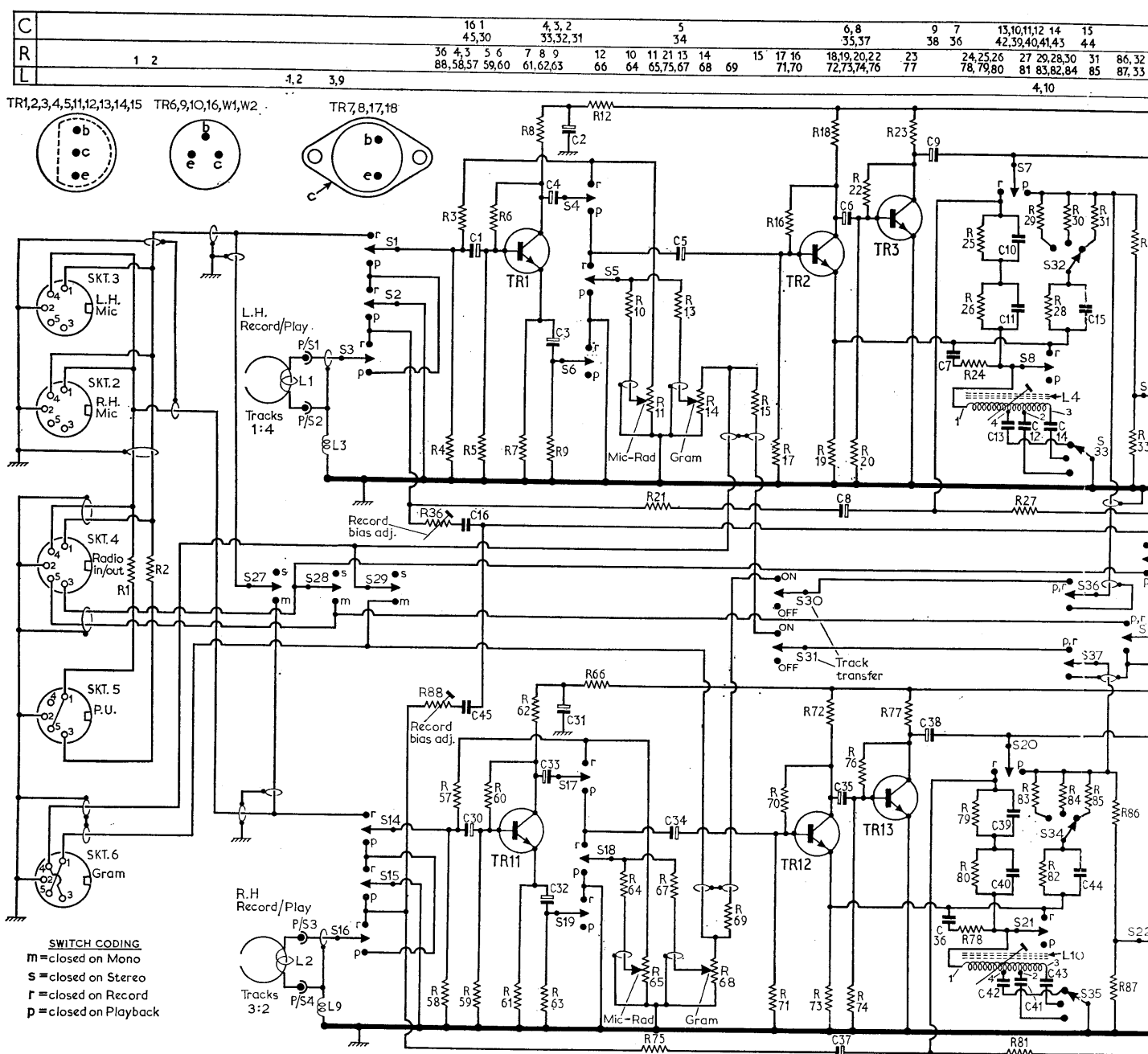


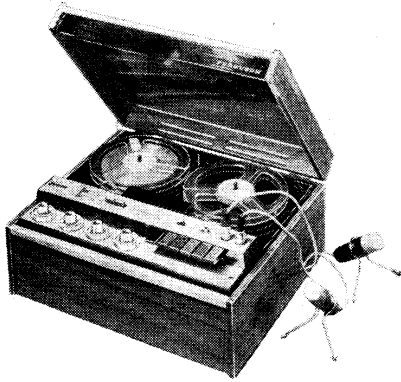
Ferguson 3232

1891

Four-track, three speed, stereo tape recorder

Below: Circuit diagram of the Ferguson model 3232 stereo tape recorder. For clarity, the bias oscillator, erase heads, and associated switching are on the centre right of the diagram.





Three-quarter view of the Ferguson 3232 with translucent plastics lid raised, showing disposition of controls.

Introduction

Styled to match Unit Audio equipment, Ferguson 3232 three-speed four-track 7in reel stereo tape recorder is designed to operate from 230-250V 50 c/s mains supplies only. Its features include twin 5W transistored amplifiers, solenoid operated stop and pause mechanism, transistor operated moving coil meter, record level indicators and a number of auxiliary sockets for external accessories, details of which are shown in the specification.

Piano key type tape motion operating controls are fitted and are interlocked to prevent accidental erasure of recorded tape. The identical amplifiers can be used as straight through amplifiers either independently or in parallel.

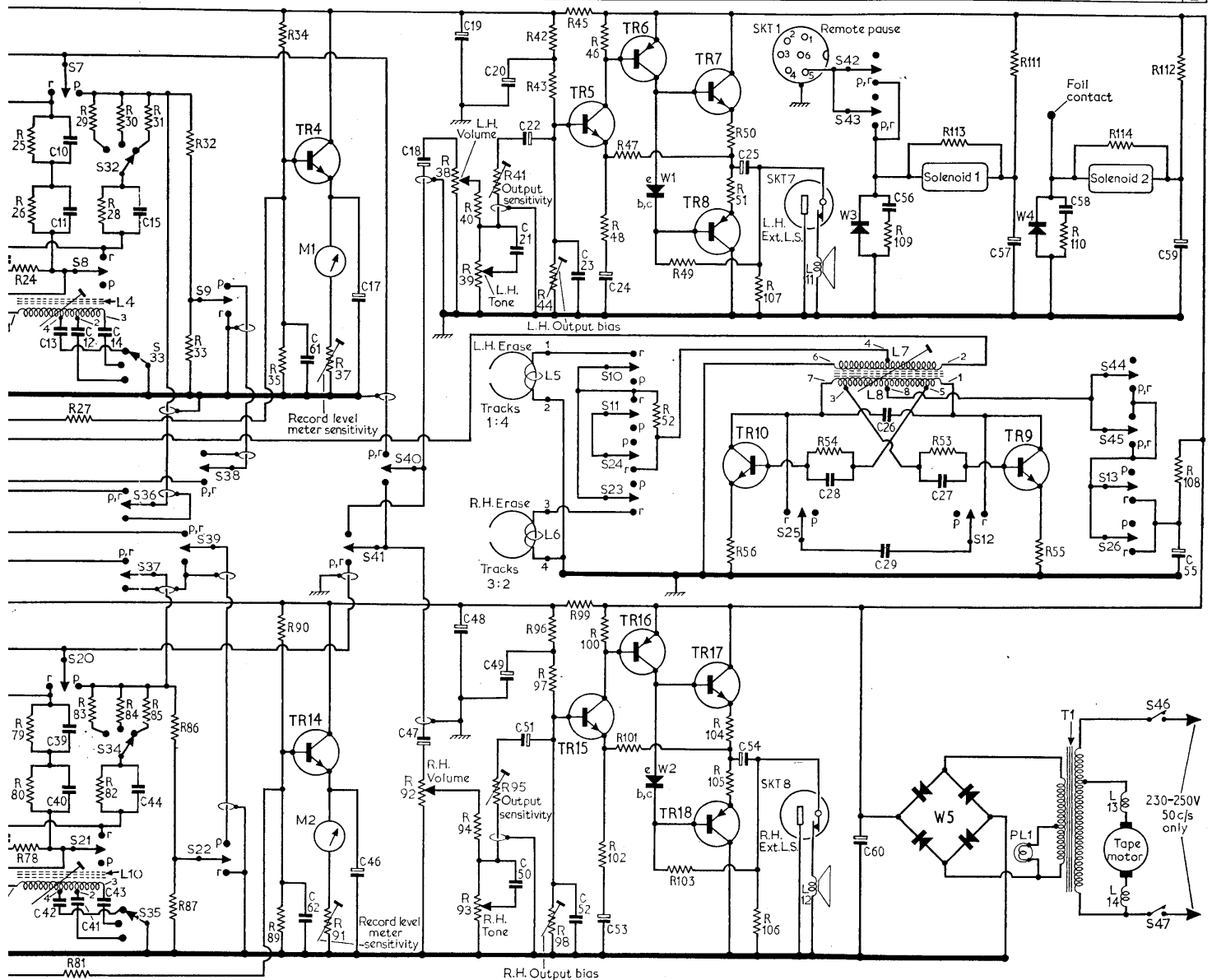
The tape is removed from contact with the heads during winding operations and a special bias circuit arrangement eliminates the possibility of the signal head becoming magnetized on cessation of the bias supply. A digital type tape position indicator is provided, with reset press-button.

Transistor analysis

Transistor voltages quoted in the table cols. 7 and 8 were obtained from information supplied by the manufacturer. They were measured under quiescent conditions on a 20,000 Ω/V meter and are positive with respect to the negative chassis line of the relevant transistor unless indicated otherwise.

(Continued overleaf col. 1)

13,10,11,12 14 15	61 17	18 19	20,21,22 23 24	25	56	57	58	59
42,39,40,41,43 44	62 46	47 48	49,50,51 52 53	54	26,29 27	111	110	112
24,25,26 27 28,29,30 31 86,32	34,35 37	38 39,40,41	42,43,44,45 46,48,47	49	109	113	114	118
78,79,80 81 83,82,84 85 87,33	90,89 91	92	93,94,95 96,97,98,99 100,102,101,52	103	54	55	55	108
4,10			5,6		11,12 8 7		T1 13,14	
								C
								R
								L



Vintage Service Data CD-Rom

Electrical and Electronic Trader 14 February, 1969

Resistors			R9	390Ω	H5	R19	470Ω	G5	R29	10kΩ	G5
			R10	68kΩ	G5	R20	100kΩ	G5	R30	10kΩ	G5
R1	1MΩ	B3	R11	100kΩ	B1	R21	12kΩ	F5	R31	3-9kΩ	G5
R2	1MΩ	B3	R12	39kΩ	H5	R22	560kΩ	G5	R32	22kΩ	G5
R3	1MΩ	H5	R13	220kΩ	H5	R23	4-7kΩ	G5	R33	22kΩ	G5
R4	100kΩ	H5	R14	250kΩ	B1	R24	390Ω	G5	R34	1MΩ	G5
R5	560kΩ	H5	R15	560kΩ	B1	R25	47kΩ	G5	R35	27kΩ	G5
R6	2-2MΩ	H5	R16	560kΩ	H5	R26	150kΩ	G5	R36	50kΩ	F5
R7	1kΩ	H5	R17	47kΩ	H5	R27	22kΩ	G5	R37	15kΩ	F5
R8	68kΩ	H5	R18	15kΩ	H5	R28	220kΩ	G5	R38	20kΩ	A1

Specification

(As supplied by the manufacturer)

Tape deck:	Thorn type DC432.
Reel diameter:	7in maximum.
Tracks:	Four (can be paired on playback).
Tape speeds:	7½in/sec (19cm/sec), 3½in/sec (9.5cm/sec), 1½in/sec (4.75 cm/sec).
Wow and flutter:	Better than 0.15 per cent r.m.s. at 7½in/sec. Better than 0.2 per cent r.m.s. at 3½in/sec. Better than 0.25 per cent r.m.s. at 1½in/sec.
Frequency range:	40-18,000c/s at 7½in/sec, 40-14,000c/s at 3½in/sec, 40-7,000 c/s at 1½in/sec.
Signal-to-noise ratio:	40dB (unweighted).
Tape position indicator:	4 digit counter (press-button reset).
Crosstalk (stereo channels):	50dB.
Record level indicator:	Two moving coil meters.
Audio power output:	5W each channel (speech and music conditions).
Power supply:	230-250V 50c/s only.
Power consumption:	45W.
Controls interlocks and latches:	(a) Self-latching pause key inoperative during spooling. (b) Play keys cannot be depressed when spooling in either direction. (c) Both record press-buttons are interlocked to prevent accidental erasure. (d) Record press-buttons are released when any other tape motion key (except pause) is depressed, and cannot be operated when play keys are depressed.
Monitoring:	Input signals may be monitored via internal or extension loud-speakers stereophonically or in parallel (mono).
Track transfer switch:	Playback of one track mixed with new recording on second track (mono only). Both channels can be monitored.
Straight-through amplifiers:	With record, pause and play keys depressed, tape stationary.
Automatic stop:	Solenoid operated by metal foils at ends of tape, functioning on play, record, rewind and forward wind.
Remote pause:	Solenoid operated temporary stop during record or play by separate switch, or with foot- or hand-operated accessory.
Respooling time:	1,800ft in 3 minutes 20 seconds.
Protection of recordings:	(a) Accidental erasure prevented by gating erase oscillator with plug keys and interlocking the record keys with it. (b) Automatic demagnetization of the signal head by fading the bias on cessation of recording.
External loudspeaker sockets:	Two; 5W at 8Ω. Switched for internal loudspeaker muting.
Remote pause socket:	Pin 5 and the plug shield are used for remote pause switching.
Gram input socket:	100mV into 100kΩ (LH pins 3 and 4, RH pins 1 and 5, pin 2 common)*.
P.U. input socket:	50mV into 1MΩ (LH pin 3, RH pins 1 and 5, pin 2 common)*.
Radio in/out socket:	Radio input; 0.25mV into 4-7kΩ (LH pin 1, RH pin 4)*. Radio output; 500mV at 10kΩ (LH pin 3, RH pin 5)*. Pin 2 common.

Left- and right-hand channels common when stereo/mono switch is set to mono.

Transistor table

Transistor	Record Emitter (V)	Base (V)	Collector (V)	Playback Emitter (V)	Base (V)	Collector (V)
TR1	BC150	0-15	0-3	5-0	0-15	0-3
TR2	BC150	0-23	0-64	12-0	0-25	0-65
TR3	BC151	0	0-48	9-4	0	0-6
TR4	BC151	0-15	0-35	20-5	0-11	0-4
TR5	BC151	13-5	13-75	23-5	14-25	14-5
TR6	U3845/2	24-0	23-5	12-75	26-0	24-9
TR7	AD161	12-6*	12-75	24-0	13-4*	13-5
TR8	AD162	12-6*	—	0	13-4*	—
TR9	BC119†	5-0‡	10-0§	25-0§	0	0
TR10	BC119†	5-0‡	10-0§	25-0§	0	0
TR11	BC150	0-15	0-3	5-0	0-15	0-3
TR12	BC150	0-23	0-64	12-0	0-25	0-65
TR13	BC151	0	0-48	9-4	0	0-6
TR14	BC151	0-15	0-35	20-5	0-11	0-4
TR15	BC151	13-5	13-75	23-5	14-25	14-5
TR16	U3845/2	24-0	23-5	12-75	26-0	24-9
TR17	AD161	12-6**	12-75	24-0	13-4**	13-5
TR18	AD162	12-6**	—	0	13-4**	—

* Measured at junction of R50/R51.

† Bias oscillator voltages measured on a calibrated oscilloscope.

‡ Peak voltage.

§ Peak-peak voltage.

** Measured at junction of R104/R105.

Erase head voltages measured across tags 1 and 2, tracks 1-4 and across tags 3 and 4, tracks 3-2 should be measured with an electronic voltmeter. These voltages are 7V r.m.s. respectively. When connected to a 240V 50c/s mains power supply T1 secondary voltages should be as follows: Record 19-5V; playback 19-75V and PL1 tap 6-8V.

R39	20kΩ	A1	C21	0-047μF	A1
R40	15kΩ	A1	C22	4μF	F5
R41	25kΩ	F5	C23	1,000pF	E5
R42	5-6kΩ	E5	C24	250μF	E5
R43	10kΩ	E5	C25	750μF	E5
R44	100kΩ	E5	C26	0-047μF	F5
R45	1kΩ	E5	C27	0-047μF	F5
R46	1-2kΩ	E5	C28	0-047μF	F4
R47	1kΩ	E5	C29	0-01μF	F5
R48	22Ω	E5	C30	1μF	H4
R49	390Ω	E5	C31	400μF	H4
R50	1Ω	E5	C32	100μF	H4
R51	1Ω	E5	C33	1μF	H4
R52	27Ω	F5	C34	1μF	H4
R53	33kΩ	F5	C35	4μF	G4
R54	33kΩ	F4	C36	0-047μF	G4
R55	22Ω	F5	C37	4μF	G4
R56	22Ω	F4	C38	4μF	G4
R57	1MΩ	H4	C39†	220pF	G4
R58	100kΩ	H4	C40	0-022μF	G4
R59	560kΩ	H4	C41	0-22μF	G4
R60	2-2MΩ	H4	C42	0-047μF	G4
R61	1kΩ	H4	C43	0-047μF	G4
R62	68kΩ	H4	C44	0-015μF	G4
R63	390Ω	H4	C45	470pF	F4
R64	68kΩ	G4	C46	20μF	F4
R65	100kΩ	B1	C47	4μF	A1
R66	39kΩ	H4	C48	400μF	F4
R67	220kΩ	H4	C49	25μF	F4
R68	250kΩ	B1	C50	0-047μF	A1
R69	560kΩ	B1	C51	4μF	F4
R70	560kΩ	H4	C52	1,000pF	E4
R71	47kΩ	H4	C53	250μF	E4
R72	15kΩ	G4	C54	750μF	E4
R73	470Ω	G4	C55††	400μF	F5
R74	100kΩ	G4	C56	0-1μF	E4
R75	12kΩ	F4	C57	900μF	A2
R76	560kΩ	G4	C58	0-1μF	E5
R77	4-7kΩ	G4	C59	900μF	A2
R78	390Ω	G4	C60	4,500μF	B2
R79	47kΩ	G4	C61†	470pF	B2
R80	150kΩ	G4	C62†	470pF	B2
R81	22kΩ	G4			
R82	220kΩ	G4			
R83	10kΩ	G4			
R84	10kΩ	G4			
R85	3-9kΩ	G4			
R86	22kΩ	G4			
R87	22kΩ	G4			
R88	50kΩ	F4			
R89	27kΩ	G4			
R90	1MΩ	F4			
R91	15kΩ	F4			
R92	20kΩ	A1			
R93	20kΩ	A1			
R94	15kΩ	A1			
R95	25kΩ	F4			
R96	5-6kΩ	E4			
R97	10kΩ	E4			
R98	100kΩ	E4			
R99	1kΩ	E4			
R100	1-2kΩ	E4			
R101	1kΩ	E4			
R102	22Ω	E4			
R103	390Ω	E4			
R104	1Ω	E4			
R105	1Ω	E4			
R106	100Ω	B3			
R107	100Ω	B3			
R108	22Ω	F5			
R109	10Ω	E4			
R110	10Ω	E4			
R111	39Ω	A3			
R112	680Ω	A2			
R113†	4-7kΩ	A2			
R114†	4-7kΩ	C2			

Coils and transformers*

L1	—	C3
L2	—	C3
L3	—	H5
L4	1-2 21Ω 3-4 7Ω	G5
L5	—	C3
L6	—	C3
L7	2-6 15Ω	F5
L8	1-7 2-5Ω	F5
L9	—	H4
L10	1-2 21Ω 2-4 2-5Ω 3-4 7Ω	G4
L11	8Ω	**
L12	8Ω	**
L13	33Ω	B3
L14	33Ω	B3
T1	[Pri 104Ω Sec 1Ω]	A3
Sol 1	27-5Ω	A2
Sol 2	27-5Ω	C2

Miscellaneous

W1†	AC169	E5
W2†	AC169	E4
W3†	BY124	E4
W4†	BY124	E5
W5	LT116	B2
M1	—	A1
M2	—	A1
PL1	8V 1-2W	A1
S1-S13	—	B3
S14-S26	—	B3
S27-S29	—	B1
S30, S31	—	B1
S32-S35	—	A2
S36-S45	—	C1
S46, S47	—	A1

Capacitors

C1	1μF	H5
C2	400μF	H5
C3	100μF	H5
C4	1μF	H5
C5	1μF	H5
C6	4μF	G5
C7	0-047μF	G5
C8	4μF	G5
C9	4μF	G5
C10†	220pF	G5
C11	0-022μF	G5
C12	0-22μF	G5
C13	0-047μF	G5
C14	0-047μF	G5
C15	0-015μF	G5
C16	470pF	F5
C17	20μF	F5
C18	4μF	A2
C19	400μF	F5
C20	25μF	F5

* Approximate d.c.

resistance in ohms.

† May not be fitted in

some chassis.

†† In some chassis C55

is 100μF.

‡ W1 and W2 are

transistors strapped

as diodes.

** Loudspeaker.

1891

Ferguson 3232

Continued from overleaf—

Circuit description

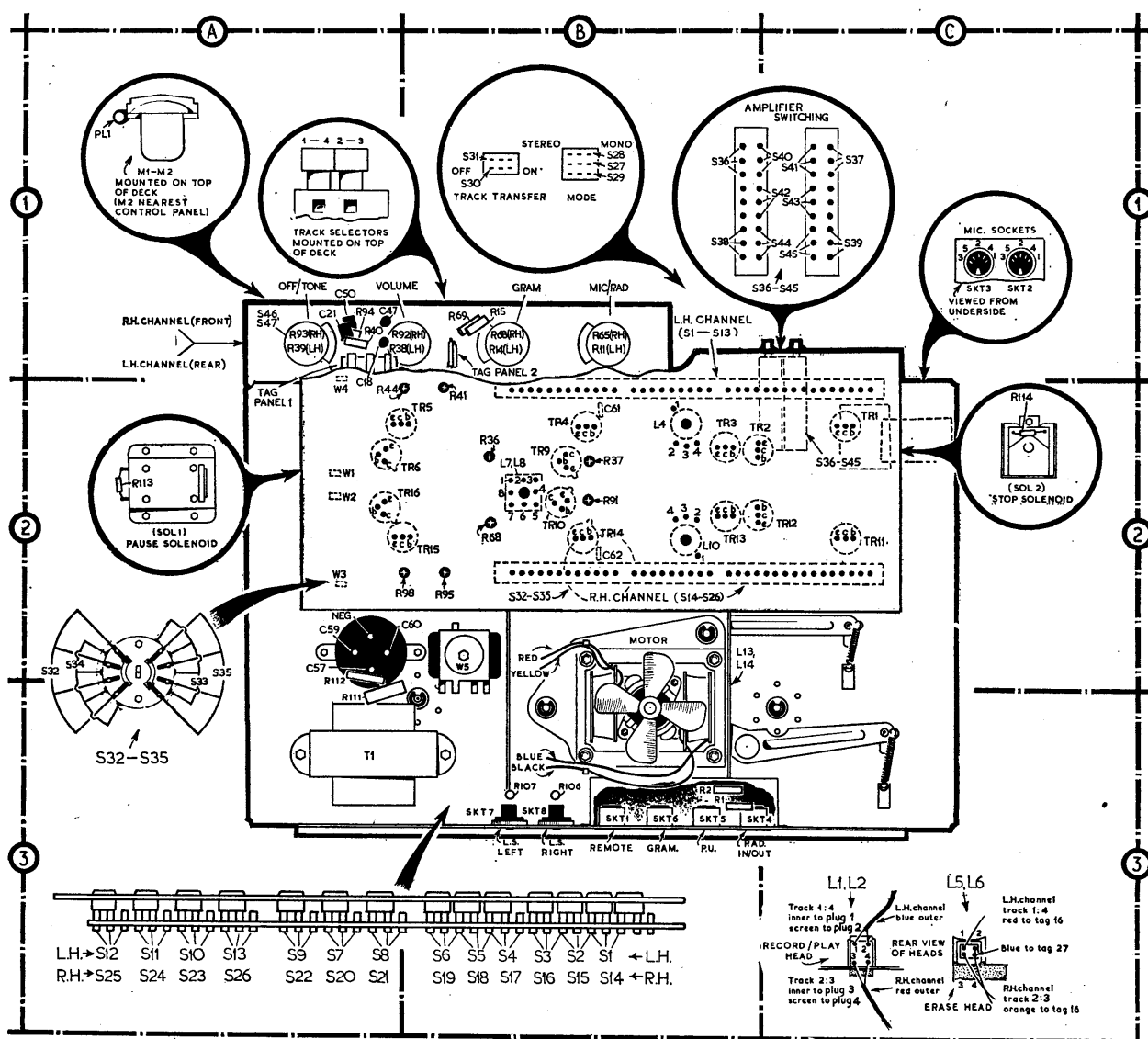
Power supply.— The motor is permanently connected to a tap on **T1** primary, no other tappings are provided, the power supply being designed for operation from 230-250V 50c/s mains supplies. The secondary winding is connected to a bridge rectifier **W5** that supplies the d.c. to operate the recorder sections and main amplifiers. It also supplies power to operate the "Pause" **SOL1** and "Stop" **SOL2** solenoids and is taken out to the 'Remote Pause' socket **SKT1** for external use. The solenoids are operated by the discharge of the reservoir capacitors (**C57** and **C59** respectively) which give a high

initial energizing current. The "Pause" solenoid is subsequently 'held on' by the current through feed resistor **R111**.

Playback.— The appropriate head (**L1** or **L2**) winding is selected by the left/right play keys operating in conjunction with **S1-S13/S14-S26**. Switches **S1, S3/S14, S16** switch the playback head voltages to the bases of **TR1/TR11**, the other side of the head windings being returned to chassis via the screening braid and **L3/L9** (humbucking coils). The amplified signal at the collector of **TR1/TR11** is via **C4/C33, S4/S17** and **C5/C34** to the base of **TR2/TR12** which, with **TR3/TR13** provide two further stages of amplification. A frequency selective feedback circuit, switched by **S32/S34** from **TR3/TR13** collector to **TR2/TR12** emitter gives bass boost playback equalization. **TR3/TR13** output is fed to the radio output socket (**SKT 4**) pins 3 and 5 via **S7/S20, R32/R86**,

S9/S22, S38/S39 and **S28**. Signals at the collector of **TR3/TR13** are fed via **C9/C38** to the left- and right-hand channel amplifiers respectively through **S40/S41**.

Left-hand channel output developed at the collector of **TR3** can be switched to the right-hand channel amplifier by **S36** and the right-hand channel output at **TR13** can be switched by **S37** to the left-hand channel amplifier. This permits playback of one track mixed with a new recording on a second track via **S30/S31** (track transfer switch). Volume and tone control to the main left-hand and right-hand channel amplifiers is provided by **R38/R92** and **R39/R93** respectively. Transistors **TR5/TR15** have the dual role of pre-amplifier for a.c. and difference amplifier for d.c. It compares the d.c. potential (**Vb**) at its base with the emitter voltage (**Ve**) of **TR7, TR8/TR17, TR18**. The loop gain of the circuit keeps



Underside view of main chassis when standing on its rear edge, plus details of switches.

this small difference between V_e and V_b constant so that V_e is defined with respect to V_b irrespective of spreads in the characteristics of transistors **TR5**, **TR6/TR15**, **TR16**. Negative feedback (both a.c. and d.c.) is via **R47/R101** from the output to the emitter of **TR5/TR15**. Decoupling by **C24/C53** removes the a.c. component, but a small known amount of a.c. feedback is reintroduced by **R48/R102**. This reduces gain spreads and distortion.

Record. — Input sockets (**SKT2-4** pins 1 and 4 and **SKT5** pins 1 and 3) are switched by **S1/S14** to the pre-amplifier stages **TR1/TR11**. The output of **TR1/TR11** is fed via **C4/C33**, **S4/S17** 'Mic-Rad' control (**R11/R65**), **R10/R64**, **S5/S18** and **C5/C34** to a.f. amplifier **TR2/TR12**. Treble boost record equalization is provided by a frequency selective feedback circuit connected between **TR3/TR13** collectors and **TR2/TR12** emitters via **S7**, **S8/S20**, **S21**. High frequency correction is provided by **L4/L10** in conjunction with capacitors **C12/C41**, **C13/C42** and **C14/C43** switched into circuit by **S33/S35**. **TR3/TR13** output is fed via **C9/C38**, **S7/S20**, **C8/C37**, **R21/R75** and **S3/S16** to the record/play heads **L1/L2**. The head windings are returned to chassis via the screening braid and humbucking coils **L3/L9**.

Part of the signal developed at the collector of **TR3/TR13** is fed to the base of **TR4/TR14**, the record level indicator rectifier and d.c. amplifier. Transistor metering circuits are employed in order to eliminate the differential loading imposed by the level meters on the third stage of the amplifiers.

Power for erasing and recording bias is supplied via **TR9/TR10** connected as a push-pull oscillator when the instrument is switched to record. The oscillator is tuned to approximately 55kc/s and erase power is fed to the erase head windings **L5/L6** from a tapping on **L7** via **S10/S23**. In order to limit the power fed to an erase head when 'record' is selected for one channel only, an oscillator level compensation resistor, **R52**, is switched in series with the appropriate erase head. The resistor is out of circuit when both heads are in use on stereo record.

Playthrough amplifier. — With the instrument switched to 'record' input signals via **SKT2-5** are fed as for record to **TR1/TR11**. Signals via gram socket (**SKT6**) are fed to **TR2/TR12** via **R14/R68** (gram), **R13/R67**, **S5/S18** and **C5/C34**. **R14/R68** control the mixing level to the amplifiers and as the record level meters are operational these can be used to predetermine the desired level from each socket as required.

General notes

Access for service. — To gain access to the top of the tape deck for routine

cleaning, etc., first pull off the speed-change and amplifier control knobs, unscrew and remove screw securing the moulded head cover and then six screws securing top cover to deck (4 Philips head, 2 slot head). The top cover can now be lifted at the rear edge and eased forward to clear the tape deck operating keys.

Chassis removal. — To remove chassis from cabinet, first release storage compartment back cover, then remove control knobs and tape deck cover as previously described. Unscrew and remove 4 binder type screws located at each corner of the mechanism top plate. Lift chassis slightly forward to allow top of fibre panel to be released from slot in cabinet back rail. The deck and amplifiers can now be lifted clear of the cabinet within limits of connecting leads to loudspeakers. To free unit completely pull off tag connections to loudspeakers noting colour coding for reassembly.

Access to printed panel. — Most meter checks and some component replacement may be carried out with the printed panel in position. For complete access, place the chassis on its rear edge, remove printed panel metal cover (4 screws), then detach the circlips, and PTFE washers from studs on the two 'record' switch links. Unscrew and remove 4 screws and washers located at each corner of printed panel and 3 screws securing heat sink bracket to main chassis. The panel may now be hinged outwards within the limits of the wiring.

Complete removal of printed panel.

1. — When handling chassis take care to avoid breaking tape counter reset button.
2. — Before dismantling component parts unsolder the following from both channels:

Mauve and white leads to right-hand

microphone socket, from tags 1 and 4. Red and blue leads to record head from tags 3 and 4. Yellow and white leads to Mic-Rad control from tags 5. Brown and orange leads to Gram control from tags 6 and 8. Green and blue leads to Mic-Rad control from tags 7 and 8. Orange and white leads to **S40/S41** from tags 10 and 12. Red and brown leads to **S32** and **S34** from tags 11 and 12. Yellow and mauve leads to **S36-S39** from tags 13 and 14. Red and orange leads to **S13-S26** from tags 15. Red and orange leads to erase head from tags 16.

Release also the following:
Speed compensation switch wafer from deck.

Leads to meters (tags 25 and 26).

Grey and black leads on tag 31.

Leads to **R40** and **R94** tone controls (tags 18 and 19).

Lead to 'STOP' solenoid (tag 20 — RH channel).

Lead to 'PAUSE' solenoid (tag 20 — LH channel).

Leads to **SKT7** and **SKT8** (tags 34).

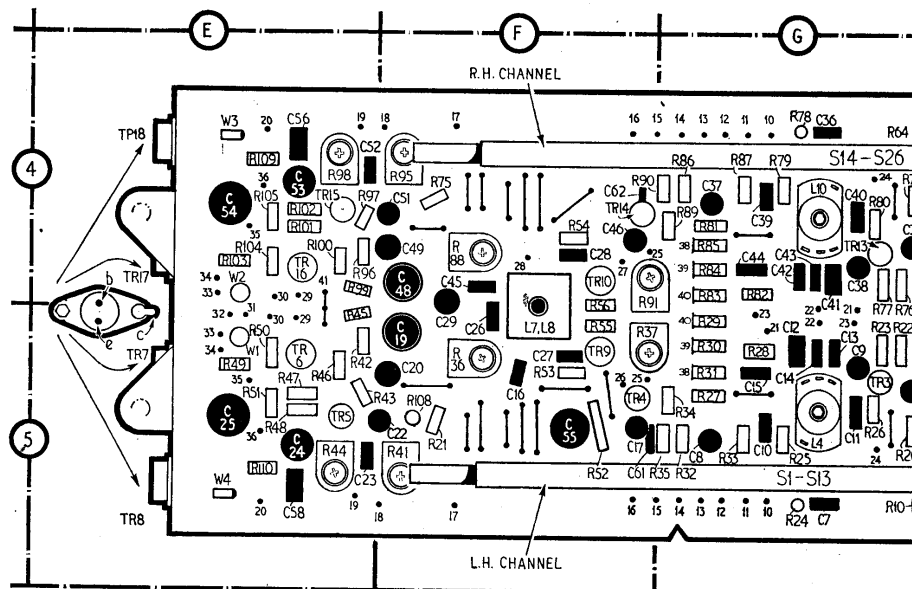
Red lead to **C60**.

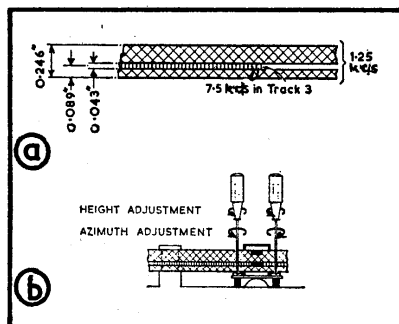
Blue lead from tag 28 to **S44/S45**

Head adjustment

Provision is made on the head mounting for both vertical (height) and horizontal (azimuth) adjustment. Adjustment only becomes necessary when the manufacturing settings have been disturbed.

Azimuth and height adjustment. — Using a special test tape pre-recorded at 3½ in/sec in the manner illustrated Fig. a*, a simultaneous indication when both of these adjustments are correct is provided by the response to track 3.





Test tape specification (a), and head adjustment (b).

Azimuth is correct when the 7.5kc/s signal is at maximum, and height when the 1.25kc/s signal is at minimum. Height is adjusted by turning both screws in the same direction and azimuth by turning in opposite directions, as shown in illustration Fig b.

* The Thorn height and azimuth test tape type 6 may be purchased direct from the manufacturers, Messrs. Tutchings Electronics Ltd., 14 Rookhill Road, Friars Cliff, Christchurch, Hants, England.

Erase head. — The erase head is accurately located by two rails and a pip moulded into the erase head mount. No adjustment is provided.

Demagnetization. — It is important that there is no residual magnetism in the heads or the capstan spindle. This condition, which may arise if magnetized objects are brought near these components, or if an ohmmeter is connected to the head windings, will lead to an increase in background noise on 'Play'. Suitable instruments for providing a demagnetizing field are available from a number of manufacturers.

