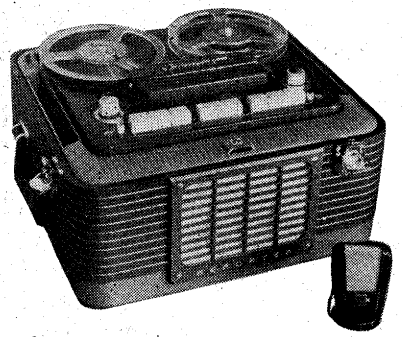
"TRADER" SERVICE SHEET

1148

GRUNDIG TK9 REPORTER

Press-button operated Tape Recorder



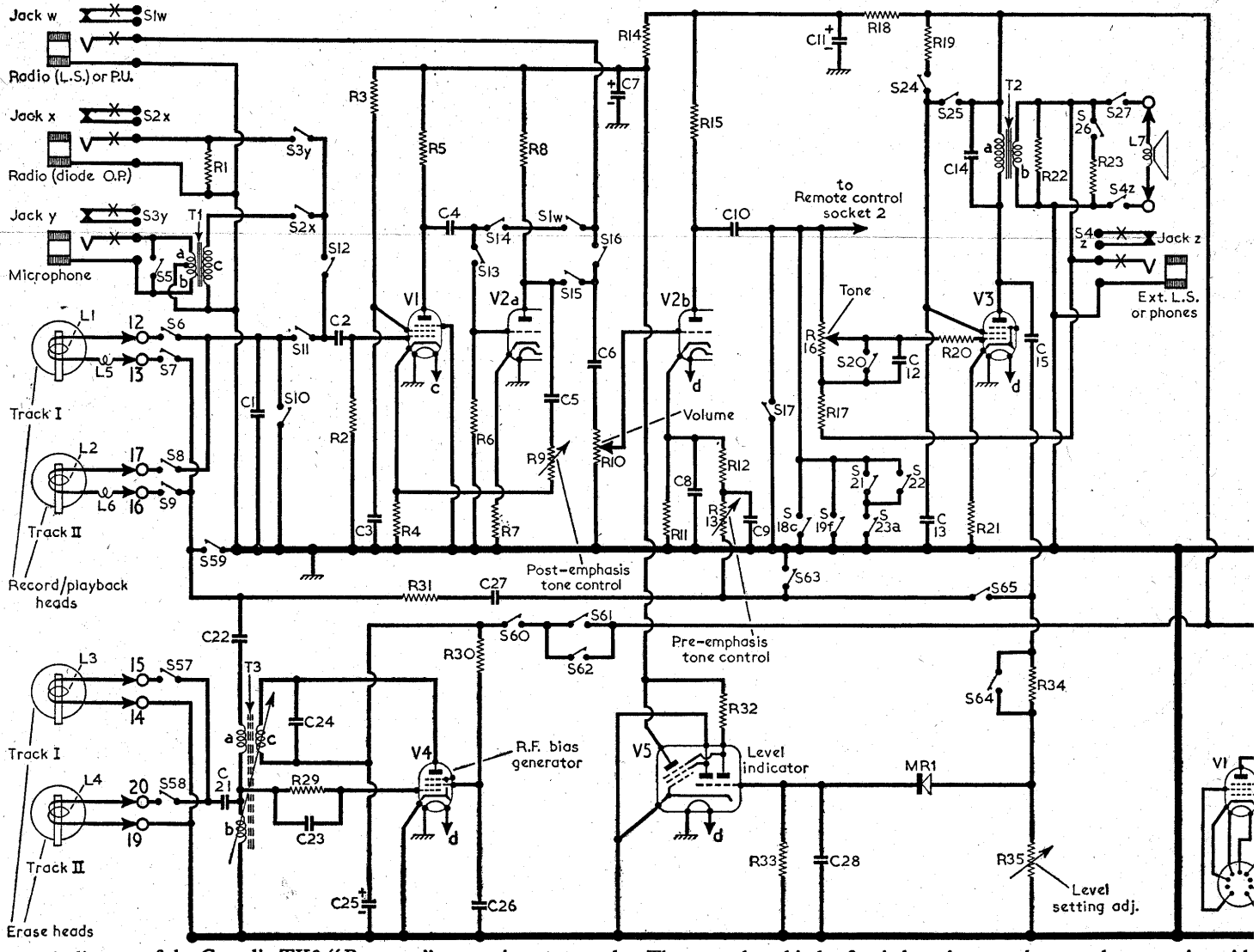
The Grundig TK9 with hinged cover removed.

THE Grundig "Reporter" TK9 is a portable tape recorder capable of recording and reproducing on ¼in magnetic tape. Half-track working is employed so that the full length of tape may be used twice. The machine is a dual track recorder and is able to record and play back in both directions; "Top-track" recording is employed, left to right, in accordance with British and American Standards. It operates at a tape speed of 3¾in per second only, giving a playing time of approximately 45 minutes per track. The change-over from track I to track II position takes less than one second, so that a virtually continuous recording up to 1½ hours can be made. Full facilities are provided for all types of input and output connections, and as most of the switching operations are performed by magnetic relays and jacks, facilities are provided for remote control.

Drive is obtained from a single split phase external rotating cage induction motor. The tape is driven by friction between the ground tape capstan and a rubber pressure roller, the latter being electro-magnetically controlled. The heavy construction of the motor and fly-wheel ensure constancy of speed, and the use of self-lubricating bearings permits long periods of operation without service.

The two spools are carried on the top halves of two electro-magnetic clutches, the lower halves of which are driven from the motor pulley by plastic belts. Two recording heads and two erase heads are fitted, and these are offset for their respective track I and II positions.

The electronic part of the chassis con-



Circuit diagram of the Grundig TK9 "Reporter" magnetic tape recorder. There are three kinds of switches: those on the press-button units, with relays, which bear suffix letters **a-f** to agree with their relay letter. Operation of the remote control unit and

sists basically of the recording and reproducing amplifiers, the oscillator (supplying HF Bias for recording and erasing), the recording level indicator and the output stage. The tape is magnetized on passing the corresponding recording/reproducing head whilst recording, after first passing the erase head of the same track, which removes any previous recording on the tape.

A precision-built playing time indicator is fitted to show the exact location of a recording on the tape. Provided that metallized-ended tape is used, the Grundig TK9 switches itself off automatically at the end of each spool by means of metal foils which operate an automatic-stop coil.

Release date and original price: February 1954, £68 5*s*.

CIRCUIT DESCRIPTION

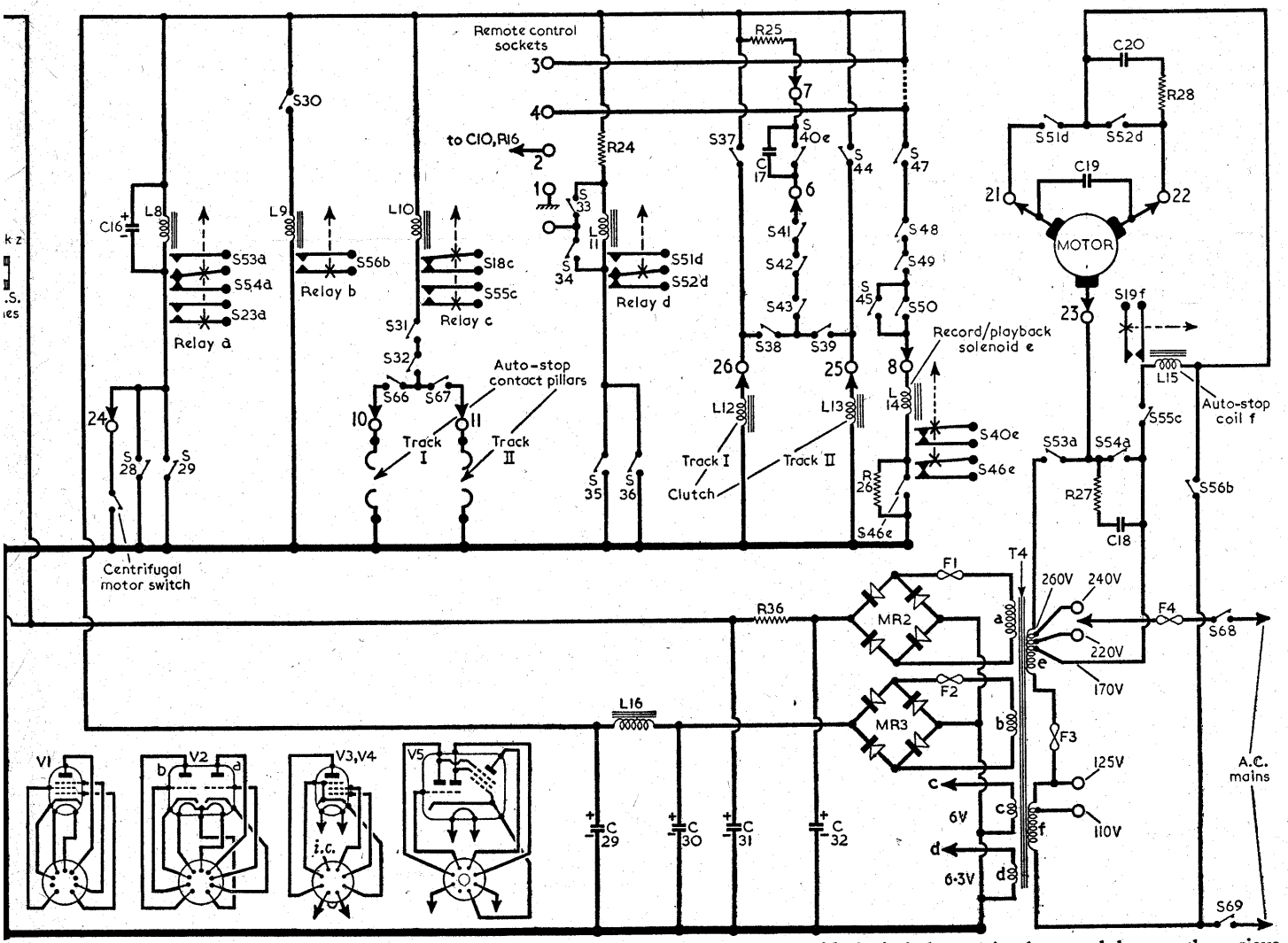
Recording Amplifier.—This employs a special low-microphony input valve **(V1, Mullard EF86)** whose heater is under-run to minimize hum. Resistance-capacitance coupling by **R5, C4, C6** and volume control **R10** between **V1** and section **b** of **V2 (Mullard ECC81).** The amplified output from **V2b** is resistance-capacitance coupled via **R15, C10** to grid of pentode output valve **(V3, Mullard EL42),** whose output is coupled to the record/playback heads **L1, L2** via **C15, C27** and **R31.** Fixed tone correction by **C14** in anode circuit. Variable negative feed-back tone control by **R17, R16** and **C12** between winding **b** of output transformer **T2** and **V3** control grid circuit. Pre-emphasis negative feed-back tone correction between **V3** anode and **V2b** cathode circuits via **C15, R13, C9, R12.**

When recording, **R16** should be tuned fully anti-clockwise to obtain the correct frequency response. In this setting, switches **S26, S27,** which are ganged with **R16,** mute the internal speaker and substitute load resistor **R23** across **T2** secondary winding in place of the speech coil winding **L7.** Provision is made for the connection of a low-impedance external speaker, or low-impedance headphones, across **T2** secondary via jack **z.** Switch **S4z** opens to mute the internal speaker when a plug is inserted in jack **z.**

Three input channels are provided to the amplifier : the first, via jack **y,** is for use with a moving coil type microphone, which is coupled via microphone transformer **T1** to **V1** input circuit; the second, via jack **x,** is used when recording from the detector diode output circuit of a radio receiver (see "General Notes"), and couples it into **V1** input circuit; the third, via jack **w,** is used when recording from the external L.S. sockets of a radio receiver or from the pick-up output of a record player, when it couples these inputs across **V2b** grid circuit. Switch **S1w, S2x** or **S3y** opens when a plug is inserted in its associated jack and disconnects the input circuits of those jacks which are not in use.

Bias and Erase Oscillator.—This consists of an output pentode **(V4, Mullard EL42)** whose grid and anode circuits are coupled together reactively via windings **b** and **c** on oscillator transformer **T3.** The R.F. voltage developed across grid winding **b** is fed via **C21** to the erase heads **L3** and **L4.** A third winding **a** on **T2** supplies R.F. bias voltage via **C22** to the record/playback heads **L1** and **L2.**

Playback Amplifier.—The output of the



nits, with plain numbers; those on the connecting jacks, which bear suffix letters **w-z** to agree with the jack that carries them; and those on the various l unit and associated sockets **1-4** is explained in the caption beside the underside view of the electronic chassis.

record/playback heads **L1, L2** is amplified by **V1** and passed to section **a** of **V2.** Post-emphasis negative feed-back tone correction is obtained at this stage by feeding part of the amplified output from **V2a** back to **V1** cathode circuit via **C5, R9. V2a** output is further amplified by **V2b** and then passed to the output valve **V3.** Only one negative feed-back circuit is employed in the output stage, **C15** being used to feed the level indicator **V5 (Mullard EM34)** only.

Level Indicator.—The level indicator is fed from **V3** anode via **C15,** level setting adjustment **R35** and **MR1,** and is in circuit for both record and playback operation. In the latter position **R34** is switched into circuit to compensate for the larger output signal present at **V3** anode.

Motor.—A single split-phase induction motor is used to power the tape deck. For record and playback operation, the motor is energized from the 170 V tapping on the primary of the mains transformer **T4.** For "Fast Wind" operation, the motor is connected to the 260 V tapping on **T4.** To give increased torque when starting, a centrifugal switch, which is held closed by the motor spindle when the motor is at rest, operates relay **a** and connects the motor to the 260 V tapping on **T4.** When full speed is reached the centrifugal switch opens and the motor is then fed from the 170 V tapping.

Magnetic Clutches.—The track I and track II take-up spindles are belt-driven from the motor via two magnetic clutches **L12** and **L13.** These clutches are located in the take-up spindle hubs and when a voltage is applied to them via their

(Continued col. 1 overleaf)

COMPONENTS AND VALUES

Capacitors

C1	600pF	D6
C2	0·025μF	J8
C3	0·5μF	H8
C4	0·01μF	H8
C5	0·005μF	J8
C6	0·01μF	H9
C7*	16μF	J8
C8	0·015μF	J8
C9	0·002μF	J8
C10	0.05μF	H8
C11*	4μF	J9
C12	0·0015μF	G9
C13	0·1μF	G8
C14	500pF	F5
C15	0·05μF	F5
C16*	100μF	E4
C17	0·1μF	A2
C18	0·2μF	F6
C19	3μF	C3
C20	0·2μF	E4
C21	0·003μF	G9
C22	600pF	G9
C23	500pF	G8
C24	0·003μF	G8
C25*	4μF	G8
C26	0·01μF	G8
C27	0·1μF	H8
C28	0·05μF	D5
C29*	200μF	H9
C30*	200μF	D4
C31*	40μF	D5
C32*	40μF	D4

Coils†

L1	550	A2
L2	550	B2
L3	12	A2
L4	12	B2
L5	12	A1
L6	12	B1
L7	3	—
L8	800	E6
L9	800	E6
L10	800	E6
L11	300	D6
L12	250	C3
L13	250	C3
L14	60	B1
L15	800	H9
L16	11	H8

Miscellaneous

F1	120mA fuse	D4
F2	500mA fuse	D4
F3	1A fuse	E4
F4	2A fuse	E4

MR1	—	D5
MR2	—	D4
MR3	—	D4

Resistors

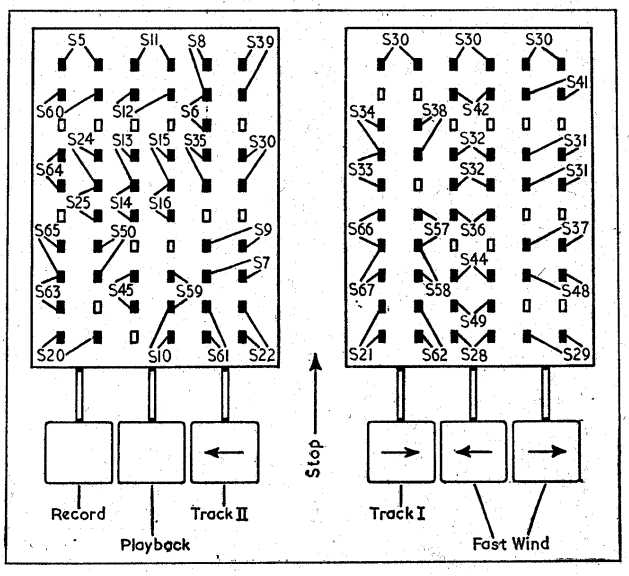
R1	500kΩ	J7
R2	10MΩ	J8
R3	1·25MΩ	J8
R4	100Ω	J8
R5	200kΩ	H8
R6	1MΩ	J8
R7	1kΩ	J8
R8	100kΩ	J8
R9	100kΩ	J8
R10	1MΩ	J9
R11	2kΩ	J8
R12	100kΩ	J8
R13	50kΩ	H8
R14	50kΩ	H8
R15	100kΩ	J8
R16	1MΩ	G9
R17	100kΩ	G9
R18	5kΩ	J8
R19	80kΩ	D6
R20	50kΩ	G9
R21	360Ω	G8
R22	50Ω	J7
R23	5Ω	G8
R24	250Ω	D5
R25	130Ω	E5
R26	160Ω	A2
R27	100Ω	F6
R28	100Ω	E4
R29	1MΩ	G8
R30	10kΩ	G8
R31	150kΩ	H9
R32	200kΩ	D5
R33	3MΩ	D6
R34	1MΩ	D6
R35	1MΩ	D6
R36	2kΩ	E5

Transformers†

T1	a	43·0	J8
	b	43·0	
	c	3,800·0	
T2	a	700·0	F5
	b	0·3	
T3	a	5·5	G8
	b	3·6	
	c	14·5	
T4	a	240·0	F4
	b	6·8	
	c	—	
	d	—	
	2	27·0, total	
	e	11·0, total	

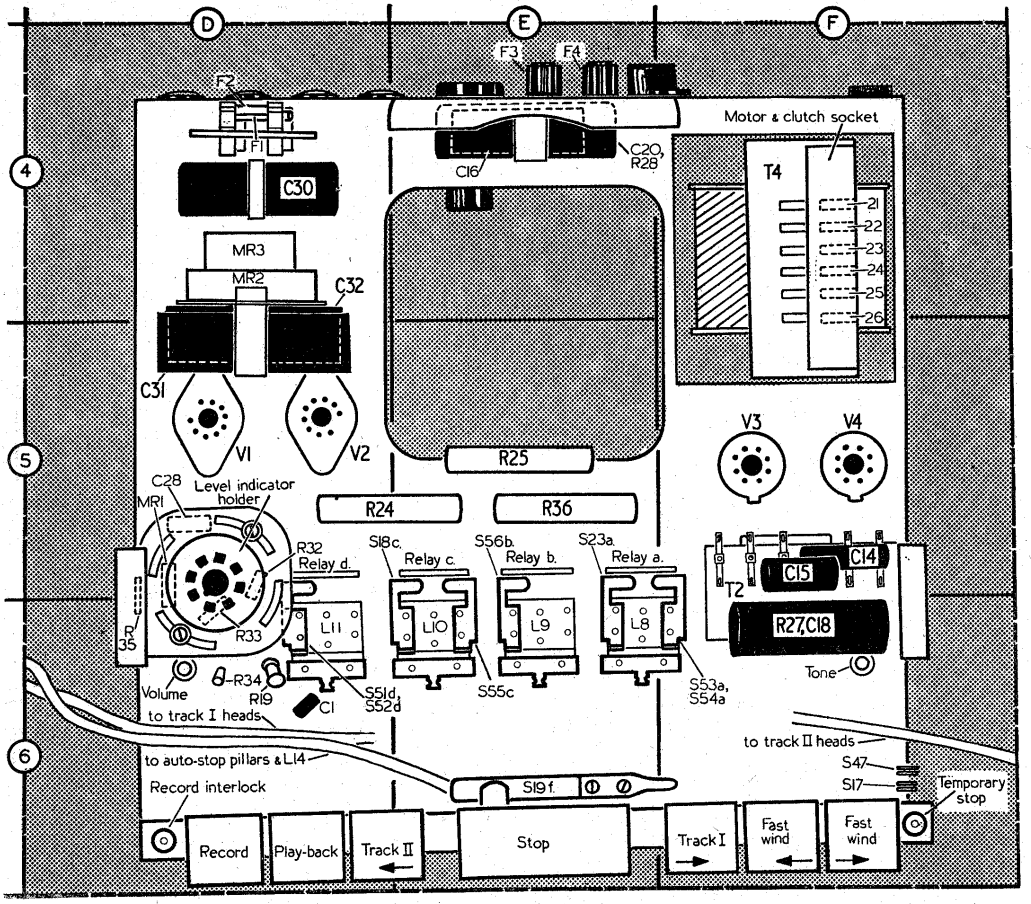
* Electrolytic. † Approximate D.C. resistance in ohms.

Diagrams of the two press-button switch units, which are drawn viewing the electronic chassis deck from above, while standing in front of it and looking down over the press-buttons to see the rear face of the units. Below is the associated switch table. To read a line on the table, a straight-edge should be used Relay and jack-operated switches are not included here.



Switches	Record	Playback	Track II	Stop	Track I	Fast Wind		Temporary Stop	
						Track II	Track I	Off	On
S5	—	c		c					
S6			—	c	c	c	c		
S7			—	c	c	c	c		
S8			c	—	—	—	—		
S9			c	—	—	—	—		
S10	c	—		c					
S11	—	c		—					
S12	c	—		c					
S13	—	c		—					
S14	c	—		c					
S15	—	c		—					
S16	c	—		c					
S17								—	c
S20	c	—		—					
S21				—	c	—	—		
S22			c	—	—	—	—		
S24	c	—		—					
S25	—	c		c					
S28			—	—	—	c	—		
S29			—	—	—	—	c		
S30			c	c	c	c	c		
S31			c	c	c	c*	c*		
S32			c	c	c	c*	c*		
S33			c	c	c	c	c		
S34			—	—	c	—	—		
S35			c	—	—	—	—		
S36			—	—	—	—	—		
S37			—	—	—	—	c		
S38			—	—	c	—	—		
S39			c	c	—	—	—		
S41			c	c	c	c	—		
S42			c	c	c	—	c		
S43	c	c		—	—				
S44			—	—	—	c	—		
S45	—	c		—	—			c	—
S47									
S48			c	c	c	c	—		
S49			c	c	c	—	c		
S50	c	—		—	—				
S57			—	—	c	—	—		
S58			c	c	—	c	c		
S59	—	c		—	—				
S60	c	—		—	—				
S61			c	—	—	—	—		
S62			—	—	c	—	—		
S63	—	c		c	—				
S64	c	—		—	—				
S65	c	—		—	—				
S66			—	—	c	—	—		
S67			c	c	—	c	c		

* May be opened to prevent operation of the Auto-Stop by pressing the button down fully.



Plan view of the electronic chassis, as seen after the tape deck chassis has been detached from it. Relays **a, b, c** and **d** are seen here, and their switch assemblies are identified. The auto-stop switch **S19f** is operated by the manual stop button and the auto-stop coil **f (L15)** which is seen in the underside view of this chassis. In the circuit diagram overleaf, the replays are all shown at rest, with arrows to indicate which way the armature contacts (marked **x**) move.

Circuit Description—*continued*

associated switches they transmit the motor drive through to the take-up spindles.

Record/Playback Solenoid.—When the solenoid coil **L14** is energized, its plunger is pulled into the coil and moves the capstan pressure wheel and the tape pressure arms forward, pressing the tape against the capstan and the heads.

Automatic Stop.—At each end of the tape supplied for use with the recorder is a strip of metal foil. When this strip of foil runs over one of a pair of auto-stop contact pillars it completes the circuit to relay **c**, which in turn energizes the auto-stop coil **L15** and pulls down the soft-iron pole piece attached to the "Stop" button lever, thus returning all the buttons to neutral.

Power Supplies.—H.T. current is supplied by bridge-connected metal rectifier **MR2.** Smoothing by **R36** and electrolytic capacitors **C31, C32.** Current to operate the relays, the record/playback solenoid and the auto-stop coil is supplied by a second bridge-connected metal rectifier **MR3.** Smoothing by choke **L16** and electrolytic capacitors **C29** and **C30.** A separate winding **c** is provided on mains transformer **T4** to feed **V1** whose heater is under-run slightly to minimize hum injection. As mentioned earlier, a 260 V tapping and a 170 V tapping are provided on the mains transformer primary winding to feed the motor.

VALVE ANALYSIS

Valve voltages and currents given in the table below are those derived from the manufacturers' information. They were measured with a 1,000 ohms-per-volt meter, chassis being the negative connection in each case.

Readings in the upper table were measured with the "Record" button pressed, and those in the lower table were measured with the "Playback" button pressed. The voltage measured across **C32** in the "Record" position was 230 V, and the current drawn from **MR2** was 31 mA. In the "Playback" position this voltage fell to 225 V and the current rose to 32 mA. The voltage measured across **C29** when recording or replaying on track I was 24.5 V, and the current drawn from **MR3** was 140 mA. On track II this voltage fell to 23.5 V, and the current rose to 175 mA.

Valve	Anode		Screen		Cath.
	V	mA	V	mA	V
Record					
V1 EF86	37·5	0·5	30	0·1	—
V2 ECC81 a	50·0	0·75	—	—	0·7
V2 ECC81 b	85·0	1·0	—	—	1·6
V3 EL42	215·0	11·0	97·5	2·0	4·5
V4 EL42	225·0	9·0	180·0	4·0	—
V5 EM34	38·0*	0·6*	—	—	—
Playback					
V1 EF86	37·5	0·5	30	0·1	—
V2 ECC81 a	50·0	0·75	—	—	0·7
V2 ECC81 b	80·0	1·0	—	—	1·6
V3 EL42	205·0	20·0	220	3·5	9·5
V4 EL42	—	—	—	—	—
V5 EM34	40·0†	0·7†	—	—	—

* Main anode (pin 3); target anode (pin 5) 200V, 2·5mA.

† Main anode (pin 3); target anode (pin 5) 205V, 2·6mA.

GENERAL NOTES

Tape Track Position.—In the direction of tape travel and position of track the Grundig tape deck conforms with the standards recently specified by the British Standards Institute, and with the standards adopted in the U.S.A.

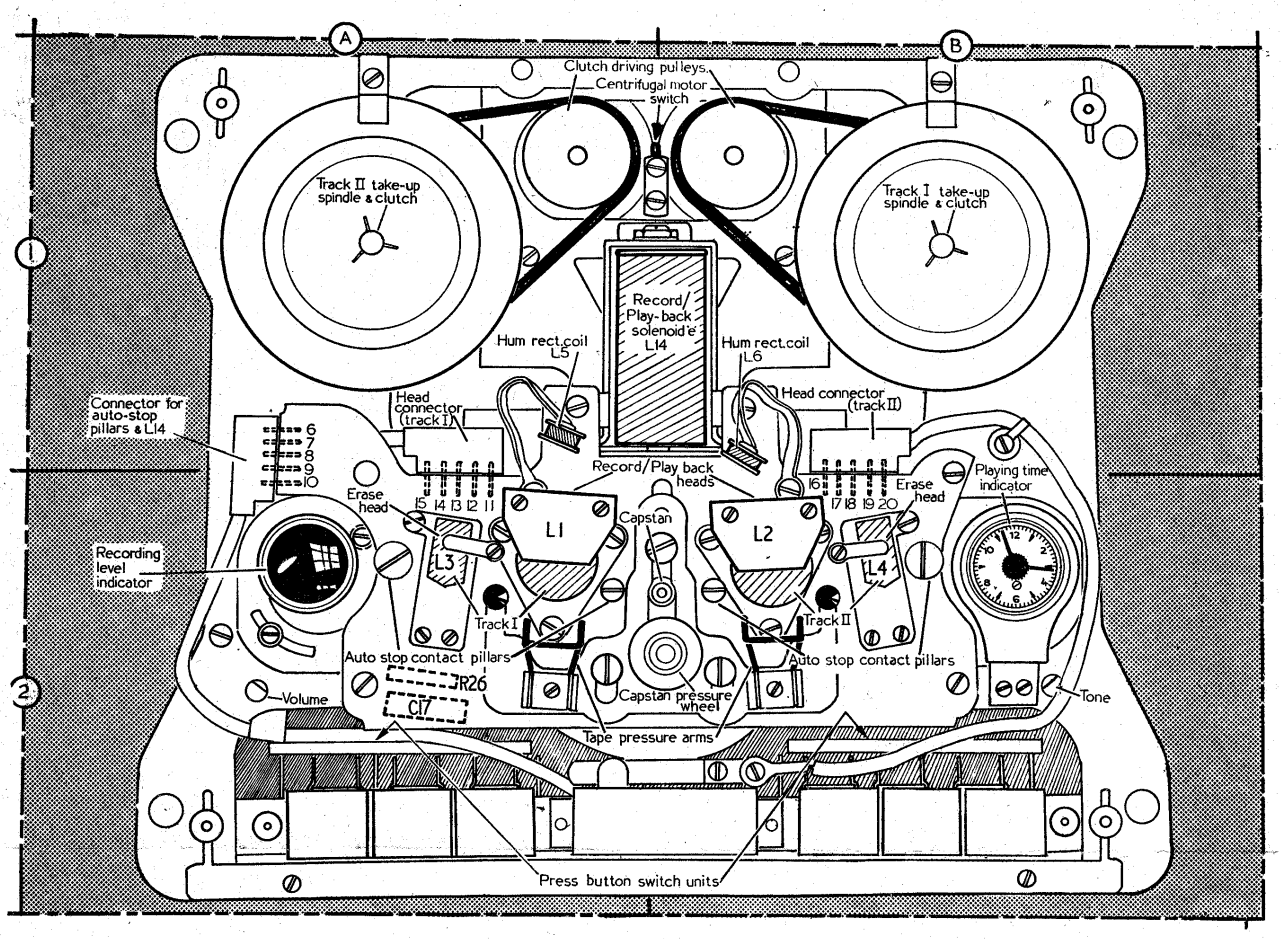
With the "Track I" button pressed, in conjunction with the "Record" or the "Playback" button, the tape travels from left to right (viewed from the front) and the heads **L1** and **L3** are in operation on the upper track. With the "Track II" button pressed, the tape travels from right to left and the heads **L2** and **L4** are in operation on the lower track.

Switches.—All switches used on the tape deck, including those operated by plugs and associated with relays, are represented by the conventional switch symbol in the circuit diagram overleaf. Switches bearing the suffix **w, x, y** or **z** are mounted on jacks bearing the same suffix. Switches bearing the suffix **a, b, c, d, e** or **f** are associated with relays bearing that suffix.

In determining which switches close when a particular button, or group of buttons, is pressed, the table should first be referred to. In this table a dash indicates open and **C** closed. After finding from the switch table the action of the switches, the position of the relays can be determined, and from this can be followed the action of the relay operated switches.

Jack x.—This is provided so that recordings can be made direct from the detector diode output of a radio receiver. The screened lead of the jack plug should be connected to the receiver in the following way.

Connect a 100 kΩ resistor from the centre conductor of the screened lead to the braiding, and connect the braiding to the receiver chassis. Connect a 1·2 MΩ resistor between the centre conductor and the top end of the receiver volume control. If a D.C. voltage is present



Plan (above) and underside views of the tape deck chassis, showing all the features associated with the tape drive and the four heads. The record/playback solenoid, **e**, is seen at the centre in the plan view.

on the volume control, a 0.025 μF isolating capacitor should be inserted between it and the 1-2 MΩ resistor. If a very long lead is used to connect the receiver to the recorder, the 1-2 MΩ resistor should be shunted with a 35 pF capacitor.

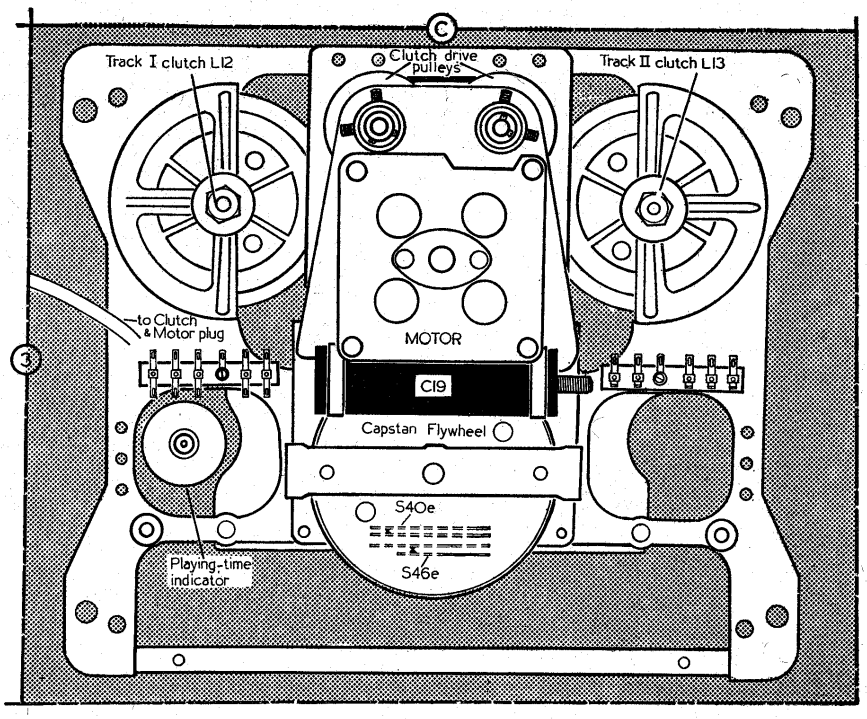
Tools.—A set of tools is supplied by the makers for certain adjustments, and they only should be used for the operations for which they are intended. These are: a pair of T-shaped lifting tools for lifting out the chassis, type 18/196; a pre-set adjusting tool for post-emphasis control **R9**, type 18/198; an oscillator core trimming tool for **T3**, type 18/197; and a blade adjuster for setting the spring contact blades, type 18/199.

TESTS AND ADJUSTMENTS

It is important to note that all the following adjustments relate to both tracks of the TK9, and the instrument should therefore be checked in both positions when carrying out any electrical tests. When checking the frequency response of the TK9 any discrepancy from track I to track II should be within ±2 db.

Head Currents.—The R.F. bias to each recording/reproducing head when recording is approximately 0.7 mA, and it may be measured by inserting a 100 ohm resistor in series with the chassis return lead of the head. The voltage across this resistor should be 70 mV ±10 per cent (0.07 V).

The erase bias to each erase head when recording should be approximately 40-50 mA, and



Switch contacts **S40e, S46e** shown in broken line are operated by solenoid **L14.**

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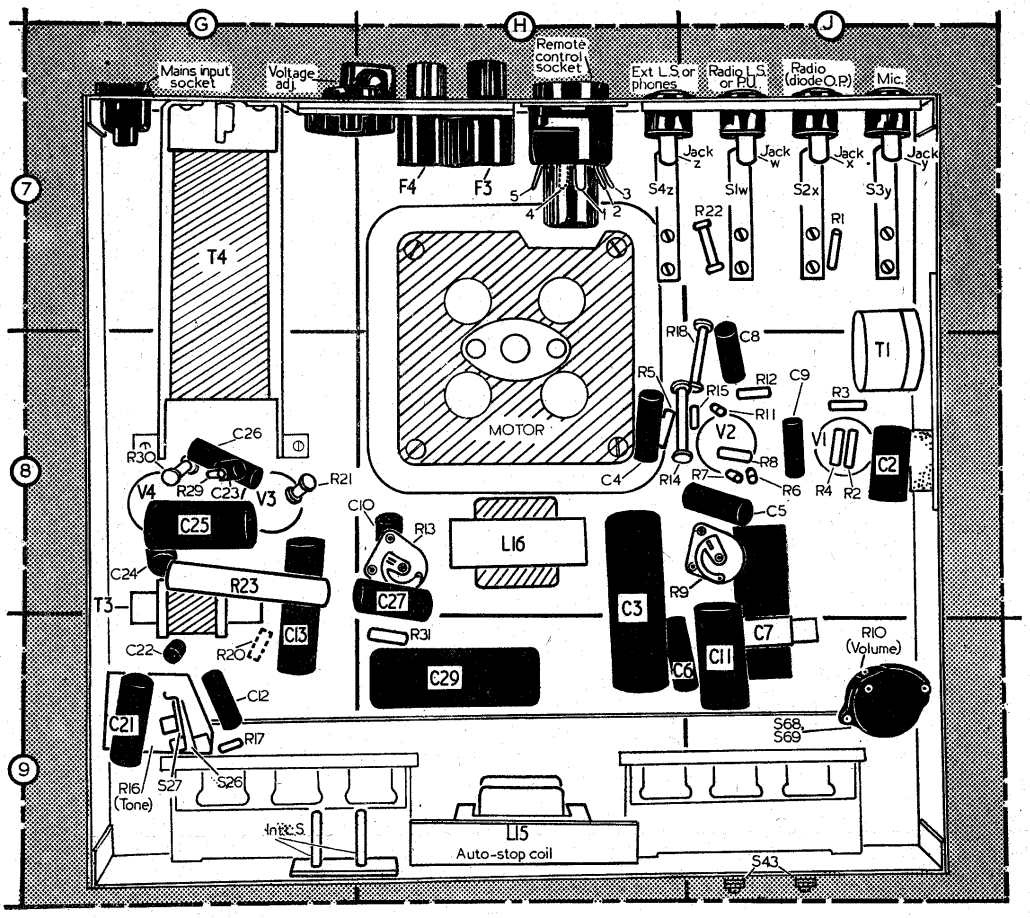

Underside view of the electronic chassis. The remote control socket in location H7 is provided for the connection of a foot-operated remote control switch. When the connecting plug is inserted in this socket, the connection between sockets 3 and 4 (shown in broken line in the circuit diagram overleaf) is opened, stopping the operation of the machine, and the signal is muted to chassis via socket 2. When the foot switch is pressed half down, socket 2 is disconnected from chassis, and sockets 3 and 4 are connected together, re-starting the machine for normal recording or replaying. When the foot switch is fully depressed a built-in relay is energized from H.T. line socket 3. The contacts on this relay close to mute the signal and reverse the motor for "back-spacing." The latter operation is achieved on track I by returning the lower end of relay **d** to chassis via **S34** and socket **5**, thus energizing it. On track II the top end of relay **d** is returned to chassis via **S33** and socket **5**, thus short-circuiting and de-energizing it.

this may be measured by inserting a 10 ohm resistor in series with the chassis return lead of the head. The voltage across it should be 400-500 mV (0.5 V).

If the R.F. bias is not correct, it may be corrected by adjusting the core of **T3** for the correct recording current, which should then be checked for accuracy on erase. The special tool (18/197) should be screwed on to the end of the core, which can then be pushed in or out. If both readings cannot be corrected by this means, there is probably a faulty component, or valve, or the operating voltages are incorrect.

The audio-frequency current to each recording head at a frequency of 1 kc fed into the diode jack **x** at full modulation level should be 0.2 mA approximately. Remove the EL42 oscillator valve for this test. With a 100 ohm resistor the voltage should be between 15 and 20 mV (0.02 V).

Adjustment of Heads.—If it becomes necessary to change either of the recording/reproducing heads then the two heads must be replaced together, since they are supplied in matched pairs. Their adjustments should be re-aligned, using either test tape TB 54, or a 6 kc recording made on a standard machine.

Pre-emphasis Control.—After removal of the bottom screen of the electronic chassis, the pre-emphasis control **(R13)** should be located between the H.T. smoothing choke **L16** (central position) and the mains transformer **T4**. This should not require re-adjustment, but if it is necessary, a 20 mV signal of 1 kc should be fed to jack **x** and recorded at full modulation level. On play-back, without altering the setting of the volume control, the reading obtained at the Ext. L.S. sockets (with the internal loudspeaker switched off) should be approximately 1.5 V. If it differs considerably from this figure, **R13** should be adjusted and the process repeated. In later versions than ours, **R13** is replaced by a 25 kΩ fixed resistor.

Frequency Response and Post-emphasis Control.—To check the frequency response, feed in a signal of 20 mV at 1 kc to jack **x** and adjust the volume control for full modulation. Next reduce this signal by 20 db (to 1/10th) and record frequencies of 60 c/s, 1 kc/s,, 4 kc/s, 6 kc/s and 8 kc/s. Connect a valve voltmeter to the contacts under the "Stop" bar in the centre of the machine via a 1 : 50 attenuator (100 kΩ and 2 kΩ connected in series from the A.F. line to chassis, with the valve voltmeter connected across the 2 kΩ resistor). Play back the recording, the level of which should be within ±3 db (referred to 1 kc/s) over the whole frequency range.

If the frequency response drops at the higher frequencies, the post-emphasis control **R9**, which gives top lift for frequencies above 800 c/s and bass cut below 800 c/s, or vice versa, should be adjusted. The control is located under the electronic chassis between the H.T. smoothing choke and the valve bases of **V1** and **V2**. Use only the special tool (18/198) for this adjustment, not a screwdriver.

Hum Level.—The hum level may be adjusted to a minimum on each reproducing channel by means of the two humbucking coils, located on aluminium brackets immediately behind their respective head assemblies. The level should be a maximum of 1/200th of a recording made with full modulation level and played back without altering the setting of the volume control.

Modulation Level.—For setting the modulation level, feed into jack **x** a signal of approximately 30 mV at 1 kc and adjust the volume control until the two halves of the Magic Eye just begin to touch. Record, and measure the distortion content by means of a Grundig distortion factor meter. The reading obtained should not be greater than 5 per cent with a maximum discrepancy of 2 per cent from track I and track II. If it differs, **R35** should be adjusted to close the level indicator when the setting of the recording level control is reduced, when a higher distortion factor was noted; or, alternatively, the level indicator should be opened up (by means of **R35**) if the reading obtained was considerably lower than 5 per cent. The full procedure should then be repeated.

DISMANTLING

Removing Chassis.—First remove the speaker grille (four brass screws) together with the gauze and the speaker, withdrawing the speaker plug from its socket on the chassis deck;

Pull off the two control knobs, and unscrew the four brass coin-slotted screws;

Lift off the upper deck; then, using a 5BA box spanner, undo the small nuts holding the chassis to the carrying case.

Insert two TK9 lifting tools into screw-holes in diagonally opposite corners of the chassis, and lift out the chassis from the case, taking care not to damage the spring sets in front of the "Record" and "Playback" buttons. On no acount must the chassis be lifted by the clutch assemblies, as serious damage may result.

Once the chassis is clear of the casing, all valves are readily accessible, and upon removal of the bottom screen (four screws) all the components are accessible also.

Separating Units.—When carrying out repairs to the press-button assemblies, the relays, or the motor, it is necessary to separate the electronic chassis from the tape deck assembly, which should be done as follows:

Unplug the three 5-way plugs leading to the head assembly on top of the tape deck and the 6-way plug from the top of the mains transformer.

Unscrew 8 screws (2 on each of the four sides of the top frame) and the two flexible connections to the volume control and the tone control.

Carefully lift off the top frame, taking care not to cause damage to the press-button switches.

When servicing, always remember that the external cage of the motor rotates. Make sure that it is well clear of any obstructions before switching on.