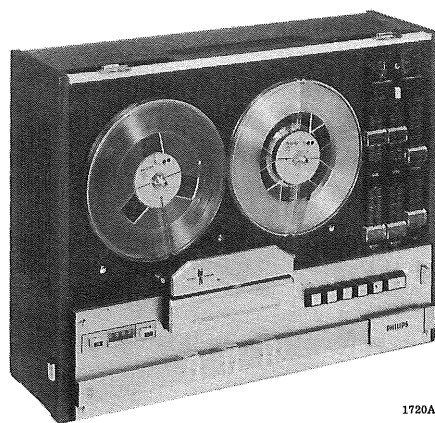


Service manual

RECORDERS N 4416

00/15/19/43



1720A

PHILIPS



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INTRODUCTION

The N4416 is a 3-speed, 4-track stereo reel-to-reel recorder which can be used both in the horizontal and in the vertical position. The recorder is suitable for mono and stereo recording and playback, multiplay, duoplay and mixing during recording. The amplifier has an output power of 2x4 W ($d < 5\%$) and incorporates acoustic loudspeaker enclosures. Operation is by means of push-buttons. The recorder is equipped with 2 heads (recording/playback head and erase head). Three motors are used: one electronically controlled d.c. motor which drives the capstan and two d.c. motors for fast winding and driving the turntables. Furthermore, the recorder features a counter with zero reset button and automatic stop facility in position "0000", automatic stop at the end of tape and tape tension controls for uniform take-up during fast winding. The audio section and the control section employ plug-in p.c. boards, so-called functional units. Moreover, it is possible to use a continuous tape cassette and to connect headphones and remote control unit N6718.

Index: CS33893-CS33900, CS33841, CS33901, CS33843, CS33844



CS33893



Subject to modification

4822 726 10936

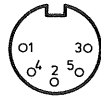


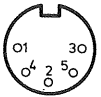





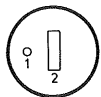

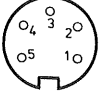



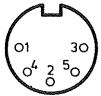

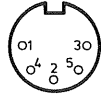

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TECHNICAL SPECIFICATION

Mains voltages	: 110 - 127 - 220 - 240 V
Mains frequency	: 50-60 Hz (no adaptation necessary).
Power consumption	: 40 W
Number of tracks	: 4
Tape speeds	: 4.75 cm/sec (1 ⁷ / ₈ i.p.s.) ± 2% 9.5 cm/sec (3 ³ / ₄ i.p.s.) ± 1% 19 cm/sec (7 ¹ / ₂ i.p.s.) ± 1%
Max. reel diameter	: 18 cm (7")
Number of heads	: 2 (1 recording/playback head, 1 erase head)
Number of motors	: 3 (1 d.c. motor for capstan drive, 2 d.c. motors for driving the turntables)
Wow and flutter at:	
4.75 cm/sec. (1 ⁷ / ₈ i.p.s.)	: ≤ 0.35 %
9.5 cm/sec. (3 ³ / ₄ i.p.s.)	: ≤ 0.2 %
19 cm/sec. (7 ¹ / ₂ i.p.s.)	: ≤ 0.15 %
Winding time for an 18 cm (7") reel with LP tape (540 m)	: ≤ 180 secs.
Input sensitivities:	
micro	: 0.2 mV/> 2 kΩ
tape	: 2 mV/ 20 kΩ
phono	: 100 mV/ 1MΩ
Output voltages:	
tape	: 1 V/> 50 kΩ
headph	: 3 V/400 - 600 Ω
Output power	: 2 x 4 W (d < 5% - 8 Ω)
Frequency range (within 6 dB)	: 4.75 cm/sec (1 ⁷ / ₈ i.p.s.) 60 - 8000 Hz 9.5 cm/sec. (3 ³ / ₄ i.p.s.) 40 - 15000 Hz 19 cm/sec. (7 ¹ / ₂ i.p.s.) 40 - 16000 Hz
Built in loudspeaker enclosures	: 2 x 5 litres
loudspeakers	: 8Ω (2x102x154 mm; 2 x 4" x 6") (4822 240 20108)
Erase frequency	: 100 kHz (± 10%)
Dimensions (incl. transparent cover)	: 515x380x200 mm (20 ¹ / ₄ "x15"x7 ³ / ₄ ")
Weight (incl. transparent cover)	: 10 kg (22 lbs)

INPUTS AND OUTPUTS

Indication	For connection of	Sensitivity	Impedance	Type of socket	Connections	Location
MICRO L+ST BU1	a microphone with a 3-pole 180° DIN plug for recording on every channel in position 1-4 and 3-2 and for recording on the left channel in position ST; a microphone with a 5-pole 180° DIN plug for stereo recording.	0,2 mV	> 2 kΩ	5p, 180°, DIN 	1 - left 4 - right 2 -  5 -  3 -	front
MICRO R BU101	a microphone with 3-pole or 5-pole 180° DIN plug for recording on the left channel in position ST.	0,2 mV	> 2 kΩ	5p, 180°, DIN 	1/4 - right 2 -  5 -  3 -	front
HEADPH BU5	a pair of stereo headphones	3 V	400-600 Ω	5p, sym. DIN 	1 - 2 -  3 -  4 - left 5 - right	front
LOUDSP L LOUDSP R BU4 BU104	a loudspeaker enclosure with an impedance of 8 Ω	—	8 Ω 8 Ω	2p, DIN 	1 - 8 Ω 2 - 	rear
REMOTE BU7	a remote control unit N6718	—	—	5p, 240°, DIN 	1 - +20 V (via SK603) 2 - 3 - 4 - 5 - pause	rear
— BU8	testpoints	—	—	5p, 180°, DIN 	1 - testpoint 1 4 - testpoint 2 2 -  5 -  3 -	rear
PHONO BU3	a record player with X-tal cartridge	100 mV	1 MΩ	5p, 180°, DIN 	1 - right 4 - 2 -  5 - right 3 - left	rear
TAPE IN/OUT BU6	another recorder or other unit with 5-pole, 180° DIN input and output socket. Input: pins 1 and 4 Output: pins 3 and 5	2 mV 1 V	20 kΩ > 50 kΩ	5p, 180°, DIN 	1 - left 4 - right 2 -  5 - right 3 - left	rear

DISASSEMBLY (see Figs. 1, 2 and 3)

- The black covering plate can be taken off after removing the 3 screws. A. For replacing the heads, pinch roller etc. the front head cover C should also be removed. (see Fig. 1).
To prevent vibrating of the covering plate three rubber strips E have been fitted on the rearmost ornamental frame. These must be kept in position when the covering plate is refitted. (see Fig. 2).
- After removing the 4 screws B the complete amplifier board can be hinged to the right (first it should be lifted slightly). The board can be locked in the hinged up position by means of the hook which is clamped to the bottom of the cabinet. For this, the hook is hooked into the hole in the heatsink of the output transistors (see Fig. 2).
The tape deck remains connected to the amplifier board with a wire harness, so that the recorder can function normally. When the board is to be removed from the cabinet, the plug on one side of the tape deck should be detached. Moreover, the loudspeaker and supply voltage connections should be detached (plugged connections).
- After removing the 5 screws D the complete tape deck can be placed on end in the cabinet (see Fig. 3).
For this purpose recesses have been made in the loudspeaker enclosures in which the two winding motors can rest. The tape deck now also remains connected to the amplifier board via a wire harness so that the recorder remains operative. After unplugging the plug on one side of the tape deck the complete tape deck can be lifted out of the cabinet.

Attention:

When the tape deck is removed from the cabinet, the drive belt should be taken off the counter pulley and placed round e.g. the left tape tension sensor.

Note:

If the recorder should operate again the counter belt should be free!

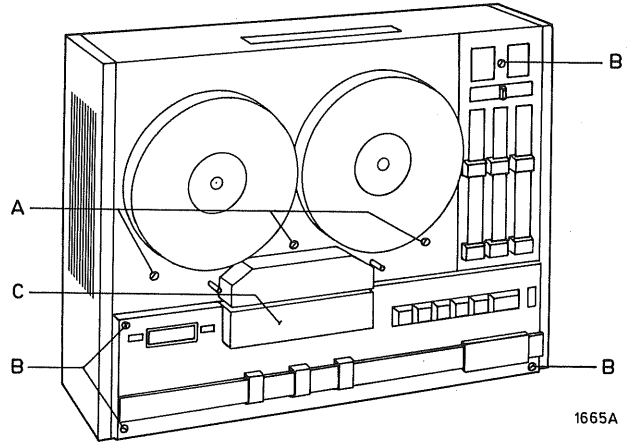


Fig. 1

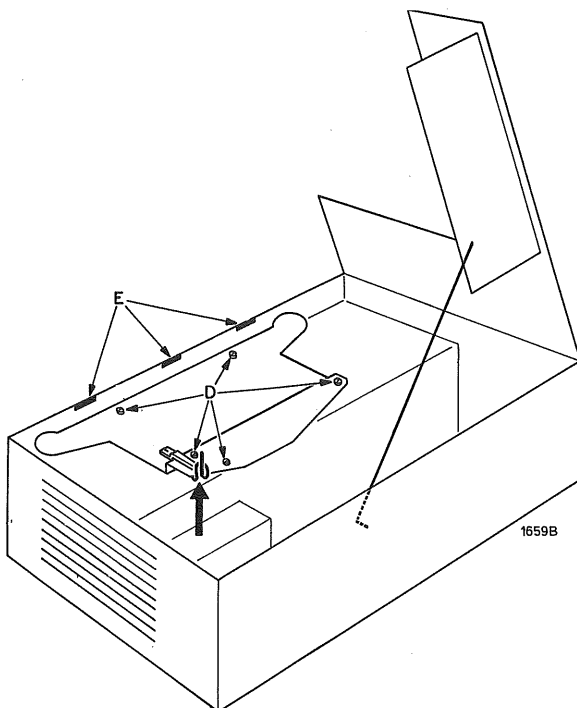


Fig. 2

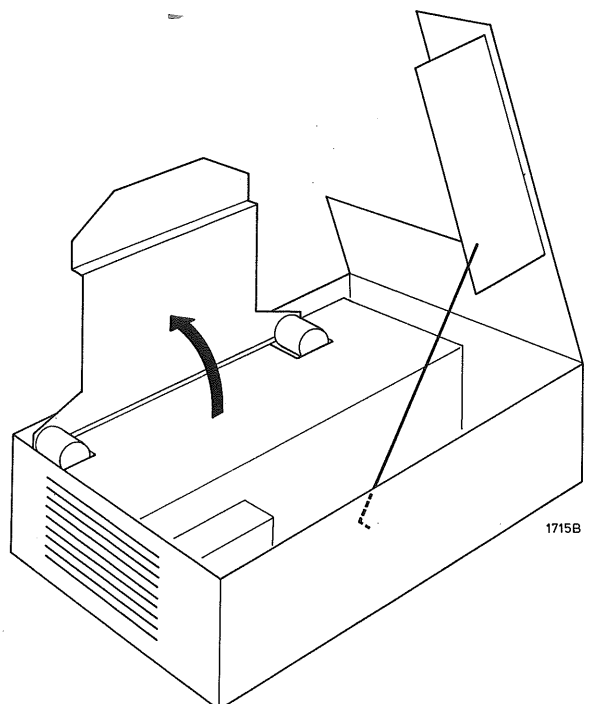


Fig. 3

REPAIR HINTS (see Figs. 4, 5, 6, 7 and 8)

- Replacing the indication strips with slide buttons (see Figs. 4 and 5).
 - Insert a screwdriver halfway the side between the panel of the slide button and the edge of the front panel or the adjacent panel and lever the panel forwards.
 - When refitting the panel first position the bottom and top into the amplifier board and then the middle piece.
 - During mounting check that the slide of the button fits over the cam of the potentiometer.
- Replacing potentiometers (see Fig. 6)
 - Remove the 2 screws A
 - Carefully bend back the plastic tags B, pull up the p.c. board and bend it to the right.
 - The potentiometers can now be unsoldered and replaced.

Note:
The indication on the potentiometers should always be located on the side with the indication "0".

- Replacing the control buttons (170 - 175) (see Figs. 7 and 8)
 - Button 175 (REW); 174 (FFORW); 170 (STOP)
 - Remove the rubber wedge 192
 - The button can now be pulled forwards out of the amplifier board.
 - Button 173 (PLAY); 172 (PAUSE)
 - Remove bracket 197 (193)
 - Remove the rubber wedge 192
 - The button can now be pulled forwards out of the amplifier board.
 - Button 171 (REC)
 - Remove the rubber wedge 192
 - Remove the 3 screws A
 - Bend bracket 205 so far back that lever 204 is disengaged from the spindle of the button.
 - The button can now be pulled forwards out of the amplifier board.

- Replacing the function buttons (152) and sliding cover (176).
 - Remove rail 153 by pulling it forwards.
 - The buttons and the cover can now be slid off the rail.
- Replacing the levers (138)
 - Remove the shouldered bolt 134
 - For the left-hand lever "1-4 - ST - 3-2" retaining ring 38 should also be removed. (see Fig. 28)
 - Tilt back the lever until it can be removed from the amplifier board.
- Replacing switches
 - Switch "1-4 - ST - 3-2" (SK2, 3); "MP - NOR - DP" (SK5, 6); "19 - 9,5 - 4,75" (SK4)
 - Remove clamping spring 135, pin 137 and coupling piece 136.
 - The switch can now be unsoldered from the p.c. board.
 - Switch "REC" (SK1, 101)
 - Remove screw 28.
 - The switch can now be unsoldered from the p.c. board.
- Replacing the loudspeakers
 - Remove the 3 screws in the left side or the 4 screws in the right side of the cabinet and the 3 Phillips screws in the bottom panel of the cabinet. After this, the side panels can be removed and the loudspeakers can be replaced.
- Replacing the output transistors
 - If the output transistors are defective, it is recommended to first measure the voltages of the driver stages. This can be done after removing the defective output transistors as the voltages in the driver stages will not change without output transistors. Only after ascertaining whether these voltages are correct, the new output transistors may be fitted.

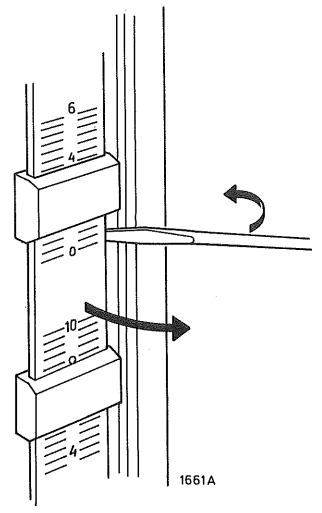


Fig. 4

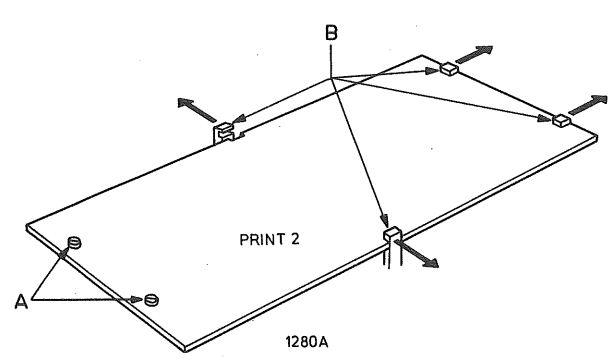


Fig. 6

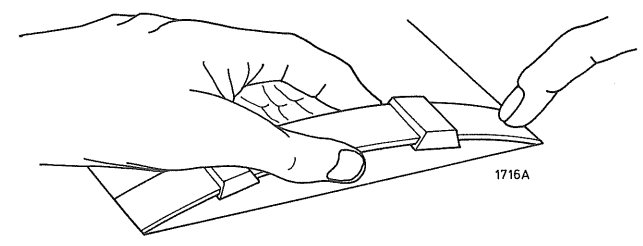


Fig. 5

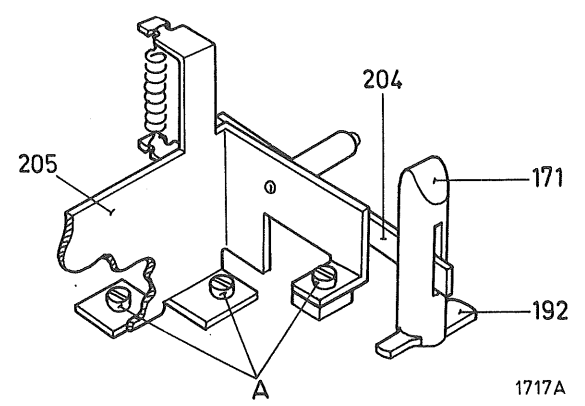


Fig. 7

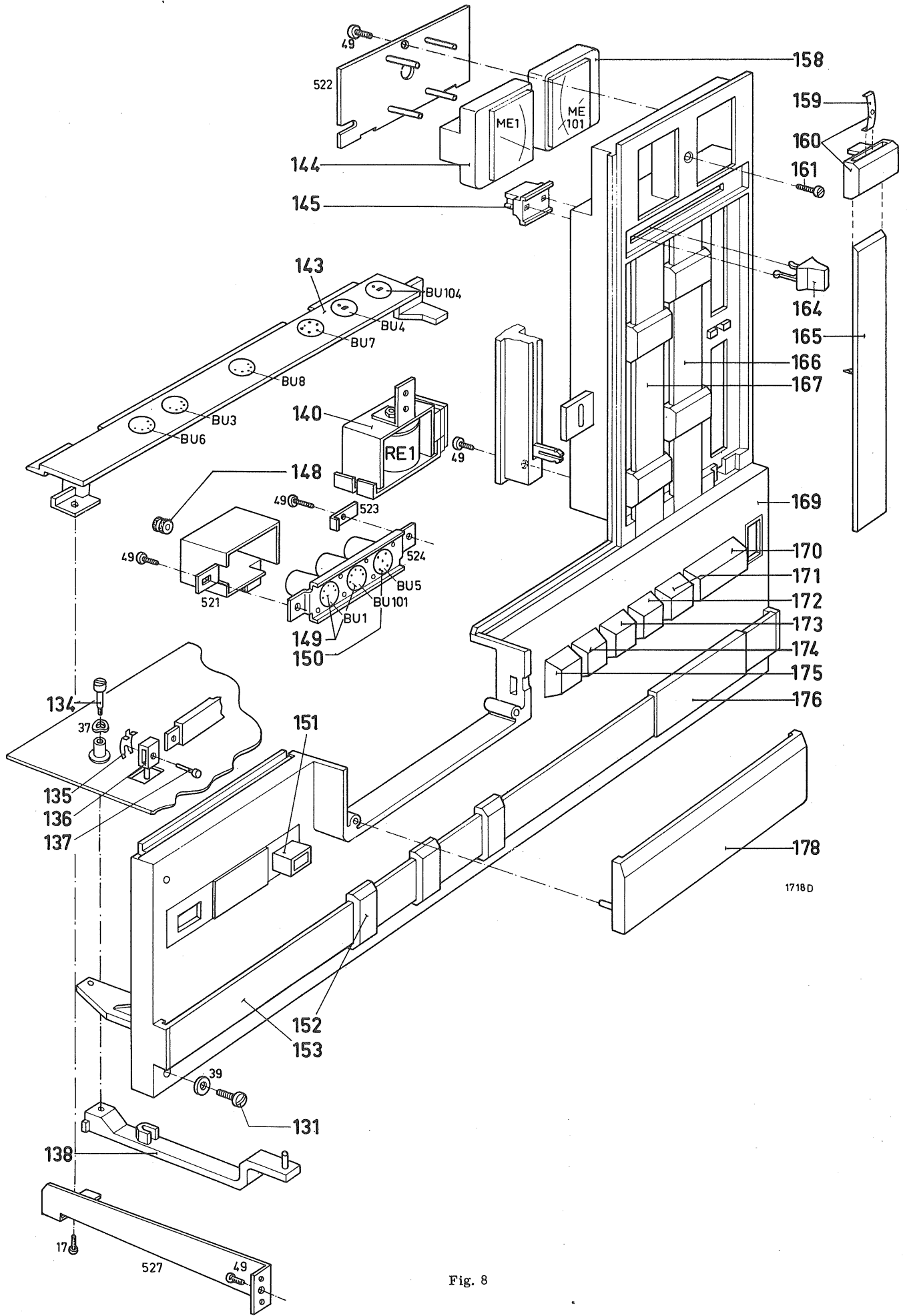
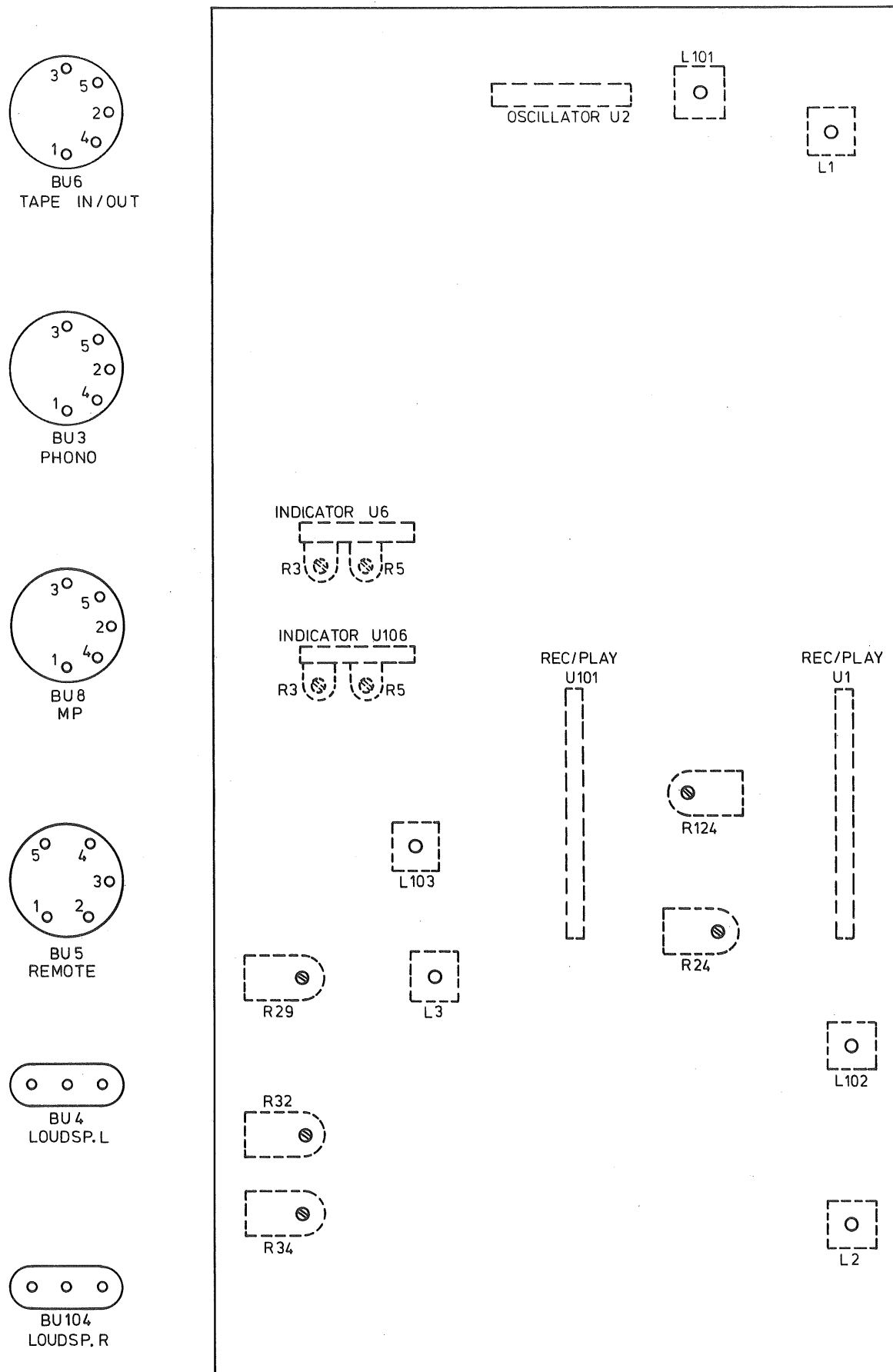


Fig. 8



1721 C

Fig. 9

MECHANICAL ADJUSTMENTS

Required tools and test equipment

- Set of feeler gauges 0.1 - 2 mm
- Spring pressure gauge 30 g
- Spring pressure gauge 1500 g
- Alignment gauge
- Test tape 1 kHz-10 kHz
- Test tape 3150 Hz, 4.75 cm/sec (1 $\frac{7}{8}$ i.p.s.)
- Test tape 3150 Hz, 9.5 cm/sec (3 $\frac{3}{4}$ i.p.s.)
- Test tape 3150 Hz, 19 cm/sec. (7 $\frac{1}{2}$ i.p.s.)
- Stroboscope 50 Hz
- Stroboscope 60 Hz
- "Wow and flutter" meter e.g. Bruno W. Walke type ME104.

4822 403 50718
4822 397 30014
8222 305 11170
8222 305 11170
8222 305 11150
4822 395 90001
4822 395 90002

1. Adjusting the recording/playback head (see Fig. 13).

Coarse adjustment

- Remove the head cover 178 and covering plate 129.
- Place the alignment gauge into the recorder as indicated in Fig. 13.
- Adjust the tape guide to the correct height with nut D.
- With screw A and nuts B and C adjust the head so that:
 - a. the top of the upper core of the recording/playback head is flush with the top of the alignment gauge.
 - b. the gauge can slide freely between the guide pins of the erase head and the tape guides
 - c. the front of the head is perpendicular to the mounting plate.

Fine adjustment (with test tape 1 kHz-10 kHz).

- Set the speed selector to position "9,5" and the track selector to position "1-4".
- Adjust the height of the recording/playback head by turning nut B until the reproduction of the 1 kHz signal is just audible above the noise.
- Adjust the azimuth of the recording/playback head by turning screw A until the reproduction of the 10 kHz signal is maximum.

2. Tape path adjustments

For removal of the cabinet, see page 4.

Adjusting the turntables (see Fig. 17)

- Loosen nut 9.
- Adjust the height of the turntable by means of pivot bearing 68 until the tape is centred between the reel flanges.
- Lock the pivot bearing with nut 9.
- Adjust the axial play to 0.1 - 0.2 mm by moving pulley 66 or ring 115.

Adjusting the pulley of the winding motors (see Fig. 29)

- Loosen screws 8 in pulley 62.
- Adjust the pulley so that the groove is at the same height as the groove of the turntable.
- Tighten the screws again and lockpaint them.
- When the belt produces noise, this can be remedied by turning this belt.

Adjusting pinch roller 105 (see Fig. 29)

- Adjust pinch roller 105 with retaining ring 11 so that the axial play is between 0.1 and 0.2 mm.

Adjusting capstan bearing 103 (see Figs. 11 and 29)

For this adjustment it is assumed that the tape guides have been adjusted to the correct height.

- Tighten screws A.
- Insert a DP tape.
- Turn screw B until the tape runs straight between the capstan and the pinch roller.
- Tighten screw C so that the setting is locked.

3. Adjusting the solenoids

For disassembly, see page 4.

Adjusting the pinch roller solenoid (see Figs. 10 and 29)

- When the solenoid is energised, the clearance between bush 112 and the lower nuts 35 on rod 114 should be 0.3 to 0.5 mm. This can be adjusted by turning the lower nuts 35.
- When the solenoid is energised, the force at the top of the pinch roller spindle (110) should be 1000 grammes \pm 100 grammes. This force should be applied at the moment that there is a visual play between the pinch roller and the capstan. This tensile force can be adjusted by turning the upper nuts 35.

- The clearance between pinch roller 105 and capstan 76 should be 10 mm \pm 1 mm when the solenoid is de-energised. To be adjusted by bending tag A.
- When the solenoid is de-energised the contacts of switch 58 should be closed. To be adjusted by bending tag A (see Fig. 14).
- When the solenoid is energised the clearance between the open contacts of switch 58 should be 0.3 - 0.5 mm. To be adjusted by bending the contacts (see Fig. 14).

Adjusting the brake solenoid and the brakes (see Figs. 15, 16 and 29)

- When the solenoid is energised the clearance between the brake shoes on bracket 59 and 73 and the turntables should be 0.6 to 0.7 mm. To be adjusted by bending tags A. Make sure that the clearance on the left and on the right is equal (see Fig. 16).
- When the brake shoes are applied the clearance between tags B and the brake brackets should be 0.2 - 0.3 mm. To be adjusted by bending tags B (see Fig. 16).
- When the brake shoes are reversed (round side of brake shoes against turntables), the clearance between the solenoid armature and the brake brackets (59 and 73) should be 0.3 to 0.4 mm. To be adjusted by bending tag C (see Fig. 16).
- The brake force of the left and right turntable should be 1000 g.cm. This force can be measured by means of a full reel and a spring pressure gauge, as indicated in Fig. 15. The gauge should give the following readings for the various reel diameters:

Reel diameter	Gauge reading
13 cm	175 g
15 cm	150 g
18 cm	125 g

The braking force equals the gauge reading x radius of the wound tape. To be adjusted by shortening, extending or replacing spring 57 (Fig. 16).

4. Adjusting the tape tension control (see Figs. 12 and 29)

For disassembly, see page 4.

- Switch 58 should make contact in the rest position. To be adjusted by bending the contact springs.
- The clearance between the centre contact of switch 58 and the side of the slot in tape tension sensor 56 should be 0.1 - 0.2 mm in the rest position. To be adjusted by bending tag A (see Fig. 12).
- The force exerted on the pin of the tape tension sensor should be 25 - 30 grammes when the contact just opens. To be adjusted by bending tag B (see Fig. 12).

5. Adjusting the capstan motor (Fig. 29)

For disassembly, see page 4.

- Motor pulley 78 should be at the same height as the core of the pulse head.
- To be adjusted by loosening screws 16 and adjusting the pulley to the correct height. After this, tighten the screws and lock-paint them.
- The clearance between pulley 78 and pulse head K3 (80) should be 0.15 - 0.2 mm.
- To be adjusted by loosening screws 17 and moving the head until the clearance is correct. Then tighten and lock-paint the screws.

6. Adjusting the speed (see Fig. 9)

- Hinge up the amplifier board (see page 4).
- Connect the "Wow and flutter" meter to BU6 TAPE IN/OUT: points 3 and earth (5 and earth).
- Play back a test tape with a frequency of 3150 Hz, recorded at 4.75 cm/sec., 9.5 cm/sec. or 19 cm/sec., depending on the speed to be adjusted.
- Now adjust for the correct speed by turning the relevant potentiometer (see Fig. 9 and the table below).

Speed	Potentiometer (see Fig. 9)	Max. speed deviation from test tape
19 cm/sec.	R34	\pm 1%
9.5 cm/sec.	R32	\pm 1%
4.75 cm/sec.	R29	\pm 2%

Note:

- The speed can also be adjusted with a stroboscope. Proceed as follows:
- Place the stroboscope next to the recorder and feed the tape around the roller.
 - Set the speed selector to the desired speed and adjust for the correct speed with the appropriate potentiometer (see table).

LUBRICATING INSTRUCTIONS

Shell Clavis 17 - 4822 390 10048

Bearings of flywheel 76, turntables 69, tape tension scanner 56 and pinch roller 105.

Attention:

Make sure that the part of the capstan protruding from ring 102 does not become greasy.

Shell Alvania 2 - 4822 389 10001

The various pivots of pressure felt brackets 72, 106, 108, brake brackets 59 and 73, pinch roller lever 110, thrust bearing of turntables 69 and flywheel 76. The pivots of the switch control mechanism, the contact faces of brackets 197, 203, 206 and 211.

Silicone grease - 4822 390 20023

The contact faces of the push-buttons, brackets 191 and 205, spindles 196 and 198 and ball at the slide buttons.

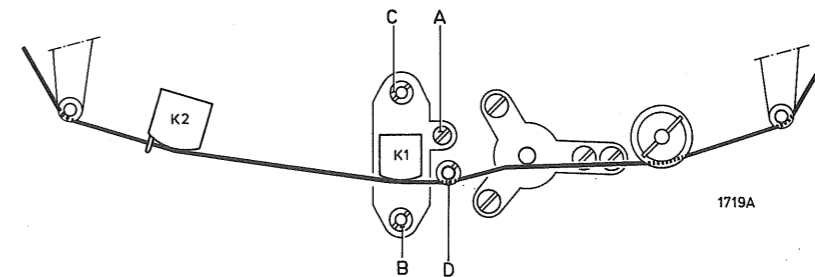


Fig. 13

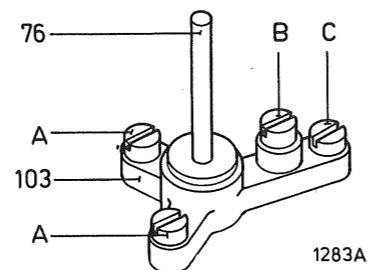


Fig. 11

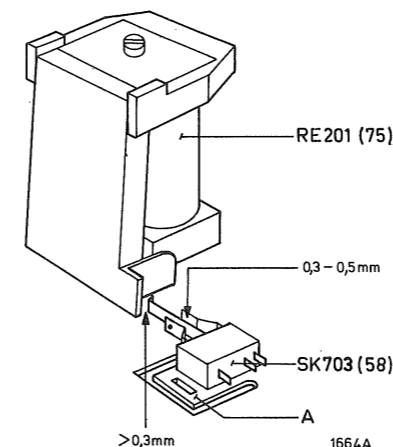


Fig. 14

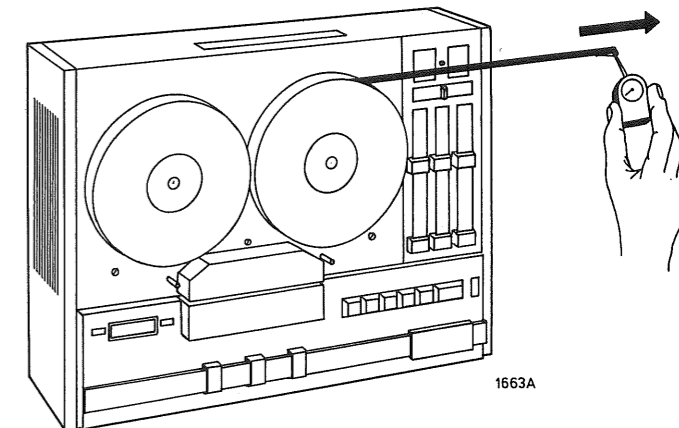


Fig. 15

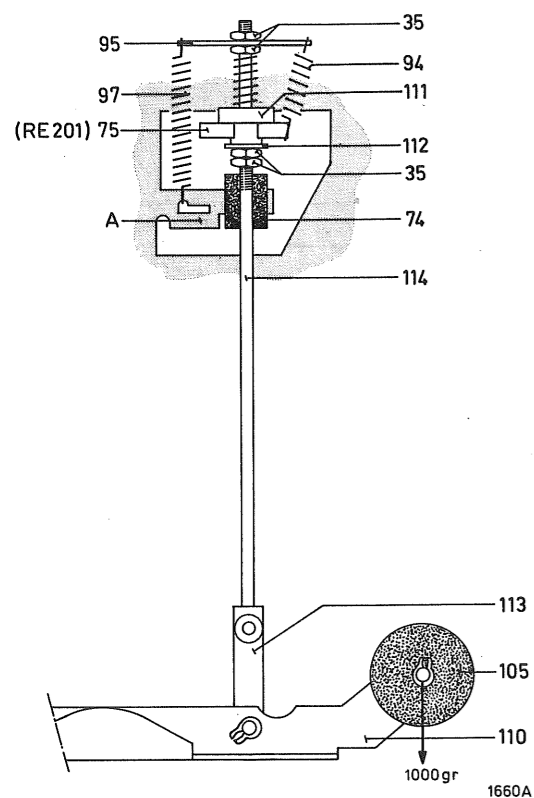


Fig. 10

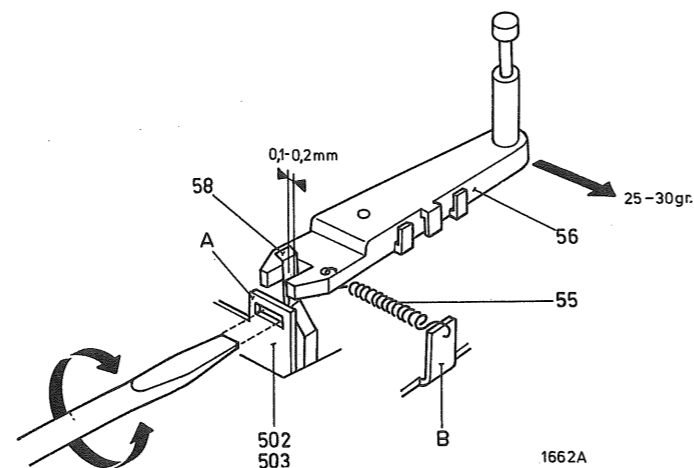


Fig. 12

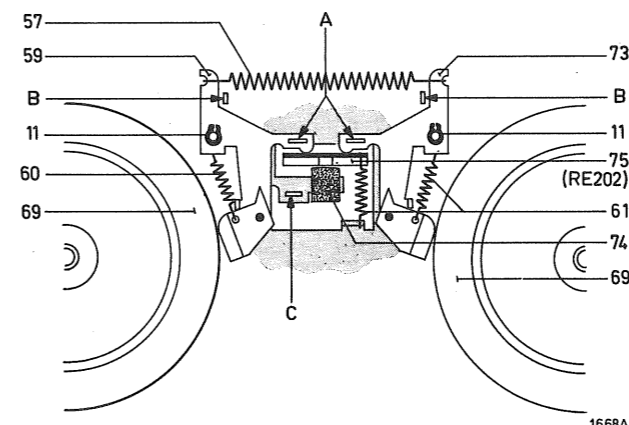


Fig. 16

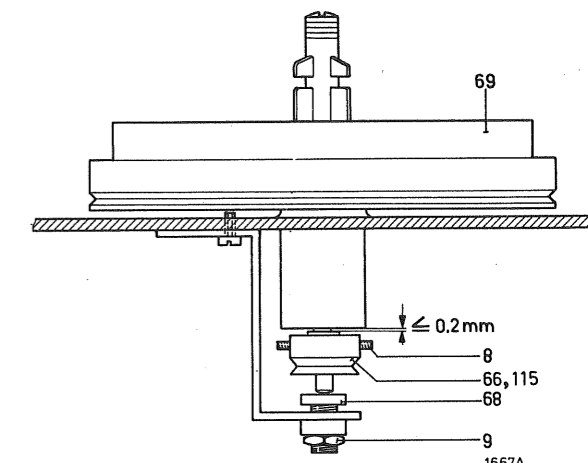


Fig. 17

ELECTRICAL CHECKS AND ADJUSTMENTS (Fig. 15)

Required test equipment:

- Multi-meter 40 k Ω /V	P81700 or PM2411
- RF milli-voltmeter	GM6012 or PM2454
- LF generator	GM2317 or PM5105

I. SENSITIVITY OF RECORDING AMPLIFIER

Recorder in position	: "ST" - "NOR" - "4.75" Button "REC" depressed. Recording level control "REC" to max.; balance control in mid position; other controls set to minimum.
Input	: BU3 PHONO A signal of 333 Hz applied between point 3 and earth (point 5 and earth).
Output	: BU8 test points Adjust the generator voltage so that 0.25 mV is measured between point 1 and earth (point 4 and earth). (The generator voltage should then be 13 - 17 mV). This adjustment should be maintained during the next measurements.
Input	: BU3 PHONO Adjust the frequency of the generator signal to 40 Hz.
Output	: BU8 test points The voltage between point 1 and earth (point 4 and earth) should be 0.28 - 0.46 mV.
Input	: BU3 PHONO Adjust the frequency of the generator signal to 8 kHz.
Output	: BU8 test points Adjust the voltage between point 1 and earth (point 4 and earth) to 1.5 mV with L2 (L102).

II. AMPLIFIER SENSITIVITY

For this measurement use a new unmodulated tape of very good quality.

Recorder in position	: "ST" - "NOR" - "19". Button "REC" depressed. Recording level control "REC" in position "6"; balance control in mid position; other controls set to minimum.
Input	: BU3 PHONO Apply a signal of 333 Hz between point 3 and earth (point 5 and earth).
Output	: BU8 test points Adjust the generator voltage so that 1.6 mV is measured between point 1 and earth (point 4 and earth). Make a recording of the generator signal. When the recorded signal is reproduced, adjust the output voltage on BU6 TAPE IN/OUT, point 3 and earth (point 5 and earth) to 1.2 V with R24 (R124).

III. SUPPRESSION ERASE OSCILLATOR SIGNAL

Recorder in position	: "1-4" ("3-2") - "MP" - "4.75". Buttons "REC" and "PLAY" depressed. Recording level control "REC" and volume control to max.; other controls to minimum.
Output	: BU8 test points Adjust the output voltage between point 1 and earth (point 4 and earth) to minimum with L103 (L3). Seal the core with wax.

IV. FUNCTIONAL UNITS (see Figs. 18 - 21)

U1/U101 RECORDING/PLAYBACK UNIT

This unit requires no adjustment

U2 OSCILLATOR UNIT

Recorder in position	: "ST" - "NOR" - "19". Buttons "PLAY" and "REC" depressed. All controls set to minimum.
Input	: BU6 TAPE IN/OUT Apply a signal of 1 kHz, 1 V between point 3 and earth (point 5 and earth).
Output	: BU8 test points Adjust the output voltage between point 1 and earth (point 4 and earth) to 1.6 mV with recording level control "REC". The deflection of the indicator should be 100%. Remove the core from coil L1 (L101). Slide the core so far into the coil that the output voltage no longer increases. Seal the core with wax. The voltage on the erase head should be 26-40 V.

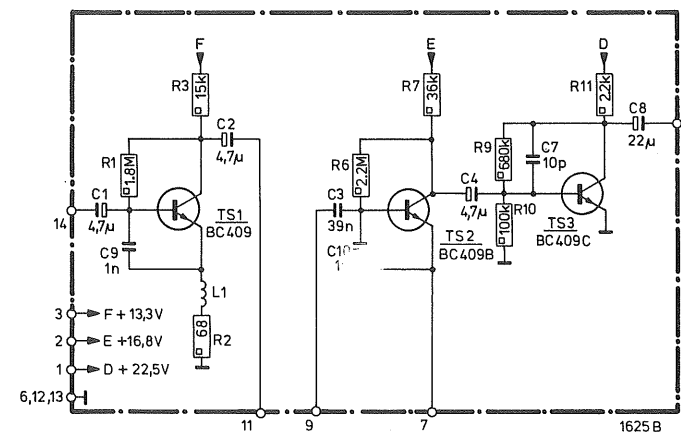
U6/U106 INDICATOR UNIT

a. Minimum adjustment	
Recorder in position	: "ST" - "STOP". All controls set to minimum. Adjust R3 of U6 (U106) so that the left (right) indicator is slightly above zero.
b. Maximum adjustment	
Recorder in position	: "ST" - "NOR" - "19". Button "REC" depressed. Recording level control "REC" to maximum; balance control in mid position; other controls to minimum.
Input	: BU3 PHONO Apply a signal of 333 Hz between point 3 and earth (point 5 and earth);
Output	: BU8 test points Adjust the generator voltage so that 1.6 mV is obtained between point 1 and earth (point 4 and earth) (The generator voltage should now be 110-170 mV). Adjust the voltage between point 1 and earth (point 4 and earth) to 0.16 mV with recording level control "REC" (The generator voltage should then be 1.1 - 1.7 mV). Adjust R 5 of U6 (U106) so that the left (right) indicator gives 100% deflection (=0dB).

U201 SPEED CONTROL UNIT

This unit requires no adjustment.

U1/U101 RECORDING/PLAY-BACK UNIT 4822 214 30165

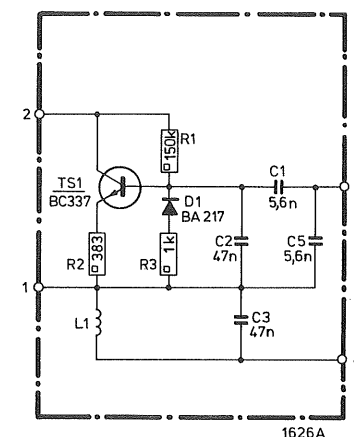


Connections:

- 1 - supply D (+22,5 V)
- 2 - supply E (+16,8 V)
- 3 - supply F (+13,3 V)
- 4 - output
- 6 -
- 7 - output to pre-emphasis
- 9 - input
- 11 - input
- 12 -
- 13 -
- 14 - input

Fig. 18

U2 OSCILLATOR UNIT 4822 214 30166

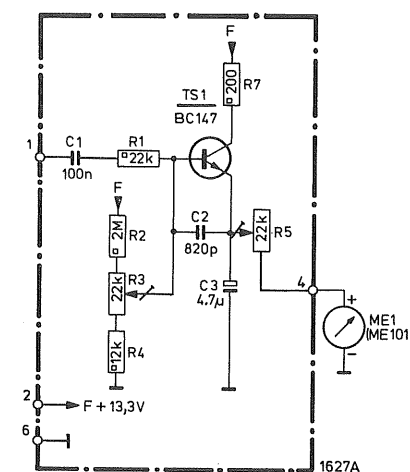


Connections:

- 1 -
- 2 - supply
- 5 - output
- 8 - output

Fig. 19

U6/U106 INDICATOR UNIT 4822 218 30059



Connections:

- 1 - input
- 2 - supply F (+13,3 V)
- 4 - output to indicator ME1/ME101
- 6 -

Fig. 20

WORKING PRINCIPLE OF THE CONTROL SECTION

The control section of N4416 can be divided into 3 parts:

- Control circuit for the reel motors;
- Control circuit for the capstan motor;
- Automatic stop at the end of tape or in zero position of counter.

As soon as button "PLAY" is depressed, the pinch roller solenoid and the brake solenoid are energised. As a result, the pinch roller is pressed against the capstan, the felts against the heads and the brake is released.

The starting torque of the right-hand turntable is increased by the circuit R203, 205 and C202. This is necessary to prevent looping; as the tape is immediately run up to full speed by the capstan motor.

The left reel motor (M1) is energised via R202. This motor provides counter-friction.

Diodes D201 and D217 ensure that no voltage surges arise when the solenoids are de-energised. However, these diodes delay the de-energising of the solenoids. To ensure that they are de-energised at the correct moment, zener diode D216 has therefore been connected in series with D217.

If one of the buttons "REW" or "FFORW" is depressed, the brake solenoid is energised, so that the brake is released.

When button "REW" is depressed the left reel motor (M1) starts to rotate. Via R201, D209, SK701, 703 and D212 voltage is fed to the right-hand reel motor (M2), so that it tends to rotate anti-clockwise. However, the tape pulls it in a clockwise direction: the right-hand reel motor provides the necessary counter-friction.

When the tape tension becomes too high, SK701 opens. As a result, no voltage is applied to the right-hand reel motor: the counter-friction decreases.

When the tape tension decreases, SK701 is closed and the right-hand reel motor is energised again: the counter-friction increases.

During "FFORW" the working is the same, the tape tension is kept constant with SK702.

Capacitors C201, 205, 206 and 207 prevent burning in of the switch contacts.

The speed of the capstan motor is controlled with the aid of "speed control unit" U201.

The pulley of capstan motor M3 is toothed. This toothed pulley and pulse head K3 produce an alternating voltage which is fed to the base of TS1. This voltage is amplified (TS1) and converted to a squarewave voltage (TS2).

The amplitude of this squarewave voltage can be adjusted with resistor R29 for 4.75 cm/sec., R32 for 9.5 cm/sec. and R34 for 19 cm/sec. (see Mechanical adjustments).

The squarewave voltage is differentiated by C2 and R5. Diodes D1 and D2 together with C3 form a rectifier and voltage doubler circuit for the pulses which remain after differentiation of the squarewave voltage.

When there are no pulses which charge the capacitor, TS3 is driven into conduction by voltage A1 via R5, which is negative with respect to the voltage on the emitter. Transistors TS4 and TS701 then also become conductive and motor M3 tends to rotate at full speed. However, as soon as the motor rotates head K3 supplies an alternating voltage which after differentiation provides the negative pulses by which C3 is charged. TS3 then becomes less conductive, thus maintaining a constant motor speed.

Diode D3 protects TS3.

Resistor R210 and diode D215 limit the motor current.

The recorder stops automatically at the end of the tape or in position zero of the counter when button "PLAY" and the counter switch (SK12) have been depressed. In position playback or fast winding the emitter of TS201 receives a positive voltage. As a result, the transistor cuts off and solenoid RE1 de-energises.

If:

- the switching tape short circuits the tape contact (= metal part of the right-hand tape tension scanner), or
- the counter reaches the zero position when buttons "PLAY" and SK12 have been depressed,

the base of TS201 becomes negative so that TS201 is turned on, and energises solenoid RE1. All buttons are then released and the recorder stops.

D214 prevents voltage surges while the solenoid is de-energised.

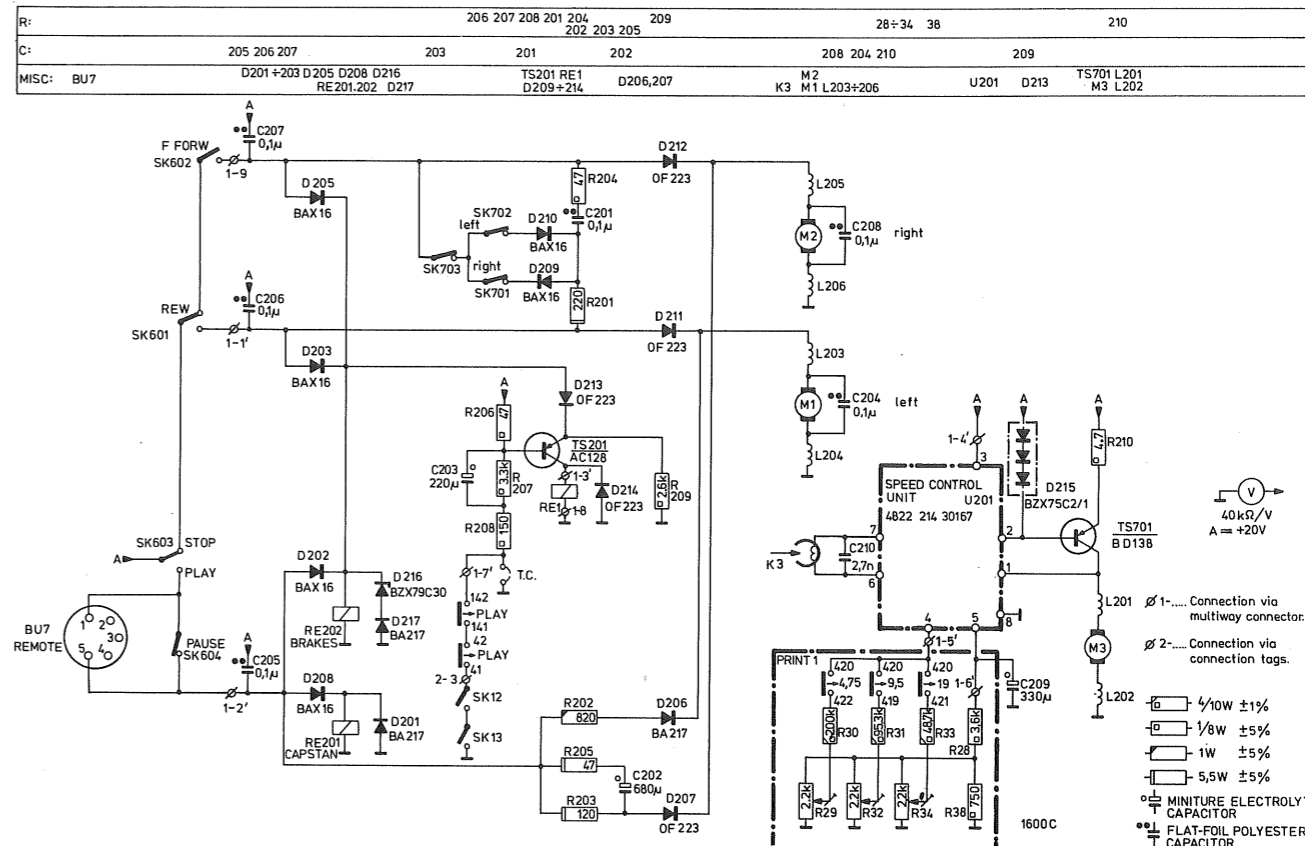


Fig. 22

U201 SPEED CONTROL UNIT 4822 214 30167

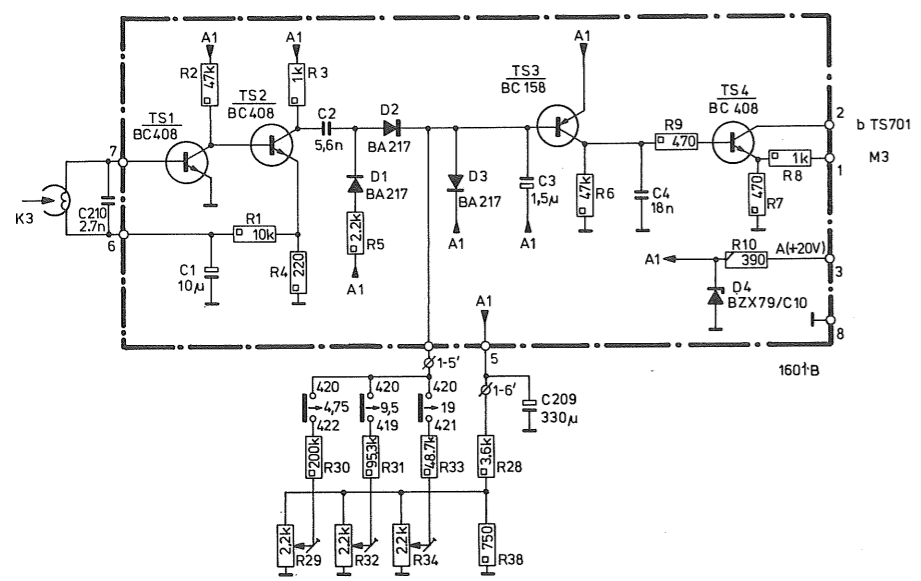


Fig. 21

PRINT 2

LIST OF ELECTRICAL PARTS

Control Section

U201	Speed control unit	4822 214 30167
SK12	Switch	4822 276 10448
SK701, 702, 703	Switch	4822 278 90035
RE1	Solenoid	4822 280 60369
RE201, 202	Solenoid	4822 280 70152
M1, 2	Reel motor	4822 361 20091
M3	Capstan motor	4822 361 20096
K3	Pulse head	4822 249 20034
TS201	Transistor AC128	4822 130 40095
TS701	Transistor BD138	4822 130 40665
L201, 202, 203, 204, 205, 206	Coil	4822 158 10224
D201, 206, 217	Diode BA217	4822 130 30703
D202, 203, 205, 208, 209, 210	Diode BAX16	4822 130 30273
D207, 211, 212, 213, 214	Diode OF223	4822 130 30791
D215	Stabistor BZX75/C2V1	4822 130 30789
D216	Zenerdiode BZX39/C30	4822 130 30701
C202	Electrolytic capacitor 680 μ, 25 V	4822 124 20412
C203	Electrolytic capacitor 220 μ, 25 V	4822 124 20398
C209	Electrolytic capacitor 330 μ, 10 V	4822 124 20402
R29, 32, 34	Preset potentiometer	4822 100 10029
R201	Resistor 220 Ω, 5 W	4822 112 20089
R203	Resistor 120 Ω, 5 W	4822 112 20083
R205	Resistor 47 Ω, 5 W	4822 112 20079
-	Base for functional unit, 8-pole	4822 267 50156

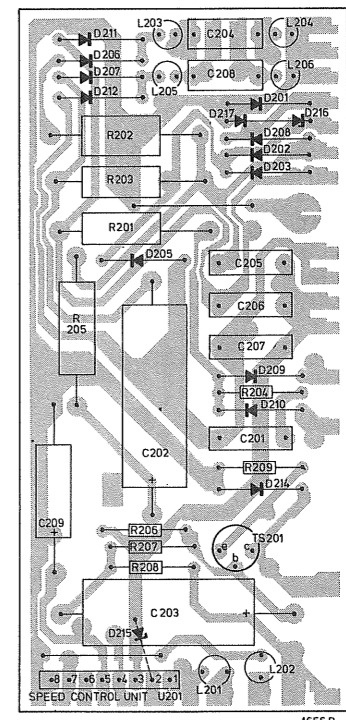


Fig. 23

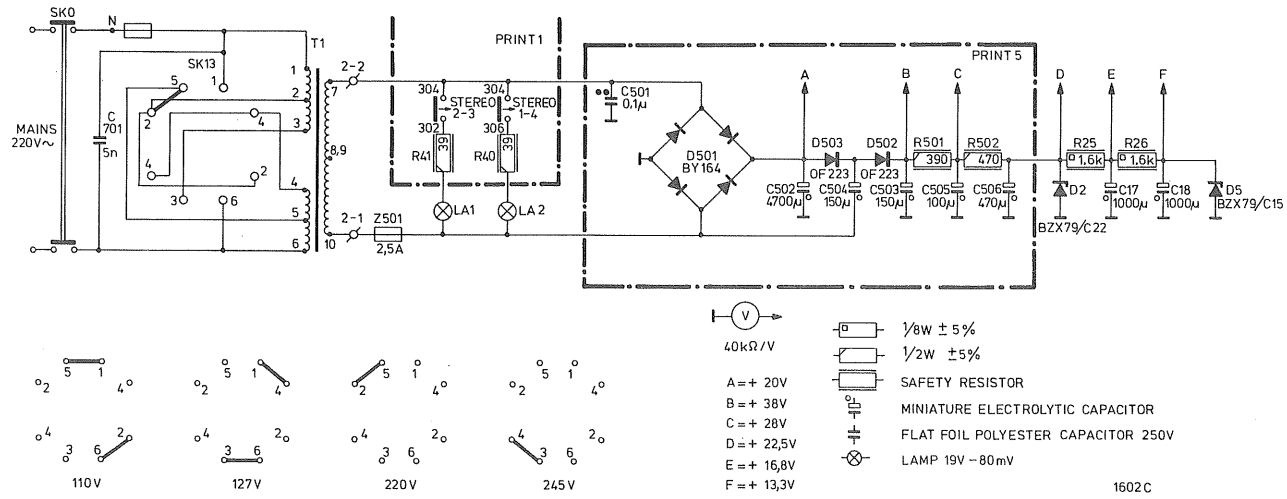


Fig. 24

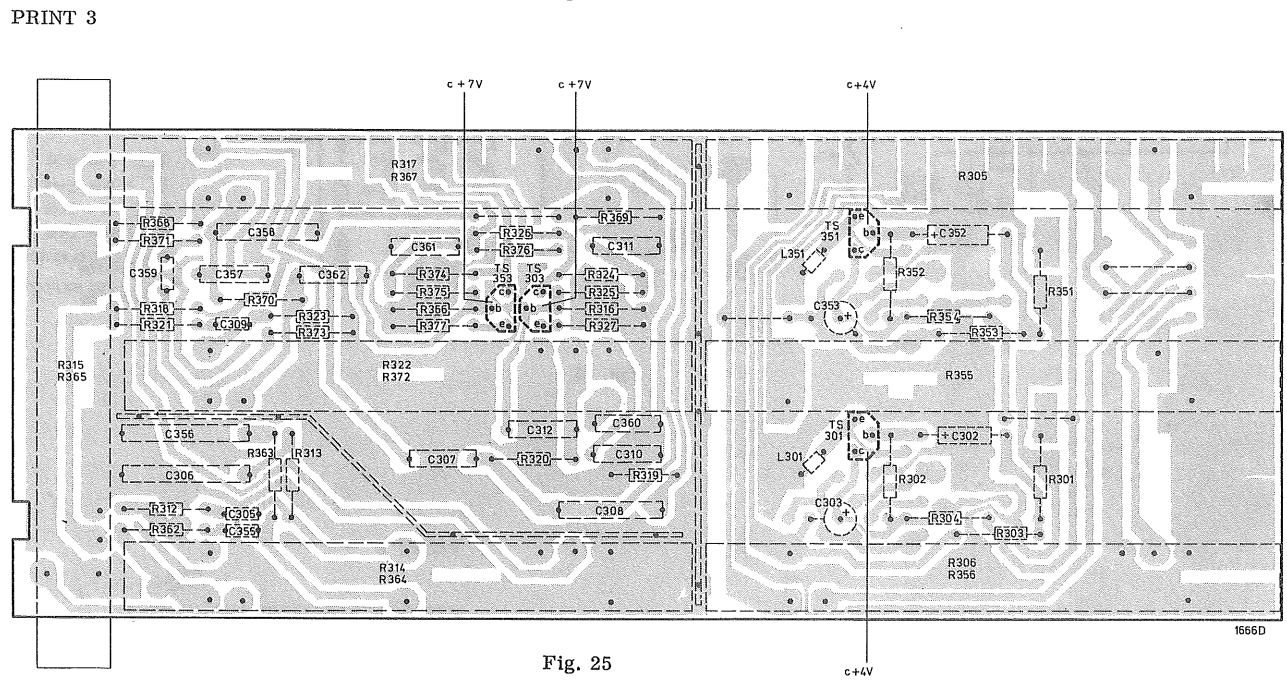


Fig. 25

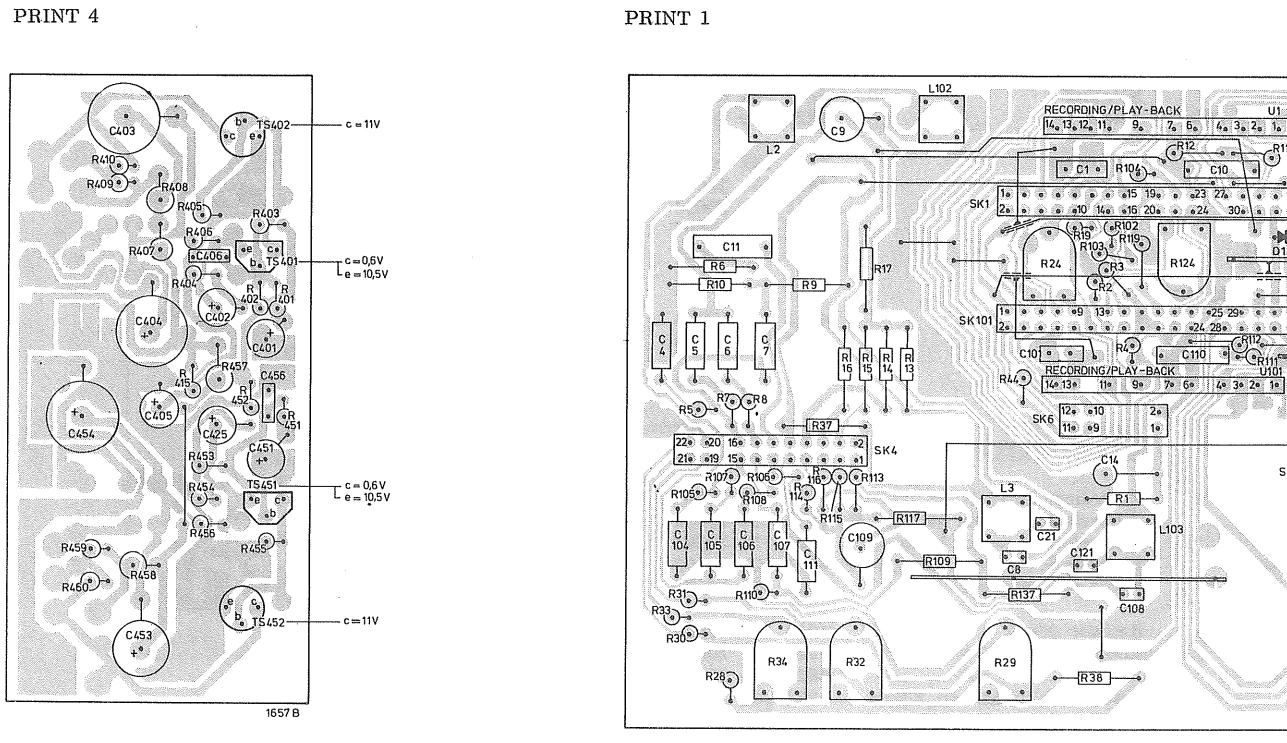


Fig. 26

Power supply

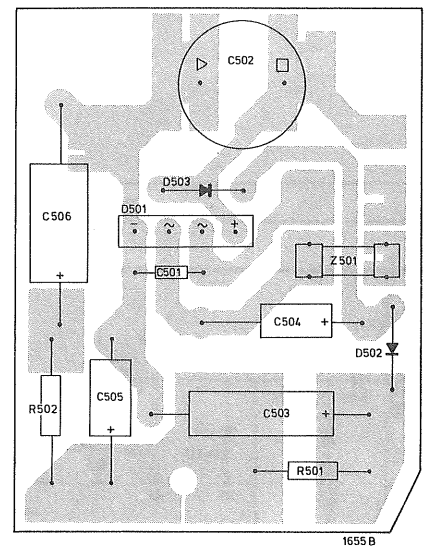
SK0	Mains switch	4822 276 10483
SK13	Voltage adapter	4822 272 10202
T1	Mains transformer	4822 146 40205
Z501	Fuse 2,5 A	4822 253 30026
D2	Zener diode BZX79/C22	4822 130 30824
D5	Zener diode BZX79/C15	4822 130 30781
D501	Diode BY164	4822 130 30414
D502, 503	Diode OF223	4822 130 30791
C17	Electrolytic capacitor 1000 µ 25V	4822 124 20419
C18	Electrolytic capacitor 1000 µ 16V	4822 124 20417
C502	Electrolytic capacitor 4700 µ 25V	4822 124 70173
C503	Electrolytic capacitor 150 µ 63V	4822 124 20389
C504	Electrolytic capacitor 150 µ 25V	4822 124 20388
C505	Electrolytic capacitor 100 µ 40V	4822 124 20384
C506	Electrolytic capacitor 470 µ 25V	4822 124 20406
R25, 26	Safety resistor 1,6 kΩ ,1/8 W	4822 111 30421
R40, 41	Safety resistor 39 Ω ,1/2 W	4822 111 50368
R501	Safety resistor 390 Ω ,1/2 W	4822 111 50364
R502	Safety resistor 470 Ω ,1/2 W	4822 111 50193
LA1, 2	Lamp 19 V - 80 mA	4822 134 40178

Amplifier

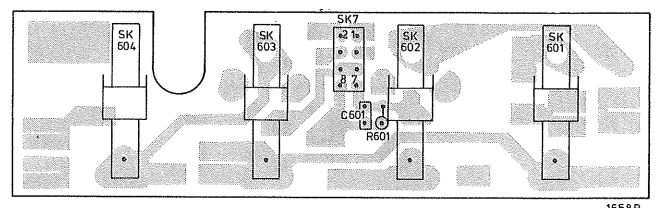
U1, 101	Rec. play unit	4822 214 30165
U2	Oscillator unit	4822 214 30166
U6, 106	Indicator unit	4822 218 30059
SK1	Slide switch (REC)	4822 277 30552
SK2	Slide switch (1-4 - ST - 3-2)	4822 277 30551
SK3	Slide switch (1-4 - ST - 3-2)	4822 277 30549
SK4	Slide switch (19, 9, 5, 4, 7, 5)	4822 277 30548
SK5	Slide switch (MP, NOR, DP)	4822 277 30547
SK6	Slide switch (MP, NOR, DP)	4822 277 30546
SK7	Slide switch (PLAY)	4822 277 30544
SK101	Slide switch (REC)	4822 277 30545
BU1, 101	Connection socket 5-pole	4822 267 40039
BU5	Connection socket, 5 pole, with switch	4822 267 40175
K1	Rec/playback head	4822 249 10072
K2	Erase head	4822 249 40064

TS1, 402, 452	Transistor BC337	4822 130 40855
TS301, 351	Transistor BC149	4822 130 40313
TS303, 353	Transistor BC149C	4822 130 40216
TS401, 451	Transistor BC158B	4822 130 40477
TS 403/404, 453/454	Transistor Matched pair AD161/162	4822 130 40349
L1, 101	Coil	4822 157 50717
L2, 102	Coil	4822 157 50736
L3, 103	Coil	4822 157 50735
L301, 351	Coil	4822 158 10223
-	Core for coil (25 mm)	4822 526 10014
-	Core for coil (12 mm)	4822 526 10095
D1, 4	Diode BA217	4822 130 30703
D3	Zener diode BZY88/C16	4822 130 30438
C15	Electrolytic capacitor 68 µ 16V	4822 124 20376
C16, 302, 352	Electrolytic capacitor 0,47 µ 63V	4822 124 20572
C303, 353	Electrolytic capacitor 2,2 µ 63V	4822 124 20571
C401, 451	Electrolytic capacitor 1 µ 63V	4822 124 20569
C402, 452	Electrolytic capacitor 22 µ 25V	4822 124 20362
C403, 453	Electrolytic capacitor 470 µ 10V	4822 124 20409
C404, 454	Electrolytic capacitor 680 µ 10V	4822 124 20411
C405	Electrolytic capacitor 10 µ 25V	4822 124 20355
R24, 124	Preset potentiometer 47 kΩ	4822 100 10079
R27	Safety resistor 1 kΩ, 1/4 W	4822 111 30108
R305/355, 314/364, 317/367, 322/372	Potentiometer 47 kΩ, log.	4822 105 10021
R306/356	Potentiometer 22 kΩ, log.	4822 105 10022
R315/365	Potentiometer 47 kΩ, bal.	4822 105 10019
R411, 412, 461, 462	Safety resistor 1 Ω, 1/2 W	4822 111 50301
R413, 463	NTC, 47 Ω	4822 116 30077
ME1	Indicator left	4822 347 10079
ME101	Indicator right	4822 347 10081
LS1, 101	Loudspeaker 8 Ω	4822 240 20108
-	Base for functional units, 14-pole	4822 267 50151
-	Base for functional units, 8-pole	4822 267 50156

PRINT 5



PRINT 6



R:	35 36	1	301+306	44	19 4 24 3 2	37 42 5+10	20	11+18 23	47	39 45 46 27	21 22	312+327	415	401+413	701
C:	101	14	302 303		119 104 124 103 102	137 105+110	2	3 10 9 21 8		16 19 15 20	112	362+377		401+406	702
MISC:	BU1 BU6		TS301 L301		107 104 105 106 111	K1 BU8	K1 L1	110 109 121 108		103 102	12	305+311		456 451+454	
	BU3 BU101		TS351 L351									TS303		TS401+404	BU5 SK8 LS1 BU4
												TS353		TS451+454	BU104

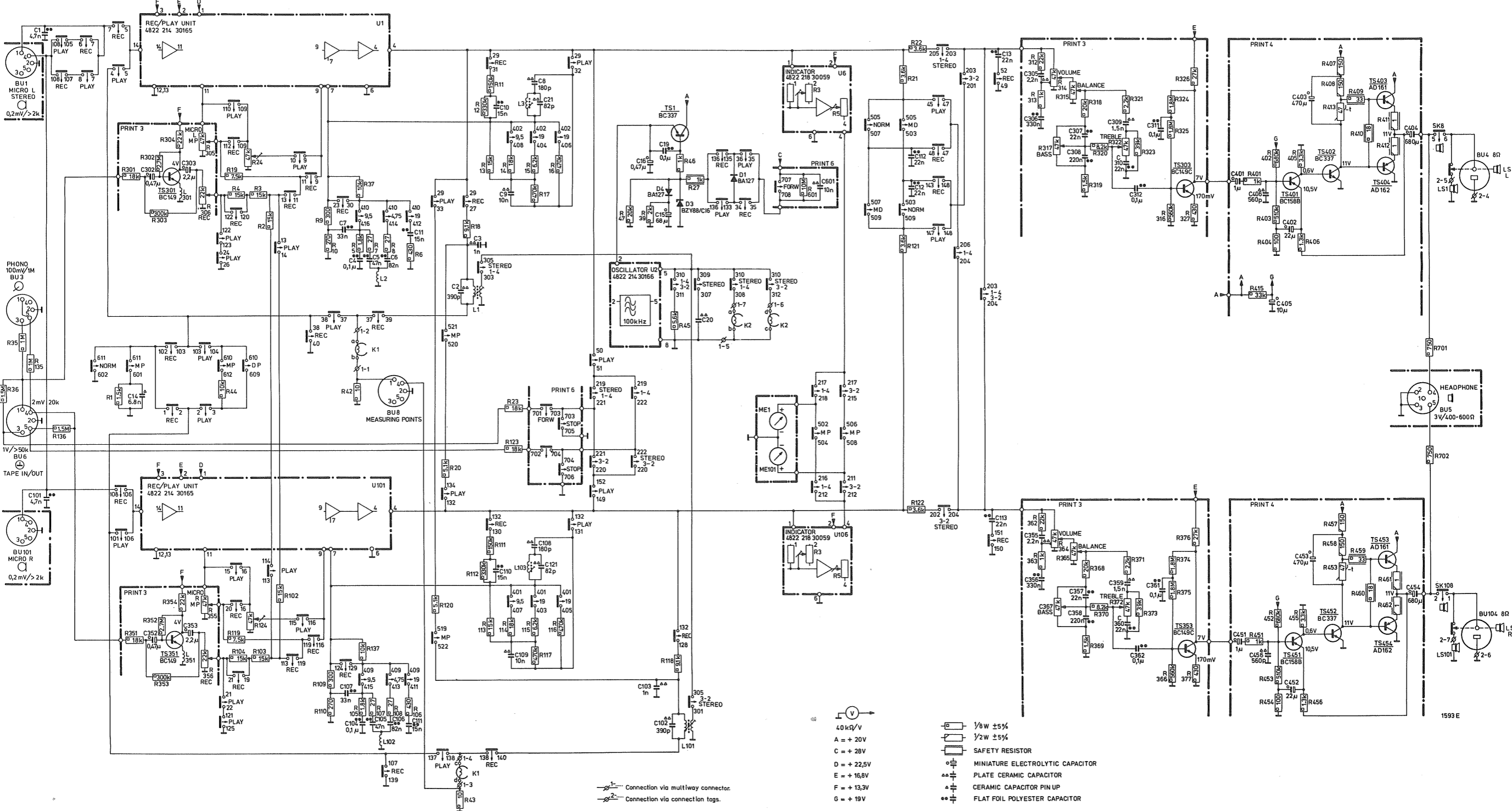


Fig. 27

LIST OF MECHANICAL PARTS

Control mechanism

3	Screw M2, 5x10	4822 502 10814
6	Screw M3x4	4822 502 11069
11	Retaining ring 3	4822 530 70115
12	Ring 3,2x5,5x0,2	4822 532 10332
13	Screw M3x10	4822 502 10689
28	Screw M2x4	4822 502 11059
31	Screw M3x6	4822 502 11064
36	Retaining ring 1,5	4822 530 70121
38	Retaining ring 4	4822 530 70116
42	Ring 2,8x7x0,5	4822 532 10215
48	Screw 2,9x12,3	4822 502 30081
49	Self-tapping screw	4822 502 30001
140	Relay (RE1)	4822 280 60369
170	"STOP" button assy.	4822 410 40025
171	"REC" button assy	4822 410 40031
172	"PAUSE" button assy	4822 410 40029
173	"PLAY" button assy	4822 410 40028
174	"F FORW" button assy	4822 410 40027
175	"REW" button assy	4822 410 40026
191	Bracket	4822 403 50713

192	Rubber wedge	4822 466 90771
193	Bracket	4822 403 50716
194	Pressure spring	4822 492 50991
195	Leaf spring	4822 492 61813
196	Spindle	4822 535 90901
197	Catch	4822 403 50714
198	Spindle	4822 535 90898
199	Stop bracket	4822 503 50675
200	Tension spring	4822 492 31087
201	Spindle	4822 535 90899
202	Lever	4822 403 30201
203	Bracket assy.	4822 403 50715
204	Bracket assy.	4822 403 50708
205	Bracket assy.	4822 403 50709
206	Bracket assy.	4822 403 50711
207	Switch (SK7)	4822 277 30544
208	Tension spring	4822 492 31086
209	Bracket	4822 403 50706
210	Tension spring	4822 492 31085
211	Bracket assy.	4822 403 50712

Tape deck

1	Screw M3x5	4822 502 10558
2	Ring	4822 532 50043
3	Screw M2,5x10	4822 502 10814
4	Self-tapping screw 2,9x6,5	4822 503 30084
5	Screw M2x5	4822 502 10679
6	Screw M3x4	4822 502 11069
7	Ring 4,2x8x0,5	4822 532 50725
8	Screw M3x6	4822 502 11107
9	Nut M5	4822 505 10513
10	Retaining ring 2	4822 530 70114
11	Retaining ring 3	4822 530 70115
12	Ring 3,2x5,5x0,2	4822 532 10332
13	Screw M3x10	4822 502 10689
14	Ring 3,1x5,6x1	4822 530 80082
15	Curved washer 4,2x9x0,1	4822 530 80076
16	Screw M1,6x6	4822 502 11258
17	Screw M2x8	4822 502 10681
18	Nut M2,5	4822 505 10464
19	Nut M2	4822 505 10397
20	Ring 3,2x5,5x0,45	4822 530 70123
21	Nut M2,5	4822 505 10471
22	Screw M2,5x12	4822 502 11055
23	Ring 4,2x7x0,9	4822 530 80163
24	Screw M4x50	4822 502 10696
25	Screw M3x18	4822 502 10559
26	Ring 3,2x9x1	4822 532 10582
27	Screw M3x15	4822 502 10691
28	Screw M2x4	4822 502 11059
29	Selftapping screw 2,9x9,5	4822 502 30103
30	Screw M3x20	4822 502 11004
31	Screw M3x6	4822 502 11064
32	Ring	4822 310 40003
33	Nut M2	4822 505 10323
34	Ring 2,2x5,5x0,5	4822 532 10331
35	Nut M3	4822 505 10325
36	Retaining ring 1,5	4822 530 70121
37	Curved washer 3,2x8x0,1	4822 530 80075
38	Retaining ring 4	4822 530 70116
39	Ring 4,2x7x0,3	4822 532 10333
51	Screw	4822 502 11218
52	Locking heads	4822 532 20578
53	Pressure spring	4822 492 51002
54	Drive belt	4822 358 30127
55	Tension spring	4822 492 31019
56	Tape tension comparator	4822 403 50657
57	Tension spring	4822 492 31018
58	Switch (SK701, 702, 703)	4822 278 90035
59	Brake bracket, left	4822 403 10123
60	Tension spring	4822 492 31084
61	Tension spring	4822 492 31016
62	Pulley	4822 528 80521
63	Reel motor (M1, 2)	4822 361 20091
64	Connector, female (17-pole)	4822 267 50187
65	Connector, male (17-pole)	4822 265 40116
66	Pulley	4822 528 80478
67	Drive belt	4822 358 30186
68	Thrust bearing	4822 502 10765
69	Turntable (assy.)	4822 528 10265
70	Erase head (K2)	4822 249 40064
71	Bracket	4822 403 50663
72	Pressure felt assy.	4822 403 50673
73	Brake bracket, right	4822 403 10124
74	Buffer	4822 466 60611
75	Solenoid (RE201, 202)	4822 280 70152
76	Flywheel	4822 528 60075
77	Drive belt	4822 358 30135
78	Pulley	4822 522 31158
79	Grommet	4822 528 80545
80	Pulse head (K3)	4822 249 20034
81	Bracket	4822 290 80249
82	Bracket	4822 403 50662
83	Capstan motor	4822 361 20096
84	Thrust-bearing	4822 520 30281
85	Nut M2	4822 505 10446
86	Bush	4822 532 20103
87	Bush	4822 532 10528
88	Nut	4822 505 10199
89	Pressure spring	4822 492 50314
90	Bracket	4822 403 50705
91	Pressure spring	4822 492 50312
92	Tension spring	4822 492 31083
94	Tension spring	4822 492 30915
95	Soldering tag	4822 290 30059
96	Pressure spring	4822 492 50923
97	Tension spring	4822 492 31017
98	Nut	4822 505 10522
99	Bush	4822 528 90223
100	Bracket	4822 403 10125
101	Recording/playback head (K1)	4822 249 10072
102	Ring	4822 532 50904

103	Capstan bearing	4822 520 10328
104	Pressure spring	4822 492 50152
105	Pinch roller	4822 528 70018
106	Pressure felt	4822 403 50674
108	Rod	4822 535 90888
109	Pressure spring	4822 492 50983
110	Pinch roller lever	4822 403 20095
111	Bush	4822 532 30256
112	Ring	4822 529 50094
113	Bracket	4822 403 50661
114	Rod	4822 535 90889
115	Ring	4822 532 30253
Cabinet and amplifier		
13	Screw M3x10	4822 502 10689
17	Screw M2x8	4822 502 10681
37	Spring washer 3,2x8x0,1	4822 530 80075
39	Ring 4,2x7x0,3	4822 532 10333
40	Screw 3,9x9,13	4822 502 30006
41	Screw M3x6	4822 502 10657
42	Ring 2,8x7x0,5	4822 532 10215
43	Screw M2,6x5	4822 502 11084
44	Retaining ring	4822 530 70114
45	Screw 3,6x6,5	4822 502 30112
46	Screw 3x13x9	4822 502 30054
47	Screw 2,4x15	4822 502 30048
48	Screw 2,9x12,3	4822 502 30091
49	Self-tapping screw	4822 502 30001
50	Screw M4x16	4822 502 11065
120	Cabinet assy.	4822 443 50196
121	Foot	4822 462 40282
122	Cover	4822 443 60383
124	Loudspeaker (LS1, 101)	4822 240 20108
125	Side panel, left right	4822 444 30186
126	Foot	4822 462 40294
127	Pin	4822 443 60398
128	Screw	4822 502 11195
129	Covering plate (assy.)	4822 443 30218
131	Screw M4x12x10	4822 502 10487
132	Counter	4822 349 50068
133	Push-button (assy.)	4822 410 10033
134	Shouldered bolt	4822 502 11259
135	Clamping spring	4822 492 61812
136	Coupling piece	4822 535 70419
137	Pin	4822 535 90912
138	Lever	4822 403 50717
139	Strip	4822 460 20072
140	Relay (RE1)	4822 280 60369
141	Handle assy.	4822 498 40326
142	Profiled frame	4822 466 80619
143	Strip for connection sockets	4822 267 20141
144	Indicator, left (ME1)	4822 347 10079
145	Slide	4822 411 60201
146	Push-button assy.	4822 410 21139
147	Switch (SK0)	4822 276 10483
148	Grommet	4822 325 60148
149	Connection socket, 5-pole (BU1, 101)	4822 267 40039
150	Connection socket, 5-pole 360° (BU9)	4822 267 40175
151	Push-button	4822 410 10032
152	Slide button	4822 411 60198
153	Indication strip	4822 454 20252
154	Plate	4822 459 80053
155	Lower hinge section	4822 403 50683
156	Lock assy.	4822 417 60094
157	Hinge section	4822 417 10516
158	Indicator, right (ME101)	4822 347 10081
159	Leaf spring	4822 492 61791
160	Slide button assy.	4822 411 60199
161	Screw M4x35	4822 502 11266
162	Spring	4822 492 40502
163	Hinge assy.	4822 417 10295
164	Knob	4822 411 60197
165	Indication strip (VOLUME - REC)	4822 454 20251
166	Indication strip (TREBLE - MICRO R - MP)	4822 454 20249
167	Indication strip (BASS - MICRO L - MP)	4822 454 20248
168	Plate	4822 403 50685
169	Amplifier board	4822 443 30233
170	"STOP" button assy.	4822 410 40025
171	"REC" button assy.	4822 410 40031
172	"PAUSE" button assy.	4822 410 40029
173	"PLAY" button assy.	4822 410 40028
174	"F FORW" button assy.	4822 410 40027
175	"REW" button assy.	4822 410 40026
176	Sliding cover	4822 464 50028
177	Cover	4822 443 20074
178	Head cover	4822 443 60404

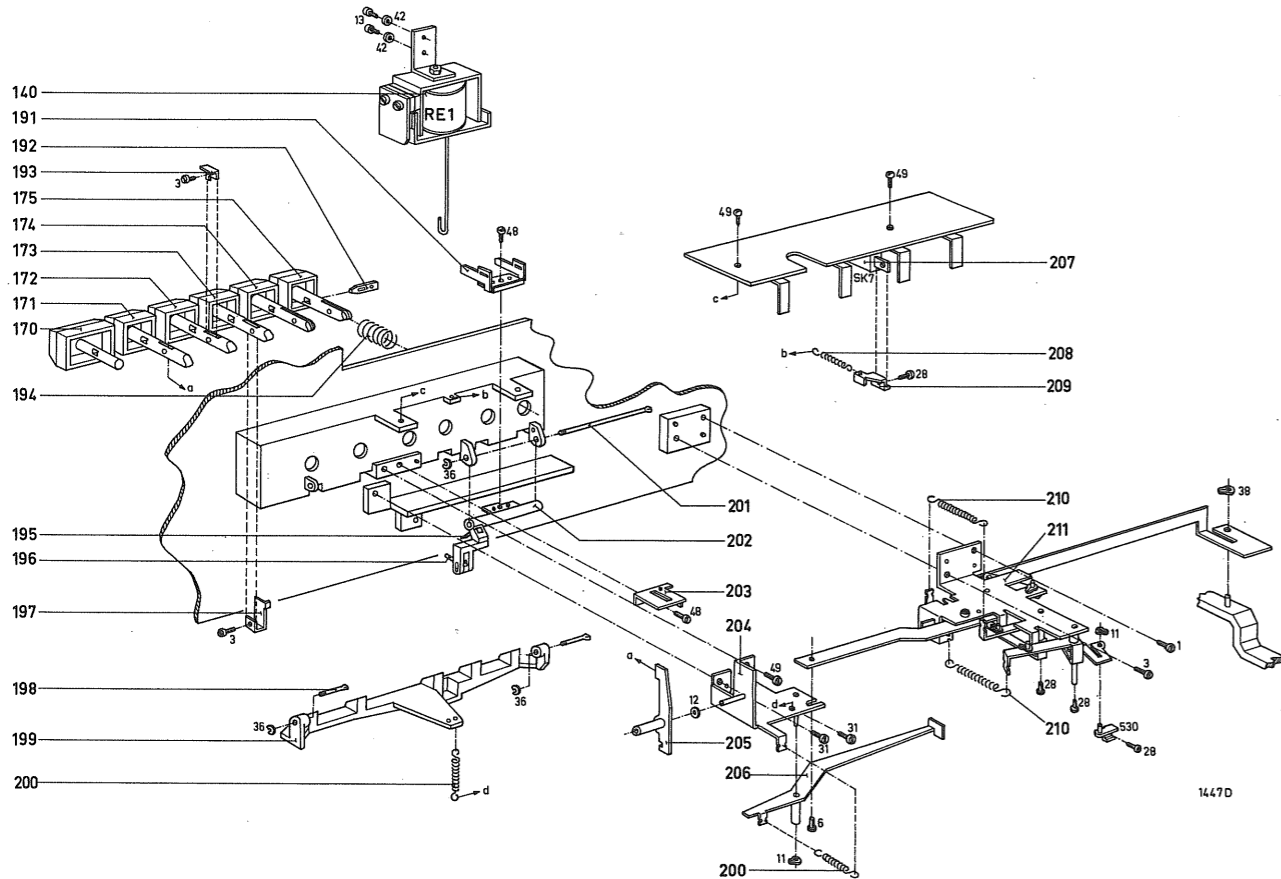
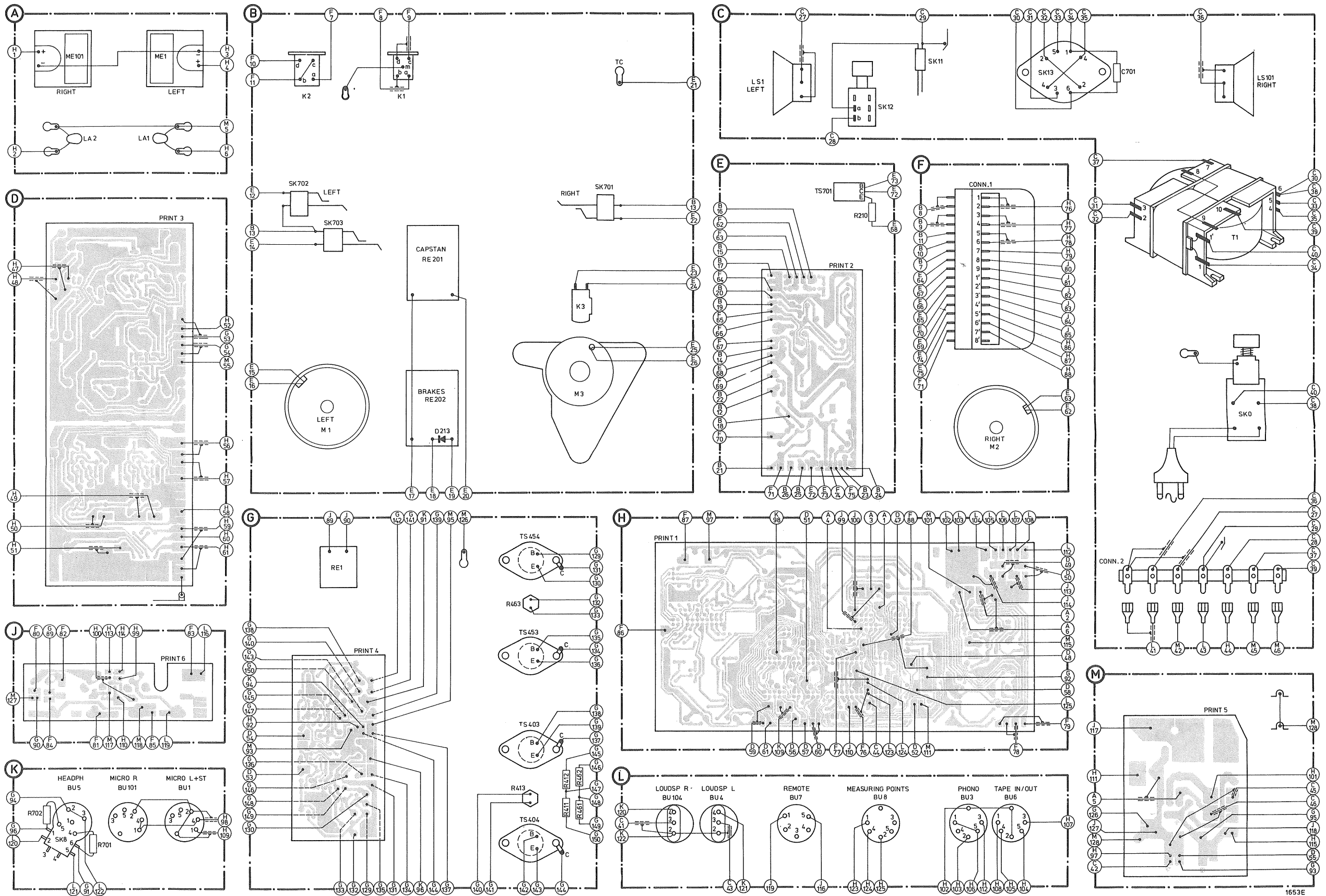


Fig. 28

MISC: R702 LA2 R701 SK8 BU5 BU101 ME101 LA1 ME1 PRINT3 PRINT6
 SK702 K2 SK703 RE1 K1 RE201 R463 TS453,454 K3 SK701 T.C. PRINT1
 M1 PRINT4 RE202 D213 R413 TS403,404 R411,412 M3 BU104 BU4 BU7 BU8 BU3 BU6 BU101 SK0 PRINT5
 LS1 TS701 SK12 PRINT2 R210 SK11 CONN.1 M2 SK13 C701 CONN.2 T1 LS101



1653E

Fig. 31

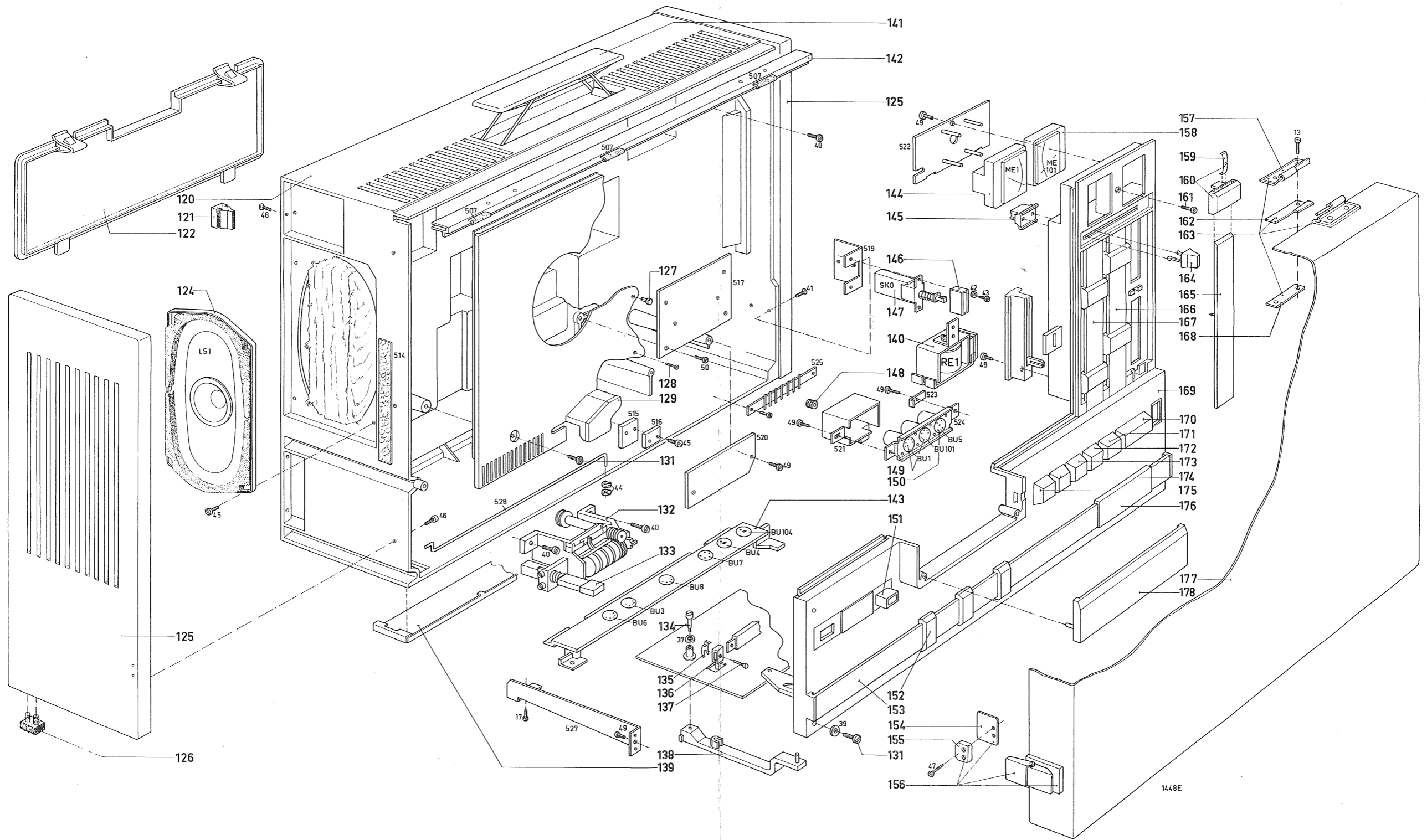


Fig. 30

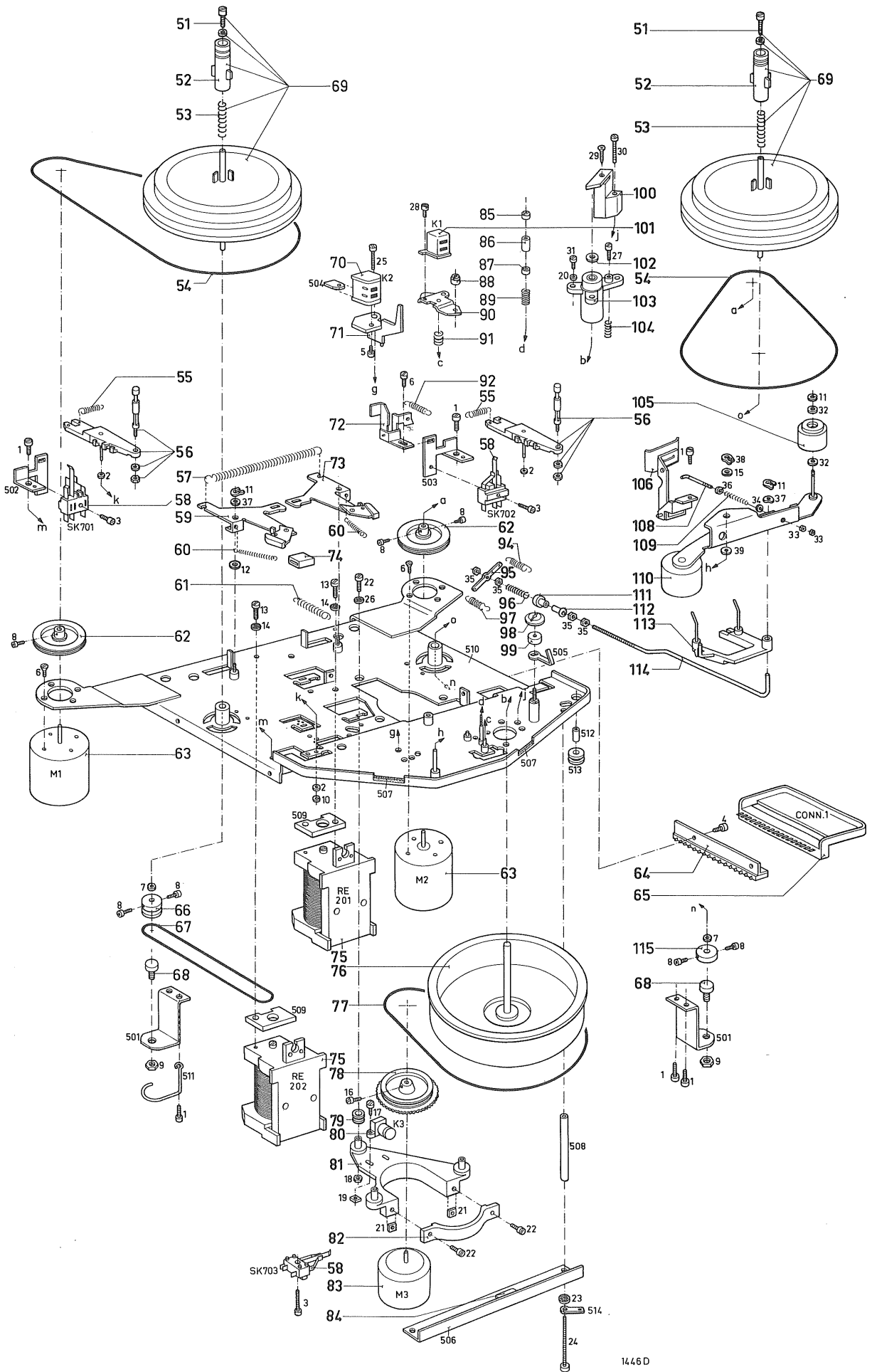


Fig. 29

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