SPECIFICATION
The General Specification applies to the models Y722 and Y724, except as
detailed below.

Track Width
Half Track (Y722) 0·090 in. (2·3 mm.); Quarter Track (Y724) 0·043 in. (1·1 mm.)

Operating Tape Speeds
Three (3) : 7 ½, 3½, 1½ in/sec. (19, 9·5, 4·75 cm/sec.)
Suffix H 15, 7½, 3½ in/sec. (38, 19, 9·5 cm/sec.)
Suffix L 3½, 1½, ½ in/sec. (9·5, 4·75, 2·875 cm/sec.)

Tape Speed Accuracy
Better than ± 1% (at specified mains frequency)

Frequency Response
Record-Replay, using LP Ferrotope B or Scotch 203 :
15 in/sec. (38 cm/sec.) : 40-20,000Hz ± 2dB
7½ in/sec. (19 cm/sec.) : 40-17,000Hz ± 2dB
3½ in/sec. (9·5 cm/sec.) : 40-14,000Hz ± 3dB
1½ in/sec. (4·75 cm/sec.) : 50- 7,000Hz ± 3dB
½ in/sec. (2·875 cm/sec.) : 60- 3,000Hz ± 3dB

Replay Characteristic

<table>
<thead>
<tr>
<th>D.I.N.</th>
<th>I.E.C.</th>
<th>N.A.B.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(later</td>
<td>(117V models)</td>
</tr>
<tr>
<td></td>
<td>models)</td>
<td></td>
</tr>
<tr>
<td>15 in/sec. (38 cm/sec.) :</td>
<td>35µ sec.</td>
<td>35µ sec.</td>
</tr>
<tr>
<td>7½ in/sec. (19 cm/sec.) :</td>
<td>50/3180µ sec.</td>
<td>70µ sec.</td>
</tr>
<tr>
<td>3½ in/sec. (9·5 cm/sec.) :</td>
<td>90/3180µ sec.</td>
<td>90µ sec.</td>
</tr>
<tr>
<td>1½ in/sec. (4·75 cm/sec.) :</td>
<td>120/1590µ sec.</td>
<td>120µ sec.</td>
</tr>
</tbody>
</table>

Signal to Noise Ratio (at 7½ in/sec. — ref. 2% distortion)
Unweighted, including hum; better than 55dB
Weighted (C.C.I.F.) ½ track; better than 60dB
½ track; better than 58dB

Input (for peak level recording of 32mMx/mm.)
Microphone : 300µV-15mV at 10KΩ
Recommended Source: 250-2,000 Ω (standard jack)
Line : 150mV-5V at 10KΩ; *isolated
Recommended Source: 600 Ω (3 contact, gauge B jack)

Output (from peak level recording of 32mMx/mm.)
600 ohm : 1V into 600 Ω; *isolated (3 contact, gauge B jack)
Low Level : 300mV into > 10KΩ; (standard jack)
Loudspeaker : 10W into 8-16 Ω; (standard jack)
Phones : suitable for headphones > 1000 Ω (3 contact, gauge B jack)

* Can be made balanced by connecting transformer centre-tap to the earth pin (green lead).
† Serial number 79458 onwards
FIG. 1. EXPLODED VIEW OF TAPE-DECK (PARTS LIST IDENTIFICATION)
FIG. 9. HEAD ASSEMBLY

FIG. 10. RECORDER CHASSIS—REAR VIEW
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FIG. 20. REPLAY BOARD
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A - Introduction

101 Apart from changes in head line-up and duplication of printed circuit boards in stereophonic models, Series Seven systems are basically identical and consequently one manual covers the whole range.

102 The recorder consists of three main assemblies, a tape deck, which is common to the whole range (except for the head block), an amplifier, and a power unit. Tape deck component parts are mounted on an aluminium chassis, which is resiliently mounted on the main cross frames forming the body of the recorder. Amplifier and power units are also clamped to the main framework and linked electrically to the tape deck and each other by plug and socket connections.

103 The 722 model stereophonic recorder is the most comprehensive and for this reason other models are related to it as shown in the following table:

**Note:** Models with a suffix A require a 117 volt 60 Hz a.c. power supply and all others a 200/250 volt 50 Hz a.c. supply.

### Table of Differences

<table>
<thead>
<tr>
<th>Model No.</th>
<th>System</th>
<th>Track</th>
<th>Tape Speed In/Sec</th>
<th>Tape Speed Cm/Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>713</td>
<td>Mono</td>
<td>Half</td>
<td>7(\frac{1}{4}), 3(\frac{3}{4}), 1(\frac{1}{2})</td>
<td>19, 9-5, 4-75, 38, 19, 9-5</td>
</tr>
<tr>
<td>713H</td>
<td>Mono</td>
<td>Half</td>
<td>15, 7(\frac{1}{2}), 3(\frac{3}{4})</td>
<td>38, 19, 9-5</td>
</tr>
<tr>
<td>702</td>
<td>Stereo</td>
<td>Half</td>
<td>7(\frac{1}{4}), 3(\frac{3}{4}), 1(\frac{1}{8})</td>
<td>19, 9-5, 4-75</td>
</tr>
<tr>
<td>702H</td>
<td>Stereo</td>
<td>Half</td>
<td>15, 7(\frac{1}{2}), 3(\frac{3}{4})</td>
<td>38, 19, 9-5</td>
</tr>
<tr>
<td>704</td>
<td>Stereo</td>
<td>Quarter</td>
<td>7(\frac{1}{4}), 3(\frac{3}{4}), 1(\frac{1}{8})</td>
<td>19, 9-5, 4-75</td>
</tr>
</tbody>
</table>

- Single channel half-track system only, each has two speakers connected to a single power output stage.
- Half-track stereo version of 722, with output stage replaced by low-level output of up to 300mV into 10 kohms or greater.
- Quarter-track version of 722, with output stage replaced by low level outputs of up to 300 mV into 10 kohms or greater.
<table>
<thead>
<tr>
<th>Model No.</th>
<th>System</th>
<th>Track</th>
<th>Tape Speed In/Sec</th>
<th>Tape Speed Cm/Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>722</td>
<td>Stereo</td>
<td>Half</td>
<td>$7\frac{1}{2}, 3\frac{1}{2}, 1\frac{1}{2}$</td>
<td>19, 9-5, 4-75</td>
</tr>
<tr>
<td>722H</td>
<td>Stereo</td>
<td>Half</td>
<td>$15, 7\frac{1}{2}, 3\frac{1}{2}$</td>
<td>38, 19, 9-5</td>
</tr>
<tr>
<td>724</td>
<td>Stereo</td>
<td>Quarter</td>
<td>$7\frac{1}{2}, 3\frac{3}{2}, 1\frac{1}{2}$</td>
<td>19, 9-5, 4-75</td>
</tr>
</tbody>
</table>

Half track stereo system with 10 watt output on each channel. A transfer switch is fitted for special effects.

Quarter track version of 722.
105  **Recording Medium**
Magnetic tape $\frac{1}{2}$ in. (6.3 mm) wide on reels of up to $8\frac{1}{2}$ in. (210 mm) dia.

**Track Width**
$\frac{1}{2}$ track 0-090 in. (2.3 mm):
$\frac{1}{4}$ track 0-043 in. (1.1 mm).

**Head Gap Width**
Record head — 250 $\mu$ in. (6.3 $\mu$): Replay head — 80 $\mu$ in. (2$\mu$).

**Operating Tape Speed**
Three (3):

| Suffix H | 7 $\frac{1}{2}$, 3 $\frac{1}{2}$, 1 $\frac{1}{2}$ in/sec. (19, 9-5, 4-75 cm/sec) |

**Tape Speed Accuracy**
Better than $\pm$ 1% (at specified supply frequency).

**Playing Time Per Track**
2,400 ft. (720 m) of tape:
1 hr. 4 min. at 7 $\frac{1}{2}$ in/sec. (19 cm/sec.)
2 hr. 8 min. at 3 $\frac{1}{2}$ in/sec. (9-5 cm/sec.)

**Fast Wind Time**
Continuously variable in either direction: at fast speed less than 1 min. for 1,200 ft. (360 m) of tape.

"Wow" and "Flutter"
Less than
0-08% at 7 $\frac{1}{2}$ in/sec. (19 cm/sec).
0-15% at 3 $\frac{1}{2}$ in/sec. (9-5 cm/sec).
0-20% at 1 $\frac{1}{2}$ in/sec. (4-75 cm/sec).

**High Speed Models (Suffix H)**
Less than
0-08% at 15 in/sec. (38 cm/sec).
0-10% at 7 $\frac{1}{2}$ in/sec. (19 cm/sec).
0-15% at 3 $\frac{1}{2}$ in/sec. (9-5 cm/sec).

**Frequency Response**
Record-Replay, using Long Play Ferrotepe type B:
15 in/sec. (38 cm/sec.) : 30-20,000 Hz $\pm$ 2dB
7 $\frac{1}{2}$ in/sec. (19 cm/sec.) : 30-17,000 Hz $\pm$ 2dB
3 $\frac{1}{2}$ in/sec. (9-5 cm/sec.) : 40-14,000 Hz $\pm$ 3dB
1 $\frac{1}{2}$ in/sec. (4-75 cm/sec.) : 50-7,000 Hz $\pm$ 3dB

**Page 11. Specification**
**All models**

<table>
<thead>
<tr>
<th>Replay Characteristic</th>
<th>D.I.N.</th>
<th>N.A.B. (117v models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 in/sec. (38 cm/sec.)</td>
<td>35$\mu$sec.</td>
<td>50$\mu$sec.</td>
</tr>
<tr>
<td>7 $\frac{1}{2}$ in/sec. (19 cm/sec.)</td>
<td>50/3180$\mu$sec.</td>
<td>50/3180$\mu$sec.</td>
</tr>
<tr>
<td>3 $\frac{1}{2}$ in/sec. (9-5 cm/sec.)</td>
<td>90/3180$\mu$sec.</td>
<td>90/3180$\mu$sec.</td>
</tr>
<tr>
<td>1 $\frac{1}{2}$ in/sec. (4-75 cm/sec.)</td>
<td>120/1590$\mu$sec.</td>
<td>120/3180$\mu$sec.</td>
</tr>
</tbody>
</table>

**Maximum Output (per channel)**
10 Watts R.M.S. into 8-16 ohm loudspeaker.

**Amplifier Distortion**
Less than 0-25% R.M.S. at all levels up to 10 Watts.
Signal to Noise Ratio (at 7 1/2 in/sec (19 cm/sec) )
Unweighted, including hum, better than 55dB — ref 2% distortion.
Weighted (C.C.I.F.), better than 60dB (1/4 track — 58 dB)

Bass Control
Continuously variable up to ± 15dB at 50Hz. ± 20dB at 20 Hz.

Treble Control
Continuously variable up to ± 10dB at 10kHz, ± 15dB at 20kHz

Internal Loudspeakers
Two (2) — elliptical 7 in. x 4 in. (180 mm. x 100 mm.)

Input Level (for full depth recording)
Microphone: 150µV-15mV at 10K Ω, Recommended Source: 250-2,000 Ω
Line: 75mV-10V at 2M Ω Recommended Source: any impedance.
Later Models (see Parts Lists — Record Board)
Microphone: 300µV-15mV at 10K Ω, Recommended Source: 250-2,000 Ω
Line: 50mV-10V at 2M Ω Recommended Source: any impedance.

Output (from full amplitude recording)
600 ohms: 2V at 600 ohms.
Low Level: 300mV into 10K ohms or greater.
*Loudspeaker: up to 10 Watts R.M.S. into 8-16 ohms.

Power Supply
200-250V, 50Hz; Suffix A: 117V, 60Hz.

Power Consumption
100 Watts approximately.

Channel Separation (Stereo Models Only)
Stereo operation — approx. 50dB:
Mono operation — better than 65dB at 1000Hz.

Overall Dimensions (with lid)
16 1/2 in. wide x 17 1/2 in. x 10 in. (425 mm. wide x 445 mm. x 255 mm.)

Weight
49 1/2 lbs. (22.5 kgm)

Alternative Models
Suffix P. Portable wood case, leather-cloth covered, with lid.
Suffix W. Wooden case, natural wood finish.
Suffix S. Uncased version.
Suffix R. Rack mounting version.

*On Models 702 and 704, this output is replaced by:—
Low Level Adjustable: up to 300 mV into 10K ohms or greater.
C - Tape deck operation

General (Fig. 8)

The main body of the tape deck is constructed on an \( \frac{1}{2} \) in. (3-2 mm.) aluminium chassis which supports the solenoids, motors and tape drive mechanism. The fore part of the chassis has a raised platform, normally covered by a deck control panel, which supports a function switch, head assembly, pressure pad assembly, pinch roller and Fast Wind and Record controls. Between platform and chassis is a pinch roller arm and flywheel. The rear part of the chassis has a raised bracket which carries the supply On/Off switch and speed selector, and is supported by the top plates of the reel motors. The centre of the chassis houses a drive mechanism and start and run solenoids with their armature assemblies. This centre chassis and raised rear bracket are normally covered by a deck cover plate.

Tape Transport

The tape transport system utilises three motors, a capstan motor (X100) and two reel motors (X101 and X102). The capstan motor, mounted below the main chassis (Fig. 15), is a split phase, capacity type, synchronous induction motor. The motor assembly is resiliently mounted on neoprene shock mounts and the motor has grease packed ball races seated in neoprene mounts. The motor runs anti-clockwise, viewed from the top, and a stepped pulley with a sand-blasted finish is mounted on its spindle.

Reel motors, supply and take-up, are both 150 volt nominal (75 volt on 117 volt 60Hz models). The left-hand supply motor, which runs clockwise when energised, is mounted directly on the chassis with a top plate supporting the raised reel bracket. This top plate carries a wrap type brake assembly which acts on the drum of the reel carrier along with a constant friction brake. The right-hand take-up motor, which runs anti-clockwise, is fixed to the main chassis and its top plate, fixed to the rear bracket, carries a wrap type brake assembly which acts on the reel carrier drum. The take-up reel carrier has a worm drive for the turns counter mechanism, the drive gear of which is mounted below the top plate. Electrical connections to both supply and take-up reel motors are via two-pin connectors, and the take-up reel motor has a dummy plug connector used to disconnect this motor when the recorder is used with an Endless Loop Cassette.

Speed Change Switch SW104 (Fig. 8)

Speed change switch SW104 is located at the centre of the rear bracket. On the centre section of the switch spindle, between bracket and chassis, is mounted a three position cam which decides the position of a start lever. At the extension of the start lever arm, a leaf spring engages in one of three slider arms. Each of the slider arms carries an idler wheel which transfers drive from the capstan motor pulley to a flywheel. When the start lever is operated by a start solenoid, the leaf spring engages the selected idler wheel arm, moving the idler wheel into contact with the pulley and the flywheel periphery.

At the bottom of the speed change switch spindle, below the main chassis, is a three position electrical switch SW104 (Figs. 27 and 28). This switch is used in conjunction with an equalisation switch SW700. If switch SW104 is set to high speed (H) then an auto-stop relay RL100 is connected to contacts L and M via a shorting bar on the switch. A slider contact of SW104 is connected via P100/SK100 pins 2, 3 and 4 to contacts H, M and L of equalisation switch

The turns counter mechanism is belt driven from a pulley on the underside of the take-up reel carrier.
Function switch SW100 changes from 2 wafer to 1 wafer plus 2 microswitches (SW109 & 110). Although performing the same functions, the switch poles change as shown.

SW700. If the slider of SW700 is set to either L or M then auto-stop relay RL100 is connected between 24 volts d.c. and earth, energising the relay. Relay contact RL100A disconnects the 24 volt d.c. line from the start relay and routes the 24 volt d.c. line to a red Reset lamp LP100 which lights to indicate a fault condition. Similar situations occur when the speed change switch SW104 is set to the M and L positions.

Function Control SW100 (Fig. 8)

111 The function control is a four position, electro-mechanical switch, which controls the operations of the tape deck. Mounted on the left-hand side of the main chassis beneath the front raised platform, switch SW100 has a cam at the top of its spindle which performs mechanical functions, and is a six pole, two bank, ceramic switch which controls solenoid and reel motor switching. The four positions of the switch are Fast, Stop, Pause and Run, and the operating sequences of the tape deck are described under these headings. It is possible to over-ride the function control when it is set to Pause, and this sequence is described under the heading Remote Control.

Function Control at Fast (Figs. 8, 27 and 28)

112 With function control SW100 set to Fast, the cam on the switch spindle (Fig. 2) operates a brake arm which moves the constant friction brake well clear of the supply reel drum. A vertical pin on the cam moves a loading arm, which lifts three pressure pads well clear of the head assembly and away from the fast moving tape.

113 The ceramic, two bank, electrical switch SW100 is at position F as shown in Figs. 27 and 28. Contact 2a completes the 24 volt d.c. supply circuit to start solenoid L100, energising the solenoid. With the solenoid energised, an armature on the start lever is engaged, moving the start lever about its pivot (Fig. 8) and performing the following functions:

(i) Self-wrapping brakes on the reel drums are released.

(ii) A leaf spring on the start lever extension moves a selected idler wheel into engagement with the capstan motor pulley and flywheel.

(iii) Two arms on the start lever rear bracket operate micro-switches SW102 and SW103.

114 Micro-switch SW102 completes the power supply circuit from P101 to the capstan and reel motors, and micro-switch SW103 operation varies dependent upon the recorder serial number, as follows:

(i) On models before serial number 70500 (Fig. 26) it acts as an economy switch. Connected in the earth return circuit of L100, it puts resistor R100 in series with L100 coil, and reduces current through the coil.

(ii) On later models the switch is connected in the 24 volt d.c. line to L100 and performs two functions. One is to put resistor R100 in series with the coil and reduce operating current, and the other is to complete the 24 volt d.c. supply line to a run solenoid L101.

115 Switch SW100 poles, 1b and 1c, connect Fast Wind control potentiometer RV103 directly across the two reel motors X101 and X102. The slider of RV103 is connected to the common connection of the series-connected reel motors, so that, at the central position of the slider, the power is divided equally between both motors. When a tape is fitted to the recorder, the motors will remain stationary
due to the tape tension and power is dissipated in the form of heat. By moving slider RV103 to either side of the central position, the power is divided unequally between reel motors, so that tape wind is achieved in either direction at slow or fast speeds.

116 Switch SW100 poles, 1a and 2b, are connected via P100/SK100 to the amplifier unit so that in the Fast position the level of the audio output, caused by the tape passing the replay head at high speed, is reduced.

Function Control at Stop (Figs. 8, 27 and 28)

117 With function control SW100 at Stop, the cam sets the constant friction brake arm so that the constant friction brake is just clear of the supply reel drum, and a pin on the cam sets the loading arm so that the pressure pads are approximately \( \frac{3}{8} \) in. (9.5 mm.) from the heads.

118 Electrical switch SW100 is at position S as shown in Figs. 27 and 28. Poles 1b and 1c disconnect the Fast Wind potentiometer from across the reel motors, and poles 1a and 2b, via P100/SK100, reduce the audio output level of the replay boards. Pole 2a of the switch disconnects the supply to solenoid L100 which is de-energised and the start lever is in the non-operating position. With the start lever in this position the following conditions apply:

(i) The wrap-round brakes are applied to the reel drums.

(ii) The selected idler wheel is disengaged from the capstan motor pulley and flywheel.

(iii) Micro-switches SW102 and SW103 are not operated. With micro-switch SW102 in its non-operated position, the supply to the capstan and reel motors, from P101, is disconnected. On later models, when SW103 is in its non-operated position, the 24 volt d.c. supply to the run solenoid L100 is also disconnected.

Function Control at Pause (Figs. 8, 27 and 28)

119 With the function control SW100 at its Pause position, the constant friction brake arm, actuated by a brake arm spring, pulls the constant friction brake into contact with the supply reel drum. The vertical pin on the cam no longer acts on the loading arm, which, actuated by a return spring, allows the pressure pads to function, and moves the pinch roller arm. The pinch roller arm is moved by a plastic ramp on the loading arm acting on the pinch roller bracket, so that the armature on the pinch roller bracket is in close proximity with the run solenoid pole piece.

120 Electrical switch SW100 is at position P as shown in Figs. 27 and 28. Pole 2a completes the circuit of start solenoid L100 and the solenoid is energised. As the armature is pulled to the pole piece, the start lever moves about its pivot and performs the following functions:

(i) Self-wrapping brakes are released from the reel drums.

(ii) The leaf spring, on the start lever extension, moves the selected idler wheel into engagement with the capstan motor pulley and flywheel.

(iii) Two arms, on the start lever rear bracket, operate micro-switches SW102 and SW103, energising the capstan and reel motors.
The Record arm has been modified slightly so that with the Function knob at Pause or Run, the Record knob cannot be pressed accidentally; the Record Release catch must be moved to the left before the Record knob can be pressed down. The Record knob is still locked down on allowing the catch to return to the right. In all other respects the operation of the Record arm is as described in the manual.

The action of the micro-switches SW102 and SW103 is explained in paragraph 114. With the reel motors connected in series across the supply from P101, and with the self-wrapping brakes released, the motors are free to rotate, but are held stationary by the tape tension.

121 Switch SW100 pole 2c connects the run solenoid via P101/SK101 to an auxiliary socket SK701 which is used for remote switching of the recorder, see paragraph 134. Further contacts, on poles 1a and 2b, complete the circuit to the Record micro-switches SW107 and SW108 (paragraph 126) and the replay level (paragraph 116) is returned to normal.

Function Control at Run (Figs. 8, 27 and 28)

122 When function control SW100 is switched to Run, the cam does not perform any function. The operating condition of the self-wrapping brakes, constant friction brake and pinch roller arm, were set when the function control was at Pause (paragraphs 119 and 120) and tape drive is initiated by electrical switch SW100.

123 Electrical switch SW100 is at position R as shown on Figs. 27 and 28. Contacts of pole 2a maintain the same conditions as described in paragraph 120 and contacts of pole 2c complete the circuit to the run solenoid L101.

124 With the circuit of solenoid L101 completed, the armature on the pinch roller arm is energised, and as it moves, the pinch roller arm pivots and performs the following functions:

(i) A post at the top of the armature block operates a micro-switch SW106, which is mounted on top of the run solenoid assembly.

(ii) The pinch roller arm forces the pinch roller against the tape, gripping it to the capstan spindle. As the capstan spindle is already rotating, due to the action of the start lever (paragraph 113), the tape is driven immediately at the correct speed. Pressure applied by the pinch roller to the tape is critical, and the full setting up procedure is given in Section 4.

125 Micro-switch SW106, operated by the pinch roller arm, puts a short circuit across the supply reel motor, and connects R105 in series with the take-up reel motor across the supply. The tape issuing from the capstan is taken up by the take-up reel, and a slight back tension on the tape is maintained by the action of the constant friction brake acting on the supply reel drum.

Record and Record Release (Figs. 8, 27 and 28)

126 When the Record button is pressed down, the record lever arm moves the Record Release arm, which then returns under spring pressure, to lock the record lever arm down in the Record position. This operation is only possible when the function control SW100 is in either Pause or Run positions, as SW100 cam inhibits the Record Release arm when at Fast or Stop. In these positions, the cam periphery moves the Record Release arm, against spring pressure, to the left, inhibiting the “locking” action. The end of the Record Release arm protrudes through the deck cover plate, adjacent to the foil stop, and when moved manually to the left, it releases the Record lever arm. It is automatically moved by SW100 cam when the function control is switched to Stop or Fast.
. . . and if the earthed tension arm touches the insulated pillar, it triggers the delay circuit (R111, R112, C106). If the pillar is earthed for more than 1½ secs. approx., transistors VT100 & VT101 conduct and operate RL100. If the pillar is disconnected from earth before VT100 conducts, the delay circuit resets and the fault relay is not energised.

With the Record button operated and locked in the Record position, a right-angled arm on the record lever operates two micro-switches SW107 and SW108. Contacts of SW108, which normally short circuit the output of the record amplifiers to earth via P100/SK100 pins 1 and 9 (pin 9 only on mono models), are opened. Micro-switch SW107 contacts route the 50 volt d.c. supply, via P100/SK100 pins 7 and 8, to the amplifier where it performs the following functions:

(i) Provides a positive 50 volts d.c. for the 100 kHz oscillator.
(ii) On models prior to Serial No. 75,000, energises relay RL700, whose contact RL700B switches the record signal, via Output switch SW702, to the VU meter (also RL700A on stereo models).

Tape Tension (Fig. 8)

Tape snatch on stopping and starting is eliminated by two differentially-damped tape tensioning arms. The left-hand arm assembly is mounted on the underside of the deck control panel, and the right-hand arm is mounted on the raised platform to the right of the pinch roller. Both arms are fitted with a differential brake, employing a nylon tape tensioned by a spring. On later models the right-hand arm tension is adjustable for vertical or horizontal operation of the deck by turning the slot to ‘V’ or ‘H’ respectively.

Auto-stop and Foil Stop (Figs. 8, 27 and 28)

The auto-stop and foil stop are two of the three safety devices which automatically inhibit the tape deck drive when they are operated. In each case, relay RL100 is energised by completing the earth return circuit of its operating coil. Relay contact RL100B open-circuits the 24 volt d.c. supply to start solenoid L100, at the same time completing the 24 volt d.c. supply circuit to the red Reset lamp, which lights. One safety device, the setting of the Speed Control and Equalisation switches, has been explained in paragraph 110 and the other two are as follows:

(i) The right-hand damping arm (paragraph 127) is normally held in its operating position by the tape, but should the tape run out or be incorrectly loaded (i.e. not on the arm), then the arm is pulled into contact with an insulated pillar by a spring. The insulated pillar is connected to the negative side of the relay RL100, and if the earthed tension arm touches the insulated pillar the circuit of RL100 is completed and the relay operates.

(ii) The tape guide, between the left-hand tension arm and the supply reel, is an insulated pillar mounted on the deck cover plate. This pillar is connected to the negative side of relay RL100, and if the metallic foil on the end of the tape makes contact with the insulated pillar and the tensioning arm, then the circuit of RL100 is completed and the relay operates.

Note: Contact RL100A is a hold-on contact, and when operated completes the negative circuit of the replay even if the fault condition is removed. To de-energise the auto-stop relay, the fault must be cleared and the function control SW100 switched to Stop.

Turns Counter and Lamps (Figs. 8, 27 and 28)

A turns counter mechanism and two lampholders are fixed to a panel which is mounted above the idler wheel assembly. The panel is fixed to the main assembly by two lugs at the front, which fit into slots at the rear of the raised platform, and a screw at the rear of the panel which clamps it to a stand-off pillar. Attached to the left-hand side of the panel is an arm which stops the idler wheel arms from moving out of their retaining slots.

Para. 128  Serial No. 78,800/2 onwards

The action of the Auto Stop now has a built-in delay of approx. 1½ seconds, but also operates if there is a loss of tape tension. Para. 128 (i) should now read:—
The rear lamp holder supports the “power on” lamp LP101. This lamp is connected to the 24 volt d.c. line on the “live” side of the d.c. fuse FS100, and when lit illuminates the amber indicator on the deck cover plate.

Mounted on a block at the left of the turns counter assembly, is a lampholder supporting the reset lamp LP100. This lamp is connected to the 24 volt d.c. supply by RL100B when a fault condition is present (paragraphs 110 and 128) and when lit illuminates a red indicator on the deck cover plate.

The turns counter mechanism is a four digit system with a zero button which protrudes through the deck cover plate, and when operated manually resets the counter to its zero position. Drive to the counter, via a flexible cable, is from a gear wheel, mounted on the take-up motor below the top plate, which meshes with a worm drive on the base of the take-up reel drum. The counter indicates the revolutions of the take-up reel, and is not related linearly to time as the length of tape per revolution is dependent upon the amount of tape on the reel. A graph showing relationship tape/turns is given in the Operator’s Handbook.

High Speed Models (Figs. 27 and 28)

High speed models, suffix H, are fitted with an additional relay RL101, which temporarily increases the power on the take-up reel motor on starting up at 15 in/sec. With the speed control set to 15 in/sec (38 cm/sec) the electrical switch SW104 is at H. Contacts of SW104 connect RL101 in parallel with the run solenoid L101, so that with function control SW100 at Run both the relay and solenoid L101 are energised (paragraph 123). Relay contact RL101A short circuits resistor R105, so that the take-up reel motor X102 has the supply from P101 applied directly across it. While capacitor C105 is charging, relay RL101 is energised but after a few seconds the current falls below the relay hold-on value and RL101 is de-energised. Contact RL101A opens, removing the short circuit across R105, and the take-up reel motor supply returns to normal.

Remote Control (Figs. 27 and 28)

A seven pin auxiliary socket SK701, mounted on the rear panel, makes provision for remote control or connection to ancillary units such as the Signal-operated Switching Unit. These duplicate the action of turning the function control from Pause to Run as follows. Pin 1 of the socket is connected via P101/SK101 pin 1 to contact P, pole 2c of function control switch SW100. With the function control switched to Pause (paragraph 121), the negative side of run solenoid L101 is connected to contact P, so that when a connection is made between pins 1 and 2 (earth) of the auxiliary socket, either by a remote switch, time clock or Signal-operated Switching Unit, then solenoid L101 is energised and the Run sequence initiated (paragraph 124).

Auxiliary socket SK701 provides a 50 volt, 200 mA d.c. supply on pin 3 (pin 2 earth), and Low Level and 600 Ohm Outputs on pins 4 and 6 (also pins 5 and 7 on stereo models). These connections can be used for remote volume control units, remote level indicators, or the Signal-operated Switching Unit as required.

Reel Height Adjustment (Fig. 11)

To accommodate different thicknesses of spools, the reel carriers are adjustable in height and the method of adjustment is the same on both reel carriers.
137 The spindle of the reel motor runs in two self-aligning bearings and the vertical height of the spindle is set at its base where it runs in a special device which limits the amount of end-float on the spindle. The limiter is fitted to a horizontal bar which is pivoted on a resilient mounting at one end and at the other end keyed into a special nut on the vertical adjuster.

138 The vertical adjuster is spring-loaded, between the special nut and deck plate, to maintain the horizontal bar steady in the set position. Adjustment is by means of a screwdriver slot in the top of the shaft, which, when rotated, raises or lowers the horizontal bar by moving the special nut on its thread. The upper overall adjustment is set by a Simmonds nut at the base of the adjusting shaft, and the lower overall adjustment by a nut at the top of the threaded portion of the shaft.

Head Assembly (Fig. 9)

139 The head assembly, mounted on the raised platform beneath the hinged portion of the deck control panel, consists of three heads each bolted rigidly on its own mounting plate. Four socket-headed, recessed bolts clamp the head assembly to the raised platform, and two socket-headed bolts at the front of the assembly provide azimuth adjustment of the record and replay heads. Electrical connections to the heads are via screened leads, taken from the base of the assembly. Record and erase head connections are via phono sockets on the rear amplifier unit, and the replay head is connected direct to pins of the replay board on the amplifier unit. On stereo models there are two screened leads for each head, viz: erase, record and replay. The removal and replacement of the head assembly is detailed in Section 3 but no adjustment to the heads should be made without consulting Section 4.
D - Electronic Units

General

140 The electronics of the recorder are contained in two main units, an amplifier and a power unit, which are mounted on the main cross frames of the recorder body. Electrical connections between the tape deck, head assembly and other units are made by plug and socket connectors.

141 Mounted at the rear of the recorder, bolted to the lower cross frames, is the power unit, which contains a power transformer, smoothed d.c. supplies, power output amplifiers and the input/output panel. The amplifier, mounted at the front of the recorder and bolted to both the cross and side frames, comprises a main control panel, potentiometers, switches and printed circuit boards. On stereophonic models, switches, controls, meters and printed circuit boards are duplicated in the second channel and a Record Mode switch and a Transfer switch are also fitted. In the circuit descriptions that follow, only one channel is described, with special references to the additional switches where necessary.

Electronic System (Fig. 25)

142 A block diagram of the electronic system is shown in Fig. 25 and it is basically similar for all models; this is achieved by the duplication of printed circuit boards on stereophonic models. Monophonic models use one channel of the stereophonic system illustrated, and are without Record Mode and Transfer switches. On earlier stereophonic models, up to serial number 70500, the signal to the transfer switch from the meter and tone control amplifier is not affected by the tone controls.

143 An input to the recorder can be applied either at the Line input socket (rear panel) or the MIC socket (main control panel), and in each case the signal passes to a pre-amplifier stage with a gain control. On stereophonic models the output of the transfer switch is applied to the line pre-amplifier gain control.

144 The outputs from the mic and line pre-amplifiers are mixed together and are fed to the record amplifier which has two outputs. One is taken to an Output switch, as the "source" signal, and the other to the record output stage. During replay, the record output stage is short-circuited to earth by a micro-switch, and this short-circuit is removed by the action of the Record button. The record output signal has negative feedback applied to it from the pre-emphasis board, before being mixed with bias and fed to the record head.

145 Signals from the replay head are fed via a replay amplifier, where they are frequency compensated and amplified before being fed to the Output switch as the "tape" signal.

146 The Output switch is manually operated to select the signal which is fed to the meter & tone control amplifier, either the "Tape" signal from the replay amplifier or the "Source" signal from the record amplifier.

Note: On models Serial No. 70,000—74,999, the Output switch has a centre position "Normal", at which the signal is selected automatically by RL700. On "fast wind", "stop" and "replay", the "Tape" signal is selected, but when the Record button is pressed (on "Pause" and "Run"), energising RL700, the "Source" signal is selected.
The meter is illuminated when in the Record Mode (Record knob pressed on Run or Pause); one lamp on stereo models, two lamps on mono models.

The first stage of the meter & tone control amplifier has three outputs, one fed to the 600 Ohm Output and the second to a panel-mounted VU meter. The meter indicates the output signal or the bias level as selected by the Meter switch.

Note: On models Serial No. 75,000—54,999, the Meter switch has a centre position “Source”, at which the “source” signal is fed to the meter (via a meter pre-amplifier) independently of the Output setting.

The third output of the meter & tone control amplifier first stage is fed to the tone control stage, which provides variable boost or cut, at both ends of the audio band, and the signal is then fed to the Low Level output and Output control. From the Output control the signal is fed to a power amplifier, mounted on the power unit, which feeds either an external speaker or internal monitor speaker. Models 702 and 704 have no power output stages, these being replaced by dummy boards taking the outputs from RV705 and RV706 to sockets JK700 and JK701, giving Low Level Adjustable outputs of up to 300 mV into 10,000 ohms or greater.

A 100 kHz oscillator, switched on by the Record button, provides power for the erase head and bias for the record head. On stereophonic models the oscillator output is fed via a Record Mode switch which selects the track or tracks to be erased and recorded.

The Transfer switch enables the signal from one track of a tape to be fed to the line pre-amplifier of the other track, without the need for external connections, and thus re-recorded. The switch can also be used for special effect recordings.

POWER UNIT
General (Figs. 6 and 7)

The power unit has two functions, one to provide smoothed d.c. supplies, and the other to route outputs via jack sockets on the rear panel. A 14 pin plug, internally connected to the amplifier, routes amplifier outputs to speakers and an auxiliary socket on the rear panel, and feeds a 50 volt d.c. supply to the amplifier. An 8 pin rectangular plug, connected to the top of the tape deck chassis, carries the 24 volt d.c. supply from power unit to tape deck, the power supply input to the On/Off switch on the tape deck, and the remote control switching from the auxiliary socket.

Mounted on the rear panel, below the carrying handle, are output jack socket connections, voltage selectors, fuses, power supply and auxiliary socket and a Line Input jack socket which is connected, via a screened lead, to the record board on the amplifier. On stereo models, all jack sockets are duplicated. Internal monitor loudspeakers are connected to 2 pin sockets at the front of the power unit.

Circuit Description (Figs. 27 and 28)

The a.c. power supply is connected to plug P701 and fed via fuse FS702 and SK101/P101 to the tape deck. On the tape deck the a.c. supply is fed via On/Off switch SW101 (single pole on early models) to three motors, and back via SK101/P101 to the power unit. From SK101 pins 3 and 4, it is taken, via voltage selectors VS700/VS701, to the primary of transformer TR700. On 117 volt models, a.c. from SK101 pins 3 and 4 is fed direct to the primary of TR700.

Transformer TR700 secondary has two outputs which feed bridge rectifiers MR700 and MR701. Bridge rectifier MR700 output, smoothed by C700, is 50 volts d.c.,...
three supplies being fed via fuse FS701. One is fed to the power amplifier, another via P700 pin 5 to the amplifier unit, and a third to auxiliary socket SK701 pin 8 for use, if required, on an external unit. On stereophonic models a second 50 volt d.c. supply is fed via fuse FS700 to the lower track power amplifier, and via P700 pin 6 to the amplifier. Bridge rectifier MR701 output, smoothed by C701, is 24 volts d.c. fed via SK101 pin 7 to the tape deck.

**Power Amplifier** (Figs. 27 and 28)

153 The power amplifier consists of a transformerless push-pull amplifier, with complementary transistors in the driving stage. Two transistors VT505 and VT504, feeding complementary transistors VT501 and VT503, comprise the driving stage. A high power output, up to 10 watts, is provided by output transistors VT500 and VT502. Heavy negative feedback is taken from both sides of the output coupling capacitor C500. Resistor R511 provides feedback down to d.c., ensuring high stability, and resistor R512 provides feedback which effectively reduces the reactance of C500 to zero. Control of quiescent current in the output stage is effected by R506 whose value, adjusted by a trimmer resistor, sets quiescent current at 20 to 35 mA. Correction of quiescent current for ambient temperature changes is obtained from the forward resistances of MR500 and MR501 which are connected to the base of VT503.

154 On stereophonic models there are two power amplifier boards, each feeding an internal monitor speaker or an external speaker via a jack socket. On monophonic models the two internal speakers are fed in phase from the one power amplifier, and there is one output via a jack socket. Models 702 and 704 have a dummy board in place of each power amplifier board and the speaker outputs are replaced by **Low Level Adjustable** outputs, the output levels being varied by the **Output** controls RV705 and RV706 (see paragraph 146).

**AMPLIFIER UNIT**

**General** (Figs. 2-5)

155 The amplifier unit is contained in a chassis mounted on the side and cross frames of the recorder, and comprises two main sections. A top section, hinged to facilitate servicing, comprises the main control panel (which carries the main controls and VU meter), and a hinged flap beneath which are the auxiliary controls and switches. A lower section houses the printed circuit boards, equalisation switch and pre-set potentiometers, and the rear panel of this section supports the sockets SK100, SK700, P600-P603. On stereophonic models, the main control panel also carries second channel controls and, beneath the hinged flap, the **Transfer** switch. The body of the **Record Mode** switch is on the oscillator board in the lower section.

**Replay Board** (Figs. 27 and 28)

156 The output of the replay head is fed, via a screened lead, direct to the replay board to avoid hum loops. Signal input is passed, via isolating capacitor C301 and RF suppression components R300/C302, to the base of low-noise transistor VT300. Transistors VT300 and VT301 amplify the signal, negative feedback being applied to VT300 emitter via equalisation switch SW700. Switch SW700 selects from resistors R315-319 and capacitors C313-317 to provide the correct characteristic at each speed; capacitors C313, 315 or 316 adjust the treble response, while the resistors R315 or 317 adjust the extreme bass. On stereophonic models the emitters of VT300 in each channel are connected by RV700, in parallel with C714, and potentiometer RV700 is adjusted for minimum cross-talk. Transistor VT302 further amplifies the signal, a small treble lift being provided by a phase shift arrangement of capacitor C311 with C305, 306 or 307, as selected
by the equalisation switch SW700. The small treble lift is followed by a sharp fall in response at frequencies above the required range. This removes any RF bias pick-up and ensures that the frequency response extends only slightly beyond the chosen limits for each tape speed, thereby reducing hiss to a minimum. The replay board output is developed across tape level potentiometer RV725, which is mounted under the hinged flap of the control panel and marked “A”. Reduction of the replay board output when the function control is at Fast, is effected by switching R313 and C312 into circuit. Signal output from the slider of RV725 is fed to the Output switch as the “tape” signal.

**Meter and Tone Control Board** (Figs. 27 and 28)

157 The meter and tone control board receives a signal input from the Output switch SW702, and this signal can be either the “tape” signal from the replay board or the “source” signal from VT203 on the record board (see paragraph 146). A low gain transistor-stage VT400 feeds the signal input to emitter follower VT401, which gives an output of 2 volts at approximately 30 ohms. There are three outputs from VT401. One fed via R406 (which increases the impedance to 600 ohms) and SK100 pin 13 to the 600 Ohm Output, another is fed direct to the Meter switch, and the third via R407 to the tone stage.

158 Except when the Meter switch is at Bias, the front-panel mounted VU meter monitors signal level and, as is usual with VU meters, an offset of 4 dB is used between sine-wave and music signals, an indication of 0 VU on music signals corresponding to maximum recording level (32 mVx/mm).

159 Resistor R407 feeds signals from emitter follower VT401 to the tone control stage, comprising VT402 and its associated circuit. Circuit parameters are such that there is little or no mid-frequency gain, but variable boost or cut at both ends of the audio band is provided by RV703 (Bass) and RV719 (Treble). Transistor VT402 has two outputs (three on stereo) fed via capacitor C412 as follows:

(i) To the power amplifier via resistor R417, Output potentiometer RV705, and SK700 pin 3.

(ii) To the Low Level Output jack socket on the power unit via R417 and SK700 pin 2.

(iii) On stereo models to the Transfer switch SW704.

**Note:** On earlier stereo models the output to the Transfer switch is taken from the junction C406/R407.

160 **Meter Board** (Serial Nos. 75,000 onwards) $4,999 (YP models 75,000 onwards)

The Meter Board is mounted directly on the back of the meter(s), the Source signal being fed to it from RV220 on the Record Board. Transistor VT800 (or VT801) amplifies this signal to a level suitable for feeding to the meter when selected by the Meter switch at Source. With the Meter switch at Bias, the bias is read directly on the meter. With the Meter switch at Output, the meter is connected to the emitter follower VT401 and reads Tape or Source as selected by the Output switch.

**Record Board** (Figs. 27 and 28)

161 The record board comprises two pre-amplifiers VT200/VT201 and VT202, an intermediate amplifier VT203, and record signal amplifier VT204. Input signals are fed to the pre-amplifiers via jack sockets; the MIC jack socket is mounted on the main control panel and the Line Input jack socket, mounted on the rear panel, is connected via a screened lead direct to the board at A.B. (X.Y. on lower track).
Signals applied to A.B. are fed via C205 (and R227 on later models) to the gate of a field effect transistor VT202, which is used in a follower configuration to give unity voltage gain with an impedance transfer from 2 megohms to a few hundred ohms. Protection of the F.E.T. from stray leakage voltages at the input is provided by MR200 (and R227). The output of VT202, fed via R216, is developed across the Line Gain control (potentiometer RV709). On stereophonic models the output of the Transfer switch SW704 is also developed across RV709.

Signals applied to the MIC jack socket are fed, via an RF filter R200/C202, to the base of transistor VT200. Transistors VT200 and VT201 form a two-stage amplifier and gain is controlled by MIC potentiometer RV727 which controls the negative feedback applied to VT200. The output of the microphone pre-amplifier is fed, via C206 and R214, to C208 where it mixes, at a low impedance to reduce noise level, with the output of the line pre-amplifier (paragraph 161).

Signals from pre-amplifiers are fed, via C208, to an amplifier VT203 and bass boost is applied by network C210 and R217. Transistor VT203 has two outputs, one via RV220 (with bass boost removed by C212 and R222) to provide the "source" signal, and the other to the record amplifier VT204. Transistor VT204 operates with heavy negative feedback which is reduced at high frequencies by a selected by-pass capacitor (see paragraph 164). Amplifier VT204 output is mixed, via a bias filter (L601/C608), with the H.F. bias and passed to the record head. With the Record button in the raised position (not recording), the output of VT204 is inhibited at C216/R212 by an earth connection which is fed via SK100 pin 9 from micro-switch SW108 (see paragraph 126).

Pre-emphasis Board (Figs. 27 and 28)

The pre-emphasis board, mounted at the front of the amplifier, carries feedback components C702-704 (and C708-710 on stereo) selected by the equalisation switch SW700 to provide high frequency boost to the record signal by reducing the heavy negative feedback on VT204 (see paragraph 163). Further boost at the extreme limit of the response is provided by inductor L700 and capacitors C705-707 (and L701 and C711-713 on stereo) and controlled by RV711-713 (and RV715-717 on stereo).

Oscillator Board (Figs. 27 and 28)

The oscillator board, mounted at the rear of the amplifier, consists of a push-pull arrangement with VT600 and VT601 operating at approximately 100 kHz. The oscillator coil L600 has a tuned secondary which passes the R.F. signal to the record and erase heads. On stereo models this is done via the Record Mode switch SW600, which also maintains the bias constant in the Upper, Stereo and Lower modes by the dummy load RV606 and the frequency is kept constant by C607. The erase/bias supply is fed to the erase head X103 via SK602 (SK603) and the bias is fed to the record head X104 via the bias control RV723 (RV724), marked "B" on the front panel (Figs. 2 and 4). The earth return of the record head to the oscillator coil is via RV721 (RV722), which gives a measurement point for the bias current when the meter is set to read Bias, and which adjusts the bias calibration of the meter. The d.c. supply for the oscillator is present only when the Record Button is pressed on Pause and Run, via SW107, and the oscillator voltage is increased slightly at the higher tape speeds by shorting out R701 and R702. This increases the bias proportionally so that at each tape speed the value is optimum, giving the best possible balance between distortion, dynamic range and frequency response.
E - General Overhaul

166 Before proceeding with the general overhaul strip the recorder as follows:

(i) Remove the recorder from its case as detailed in Section 3.
(ii) Remove the deck cover plate as detailed in Section 3.
(iii) Remove the deck control panel as detailed in Section 3.
(iv) Replace the Speed, Fastwind and function control knobs, and the auto-stop arm guide.

167 Thoroughly clean, with the brush provided, any dirt, dust or tape oxide from the tape transport system, paying particular attention to the following:

(i) Head assembly (record and replay head faces should have a polished finish).
(ii) Tape guides.
(iii) Capstan spindle.
(iv) Pinch Roller.
(v) Guides on tape tensioning arms (one mounted on deck control panel).
(vi) Pressure pads (replace if hard or damaged).

Warning: Do not use abrasives. If accumulation of tape oxide is excessive, use methylated spirits.

168 Clear any dirt, dust, tape oxide or solidified grease from the tape deck chassis and mechanisms, paying particular attention to the following:

(i) Capstan motor pulley.
(ii) Idler wheels.
(iii) Flywheel.
(iv) Self-wrapping brakes.
(v) Constant friction brake pad (replace if hard or damaged).
(vi) Cam mechanism of the function control.
(vii) Lock Release assembly.
(viii) Loading arm leaf spring.
(ix) Record micro-switch assembly (SW107 and SW108).
(x) Solenoid pole pieces; these should be free from obstruction.
(xi) Foam pads; these should be firmly attached to the solenoid armatures to minimise mechanical noise.
(xii) Spool height adjuster assembly.
(xiii) Start lever pivot.
(xiv) Run lever pivot.
(xv) Record lever pivot.
(xvi) Record release arm.
(xvii) Turns counter and flexible drive.

169 Lightly oil the following points, using a highly refined straight mineral oil such as Shell Tellus 27, Aeroshell No. 3, etc.:

(i) Idler wheel bushes (see Section 3 for access to bushes).
(ii) Pinch roller bush.
(iii) Capstan spindle bearing.
(iv) Start lever pivot
(v) Run lever pivot
(vi) Spool height adjuster assembly (see Fig. 11).
(vii) Friction brake arm pivots.
(viii) Lock release mechanism.

**Warning:** Do not over-oil as this will cause more trouble than lack of oil.
(This applies particularly to the idler wheels and pinch roller).

170 Lightly grease the following points, using a high viscosity grease:
(i) Face of Function switch cam mechanism.
(ii) Record release mechanism (arm and lever pivot).
(iii) Face of record micro-switch operating arms.
(iv) Loading arm locking spring.

171 Check the condition and action of all return springs and replace if damaged.

172 Check the operation of the tape deck as follows:
(i) Set voltage selectors to the local supply voltage.
(ii) Connect the recorder to the local supply and switch On.
(iii) Load the recorder with a recommended tape.
(iv) Switch the function control to Run, and check that tape runs smoothly and does not twist or curl in the tape transport.
(v) Ensure that the height of the tape across the head faces is correct (see Fig. 12).
(vi) Ensure that the reel height adjusters operate, and that the tape reels do not scrape on the side frames.
(vii) Check that tape runs central on the pinch roller.
(viii) Check that pressure pads hold tape in intimate contact with the headfaces.

173 Check the recorder controls as follows:
(i) Examine all switch and control knobs, and ensure that they are tight on their spindles.
(ii) Operate each switch in turn, and ensure that the action of the switch is positive.
(iii) Rotate each potentiometer in turn, and ensure that the action is smooth.
(iv) Check that all gain control knobs indicate zero when turned fully anticlockwise and also that the tone controls indicate equally plus or minus when rotated to their extreme settings.
(v) Visually inspect the wiring for signs of over-heating, and ensure that all internal plugs and sockets are properly mated.

**Warning:** Visual inspection should be carried out with power disconnected.

174 For a more detailed examination of the tape deck operation and setting up procedure see Section 4.
Fault Finding

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<td>202 Tape slips or &quot;wows&quot;.</td>
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<td></td>
<td>Accumulation of dirt or tape oxide on tape heads and pinch roller. Clean heads and roller as detailed in Section 1E.</td>
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<td></td>
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<tr>
<td>203 Tape &quot;flutters&quot;.</td>
<td>Dirt or tape oxide on pressure pads. Clean pads as detailed in Section 1E and check settings detailed in Section 4 paragraph 407.</td>
</tr>
<tr>
<td>204 Tape winds unevenly.</td>
<td>Faulty tape. Check tape for stretching, indicated by tape being concave or wavy. Reel carrier loose on supply or take-up motor spindle. Check tightness of reel carriers on spindles.</td>
</tr>
<tr>
<td>205 Take-up reel carrier appears to run hot.</td>
<td>It is normal for the take-up reel carrier to feel hot compared to the supply reel carrier, as the latter is not energised on Run.</td>
</tr>
<tr>
<td>206 Turns counter does not register.</td>
<td>&quot;Zero&quot; button incorrectly set. Flexible drive loose or broken. Tighten grub screws or replace drive cable.</td>
</tr>
<tr>
<td>207 Motors will not start (Capstan does not</td>
<td>Start solenoid faulty. Check circuit (Figs. 27 and 28) and replace solenoid if required. Function switch faulty. Clean electrical contacts and check connections.</td>
</tr>
<tr>
<td>rotate).</td>
<td></td>
</tr>
<tr>
<td>Symptom</td>
<td>Possible Cause and Remedy</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>208 Start solenoid energised but motors do not run.</td>
<td>Micro-switch SW102 not operated. Check as detailed in Section 4 paragraph 403. Faulty micro-switch. Check switch, replace if required.</td>
</tr>
<tr>
<td>209 Tape not driven with function control at &quot;Run&quot;.</td>
<td>Faulty run solenoid. Check run solenoid and replace if necessary. No supply to solenoid. Check contacts of switch SW100 (function control), clean or replace as required.</td>
</tr>
<tr>
<td>210 Supply reel still energised at &quot;Run&quot;.</td>
<td>Micro-switch (SW106) not operated or faulty. Check micro-switch as detailed in Section 4 paragraph 406.</td>
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### B - Electronic Faults

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| 211 Tape transport operates but no output heard or indicated on meter. | Faulty d.c. fuse. Check fuse and replace if required.  
**Note:** There are two fuses on stereo models                                                                            |
| 212 Low output.                                                         | Excessive dirt or tape oxide on heads. Clean as detailed in *Section 1* paragraph 166.  
Pressure pad pressure incorrect. Check setting of pressure pads as detailed in *Section 4* paragraph 407.  
Fault in power amplifier. Check amplifier quiescent current as detailed in *Section 4* paragraph 439.  
Incorrect bias setting. Check bias as detailed in *Section 4* paragraph 427.                                            |
| 213 Distorted output.                                                   | Recording level too high. Input level too high. Incorrect bias setting. Check bias as detailed in *Section 4* paragraph 427.  
Faulty amplifier. Check replay section with test tape and then check individual boards.                                  |
| 214 Low output and severe distortion.                                  | No bias. Check H.T. supply to 100 kHz oscillator and relay RL700 via micro-switch SW107. If H.T. supply available, check oscillator circuit.  
Faulty record or replay head. Check head for cleanliness and wear. Clean or replace as required. If head replaced, re-align head assembly as detailed in *Section 4* paragraphs 420 and 426. |
| 215 Excessive hum.                                                      | Check that voltage selectors are set to same position. Check for double earths on recorder and associated equipment.  
Reverse power supply connections to the motors. Check input screened leads and ensure proper earth connections.       |
| 216 Excessive hiss when recorded tape is replayed.                      | Head magnetised. Demagnetise heads using a defluxer. Incorrect bias (too low). Check bias setting as detailed in *Section 4* paragraph 427.  
Record head misaligned. Check head alignment and frequency response as detailed in *Section 4* paragraphs 426, 427 and 428. |
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<td>217 No erasure.</td>
<td>Faulty erase head. Check head and head alignment as shown in Fig. 12. No feed to erase head. Check 100 kHz oscillator and oscillator supply via micro-switch SW107.</td>
</tr>
<tr>
<td>218 Poor top response.</td>
<td>Heads dirty. Clean heads as detailed in Section 1 paragraph 166. Pressure pad pressure incorrect. Check pressure pad setting as detailed in Section 4 paragraph 407. Incorrect bias. Check bias setting as detailed in Section 4 paragraph 427. Incorrect head alignment. Check head height as shown in Fig. 12 and reset azimuth as detailed in Section 4 paragraphs 420 and 426.</td>
</tr>
<tr>
<td>219 Poor bass response.</td>
<td>Faulty capacitor. Check by-pass capacitors in amplifying stages. Check replay section by playing a test tape, this should indicate if fault is in replay or record section.</td>
</tr>
<tr>
<td>220 Excessive crosstalk—</td>
<td>Incorrect head height. Check alignment as detailed in Section 4 paragraphs 420 and 426. RV700 faulty or incorrectly set. Check RV700 and C714 and check setting as detailed in Section 4 paragraph 436. Transfer switch faulty. Check operation of transfer switch and replace if required. Check position of white and violet leads from replay board to equalisation switch. stereo models only.</td>
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# Removals and Replacement

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Removal/replacement of the recorder from case

301 To remove the recorder from the case proceed as follows:

(i) Stand recorder vertical, with the handle at the top and amplifier at the bottom.

(ii) Remove all connections and fuses from the recorder rear panel.

(iii) Lift the handle, push down one end, then the other end, into the recess to take it clear of the inside of the case.

(iv) Remove four securing bolts from the floor of the case.

(v) Ease the recorder just clear of the case.

(vi) Unplug the loudspeaker connections, one plug each side.

(vii) On earlier models remove earth (screen) connection by removing the 4 BA screw securing the solder tag (located on right-hand side).

(viii) Replace the 4 BA screw after removing the solder tag.

(ix) The case can now be removed completely and the fuses replaced.

302 Before replacing recorder, remove fuses. Insert a length of tape or string between the handle and its recess, and feed the ends through the slot in the rear of the case, so that the handle can be pulled out of the recess after the recorder has been replaced. To replace the recorder in the case, reverse the removal procedure.

Removal/replacement of deck cover plate

303 To remove the deck cover plate proceed as follows:

(i) Lay recorder on its back.

(ii) Remove tape spools.

(iii) Remove On/Off knob (earlier models are fitted with an On/Off slide switch which can be left in position).

(iv) Remove speed control knob.

(v) Remove four screws securing the plate to the chassis.

(vi) Ease plate clear of chassis, lifting rear first and taking care not to strain the record release lever.

(vii) Remove foil stop connection on underside of plate, by releasing solder tag fitted to tape guide. On later recorders this step is not necessary.

304 The replacement of the deck cover plate is the reverse of the removal procedure.

Removal/replacement of deck control panel

305 To remove the deck control panel proceed as follows:

(i) Remove fast wind control knob.

(ii) Remove the function knob after setting the function switch to "Run" with the loading gate closed.

(iii) Remove the auto-stop contact from the auto-stop arm (not necessary on later models).

(iv) Remove four screws securing panel to chassis.

(v) Lift panel clear, taking care not to damage or strain the loading knob.

(vi) After removal of the panel remove the four brass spacing washers (located under four securing screws).

Note: If tests or alignment are to be carried out, replace function knob and the auto-stop contact on the auto-stop arm.
The replacement of the deck control panel is the reverse of the removal procedure.

Removal/replacement of amplifier assembly (Figs. 2 - 5)

To remove the amplifier assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.
(ii) Remove 9 pin and 14 pin plugs from the rear of assembly.
(iii) Remove the head phono plug connectors from rear centre bracket.

Note: There are two connectors on mono models and four on stereo models.
(iv) Remove the screened-lead connections from the bottom right-hand pins of the replay board as follows:
    (a) Stereo models (Figs. 2 and 20). On the upper replay board the lead is marked with a red sleeve, and on the lower replay board the lead is marked with a white sleeve.
    (b) Mono models (Figs. 4 and 20). The lead to the board is marked with a red sleeve.
(v) Remove the screened-lead connections from the top left-hand pins of the record board as follows:
    (a) Stereo models (Figs. 2 and 19). On the upper record board the lead is marked with a red sleeve and on the lower record board the lead is marked with a black sleeve.
    (b) Mono models (Figs. 4 and 19). The lead to the board is marked with a red sleeve.

(vi) Remove the six securing screws (three each side).
(vii) Lift amplifier assembly clear of chassis.

The replacement of the amplifier assembly is the reverse of the removal procedure.

Removal/replacement of main panel controls (Figs. 2, 3 and 4)

To remove one of the main panel controls proceed as follows:

(i) Remove amplifier assembly as detailed in paragraph 307.
(ii) Remove the Equalisation switch link, by locating and then removing the bolt connecting the link arm to the switch spindle extension (see Fig. 3). Equalisation switch should be in “Medium” position.

Note: On stereo models only, remove the Record Mode switch spindle as follows:
    (a) Ensure that Record Mode switch is in the “Stereo” position.
    (b) Locate the spindle extension upper locking screw (Fig. 3).
    (c) Slacken screw and remove spindle extension.
(iii) Slacken the grub screw of each control knob, and remove the control knobs.
(iv) Slide out plastic facia of the main control panel, lifting it over the control spindles. The panel can then be hinged upwards to give access to the potentiometer tags.
(v) Removal/replacement of individual components on the main control panel now becomes self-evident.

Before replacing the control knobs on potentiometers, turn all potentiometers to zero. The replacement of the main control panel is the reverse of the removal
procedure. Ensure that marks on knobs and switches correspond to the positions indicated.

Removal/replacement of record and replay boards and components (Figs. 2 and 4)

311 Locate the required board on Fig. 4 for mono models and Fig. 2 for stereo models, and proceed as follows:
   (i) Remove the three screws securing the board.
   (ii) Lift the board partially clear.
   (iii) Removal/replacement of individual components is self-evident (Figs. 19 and 20).
   (iv) To remove the complete board, note connections then disconnect wires to pins (Figs. 19 and 20).

312 The replacement of record and replay boards is the reverse of the removal procedure.

Removal/replacement of meter & tone control boards and components on stereo models (Fig. 2)

313 Locate the required board and proceed as follows:
   (i) Remove the replay board as detailed in paragraph 311 (i) and (ii).
   (ii) Remove the three hexagonal stand-offs.
   (iii) Lift the board partially clear.
   (iv) Removal/replacement of individual components is self-evident (Fig. 21).
   (v) To remove the complete board, note connections then disconnect wires to pins.

314 The replacement of meter & tone control boards is the reverse of the removal procedure.

Removal/replacement of meter & tone control board and components on mono models (Figs. 4 and 21)

315 The removal/replacement of meter & tone control board and components is the same procedure as detailed in paragraph 311.

Removal/replacement of equalisation board (Figs. 2 and 4)

316 To remove the equalisation board proceed as follows:
   (i) Remove the four screws securing the board.
   (ii) Lift board partially clear.
   (iii) Removal/replacement of individual components is self-evident (Figs. 15-18).
   (iv) To remove complete board, note connections then disconnect wires to pins.

317 The replacement of the equalisation board is the reverse of the removal procedure.

Removal/replacement of oscillator board and components (Fig. 10)

318 To obtain access to the oscillator components and to remove the oscillator board proceed as follows:
(i) Unsolder the leads to the earth tags at the bottom of the equalisation board (Fig. 2 or 4).

(ii) Remove the four screws fastening the board to the chassis.

(iii) Swing the equalisation board upwards to expose the oscillator components.

(iv) Removal/replacement of individual components is now self-evident (Figs. 23 and 24).

(v) (a) On Stereo Models, slacken the lower grub screw in the Record Mode switch shaft (Fig. 3) and remove the two nuts holding the switch to the cross bracket.

(b) On Mono Models, remove the two screws and spacers holding the board to the cross bracket.

(vi) The oscillator board can now be moved downward and clear of the chassis.

(vii) To remove the complete board, note the connections to the pins and disconnect the wires.

319 The replacement of the oscillator board is the reverse of the removal procedure. Do not forget to resolder the earth leads, when refitting the equalisation board.

Removal/replacement of power unit assembly (Figs. 6, 7 and 10)

320 To remove the power unit assembly proceed as follows:

(i) Remove recorder from case as detailed in paragraph 301.

(ii) Lay the main chassis on one side.

(iii) Remove 14 pin plug P700 from socket SK700 at rear of amplifier assembly (Fig. 3 or 5).

(iv) Lay the main chassis horizontal.

(v) Remove rectangular socket SK101 from plug P101 on top of chassis (Fig. 8).

(vi) Disconnect Line Input jack socket (two on stereo models) by removing jack assembly from chassis (Fig. 10), taking care to retain the spacing washers.

(vii) Lay the main chassis on one side.

(viii) Remove four countersunk securing screws from the cross frames (Fig. 10).

(ix) Lay main chassis horizontal.

(x) Ease power unit partially clear of main chassis taking care not to damage the electrical switch at the base of the Speed control.

(xi) Lift the handle cables clear of slots on each side.

(xii) Hold the handle clear, easing cables sideways, and slide unit clear of chassis.

321 The replacement of the power unit is the reverse of the removal procedure.

Removal/replacement of turns counter assembly

322 To remove the turns counter assembly proceed as follows:

(i) Remove the deck cover plate as detailed in paragraph 303.

(ii) Slacken the flexible drive retaining screw at the counter end and remove from spindle. On later models with the "spring" flexible drive, pull off the drive while rotating it clockwise with the counter pinions held locked.

(iii) Remove the turns counter drive belt from the counter pulley (taking care to keep it clear of oil or grease).
iii) Remove the screw securing the power supply "On" lamp tag.

(iv) Lift the "On" lamp clear, and unclip and remove the reset lamp.

(v) Pull the turns counter chassis clear of the retaining slots on the chassis and lift turns counter assembly clear.

323 The replacement of the turns counter assembly is the reverse of the removal procedure. When refitting the "spring" flexible drive, lock the counter pinions and push on the drive, at the same time turning it clockwise.

Removal/replacement of idler wheels

324 To remove the idler wheels proceed as follows:

(i) Remove the turns counter assembly as detailed in paragraph 322.

(ii) Turn the speed control knob to the highest speed.

(iii) Slide the top idler arm clear of the assembly, being careful not to damage or stretch the spring.

(iv) Slide the second idler arm clear of the assembly, being careful not to damage or stretch the spring.

(v) Turn the speed control knob to medium or low speed.

(vi) Slide lower (high speed) idler arm clear of assembly and lift clear, being careful not to damage or stretch the spring.

(vii) To remove/replace individual idler wheels:

(a) Remove the spring retaining clip and lift the washer and then the wheel clear of the idler arm spindle.

(b) Replace in the reverse order with the small boss nearer the idler arm.

Note: The lowest wheel (high speed) is fitted with the large boss next to the idler arm and on earlier models it is fitted to the arm which has the spring clip.

325 Before replacing the idler wheels, ensure that they rotate freely and that the special idler wheel arm is the lowest one. To replace the idler wheels, reverse the removal procedure.

Removal/replacement of supply reel motor assembly (Fig. 8)

326 To remove the supply reel motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove the deck cover plate as detailed in paragraph 303.

(iii) Remove the power unit as detailed in paragraph 320.

(iv) Remove the supply reel carrier by slackening grub screw and lifting clear.

(v) Remove the packing washer(s) from the motor spindle.

(vi) Remove the spring clip at the constant friction brake arm pivot, and ease arm clear of motor assembly.

(vii) Lift the plastic brake linkage clear of brake actuating arm.

(viii) Remove two bolts and one screw holding the top plate to the motor assembly and speed arm bracket.

(ix) Remove the brake return spring and lift motor top plate clear of tape deck.

(x) Remove the electrical plug from the motor assembly.

(xi) Remove the nuts securing the motor assembly to the tape deck chassis and lift motor clear of tape deck.
(iv) Remove the take-up reel carrier by loosening the grub screw, unlooping the counter drive belt and lifting clear. Unloop the belt from the motor spindle.

327 The replacement of the supply reel motor is the reverse of the removal procedure.

Note: After replacing the motor assembly check the adjustment as follows. Ensure that the reel carrier is parallel with the deck by using a straight edge across the carrier face. Adjust motor securing nuts as required.

Removal/replacement of take-up motor assembly (Fig. 8)

328 To remove the take-up motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.
(ii) Remove the deck cover plate as detailed in paragraph 303.
(iii) Remove the power unit as detailed in paragraph 320.
(iv) Remove the take-up reel carrier by loosening grub screw, and lift clear, being careful not to damage the turns counter driving gear.
(v) Remove the packing washer and 'C' clip from the motor spindle.
(vi) Remove the three bolts and screw holding the top plate to the motor assembly and speed arm bracket.
(vii) Lift the plastic brake linkage clear of the brake actuating arm and lift top bracket clear of motor.
(viii) Remove electrical plug connections from the lower two pins on the motor body.
(ix) Remove the nuts and washers securing the motor assembly to the tape deck chassis and lift motor clear of tape deck.

329 Before replacing the motor assembly ensure that the anti-vibration mountings (if fitted) are in good condition, and, when refitting the reel carrier, that the counter mechanism gears are adequately meshed but without binding. To replace motor assembly reverse the removal procedure.

Note: After replacing motor assembly check the adjustment as follows. Refit cover plate and adjust height adjuster to its lowest position. Adjust the packing washers until the carrier surface is 3/16 in (2.3 mm) above the cover plate. Tighten the motor securing nuts and, with a straight edge across the face, check that the reel carrier is parallel with deck. Adjust motor securing nuts as required.

Removal/replacement of capstan motor assembly (Fig. 10)

330 To remove the capstan motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.
(ii) Lay the recorder on one side.
(iii) Remove cable clip from C101 securing clamp.
(iv) Remove electrical plug connector.
(v) Remove the four bolts holding the capstan motor bracket to the tape deck chassis (see Fig. 10).
(vi) Ease motor and bracket (complete) clear of the tape deck.
(vii) Remove the four nuts securing the capstan motor to the anti-vibration mountings, unsolder the capacitor connections and lift the capstan motor clear.
(viii) Remove the stepped pulley from the capstan motor spindle.
(ix) Remove fan from motor spindle.
Before replacing the capstan motor ensure that the anti-vibration mountings are in good condition. To replace the capstan motor assembly reverse the removal procedure. While doing so, ensure that the motor pulley is centrally situated through the hole in the deck plate, or the idler wheels may not engage properly.

**Removal/replacement of pinch roller arm** (Fig. 8)

To remove the pinch roller arm proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove the deck cover plate as detailed in paragraph 303.

(iii) Remove the deck control panel as detailed in paragraph 305.

(iv) Remove amplifier assembly as detailed in paragraph 307.

(v) Remove the two screws and locking plate (no plate on earlier models) securing the pinch roller bracket to the pinch roller arm and remove the pinch roller and bracket.

(vi) Remove the pinch roller arm return spring from the tag on the pinch roller arm.

(vii) Remove the micro-switch SW106 actuating arm.

(viii) Remove the two counter-balance weights by unscrewing the weights and spindles from the pinch roller arm (no weights fitted on modified arm of later models).

(ix) Remove the screw (from the bottom) and ‘C’ clip (from the top) of the pivot spindle and withdraw pivot spindle from the bottom of the tape deck chassis.

(x) Ease the pinch roller arm clear of the assembly from the front.

To replace the pinch roller arm reverse the removal procedure. After the pinch roller arm has been replaced, the gap between armature and the pinch roller arm must be set correctly as detailed in Section 4A paragraph 406.

**Removal/replacement of spindle and/or flywheel** (Figs. 8 and 10)

To remove the spindle and/or flywheel proceed as follows:

(i) Remove the pinch roller arm as detailed in paragraph 332.

(ii) Remove the screw from the lower end of the flywheel spindle (Fig. 10).

(iii) Slacken the pinch clamp which is located just above the surface of the flywheel.

(iv) Withdraw the capstan spindle upwards.

(v) Lift the flywheel clear of the lower flywheel bearing and remove from the recorder.

Before replacing the flywheel ensure that the spring is firmly fitted to the top and grease the spring and lower flywheel bearing using a high viscosity grease. On later models the spring has been replaced by a fixed pin in the flywheel. To replace the flywheel reverse the removal procedure, fitting the spindle so that the lower end is almost flush with the bottom bearing plate but slightly recessed into the bearing.

**Note:** After replacing the flywheel, check the adjustment of the gimbal bearing and flywheel as detailed in Section 4A.

**Removal/replacement of head assembly** (Figs. 3, 5 and 9)

To remove the head assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove the deck control panel as detailed in paragraph 305.
(iii) Unplug the erase and record head leads from the phono socket at the rear of the amplifier (Fig. 8)—there are four connections on stereo models (Fig. 3).

(iv) Remove the replay board connections as follows:
   (a) On mono models (Fig. 4) the lead with a red sleeve connected to the two bottom right-hand pins on the board.
   (b) On stereo models (Fig. 2) the lead with a white sleeve from the lower replay board and the lead with a red sleeve from the upper replay board and in each case it is the two bottom right-hand pins on the board.

(v) Remove the cable clip from C101 securing clamp.

(vi) Pull back the loading arm to the "Load" position and remove the four clamp bolts from the head assembly (Z in Fig. 8).

(vii) Lift the head assembly clear of the raised platform, threading the cables through the holes in the chassis and raised platform.

337 To replace the head assembly reverse the removal procedure, ensuring that the pressure arms are correctly located with respect to their actuating pins in the loading arm. When reconnecting the leads, check that they do not foul the fan blades on the capstan motor assembly.

Removal/replacement of heads (Fig. 9)

338 To remove one of the heads proceed as follows:
   (i) Remove the complete head assembly as detailed in paragraph 336.
   (ii) To enable the head plate to be removed it is first necessary to remove one of the tape guides by loosening the screw on the underside of the head assembly.
      (a) For the Erase head, remove the L.H. tape guide then remove the screws on the front and rear flanges.
      (b) For the Record head, remove the centre tape guide.
      (c) For the Replay head, it is not necessary to remove any guide.
   (iii) Remove the spindle holding the head mounting plate to the main head assembly by sliding it towards the rear.
   (iv) Raise the head plate, easing the leads through the hole. On the Record and Replay heads take care not to lose the springs under the two right-hand fixing screws.

WORKING FACES OF HEADS

Correction to Fig. 3b — substitute in place of previous diagram.

HEADS VIEWED FROM REAR.

Fig. 301b Head Wiring (Serial Nos. 81,400 onwards)
(v) Unsolder the leads to the head pins, noting to which pin the braid is soldered (normally the left-hand pin viewed from front face) and on stereo models which lead is soldered to the rear two pins (Upper Track).

(vi) Remove the four screws which fasten the heads to the mounting plate. On the Record and Replay heads take care not to lose the spring under the socket-headed screw at the front left of each head.

To replace a head, reverse the removal procedure, ensuring that the springs are refitted to the Record and Replay heads. After a Record or Replay head has been replaced (or refitted) and the head block remounted, it must be re-aligned correctly. The socket-headed aligning screw (Fig. 9) should be set so that the head cap appears vertical, then the height checked as in Fig. 12. The head height is adjusted by inserting or removing thin shims of B.P. (or non-magnetic material) between the head and its mounting plate, and retightening the fixing screws. As the head face must remain vertical, shims of equal height must be inserted front and rear. The gap azimuth alignment should then be set accurately as in paragraph 420 or 426.
MODIFICATION NOTE No. 2

SECTION 3

Serial Nos. 81,400 onwards

Paragraph 338

To remove one of the heads proceed as follows:

(i) Remove the deck control panel as detailed in paragraph 305.
(ii) Unsolder (or unplug) the leads from the pins at the rear of the head.
(iii) Remove the two screws fastening the headplate to the head block plate, taking care not to lose the spring on the rear right screw.

Paragraph 339

To replace a head, reverse the removal procedure, ensuring that the spring is fitted to the Record and Replay heads. After a Record or Replay head has been replaced (or refitted), it must be re-aligned correctly, as follows:

(i) Set the spring-retaining screw (rear right) so that its top is approximately 1/2 in. (3 m.m.) above the head block plate.
(ii) Adjust the socket-headed screw (front left) so that the head plate appears level.
(iii) Adjust the two set screws (front and rear) on the centre line so that the head height is correct as in Fig. 12, and that the head face is vertical.
(iv) Set the gap azimuth alignment accurately as described in paragraph 420 or 426.

Fig. 301b Head Wiring (Serial Nos. 81,400 onwards)
Test Procedures and Adjustments

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A. MECHANICAL

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Wow and Flutter Measurement

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Replay Response Correction
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Ignore part (vi) for all recorders with the belt-driven turns counter.

A - Mechanical

General

401 Before proceeding with mechanical adjustments it is good practice to carry out a general overhaul, as detailed in Section 1E.

SECTION 4

402 Remove the recorder from case and remove the deck cover plate and deck control panel as detailed in Section 3. Check that the settings of the Voltage Selectors agree with the power supply voltage available, and connect the recorder to the power supply. Set the function control to Stop and then switch On the recorder. Except where specified otherwise, the deck should be loaded with a full 7 in. reel of Long Play tape.

Solenoids, Micro-switches, Motors and Brakes

403 To check the correct operation of solenoids, micro-switches, motors and brakes proceed as follows:—

(i) Turn the function switch to Pause and check that there is no “chatter” when the start solenoid is energised. If it does occur, this is usually due to incorrect setting of the operating stud of the economy switch SW103.

(ii) Should the stud of SW103 require resetting, disconnect the power supply and operate the start lever mechanism by hand until it is fully engaged with the start solenoid. Slacken the locknut and adjust the operating stud until it is 0.015—0.020 in. (0.4—0.5 mm) from the body of the micro-switch. Reconnect the power supply and repeat (i) above. If satisfactory, retighten the locknut and proceed to (iv). If chatter occurs, proceed to (iii).

(iii) If chatter occurs, slightly increase the distance between the operating stud and the body of the micro-switch until the chatter ceases (the distance must not be so great that the micro-switch is not operated). Retighten the locknut.

(iv) Ensure the microswitch SW102 is operated immediately before SW103. If not, adjust the operating stud of SW102 accordingly. Do not forget to retighten the locknut after adjustment.

(v) Turn the function switch to Pause (energising Start solenoid) and check that the gap between the brake shoe and the reel carrier drum is equal all round and is approximately \(\frac{1}{32}\) in. (0.8 mm). If not, slacken the two nuts holding the brake arm and reset the arm, ensuring that on returning to Stop the pin on the end of the arm is not exerting pressure on the plastic linkage and holding off the brake.

(vi) Ensure that the take-up reel carrier is engaged with the counter pinion over the full range of the reel height adjustment.

(vii) Turn the function control to Fast. Check the action of the Fast Wind control, ensuring that the tape winds freely in either direction.

(viii) With the tape travelling at maximum speed on Fast, return the function switch to Stop and check that the tape comes to rest smoothly and without snatch ing or tape spillage. Repeat with the tape travelling in the opposite direction and adjust the brakes if necessary (see (ix)).

(ix) To adjust the brake tension, release the spring tension adjusting screw (Fig. 8) — on later models use a 3BA Allen key — and re-clamp in the correct position. Moving the adjuster away from the reel carrier increases the brake spring tension, and vice versa.

51
(ii) Check that the turns counter belt drive is running correctly on both pulleys, and that rotating the take-up reel carrier in each direction drives the turns counter.

**Counter Mechanism**

404 To check the operation of the counter mechanism proceed as follows:

(i) Check that the counter gears do not over-mesh and bind on the blind portion of the teeth.

(ii) Check that the flexible drive is firmly fixed at each end and follows a smooth curve between the take-up reel and counter assembly.

(iii) Switch the function control to *Run* and check that the counter mechanism movement operates satisfactorily.

(iv) Switch the function control to *Stop* and check the function of the *zero* button. Switch back to *Run* and check that counter operates satisfactorily.

(v) Examine the two lampholder assemblies and connections and ensure that there is no chance of a short-circuit.

**Idlers and Idler Arms**

![Diagram of idler and idler arm assembly]

*Fig. 401 Idler and Idler Arm Assembly*

405 To check the operation of the idlers and idler arms proceed as follows:

(i) With the recorder switched *On* and the function control set to *Stop*, check that there is clearance between the leaf spring (Fig. 8) and the appropriate idler arm, at each setting of speed change switch SW104. This is adjusted by the set screw (Fig. 8) on the start lever arm.

(ii) Check that on turning to *Pause* at each setting of the speed change switch SW104, a slight movement of the idler arm is possible (Fig. 401).

(iii) Check the height of idler wheels in relation to the stepped capstan motor pulley (Fig. 8). The pulley should be such that no idler wheel runs on the edge of a step.

(iv) Ensure that (when fitted) the outrider on the high speed arm (lowest arm) keeps the idler wheel lying square to the flywheel and drive pulley. In this condition the outrider should be touching the deck plate (not fitted on later models).

(v) Check that the pressure applied by the start lever spring to the idler arm is 200 grams (see Fig. 401).

(vi) On *Pause*, check that the leaf spring is held clear of the start lever adjusting screw.
Run Solenoid and Pinch Roller Arm

406 To check and adjust the run solenoid and pinch roller arm proceed as follows:

(i) Switch the function control to *Run* and ensure that the run solenoid (Fig. 8) is energised and that the armature moves the pinch roller arm assembly. The solenoid should be reasonably quiet in operation. Return function control to *Pause*.

(ii) Place a \( \frac{3}{16} \) in. (2.38 mm) thick bar between the armature and its carrying arm and switch the function control to *Run*.

(iii) Check that the pinch roller is just touching the capstan spindle. If not, slacken the two screws holding the pinch roller bracket and adjust. Retighten screws when in correct position.

(iv) Switch the function control to *Pause* and remove the bar from between the armature and its carrying arm.

(v) When the function control is set to *Run* there should be a gap between the armature and the arm. This ensures that the spring has, full control of the pressure of the pinch roller, independent of the magnetic force.

(vi) With the function control still on *Run*, check that there is approximately \( \frac{3}{8} - \frac{1}{4} \) in. (0.8-1.6 mm) clearance between pinch roller bracket and plastic ramp. If not, reset the plastic ramp.

(vii) With a Tension Gauge check the pressure of the pinch roller on the drive spindle. This should be between 1200-1400 grams, adjustable by the armature adjusting nut on the pinch roller arm (Fig. 8).

(viii) Switch the function control to *Pause*, and check that the pinch roller moves clear of the capstan by .015-.02 in. (0.4-0.5 mm).

(ix) Check the action of the pinch roller, it should be very free in movement and a slight end play is preferred.

(x) Switch the function control to *Run*.

(xi) Check that the pinch roller runs parallel to the capstan spindle.

(xii) There should be no heavy run up or down of the tape caused by the pinch roller. This can be determined by observing the behaviour of the tape in the right-hand guide. Check that the tape runs reasonably central on the pinch roller.

(xiii) Check the action of micro-switch SW106 (top of Run solenoid); this should short out the supply motor on *Run* and re-energise it on *Pause*.

(xiv) With the function control at *Run* check the armature does not bind on the sides of the arm by moving the assembly gently back to the “off” position to see if any stiffness is present.

Loading Arm & Pressure Arms

407 To check the operation of the loading arm and pressure arms proceed as follows:

(i) With the function control at *Pause* check that the clearance between the pinch roller and capstan spindle is .015-.02 in. (0.4-0.5 mm) and check the clearance for tape loading with the lever in the *Load* position.

(ii) Check the action of the loading arm, which should not be too stiff, and in the *Load* position some slight movement should be possible.

(iii) Set the function control to *Run* and check the pressure setting of the pressure pad arms which should be 25 grams measured on the arm “neck” behind the pad. Each pad should be self-aligning except on the playback head, which has the mumetal wing.
(iv) On the playback head pressure pad ensure that the Mu-Metal Wing is locked in the correct position such that the pad is making proper contact with the head face, and the wing is not fouling the tape.

**Cut-Out Switches and Damping Arms**

408 To check the operation of the cut-out switches and damping arms proceed as follows:

(i) Replace the deck control panel as detailed in Section 3 paragraph 306.

(ii) Load the recorder with 8\(\frac{1}{2}\) in. reels and ensure that almost all the tape is on the take-up reel, as this is the most critical condition.

(iii) Switch *On* recorder and observe the operation of the tape transport in all positions of the function control. Check that the spring of the right-hand tape tension/auto-stop arm is not so strong that the arm traps the tape continuously against the insulated auto-stop pillar. However, it is normal for it to trap the tape on starting to run, while the take-up reel is picking up speed.

(iv) Switch the function control to *Pause* and unloop tape from right-hand guide. Ensure that when left free the arm touches the "live" auto-stop pillar, lighting the *Reset* lamp and switching off the motors.

(v) Replace tape and check that *Reset* lamp is still lit and that the function control has to be switched to *Stop* before lamp is extinguished.

(vi) Ensure that when the left-hand guide and the tape damping arm are bridged by the metal foil on the tape, the auto-stop relay is tripped and the *Reset* lamp lights.

**Tape Transport**

409 To check the correct operation of the tape transport system proceed as follows:

(i) Load a tape on the recorder and switch *On*. Turn the function control to *Run* and observe the tape running. There must be no evidence of tape buckling due to guides being incorrectly set.

(ii) Check the setting of the spool height adjusters and see that the tape does not scrape on the spool rim. At the lowest setting of the spool height adjusters the edges of the tape must not scrape on the plastic supports of the cover box.

(iii) Check ease of tape loading.

**Capstan and Flywheel**

410 To check the correct operation of the capstan and flywheel proceed as follows:

(i) Grasp the flywheel and the capstan spindle (Fig. 8) — there should be slight end play and a very small rotary movement between the two components.

(ii) The freedom of the gimbal bearing can be observed on a W. & F. meter as in paragraph 415 by gently pressing either side of the gimbal, when a change in the tape speed should be observed. There should be a complete return to normal on releasing the pressure on the bearing.

(iii) Set the recorder to *Run* at 7\(\frac{1}{2}\) in/sec (19 cm/sec), then return to *Stop*. Check that the flywheel runs for approximately 45 seconds after switch off.

**Friction Brake**

411 To check the correct operation of the friction brake proceed as follows:

(i) Check that the lever is free moving.
(iii) Switch the Function control to Pause and try to press the Record button. It should not operate unless the Record Release catch is moved to the left, and is locked down on allowing the Record Release catch to return.

(ii) Switch On the recorder and set the function control to Run.

(iii) Observe that the brake causes just sufficient damping of the supply reel to prevent overrun on starting.

**Record Button**

412 To check the correct operation of the record button proceed as follows:

(i) Press the Record button and check that the action is smooth.

(ii) Check that the arm will not lock in the Record position (down) when the function control is at Fast and Stop.

(iii) Switch the function control to Pause and operate the Record button. Check that the arm is locked in the Record (down) position.

(iv) Check the action of the record release arm and its return spring.

(v) With the function control at Pause, operate the Record button and then switch the function control to Stop and check that the record arm is released.

(vi) Check that the switch operating bracket on the record arm is clear of the micro-switch arms when in the "Off" position.

(vii) Press the Record button and check that micro-switches SW107 and SW108 (Fig. 8) are operated by the bracket well before the arm locks "on".

**Main Function Switch and Lock Lever**

413 To check the correct operation of the function switch and lock lever proceed as follows:

(i) Switch the function control to Fast, then back to Stop and then check that the lock lever prevents the control from being turned to Pause.

(ii) Release lock by operating the Lock Release button and observe that the Function Control advances to the normal Stop position so that it can now be turned to Pause.

(iii) Check that the lock lever spindle is rigidly fastened to the frame, but allows the lever to operate freely.

**Tape Speed Using Measured Tape or Stroboscopic Tape**

414 To measure the speeds of the recorder a stroboscopic tape should be used as in (viii) below, or (in the absence of special equipment) a speed tape can be calibrated and used as follows:

(i) Take a full 7 in. reel of tape and make a visible mark near the beginning. At exactly 31 ft. 3 in. (9-525 m) from this mark make another mark and give this mark a number 0. At 3\(\frac{1}{2}\) in. (95-25 mm) intervals along the tape and either side of the 0 mark, place further marks with the numbers -1, -2, -3, -4, -5, -6, (towards end of tape) and +1, +2, +3, +4, +5, +6 (towards start of tape). At tape speeds of 15, 7\(\frac{1}{2}\), 3\(\frac{1}{2}\) and 1\(\frac{1}{2}\) in/sec (38, 19, 9-5 and 4-75 cm/sec), it takes exactly 25, 50, 100 and 200 seconds respectively for a tape of 31 ft 3 in. (9-525 m) to pass through the machine.

(ii) Load the tape onto the recorder and switch On. Set speed change switch to a predetermined speed.

(iii) With the function control at Pause, align the start mark on the speed tape with a visible and static element (e.g. tape guide).

(iv) Switch the function control to Run and after exactly 25, 50, 100 or 200 seconds depending on tape speed selected (use stop-watch), switch control back to Pause.
(v) Read off speed variation in percentages from the mark on the tape as indicated by the static element selected in (iii). On faster speeds it is advisable to repeat (iii) to check accuracy of measurement.

(vi) If speed is incorrect, do not adjust whilst speed tape is operating. Recheck after each adjustment.

(vii) The tape speed accuracy should be better than ± 1%. If outside these limits check the idler wheel (paragraph 405) and the pinch roller pressure (paragraph 406), and also the action of the wrap-round type brakes (paragraph 403) and friction brake (paragraph 411). Recheck tape speed (ii) to (v) after each adjustment.

(viii) As an alternative to paragraphs (i)-(vii) above, a stroboscopic tape (100 stripes per 7\(\frac{1}{4}\) in (19 cm)) could be replayed as part of a full 7 in reel of tape, and viewed under 50 Hz mains lighting. If the tape is running at exactly the nominal speed the stripes will appear to stand still. If the tape appears to move, count the number of dark stripes progressing (tape speed too fast) or regressing (tape speed too slow) past a fixed mark in a certain number of seconds. This should be not more than the following:

- 15 in/sec (38 cm/sec) — 2 stripes per second
- 7\(\frac{1}{4}\) in/sec (19 cm/sec) — 1 stripe per second
- 3\(\frac{3}{4}\) in/sec (9-5 cm/sec) — 1 stripe per 2 seconds

**Note:** This test cannot be used at 1\(\frac{1}{2}\) in/sec (4-75 cm/sec) tape speed.

**Wow and Flutter Measurement**

415 To measure wow-and-flutter using a meter with DIN weighting, *e.g.* Miniflux type ME101, proceed as follows:

(i) Connect oscillator output of wow-and-flutter meter to tape recorder *Line Input*.

(ii) Connect meter input to *Low Level* output socket of recorder.

(iii) Record the fixed frequency for approximately 5 minutes.

(iv) Play back the recording and
   (a) Adjust W & F meter input sensitivity.
   (b) Select total wow-and-flutter reading.
   (c) Select percentage range.

(v) Note the wow-and-flutter reading.

(vi) Repeat (ii) to (v) for all three tape speeds.

(vii) Check the readings noted in (v) against the following figures:
   (a) Normal Speed models
      - Less than 0-08% at 7\(\frac{1}{4}\) in/sec (19 cm/sec)
      - 0-15% at 3\(\frac{3}{4}\) in/sec (9-5 cm/sec)
      - 0-20% at 1\(\frac{1}{4}\) in/sec (4-75 cm/sec)
   (b) High Speed models (suffix H)
      - Less than 0-08% at 15 in/sec (38 cm/sec)
      - 0-10% at 7\(\frac{1}{4}\) in/sec (19 cm/sec)
      - 0-15% at 3\(\frac{3}{4}\) in/sec (9-5 cm/sec)

(viii) If the wow-and-flutter readings are out of tolerance, thoroughly check that the General Overhaul detailed in Section 1 E has been carried out. All mechanical operations can affect the wow-and-flutter readings and if a general overhaul fails to bring the recorder into tolerance, carry out the checks and adjustments detailed in paragraphs 403 to 413 of this section.
Electronic Section

General

416 The following paragraphs detail the overall electrical test procedure. It must be emphasised that existing settings should not be disturbed unless accurate test equipment is available.

417 The tape heads should be thoroughly demagnetised before any alignment procedure is carried out or before standard test tapes are played. Calibration of these tapes will be permanently damaged if they are played on magnetised heads.

418 An earthed soldering iron must not be used to make connections to any part of the electronics while the recorder is switched on, since this may cause current surges resulting in damage to transistors or head magnetisation. For the same reason, the replay head must not be reconnected to the amplifier while the recorder is switched on.

Equipment Required

419 The instruments required to carry out the alignment procedure are as follows:

(i) Test Tape(s)  
     - Head alignment
     - Frequency Response (for each speed)
     - Peak (or 0 VU) signal level

(ii) Millivoltmeter (3mV-3V).

(iii) AF Signal Generator (20Hz-20kHz, sine-wave).

(iv) Distortion Meter.

(v) Head Demagnetiser.

(vi) Wave Analyser or 1kHz Filter.

(vii) Milliammeter (0-50mA).

(viii) Throughout the following tests and adjustments, Ferrotape type B or Scotch Dynarange 203 tape must be used. If neither of these is available, reasonable results can be obtained using similar low noise tape, such as Ampex 444 or BASF LP35LH.

Warning: Before starting the test and alignment procedure, see that the General Overhaul as detailed in Section 1 E has been carried out and that the mechanical checks laid down in part A of this Section have been carried out. For example, oxide on tape heads or incorrect setting of pressure pads will lead to imperfect contact between heads and tape, causing high frequency losses.

Replay Head Alignment

420 To carry out the head alignment proceed as follows:

(i) Load a standard head alignment tape onto the recorder and switch On.

(ii) Connect a millivoltmeter to the 600 Ohm Output and turn the function switch to Run.

(iii) Using the 4BA azimuth aligning screw (Fig. 9), adjust the replay head for the highest output on the millivoltmeter, Output switch at Tape.

Note: On stereo recorders both tracks should be monitored while this adjustment is being carried out.

(iv) Inspect visually to make sure that the tape runs over the replay head at the correct height, see Fig. 12.
**Note:** On quarter track mono and quarter track stereo the top edge of the active head face should coincide with the top edge of the tape (use transparent leader). On half track stereo the head is set centrally on the tape allowing .002 in (.05 mm) of head face to be visible at each edge of the tape. On half track mono the top edge of the active head face should be .010 in (.25 mm) below the top edge of the tape (use transparent leader). If any adjustment is necessary, see paragraph 339.

**Replay Frequency Response**

421 To check the replay frequency response proceed as follows:

(i) Load an appropriate response test tape onto the recorder and switch **On**.

(ii) Connect a millivoltmeter to the **600 Ohm Output** and set the **Output switch to Tape**.

(iii) Turn the function control to **Run** and measure the recorder output on the millivoltmeter for all recorder speeds as follows:

<table>
<thead>
<tr>
<th>Speed</th>
<th>H</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 μsec</td>
<td>15 in/sec (38 cm/sec) 30Hz-20kHz ± 2dB</td>
<td>3½ in/sec (9.5 cm/sec) 40Hz-14kHz ± 3dB</td>
<td>1½ in/sec (4.75 cm/sec) 60 Hz-7kHz ± 3dB</td>
</tr>
<tr>
<td>50/3180μ sec</td>
<td>7½ in/sec (19 cm/sec) 30Hz-17kHz ± 2dB</td>
<td>9½ in/sec (9.5 cm/sec) 40Hz-14kHz ± 3dB</td>
<td>1½ in/sec (4.75 cm/sec) 60 Hz-7kHz ± 3dB</td>
</tr>
<tr>
<td>90/3180μ sec</td>
<td>3½ in/sec (9.5 cm/sec) 40Hz-14kHz ± 3dB</td>
<td>120/1590μ sec</td>
<td>1½ in/sec (4.75 cm/sec) 60 Hz-7kHz ± 3dB</td>
</tr>
</tbody>
</table>

**Replay Response Correction**

422 If the frequency response is not within the limits specified, the level of the high frequencies may be adjusted by means of capacitors C313, C315 or C316 and the low frequencies by R315, R317 or R320 (later models). These components are soldered to pins on the Replay Board (see Figs. 2, 4, & 20a, b or c) and are adjusted at each tape speed as follows:

(a) Medium speed models, Serial No. 70,500-74,999

<table>
<thead>
<tr>
<th>Speed</th>
<th>H</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Frequencies</td>
<td>C316</td>
<td>C315</td>
<td>C313</td>
</tr>
<tr>
<td>Low Frequencies</td>
<td>R315</td>
<td>R317</td>
<td>R317</td>
</tr>
</tbody>
</table>

(b) Medium speed models Serial No. 70,000-70,499 & 75,000-78,800/2

<table>
<thead>
<tr>
<th>Speed</th>
<th>H</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Frequencies</td>
<td>C313</td>
<td>C315</td>
<td>C316</td>
</tr>
<tr>
<td>Low Frequencies</td>
<td>R317</td>
<td>R317</td>
<td>R315</td>
</tr>
</tbody>
</table>

(c) Medium speed models, Serial No. 78,s00/2-

<table>
<thead>
<tr>
<th>Speed</th>
<th>H</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Frequencies</td>
<td>C313</td>
<td>C315</td>
<td>C316</td>
</tr>
<tr>
<td>Low Frequencies</td>
<td>R320</td>
<td>R317</td>
<td>R315</td>
</tr>
</tbody>
</table>
It is not usually necessary to replay test tapes at 1 1/2 in/sec. (4.75 cm/sec). The value of the treble control capacitor C313 may be twice that required for 3 1/4 in/sec. (9.5 cm/sec).

**Note:** Test tapes are usually recorded across the full width of the tape and when they are replayed on quarter track heads, fringing flux from that part of the tape between the tracks will cause a rise in bass response. At 40Hz this is approximately + 2dB on the upper track and + 3 dB on the lower track. This rise should not be compensated for, since it is not present when the correct recording track width is used.

**Replay Output Level**

423  To adjust the output level using a European test tape proceed as follows:

**Note:** On European test tapes the maximum recording level is 32 milli-maxwells per mm at 15 in/sec. (38 cm/sec) and 7 1/2 in/sec. (19 cm/sec); and 25 milli-maxwells per mm at 3 1/4 in/sec. (9.5 cm/sec) and 1 1/2 in/sec. (4.75 cm/sec). This level corresponds to a reading of + 4VU on the meter, which is greater than full scale deflection, and in this case a millivoltmeter is used across the 600 Ohm Output.

(i) Load the peak level test tape onto the recorder, set the speed selector to 7 1/2 in/sec. (19 cm/sec) and switch On.

(ii) Connect a millivoltmeter to the 600 Ohm Output, and turn to Run.

(iii) Locate the preset control marked “A” (RV726 under hinged flap) and adjust control to give a reading of 2 volts on the millivoltmeter, with the Output switch at Tape.

424  To adjust the output level using an American test tape proceed as follows:

(i) Load the test tape onto the recorder, set the speed selector to 7 1/2 in/sec. (19 cm/sec) and switch On.

(ii) Locate the section on the tape which has a recorded level 4-6 dB below peak level, corresponding to O VU.

(iii) Locate the preset control marked “A” (RV725 under hinged flap) and adjust control to give a reading of 0 VU on the internal VU meter.

**MIC and LINE Inputs**

425  To check the inputs proceed as follows:

(i) Connect the AF Signal Generator giving a 1kHz signal (1mV) to the Mic input.

(ii) Switch On recorder and turn up Mic and Output controls. Set the Output switch to Source and check that the signal is heard on the internal loudspeaker (external on models 702 and 704).

(iii) Connect the AF Signal Generator giving a 1kHz signal (1/2V) to the Line Input and turn up Line gain control. Check that the signal is heard on the internal loudspeaker.

(iv) Switch the Output switch to Tape, and check that no output is heard.

(v) With the Output switch at Normal and the function switch at Run, check that no signal is heard. Press the Record button and check that an output is then heard on the internal loudspeaker.

**Note:** On models Serial No. 75,000 onwards, the Normal position is not fitted and 425 (v) should be omitted.
Record Head Alignment

426 To align the record head ensure that the Replay Head is correctly aligned as in paragraph 420, then proceed as follows:

(i) Load a tape onto the recorder and set the speed selector to 7\(\frac{1}{4}\) in/sec. (19 cm/sec.).

(ii) Connect an AF Signal Generator to the Line Input and a millivoltmeter to the 600 Ohm Output.

(iii) Switch On the recorder and adjust the Signal Generator output to give 200 mV on the meter at a frequency of 16 kHz (output switch at Source).

(iv) Turn the function control to Run and press the Record button.

(v) Adjust the azimuth setting of the record head by adjusting the aligning screw (Fig. 9) for maximum replay output whilst monitoring from the tape, Output switch at Tape.

(vi) On stereo models, both tracks should be checked before a final position is adopted.

(vii) Check the position of the tape (using transparent leader) in relation to the record head, see Fig. 12.

Note: On quarter track mono and quarter track stereo the top edge of the active head face should coincide with the top edge of the tape (use transparent leader). On half track stereo the head is set centrally on the tape allowing -002 in (-06 mm) of head face to be visible at each edge of the tape. On half track mono the top edge of the active head face should be -010 in (-025 mm) below the top edge of the tape (use transparent leader). If any adjustment is necessary, see paragraph 339.

HF Bias Setting

427 To set the HF bias proceed as follows:

(i) Load either Ferrotape type B or Scotch Dynarange 203 tape onto the recorder and set the speed selector to 7\(\frac{1}{4}\) in/sec. (19 cm/sec.). On stereo models, set Record Mode switch to Stereo.

(ii) Connect an AF Signal Generator giving 1 kHz to the Line Input and millivoltmeter to the 600 Ohm Output.

(iii) Switch On recorder and set Output switch to Tape. Turn to Run, press the Record button and adjust the Signal Generator output to give a reading of approximately 200 mV on the millivoltmeter.

(iv) Locate and adjust the preset control "B" (RV723 or RV724 on Figs. 2 or 4) for a maximum reading on the millivoltmeter. Turn to Pause.

(v) Switch the Meter switch to Bias and ensure that a reading of 0 VU is obtained on the record level meter. If this reading is not obtained adjust RV 721 (see Fig. 5).

Note: On stereo models adjust RV721 for upper track and RV722 for lower track (see Fig. 3).

(vi) Connect the millivoltmeter to the collector of VT204 on the record board.

(vii) Tune L601 (through access hole in oscillator board, see Fig. 5) until millivoltmeter reading (bias leakage voltage) is less than 300 mV.

Note: On stereo models adjust L601 for upper track and L602 for lower track (see Fig. 3).

(viii) On stereo models repeat (ii)-(vii) for the other channel.
(ix) On stereo models, with the meter switch at Bias, release Record button, turn Record Mode switch to Upper and press Record button. Check that the bias still reads 0 VU on the Upper meter. If not, adjust RV 606 on oscillator board.

(x) Release the Record button and turn Record Mode switch to Lower. Press Record button and check that the bias reads approximately 0 VU on the Lower meter.

**Note:** Do not turn the Record Mode switch while the Record button is depressed (i.e. on Record) as this will polarise the head.

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**Record/Replay Frequency Response Measurement**

428 To measure and adjust the record/replay frequency response proceed as follows:

**Note:** It is essential that the recording tests using constant tones are carried out at 20 dB below maximum recording level i.e. producing 200 mV at the 600 Ohm Output. Frequency responses carried out at recording levels significantly higher than this are meaningless due to the danger of tape overload at the high frequencies.

(i) Load unused, or bulk erased, Ferrotype type B or Scotch Dynarange 203 tape onto the recorder.

(ii) Connect an AF Signal Generator to the Line Input and a millivoltmeter to the 600 Ohm Output.

(iii) Set the speed selector to 7¼ in/sec. (19 cm/sec.) and switch On.

(iv) Set the function control to Run and press the Record button.

(v) Vary the Signal Generator output between 30 Hz and 17 kHz, keeping the signal at a constant voltage level.

(vi) With the Output switch at Tape, check that the frequency response on the millivoltmeter does not vary more than ± 2 dB.

(vii) Repeat (iv)-(vi) for all three speed settings of the recorder. The Signal Generator settings and frequency response limits are as follows:

- 15 in/sec. (38 cm/sec.) 30 Hz — 20 kHz ± 2 dB
- 7¼ in/sec. (19 cm/sec.) 30 Hz — 17 kHz ± 2 dB
- 3½ in/sec. (9-5 cm/sec.) 40 Hz — 14 kHz ± 3 dB
- 1½ in/sec. (4-75 cm/sec.) 50 Hz — 7 kHz ± 3 dB

(viii) If the frequency response is within the limits specified, set the speed selector to 7¼ in/sec. (19 cm/sec.) and adjust RV220 (located on record board) until the signal output level is the same on Source as on Tape. On stereo models repeat (iv)-(viii) on the other channel.

(ix) If the frequency response does not fall within the limits specified adjust as detailed in paragraph 429.

---

**Record/Replay Frequency Response Correction**

429 If the record/replay frequency response does not fall within the limits specified in paragraph 428 the equalisation board components (Fig. 15 - 18) may be adjusted as follows:
(i) On normal speed models

<table>
<thead>
<tr>
<th>Speed</th>
<th>7 1/4 in/sec. (19 cm/sec)</th>
<th>3 3/4 in/sec. (9.5 cm/sec.)</th>
<th>1 1/8 in/sec. (4.75 cm/sec.)</th>
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</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>5kHz– 15kHz</td>
<td>3kHz– 10kHz</td>
<td>1kHz– 5kHz</td>
</tr>
<tr>
<td></td>
<td>15kHz– 18kHz</td>
<td>10kHz– 15kHz</td>
<td>5kHz– 8kHz</td>
</tr>
<tr>
<td>Upper Track</td>
<td>C704 R713</td>
<td>C703 R712</td>
<td>C702 R711</td>
</tr>
<tr>
<td>Lower Track</td>
<td>C710 R717</td>
<td>C709 R716</td>
<td>C708 R715</td>
</tr>
</tbody>
</table>

(ii) On High Speed models (suffix H)

<table>
<thead>
<tr>
<th>Speed</th>
<th>15 in/sec. (38 cm/sec.)</th>
<th>7 1/4 in/sec. (19 cm/sec.)</th>
<th>3 3/4 in/sec. (9.5 cm/sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8kHz– 18kHz</td>
<td>5kHz– 15kHz</td>
<td>3kHz– 10kHz</td>
</tr>
<tr>
<td></td>
<td>18kHz– 22kHz</td>
<td>15kHz– 18kHz</td>
<td>15kHz– 10kHz</td>
</tr>
<tr>
<td>Upper Track</td>
<td>C704 R713</td>
<td>C703 R712</td>
<td>C702 R711</td>
</tr>
<tr>
<td>Lower Track</td>
<td>C710 R717</td>
<td>C709 R716</td>
<td>C708 R715</td>
</tr>
</tbody>
</table>

(iii) When frequency responses are within the limits specified, carry out adjustments detailed in paragraph 428 (viii).

Record Head Muting

430 To check the record head muting proceed as follows:

(i) Load an unused or bulk erased tape onto the recorder, switch On and select the medium speed.

(ii) Connect the AF Signal Generator, giving 1 kHz, to the Line input (Upper on stereo models) and adjust to give + 3 VU on the internal meter.

(iii) On stereo models switch the Record Mode selector to Stereo. Turn the function switch to Run. Do not press the Record button.

(iv) After running a section of the tape, turn the function control to Stop. Rewind tape to the ‘start’ position and then turn function control to Run.

(v) Turn recorder Output fully up and check that no recording has been made.

(vi) On stereo models, repeat (ii) - (v) for Lower channel.

Noise Level Measurement

431 To measure the noise level on the replay amplifier proceed as follows:

Note: Avoid double mains earths on the recorder and associated test equipment during noise measurements.

(i) Load a Ferrotype type B or Scotch Dynarange 203 tape onto the recorder and set the speed selector to 7 1/4 in/sec. (19 cm/sec.)

(ii) Connect a millivoltmeter to the 600 Ohm Output.
(iii) Short-circuit the replay head with a very short wire across the pins on the replay amplifier board, to avoid hum loops. These are the two lower R.H. pins on the board, (see Fig. 20).
(iv) Switch On recorder and turn the function control to Pause.
(v) Note the reading on the millivoltmeter. It should be less than 1·5 mV.
(vi) Switch Off recorder.
(vii) Remove the short circuit from the replay board.
(viii) Switch On recorder and note the reading on the millivoltmeter.
(ix) The hum picked up should not increase the reading to more than 3 mV for half track models or 4 mV for quarter track models.
(x) On stereo models repeat (iii) - (ix) for the other channel. See Fig. 20 for replay amplifier board connections.
(xi) Turn to Run and press Record button.
(xii) Run tape for a short time with Mic and Line gain controls at zero, then rewind.
(xiii) Replay erased part of tape and measure the output on the millivoltmeter. This should be less than –55 dB below a peak level recording (2V), viz. less than 3·56 mV. On stereo models repeat (xi) - (xiii) for other channel.

Noise Level Correction

If the noise level readings noted in 431 (v), (ix) and (xiii) are more than those specified proceed as follows:
(i) Reverse the power supply connections to the capstan and take-up motors in turn to check if the hum level is reduced.
(ii) Check transistor VT300 and if necessary replace with a low noise transistor.
(iii) Check capacitor C301 (which is a tantalum low-leakage type) by connecting a milliammeter in series with the head lead (switch Off when doing this). The reading, after recorder has been switched on for a few seconds, should not exceed 0·5 µA. If it is greater than this replace C301.
(iv) Recheck noise level after each of (i) to (iii) and on stereo models repeat tests on each channel.

Distortion Measurement

To measure overall record/replay distortion proceed as follows:
(i) Load a Ferrotape type B or Scotch Dynarange 203 tape onto the recorder and switch On. Set the speed control and equalisation switch to 7 1/4 in/sec. (19 cm/sec.)
(ii) Connect an AF Signal Generator giving 0-5V at 1 kHz to the Line Input, and adjust the Line gain control to produce 2V at the 600 Ohm Output measured on the millivoltmeter (Output switch at Source).
(iii) Turn the function control to Run, and press the Record button.
(iv) Record for a short time then rewind the tape.
(v) Connect the distortion meter or the Wave Analyser to the 600 Ohm Output and replay the tape.
(vi) With the Output switch at Tape, measure the distortion. At 2 volt output it must be < 3% at 7 1/4 in/sec. (19 cm/sec.).

Note: The distortion cannot be measured while recording as, due to the low signal levels involved, any stray bias pick-up in the output leads would give misleading results.
Causes of Excessive Distortion

434 Excessive distortion may be caused by one of the following:

(i) Too high a recording level. Recheck Output Level, paragraph 423 or 424, and Tape/Source setting, paragraph 428, (viii).

(ii) Incorrect bias. Recheck H.F. Bias setting, paragraph 427. Note that Ferrotype type B or Scotch Dynarange 203 must be used for distortion and bias measurements, as other brands of tape may give different results.

(iii) Faulty Signal Generator. Measure the distortion of the AF Signal Generator by connecting directly to the Distortion Meter and also check that the input to the recorder does not exceed 10V.

(iv) Electronic Fault. If (i), (ii), and (iii) have not cured the distortion, recheck the calibration of the distortion meter. If the distortion is still high, carry out the following checks:

(a) Connect the AF Signal Generator to the Line Input, set the Output switch to Source and connect the Distortion Meter to the 600 Ohm Output. At 2V output the distortion should be less than 0-3%.

(b) Replay the Output Level test tape as in paragraph 423 or 424 and measure the distortion at the 600 Ohm Output. With the European test tape (peak level) this should be less than 3%; with the American test tape (−5 dB below peak level) this should be less than 1%.

(c) If the distortion is excessive in only (a) above, check the record pre-amplifier (VT202, 203). If it is only excessive in (b), check the replay pre-amplifier (VT300-302). If the distortion is excessive in both (a) and (b), check the Meter and Tone Control amplifier (VT400,401). If neither gives excessive distortion, carry out (d) below.

(d) The distortion of the record head signal may be checked by connecting the distortion meter to the Bias tag of the Meter switch with the switch NOT at Bias (on stereo models check that it is the correct track). Connect the AF Signal Generator to the Line Input and set the Output switch to Source. Connect the millivoltmeter to the 600 Ohm Output and adjust the signal to give 2V output. The Record button should be held down manually (to unshort the record head), with the function switch at Stop (to avoid any bias masking the signal). The record distortion measured on the Meter switch should be less than 0-3%.

Erasure

435 To check erasure proceed as follows:

(i) Load an unused or bulk erased tape onto the recorder, switch On and select the medium speed.

(ii) Connect an AF Signal Generator giving 1 kHz to the Line Input and adjust to give 2V at the 600 Ohm Output measured on the millivoltmeter (Output switch at Source).

(iii) Turn to Run, note counter reading; press record button and record the 1 kHz signal on a predetermined length of tape. On stereo models record in Stereo position.

(iv) Wind back the tape to the middle of the recording (determined by counter reading) and disconnect the AF Signal Generator. Turn Mic and Line gain controls to zero.
(v) Re-record (i.e. erase) part of the tape. On stereo models record in Stereo position.

(vi) Connect the Wave Analyser (or millivoltmeter via the Filter) to the 600 Ohm Output and tune to give a maximum at 1 kHz.

(vii) Replay the whole recording (Output switch at Tape) and note the difference in level between the recorded and erased sections of the tape.

(viii) On stereo models, repeat for each track with the Record Mode switch in the Upper or Lower position.

Note: The erased (residual) signal level must be more than 60 dB below peak level, i.e. less than 2 mV with reference to 2V.

Crosstalk

436 To measure crosstalk proceed as follows:

(i) Load an unused or bulk-erased tape onto the recorder and switch On.

(ii) Turn the speed and equalisation switches to 7\(\frac{1}{2}\) in/sec. (19 cm/sec.).

(iii) Connect an AF Signal Generator giving 1 kHz output to the Line Input and a millivoltmeter to the 600 Ohm Output. On stereo models set the Record Mode switch to Upper.

(iv) Turn the function switch to Pause and press the Record button.

(v) Adjust the Line gain control to give 2V signal at the 600 Ohm Output (Output switch at Source).

(vi) Turn the function switch to Run and record a section of the tape, then re-wind.

(vii) Connect a Wave Analyser (or millivoltmeter via a 1 kHz filter) to the 600 Ohm Output (Upper track on stereo models).

(viii) Replay the tape (Output switch at Tape) and tune the Wave Analyser (or 1 kHz filter) for maximum reading.

(ix) On mono models, wind on the tape to the end of the recording then reverse the tape. Replay the unrecorded half of the tape, when the output should be less than –65 dB below the peak level reading obtained in (viii). If not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(x) On half track stereo models, replay the tape on Upper as in (viii), then connect the Wave Analyser to the Lower 600 Ohm Output and observe the readings, which should be less than –65 dB below the peak level reading. If not, see (xii). Wind on to the end of the recording and reverse the tape. Replay the tape and measure the output (peak level) on Lower, than connect the Wave Analyser to the Upper 600 Ohm Output, when the reading should again be more than –65 dB down. If not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(xi) On quarter track models, record on Upper as in (i)-(viii) above.

(a) Replay the tape, measuring first on Upper then on Lower. The difference should be greater than 65 dB. If not, see (xii).

(b) Wind on the tape to the end of the recording and reverse tape. Replay the tape, measuring on Lower, when the reading should be less than –65 dB below previous peak level reading on Upper (a). If not, check head heights as in paragraphs 420 (iv) and 426 (vii).

(c) Repeat the recording procedure (i)-(vii) but with the Record Mode switch at Lower.
(d) Wind back the tape and replay, measuring first on Lower, then on Upper. The difference should again be greater than 65 dB, and if not, see (xii).

(e) Wind on to the end of the recording and reverse the tape. Replay the tape, measuring first on Upper, then on Lower. In each case the reading should be less than –65 dB below the peak level reading on Lower (d), and if not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(xii) On stereo models the crosstalk between Upper and Lower tracks can usually be reduced by adjusting RV700 (see Fig. 3) for minimum.

Note: For a peak level output of 2V, –65 dB is 1.1 mV.

Replay Amplifier

437 To check the replay amplifier proceed as follows:

(i) Load a pre-recorded tape onto the recorder and switch On.

(ii) Replay the tape and check that the recording can be heard over the loudspeaker with the Output switch at Tape. Turn to Stop.

(iii) Turn the speed selector switch to the slowest speed and turn the function control to Pause.

(iv) Turn the Output control fully on and listen to the replay amplifier hiss. It should not contain any "crackles" or intermittent noises.

Loudspeaker Output

438 To measure the loudspeaker output proceed as follows:

(i) Load a peak level test tape onto the recorder and switch On.

(ii) With the function control at Run, the Output switch at Tape, and the Output control fully clockwise, measure the output from the 8-16 Ohm Speaker jack across a 15 ohm, 10 watt resistor. Check that the output is at least 12 volts.

(iii) Connect the AF Signal Generator at 1 kHz to the Line Input and adjust the Line gain control to give peak level (2V) at the 600 Ohm Output (Output switch at Source).

(iv) Connect the Wave Analyser or distortion meter to the 8-16 Ohm Speaker output across the 15 ohm 10 watt resistor. With the Output switch still at Source, measure the distortion at 12 volts. Check that it is < 0.5%.

Power Amplifier

439 When a fault occurs on the power amplifier printed circuit board, it is recommended that the complete board be replaced. If this is not possible and an individual component is replaced, the quiescent current must be checked as follows:

(i) Connect a milliammeter in series with the d.c. supply to the board.

(ii) Short circuit the audio input to chassis.

(iii) Switch On the recorder and allow to stabilise for 5 minutes.

(iv) Measure the total current on the milliammeter. This should be between 20-25 mA. If it is not, adjust the trimmer resistor soldered across R506 until the correct reading is obtained.
GENERAL DETAILS

The Model Y713 is basically similar to the Model 713, and the same servicing details apply. However, the Line Input and 600 ohm output are fitted with isolating transformers and 3 contact, gauge B jack sockets, making them suitable for connection to 600 Ω lines.

Phones Output

The Phones output, on the side of the cabinet, gives an output suitable for headphones with an impedance of 1000 Ω or greater. The level is adjusted by the Output Control.

Speaker Switch

The Speaker switch, on the side of the cabinet, can be used to switch off the internal loudspeaker if not required, usually when the output control is used to adjust the signal level at the Phones output.

SERVICING

The servicing procedure for the model Y713 is the same as described for the model 713.†

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**Model Y713**

**Circuit Ref.** | **Part No.**
--- | ---
R733 Resistor 10K Ω | 625-08-10K
R737 Resistor 39 Ω | BP/2960/R
R738 Resistor 330 Ω | 625-07-330
SW705 Speaker Switch | 746-003
TR701 Transformer | MC/T1702M
TR702 Transformer | MC/297A
JK700 Jack Socket, 2 way | 692-011
JK702 Jack Socket, 3 way — gauge B | 692-015
JK708 Jack Socket, 3 way — gauge B | 692-015
P704 Plug, 4 way | 577-009
SK704 Socket, 4 way | 692-016
LS700 Loudspeaker (30 Ω) | 700-000

† Later models (Serial No. 79458 onwards) are equalised to the I.E.C. characteristic.
SPECIFICATION
The General Specification applies to the model Y713 except as detailed below.

Track Width
Half Track 0·100 in. (2·5 mm.).

Operating Tape Speeds
Three (3): 7 1/4, 3 3/4, 1 1/4 in/sec. (19, 9·5, 4·75 cm/sec.)
Suffix H 15, 7 1/4, 3 3/4 in/sec. (38, 19, 9·5 cm/sec.)
Suffix L 3 3/4, 1 1/4, 1 1/8 in/sec. (9·5, 4·75, 2·875 cm/sec.)

Tape Speed Accuracy
Better than ± 1% (at specified supply frequency).

Frequency Response
Record-Replay, using LP Ferrotape B or Scotch 203:
15 in/sec. (38 cm/sec.) : 40-20,000Hz ± 2dB
7 1/4 in/sec. (19 cm/sec.) : 40-17,000Hz ± 2dB
3 3/4 in/sec. (9·5 cm/sec.) : 40-14,000Hz ± 3dB
1 1/2 in/sec. (4·75 cm/sec.) : 50- 7,000Hz ± 3dB
1 1/8 in/sec. (2·875 cm/sec.) : 60- 3,000Hz ± 3dB

Replay Characteristic

<table>
<thead>
<tr>
<th>D.I.N.</th>
<th>I.E.C.</th>
<th>N.A.B.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(later</td>
<td>(117V models)</td>
</tr>
<tr>
<td></td>
<td>models)</td>
<td></td>
</tr>
<tr>
<td>15 in/sec. (38 cm/sec.)</td>
<td>35µ sec.</td>
<td>35µ sec.</td>
</tr>
<tr>
<td>7 1/4 in/sec. (19 cm/sec.)</td>
<td>50/3180µ sec.</td>
<td>70µ sec.</td>
</tr>
<tr>
<td>3 3/4 in/sec. (9·5 cm/sec.)</td>
<td>90/3180µ sec.</td>
<td>90µ sec.</td>
</tr>
<tr>
<td>1 1/2 in/sec. (4·75 cm/sec.)</td>
<td>120/1590µ sec.</td>
<td>120µ sec.</td>
</tr>
</tbody>
</table>

Signal to Noise Ratio (at 7 1/4 in/sec. — ref. 2% distortion)
Unweighted, including hum; better than 55 dB
Weighted (C.C.I.F.); better than 60 dB

Input (for peak level recording of 32mMx/mm.)
Microphone: 300µV-15mV at 10K Ω
Recommended Source: 250-2,000 Ω (standard jack)

Line: 150mV-5V at 10K Ω, *isolated.
Recommended Source: 600 Ω (3 contact, gauge B jack)

Output (from peak level recording of 32mMx/mm.)
600 ohm: 1V into 600 Ω: *isolated (3 contact, gauge B jack)
Low Level: 300mV into > 10K Ω; (standard jack)
Loudspeaker: 10W into 8-16 Ω; (standard jack)
Phones: suitable for headphones of 1000 Ω or greater (standard jack)

* Can be made balanced by connecting transformer centre-tap to the earth pin (green lead).
† Serial Number 79458 onwards.
Models Y722 & Y724

GENERAL DETAILS
The Models Y722 & Y724 are basically very similar to the Models 722 & 724 respectively, and the same servicing details apply.‡ The Line inputs and 600 ohm outputs are fitted with isolating transformers and 3 contact, gauge B jack sockets, making them suitable for connection to 600 Ω lines.

Phones Output
The Phones output, on the side of the cabinet, gives an output suitable for stereo headphones with an impedance of 1000 Ω or greater and wired to a standard stereo phones jack (3 contact, gauge A). Mono headphones wired to a standard jack (2 contact, gauge A) can also be plugged in, when the Upper Track signal will be heard. The signal levels are adjusted by the respective Output controls.

Speaker Switch
The Speaker switch, also on the side of the cabinet, can be used to switch off the internal loudspeakers if not required, usually when the Output controls are used to adjust the signal levels at the Phones output.

SERVICING
The servicing procedure for the Models Y722 & Y724 is the same as described for the Models 722 & 724 respectively.‡

<table>
<thead>
<tr>
<th>Circuit Ref.</th>
<th>Part No.</th>
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<tbody>
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<td>Resistor 10K Ω</td>
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<td>R734</td>
<td>Resistor 10K Ω</td>
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<td>R735</td>
<td>Resistor 330 Ω</td>
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<td>R736</td>
<td>Resistor 330 Ω</td>
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<td>R737</td>
<td>Resistor 39 Ω Wound</td>
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<td>R738</td>
<td>Resistor 39 Ω Wound</td>
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<td>Speaker Switch</td>
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<tr>
<td>LS701</td>
<td>Loudspeaker (30 Ω)</td>
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‡ Later models (Serial No. 79458 onwards) are equalised to the I.E.C. characteristic.