounting boards. The tape passes through the box, adjacent tapes being separated by aluminium dividers which locate in slots in the back and front of the box. The lid prevents the tapes from rising out of the box when the tape is being played.

g) CYCLING MOTOR AND CHAIN DRIVE. FIGS. P.3.

The chain drive is used because it is essential that the front and rear rollers stay in exact synchronism. That is, if the front roller pays out 10 turns of tape, then the rear roller must take up 10 turns of tape otherwise the difference would alter the amount of tape in the storage loop. The cycling motor is a shunt wound D.C. motor with a 30:1 gear box on it.

The speed of the motor when cycling the tapes is 150 rpm. or thereabouts. Also driven by the chain is a unit called the SYNCHRONISED SWITCH which enables the STATION SELECTION CONTROL SYSTEM to locate the correct stopping point. See 1.4

The slack in the chain is taken up by the tensioning jockey mounted under the bar which supports the keys.

h) KEYS. FIGS. P.4.

The keys are manufactured from seasoned soft woods which are chosen for their resistance to warpage. The white notes are covered with IVORETTE (Trade Name) and the black are formed by plastic mouldings glued on to the wood.

Each key is mounted on a strip of spring steel which has a hole which locates over a screw in the key mounting bar. A NYLOC nut holds down the spring and provides adjustable tension to each note individually. The front of the key is guided by an oval pin, set in the guide pin bar, which fits in a felt lined hole in the underside of the key. The guide pin can be turned to take up side play in the key which can develop as the felt beds in.

The key also carries two adjusting screws - the front one controlling the pressure pad (See (d) above) whilst the rear one adjusts the pressure on the pinch roller. For correct method of adjustment see 3.1a.

The keys are correctly set for height above the guide pin bar by the key top stop which is an alloy angle with a self adhesive cellular rubber pad underneath. This rubber has been shaped at the factory to make all the keys lie straight, and therefore the left and right hand top stop bars are NOT interchangeable. In order to achieve the same result it may be found that small paper labels have been stuck to the top side of the keys where they come up against the top stop bar. These must not be removed.

j) THE KEYLOCK. FIGS. P.4.

This is a device to prevent inevitable damage to the tapes if they were played whilst the instrument was being cycled. (See 1.2). It is obvious that by playing a tape at the constant speed of $7\frac{1}{2}$ inches per second, at the same time that the cycling was carrying the tape at 36" (inches) per second, can only result in severe and almost certainly permanent damage to the tapes. The device consists of a moveable bar or flap, which can be tilted by a linkage pulled by a solenoid. Only when the flap is in such a position as to prevent the keys being depressed, will it close a microswitch enabling the cycling operation to start.

1 - 4(a) PREAMPLIFIER. FIGS P.5. CIRCUIT DIAGRAM D.4.

This unit is to be found mounted by brackets to the back of the cabinet just above the left hand rear tape storage roller. As can be seen from Fig.4.D. the circuit consists of three identical sections V1 V2A V3 V2B and V5 V4B. Since they are identical sections, only one will be described.

V1A accepts the input from the Rhythm Head Block and amplifies the signal, the amplified version being coupled by C1 R6 to the grid of V1B which operates with auto bias. The output from V1B is directly coupled to the grid of V2A, a cathode follower, a portion of this output being fed back to the cathode of V1A via the frequency conscious network C3, VR1, - C4. This network is adjustable to give an NARTB replay equalisation or to give the type of results wanted by the player. C4 is included to give additional reduction in gain at high frequencies to prevent instability. The output of V2A is coupled via C4 to the preset output level control VR2 and thence to the output coupling cable.

V3 V2B and V5 V4B perform the same function for the Fill and Lead section respectively. The position of the controls is as shown in Fig. P.5.

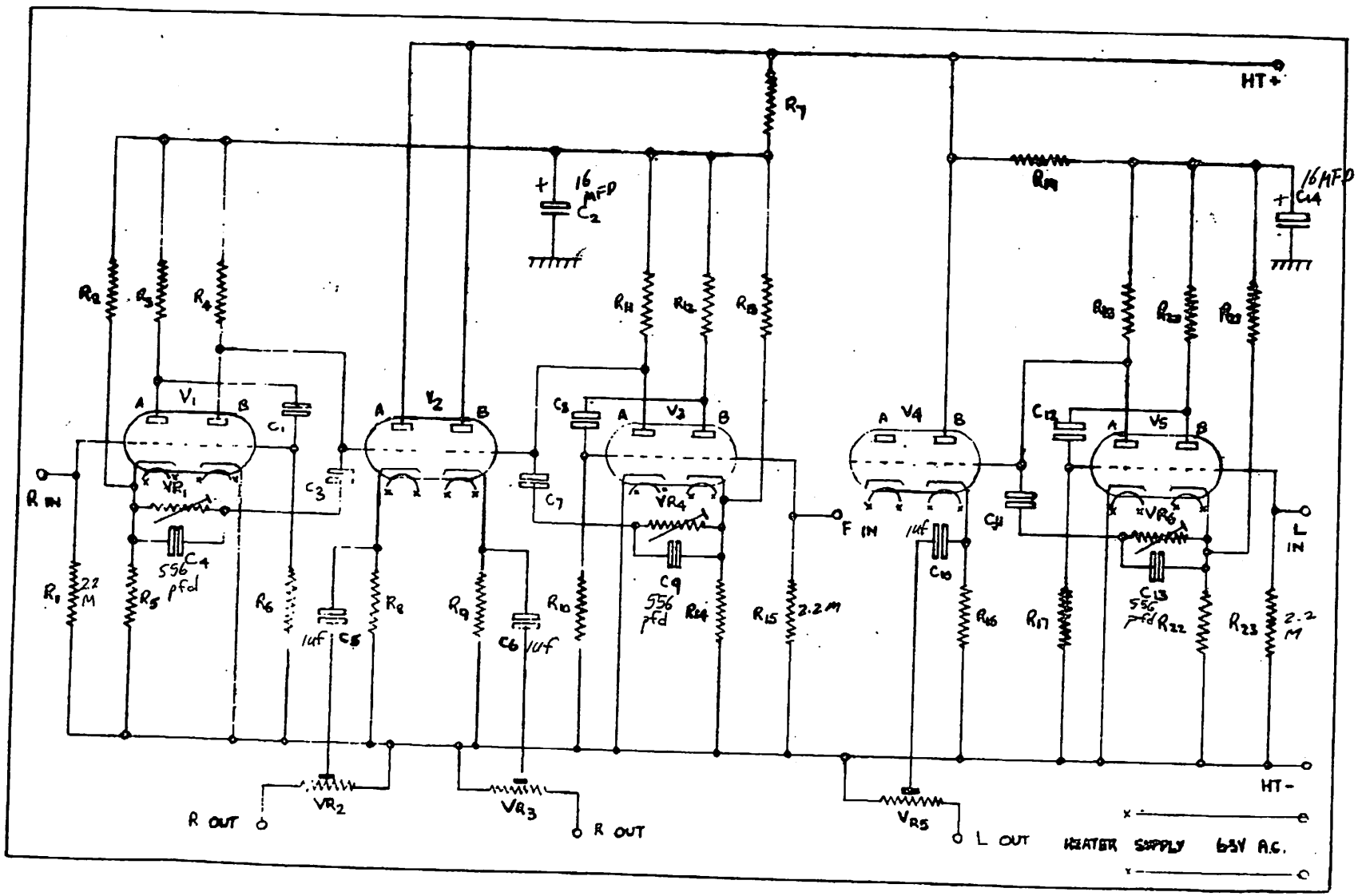
1 - 4(b) POWER AMPLIFIER. FIGS P.6. CIRCUIT DIAGRAM D.5.

The power amplifier takes the signal from the sound control panel (or distribution point) and amplifies it until it has sufficient power to drive the loudspeaker. The maximum power output which depends directly on the loudspeaker impedance is 30 watts into 15 ohms (1.5 K). The power amplified is fully transistorised.

Reference to Fig. 28 (a or B, dependent on type of main amp fitted (2) on early units (b) on current production) shows that the circuit can be divided into two parts:- the part preceding the transformer, or driver section, and the output pair. Taking circuit (a) first the driver is a development of the 500 mW transformerless power amplifier of Texas Instruments adapted to give a higher voltage output swing. It will be seen that the collector of TR5 is fed from the emitter follower TR6. This gives one order of stabilization to the voltage supply for this stage and the voltage is maintained at about – 15V. Thus the voltage at the junction of R16 R17 is around – 7.5V. If this is not maintained severe distortion will result. The coupling to the transformer is effected via C10.

The transformer drives the familiar single ended push pull output stage TR7 TR8 overall N.F.B. being taken from the output point via R4 R23 and R26 are set so that under quiescent conditions there is a bias of 30 mA, to minimise crossover distortion, flowing through the output devices when the P.D. across the speaker is O.V. The sensitivity of this version is 40 mV for full output.

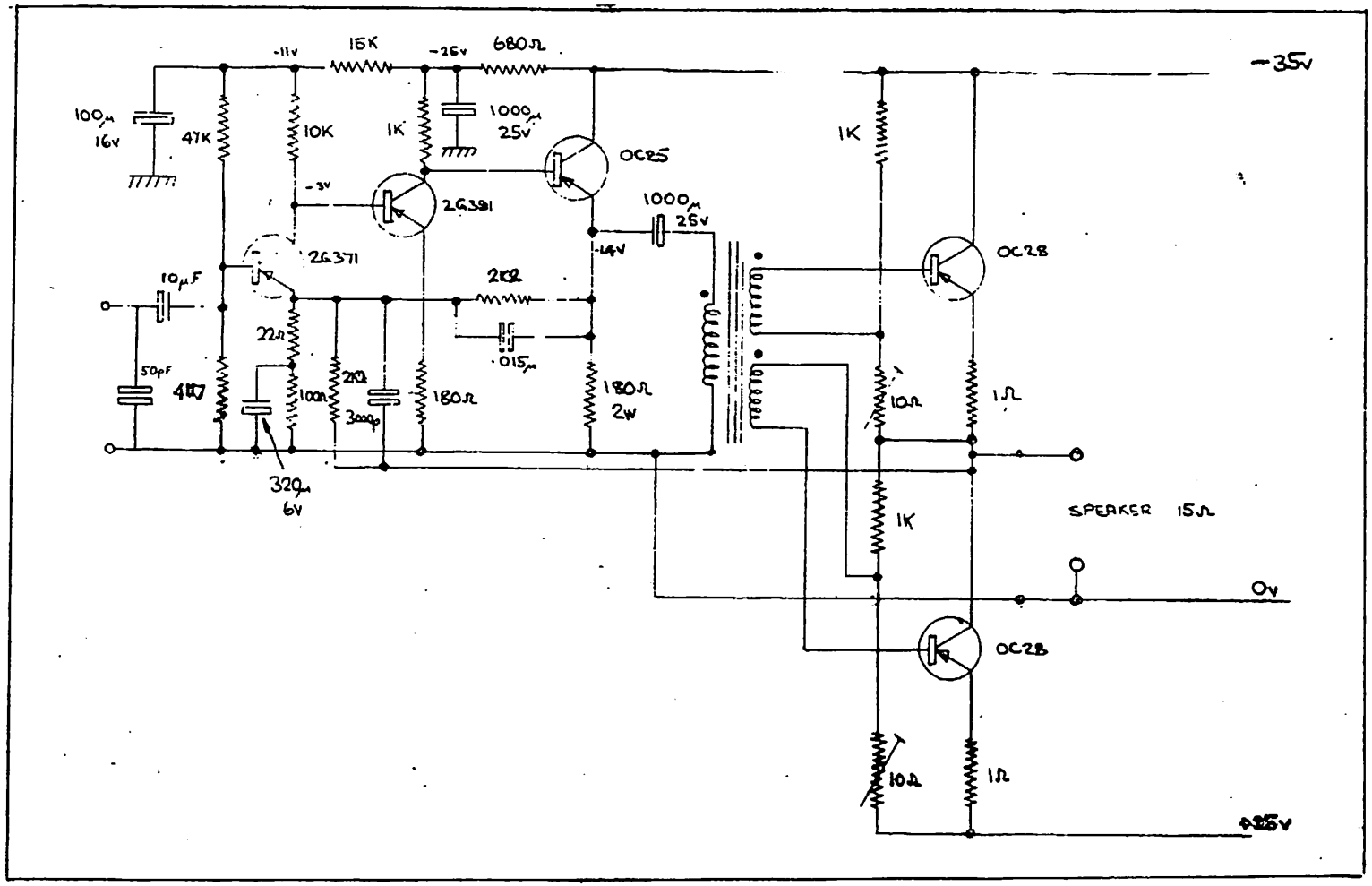
Circuit (b) shows that here a much simpler driver section has been designed. This uses fewer components than circuit (a) and is therefore less likely to give any trouble. TR1 TR2 and TR3 form a direct coupled amplifier with overall D.C. and A.C. N.F.B. The output stage is the same as (a) extra N.F.B. being taken to the emitter of TR1, from the output point. Sensitivity of version (b) is 150 mV for full output.



THERMIONIC PREAMPLIFIER (PAI)

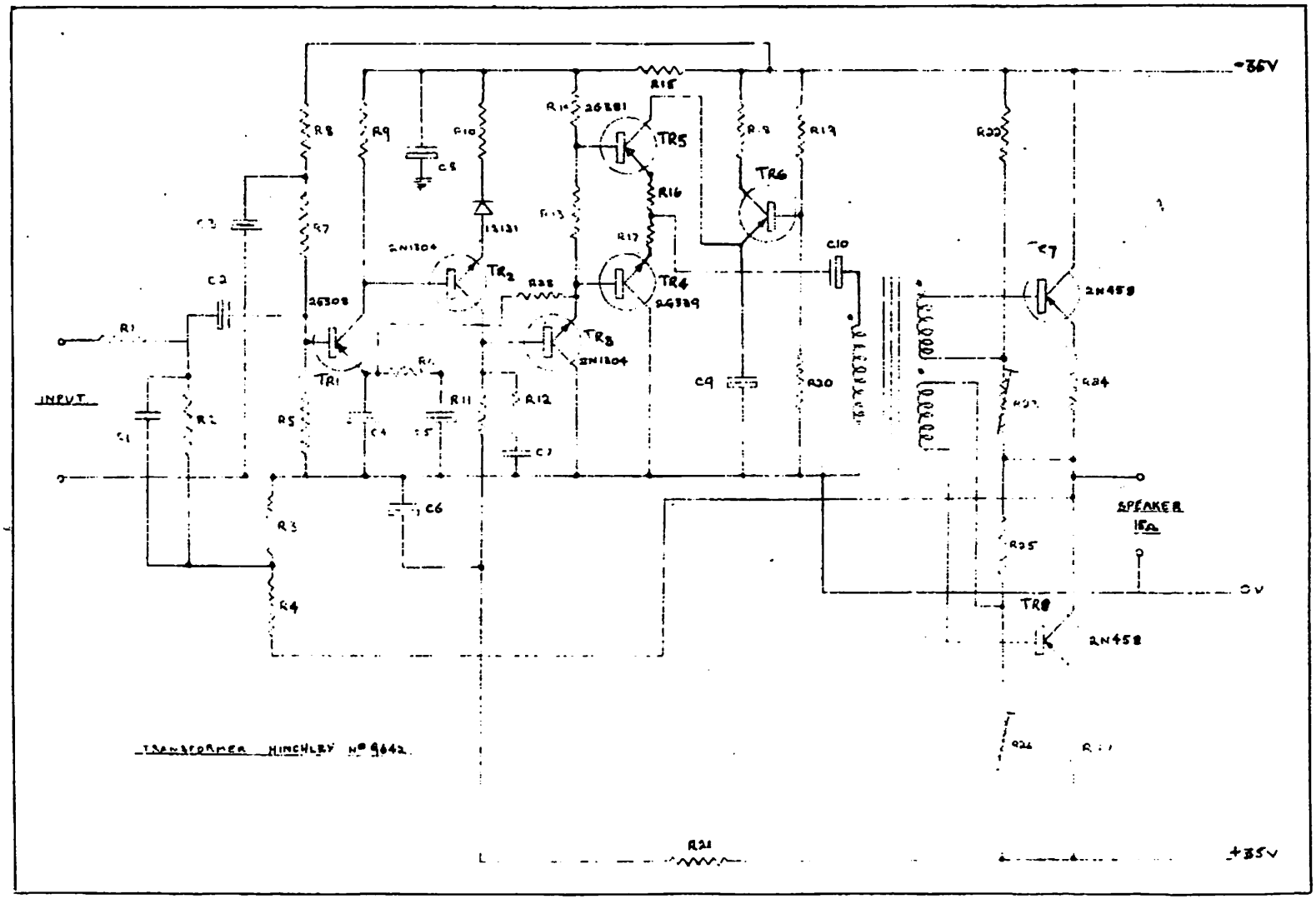
FIG. D4

Section 1.4n



MAIN AMPLIFIER

FIG.D5
Section 1.4



MAIN AMPLIFIER (TEXAS DESIGN)

FIG. D5
Section 1.4b(Alt)

1 - 4 (c) SOUND CONTROL PANEL. FIGS P5.
CIRCUIT DIAGRAM D6.

The circuit diagram shows that all the inputs are connected to the wipers of their respective potentiometers. The mixed output is obtained by joining together the upper end of the Rhythm Fill and Reverb potentiometers and this is fed to the Left Hand Main amplifier from the output socket.

The Pitch Control is connected via a non-reversible coupling to the Variable Frequency Oscillator. The function of this control is to vary the frequency of the VFO and thus the motor speed.

The Vol. control is intended as a means of setting the minimum volume of the instrument, that is the volume to which the output from the R.H. speaker falls when the Footpedal is fully closed.

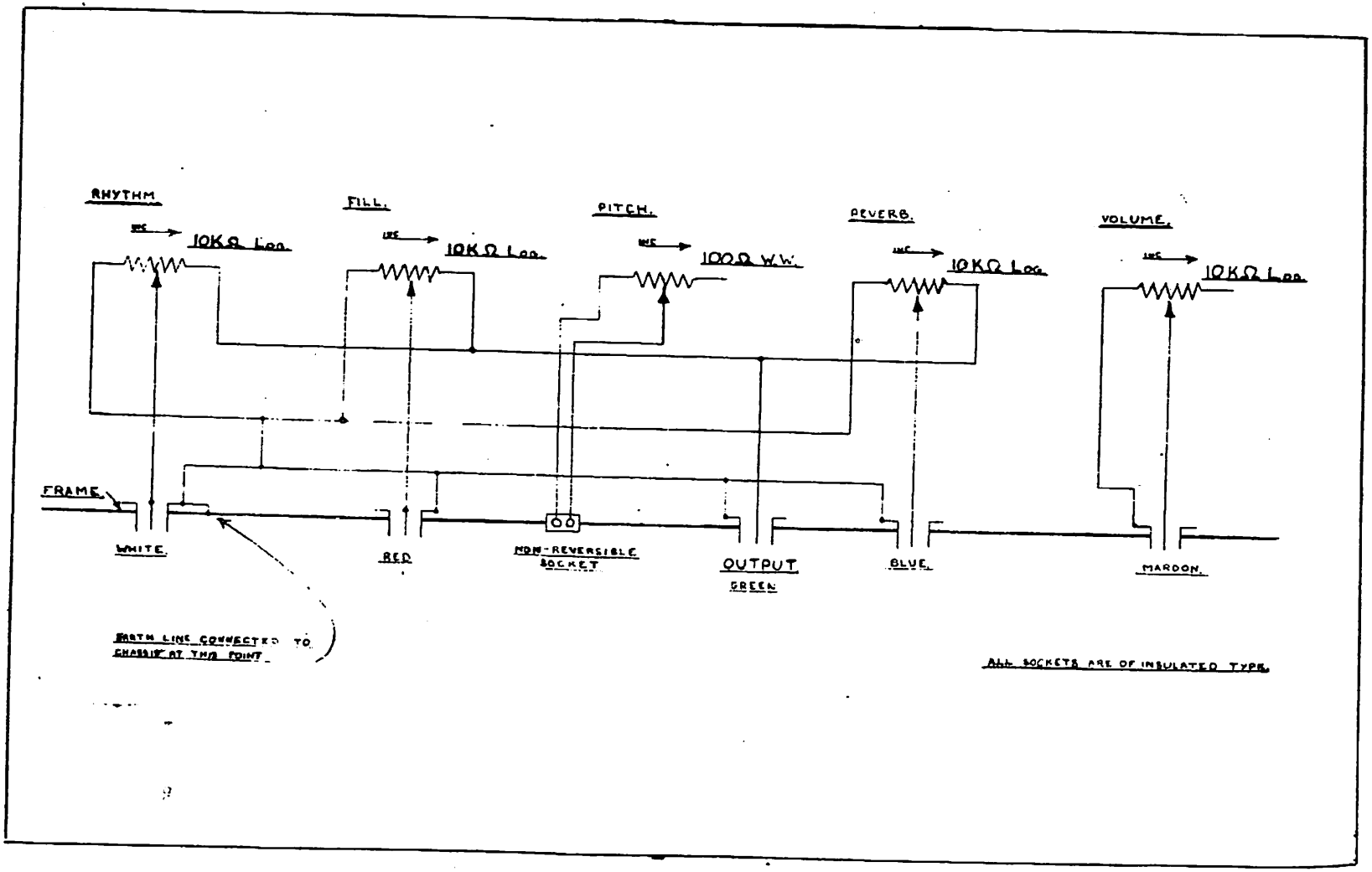
It will be noticed that all the coaxial sockets are of the insulated type to avoid interaction between the left hand and right hand earth system. This will be gone into more fully in 1-4 (e)

1 - 4 (d) FOOT PEDAL. FIGS P7
CIRCUIT DIAGRAM D7.

The Foot Pedal is partly mechanical and partly electrical. The actual part on which the foot operates is made of hardwood covered with a rubber pad and trimmed with black plastic. It is pivotted on a shaft which passes through the vertical pillars, the return tension being supplied by a leaf spring which presses on the underside of the pedal itself. To the pedal is fixed a quadrant gear which engages with a pinion on an intermediate shaft, the drive being finally transmitted to the potentiometer by a further pair of gears. The overall ratio is 12 : 1. This high ratio is necessary because the potentiometers must turn through about 270 degrees while the pedal can only operate through about 22 degrees. To remove backlash from the intermediate shaft a tensioning spring has been fitted which biases the potentiometers in the closed direction. To give further rigidity, a bracket is fitted to the top of the vertical pillars which is then screwed to the front of the cabinet.

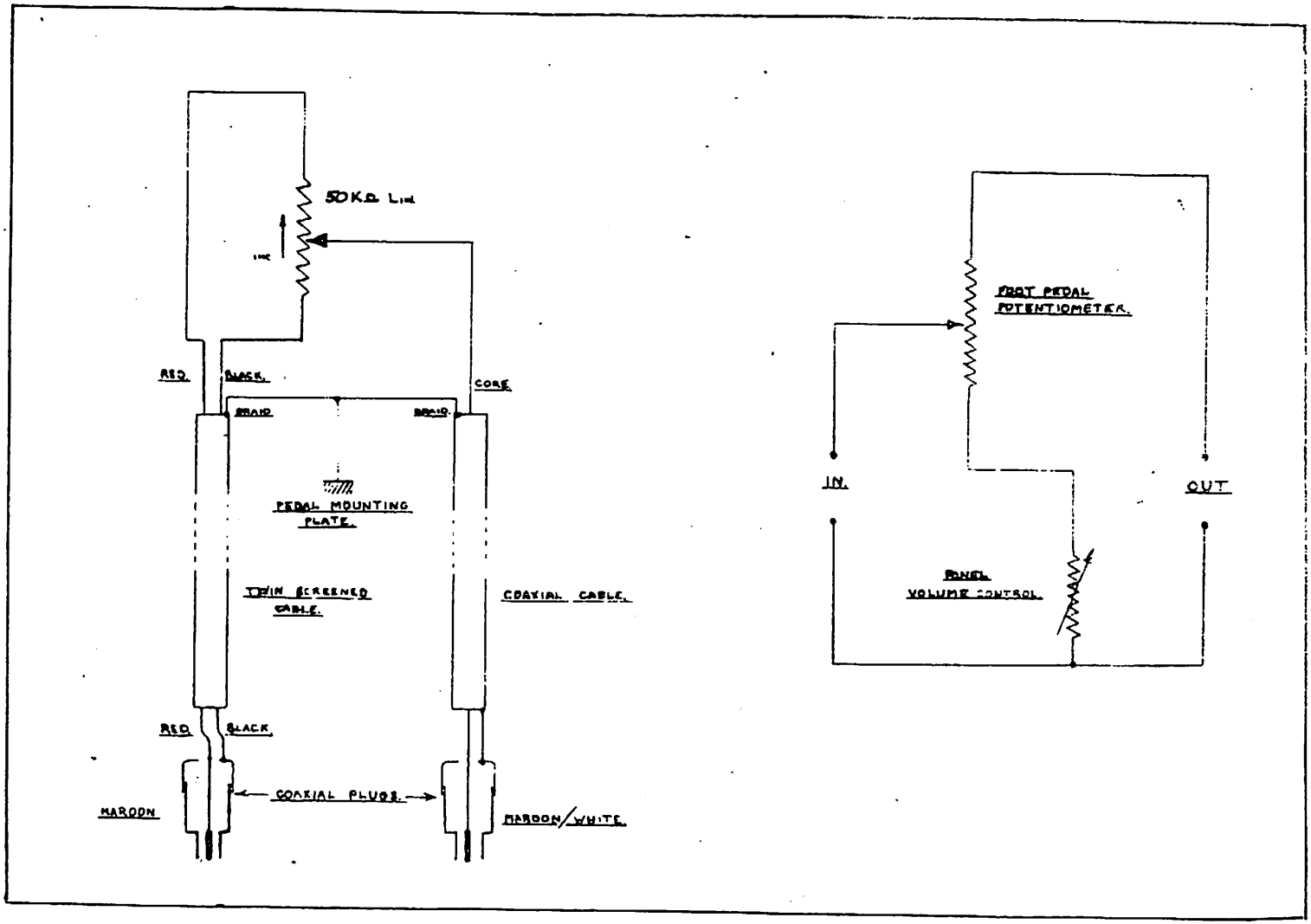
The action of the footpedal is best understood from the diagram in FIG. D7 (b). This shows how the pedal potentiometer works in conjunction with the panel volume control. See 1 - 4 (c).

If the panel volume control is set to zero resistance, it can be seen that the volume can be reduced to zero by the action of the foot pedal potentiometer. However if the panel control is adjusted to give a higher resistance than zero, there is always some resistance in series with the earth return of the foot pedal potentiometer and the volume cannot be reduced to zero.



SOUND CONTROL PANEL

FIG D6
Section 1.4c.



FRONT PEDAL WIRING

FIG. D7
Section 1.4d

1 - 4 (e) EXTENSION SPEAKER PANEL. FIGS. P15.
CIRCUIT DIAGRAM D8.

This is provided to enable the MELLOTRON to be used to operate loudspeakers other than those provided internally. As an additional facility, a coaxial line out put socket is provided which may be used to drive external sound equipment, such as tape recorders or amplifiers. For notes on use see 1 - 5.

(f) DISTRIBUTION POINT. FIGS P15.
CIRCUIT DIAGRAM D9.

The distribution point is a socket panel which is used to couple the foot pedal control, the panel volume control, the preamplifier and the right hand main amplifier together.

(g) SOUND INTERCONNECTIONS. FIG. D10.

This diagram shows the way in which the various units of the sound system are connected together and is largely self explanatory. A word of warning is necessary concerning earth loops. If it should be required to change a lead for any reason, it must be ensured that the correct connections are made to any earth wiring. For example, if the braid of the coaxial cable were connected to the collet in the plug where the maroon/white cable from the distribution point plugs into the preamplifier, a severe hum would develop in the loudspeakers even with the volume controls turned down. The fault that would be caused is called an earth loop and thus the earthing of the cables must be rigidly observed.

(h) POWER & CONTROL INTERCONNECTIONS. FIG. D11.

Shown in this diagram are the connections between the power supply and the various units which it feeds, and also the interconnections of the station selection control system. The plugs and the wiring of the sockets has been so arranged it is difficult to insert any plug into a socket not intended for it and even if this is done, no damage should result.

Referred to in the diagram are the Centre Socket Panel and the Sensing Head Bracket.

CENTRE SOCKET PANEL. FIG. P11.

This is situated between the keys and is provided as a convenient means of connecting the wiring from the STATION SELECTION SWITCH to the S.S.C.U.

SENSING HEAD BRACKET. FIG. P11.

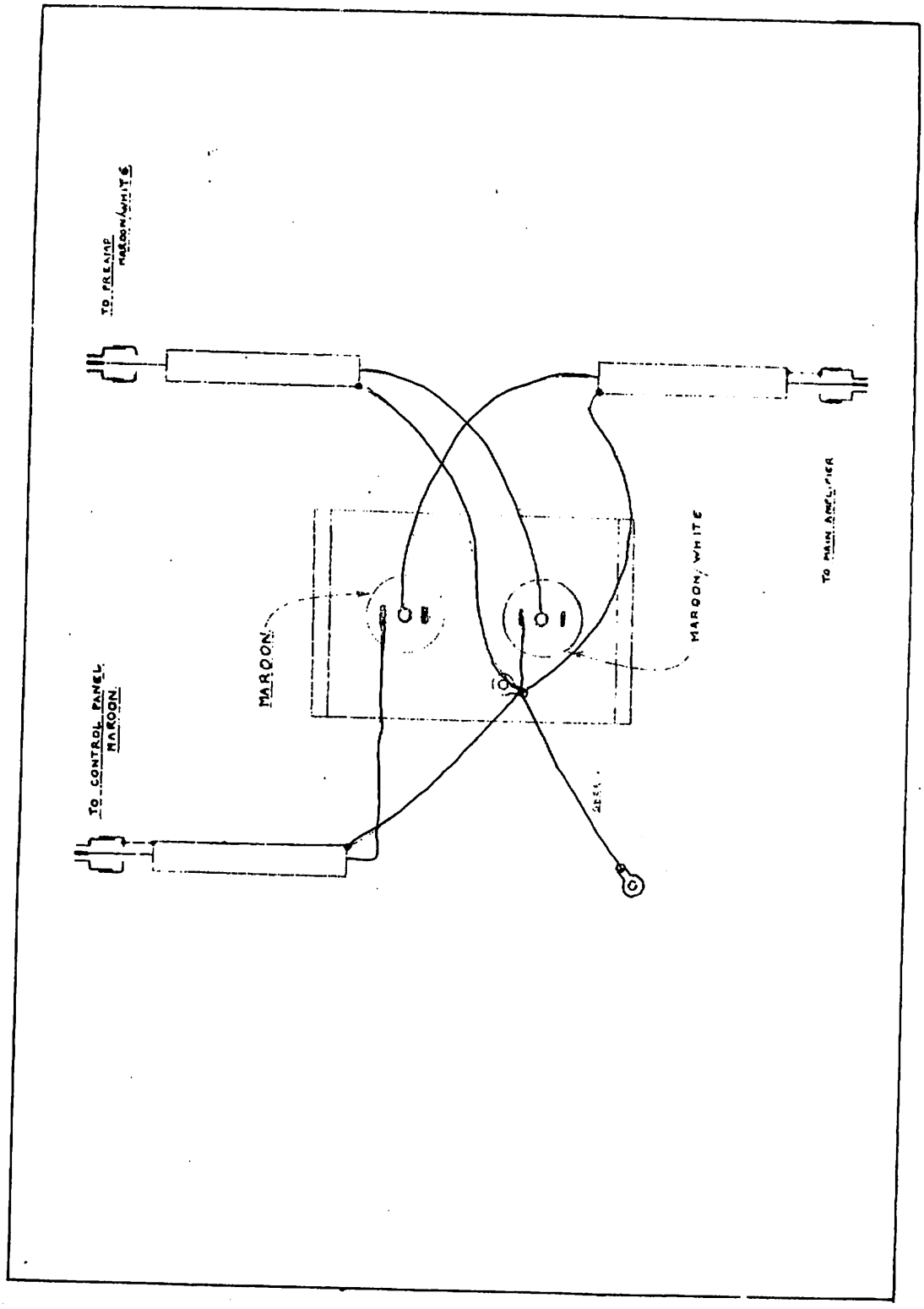
Screwed to the top of the outer capstan bearing housing this unit carries the head which detects the presence of the index signal on the sensing tape. Also mounted on this bracket is the socket which enables the wiring from the S.S.C.U. to be connected to the synchronised switch.

STATION SELECTION SWITCH. FIG. P2.

This is a six button, self cancelling, switch which enables the direction and extent of cycling to be controlled by the player. The resistors R41 to R45 in Fig. D13 are wired between the tags of the switch and SW2 in Fig.D13 is mounted on a small bracket opposite the end of the Latch bar.

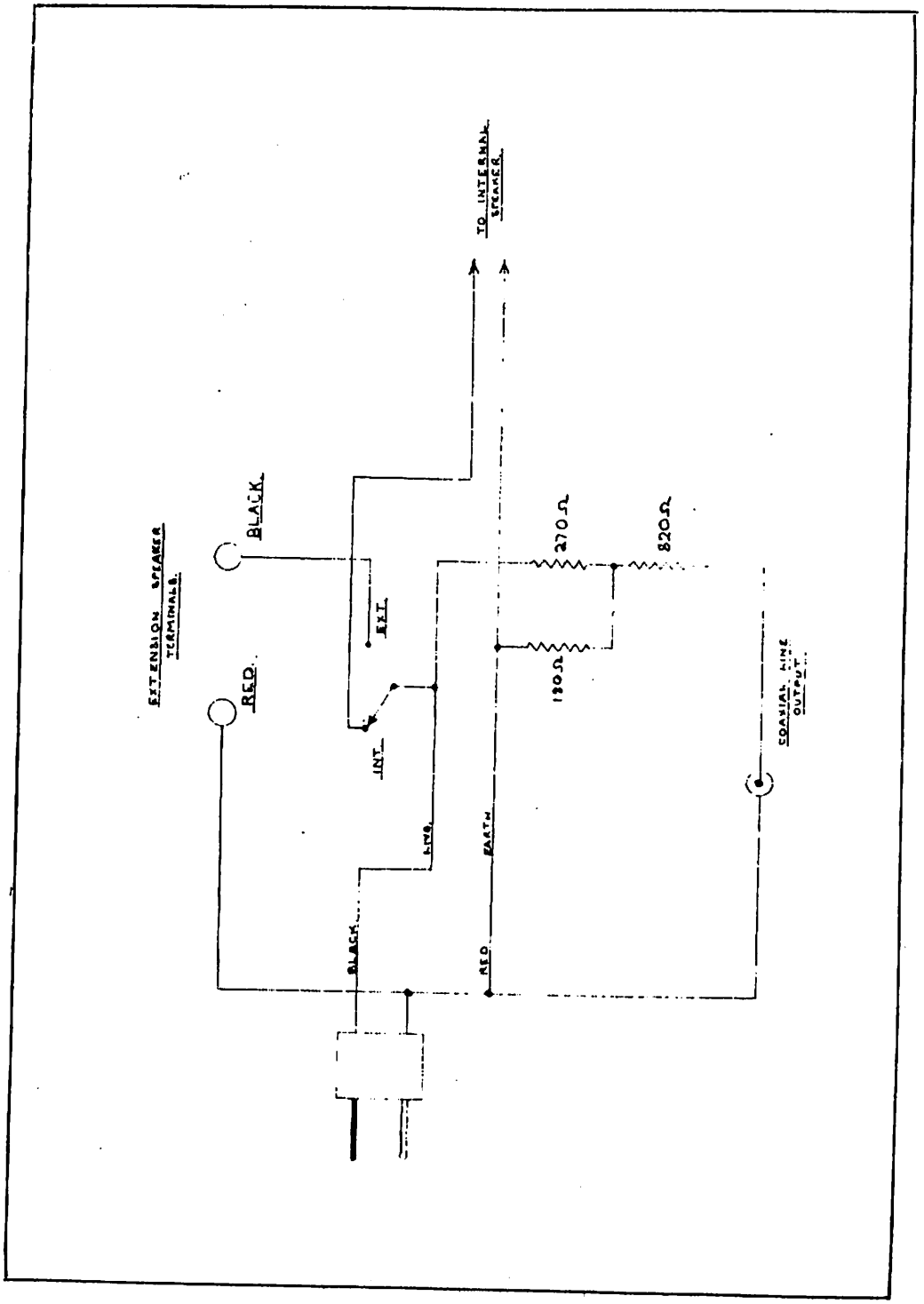
DISTRIBUTION POINT

FIG. D9
Section 1-4f.



EXTENSION SPEAKER PANEL

FIG. D8
Section 1.4e



SOUND INTERCONNECTIONS
MELLOTRON MK I.

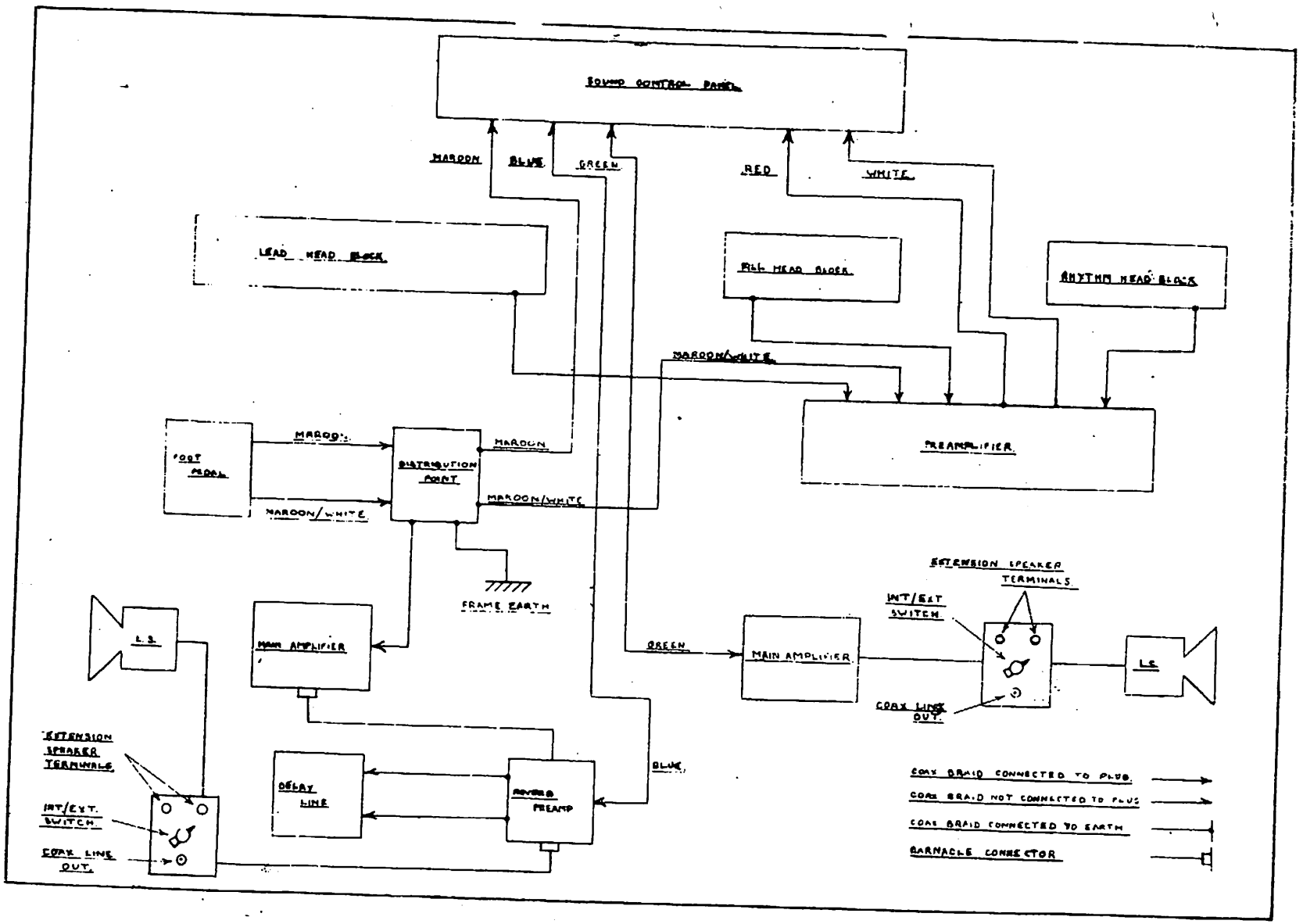
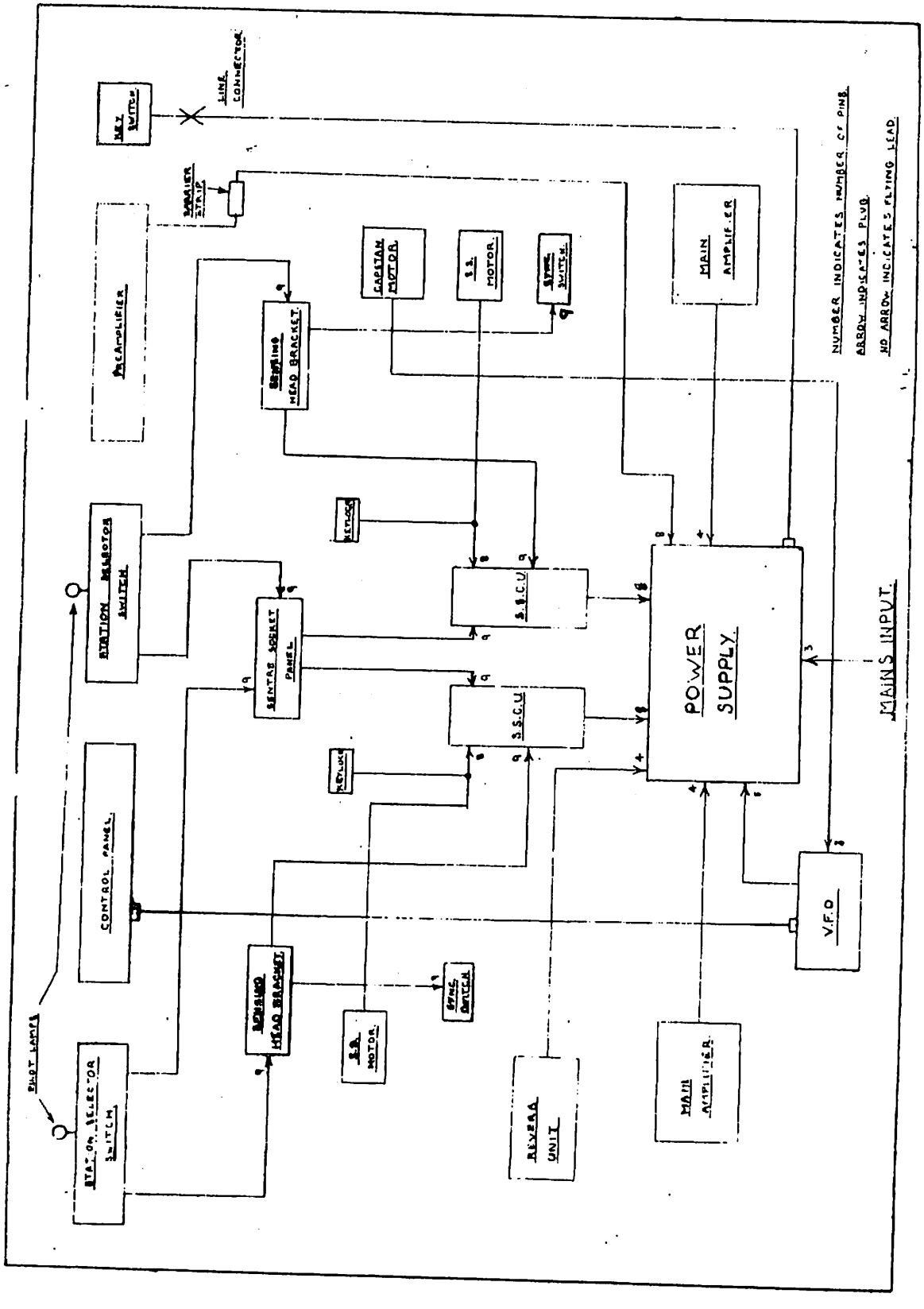


FIG D10.
Section 1.49

POWER AND CONTROL INTERCONNECTIONS
MELLOTRON Mk. I.

FIG. D11.
Section 1.4h.



j) POWER SUPPLY. FIG. P.15.
CIRCUIT DIAGRAM D12.

In this unit, a range of Mains voltages, from 100 to 250 v. at 50 or 60 cps. can be used to provide the various voltages needed to operate the electronics of the MELLOTRON. The peak power that can be required by the Unit is 500 watts but this is only an intermittent requirement. The usual running power is of the order of 100 watts but the mains fuse is rated to cope with the surge.

As can be seen from the circuit diagram there are two switches in the live lead, so that the P.U. can be energised either by use of the lock switch S1 or the service switch S2. The service switch is mounted on the power supply chassis. The meter provided gives an approximate guide as to which tapping should be selected on the comprehensive tapping panel. More accurate setting is as detailed in 1.5.

Taking the supplies in order from the top of the diagram (Fig.D.12) the first is two balanced full wave rectifiers supplying + 35 V.and — 35 V. at a current capacity of 3A on each line. These supplies are used by the main power amplifiers.

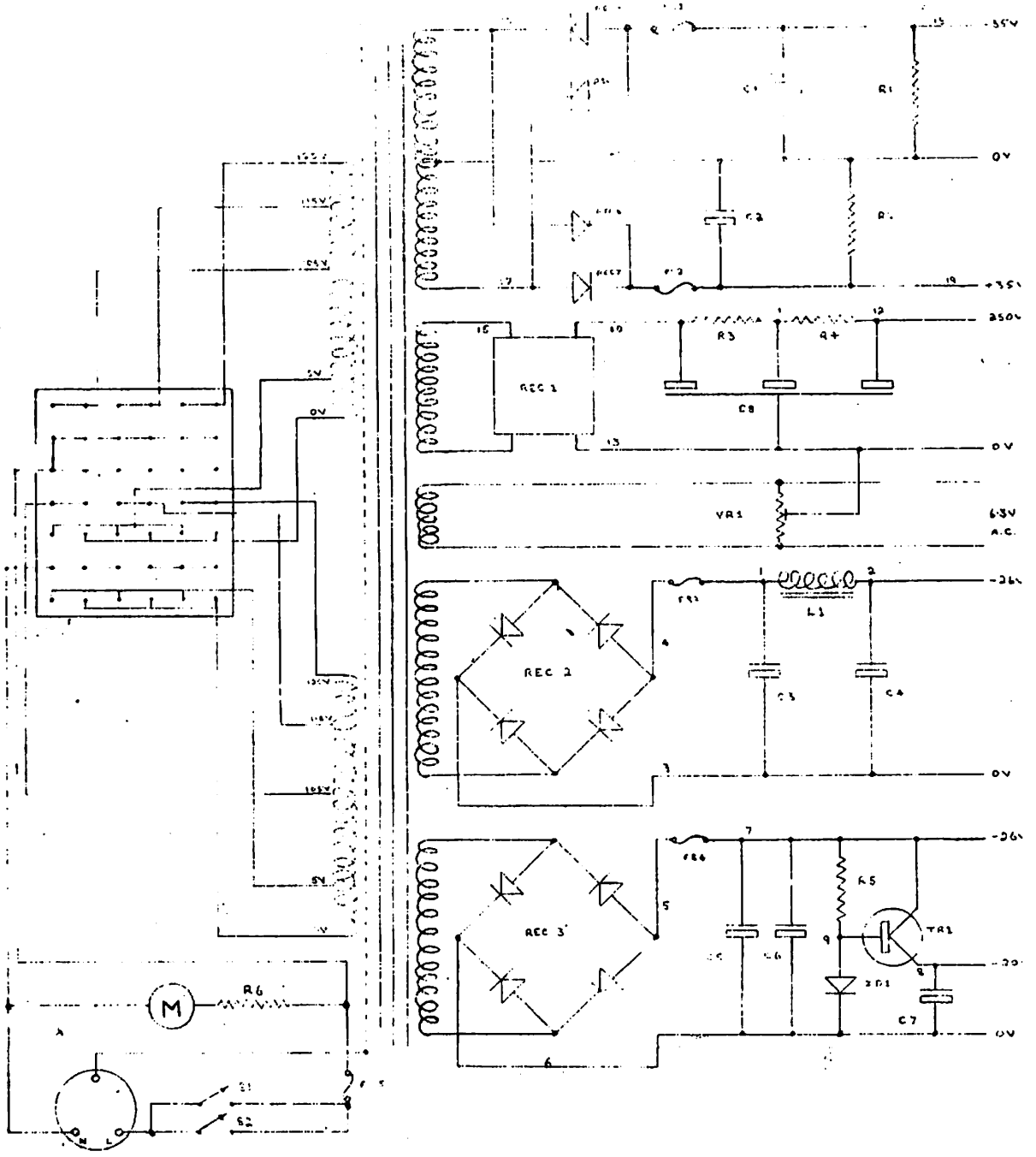
Next we have the two supplies needed by the Valve Pre-amplifier. These are 250 V. at 40 mA and 6.3 V. at 2A. The rectifier for the H.T. is a contact cooled unit and the three sections of the smoothing filter capacitors are contained in one can.

The four rectifiers marked R E C 2 provide the supply for the V.F.O. are mounted on one heat sink, and the supply is smoothed by the L.C. filter. The reason for the special smoothing is that if there is heavy ripple on the supply rail, this will beat the oscillator frequency which is in the region of 50 cps. and produce a cyclic variation in speed of the capstan motor giving a "WOW" on the sound tapes.

The final supply, rectified by R.E.C 3 is unsmoothed because it is needed by the D.C. shunt wound motors used for cycling the tapes, and there is no need for special smoothing. It is also needed by the relays in the Station Selection Control Units. Derived from this supply is a stabilised — 20 v supply. which is generated by the Zener Diode ZD1. and the power transistor TR1. The Capacitor C8 is included to remove the interference pulses from the stabilised line, when the S.S.C.U. is inching.

FIG. D12
Section 1.4j

POWER SUPPLY



k) STATION SELECTION CONTROL UNIT. FIG P.15.
CIRCUIT DIAGRAM D.13.

The function of the Station Selection Control Unit (S.S.C.U.) is to control the operation of "cycling" (See 1.2) The precision of the system has to be great as is explained in 1.2 and the way this is achieved is as laid out below -

The system comprises four main parts:-

The cycling Motor.
The index Tape.
The Synchronised Switch.
The Electronics or S.S.C.U.

THE CYCLING MOTOR. FIG P.3.

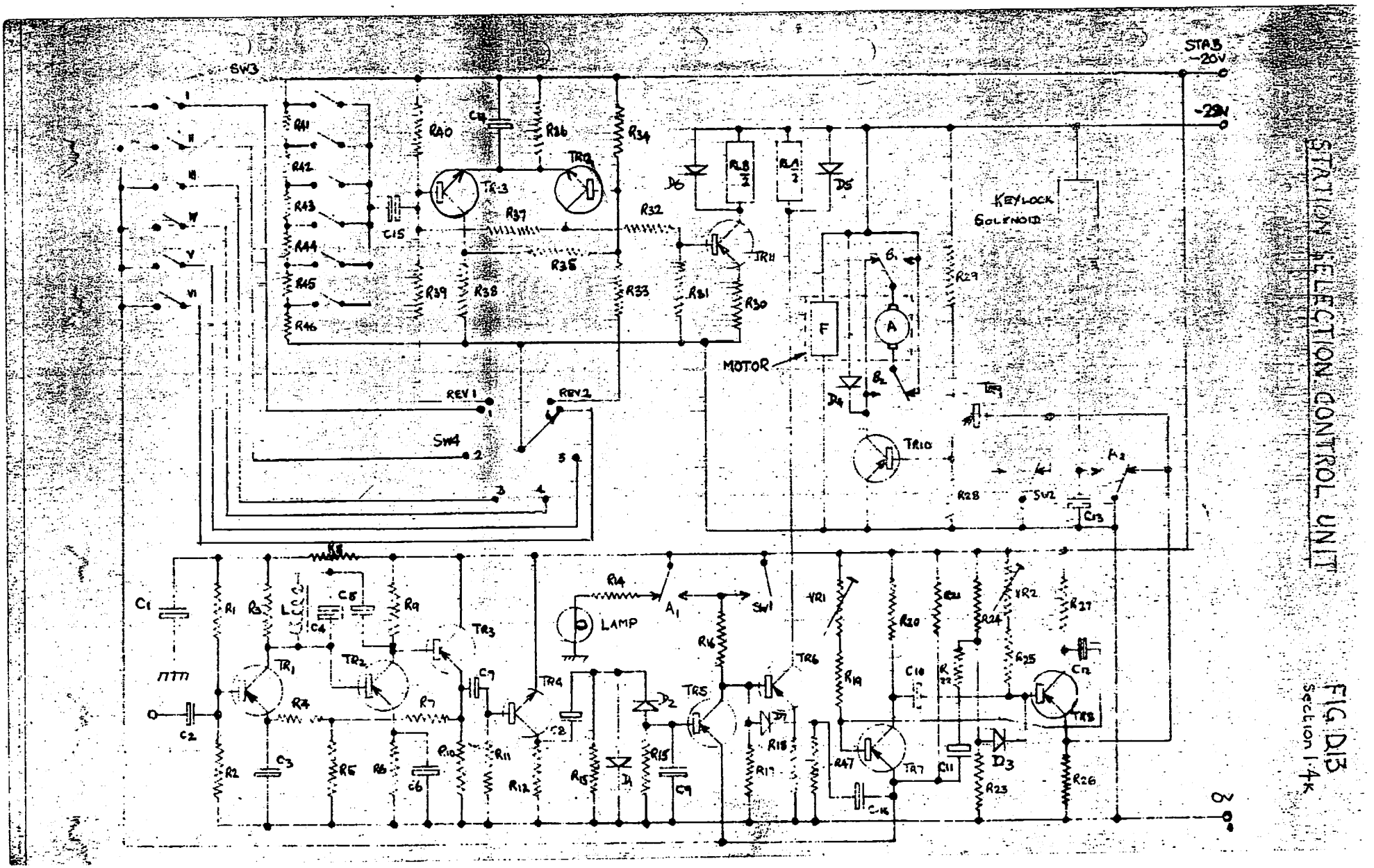
This is a shunt wound unit operating from 28 volts D.C. In the normal fast run condition, the field is connected permanently across the supply, the armature being supplied by the output transistor. TR10 is run in the "bottomed" condition. During the "inching" process, or slow run condition TR10 is alternately cut off and "bottomed" by the Multivibrator TR7 TR8 and switching transistor TR9. The time constants C12 (R19 - VR) and C10 (R25 - VR2) control the 'On' and 'Off' periods respectively.

THE INDEX TAPE. FIG P.11.

The tape has blocks of 1 Kc/S signal at saturation level recorded on it in such a position that the centre of the block, 3/8" long, is the exact start of the signal on the sound tapes. There are thus six blocks, corresponding to the six stations of tape.

THE SYNCHRONISED SWITCH. FIG.P.3.

This switch is driven from the chain which connects the cycling motor to the front and rear storage rollers. It consists of an earthed wiper, driven by a worm and pinion, and a printed circuit board into which are soldered copper contact pins. The wiper moves in a circle and makes contact with the pins which are so positioned that the wiper is symmetrically positioned over a pin when the appropriate index signal is energising the sensing head. There are therefore six pins corresponding to the six index signals. Two extra pins provide automatic reversing, should the system overrun the end positions. It should be noted that due to the width of the wiper, this actually first makes contact with the pin when the index signal is about 12" away from the sensing head.



THE ELECTRONICS.

This comprises three main parts:-

THE MOTOR DRIVE CIRCUIT (outlined above)

THE MOTOR DIRECTION CIRCUIT.

THE INDEX SENSING CIRCUIT.

Motor direction is dictated by the condition of relay B/2. and this is arranged to be de-energised when the motor is driving the tapes from a low numbered selection, to a high one. This is achieved as follows. The current thro' RLB/2 is controlled by the TR11 which is switched on or off by the potential difference across R31. The state of current in R31 is controlled by the bistable trigger pair TR13 and TR12. When TR12 is conducting R31 will have a current of about 18 mA passing which will give sufficient P.D. to bottom TR11 and energize RLB/2. If TR12 conducts, the TR13 must be cut off and to do this a negative pulse must be given by the STATION SELECTOR SWITCH SW 3. To see how this is done, consider that button (11) on the switch is depressed. This will mean that the side of C 15. nearest the switch will be at a potential of 16 V approximately. Button (1) is now pressed, until (11) is out and the voltage at the switch side of C15 is suddenly raised to - 20 V., the change in voltage being felt as a negative pulse of - 3V by TR13 which is thus switched off. By a similar argument, if a higher numbered button were depressed when a lower one was already selected, a positive pulse would be given which would cause the relay to be de-energised.

If the situation should arise that, for some reason, such as changing one's mind, about a selection while cycling was in progress, the motor were running in the wrong direction, seeking the selected stopping point (See 1.5C), the wiper on the synchronised switch would eventually make contact with one of the end reverse contacts which have been wired in such a way as to make the motor reverse direction whenever they are touched. In order to make the motor overrun position (1) RLB/2 must have been energised from the previous argument. To reverse it we must de-energise the relay and this is done by putting the contact called REVERSE (1) adjacent contact (1). When REVERSE (1) is connected to OV, R39 passes a current which is sufficient to 'bottom' TR13 which in consequence de-energises the relay and makes the motor run away from the contact.

TAPE SENSING CIRCUIT.

The function of this is to de-energise the RUN relay (RL2) when the correct station signal on the index tape passes over the sensing head. The transistors TR1 TR2 TR3 form a tuned amplifier with maximum gain at about 500 cps. The D.C. stability of the circuit is maintained by the feedback loop from TR3 emitter to TR1 emitter. TR4 is a limiting amplifier which only gives output when the input exceeds a given amplitude. This prevents the circuit from responding to spurious signals. The continuous burst of signal is

obtained when the index recording passes over the sensing head. If integrated by D2 C9 and this pulse will bottom TR5, if the emitter is connected to OV by the action of the synchronised switch, when bottomed TR5 will reduce the base voltage of TR6 sufficiently to allow the relay to de-energise.

To give an understanding of the operation of the control unit, a description of an operation cycle follows. Let us consider that the synchronised switch (SW 4) is in the position as shown in Fig. D.13. To get to this position the Button (6) must have been depressed and so C15 will be connected to the junction of R45 R46. Under these conditions, the emitters of both TR5 and TR7 will be connected to OV. The effects of this condition will become clear later.

If we now press button (5) the connection of C15 will be suddenly changed to the junction of R44, R45, which will give the required negative pulse to the trigger circuit to energise RLB/2. See above for the argument concerning motor direction. At the same time contact (VI) is opened and (V) is closed, disconnecting the emitter of TR5 and TR7 from OV. TR7 is unable to pass any current and multivibrator action between TR7 and TR8 is not possible. TR8 will thus be continuously 'bottomed' because of the heavy base current supplied by R25 + VR2 and will draw a heavy emitter current of the order of 20 mA. It will be noticed that at this time R26 is shorted out both by A2 relay contact and SW2, the keylock microswitch. Thus TR9 will draw no current at this time and similarly TR10. The motor is therefore not running. As the button is depressed on the STATION SELECTOR SWITCH, SW1, which is mounted so as to be operated by the latch bar of the S S S W, is momentarily closed. This action supplies TR6 with base current to bottom it, and thus to energise RLA/2. Contact A1 changes over extinguishing the panel light and shorting out SW1 (the microswitch) causing the relay to hold in. At the same time contact A2 changes over, energizing the keylock solenoid and removing one of the short circuits across R.26.

MODIFICATION.

On later models, SW1 has been omitted and the components C16 R47, D7 have been introduced to perform the same function. Let us consider that we are on Station (VI) as described above. Then the emitter of TR7 will be at OV and when button (V) is pressed, releasing button (VI) it will rapidly rise towards − 20 V. This negative going voltage edge will be differentiated into a pulse by C10, R47 and applied to the base of TR6 via D7. This pulse will 'bottom' TR6 for long enough for the relay A/2 to be energised and hold the base current on via A1 and R16.

When the keylock is fully in position that is, it is safe for the tapes to cycle, the microswitch SW2 is operated and the other short circuit across R26 is removed. This enables the P.D. across R26 to rise to such a value that TR9 is 'bottomed' and the entire emitter current, about 250 MA is used to supply the base current of TR10. This is more than enough to 'saturate' TR10 and the motor will now run. This will cycle the tapes and will at the same time turn the wiper of the synchonous switch (SW4) in the direction of contact (5).

During this period the voltage at the emitter of TR7 will rise toward − 20 V as capacitor C11 charges. This will typically take about 2 seconds and when fully charged, C11 will have a P.D. of − 17 V across it. This is because the junction of R 24 and R 23 is about − 3V, D3 having no effect since it has a reverse bias of − 2 V across it. This state of affairs lasts until the wiper on the synchronous switch first makes contact with pin 5. At this instant the emitters of both TR5 and TR7 are earthed to OV. and the anode of D3 is immediately driven to + 7V because C11 cannot change its state of charge instantaneously. D3 thus conducts, and drives the base of TR8 to + 7V thus cutting it off and removing the drive from the motor. TR8 is cut off until C11 has discharged sufficiently to stop D3 conducting, the time to do this lasting about 1½ seconds, during which time the inertia of the moving tapes is lost.

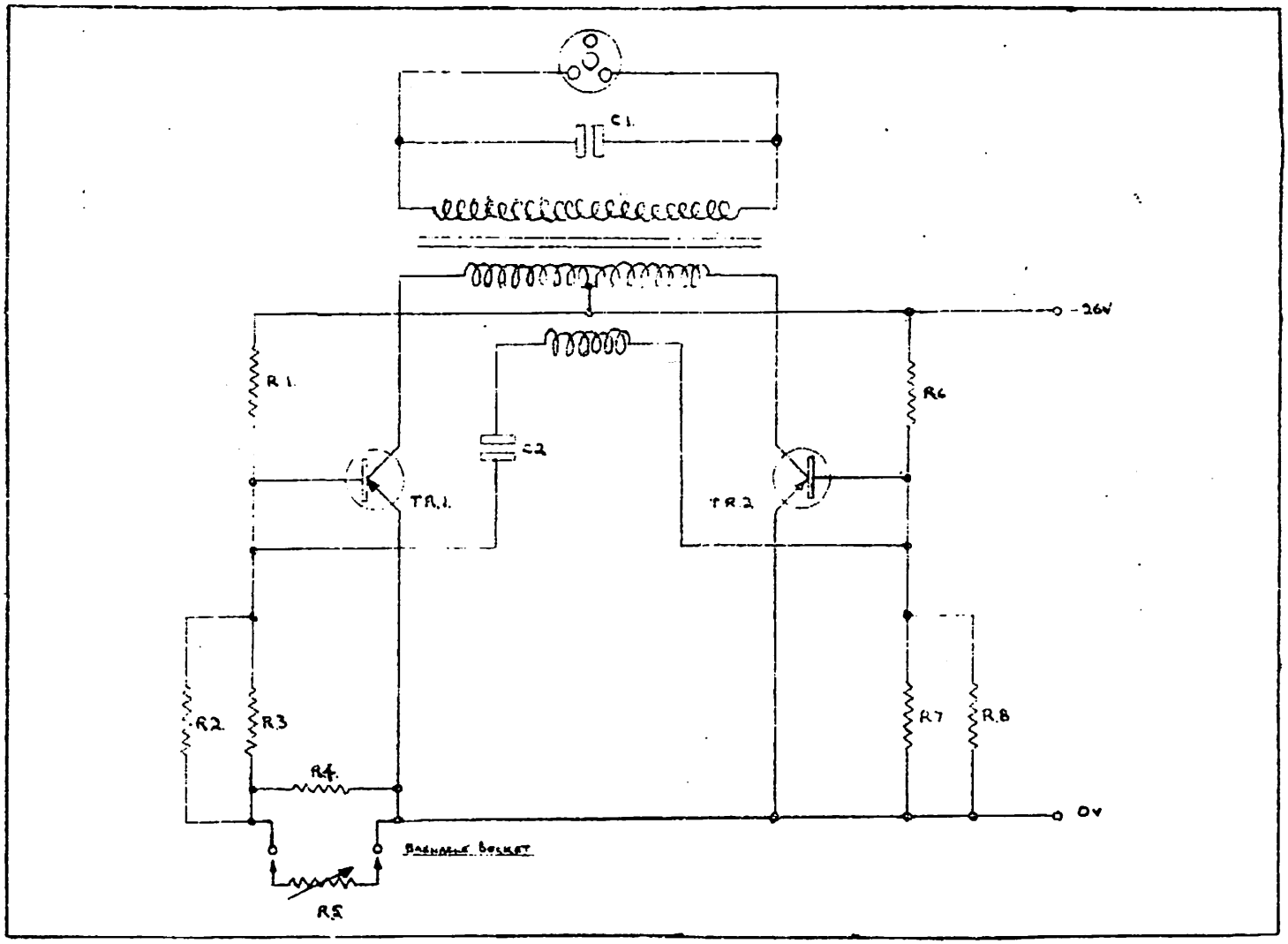
Normal multivibrator action then follows and pulses of voltage are developed across R26, a typical pulse being 20 mS duration spaced from the next by 80 mS. This will give an equivalent tape speed of about 1½ inches per second. The tapes are thus 'inched' along in a series of short jumps until the block of index signal passes over the sensing head.

This gives a series of impulses which is used to remove the bias from TR6 and to de-energise RLA/2. Contact A1 and A2 change back and the motor is brought to rest with the tapes exactly positioned for playing.

1) V.F.O. FIGS. P.6.
CIRCUIT DIAGRAM. D.14.

The V.F.O. is a power oscillator, which generates a square wave of 150 V amplitude at a power of about 60 W. which is needed to drive the Hysteresis Synchronous capstan motor. The frequency of oscillation is variable in order to vary the speed of the capstan for tuning purposes (See 1.5).

From the circuit diagram, it can be seen that the circuit consists of two transistors coupled to a transformer, positive feedback being provided by a small secondary winding, the large value capacitor C1, with the variable potentiometer VR1, which is mounted on the front panel and is called the PITCH control.



VARIABLE FREQUENCY INVERTER

FIG. D14
Section 1-4.2.

REVERB UNIT

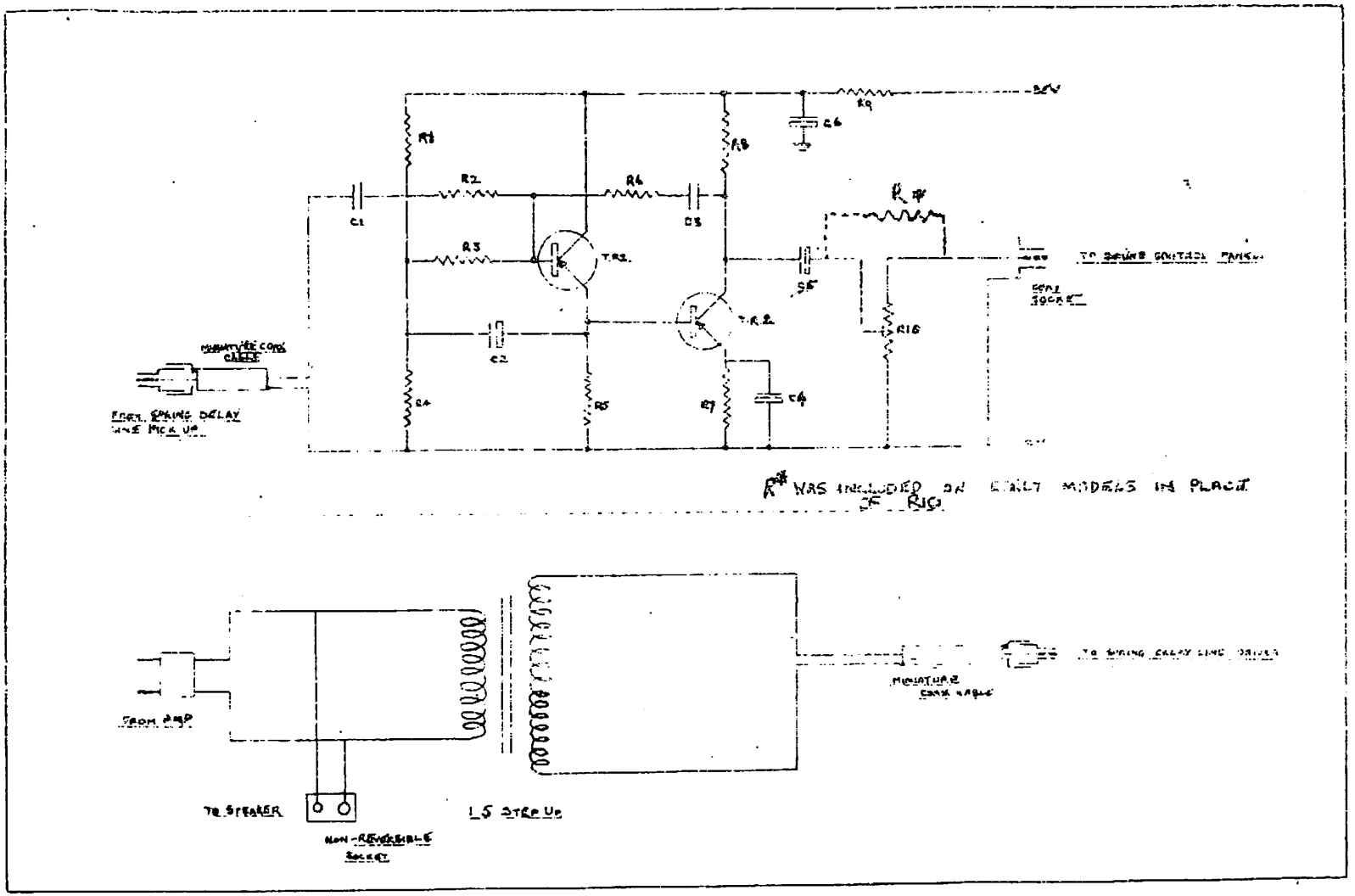
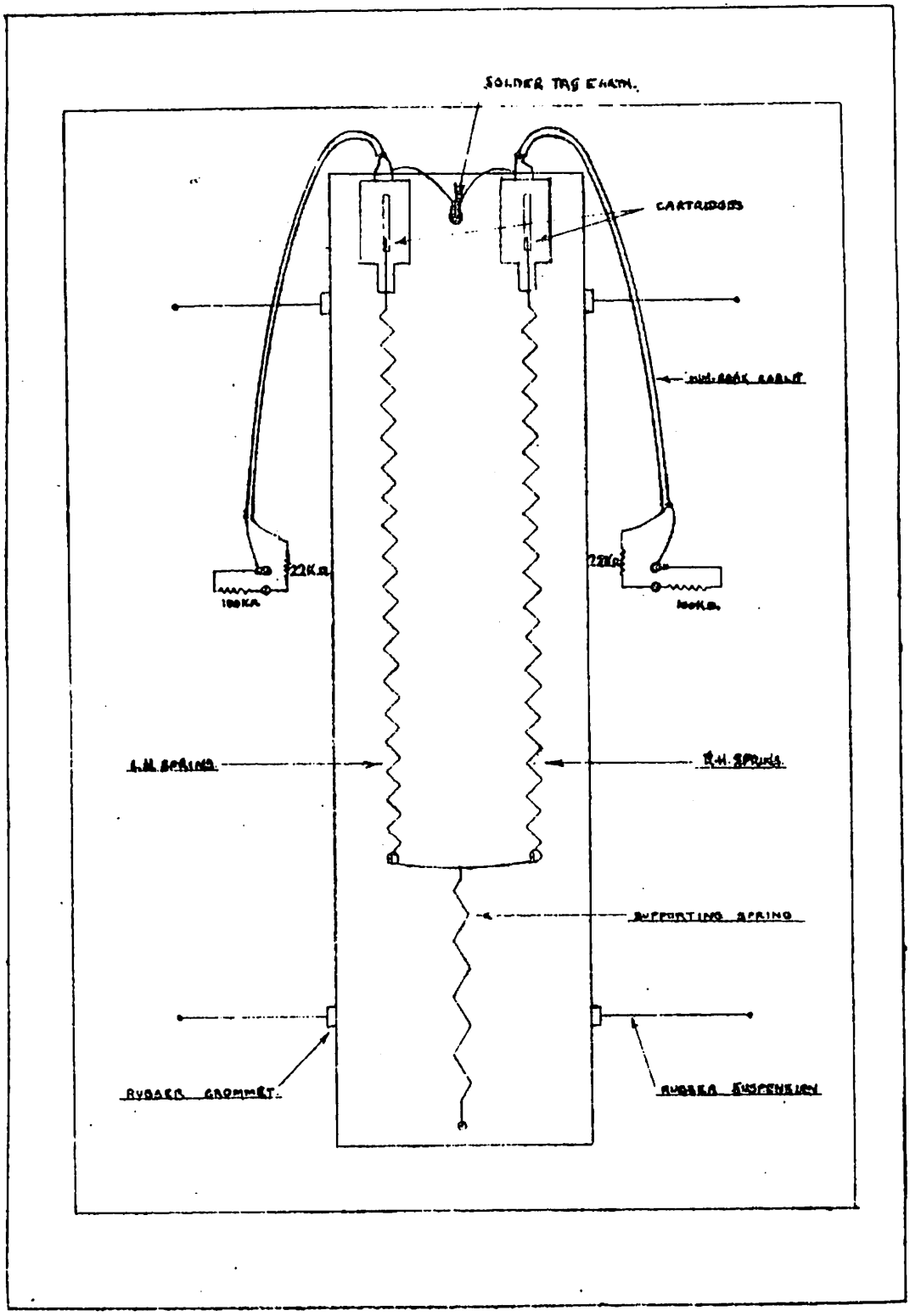


FIG. D15
Section 1-4m

SPRING DELAY LINE

FIG. D16
Section 1·4n



(m) REVERB UNIT. FIGS P.15.
CIRCUIT DIAGRAM D.15.

This unit drives the spring delay line and amplifies the output of the line to a level suitable for mixing into the left hand channel. The amplifier output energises the primary of a step-up transformer, The secondary voltage stimulates the spring delay line via its driver cartridge.

The "echo" output from the pick-up cartridge is amplified by TR1, TR2, and is fed to the sound control panel via the blue cable. The resistor R* is selected on test to give the maximum output of echo without allowing feedback howl to develop. On later models an output level control is fitted.

(n) SPRING DELAY LINE. FIGS. P.6.
CIRCUIT DIAGRAM. D.16.

Used in conjunction with the reverb unit, this consists of two crystal gramophone pick-up cartridges joined by two springs one being wound clockwise and the other anti-clockwise. This improves the smoothness of the frequency response. Fig. D.16 shows the construction and wiring.

1 - 5 OPERATION OF MELLOTRON.

This section is intended to give guidance to the Service Engineer who may be called up to advise on the use of the Mellotron in unusual conditions, typically in conjunction with other sound equipment. To this end, the correct function of all controls is outlined, together with a note on the Station Selector Switch.

KEYSWITCH. Refer to FIG. P.5.

(a) On the left of the control panel is the Keyswitch. This is intended to enable the player to switch on the mains supply to the instrument and is operated by key to prevent tampering by unauthorised persons.

(b) RHYTHM TRACK SELECTOR.

Next to the keyswitch is the Rhythm Track Selector which gives the player the choice of any one of three tracks on the Rhythm Tapes (Keys 1 - 17). Note that no mixing facility has been included because it has been found to be impractical to attempt to mix rhythms.

(c) LEFT HAND SELECTOR SWITCH.

Situated between the Rhythm and Fill Track selectors is the six button switch which controls the selection of the stations, by cycling (See 1.2) on the Rhythm and Fill Tapes. Like all the push button switches on the MELLOTRON, this unit is of the self-cancelling type. Above the centre of the switch is mounted the indicator lamp which indicates when cycling is complete. (See 1.4K). Reference to Fig. D.13 will show that the lamp will light whenever RLA/2 is de-energised, and this is not necessarily when the tapes are correctly positioned. A fault condition could exist which could give the same indication (See 4.2 and 3.1).

At this point it is well to mention how the Station Selection Control Unit can be "fooled" by use of the Station Selection Switch. This procedure does no damage & is of use in certain checking operations (Section 2.2). Let us say that the instrument has been cycled to Station 3 previously so that Button 3 is at this moment depressed. As we know from 1.4K, pressing a button gives a pulse telling the S.S.C.U. in which direction to drive the cycling motor to locate the desired Station in the shortest possible time. We now press button 6 and the S.S.C.U. will drive the tapes towards selection 6.

However, if button 5 is pressed immediately, before the synchronised switch has reached selection 5 the motor will reverse because the wrong sense pulse has been given. In other words, the S.S.C.U. is 'fooled' into looking for selection 5 in the wrong

direction, and the system will overrun Selection 1, reverse automatically and reach selection 5 eventually, where it will stop. This operation is of use in testing the automatic reverse, but should be used with caution (See Section 2.2).

(d) FILL TRACK SELECTOR.

Used as (b) with the added facility of being able to blend two tracks. This is done with the black mix buttons.

(e) SOUND CONTROL PANEL.

This carries five knobs which allows the player to control the level of sound from the various sections of the Instrument. The controls marked Rhythm, and Fill effect the balancing of sound level of the two sections operated by the left hand keys. These controls are used to set the basic volume of sound from the instrument since the lead side is played loud enough to be heard above the Rhythm and Fill and not vice-versa. This is because the Lead has the facility of a swell pedal (See H) which enables the player to change the Lead volume to lend 'expression' to his playing.

The Reverb control sets the level of reverberated Lead sound that is mixed into the left hand channel. In order to make the reverberation realistic, the circuits (Fig.D.11) have been so arranged that the amount of reverberation is proportional to the lead volume level. This means that if the lead is played at a high volume, the echo takes longer to die away than if a low volume is used. The panel control is set for satisfactory echo, whatever the volume used.

The volume control should be regarded more accurately as a minimum volume control. This means that it sets the level at which the lead side plays if the foot is taken off the swell pedal. The facility was introduced to reduce fatigue on the foot when playing for prolonged periods at a low volume. Thus the control should not be expected to be able to bring the lead volume up to maximum.

The centre knob is used to tune the instrument to others, with which it might be played, which cannot readily be altered themselves, such as a piano or electronic organ. It can also be used to alter the tempo of the instrument to enable beginners to follow the rhythm more easily. This gives a wider range of rhythms than are actually recorded on the tapes, and will also alter the tone colour of the instruments on the lead side. A further use is giving 'instant transposition' without change of fingering.

(f) R.H. STATION SELECTOR.

As (c).

(g) LEAD TRACK SELECTOR.

As (d).

(h) FOOT (OR SWELL) PEDAL.

The purpose of this control has been outlined in (e) where its use in conjunction with the volume control is discussed.

(j) THE POWER SUPPLY. FIG. P.15.

Only these parts of the power supply visible when the back is in position will be discussed here. These are:-

MAINS FUSE. Provides protection against faults developing in the mains transformer and mains wiring. It is of 5 A rating and is a standard 1¼" cartridge fuse in a screw holder.

MAINS TAPPING PANEL, which enables the instrument to be run from a wider range of voltages from 100 to 250 volts.

METER gives an approximate reading of the mains voltage assisting in the selection of the correct setting for the mains tapping panel. This is done as follows:-

Before the mains is applied the arrowed plug is removed.

The 3 pin connector is then plugged in and the key switch on the panel operated. (Note in some models there is visible a Service Switch which is provided for the convenience of the Service Engineer. This is a toggle switch which is wired parallel with the key switch, and may be used at this time instead. Remember to switch it off after use as it renders the panel switch ineffective.)

The meter should now show a reading of the mains voltage and the arrowed plug should be inserted with the arrow pointing to the voltage indicated by the meter. A more accurate method of setting the tapping is discussed in section 2.2.

(k) EXTENSION SPEAKER PANEL. FIG. 24 P.15.
USE OF E.S.P. D.17.

When it is required to use the MELLOTRON with other sound equipment, the extension speaker panel should be employed. Reference to figure D.17 will show the various ways in which the extension speaker terminals may be loaded and the results that can be expected. There is one inflexible rule - NEVER UNDER ANY CIRCUMSTANCES ALLOW THE IMPEDANCE ACROSS THESE TERMINALS TO BE LESS THAN 15 OHM.

Since the internal amplifier is a transistorised unit, the output impedance is very low and the amplifier will maintain an output voltage constant across a very low load resistance. Under these conditions, it is possible to exceed the maximum safe working current of the output transistors and they can be destroyed. Particular care should be taken when using two loudspeakers fed through a dividing network. With poor networks, it is possible for the two loudspeakers to be effectively in parallel at frequencies in the region of crossover, and with 15 ohm units, this would represent a grave danger.

If it becomes necessary to drive a single speaker from both channels of the MELLOTRON, this must be done using isolating resistors so that neither amplifier is loaded with less than 15 ohm. For this reason the power available in a speaker used in this way is limited. Fig. D.17 gives suitable values which would deliver a total maximum of about 30 watts to the speaker. The 10 ohm resistors would be of a 10 watt rating.

Fig D.17 (c) and (d) shows the way to use the line output coaxial sockets with a tape recorder or amplifier. Here again to avoid earth loops, we do not connect the earthy terminals from both channels to the ancillary equipment.

T H E

"M E L L O T R O N"

SERVICE MANUAL

P A R T 2.

DELIVERY AND INSTALLATION.

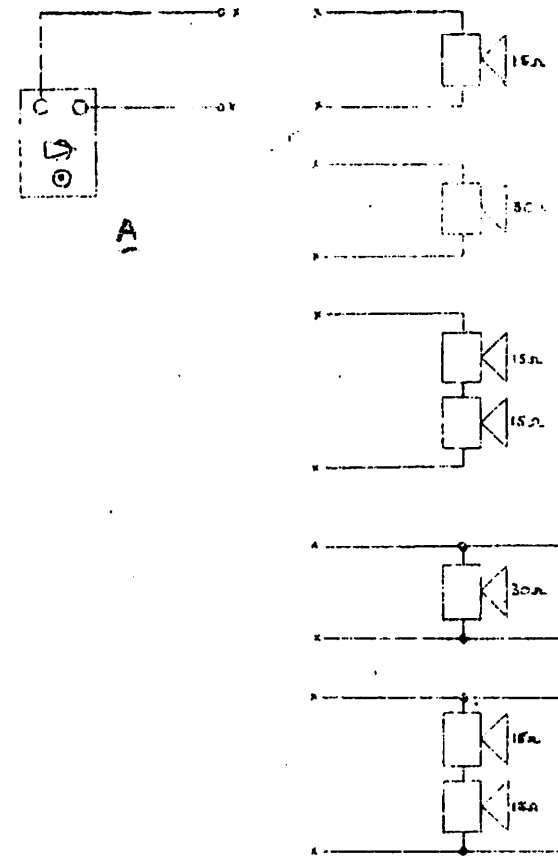
GENERAL.

FIG.D17
Section 1·5k

POWER OUTPUT COMBINATIONS

THIS COMBINATION — WILL GIVE — THIS MAXIMUM OUTPUT

A



30 WATTS

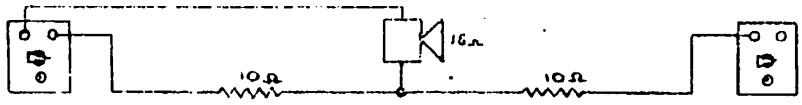
15 WATTS

15 WATTS

30 WATTS

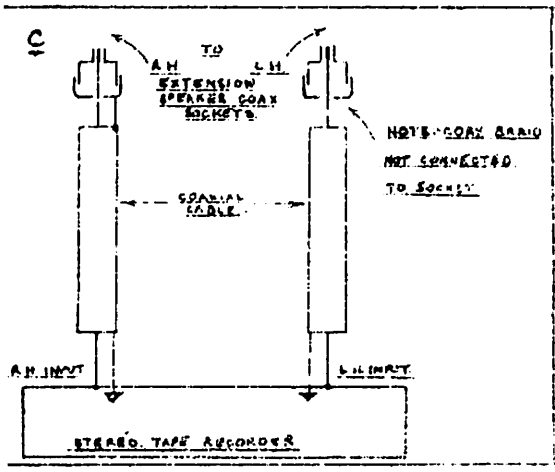
30 WATTS

B

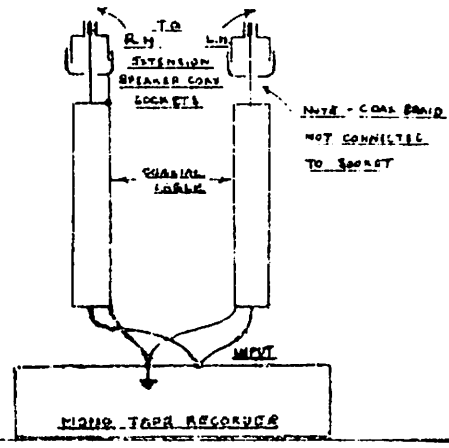


NOTE:- ONLY ONE EARTH RETURN CONNECTED TO AVOID EARTH LOOPS.

C



D



PART 2.

DELIVERY AND INSTALLATION.

When the MELLOTRON leaves the factory it is in perfect working order, but, as can be seen from Part (1) there is a large number of moveable parts which no practical way has been found in securing for transit. For this reason the vibration, which the instrument receives while travelling, may make necessary certain adjustments upon delivery. For the purpose of ensuring that no damage is done to the instrument by operating it while parts are out of position, the following checks are done as soon as the instrument is set down in its destination, and the protective cover removed. These checks are carried out BEFORE SWITCHING POWER ON.

2 - 1 BEFORE POWER ON.

Unlock the lid and slide back to remove. Unlock and remove the back.

Check that all plugs are firmly in their respective sockets.

By looking at the tape storage loops Figs. P.6. from the rear ensure that all loops come to about the same length within an inch or so, and that each loop comes to more than $1\frac{1}{2}$" above the bottom of the separator. If they do not, investigate the cause immediately (See section 3.2 C). As an example of a possible mishap, the instrument could have been turned completely upside down in transit, allowing a tape to slip off one of the bottom rollers. This would be obvious at a glance. Section 3.2 (a) will tell you how to put it back.

Check that the valves in the preamplifier are in place and that the relays on top of the S.S.C.U. are firmly seated.

Check that no foreign bodies are lying on the output transistors in the main amplifiers or across the cooling fins of the rectifiers on the power supply.

Check tightness of all screws in barrier strips on left and right hand motor boards and in the preamplifier power supply lead.

The foregoing checks will ensure that it is safe to apply power to the instrument.

2 - 2 POWER ON.

Before switching on the mains supply set the mains tapping plug correctly as described in Sec: 1.5. Ensure that the Mains source available is of sufficient capacity to run the instrument safely. Do not try to operate it using a bayonet adaptor in a light bulb socket for instance; bear in mind that the peak load taken by the MELLOTRON is 500 watts.

(a) PRELIMINARY.

The key operated panel switch should now be turned clockwise whereupon the indicator lights above the station selector switches should light. If they do not, investigate as per Section 4.1a. The instrument will take about 15 to 20 seconds to warm up and now with the rhythm and fill and volume control having been turned half way open, if a key is depressed a sound of some sort should be heard. Assuming that sound is obtained, this will show that the capstan is turning, the key is functioning, the sound interconnections are complete and that the electronics and loudspeakers are operative. If sound is not obtained refer to Section 4.1a.

(b) CYCLING CHECKS.

The cycling checks are best carried out with top and back of the machine removed. By inspection of the index tape where it lies across the sensing head, a number should be visible. This number should correspond with the button depressed on the panel. If it does not, switch off and depress the correct button, switching on again afterwards.

Press an adjacent button whereupon the indicator light will go out, the keylock will be heard to operate and the tapes will begin to move. They should move rapidly for about 3 seconds - come to a temporary halt - and then begin to inch in a series of short jumps. As the numbered mark on the index tape passes over the sensing head the tapes will stop, the keylock will be heard to release, and the panel light will come on again to show that a station has been selected. The number on the index tapes should agree with the number of button pressed. If the tapes show no indication of coming to a halt after 5 seconds, switch off panel switch and investigate.

While cycling takes place, the bottom rollers should all stay near the bottom of the separators. This can be checked by inspecting the loops as the tape is cycled. If any loop shows a tendency to rise as cycling takes place, see Section 4.4a. This must be checked while cycling in both directions.

Repeat the above operation by cycling the tapes back to their original position, checking that the inching time is the same forward as reverse. To check this, approach a station from both directions, e.g. cycle to Station 3 from 4 and from 2 and note the actual inching time from each direction. If these are not approximately equal, see Section 3.1(d)

3 - 1 (b) TRACK SELECTOR LINKAGE. FIG. P.2.

It will be seen that the arrangement of the switches varies, in fact the RHYTHM selector has the screwed end of the actuating rod protruding from the left hand end, while the FILL and LEAD selectors have it protruding from the right. The description following will relate to one having the left hand protrusion but the same remarks apply to the other.

CYCLE RHYTHMS TO STATION 3.

Select Track B and play any rhythm key.

It should be obvious if the sound obtained is clean or if a mix is occurring. If there is a mix, identify if it is track A or C which is interfering. If track A interferes then we must move the head block more towards track C or to the right, and vice versa.

Let us say that the head block has to move to the right then looking from the keyboard end, slacken the nut on the right of the connecting angle (Nut A. in Fig. P.2) half a turn and tighten other nut. This must be done with two spanners to avoid strain on the long pin which operates in a slot in the mounting plate. If only one spanner is used, the risk of bending this pin is considerable.

Check again by playing track B to see if this is sufficient movement or if it has been too much. To move to the left we would slacken nut B and tighten Nut A. (For the right hand protrusion, the lettering) of these nuts would be reversed).

When the correct positioning has been achieved, there should be no suspicion of any of track A or C sound when playing track B.

If, in the correct position Nut A is hard up against the support pillar, or very close to it, slacken Nut J again using two spanners, and move the head block to the right. Re-tighten nut J firmly and reposition the connecting angle as described above. In the case of a right hand protrusion, move the head block to the left.

3 - 1 (c) ADJUSTING TRACK SELECTOR SWITCH. FIG. D.3.

There are two systems of adjustment which may be encountered and the most recently introduced is described first.

ADJ. FOR SLOP IN ACTUATING BAR.

When the switch is in correct adjustment there should be a very small amount of end play in the actuating rod, to allow a positive selection to be made. If one position has more play than the others, proceed as follows Remove control panel as described in 3 - 3 a.

TYPE 1. Gently turn screws A and B equal amounts in a clockwise direction not more than a 1/4 turn at one time, and check for slop again. Repeat if necessary and replace front panel.

TYPE 2. Turn screw C a 1/4 turn anti-clockwise and turn screws A and B clockwise about a 1/4 turn each, and turn screw C clockwise until tight again. (Be very gentle as these screws have fine threads.) Check for slop and repeat until acceptable.

The second adjustment is to set the position of the head block selected relative to the others. This adjustment becomes necessary if for instance track A is clear; C is clear, but B has a mix of A or C on it. Let us assume that there is some A mixed with B and so we must move the head block to the right to lose it.

TYPE 1. Turn screw A a 1/4 turn anti-clockwise and screw B a 1/4 turn clockwise. Check again for mix and repeat if necessary.

TYPE 2. Exactly as Type 1.

If there were C mixed with B reverse the procedure.

3 - 1 (d) SETTING SYNCHRONISED SWITCH. FIG P.3.

The purpose of this adjustment is to equalise the time taken to inch to an index position when approaching it from both directions.

A centre station is selected at Station 3. Approach both from 2 and from 4 and see if the time taken from the start of inching to the stop is the same from both directions. If not, follow the simple rule set out below.

To increase the inching time from a direction, turn the sprocket on the synchronised switch in the same direction as it was rotating when the stopping point was approached from that direction.

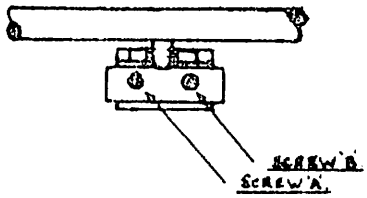
Let us say that the inching time from 2 to 3 is shorter than that from 4 to 3. We, therefore, wish to increase the inching from 2 direction and at the same time reduce that from 4. Cycle to 2 and then cycle to 3. Resting the fingers lightly on the synchronised switch sprocket, it will be possible to feel the direction of rotation, as the system inches. When the stopping point is reached, slip the sprocket against the chain in the direction it was going a few 'clicks'. Return to 2 and try again. It may be necessary to repeat the performance several times to get the inching time equalised.

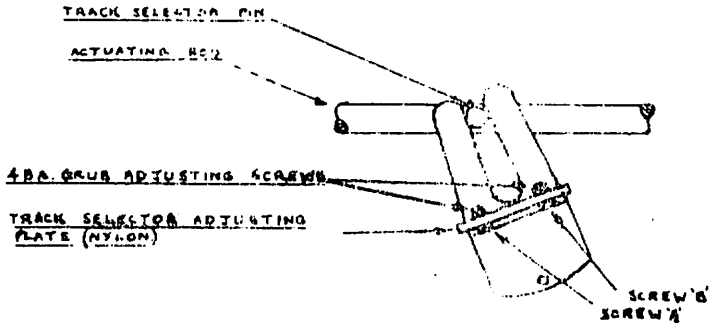
On recent models, a roller chain has been fitted to the instrument and adjustment of inching distance is carried out by moving the wiper on the synchronised switch. The same principle applies as above. Note the direction of rotation of the wiper as it approaches a station. To lengthen the inching time from that direction, slacken the grub screw securing the wiper to the shaft and turn it on a small amount in the direction it was going. Tighten grub screw and try again.

TRACK SELECTOR SWITCH ADJUSTMENT

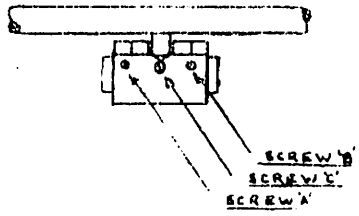
FIG. D3.
Section 3.1c

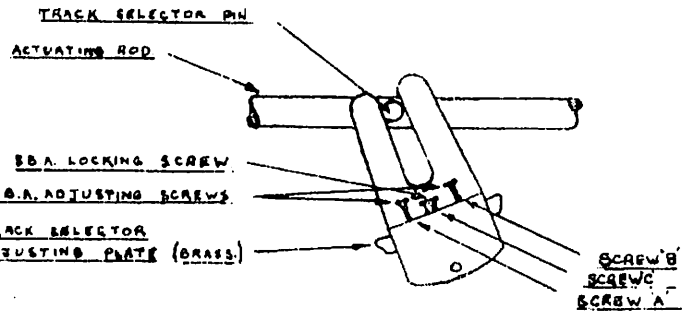
LATEST VERSION





ORIGINAL TYPE





3 - 1 (e) INCHING CONTROLS.

These controls situated on top of the S.S.C.U. (See Fig.P.15) control the pulse period and the space time between pulses. The controls are adjusted in what is called a "Tram Driving" manner for optimum inching. "Tram Driving" means that the controls are interdependent and must be adjusted together.

Optimum inching may be defined as the type of movement which is firmly under the control of the drive pulse, but not too slow. It is obvious that the inching could be made very slow and very accurate. This would cause undue irritation to the player because he would have to wait longer for cycling to stop.

In practice, it has been found that pulses causing a jump of about 3/16" at a rate of about six per second are a satisfactory compromise.

Proceed as follows:-

Select a station adjacent to the one selected at present. When inching commences, adjust the space control until pulses occur at about six per second. By this time the cycling will probably have ceased. Select the original station, allow one second to elapse, then re-select the second station. This will cause the system to run out of inching range, reverse and come back allowing inching to re-start. This procedure will save time during this operation.

Next adjust the mark control for a jump of about 3/16". This will alter the pulse rate and so the space control should be re-adjusted to give about 6 per second. This adjustment and re-adjustment is continued until the optimum is achieved.

(f) PREAMPLIFIER PRESET CONTROLS.

The present controls involved are equalization control and output level control for each channel (See Fig P.2.)

EQUALIZATION CONTROL.

This enables the frequency response of each channel to be set to give N.A.R.T.B. replay characteristic but in practice is used as a kind of tone control. It is adjusted at the factory according to certain criteria which have been established, but the setting is as much a matter of personal choice as anything. The Engineer must set this, if required, to the taste of the customer.

Preset Level.

To enable a balance of the channels to be set up this control has been incorporated. It is adjusted as follows:- Cycle to Station 3. Set Rhythm and Fill controls to the half-way position. Adjust the output level controls of the Rhythm and Fill Section to give comfortable listening level and good balance between the Trombone Fill on A and the Dixieland Rhythm on A.

On the lead side the level control is adjusted so that even with the panel VOL control at maximum, the amplifier noise is not too obtrusive.

(g) SETTING OUTPUT TRANSISTOR BIAS.

Inspection of the inside of the main amplifier case will reveal two preset controls. These control the base bias of the output pair of transistors.

Proceed as follows:-

Turn both controls to the short circuit condition.

Using a Model 8 Avo meter on the 10 v. range, measure the D C across the output terminals with the loudspeaker dis-connected - at this time it should be nearly OV.

Adjust either control to make the meter read 1.5 V. Adjust the other control to return the reading to zero. This system only works if a dummy load of 68 ohm is used. The amplifier is now correctly set with about 30 mA. emitter bias current flowing.

(h) HUM BALANCE CONTROL. FIG P.15.

This control is set as follows:-

Adjust hum balance control for minimum hum and noise from the loudspeakers, with all panel controls at maximum.

3 - 1 (j) PRESSURE PADS.

The purpose of this adjustment is to equalize the response in all three tracks of the tape. Should it be found, for example, that the response of tracks A & B is clear but that C is muffled, proceed as follows:-

Perform operation 3.3 a. Remove key top stop bar and key affected by undoing the 2 BA Nyloc nut at the rear of the key. Remove the 4 BA screw holding the pressure pad arm and lift out pad. Viewing the pad end of the arm, it can be seen that if track C is weak in H.F. response due to too little pad pressure, we must increase this pressure by twisting the pad so that the left side comes lower. Care must be taken not to twist the spring which holds the pad arm.

Refit the pad arm making sure that the pad sits exactly over the tape and square on the head. Re-assemble and test. Make sure that improving track C has not worsened track A. If so, you have gone too far. Remove and try again.

A simple ruleis as follows:-

To increase pressure on track A twist pad clockwise.

To increase pressure on track C twist pad anti-clockwise.

This rule applies when viewing the arm from the pad end.

If it should be observed that the pad does not come up against the antivibration bars, form the spring around a rod of 3/4" diameter which will give it it's correct set.

3 Cont 1 d (j) If the response is poor off all three tracks, the pad may not be pressing directly on to the gap area and must be checked for position over the head. The pad should come down flat onto the head so check that there is no tendency to "toe in". This means that the tip of the pad is lower than the inner side. Bend the pad so that it is flat. If the response is still poor move the pad forward or back and try again. This may require a certain amount of trial and error.

3 - 1 (k) REVERB UNIT PRESET LEVEL.

The control on this unit is adjusted until, with the REVERB control on the panel set to maximum, there is no tendency for the system to 'howl round'. This phenomenon is produced by the spring delay line (S.D.L.) being stimulated by the output from the L.H. Loudspeaker. The noise generated then feeds the amplifier which drives the loudspeaker and this in its turn stimulates the S.D.L. If the gain of the system is set too high and the cabinet is bumped or the S.D.L. is disturbed in any way the 'Howl round' will develop.

To set the control:-

Open up REVERB control to maximum.

Turn preset clockwise until 'howl round' develops.

Turn back preset until 'howl' dies away.

Replace back of cabinet and check that the howl cannot be re-started, by playing loud lead notes. If it can, back off control unit until the system is stable.

This facility is available on later models only.

3 - 2 IT IS OF THE UTMOST IMPORTANCE THAT ALL TOOLS USED ANYWHERE NEAR THE MAGNETIC TAPES ARE DEMAGNETISED

The reason is that the relatively weak magnetic fields recorded on the tape can be obliterated by placing a magnet, even a fairly weak one, in contact with the tape. The audible result is a loss of signal. All ferrous metals, steel, iron etc., will magnetise in time, particularly if used in areas of high magnetic field strength such as occur near the loudspeakers. Therefore demagnetise your tools frequently.

(a) REPLACING A TAPE.

Cycle to Station (1): Perform Operations 3.3 (a.b.c.d.)
Remove tape storage box lid.
Slacken clutch on drive motor using tool e or f.
Turn rollers until screws on rear roller are accessible.
Release the screws holding the tape clamp, on either side of the tape to be removed, and pull tape out of instrument so that it hangs down the front. Be careful that adjacent tapes do not release at the same time. Place a cardboard box for the tape to fold into.
The replacement tape will be supplied with the start out and this should be placed under the clamp, the screws then being tightened.
Turn rollers by hand winding new tape onto rear roller and old tape off front roller at the same time folding it into the cardboard box. Continue until the screws on the front roller are accessible and release the old tape. Wind surplus new tape off the spool and clamp end in place of old one.
(See Fig. P.8.)
Using service tool 'K' push the tape down on either side of the top support roller so that it goes in two loops between the separators. Continue pushing the tape down until the tongs are fully down, then leaving them in place and feeling upwards between the two separators, catch the two loops on the first and second fingers. Pull down the loops fully and place them round the two pulleys on the V spring. Make sure that the V spring is towards the weld on the separator. This avoids the catching of the rollers in the weld.

The tape must now be positioned so that it's start is in line with the start on all the other tapes. To assist in this, a burst of signal about 1/8" long has been recorded on each tape about 10½" from the end. Replace tape storage box lid, keylock flap, pad assembly, keys and front panel. Switch on power and tap a key near to that operating the replaced tape. Move the rear roller until when a key is tapped a sound is obtained. This sound will not be musical but more in the nature of a squeak.

The tape clamps are then partially released on the new tape and the key operating this tape is tapped. The tape is pulled through until the squeak is obtained from this tape too. It is then correctly positioned with respect to the rest.

On earlier models no squeak was recorded, and positioning must be achieved by 'trial and error'. Experience will show when the best results are obtained. The tape clamp screws are firmly tightened and the clutch on the driven motor is screwed up.

Pressing any selection button will put the instrument in a playing condition.

To avoid confusion single tapes should be ordered according to the following code:-

KEY NO: LEFT HAND	INDEX	1	2	-	to	-	18
ORDER AS RHYTHM	"	EC	1	-	to	-	17
KEY NO: LEFT HAND	"	19		-	to	-	35
ORDER AS FILL		1		-	to	-	17
KEY NO: RIGHT HAND		1		-	to	-	35 INDEX
ORDER AS LEAD		1		-	to	-	35 INDEX

3 - 2 (b) REPLACING A SET OF TAPES.

The procedure for replacing a set of tapes differs slightly from that for single tapes because the tapes are supplied already correctly positioned on a substitute rear roller.

Cycle to Station 6.
Again perform operations 3 - 3 (a.b.c.d.)
Remove tape storage box lid.
Slacken clutch on drive motor.
Turn rollers until clamp screws on front roller are accessible.
Slacken all clamp screws to release tapes.
Turn rollers to wind released tapes on to rear roller and secure the ends of the tapes with splicing tape if it is desired to retain the tapes for further use.
Remove the 2 BA cap screws from the rear roller spindle and slip the chain off the drive sprocket.
Lift out the old roller and replace with the new, re-fitting the chain.
Release the free ends of the new tapes and turn the rollers forward

forward about 2 turns to allow the free ends to fall between the roller and the tape storage box. Make sure that all tapes unwind the same number of turns. This will be immediately obvious because of an extra turn unwound will make the free end of that tape a foot longer than the others. Using a screwdriver, lift each tape in turn and place it so that it lies coiled in the bottom of its compartment in the tape storage box.
Turn the rollers another three times feeding more tape into the tape storage box.
Taking each tape in turn from the tape storage box, bring it forward and clamp it to the front roller. Care should be taken not to release tapes previously secured while this is done.
Form the loops as described above in 3.2a observing the correct position of the V spring with respect to the weld on the separator.
Replace T.S.B. lid, Keylock flap, etc.
Tighten clutch on cycling motor.
Cycle and check results.
The height of the loops can now be set to the correct position as described in 2.1.
Slip the chain off the rear roller sprocket, and hold it so that the front roller cannot move. Turn the rear roller until the tapes loops come to the correct height. Replace the chain.

3 - 3. STRIPPING PROCEDURE.

(a) FRONT PANEL. FIG. P.5.

Slide the top off the cabinet. Unplug all leads from the sound control panel. Remove the nine pin plugs from the sensing head brackets and the centre socket panel. Disconnect the mains lead from the key operated switch. Select B track on all track selector switches.

The panel may now be eased gently upwards making sure that the track selection linkages do not lift the head blocks with them.

(b) KEYS. FIG. P.9.

First the top stop bar is removed by undoing the two 2 BA screws. This will allow the keys to spring upwards off the front guide pins. Slide service tool 'M' under the keys just behind the front guide pins, taking care not to catch the tapes. Using the bar, lift the keys sufficiently to allow the bar to be rested on top of the key stop pillars. This will relieve the strain on the key mounting bar and enable the 2 BA cap screws to be removed safely. Use service tool (j).

Grasping the bar and the end keys, it will be found possible to lift all the keys together and, being careful to manoeuvre the chain tensioning jockey between the chain and the index tape, remove from the instrument. Place down the keys on a clean surface, such as newspaper, to avoid dirtying the pinch rollers.

(c) PAD ASSEMBLY. FIG. P.10.

The pad assembly can now be removed by releasing the 2 BA screws holding it, and lifting clear, care should be taken not to bend any of the pads when placing the assembly on a clean surface.

(d) KEYLOCK FLAP. FIG. P.10.

Loosen the collar on the shaft which carries the flap, found near to the centre support pillar. This will enable the flap to be slid along towards the centre of the instrument releasing the crank pin and allowing the outer end of the shaft to clear the outer support pillar. The flap can now be moved towards the outside of the frame allowing the shaft to come out of the hole in the centre pillar and enabling the flap to be lifted upwards.

(e) HEAD BLOCKS. FIG. P.12.

The tapes are lifted clear of the head block and tape guides by sliding service tool (M) under the tapes one by one until all the tapes are supported by the bar. The bar can now be raised carefully without doing any damage, as the tape is pulled out of the storage loops.

The W shaped springs holding down the head block are lifted clear of the holes in which they engage and are allowed to pass down the side of the head block. The head block can now be removed from the instrument by passing it carefully between the tapes and lifting clear.

(f) REMOVING FRAME FROM CABINET. FIG. P.13.

Remove panel as shown above.

Take out the black end blocks by pressing down the end keys and removing the screw from the back end. The block can then be lifted out of the clip which holds the front end down Looking down into the instrument at the front (See Fig:P.13) two wedges will be visible, one at each end of the front angle of the frame. These must be removed. The three front frame clamps must be released and rotated out of the way.

Also to be removed are the four screws and clamps which hold the rear angle of the frame to it's support. These are accessible from underneath.

The following cables must be disconnected.

The two octal plugs from S.S.C.U's to Power Unit.

The four pin plug from reverb unit to P.U.
The two coax plugs from reverb unit to S.D.L.
Lead from Reverb unit to R.H. spkr. panel.
Input cables to both main amps.
Leads to foot pedal.
Leads from V.F.O. to capstan motor.
Non. rev. plug V.F.O. to control panel.
" " " P.U. to key switch (early models)
Secure all leads out of way.

At least two persons are required to lift the frame out, three being preferable.

With one person at each end, a lifting handle Service Tool (L) is hooked under the rear storage roller spindle, the other hand grasping the key top stop bar. The frame is then gently lifted and moved forward to clear the fillet at the rear of the cabinet. Lifting then continues, the lifting handle being held slightly higher than the front hand to avoid ripping the foam rubber sheet, fixed to the front of the cabinet, with the lower separator pins.

When the frame reaches chest height, the third person becomes valuable because he is able to support the frame while the end lifters change their hand position to lift the down frame clear of the cabinet.

A suitable cradle should be provided preferably consisting of two parallel bars about 20 inches apart supported by 2½ feet above the floor. This will ensure that the frame is supported correctly and not rested on the down frame, which should be avoided.

3 - 5 SERVICE TOOLS. FIG.P.14.

The list below gives a guide to the tools required to service the MELLOTRON efficiently.

(a) DEMAGNETISER.

Illustrated is the inexpensive INSTANT bulk eraser which can be purchased from NORMAN ROSE LIMITED. This is absolutely essential if the MELLOTRON tapes are to be given their greatest expectation of life.

(b) INSTRUMENT SCREWDRIVER.

STEADS. 1/8" BLADE. 6" LONG.

(c) HEAVY SCREWDRIVER.

STANLEY RATCHET 1/4" BLADE.

(d) SNIPE NOSE PLIERS.

6" LONG.

(e) SPANNER.

Two required:- THIN 1/4" B.S.F.

(f) SPANNER.

THIN 2BA.

(g) SET OF SOCKET SCREW WRENCHES.

(h) CLUTCH SPANNER.

Short 2BA box spanner at right angles to operating handle. Obtainable from factory.

(j) EXTENSION SOCKET WRENCH.

Mild steel shaft with handle, drilled to take 2BA size socket wrench with grub screws for holding wrench in place.

(k) TONGS.

Strip of soft aluminium 3/8" wide and 18" long, bent to form hairpin shape.

(l) HANDLES.

1/4" Mild STEEL ROD bent as shown.

(m) BAR.

Aluminium BAR 20" long 1/2" x 1/4" section chamfered all round both ends.

(n) SIDE CUTTERS.

(p) RING SPANNER.

1/4" B.S.F.

(q) 2BA BOX SPANNER.

T H E

"M E L L O T R O N"

SERVICE MANUAL.

P A R T 3.

MAINTENANCE PROCEDURE.

GENERAL.

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3 - 1 (a) KEY ADJUSTMENT.

1) Depth of Movement of Keys. This is controlled by the aluminium angled bars which are supported about 8" from the front of each keyboard on top of the keys. The height of these bars is adjusted so that the maximum depth of key movement is 3/8".

2) KEY TENSION (OR TOUCH) FIG. P.4.

The key tension is determined by the 2BA NYLOC NUTS, retaining the key leaf springs at the rear of the keys. By turning each nut clockwise the key tension will increase and the key will rise. In manufacture keys are adjusted by the above method until the key rises and just comes into contact with the angle bar above the keys. When all the keys are just touching the underside of the bar a further 1/4 turn is applied. This is standard key adjustment.

3)(a)PAD ADJUSTMENT. FIG. P.4.

Pressure pad adjustments are made by turning the 4BA screws protruding from the top of keys nearest to the front panel hereinafter called PAD ADJUSTMENT SCREW.

Assume that the pad is not pushing the tape into contact with the reproducing head at all. Clockwise movement of the adjusting screw will cause the pad to move down under key pressure and with correct adjustment allow the tape to play.

THE PAD ADJ. SCREW should be turned clockwise until a good response is obtained from A, B & C tracks. When this is achieved a further 1 complete turn should be made.

PINCH ROLLER ADJUSTMENT.

This adjustment is also effected from screws on top of the keys. This time the screw nearest the rear of the keys.

Correct adjustment of the pinch rollers is a full 3 turns beyond stall.

To achieve this setting turn the Pinch Adjustment Screw ANTI CLOCKWISE until the tape slows down and eventually stalls or stops driving. This can easily be heard if the volume control for the keyboard concerned is raised. Now the screw should be turned 3 full turns hence the term "3 turns beyond stall".

PART 3.

MAINTENANCE PROCEDURES.

This section gives in detail all the standard adjustments and procedures called for in other sections.

Firstly, two general important directions.

1) All tools used must be DEMAGNETISED. See 3.2

2) Whenever work is done inside the back of the instrument it is advisable to remove your watch. The powerful magnetic field of the loudspeaker can magnetise even so-called anti-magnetic watches.

   Following from the two above remarks, it can be seen that if a tool is used anywhere near the loudspeakers, it should be demagnetised immediately after use, lest it be overlooked.

4 - 1 (a)

NO SOUND WHEN ANY KEY IS PRESSED

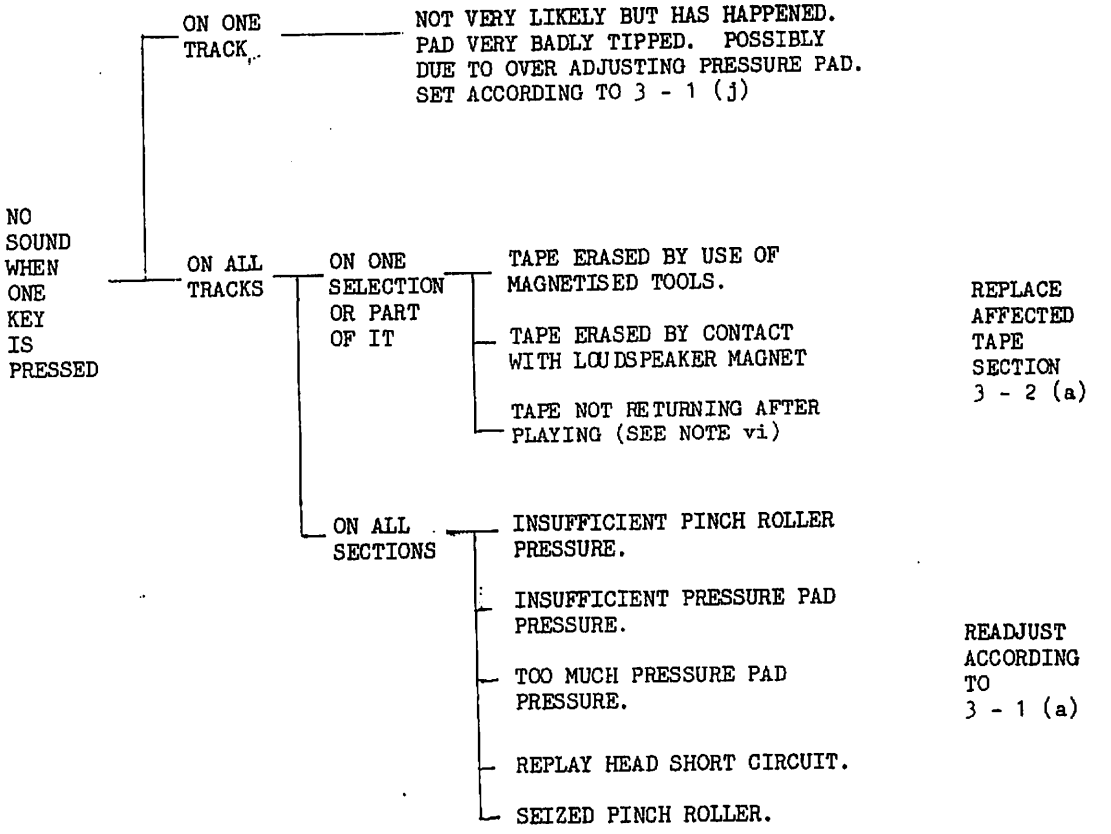
- PANEL LIGHTS OUT
  - MAINS PLUG NOT IN
  - PANEL SWITCH FAULTY - CHECK BY OPERATING SERVICE SWITCH OR IF NOT FITTED BRIDGING OUT TERMINALS ON BARRIER STRIP.
  - MAINS FUSE BLOWN - REPLACE. IF IT BLOWS AGAIN REMOVE ALL OUTPUTS FROM P.U. AND REPLACE. IF O.K. REPLACE OUTPUTS UNTIL CULPRIT REVEALED.
  - POWER UNIT FAULTY - IF MAINS FUSE BLOWS WITH ALL OUTPUTS REMOVED, POWER UNIT REQUIRES INVESTIGATION - SEE NOTE (i)
  - CAPSTAN NOT TURNING -
    - CAPSTAN MOTOR U/S OR PHASE SHIFT CAPACITOR OUT OF CIRCUIT.
    - VFO. NOT WORKING CHECK FUSE ON POWER UNIT, IF IT BLOWS WHEN REPLACING REPLACED, TEST TRANSISTORS ON VFO.
- PANEL LIGHTS ON
  - PREAMPLIFIER NOT WORKING - CHECK FOR VOLTAGES ON BARRIER STRIP ALONGSIDE. ARE VALVES ALIGHT.
  - SWITCHES ON EXT. SPEAKER PANEL IN WRONG POSITION.
  - MAIN AMPLIFIERS BOTH NOT WORKING. - INVESTIGATE POWER SUPPLY, ARE FUSES INTACT ON + AND — 35 V RAILS.

4 - 1 (b)

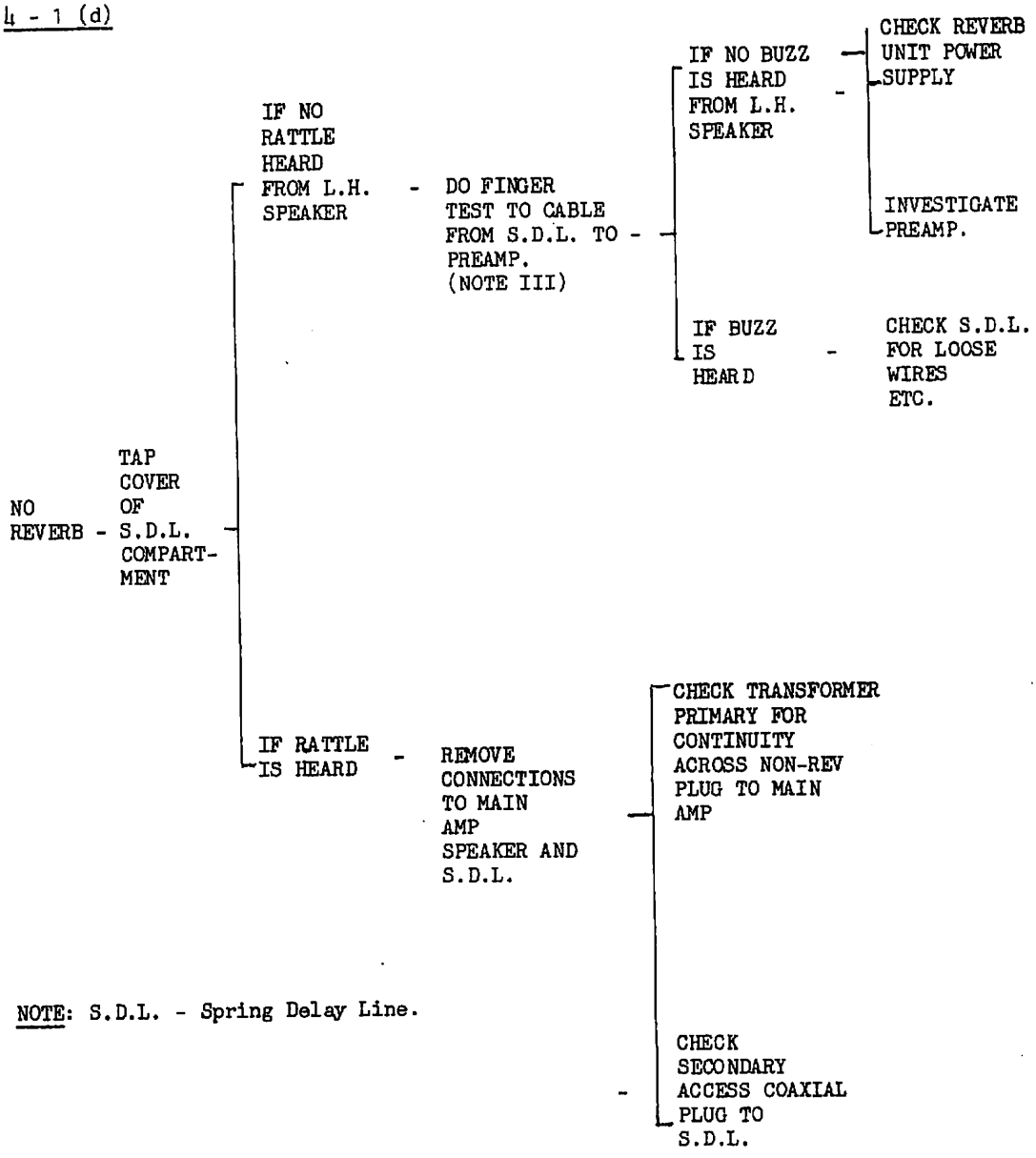
NO SOUND WHEN A KEY IN A PART-ICULAR SECTION IS PRESSED

- LEAD OR BOTH RHYTHM AND FILL NOT WORKING
  - SPKR O/C
    - IF LEAD SIDE-CHECK IF REVERB WORKS IF O.K. SPEAKER O/C IF RHYTHM & FILL. CHECK SPKR WITH BATTERY OR METER. (See Note (ii)
  - INT/EXT SWITCH IN WRONG POSITION
    - DO FINGER TEST (Note iii) TO INPUT OF MAIN AMP. NO BUZZ INDICATES U/S.
  - MAIN AMP NOT WORKING
    - DO FINGER TEST TO CABLES AT PRE-AMPLIFIER FOR LEAD OR SOUND CONTROL PANEL FOR RHYTHM & FILL.
  - INTERCONNECTIONS O/C. S/C.
  - PREAMPLIFIER U/S. RHYTHM & FILL ONLY.
    - RATHER UNLIKELY (Note iv)
- RHYTHM FILL OR LEAD NOT WORKING
  - PREAMPLIFIER U/S.
    - INTERCHANGE VALVES WITH CHANNEL KNOWN TO BE WORKING.
  - HEAD BLOCK O/C.
    - IF LOUD BUZZ OBTAINED WHEN CONTROL ON AFFECTED SECTION TURNED UP HEAD BLOCK IS O/C. CHECK BY SWOPPING LEADS WITH ANOTHER HEAD BLOCK (Note v)
- FILL FAULTS THAT ARE NOT COVERED ABOVE
  - HEAD BLOCK S/C.
    - CHECK BY SUBSTITUTION (Note v)
  - (LEAD ONLY) FOOT PEDAL CONTROL U/S.
    - REMOVE LEADS TO FOOT PEDAL FROM DISTRIBUTION POINT AND BRIDGE CENTRES OF COAX PLUGS. SIGNAL O/K. INDICATES FOOT PEDAL U/S.

4 - 1 (c)

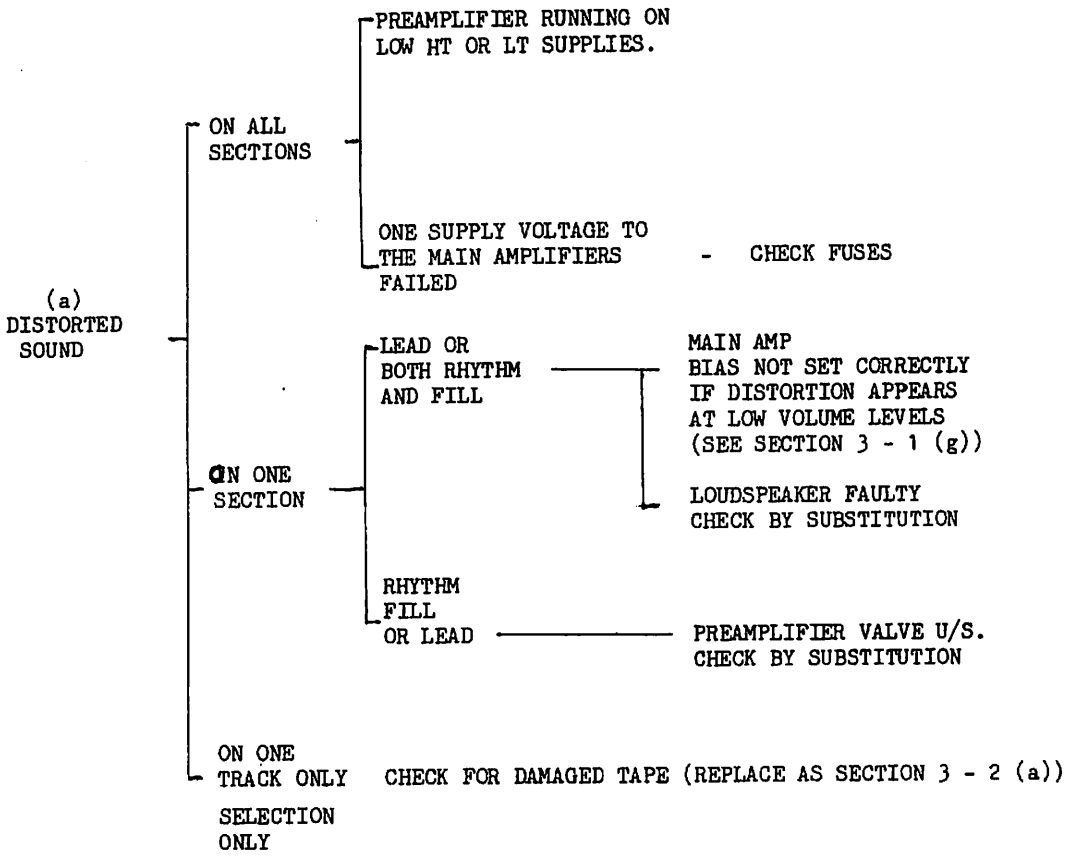


4 - 1 (d)



NOTE: S.D.L. - Spring Delay Line.

4 - 2. BAD SOUND OF VARIOUS TYPES.



b) BACKGROUND HISS WHEN TAPE IS PLAYED.

Usually due to two causes. The first contributes a moderate amount of hiss and is called modulation noise on the tape. This is a function of tape recording continuous tones and there is no cure.

A severe hiss is most likely caused by a magnetised head block. If this is the case the head block must be removed and demagnetised immediately. If this is delayed, permanent damage to the tapes will result.

c) BACKGROUND HISS OR HUM.

Check that the hum balance potentiometer is correctly set (See Section 3 - 1 h). Hum that cannot cured by this means is possibly due to heater cathode leakage on the preamplifier valve, if it is on one section only.

4 - 2 (c) Cont'd.

Pickup of Television carrier is another possible cause of hum. The reason for this is the very high impedance of the head block.

Check also for earth loops introduced by correct use of Ext. L.S. Panels, etc. Are cables earthed exactly as per Fig. D.10.

(d) MICROPHONY.

Preamplifier fault. Replace affected valve or inter change it with a cathode follower where microphony will not cause trouble.

(e) INSTABILITY.

Check that the earthing of the cables in the instrument is exactly as the diagram Fig. D.10 shows. If the instability occurs only when the Rhythm or Fill Control is turned up, check that the equaliser control is correctly set. If so, the 50 pf. capacitors C.4. 9. 13. should be fitted if not in place.

Another cause of instability is failure of main amplifier. Check by disconnecting input. If instability persists change main amplifier. N.B. Touch the screen of the plug on to the chassis of the amplifier otherwise instability will be caused by this test.

Instability may also be caused by head block assy. S/C. to frame giving earth loop.

(f) CLICKS AND OTHER INTERMITTENT NOISES.

Check tightness of screws in barrier strips, seating of plug and valves, etc. Cause of intermittent crackling can sometimes be located by discreet tapping around the instrument.

(g) ZIP.

This noise is caused by the returning tape, after being played, passing too close to the replay head. It should be well out of the way. Check setting of pads according to Section 3-1 (j). Check also for correct adjustment of key. (See Section 3-1 a).

It may be necessary to lower the head block on early instruments by fitting new head block rollers. Consult the Factory for details.

i) SECTION 4 - 1 (a)

Mains fuse blowing with no load on the power supply indicates the following faults in order of likelihood.

Smoothing capacitor short circuit.
Rectifier short circuit thus putting AC. on to capacitors giving high current drain.
Short circuit in wiring.
Main transformer short circuit turns.
Insulation breakdown on Mains transformer or smoothing.
Insulation breakdown on rectifier stack.

ii) SECTION 4 - 1 (b)

To check a speaker with a battery, connect leads to the battery and touch the terminals of the loudspeaker. A crackling noise indicates speaker O.K.
An AVOmeter can be used for continuity check.
If no meter or battery is to hand, remove non -rev. plug from amplifier and touch it lightly on the socket contacts. A slight crackle will show speaker O.K.

iii) SECTION 4 - 1 (b)

THE FINGER TEST.

To apply this test, hold instrument screwdriver in hand and touch centre contact of "coaxial socket" (or coax plug in the case of a cable). Loud buzz from speaker indicates section O.K. When testing a coaxial cable, it is best to touch the shield of the plug onto the earthing contact of the socket when performing the test because in the instrument some of the cables complete the signal earth for other parts. Removal of the earth would thus cause instability to develop.

iv) SECTION 4 - 1 (b)

This unlikely fault concerns the HT supply to V1, V2, V3 of the preamplifier and is caused by either R7 going O/C or C2 going S/C.

v) SECTION 4 - 1 (b)

It will be seen that the FILL head block lead could be plugged into either the RHYTHM or LEAD INPUTS. The LEAD head block lead can be used to check the FILL input. Remember to turn down the gain on any section from which you remove the head block lead. It is most important that no head block should ever be plugged into the LEAD output socket (coded MAROON/WHITE). This will almost certainly magnetise the head block, this condition being shown by a loud background HISS whenever a tape is played on it. See Section 4.2b.

vi) SECTION 4 - 1 (c)

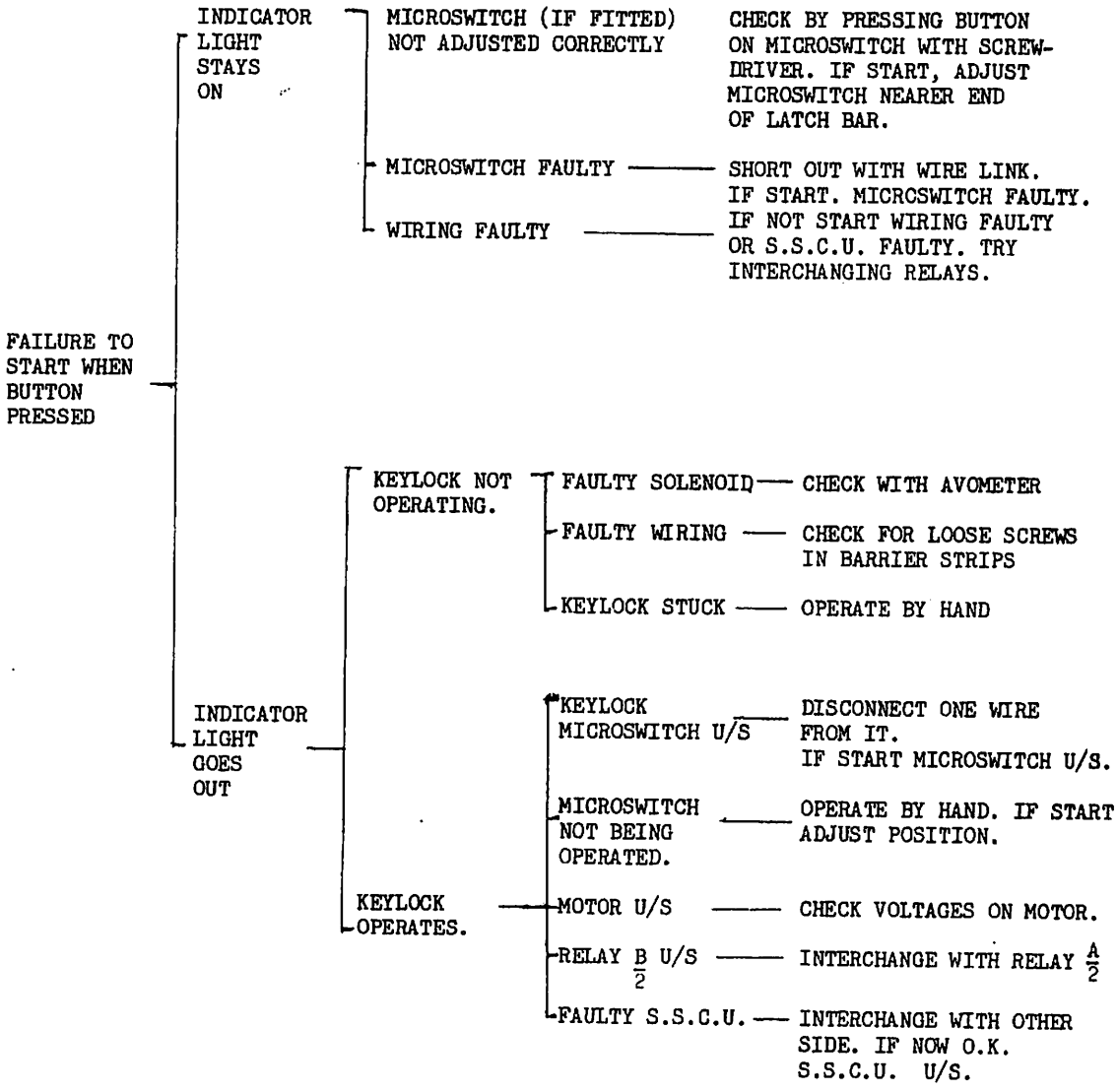
If a tape fails to return, check that the pinch roller is adjusted correctly (See Section 3 - 1 a). Make sure that the tape is lying across its correct guides and that it is not gripped in any way. Check rollers in storage loop for tightness. They should all turn quite freely.

vii) SECTION 4 - 2 (j)

It is no secret that the use of high impedance heads, which are the only ones at present available at the right size and of good enough quality, leads to undesirable results when many are connected in series. Due to the complex arrangement of inductances and stray capacitances, certain heads give less output at high frequencies, than others. This is minimised by the careful selection and matching of sets of heads for use in a head block.

However, even if all conditions are set correctly, a variation in high note response is obvious as the different keys in a section are played. This effect is most noticeable on the rhythm Head block and at this time, nothing can be done about it.

4 - 3 CYCLING FAULTS.



4 - 3 (b) FAILURE TO INCH.

If the system passes but fails to inch the S.S.C.U. is almost certain to blame.

If all the selected positions are completely ignored again the S.S.C.U. is usually faulty - often the output transistor TR10. If only one station is ignored, check the push button switch, the wiring and the synchronous switch (for good contact). Check also correct seating of all plugs.
Sync. switch wiper making poor contact.

FAILURE TO STOP.

The possibilities are as follows:-

INDEX TAPE ERASED	- Not very likely unless just one position is affected.
SENSING HEAD O/C SERIOUSLY OR OFF AZIMUTH.	- Check for continuity and demagnetise afterwards. Inspection will show if azimuth is near enough.
CABLE TO SSCU BROKEN	- Check with avometer. Demagnetise head afterwards.
SSCU FAULTY	- Interchange with other side. If now O.K. SSCU should be investigated for cause of low gain.
RELAY $\frac{A}{2}$ STICKING IN	- Interchange.

FAILURE TO REVERSE.

S.S.C.U. fault - Check by interchanging.

OVERSHOOTING.

Inching controls are set to give too fast approach. Set as per section 3 - 1 (e)

Synchronised switch out of position (See Section 3 - 1 (d)).

4 - 4 MECHANICAL FAULTS.

(a) TAPES HANGING UP while cycling.

This condition can be detected by inspection of the storage loops as cycling takes place. Section 2 - 2 (b).

Possible causes are - maladjusted keys. Section 3 - 1 (a)

Stiff pinch rollers - also causes a slow return of tape after playing.

Dirt or fluff in tape guides - clean them.

Tape being caught by tape separator pins. Check that there is at least a gap of .400" between pins.

(b) When the track selector switches are set to give A B or C it should not be possible to hear anything but the track selected.

If breakthrough of an adjacent track is heard, adjust track selector as detailed in 3 - 1 (b).

(c) TRACK SELECTION STIFF.

This condition is usually caused by lack of care on reassembly of instrument after service operations. (See Section 3 - 3 (e)). It is possible, however, with the passage of time for dirt to accumulate on the actuating bar of the track selector switch. (See Fig.11). The bar should be cleaned with a rag damped with light machine oil and the bearings sparingly lubricated with the oil.

(d) CAPSTAN MOTOR NOISY.

Remove and oil felt pads.

(e) TRACK SELECTOR MOTORS NOISY.

Check grease filling in gear box.

Oil Felt Pad at rear of Unit.

Check brushes for wear and replace if necessary.

(f) CAPSTAN DRIVE BELT STRETCHING.

Re-position capstan motor.

(g) CHAIN FALLS OFF OR IS NOISY.

The chain has probably stretched with wear and requires resetting. Remember that the chain has to wear only 1 thousandth part of an inch per link to give a chain stretch of 0.320" since there are 320 links. Firstly check that the jockey mounted under the key mounting bar is operating correctly.

4 - 4 (Cont'd) (g) The chain can be tightened by re-positioning the synchronised switch. Slacken the upper screw which mounts the synchronised switch until it clears the wood. Swing the switch inwards about its lower mounting screw to tighten the chain and screw up the upper fixing screw, making a new hole in the wood to do so. The chain is tight enough when the jockey is raised from its relaxed position. Slacken the clutch on the motor and cycle by hand to check the jockey never loses control of the chain.

If the upper fixing screw has to be moved more than about ½" a link should be removed from the chain as follows:-

Cycle the system by hand until the softened link is accessible (THE REST OF THE CHAIN IS CASE HARDENED AND WILL SNAP IF THE LINKS ARE FORCED).

Wedge front and rear rollers to avoid spillage of tape. Open softened link carefully and remove chain from instrument. Anneal an adjacent link by heating to redness in a flame and allowing to cool slowly. Open annealed link to remove old soft link and scrap old link.

Re-thread chain and close link. N.B. The free ends of the link should be on the outside of the chain run. Take wedges out from rollers and tension chain as described above.

The above remarks apply to early machines. On later models, three links of unhardened chain have been let in which means that the chain need not even be removed from the instrument to perform this operation.

(h) EXCESSIVE SIDE PLAY IN HEAD BLOCK.

If this occurs when set to one track only, adjust the track selector arm as described in 3 - 1 (c). If the slackness occurs on all tracks (the play should not be more than 1/32") then inspect the linkages for signs of wear and replace any necessary parts.

3 - 4 REASSEMBLY HINTS.

GENERAL.

The re-assembly procedure is mostly the exact reverse of the stripping procedure. The following hints are just special remarks which will help the re-assembly to be performed easily.

(a) FRONT PANEL.

Take care to see that the pegs on the track Selector Arms engage correctly with the angle brackets.

Plug in the B9A plugs to the centre socket panel first before the coaxes.

(b) KEYS.

If you have had both sets of keys off, be sure that you fit the correct top stop bar to each as they are not interchangeable.

(c) PAD ASSEMBLY.

No special remarks.

(d) KEYLOCK FLAP.

When the collar is adjusted to hold the flap with the crankpin from the solenoid engaged with the grommet, do not force the flap too hard against the pin. This will make the keylock stiff in operation.

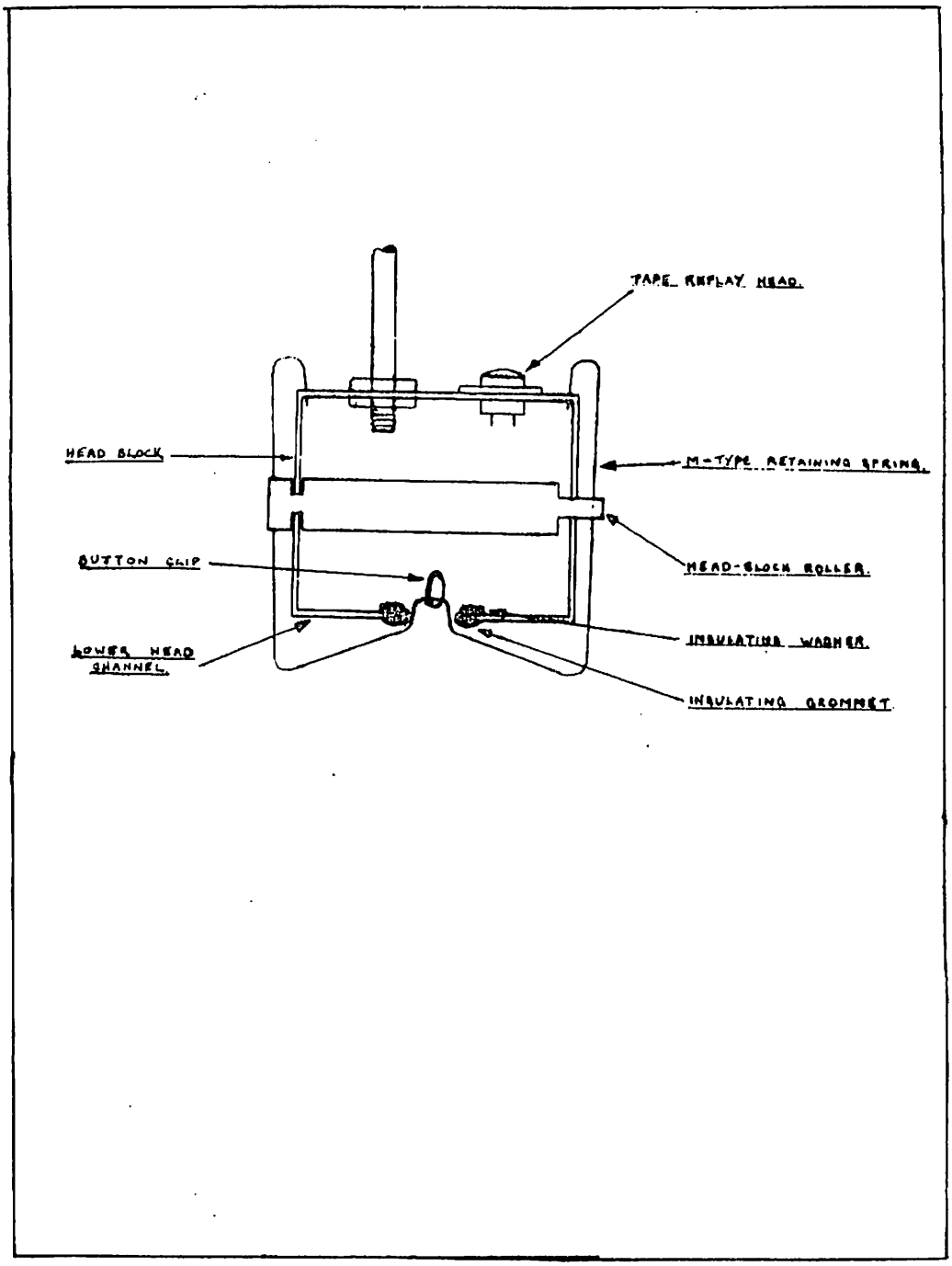
(e) HEAD BLOCK.

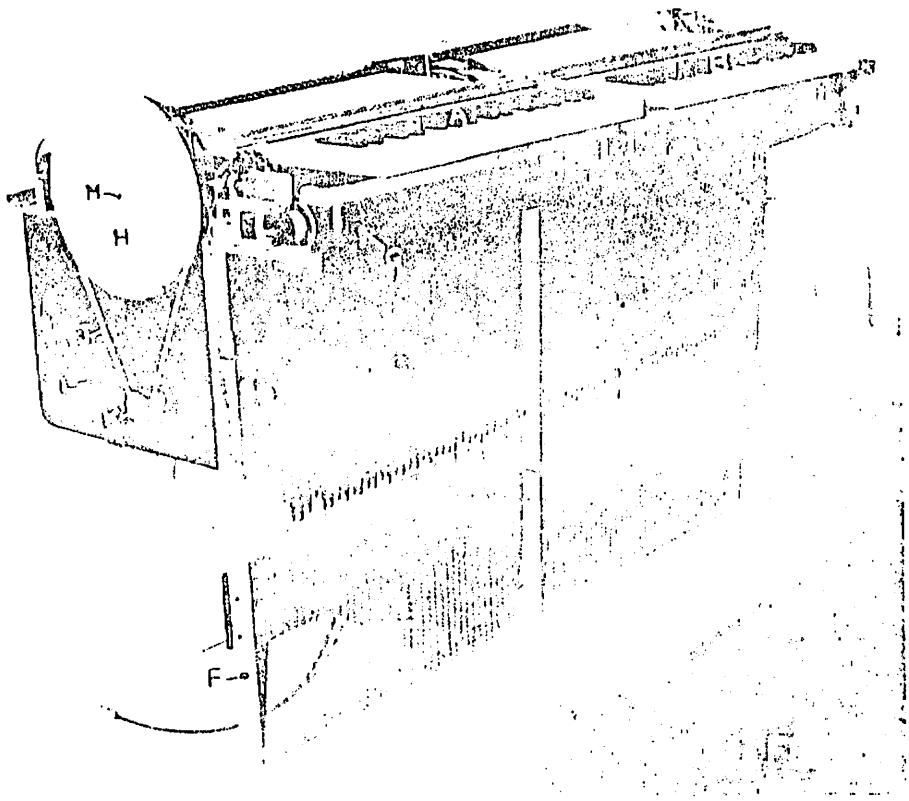
The "W" spring can easily be replaced by lifting each end at a time with a small screwdriver (Service Tool B). Check that the head block moves freely but that the "W" spring retains it on to the rollers.

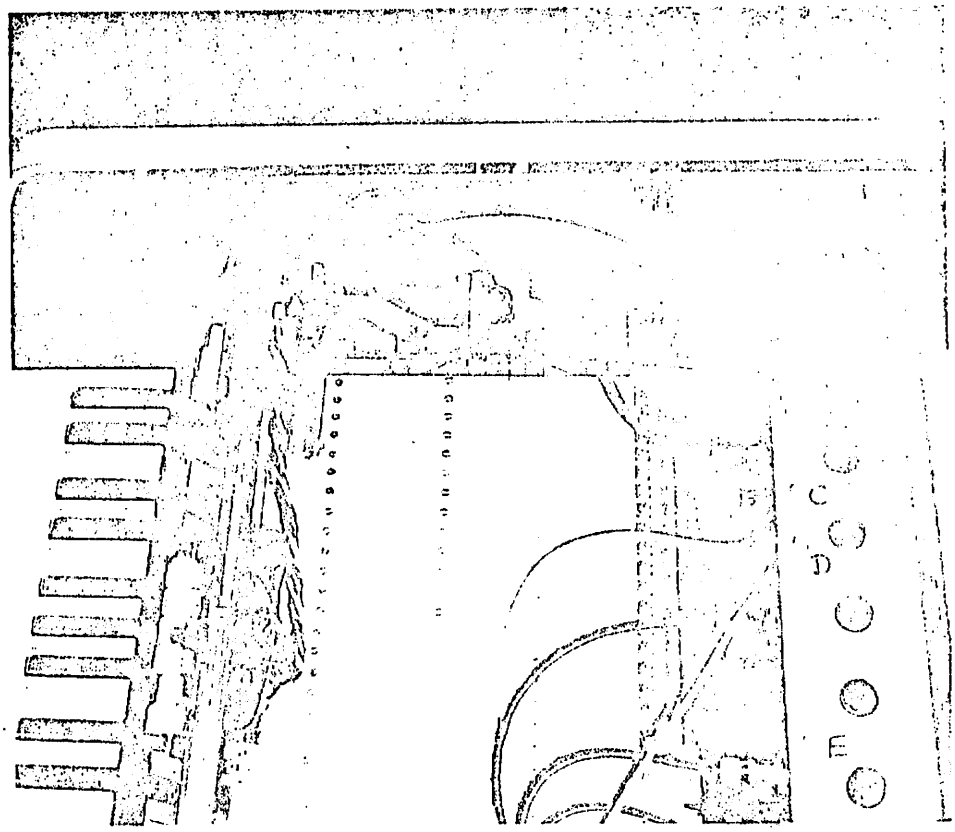
(f) Care should be taken not to damage the finish on the top of the sides of the cabinet when lowering the frame. As when the frame was removed, tilt it forward to avoid ripping the foam rubber pad.

FIG. D2
Section 1.3b

HEAD BLOCK MOUNTING







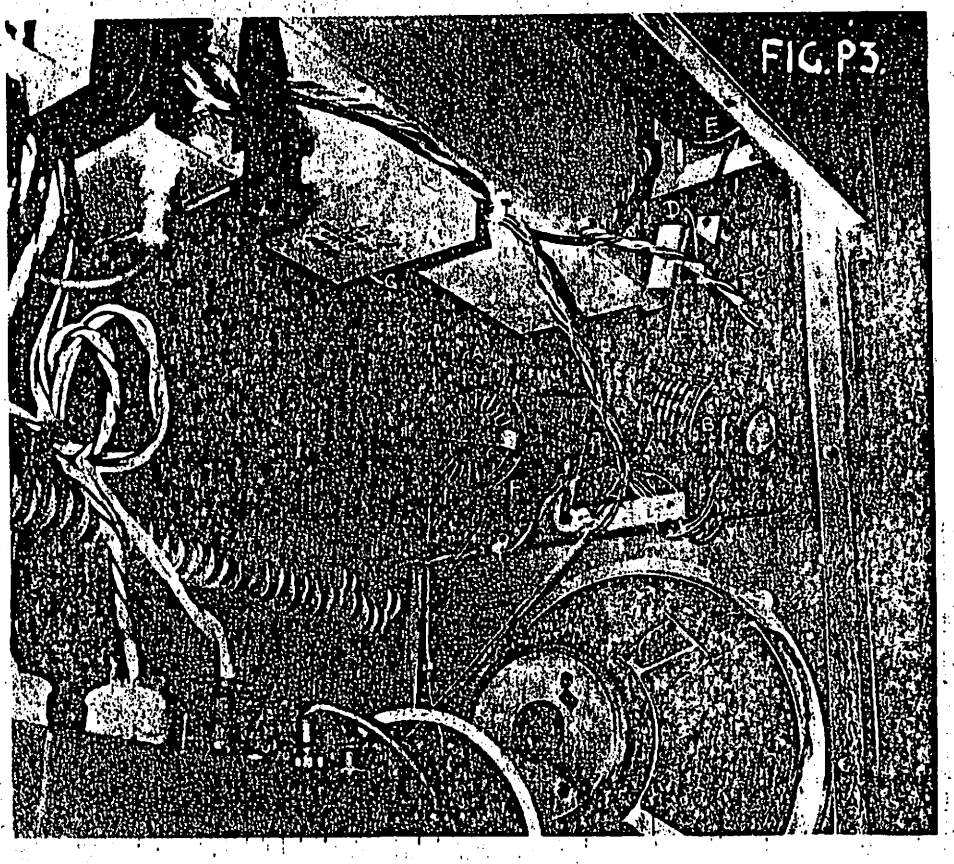


FIG. P3

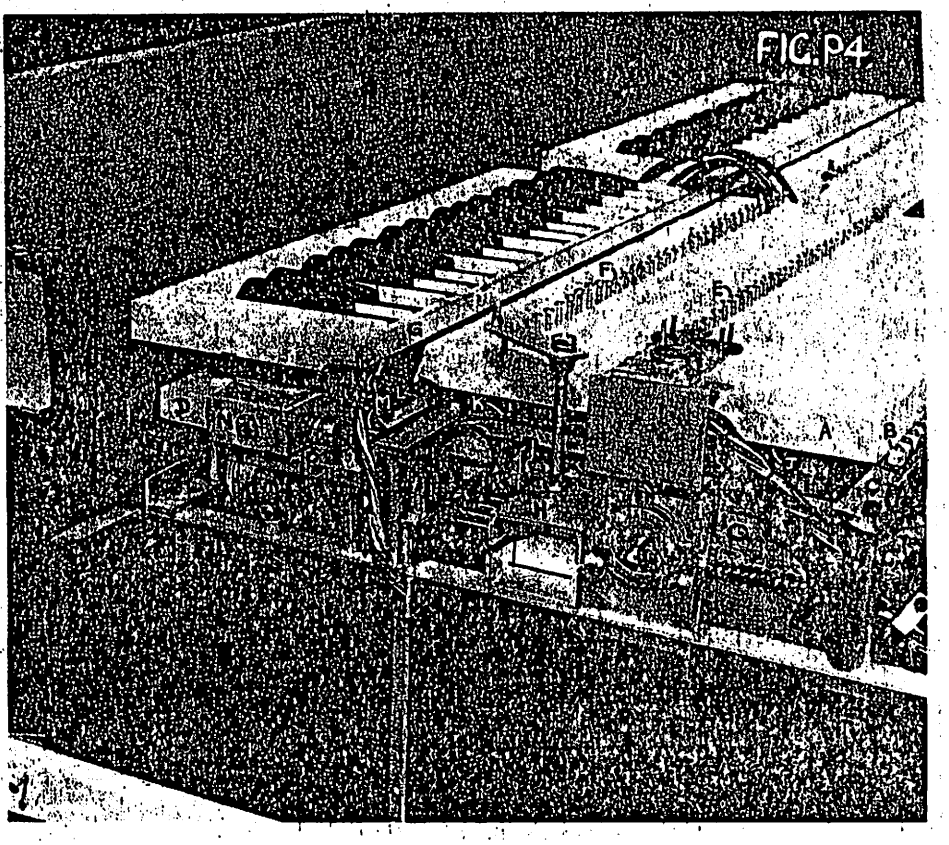


FIG. P4

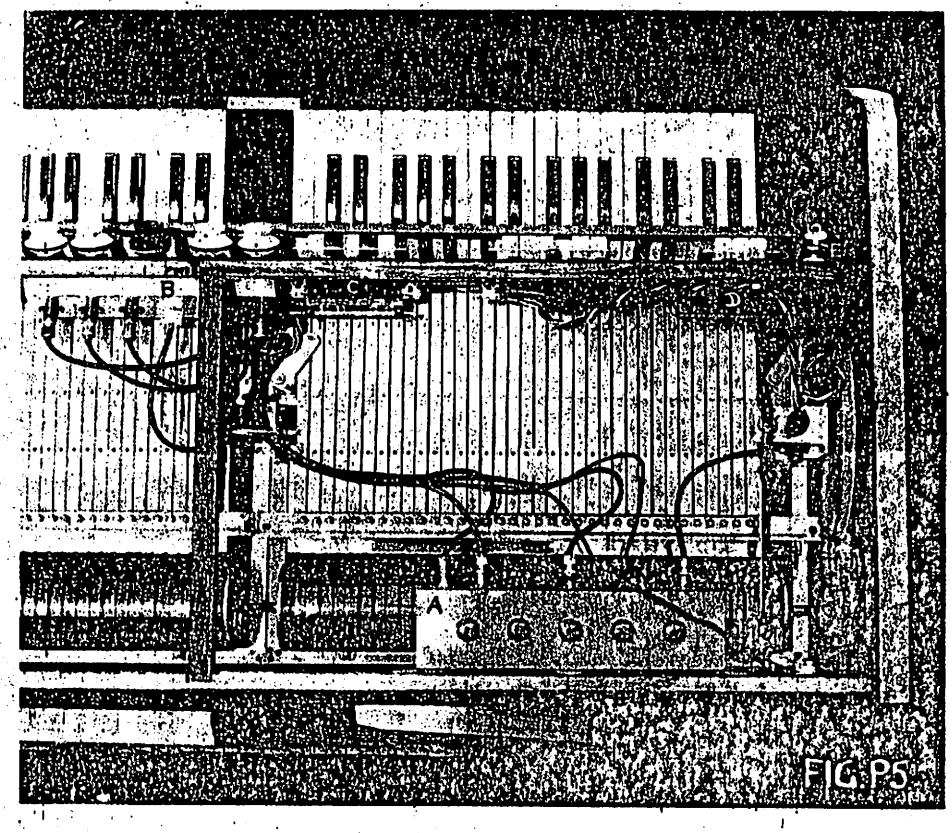


FIG. P5

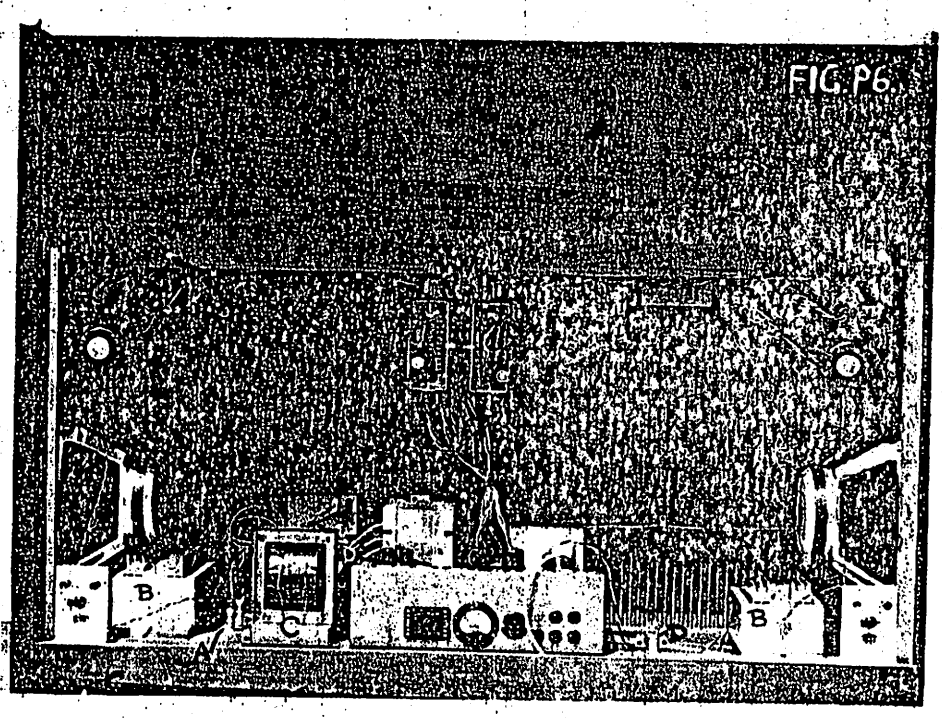


FIG. P6

FIG. P7.

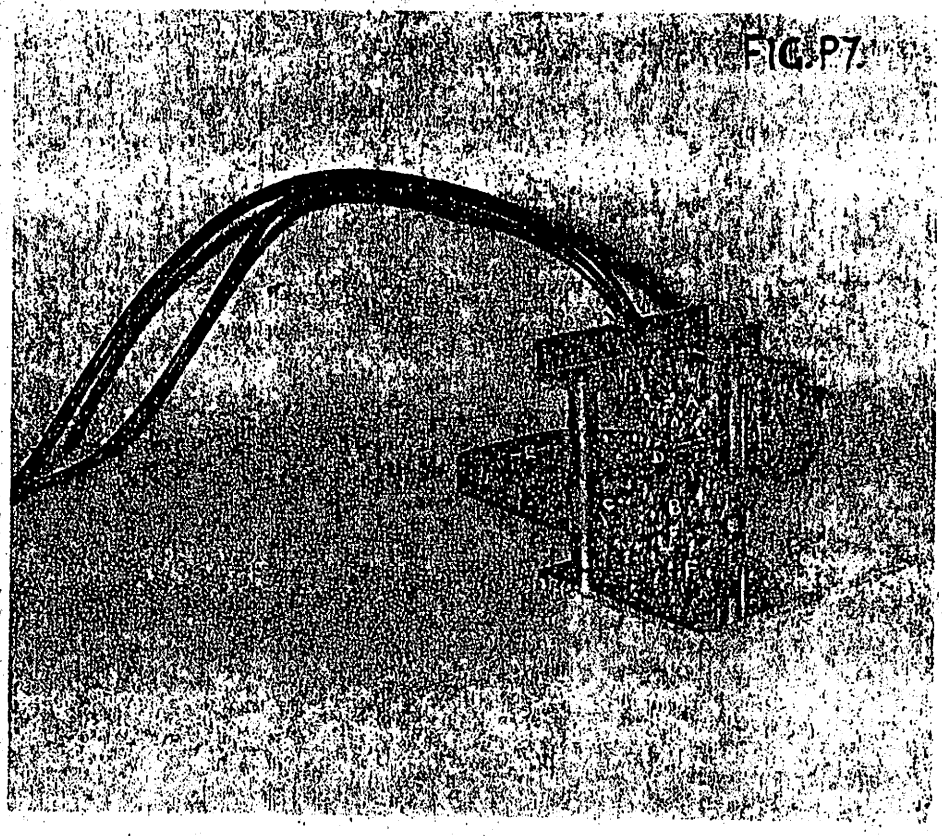
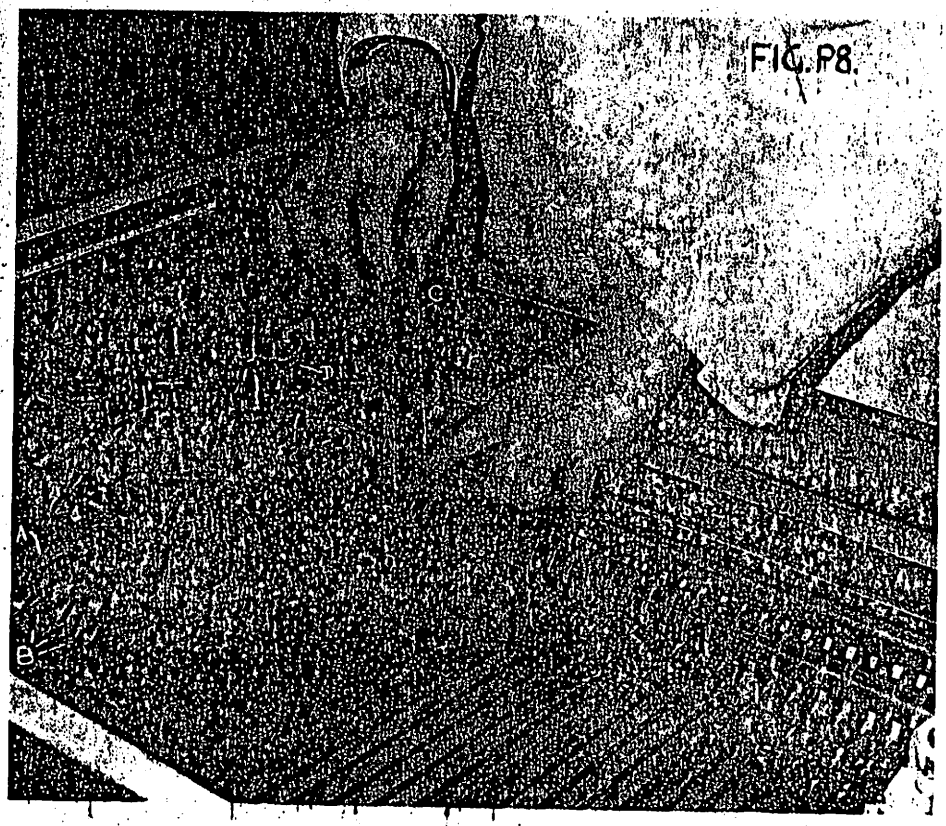


FIG. P8.



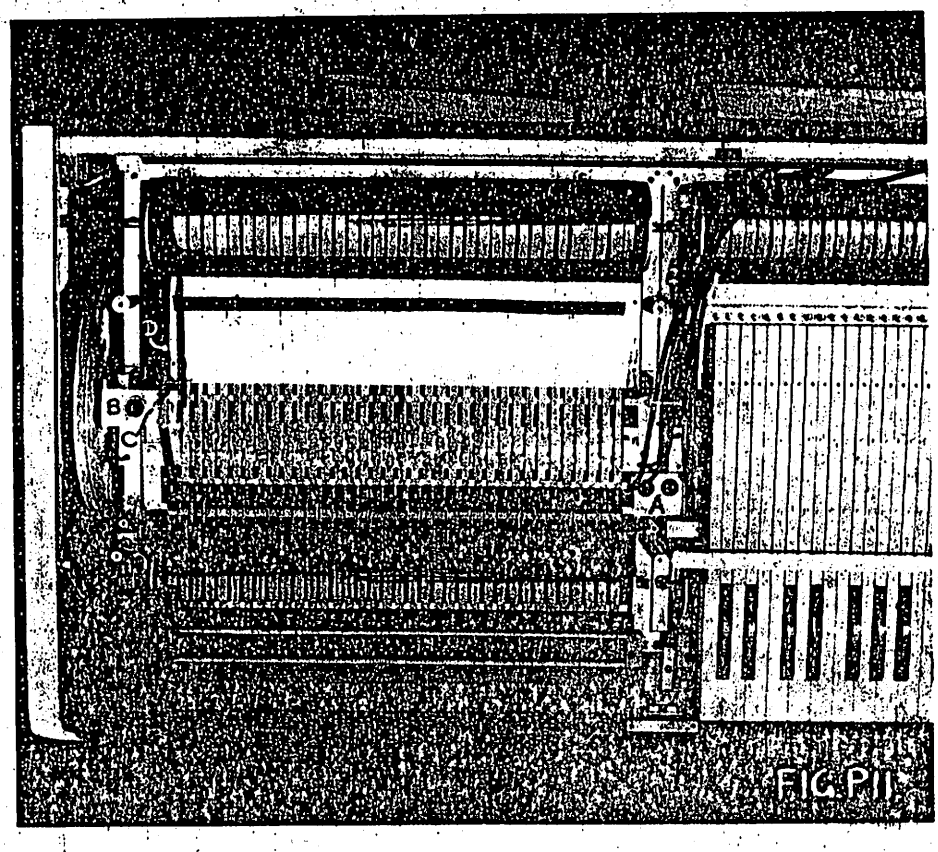


FIG. P11.

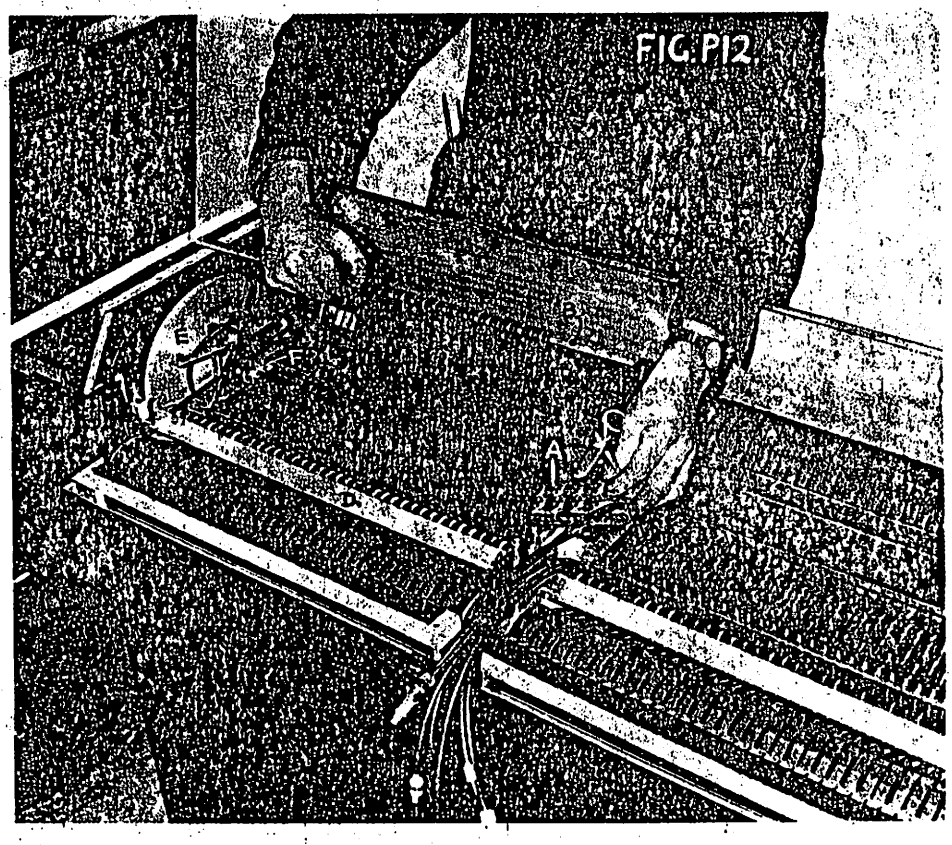


FIG. P12.

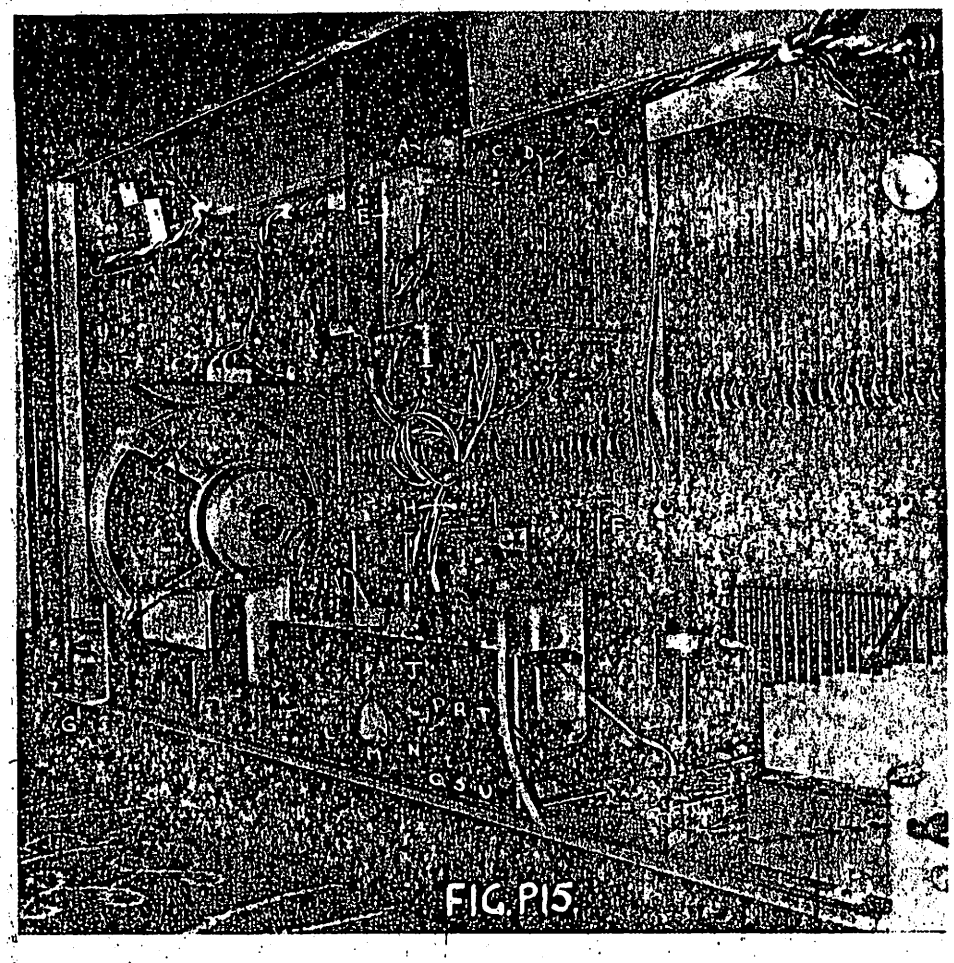


FIG P15

FIG. P9.

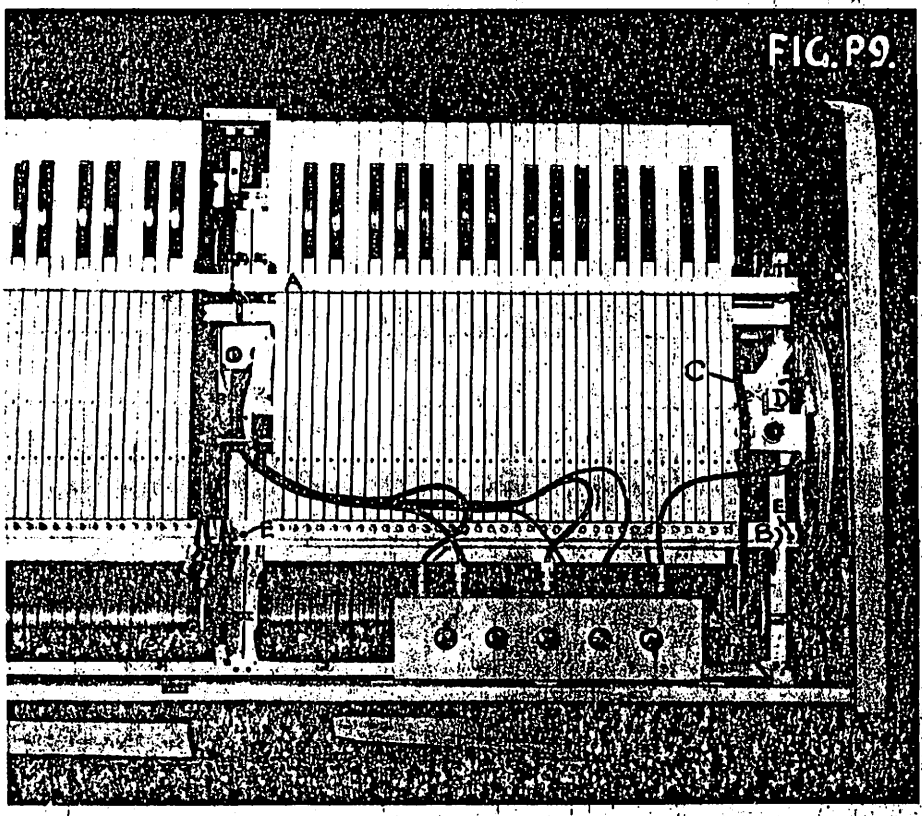


FIG. P10.

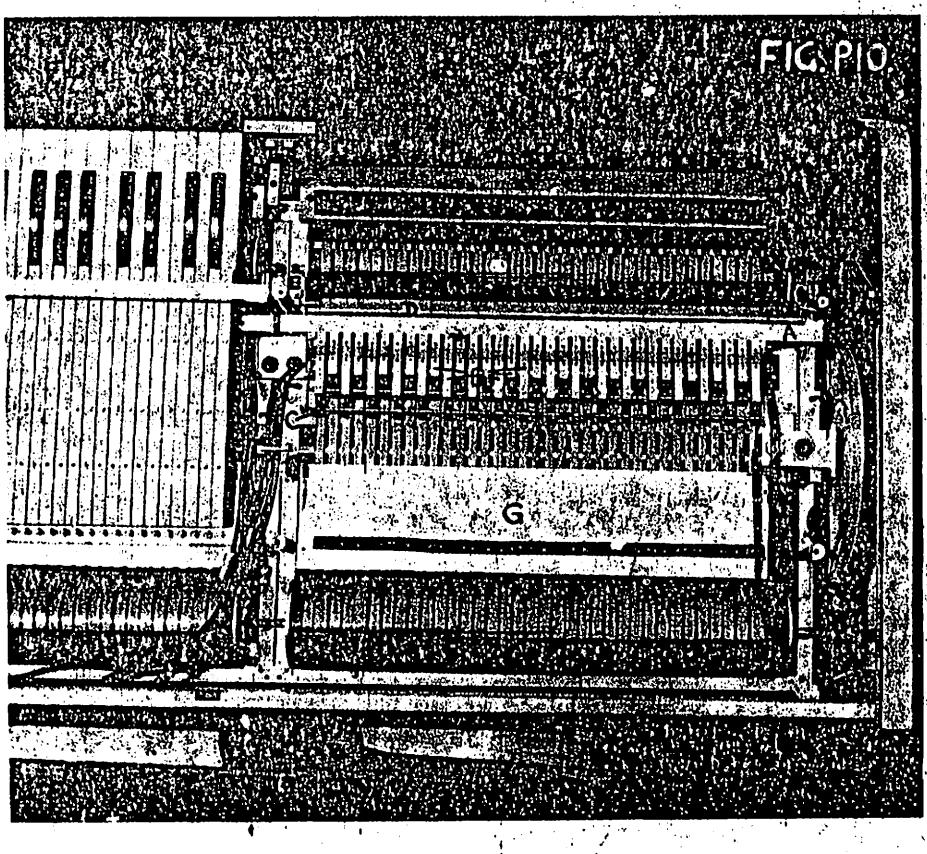


FIG. P13.

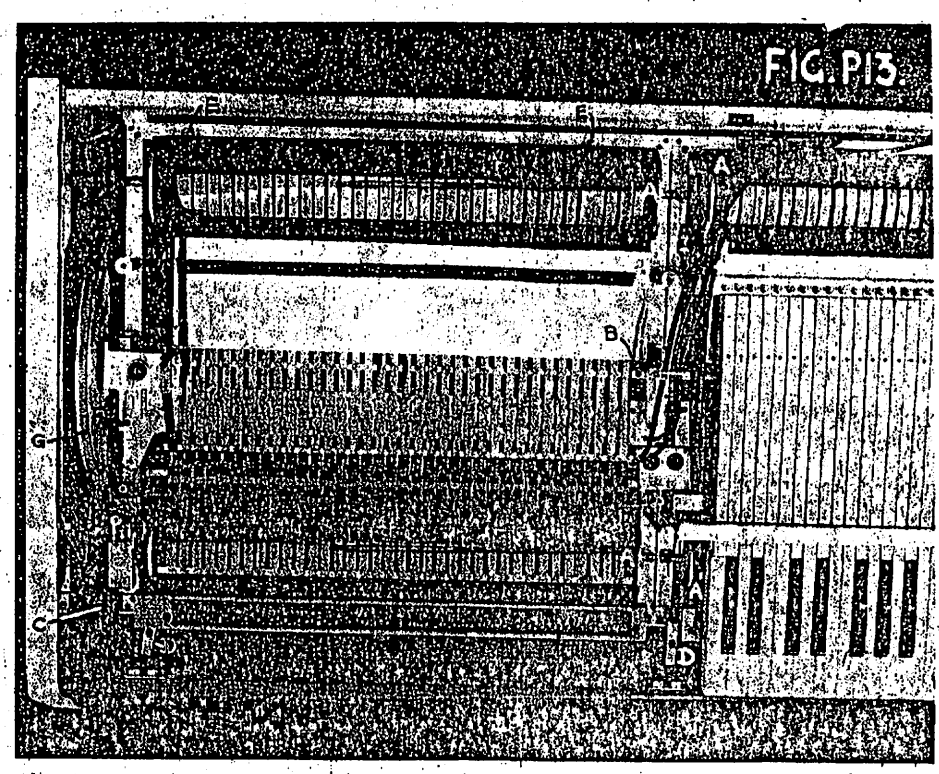
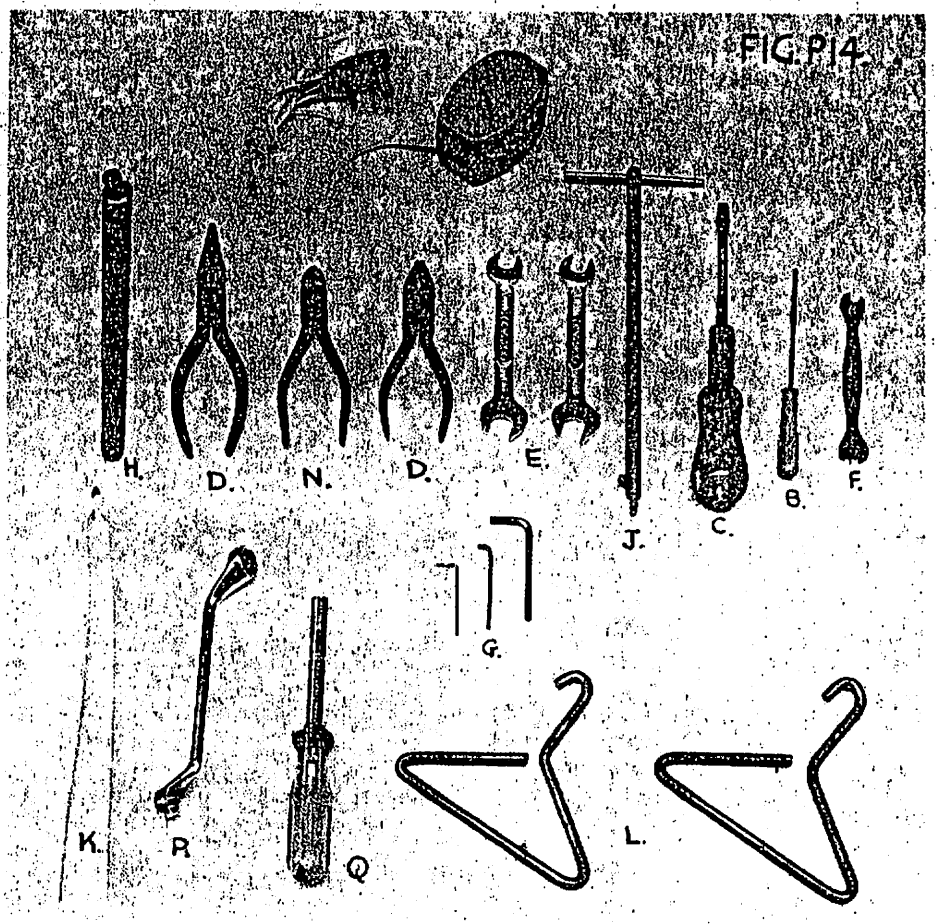


FIG. P14.



T H E

"M E L L O T R O N"

SERVICE MANUAL.

P A R T 4.

FAULT FINDING.

GENERAL.

P A R T 4.

F A U L T F I N D I N G.

In this part we discuss the various faults which could possibly occur and give some idea of how to go about locating the source of the trouble. Where possible, the breakdown of the fault has been given as the form of a "flow chart".

In order to expand certain parts of the charts, a series of supplementary notes is included. In the charts certain abreviations are used, as follows:-

U/S	...	UNSERVICEABLE.
O/C	...	OPEN CIRCUIT.
S/C	...	SHORT CIRCUIT.

When fault finding, bear in mind that the instrument has worked properly at one time or it would never have left the factory. For this reason, one is unlikely to come across faults such as wrong wiring, etc.

It is not claimed that this list of faults is exhaustive, and supplementary sheets will be issued as the need arises. For obscure faults, an advisory service is available.

The automatic reverse must now be checked and this can be done by 'fooling' the S.S.C.U. by the method described in Section 1.5. Great care is needed to avoid damage to the tapes should a fault exist. Cycle to station 3. press button 6. and immediately press 5. The tapes will now be driven towards (1). With the hand on the key switch, watch the index tape as the stations are passed through. If the tapes do not reverse within 1 second of passing Station (1), switch off and investigate as per Section 3.1 (d).

If all is well the tapes will reverse and eventually come to rest at selection (5). The automatic reverse at the other end can now be checked by returning to (3) and then pressing (1) and (2) immediately after.

The auto reverse check ensures that the instrument is protected against the 'fooling' of the S.S.C.U. inadvertently. This could occur by the player changing his mind after first making a selection, and pressing another button before the first selection was completed.

All six stations should now be selected in turn to check that all positions can be reached. In order to obtain accurate selection, it may be found that the controls of the S.S.C.U. require adjustment. This should not be so as they are set at the factory to give smooth inching consistent with reliable selection.

(c) SOUND SYSTEM CHECKS.

As we have seen in the general remarks above, the mains tapping is set to give a safe condition to switch on. There is however, a way of selecting the tapping more accurately than this, since the meter is only an approximate guide.

At the factory, the instrument is adjusted to tune to New Philharmonic Concert pitch, when the pointer on the Pitch Control is pointing to the triangular mark between the 'Hi'and 'Lo'. When the instrument is installed, it is necessary to check that this is the case at it's destination.

Set the pointer as described above and having cycled to Station (3) sound the piano note 'C' strike a C 522 tuning fork on a solid object and hold to the ear or better still hold the handle against a thin board such as a chair seat. These two notes should be the same. If the piano note sounds HIGHER than the tuning fork select a HIGHER mains tapping. If the piano note sounds LOWER, select a LOWER tapping.

The best tapping point is obtained when the two notes sound closest together. It should now be possible to raise or lower the pitch of the instrument at least one semitone by use of the pitch control.

The keys must now be checked to see that each key plays the tape to the end without faltering and that each of the three tracks A, B and C are played clearly. If this is not the case, the offending key must be adjusted as described in Section 3.1a.

(d) REVERB CHECK.

Open VOL control to maximum and play lead keys. Advance REVERB control until the 'ECHO' is obtained from the left hand channel.

Finally open REVERB control fully and check that there is no suspicion of 'howl' round.

If no result see Section 4.1d.

(e) TRACK SELECTOR CHECK.

This check is to see that the tape heads can be correctly positioned by the track selector switch.

The Rhythm track selector is best checked on Station (3) where we have track A fairly loud; B quieter, and C loud again. Listening on track B will show immediately if there is any pickup of A or C. If there is any A or C mixed in the B the track selector must be adjusted as described in Section 3.1b.

Fill track selector can be checked on station (3) as well and it should be possible to get approximately equal amounts of A and B if the mix button is pressed.

Check Lead Selector on Station (5) where the Harpsichord effect is on Track B, between two organ sounds. Here again make sure that when the MIX buttons are pressed there are approximately equal amounts of sound B mixed with sound A or C.

The above checks will be useless unless the stretcher rail is in position between the control panel and the back of the machine.

The machine is now in perfect working order and the lid and back can be replaced.

2 - 3 POSITIONING OF INSTRUMENT.

Since the speakers are mounted in the ends of the instrument, it is not possible to hear the best results from both the speakers at once unless a little care is taken in siting the instrument. It is a well known fact that the best results are obtained from a cone speaker when listening directly in front of it. It is obviously impossible to be in front of both speakers at the same time. The best results are obtained from the internal speakers of the MELLOTRON when the instrument is sited across a corner, as shown in Fig. D.18a. In this position the sound is reflected from the walls of the room and reaches the listeners behind the player. They will then hear the sound almost as if they were in front of each speaker at the same time.

A great improvement can be effected by the use of external speakers positioned as shown in Fig. D.18B. The greater distance obtainable between the speakers gives a much better spread of sound while at the same time giving ideal listening conditions as discussed above.

POSITIONING OF MELLOTRON

FIG. D18
Section 2-3