EL3541
ER1502

PHILIPS *Service* notes

TAPE RECORDERS
EL3541 & ER1502

Models EL3541 and ER1502 are contained in wooden cabinets; Model EL3541/15B is contained in a polystyrene case. Refer to Parts Lists for details of items which vary between the two versions.

TECHNICAL DATA:

Tape Speed: $3\frac{3}{4}$" sec.
Power Consumption: Approx. 60W.
Dimensions: 13.8" x 11.8" x 6.8".
Weight: Approx. 17 lb.
Reel Diameter: 7" max.

VALVES AND DIODES:

V1. EF86: Pre-amplifier.
V2. 12AX7: Pre-amplifier.
V3. 6BM8: Pre-amplifier + Oscillator/Power-amplifier.
V4. EM84: Modulation Indicator.
V5. 6V4: Rectifier.
W1. 0A85: Germanium Diode.

MICROPHONE:

EL3541 — Type EL3750.
EL3541/15B — Type EL3753/00.
ER1502 — Type EV4300A.

DIVISION OF DOCUMENTATION:

A. Figure-index.
B. Mechanical adjustments.
C. Lubricating instructions.
D. Test measurements at the amplifier.
E. Replacement of the EM84 (modulation indicator).
F. List of service components.

(A) FIGURES:

Fig. 1-12: Figures illustrating adjustment and alignment.
Fig. 13: Track adjustment.
Fig. 14: Controls and connecting sockets.
Fig. 15: Circuit diagram.
Fig. 16: Exploded view of the mechanism.
Fig. 17: Exploded view of push buttons.
Fig. 18: Exploded view of the plate 39 with heads and pressure roller.
Fig. 19: Exploded view of the motor.

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(B) MECHANICAL ADJUSTMENTS:

(1) Drive belt 96 and tension wheel 18.
(2) Flywheel 36 and bearings 12 and 45.
(3) Record/Playback head H1.
(4) Erase head H2.
(5) Pressure felt (60, Fig. 18) against Record/Playback head.
(6) Bushes 64 (Fig. 18).
(7) Pressure roller 66B (Fig. 18).
(8) Reel discs 94 and 95 (Fig. 16) and coupling wheels 89 (Fig. 16).
(9) Clutch discs 93 and 126 (Fig. 16).
(10) Brakes.
(11) Interrupt button.
(12) Driving motor 140 (Fig. 19).

(B1) DRIVE BELT (96) AND TENSION WHEEL (18):

The tension of the drive belt (96)—approximately 500-600 gr.—is provided by the tension wheel (18).

This wheel should be in such a position (with belt fitted) that the movement of the wheel spindle from the working position to the position where the bracket touches the stop cam is not less than 10 mm. (see Fig. 2).

If the above movement is less than 10 mm., the drive belt has stretched and should be replaced.

If fitting a new belt does not improve the position, the tension of spring 20 must be too high.

This can be measured by removing the drive belt and measuring the force at the spindle of the tension wheel (Fig. 1) after moving this wheel to the normal working position, 10 mm. (Fig. 2).

The height of the tension wheel should be adjusted so that the drive belt runs without twisting.

(B2) FLYWHEEL (36) AND BEARINGS (12 and 45):

The flywheel (36) should be mounted in such a position that the tape is drawn past the heads (57 and 141) without twisting.

This may be adjusted by moving the plate (39, Fig. 18) while the screws (121) are not fully tightened.

When the spindle of the flywheel reaches a vertical position (tape lies flat against heads), the screws (121) must be tightened.

The bearings should then be adjusted by tapping against the bearing housings with a wooden or plastic screwdriver handle while the flywheel is turning.

The height of the flywheel should be adjusted with screw (6, Fig. 3) so that the groove in the flywheel is level with the grooves in the coupling wheels.

(B3) RECORD/PLAYBACK HEAD H1:

The spacing between the four tracks recorded by the Record/Playback head H2 (57, Fig. 18) must be equal.

ADJUSTMENT AND CHECK (Fig. 4 and Fig. 13):

- Adjust the height of the head by means of the three screws A, B and C so that the top of the core of the upper head is level with the top of the tape.
- Put the track selector switch (360, Fig. 14) in position 1-4.
- Depress the super-impose button (361, Fig. 14) during recording.
- Record a signal of 1,000 c/s with a modulation depth of 100% on a new and unused piece of tape.
- Turn the tape and record the same signal.
- Put the track selector switch (360, Fig. 14) in position 2 x 3.
- Follow the above procedure and record a 1,000 c/s signal.
- Turn the tape and record the same signal again.

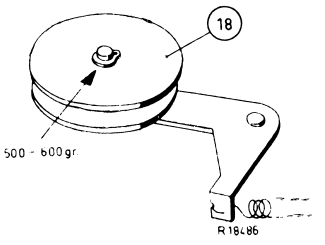


Fig.1

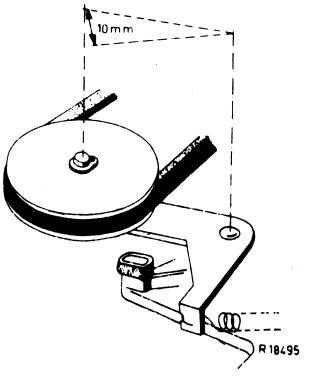


Fig.2

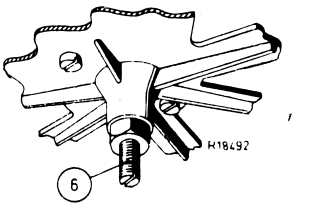


Fig.3

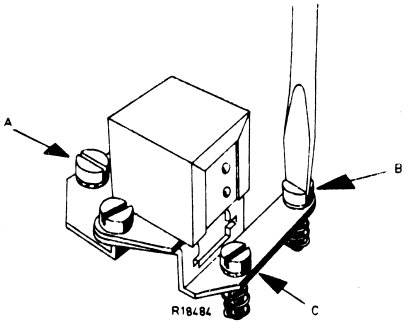


Fig.4

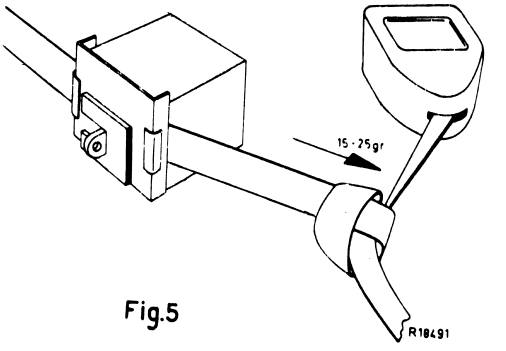


Fig.5

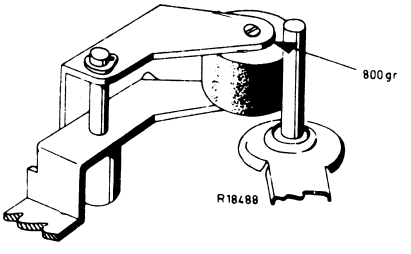


Fig.6

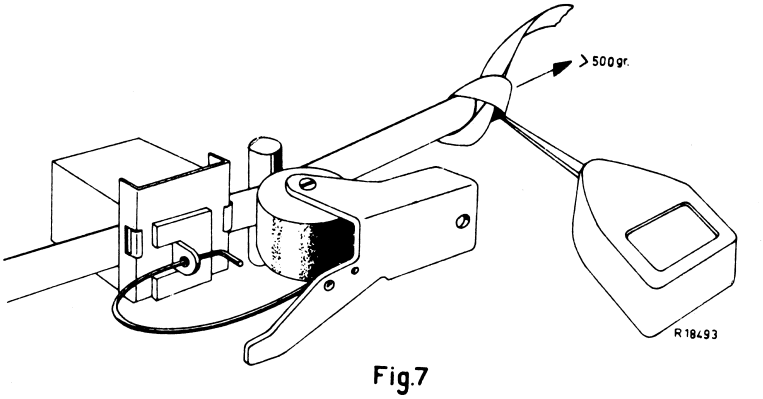


Fig.7

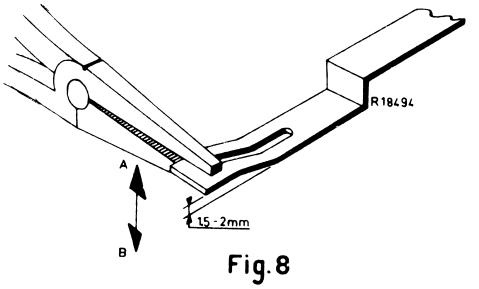


Fig.8

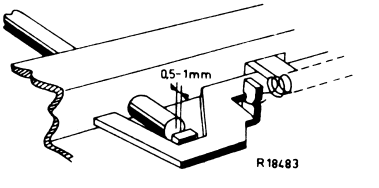


Fig.9

(B3) Contd.

The tape has now been magnetised on 4 tracks by the record/playback head only.

Fill a glass cup with 100 gr. carbon tetrachloride. Add approx. ½ gr. iron powder with a grain size of 3 to 5 μ (part number iron powder A9 881 36/F10).

Shake this mixture until the iron powder has been spread through the liquid.

Cut a piece of approx. 4" out of the centre of the piece of tape recorded previously. Immerse this piece of tape in the liquid and shake a few times.

After approx. 10 secs., take the tape carefully out of the cup and let it dry.

The recorded tracks are now visible by the iron powder attached to them. The recorded track should be arranged as in A of Fig. 13.

If the tracks deviate from A as shown in B, the tape guide should be bent upwards. (Refer Fig. 13D.)

If there is a deviation as shown in C, the tape guide should be bent downwards.

GAP ALIGNMENT:

Connect a vacuum tube voltmeter to P.U./Radio input socket. Play a 4,000 c/s. test tape on the apparatus and adjust to maximum output voltage with screw B (Fig. 4).

(B4) ERASE HEAD H2:

In order to check the adjustment of the erase head H2 (141, Fig. 18), the procedure described above under B3 should be repeated, however, without depressing the super-impose button (361, Fig. 14).

The spacings between the tracks should not differ more than 0.1 mm. If the difference is greater, the erase head should be raised or lowered, depending on the deviation from A as shown in Fig. 13.

(B5) PRESSURE FELT (60, FIG. 18) AGAINST RECORD/PLAYBACK HEAD:

The pressure of the pressure felt (60, Fig. 18) against the Record/Playback head H1 should be such that a force of 15-25 gr. is required to pull a length of tape along the head (see Fig. 5).

This pressure may be adjusted by bending the brass spring to which the felt has been glued.

NOTE: The screening plate should close fully against the screening of the head.

(B6) BUSHES (64, FIG. 18):

The bushes (64, Fig. 18) should be adjusted so that the distance between the lower side of the guide brackets (62, 63) and the plate (39, Fig. 18) is approximately 16.5 mm.

NOTE: After adjustment of the bushes (64), it is advisable to check the alignment of the Record/Playback — and erase heads as described in B3 and B4.

(B7) PRESSURE ROLLER (66B, FIG. 18):

The pressure of the pressure roller (66B, Fig. 18) against the capstan should be approximately 800 gr. (see Fig. 6).

The force with which the pressure roller draws the tape through the apparatus should be greater than 500 gr. (see Fig. 7).

This may be adjusted by —

(a) cleaning (degreasing) the surface of the pressure roller and the capstan;

(b) cleaning and greasing the bearing of the pressure roller;

(c) increasing the pressure of the pressure roller against the capstan to a maximum of 1,000 gr.

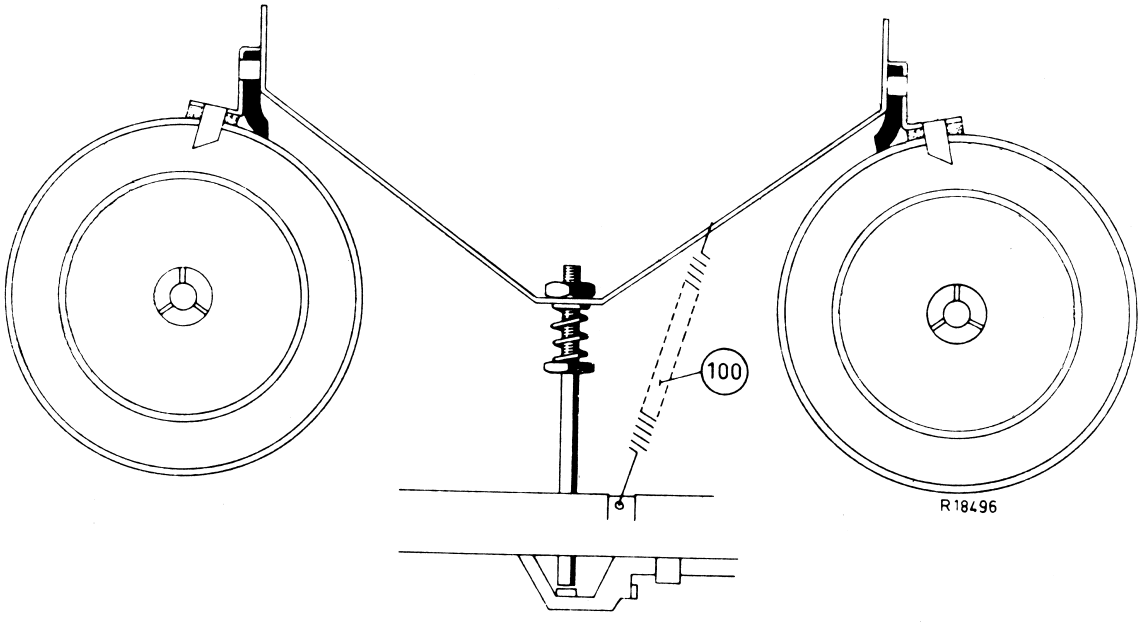


Fig.10

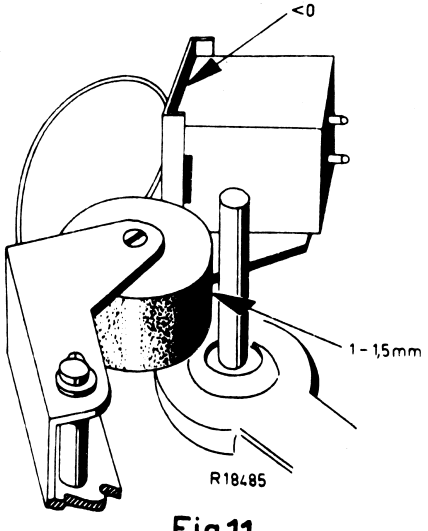


Fig.11

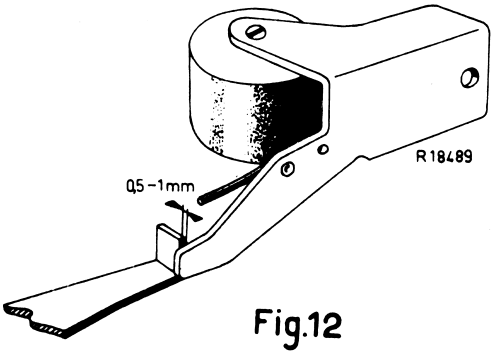


Fig.12

(B8) REEL DISCS (94 and 95, FIG. 16) AND COUPLING WHEELS (89, FIG. 16):

Check if the bend in the brackets (87, 88, Fig. 16) is between 1.5 and 2 mm. Adjust if necessary as illustrated in Fig. 8.

Check if the tape runs freely through the guide brackets (62, 63, Fig. 18), and correct the height of the reel discs 94 and 95 if necessary.

This height adjustment is effected by means of a filling washer underneath the clutch disc 93 or 126. (A bag containing 150 filling washers of various thicknesses and 4 mm. diameter can be supplied under part number A9-868-66).

Check the spacing between the reel discs (94, 95) and the vulcolan pads of the coupling wheels (89, Fig. 16). This spacing should be 0.8-1.2 mm. If incorrect, this should be adjusted by means of a filling washer underneath the coupling wheels. (A bag containing 150 filling washers of various thicknesses and 6 mm. diameter can be supplied under part number A9-868-65).

(B9) CLUTCH DISCS (93 and 126, Fig. 16):

The friction between the felt underneath the reel discs (94 and 95, Fig. 16) and the clutch discs (93 and 126, Fig. 16) can be measured as follows: Place 5" reel filled with tape to a radius of $2\frac{3}{8}$" on the reel disc and measure the force required at the end of the tape to turn the reel disc.

When turning the left-hand reel disc anti-clockwise, this force should not be less than 10 gr.

When turning the right-hand reel disc anti-clockwise, it should not be less than 16 gr.; clockwise, not less than 21 gr.

The above friction may be corrected by cleaning the felt and the clutch disc with carbon tetrachloride.

NOTE: For the above measurements, the recorder should be switched off in the "Record" or "Playback" position.

(B10) BRAKES:

Check that the cam A, Fig. 10, of bracket (50, Fig. 18) does not touch the brake rod (98, Fig. 16) when the recorder is in the "Stop" position. In the positions "Fast Forward/Rewind" or "Record/Playback", the distance between the brake blocks and reel discs should be at least 1 mm. This distance can be adjusted with the nuts (99, Fig. 16) on brake rod (98, Fig. 16).

The braking force (recorder in "Stop" position) can be measured with a 5" reel of tape as described under B9.

The minimum braking force should be:

Right-hand disc, turning clockwise, 150 gr.; turning anti-clockwise, 75 gr.

Left-hand disc, turning clockwise, 50 gr.; turning anti-clockwise, 150 gr.

Adjustment of the braking force may be done by —

(a) moving spring (100, Fig. 10) to another hole in the brake bracket (97, Fig. 16);

(b) cleaning the brake blocks and surfaces.

When the rubber brake shoe is worn, the brake felts may be shortened a little at the side of the rubber brake shoe.

(B11) INTERRUPT BUTTON:

Check that, in position "Record/Playback", the bracket (109, Fig. 18) does not touch the pressure roller lever (66a, Fig. 18). This is illustrated in Fig. 12.

When depressing the interrupt button, the pressure roller (68b, Fig. 18) should be lifted approximately 0.8 mm. from the capstan.

The brake force now exerted on the left-hand reel disc should be between 35 and 70 gr., turning anti-clockwise (to be measured with 5" reel of tape as described under B9.)

(B12) DRIVING MOTOR (FIG. 19) PARTS LIST POSITION 140:

After dismantling and reassembling the motor (140, Fig. 19), the air-gap between stator and rotor should be adjusted to 0.2 mm.

The rotor can be centered with the aid of three spacing gauges (Part number A9-600-22).

(C) Lubricating Instructions:

Lower and upper motor bearings to be lubricated with Shell G960.

All other bearings, except pressure roller bearings, to be lubricated with Shell G960 also.

Levers, sliding surfaces, etc., and pressure roller bearings to be greased with Shell Alvania Grease No. 3.

NOTE: It is most important that the drive belt, coupling wheels, flywheel, motor pulley and tension wheel are free from any trace of grease or oil, because this would cause wow in the sound. If necessary, degrease thoroughly with carbon tetrachloride.

(D) Test Measurements at the Amplifier:

1. General check.
2. Adjustment of L1.
3. Recording amplifier.
4. P.A. amplifier.
5. Playback amplifier
6. Bias adjustment.
7. Recording tests.

General Check:

(D1) Switch on the tape recorder.

Check operation of all controls.

Check high tension voltage and bias voltage on 6BM8. These voltages should be 245V and 17V D.C. respectively.

Connect a 5.6 ohm. (3 watt) resistor across the extension speaker socket and measure the (noise) voltage. This should not be more than 100mV.

Adjustment of L1:

(D2) Turn all controls fully clockwise.

Connect a vacuum tube voltmeter to test point (T.P.).

Depress the recording button (7, Fig. 14).

Apply a signal of 1,000 c/s. to the radio input socket and adjust input until the output at test point (T.P.) reaches 2.8mV. Now apply a signal of 13 Kc/s to radio input socket and adjust the core of L1 in such a way that the output at T.P. is approximately 16mV.

It is recommended to seal the core after adjustment.

Recording Amplifier:

(D3) Turn all controls fully clockwise.

Depress recording button (7, Fig. 14).

Connect a 1.5K ohm resistor across the headphone socket.

Apply a signal of 1,000 c/s., 24mV, to the radio input socket.

Measure the output voltage at headphone socket. This should be greater than 30mV.

Connect a vacuum tube voltmeter to the test point (T.P.) and measure the output voltage. This should be approximately 3mV.

If the input frequency is increased to 13 Kc/s, the output (at T.P.) should rise to approximately 16mV.

P.A. Amplifier:

(D4) Turn all controls fully clockwise.

Depress the P.A. button.

Connect a 5.6 ohm (3 watt) across the external loudspeaker socket.

Apply a 1,000 c/s signal to the microphone input socket and adjust the input so that the vacuum tube voltmeter connected across the 5.6 ohm resistor indicates 1 volt.

The input voltage should be approximately 1mV.

Playback Amplifier:

(D5) Turn both volume controls fully anti-clockwise and turn the tone control fully clockwise.

Switch the recorder to position "Playback".

Apply a signal of 1,000 c/s to the test point (T.P.) via a series resistor of 47K ohm.

Connect a vacuum tube voltmeter to the radio input socket.

Adjust the input to such a value that the vacuum tube voltmeter indicates 60mV.

The input voltage should now be approximately 16mV.

Turn the playback volume control fully clockwise.

Connect a 5.6 ohm resistor across the external speaker socket and measure the voltage across this resistor.

Adjust the input signal to such a value that the output is 500mV.

The input signal should now be approximately 30mV.

Bias Adjustment:

(D6) Turn all controls fully anti-clockwise.

Depress the playback button and recording button (red) simultaneously.

Put the track selector switch in position 1-4.

Connect a vacuum tube voltmeter to the test point (T.P.).

The voltage should be approximately 100mV, which may be adjusted by turning C17 (concentric air trimmer).

Select position 2-3 with the track selector switch.

Repeat the above procedure, using C18 for adjustment.

The bias frequency should be 56-63 Kc/s.

Playback and Recording Tests:

(D7) Select position 1-4 on the track selector switch.

Play pre-recorded music and check for wow and flutter. In case of low output, check alignment as in B3.

Turn radio volume control and tone control fully clockwise and depress red recording button.

Apply a signal of 1 Kc/s to the radio input socket and adjust this to such a value that the modulation indicator reaches the red section.

The input voltage should now be approximately 100mV.

Record a few seconds at this signal.

Play back recording and measure output voltage at "radio" socket. This should be approximately 1.8V.

Apply a signal of 20mV at 100 c/s to radio socket and record a few seconds, then record at 1 Kc/s and 10 Kc/s respectively.

Play back recording and measure output at "radio" socket.

The output voltage should be approximately 350mV for all three frequencies.

Low output at 10 Kc/s may be corrected by reducing the bias slightly (by means of C17).

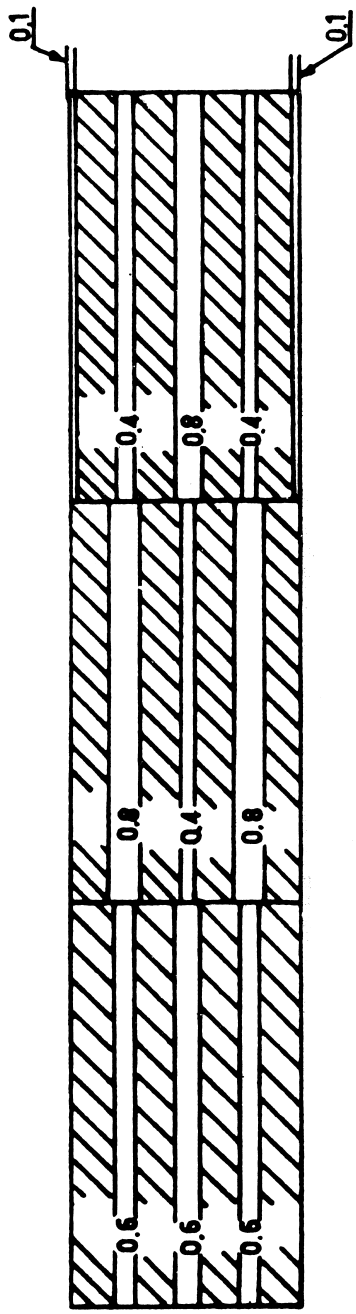
High output at 10 Kc/s may be corrected by increasing the bias slightly.

In this way it should be possible to adjust the frequency response curve to $\pm$ 3 dB from 100 c/s to 10 Kc/s.

Erase the tape and play back.

There should be no sign of any signal.

Select position 2-3 on the track selector switch and repeat the above procedure. However, the bias should now be adjusted by means of C18.



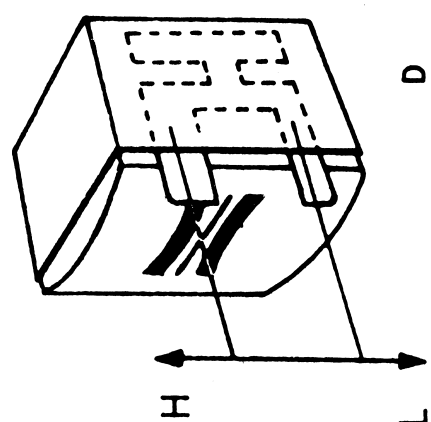


Fig. 13

EL3541 & ER1502

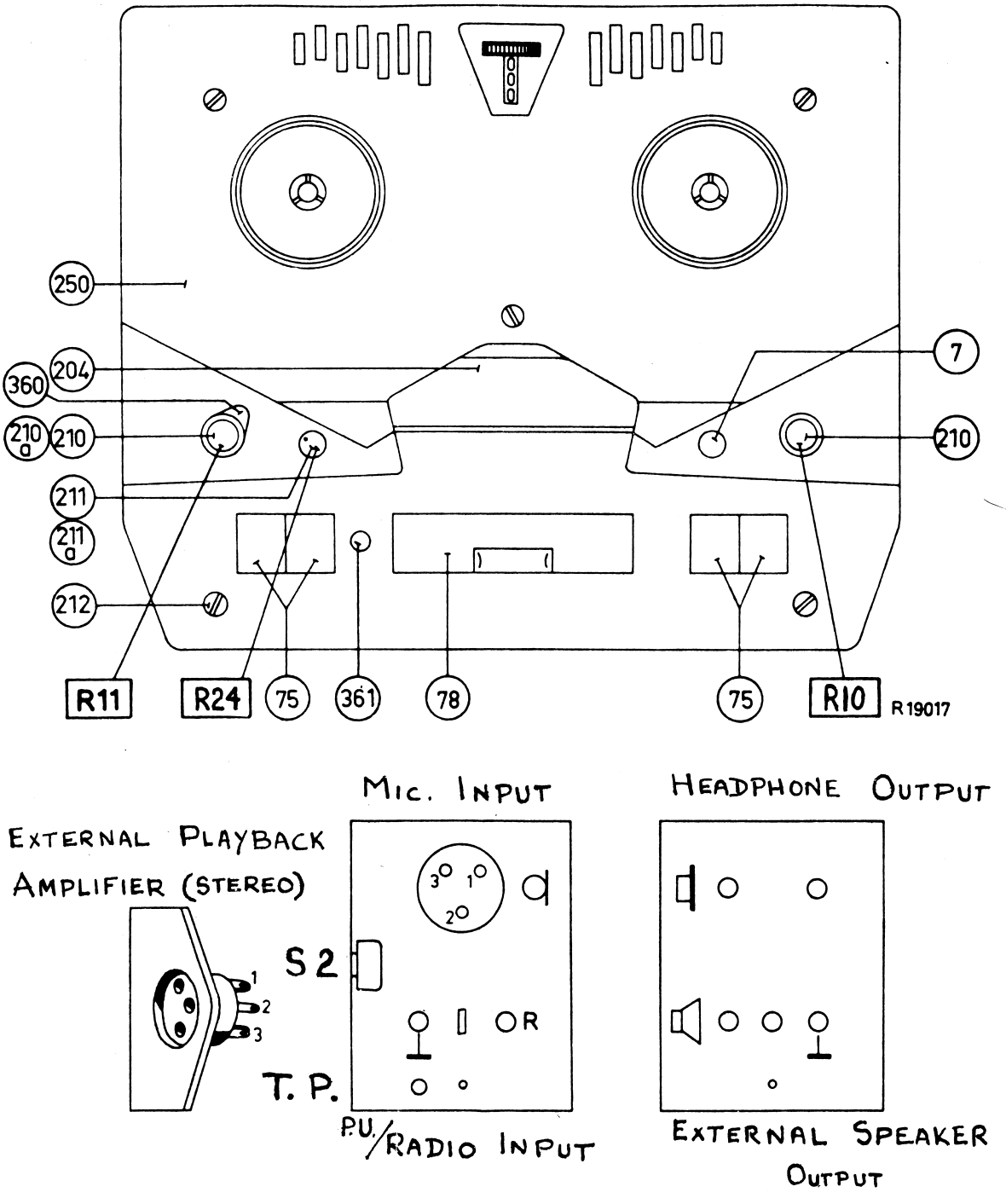
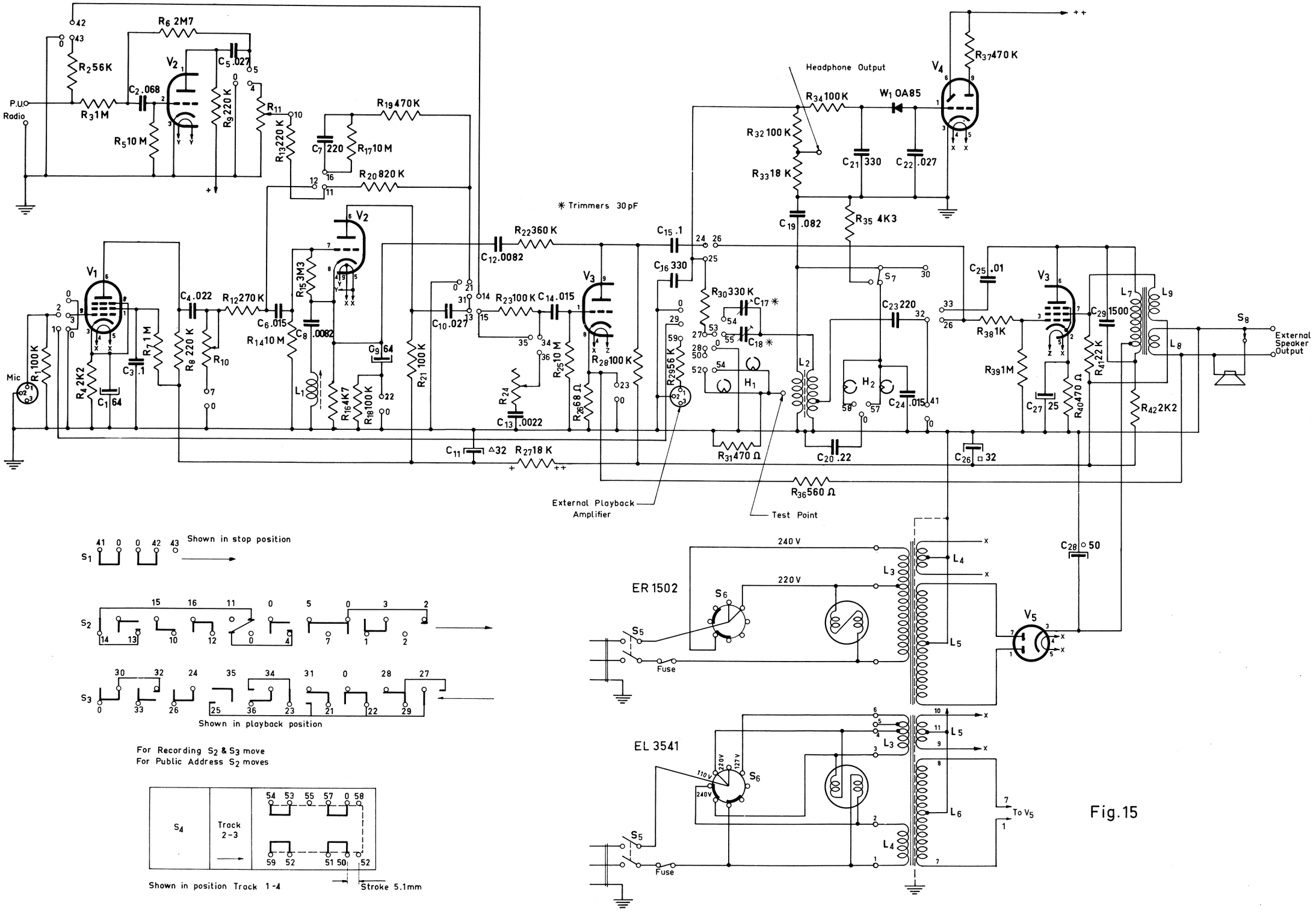


Fig. 14


P.U. Radio
Mic
Headphone Output
External Playback Amplifier
Test Point
* Trimmers 30 pF
ER 1502
EL 3541
Fuse
240 V
220 V
110 V
127 V
To V5
External Speaker Output

Shown in stop position
Shown in playback position
For Recording S2 & S3 move
For Public Address S2 moves

Track 2-3
Shown in position Track 1-4
Stroke 5.1mm

Fig.15

EL3541 & ER1502

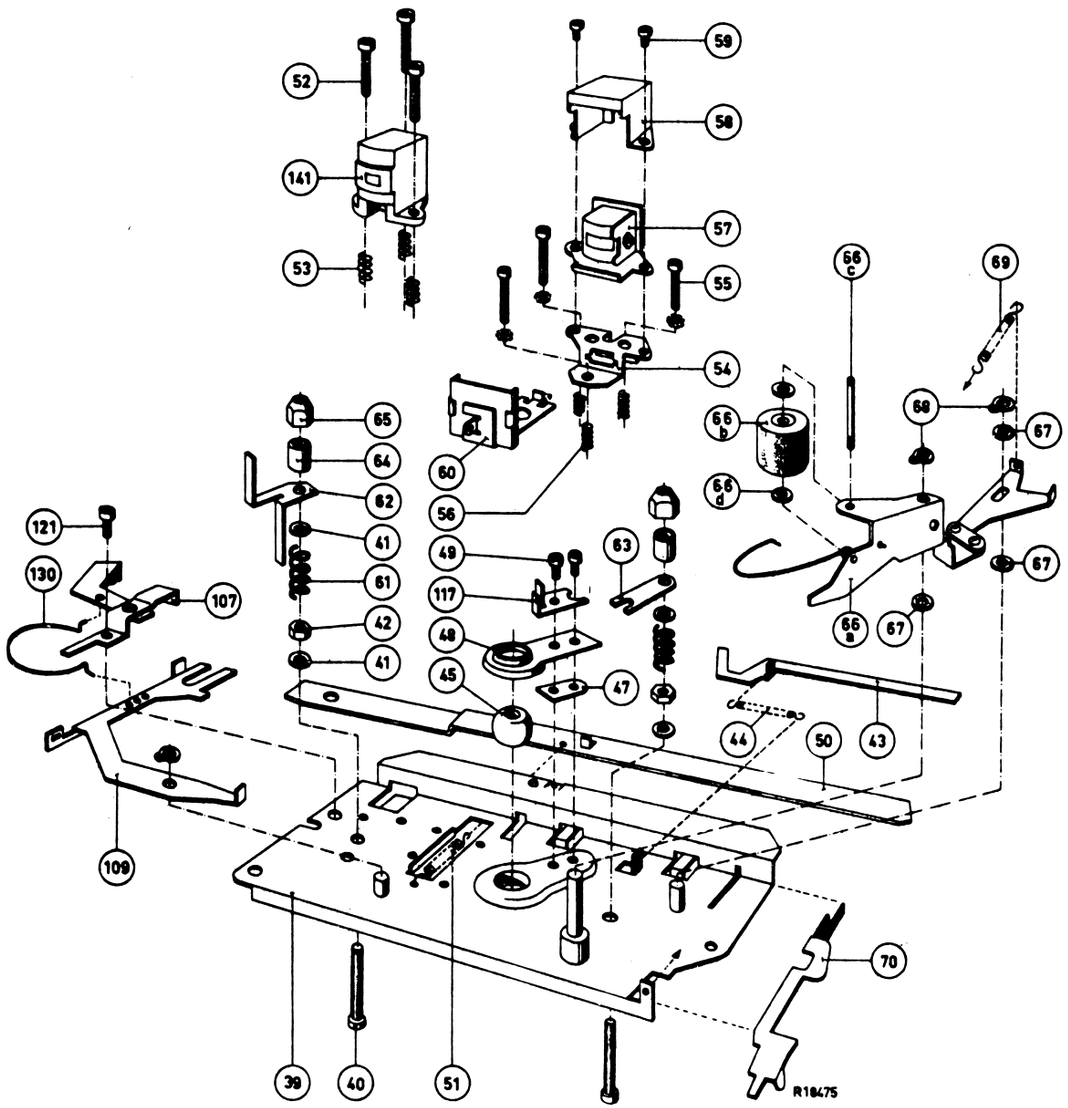


Fig. 18

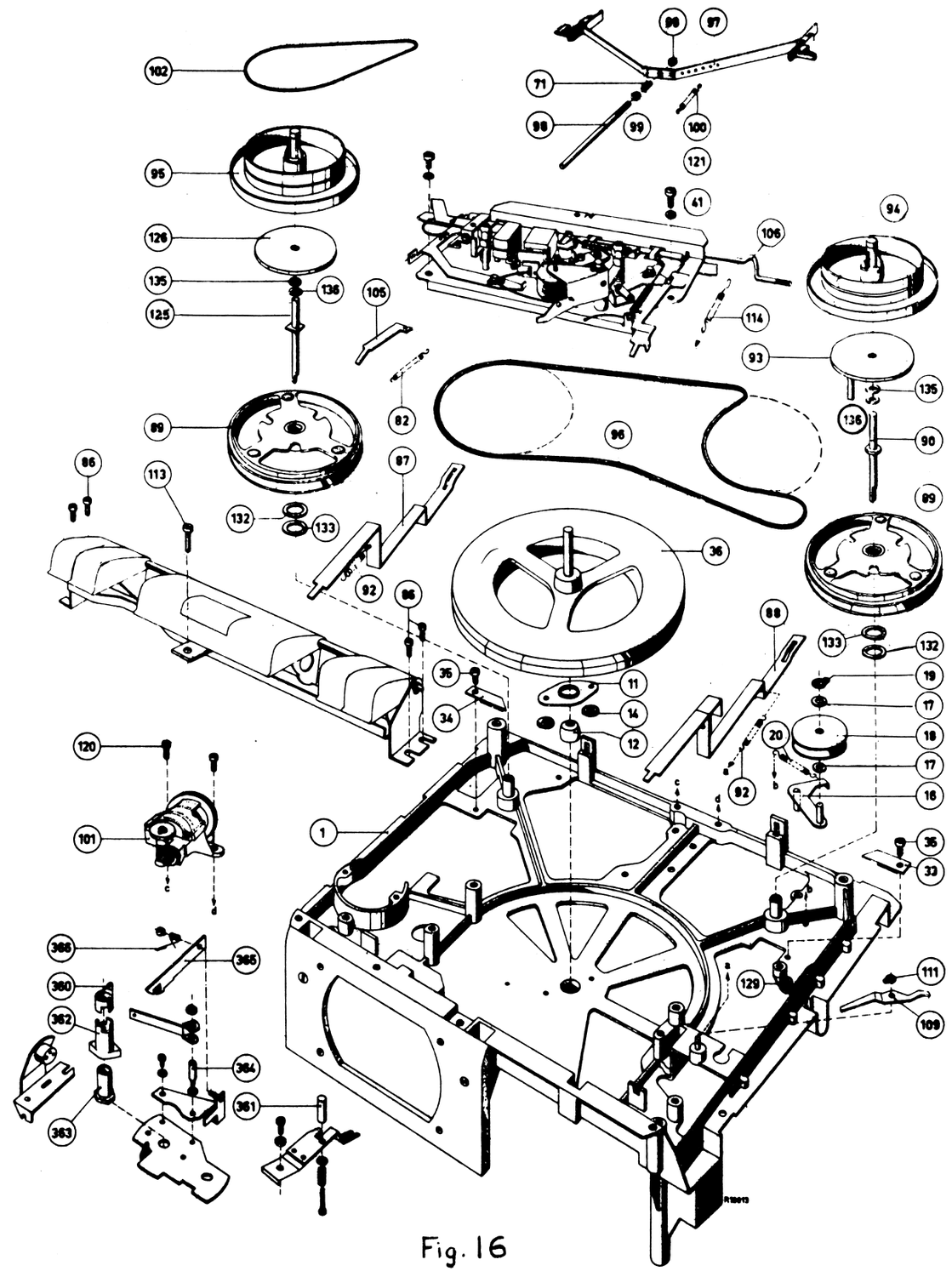


Fig. 16

(F1)

MECHANICAL PARTS LIST

ITEM	FIG.	CODE NUMBER	DESCRIPTION
6	3	WT 835 88	Set screw
7	14	WT 832 49	"Recording" push button
11	16	WT 277 17	Bearing plate
12	16	WT 265 28	Bearing
16	16	WT 882 26	Bearing plate for tension wheel
17	16	A9 868 95	Ring
18	1, 16	WT 881 87	Tension wheel
19	16	984/4	Circlip
20	16	WT 740 91	Tension spring for item 18
28	19	WT 882 25	Motor pulley 50 c/s
36	16	WT 886 94	Flywheel
43	18	WT 035 76	Locking bracket
44	18	WT 740 86	Tension spring
45	18	WT 265 28	Bearing
48	18	PW 307 21	Bearing plate
51	18	WT 740 87	Tension spring
53	18	WT 730 47	Pressure spring
56	18	WT 730 47	Pressure spring
57	18	WT 855 39	Recording/playback head H1
58	18	WT 035 98	Screening
60	18	WT 856 04	Screening plate and felt
61	18	WT 730 62	Pressure spring
64	18	WT 458 02	Roller
65	18	WT 924 52	Nut
66a	18	A9 869 49	Pressure roller lever
66b	18	WT 881 66	Pressure roller
66c	18	WT 646 12	Shaft
69	18	WT 740 92	Tension spring
70	18	WT 943 15	Connecting bracket
71	16	WT 730 65	Pressure spring for brake
75	14, 17	WT 261 63	Push button
78	14, 17	WT 261 64	"Stop" button
81	17	WT 760 14	Torsion spring

(F1) Contd. **MECHANICAL PARTS LIST**

ITEM	FIG.	CODE NUMBER	DESCRIPTION
82	16	WT 740 77	Tension spring
89	16	WT 882 24	Coupling wheel
90	16	WT 821 84	Spindle (right hand)
92	16	WT 740 85	Tension spring
93	16	WT 886 55	Clutch disc (right hand)
94	16	WY 820 01	Reel disc
95	16	WY 820 01	Reel disc
96	16	WT 496 04	Drive belt
97	16	PW 307 40	Brake bracket
100	10, 16	WT 740 89	Tension spring
101	16	PW 306 00	Counter
102	16	WT 496 08	Drive belt (for counter)
105	16,	WT 678 96	Pressure piece
107	18	PW 306 73	"Quick stop" bracket
109	16, 18	WT 045 85	Switch lever
114	16	WT 740 90	Tension spring
125	16	WT 821 95	Spindle (left hand)
126	16	WT 477 97	Clutch disc
130	18	WT 765 45	Profile spring
132–133	16	A9 868 65	Ring P.V.C.
135–136	16	A9 868 66	Ring P.V.C.
140	19	JW 304 90	Motor
140a	19	49 916 37	Upper bearing
140b	19	49 916 36	Lower bearing
140c	19	971/67	Ball
141	18	WT 857 01	"Erase" head H2
204	14	WT 251 99	Cover for heads
211	14	WT 261 53	Knob
211a	14	WRB 903/TT/7/32"	Clamping ring for knob
212	14	WRB 801 UT/4 x 8	Ornamental screw
360	14, 16	WT 914 52/159	Knob
361	14, 16		Super impose button
362	16	WT 937 53	Switching cam
363	16	WT 598 33	Nylon nut

(F1) Contd.

MECHANICAL PARTS LIST

ITEM	FIG.	CODE NUMBER	DESCRIPTION
364	16	WT 001 97	Screw
365	16	WT 306 98	Locking bar
366	16	WT 765 56	Torsion spring
		WE 398 75	Plug for stereo socket
		56 681 53	Core of L1

CABINET COMPONENTS (EL 3541, ER 1502)

ITEM	FIG.	CODE NUMBER	DESCRIPTION
250a	14	WT 395 95	Plastic deck cover plate
250b	14	WT 855 80	Cabinet carcass
204	14	WT 251 99	Cover for heads
		WT 822 89	Base plate (complete)
		WRB 976 YY/850	Rubber feet
		WT 854 41	Cover for cord space
		WT 855 79	Lid, cabinet
		WT 646 61	Carrying screw
		WT 912 61	Ornamental grille
		WT 886 86	Voltage adaptor
		WT 937 19	Locking hook
		WT 896 65	Slide knob for "P.A." switch (S2)
		WY 840 04	Carrying strap
		WT 679 32	Press key function indicator strip
		WT 865 49	Socket plate (right)
		WT 937 14	Indication plate (right)
		WT 865 47	Socket plate (left)
		WT 937 35	Indication plate (left)
210	14	WT 261 51	Knob
210a	14	WRB 903 TT/7/32	Clamping ring for knob

CABINET COMPONENTS (EL 3541/15B)

The EL 3541/15B is identical to the EL 3541 tape recorder, with the exception of the case, however, which is the polystyrene version.

For repairs and replacements of parts not listed below, the service data for the EL 3541/ER 1502 should be consulted.

ITEM	FIG.	CODE NUMBER	DESCRIPTION
		WT 937 20	Indication plate (right)
204	14	WT 252 18/159GH	Cover for heads
		WT 823 31	Base plate
		WT 856 33	Cover for cord space
210	14	WT 832 69	Knob
		WY 840 23	Carrying strap
		WT 832 70	Lid, cabinet
		WT 856 31	Bracket for carrying strap (right)
		WT 856 32	Bracket for carrying strap (left)
		WT 697 29	Indication strip
250	14	WT 856 09	Case (including deck cover)
		WT 912 79	Grille
		WT 865 87	Socket plate (left)
		WT 937 36	Indication plate (left)

(F2)

ELECTRICAL PARTS LIST

	CODE NUMBER		CODE NUMBER
R1	901/100K	C1	909/C64
R2	902/56K	C2	906/68K
R3	902/1M	C3	906/100K
R4	902/2K2	C4	906/22K
R5	902/10M	C5	906/27K
R6	902/2M7	C6	906/15K
R7	901/1M	C7	904/220E
R8	901/220K	C8	906/8K2
R9	901/220K	C9	909/C64
R10	916/GL 200K + 916/01 (W/-SW)	C10	906/27K
R11	916/DL 200K + 916/01	C11	AC 5483/50 + 32 + 32
R12	902/270K	C12	906/8K2
R13	902/220K	C13	904/2K2
R14	902/10M	C14	906/15K

(F2) Contd.

ELECTRICAL PARTS LIST

	CODE NUMBER
R15	902/3M3
R16	902/4K7
R17	902/10M
R18	901/100K
R19	902/470K
R20	902/820K
R21	902/100K
R22	901/360K
R23	902/100K
R24	E098 AG/30D13
R25	902/10M
R26	901/68E
R27	902/18K
R28	902/100K
R29	902/56K
R30	902/330K
R31	901/470E
R32	902/100K
R33	902/18K
R34	902/100K
R35	901/4K3
R36	902/560E
R37	902/470K
R38	902/1K
R39	902/1M
R40	900/470E
R41	902/22K
R42	902/2K2

	CODE NUMBER
C15	906/100K
C16	904/330E
C17	908/30E
C18	908/30E
C19	906/82K
C20	906/220K
C21	904/330E
C22	906/27K
C23	904/220E
C24	906/15K
C25	906/10K
C26	see C11
C27	909/C25
C28	see C11
C29	0.0015μF mica (ER 1502 only) SM
L1	Peaking Coil WT 590 97
L2	Oscillator Coil WT 561 91
W1	OA 85
L6, L7, L8	Output Transformer WT 510 96
L3, L4, L5, L6	Power Transformer WT 510 94

SLIDE SWITCHES

	CODE NUMBER
S1	WT 887 11
S2	WT 887 08
S3	WT 887 09
S4	WT 887 67

SPEAKERS

	CODE NUMBER
EL3541	940/AD1400W
ER1502	Rola 4C

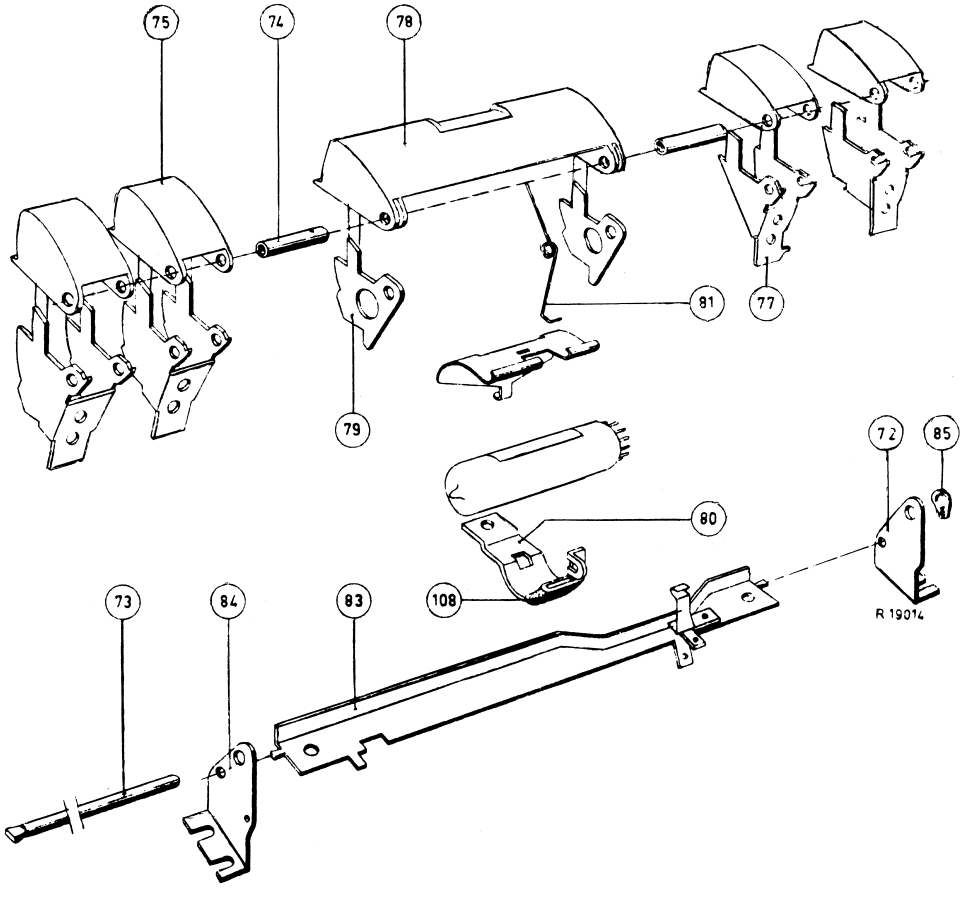


Fig. 17

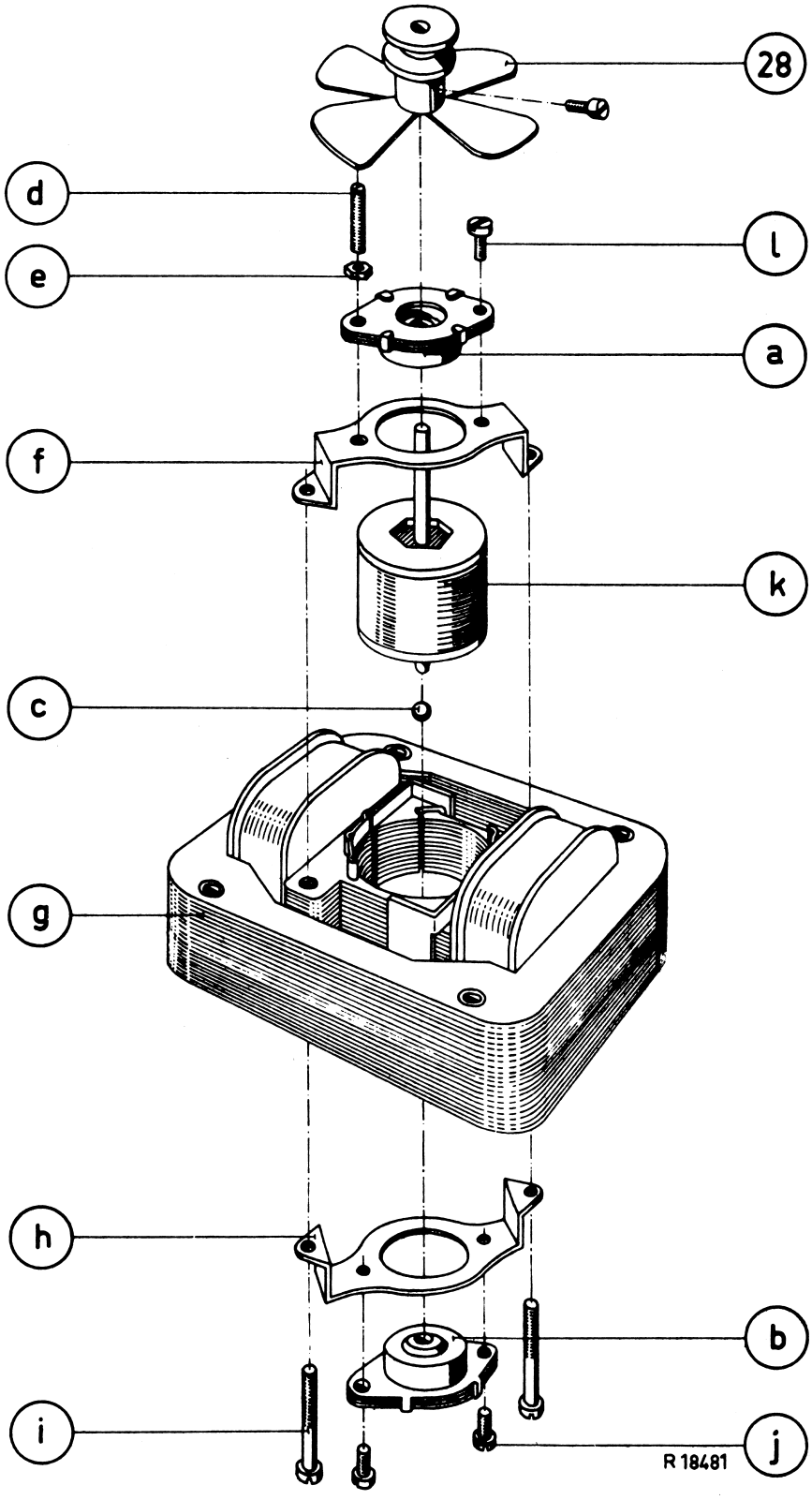


Fig. 19