

Dual

Edition July 1973

701



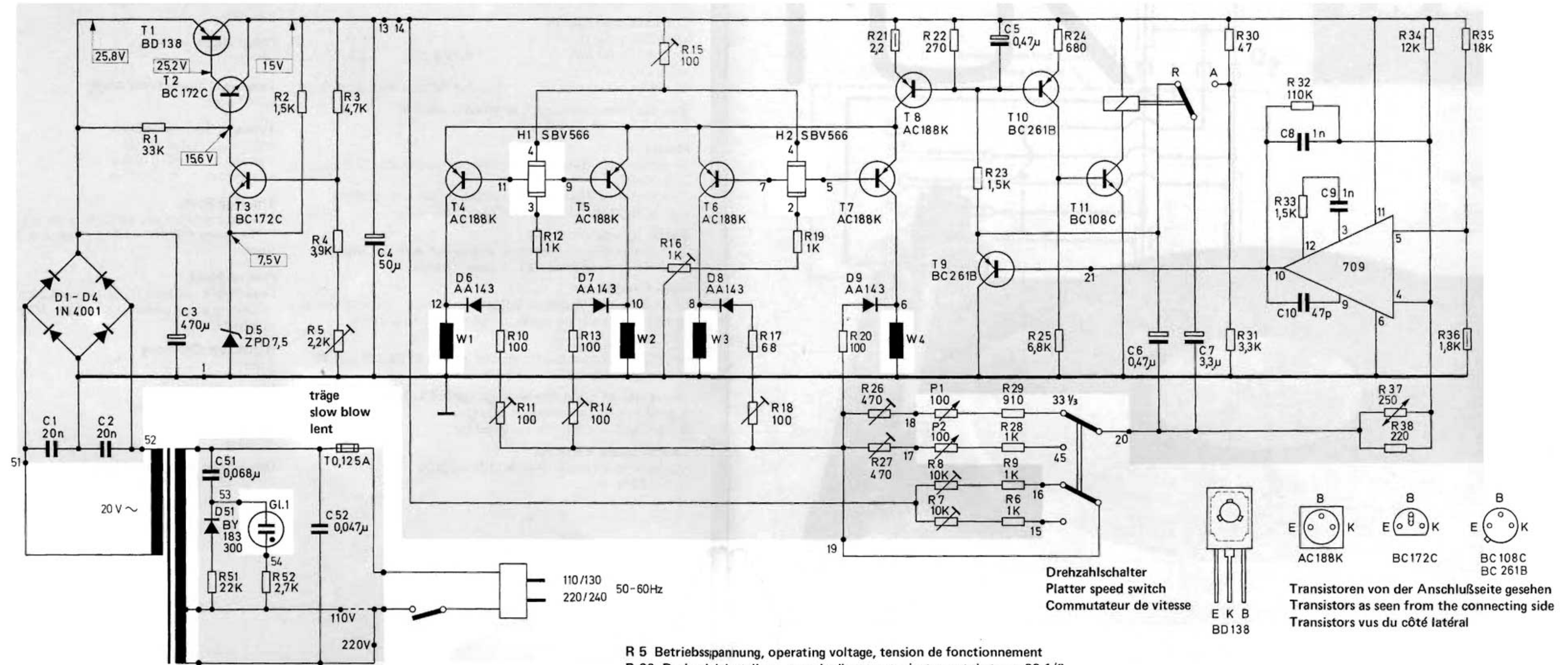
Service Manual

Dual Gebrüder Steidinger · 7742 St. Georgen/Schwarzwald

Fig. 1 Circuit diagram

Dual

EDS 1000



- R 5 Betriebsspannung, operating voltage, tension de fonctionnement
- R 26 Drehzahleinstellung, speed adjustment, ajustement de tours 33 1/3
- R 27 Drehzahleinstellung, speed adjustment, ajustement de tours 45
- P 1 Drehzahlfeinregulierung, speed fine adjustment, réglage précis de tours 33 1/3
- P 2 Drehzahlfeinregulierung, speed fine adjustment, réglage précis de tours 45
- R 7/8 Frequenzverdopplung, double frequency, doublage de fréquence
- R 11/14/18 Symmetrie Tachospaltung, symmetrizing the speed indicator voltage, symétrie de la tension de vitesse
- R 16 Symmetrie Hallspannung, symmetrizing the Hall voltage, symétrie de la tension de Hall

Belastbarkeit der Widerstände
Resistor loading capacity
Capacité admissible de charge des résistances

= 0,25 W
 = 0,5 W

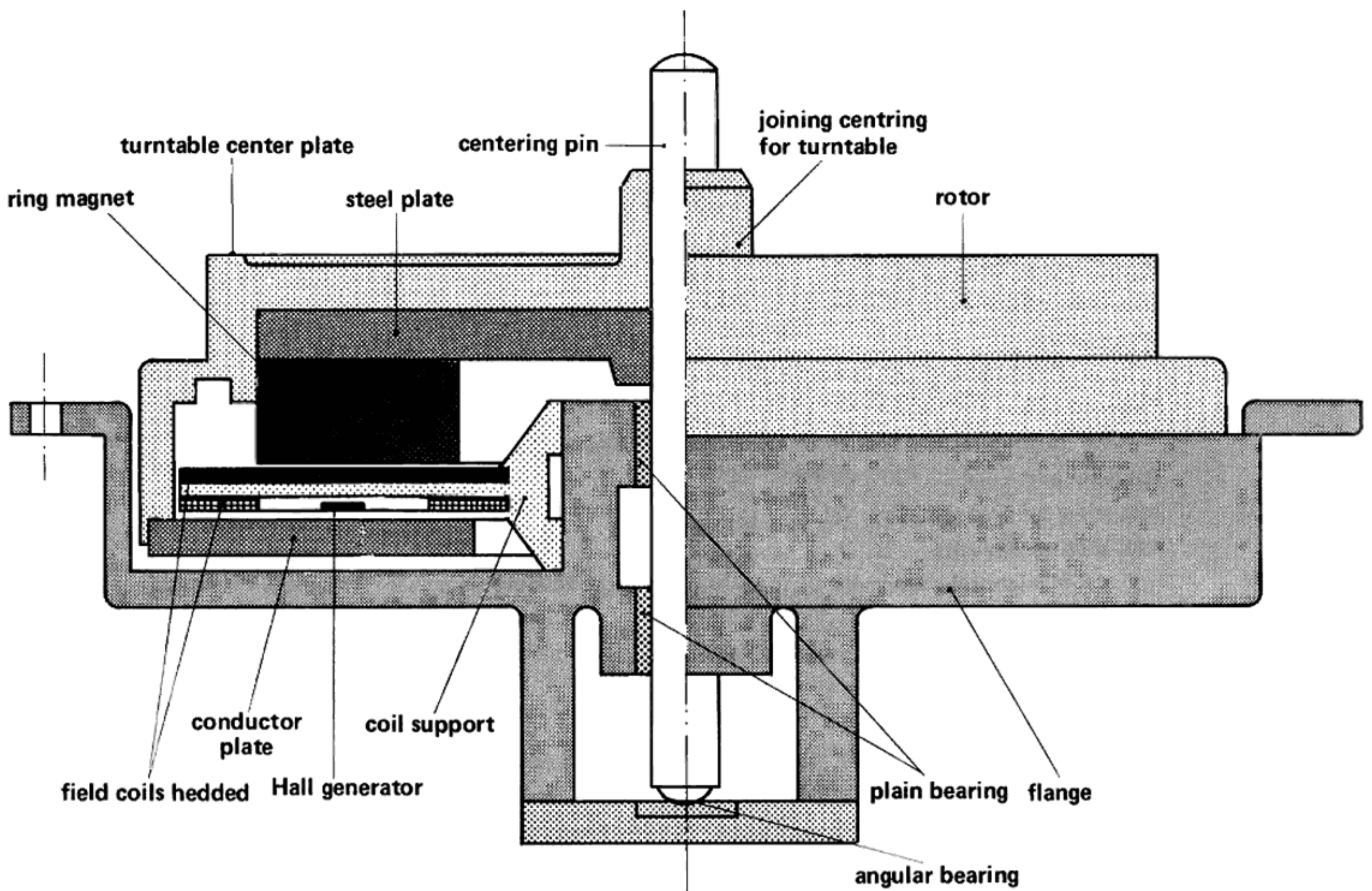
Spannungen gemessen mit Meßinstrument (7 – 10 MOhm Eingangswiderstand) gegen Masse
Voltages measured with measuring instrument (7 – 10 MOhm input resistance) to ground
Tensions mesurées avec instrument de mesure (7 – 10 MOhm résistance d'entrée) contre masse

R	R1	R2	R3	R4	R5	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38
C	C1	C2	C3	C4	C5	C51	C52	C53	C54	C55	C6	C7	C8	C9	C10														

Contents

	Page
Specification	2
Circuit Diagram	3, 4
Dual EDS 1000 Electronic Direct Drive System	6, 7
Description of Function	8
Speed Regulation	9
Assembly Instructions for Dual EDS 1000	10
Stroboscope	10
Glow lamp of stroboscope does not come on	11
Pitch control	11
Nominal speed is at the edge of the control range of the pitch control	11
Tonearm and Tonearm Suspension	12
Adjusting the Tonearm Bearing	12
Anti-skating Device	13
Horizontal movement of tonearm impeded on set-down	13
Stylus skips	14
Vertical tonearm movement shows resistance during set-down	14
Tonearm Control	14
Cue Control	15
Tonearm does not set down at the edge of record	15
Tonearm does not set down on record after operating cue control	15
Tonearm lowers onto record too quickly when cue control is operated	15
Tonearm returns to rest after manual set-down immediately after the platter starts to turn	15
Starting	16
Manual Start	16
Stopping	16
Short Circuiter	16
Shut-off	17
Tonearm moves with tracking force and anti-skating scale in 0-position	17
Disturbing noises perceptible during operation	17
No reproduction	17
Motor does not shut off when tonearm sets down on rest	17
Acoustic feedback	17
Platter remains stationary after automatic set-down of tonearm on record	18
Tonearm remains suspended just outside the 30 cm record when moved on or out	18
Tonearm does not move into position when control lever is operated	18
Lubricating Instructions	19
Spare Parts	19,20
Exploded Drawing – Parts Above Chassis	21
Exploded Drawing – Parts Below Chassis	22
Spare Parts	23, 24
Spare Parts Motor electronic	25
Pick-up Connection Diagram	26

Fig. 2 Dual EDS 1000 Electronic Direct Drive System



Dual EDS 1000 Electronic Direct Drive System

The EDS 1000 motor specially designed for the Dual 701 is a slow-running no-commutator DC electronic motor which draws its power supply from a stabilized power pack.

The electro-mechanical commutation normally carried out on DC motors by the commutator is electronically controlled in the case of the Dual EDS 1000 motor by two Hall generators. These two Hall generators – dependent on the rotor position – control four switching transistors which in turn have the effect of a rotating magnetic field occurring in the field coils of the rotor by means of which the four pairs of magnets of the rotor are continuously attracted or repelled. By means of the torque thus exerted, uniform rotation is induced in the rotor – and with it the platter.

A speed-dependent voltage (tacho voltage) induced in the motor windings not switched on is coupled out and controls the electronic regulator circuit. This ensures that even the slightest deviations from the nominal speed are corrected in fractions of a second by a change in the motor current. Speed fluctuations are, therefore, practically eliminated.

Absolute maintenance of the nominal speed no longer presents any problem with this control system.

The above-mentioned Hall generator is a magnetically controllable semi-conductor element named after the physicist E. Hall. With the Hall effect as a result of the action of a magnetic field on the Hall generator a voltage approximately proportionate to the strength of the magnetic field is generated, its polarity being dependent on the direction of the magnetic flux.

A control current flows through the Hall generator. If now a magnetic field becomes effective at right angles to the area of the Hall generator, the so-called Hall voltage occurs. With constant control current this Hall voltage is dependent on the direction and strength of the magnetic field. If the polarity of the magnetic field is reversed, the polarity of the Hall voltage changes as well. In the absence of a magnetic field the Hall voltage is zero.

This effect is utilized to control the Dual EDS 1000 motor.

As the motor is operated on DC from a stabilized power pack it operates independently of line voltage and frequency fluctuations.

The motor is of 8-pole disk rotor design. The rotor has a barium ferrite annular magnet inside which has 8-pole magnetization on its lower face.

A slotless steel disk connected to the rotor acts as magnetic return.

The field windings of the motor are ironless and are embedded in a plastic support. The field windings consist of 16 double wound coils which are arranged in two planes above one another. The 8 coils of the lower plane are 22.5° offset in relation to the top plane. In each plane there is a Hall generator in the center of one coil. The two Hall generators are also offset by 22.5° in relation to one another.

The individual windings – 32 in all – are connected together so that four all round phase windings are produced.

Compared with other directly-driven record players in the case of the Dual EDS 1000 motor no form of magnetic drag or restoring force is present (pole jerk etc.) as can easily be detected by turning the rotor. As a result of the ironless field coils no hysteresis or eddy current losses or interfering slot-ripple frequencies occur.

This results in completely vibration-free motor running together with a low power consumption of less than 50 mW during play (the electronic system is not taken into account). By virtue of this vibration-free running the motor can be rigidly connected to the chassis. The electronic system itself is divided into the switch, commutation and control sections (see block diagram).

Fig. 3 Line Board (Equipment Side)

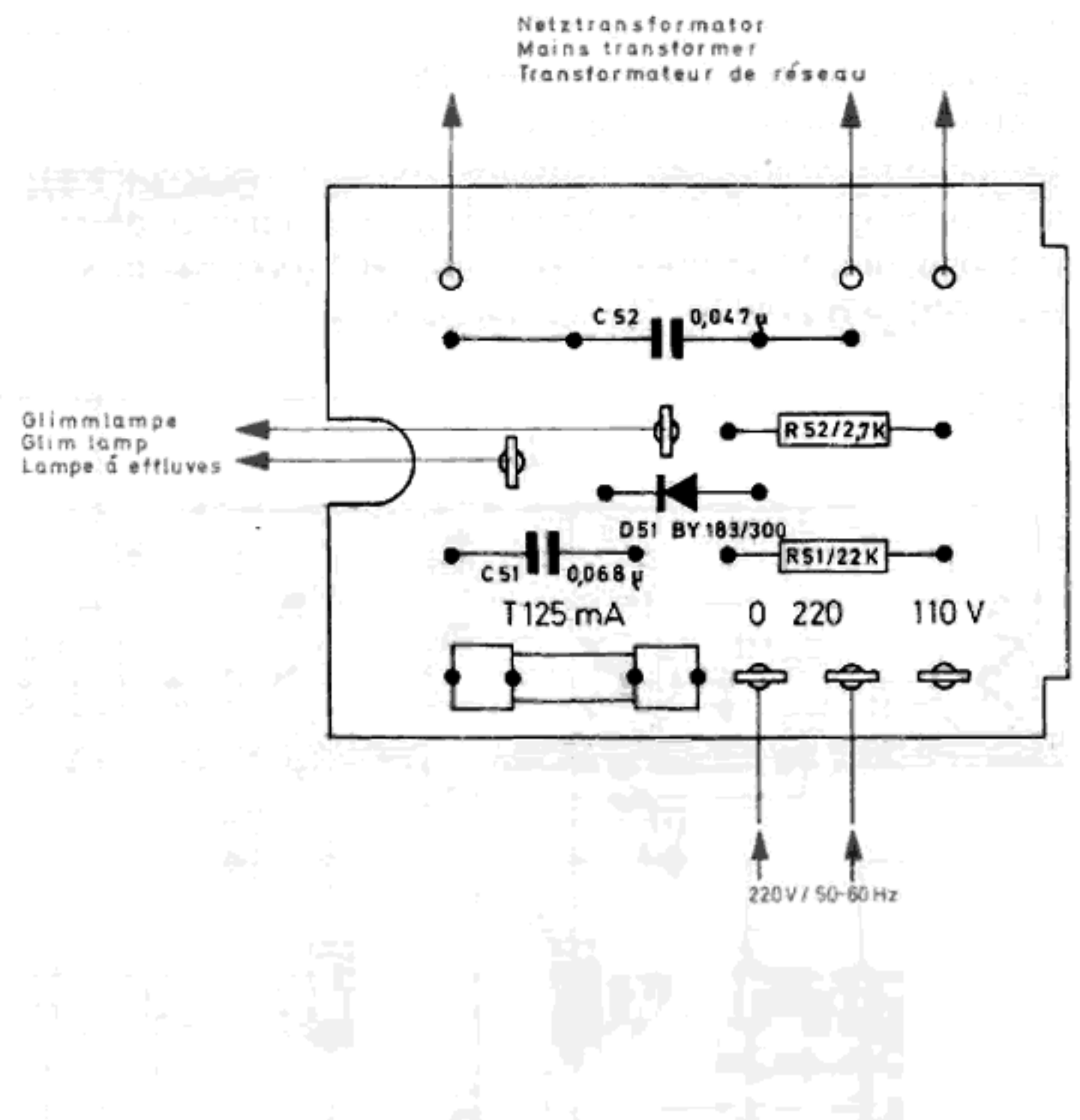
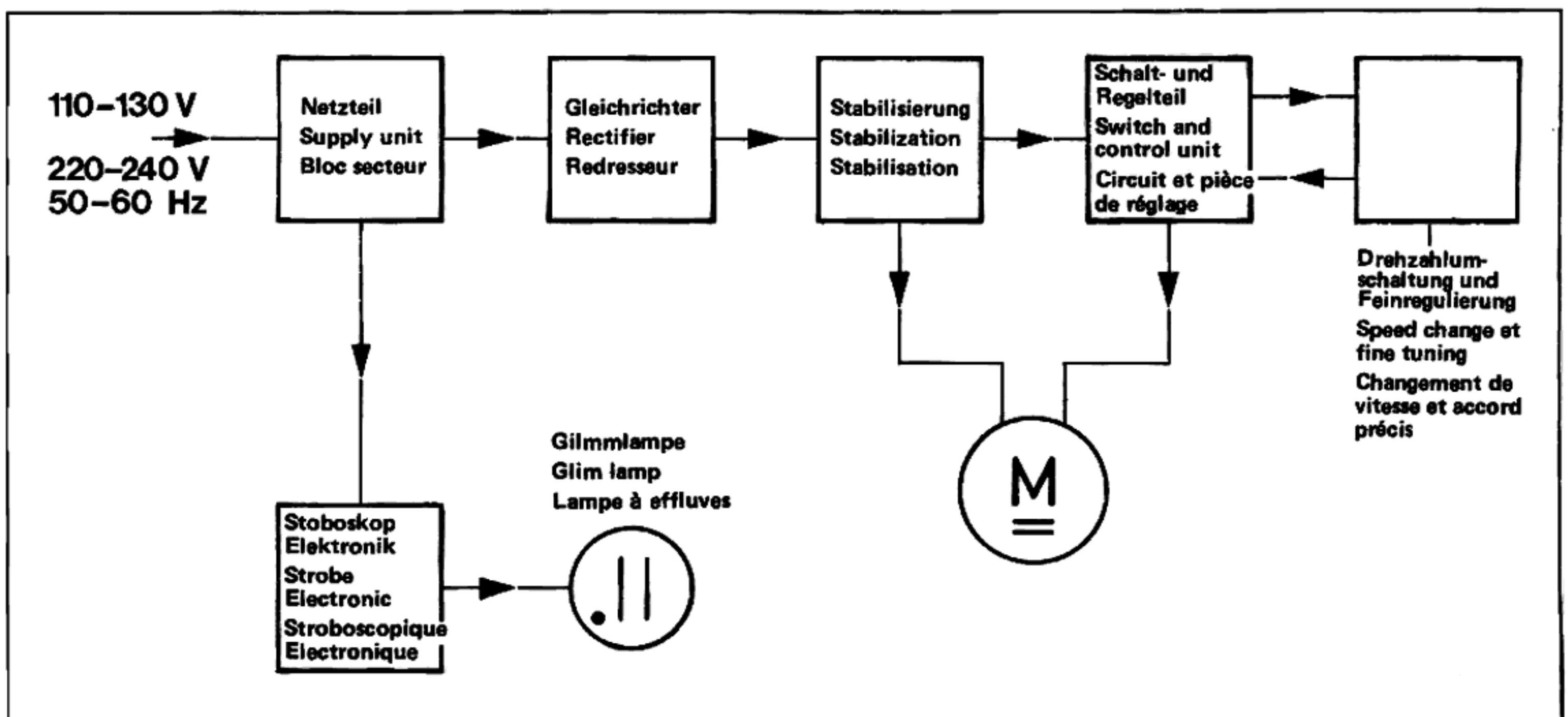


Fig. 4 Block Diagram



Description of Function

The 4 phase windings are each in the collector circuit of the 4 switching transistors T 4 to T 7 (Fig. 5) and are connected together in star form at one point. This point is connected to the minus pole of the supply voltage.

The position of the rotor illustrated in Fig. 6 has the effect that the magnetic field of the south pole of a pair of poles at connection 11 of the Hall generator H 1 gives rise to a Hall voltage maximum of negative polarity.

Transistor T 4 whose base is joined to connection 11 of the Hall generator therefore receives a negative base emitter voltage and is fully connected through whereby the current flows through the phase winding W 1 located in the collector section or it is switched on.

Transistor T 5 whose base is joined to connection 9 of Hall transistor H 1 is blocked by the positive Hall voltage potential.

Fig. 5

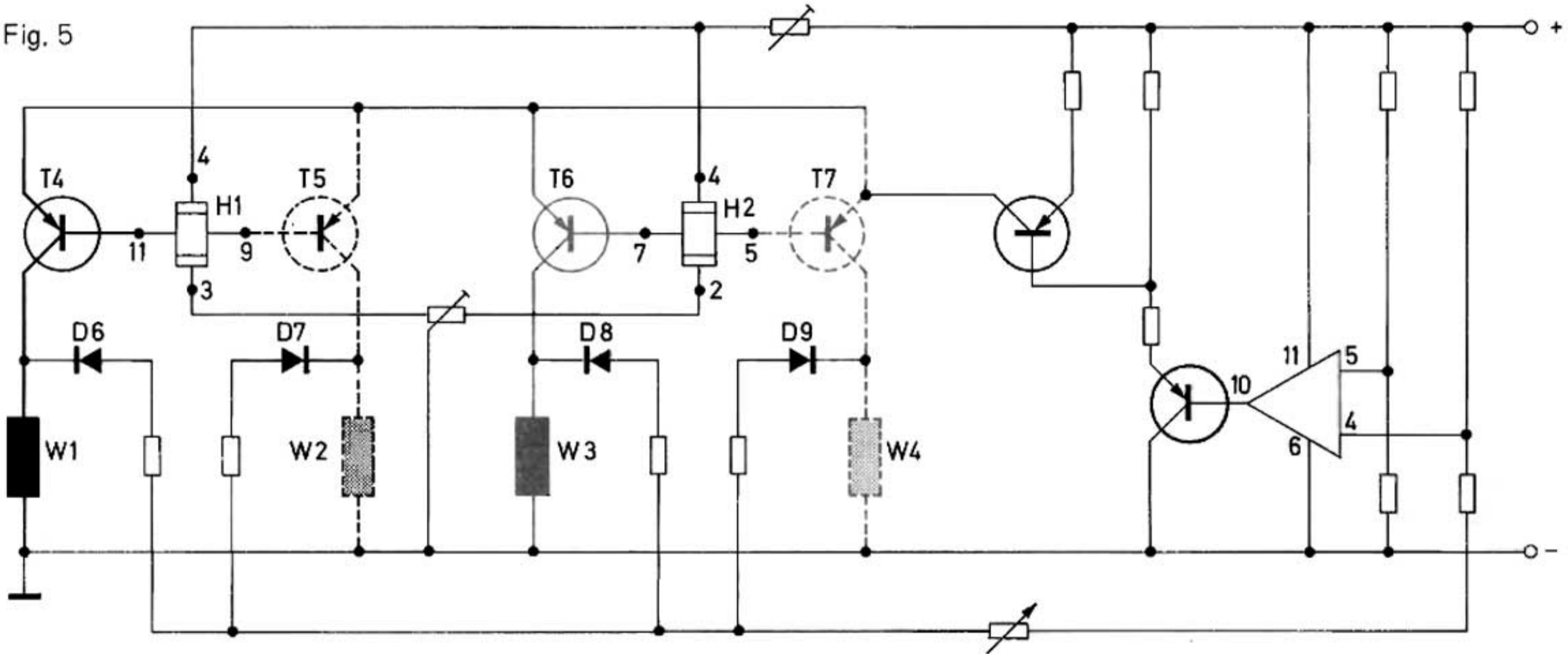
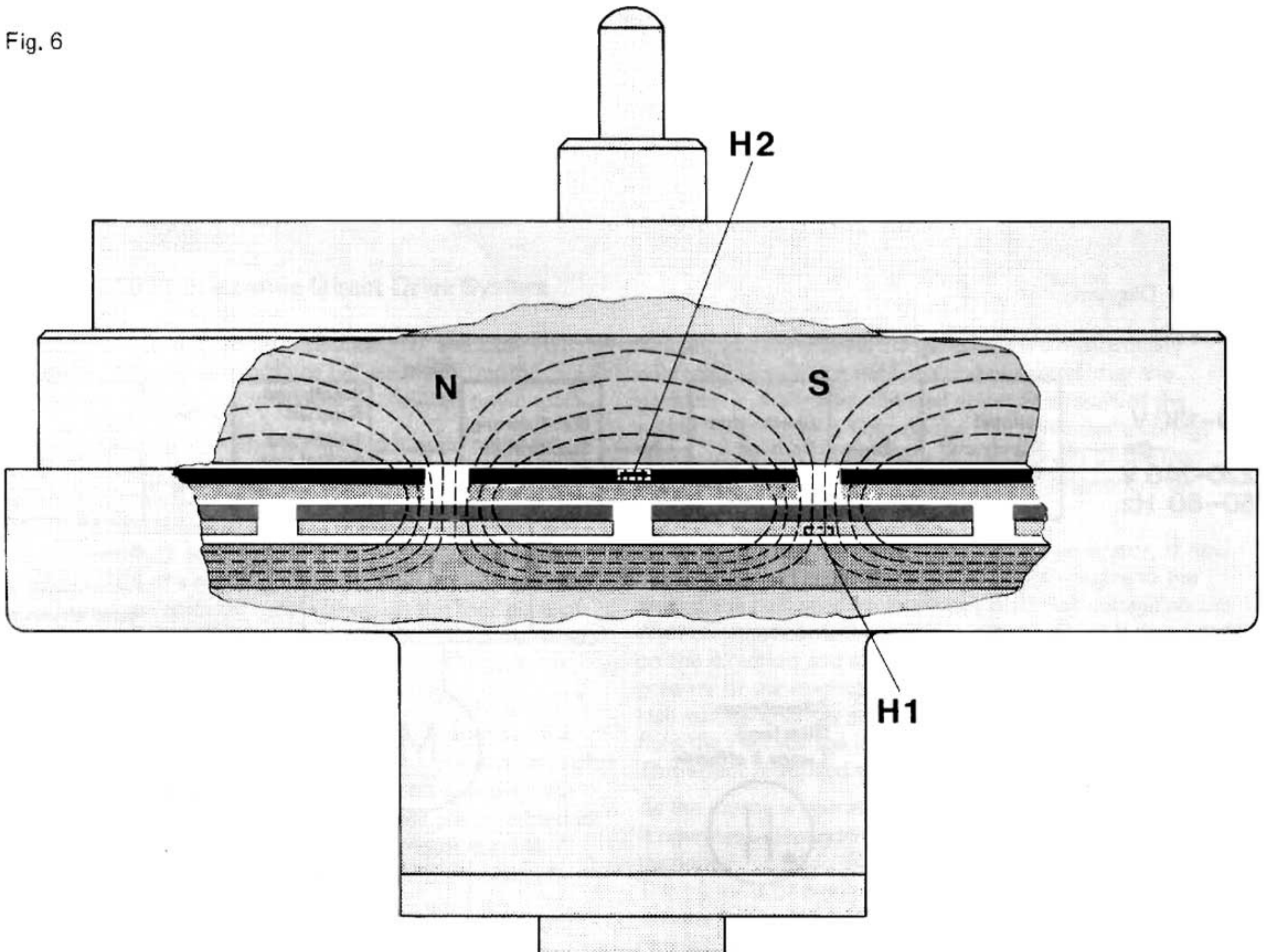


Fig. 6



As Hall generator H 2 is in the neutral zone of the pair of magnetic poles during this period, no Hall voltages occur at its connections 7 and 5. The transistors T 6 and T 7 joined to these connections are, therefore, blocked as well.

The switched on phase winding W 1 (Fig. 7a) produces clockwise rotation of the rotor through $22\ 1/2^\circ$. This cycle takes place, displaced electrically in each case by 90° , in sequence in all four phase windings.

Thus the following sequence of movement takes place:

After the 1st rotation phase (Fig. 7b) the Hall generator H 1 is located in the neutral zone of a pair of magnetic poles.

One south pole is now directly above Hall generator H 2 and now also produces at its connection 7 a Hall voltage maximum of negative polarity which switches on phase winding W 3 via transistor T 6. All other transistors are blocked. The rotor now rotates again through $22\ 1/2^\circ$ through the magnetic fields generated in phase winding W 3.

After elapse of the second rotation phase (Fig. 7c) the Hall generator H 2 is now in the neutral zone of a pair of magnetic poles. Hall generator H 1 is now directly underneath a north pole and a Hall voltage of reversed polarity occurs, i.e. the negative polarity Hall voltage maximum is now present at connection 9 which connects through phase winding W 2 via transistor T 5.

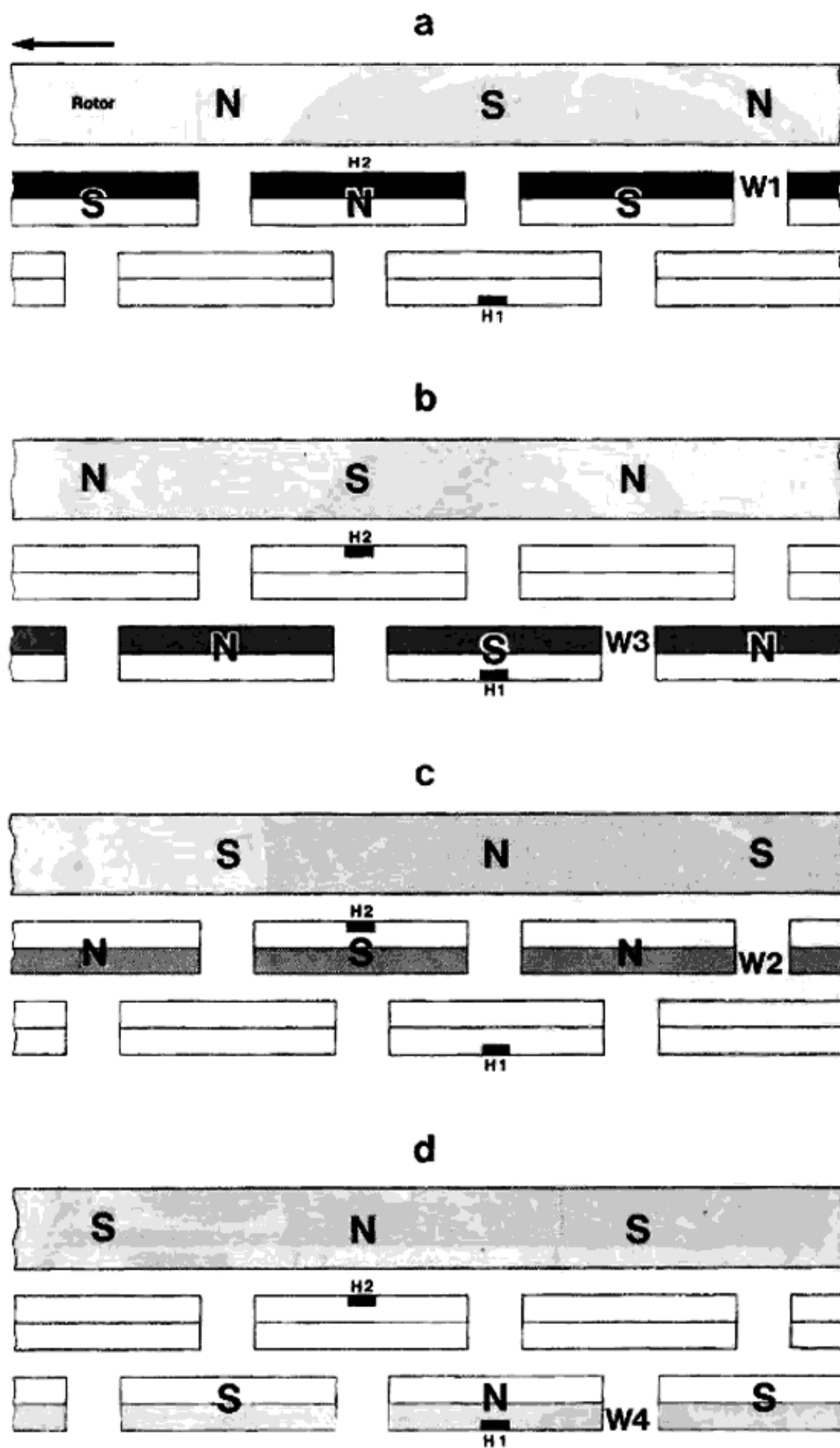
The other transistors are blocked. The rotor again advances by $22\ 1/2^\circ$.

After this 3rd rotation phase (Fig. 7d) Hall generator H 1 is in the neutral zone. A north pole is above Hall generator H 2 and produces a negative Hall voltage at its connection 7 which switches on phase winding W 4 via transistor T 7. The rotor advances by a further $22\ 1/2^\circ$.

After conclusion of this 4th rotation phase the process starts again. Thus, a continuous rotating field occurs which drives the rotor at a uniform rate.

If the rotor is, for example, between two phase windings, a partial flux of a pair of magnetic poles passes through both Hall generators and thus two switching transistors are partly opened. The current is divided accordingly between two phase windings. Both phase windings participate simultaneously in the torque formation and together produce the torque of a fully-connected phase winding. The torque is, therefore, almost constant in any position of the rotor.

Fig. 7



Speed Regulation

As a result of the rotary movement of the rotor, voltages are induced in the phase windings not connected through which are coupled out via diodes D 6 to D 9. Thus, a tacho voltage proportionate to the speed is obtained.

The tacho voltage passes via a voltage divider to connection 4 of the operation amplifier in the control section and counteracts the voltage present there. A stabilized voltage is present at connection 5 of the operation amplifier.

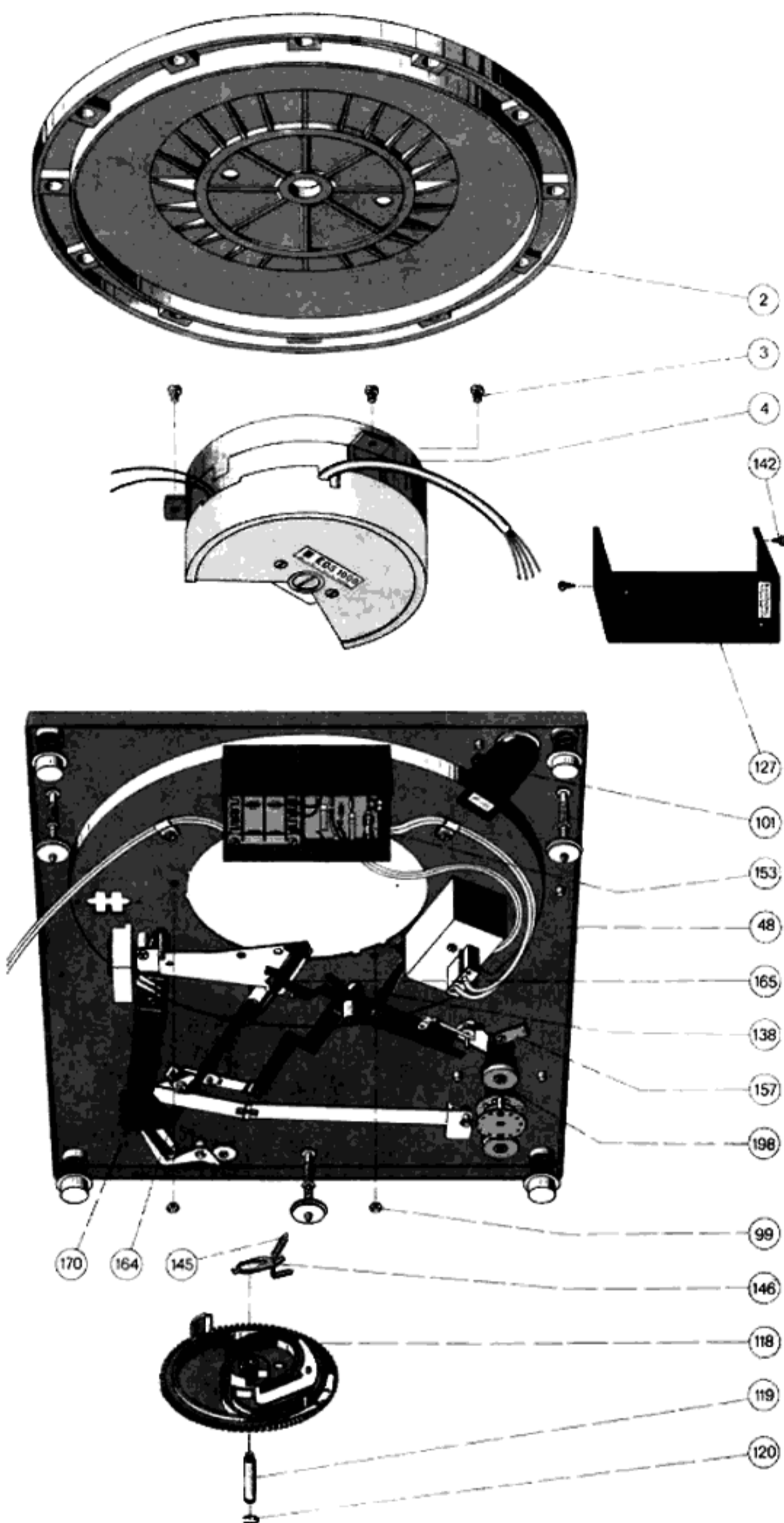
On start-up and during run-up of the motor the potential at connection 4 of the operation amplifier is more or less positive in relation to connection 5. In this condition the operation amplifier fully drives transistor T 8 via transistor T 9. T 8 is present as variable resistance in the common emitter circuit of the four switching transistors through which practically the full switching current can flow in sequence.

The nominal or controlled speed is reached when the same potential is present at connection 4 of the operation amplifier as at connection 5, because at this moment the operation amplifier closes transistor T 8 via T 9. As a result, the resistance of T 8 increases, the motor current drops and the speed cannot, therefore, increase any further.

By switching over or altering the voltage divider in the control circuit the controlled speed can be preselected or altered. With reducing speed the potential at connection 4 of the operation amplifier would change so that transistor T 8 would be fully driven by T 9. T 8 would thus become of low resistance, the result would be a sharp rise in the motor current and thus of the speed.

As this control process takes place even at minor deviations from the nominal speed, a constant speed independent of load fluctuations is obtained.

Fig. 8



Assembly Instructions for Dual EDS 1000

For repair of the Dual EDS 1000 special tools and measuring equipment are necessary. Work on the motor or motor electronic system should, therefore, only be carried out by an authorised Dual service station. Expense arising from unauthorised interference will be charged to the consignor.

Removal

Lift off platter (2). Remove housing of power pack (127) after removing screws (142). Unsolder leads for operating voltage on power board (123).

Note: Do not remove cable on motor side, it must remain connected to the motor.

Unsolder connections at the control bridge (198) and undo cable clip (157). Pass insulating sheath with connecting leads through the recesses in the fitting plate (48) so that they are free from the motor. Pull insulating sheath down. Pull off washer (120). Remove cam wheel (118).

Note: Be careful with ball (165) in stop bar (164) (can drop out).

Disengage spring (145) and pawl (146), remove ball (165), unscrew bearing pillar (119) and hexagon nuts (99), switch on start button (55) and lock so that control arm (138) does not touch the motor housing. Undo the three screws (3) and remove. Lift motor and ensure that the leads are located in the chassis recesses (for the ribs of the fixing lugs). The motor should be turned clockwise slightly. Push insulating sleeve back over the 6 connections and place motor in original carton for return shipment.

Fitment

Remove motor from packing, pull off insulating sheath and when inserting motor, ensure that the lead outlet hole faces towards the light passage (101) of the stroboscope indicator. Now, refit motor and other disassembled components in reverse order to that described under "Removal"

Note: To prevent deformation of the shorting springs the camwheel (118) should not be fitted in 0 position. Ensure that the pin of main lever (170) engages in the guideway. When assembly has been carried out set the two scale rings (56) so that the recesses face towards the tonearm bearing. The pitch control (53) of both speed ranges should be set to 0 position (in alignment with scale rings). Switch on unit and check current consumption. Current consumption during play 220 V/50 Hz approx. 18 mA, 117 V/60 Hz approx. 35 mA.

With regulator (R 27) set nominal speed at 45 rpm, with regulator (R 26) nominal speed at 33 1/3 rpm. Check with the aid of the stroboscope indicator. Run unit in for approximately 5 minutes and, if necessary, correct speed again.

Note: It is advisable subsequently to carry out a brief check of all unit functions.

Stroboscope

Accurate setting of the platter speeds 33 1/3 and 45 rpm can be checked during play with the aid of the stroboscope device.

When the platter (2) is rotating at exactly 33 1/3 or 45 rpm the lines of the stroboscope appear to stand still. If the lines move in the direction of rotation of the platter, the platter speed is too high. If the lines move backwards, the platter is rotating more slowly than the nominal speed.

Adjustment of platter speeds 33 1/3 and 45 rpm is carried out separately with the "pitch" knobs (53).

By turning the stroboscope ring (24) the viewing angle can be altered.

It can happen that the stroboscope lines appear to move slightly although the exact speed setting with stroboscope lines stationary has not been altered. This apparent contradiction is explained by the fact that the electronic central drive motor operates fully independently of line frequency whilst the only relatively accurate line frequency of the AC current supply is used for speed measurement with the light stroboscope.

The constantly detectable fluctuations of line frequency by $\pm 2\%$ (according to the information of the electricity supply company) brief frequency fluctuations up to 1% are possible – only affect the stroboscope indication and can cause the lines to “wander” although the platter speed is as constant and absolutely accurate as before. To change the stroboscope over to line frequency of 50 or 60 Hz the platter should be removed.

Then slacken fillister head cap screws (6), move stroboscope housing (5) to “50” or “60” and retighten screws. After removing the housing top (7) the glow lamp (9) can be changed. In the case of glow lamps with red spot ensure that the red spot (anode) (P) locates on the left-hand contact spring (viewing the unit from the front).

Defekt

After switching the unit on the glow lamp (9) of the stroboscope does not come on.

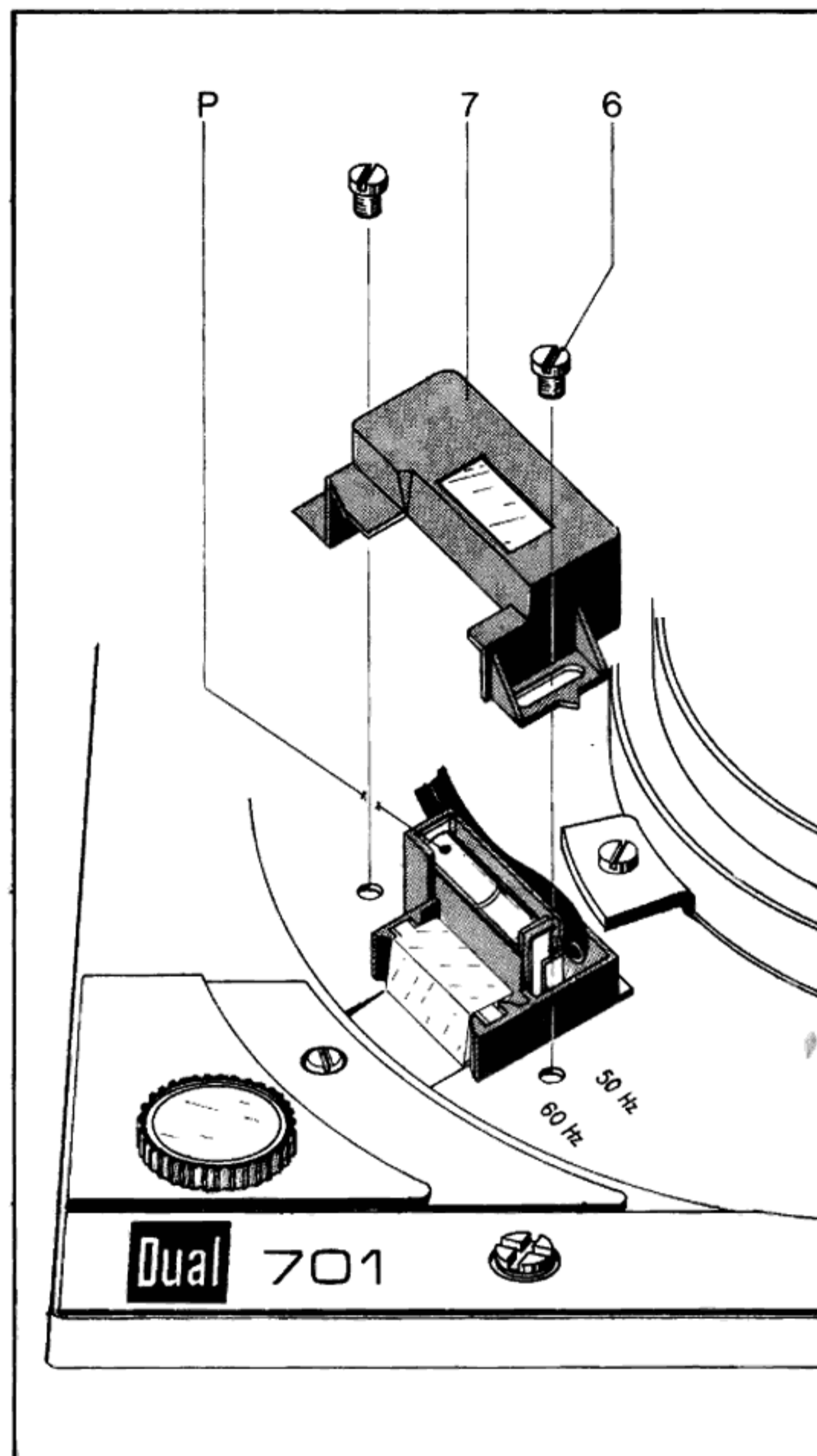
Cause

- Glow lamp (9) defective.
- Power supply interrupted.

Remedy

- Renew glow lamp (9). In the case of glow lamps with red spot, ensure that the red spot (anode) (P) locates on the left-hand contact spring (viewing the unit from the front).
- Check connections at power pack, check components.

Fig. 9 Stroboscope



Pitch Control

The unit has a separately adjustable pitch control for each platter speed. By turning the “pitch” knobs (53) the potentiometers P 1 or P 2 located in a voltage divider are adjusted.

By this means, the potential of the control voltage at the operation amplifier is altered and the motor speed alters correspondingly. Each of the two standard speeds 33 1/3 and 45 rpm can be varied by approximately 8%.

Defect

Nominal speed is at the edge of the control range of the pitch control

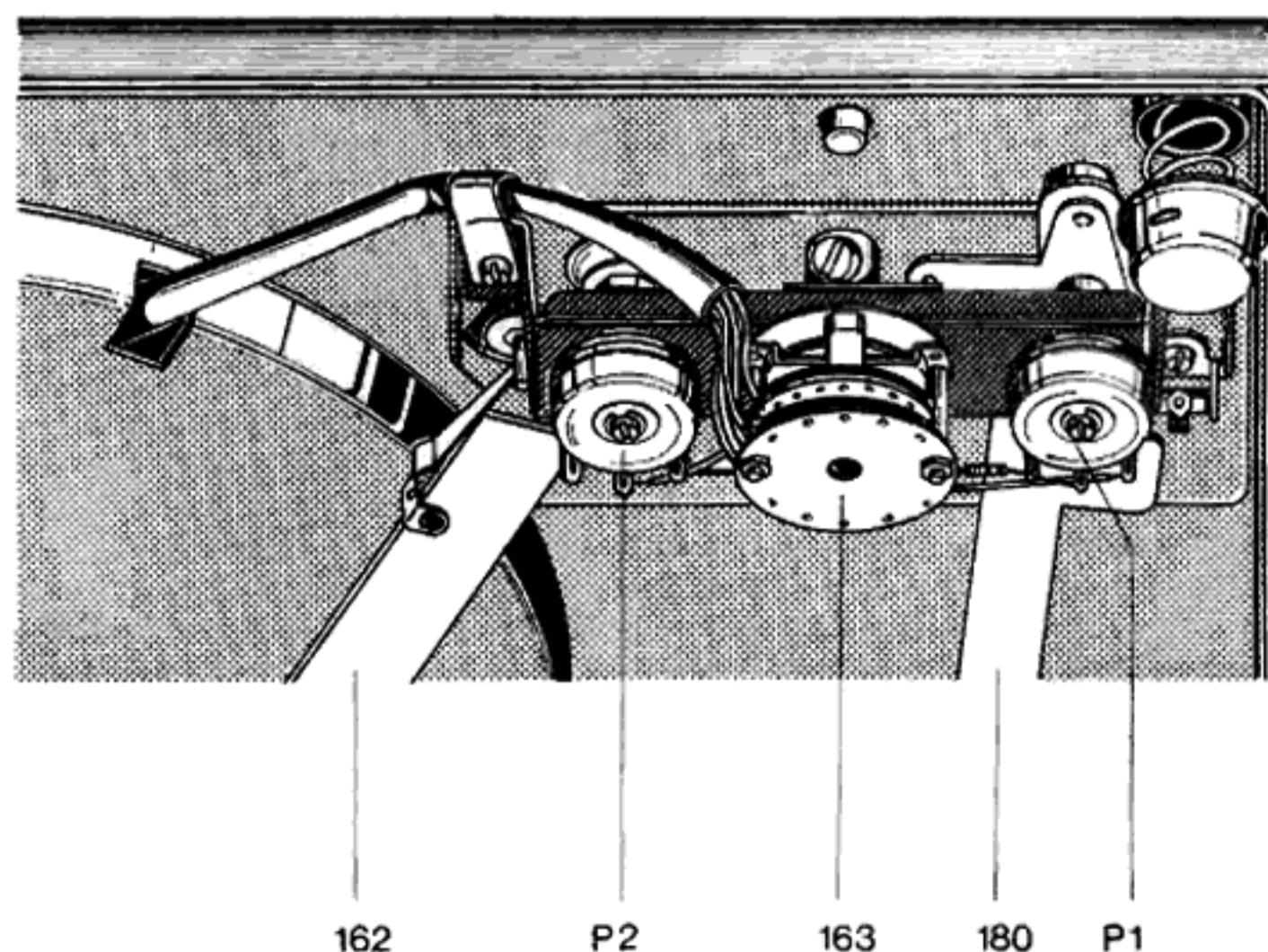
Cause

Setting of regulator (R 26) for 33 1/3 rpm or of the regulator (R 27) for 45 rpm inaccurate.

Remedy

Set scale rings (57) so that the recesses face exactly to the rear (in the direction of the tonearm bearing). The knobs (53) of both speed ranges should be set to “0” position (in alignment with scale rings). Then adjust nominal speed at 33 1/3 rpm with regulator (R 26) and at 45 rpm with regulator (R 27). Check with the aid of the stroboscope indicator.

Fig. 10 Pitch control



Tonearm and Tonearm Suspension

The Dual 701 has a feather-light, extremely torsion resistant all-metal tonearm which is suspended in a gimbal. Suspension is by means of 4 hardened and precision polished steel points which rest in precision ball bearings. Tonearm bearing friction is thus reduced to a minimum.

Bearing friction vertical 0,007 p } related to
 Bearing friction horizontal 0,015 p } stylus point

Fig. 11 Tonearm suspension

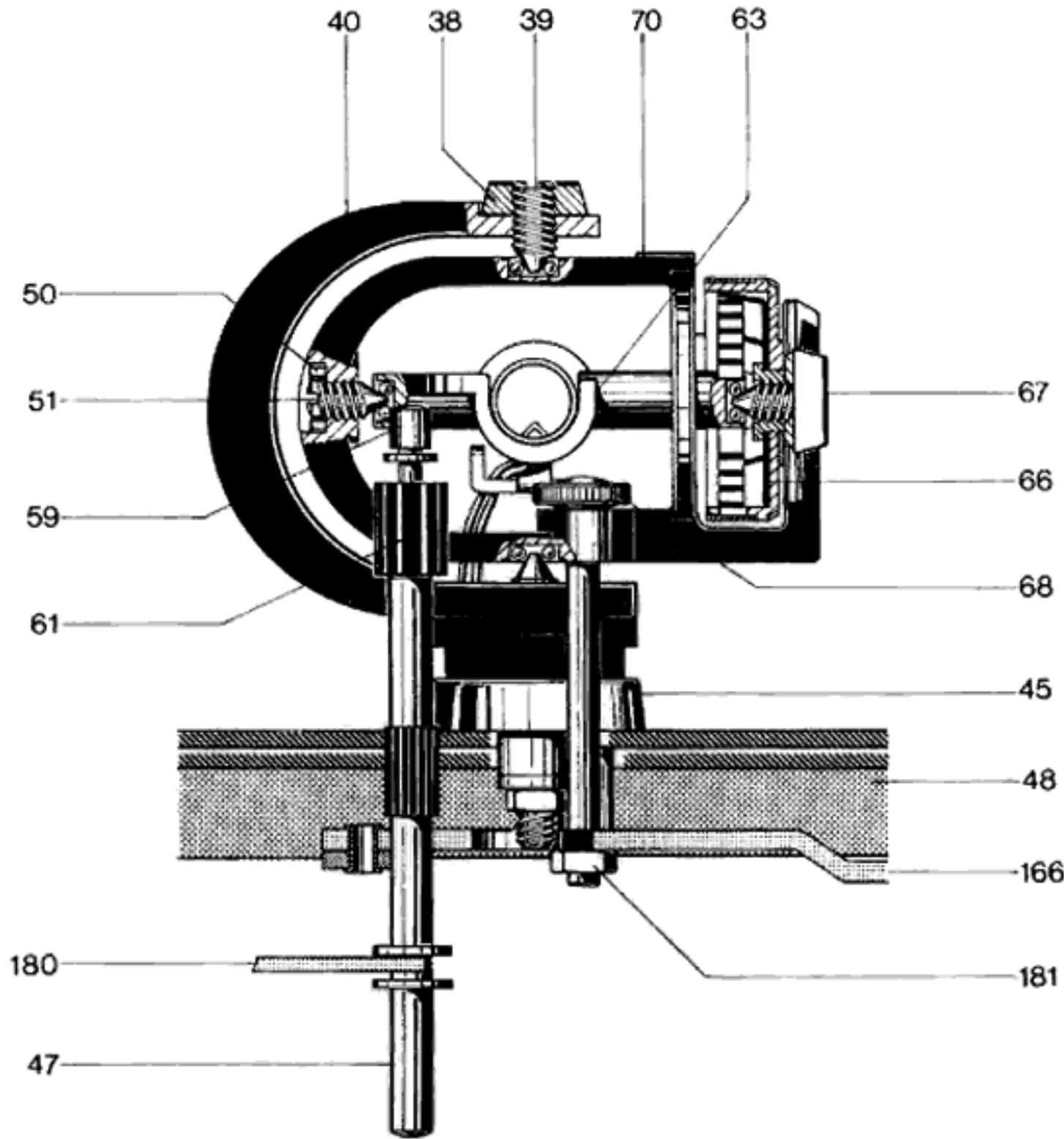
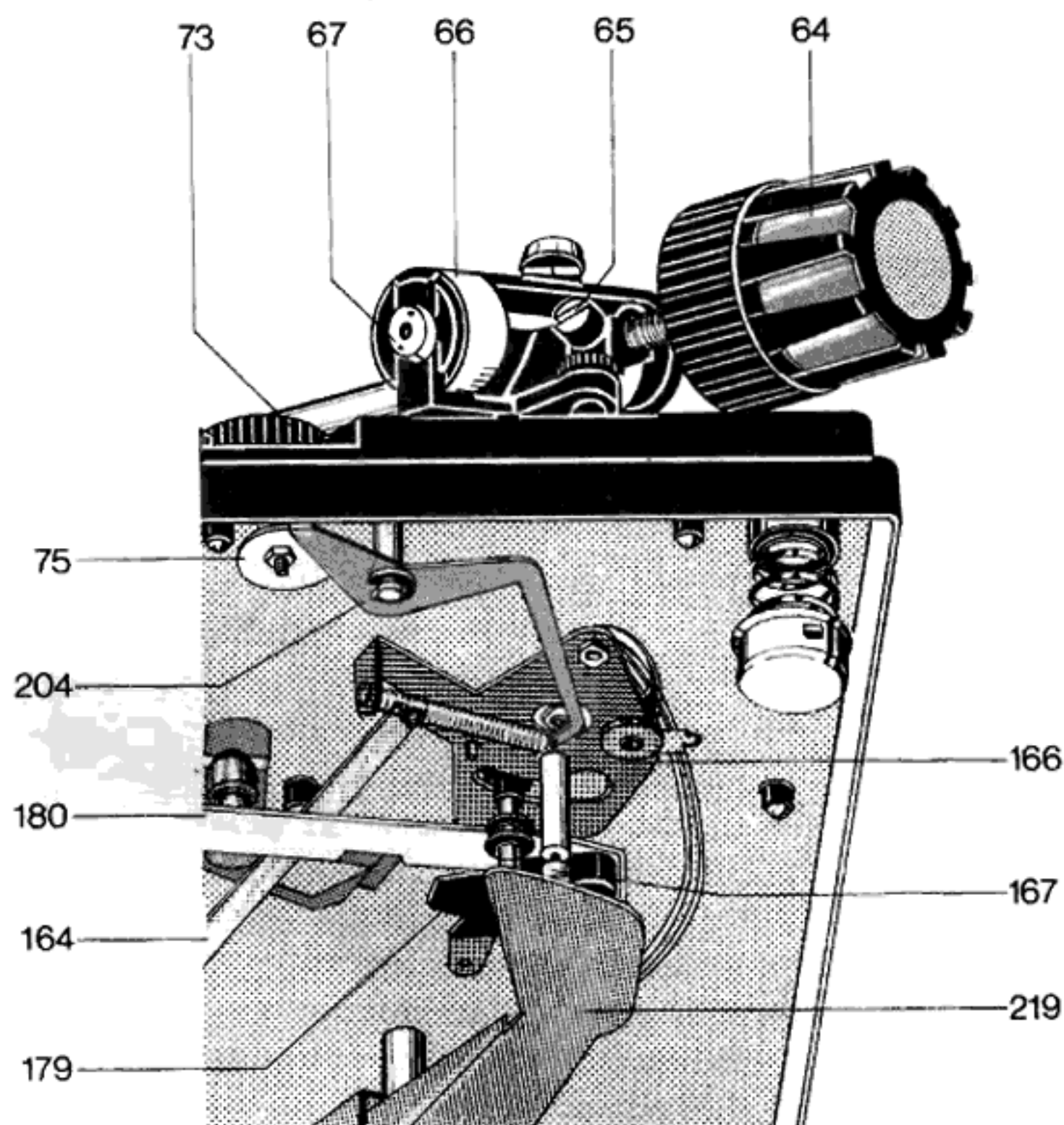


Fig. 12 Tonearm suspension (view from below)



As a result, it ensures extremely favourable pick-up conditions. The pick-up head is removable. Before adjusting the pick-up force to suit the built-in pick-up cartridge the tonearm is balanced with the scale set to 0. Coarse adjustment is carried out by moving the weight (64) with stem, the subsequent fine adjustment by turning the weight.

The balance weight is designed so that pick-up cartridges with a deadweight of 2 - 10 g can be balanced. It takes the form of a double anti-resonator thus absorbing the vibration energy in the range of tonearm and chassis resonance. For this purpose, the inner part weight is matched to the tonearm resonance and thus acts as anti-resonator by means of antiphase vibration. The outer part of the balance weight taking the form of a higher balanced anti-resonator prevents transmission of partially occurring chassis resonance to the tonearm. The balance weight is flexibly connected to the threaded stem and is arrested to prevent unintentional rotation. The pick-up head is suitable for accommodating all pick-up cartridges whose type of mounting conforms with the international 1/2" standard. The tracking force is adjusted by turning the graduated spring housing (77) and thus tensioning or releasing the coil spring mounted inside. The scale has markings for a range of adjustment from 0 - 3 p which permit, in the range from 0 - 1.5 p, accurate adjustment of the tracking force from 0.1 - 0.1 p and in the range from 1.5 - 3 p from 0.25 - 0.25 p. To change the tonearm complete with tonearm suspension we recommend proceeding as follows:

1. Set tracking force scale to 0.
2. Secure unit in repair jig and move into head position.
3. Unsolder tonearm leads.
4. Remove main lever (219) and compression spring (184), stop (179) and tension spring (176).
5. Disengage tension spring (182), remove skating lever (204), be careful with compression spring (205) as it may drop out.
6. Undo washers (191) and (218), turn setscrew (44) until pivot bearing (190) is loose, then remove pivot bearing and slide bar (180).
7. After removing washer (178) and sliding washer (177) detach shut-off bar (253) from segment (166).
8. Undo hexagon nut (181) and pull off segment (166).
9. Remove hexagon nut (188) and washer (187), then withdraw tonearm, be careful with washer (52) which may drop out.

When inserting the tonearm complete with suspension, proceed in reverse order.

The unit should first of all be in normal position, insert washer (52), insert tonearm and secure. Move unit into head position, fit washer (187) and hexagon nut (188).

To remove the tonearm from the bearing race the tracking force scale should first be set to zero position after unsoldering the tonearm leads. Unscrew locknut (50) with grub screw (51) and mounting screw (67).

Adjusting the Tonearm Bearing

Both bearings must have slight, just perceptible play. Adjustment of the vertical bearing should only be carried out by means of grub screw (51), that of the horizontal bearing by means of grub screw (39). The horizontal tonearm bearing is correctly adjusted when at anti-skating setting "0.5" (tonearm previously balanced exactly) the tonearm slides in without resistance.

Anti-Skating Device

The geometrical skating force acting on every tonearm is eliminated on the Dual 701 by means of a precision anti-skating device. The skating force is dependent on the geometry of the tonearm, on the tracking force and on the tip curvature of the stylus of the pick-up cartridge. The pull on the tonearm to the center of the platter caused by the skating effect leads not only to troublesome jumping of the tonearm when lowered manually or automatically, but also the uneven flank loading of the sound groove with the resultant effects which have to be eliminated on a high-quality record player with the aid of an anti-skating device.

Turning the knob (73) of the anti-skating device on the mounting plate moves the asymmetrical plate cam (75) attached to the knob spindle. This plate cam has two different curves which, according to use of the red anti-skating scale for conical styli or the white anti-skating scale for elliptical styli, move the skating lever 204 from its neutral position and transmit the counter force to the tonearm by means of tension spring (182).

Optimum adjustment is carried out at the works for styli with a tip radius of $15 \pm 2 \mu\text{m}$ (conical) and $5/6$ and $18/22 \mu\text{m}$ (elliptical). The hexagon nut (76) is tightened and locked with paint. Alteration can only be carried out with the aid of the Dual Skate-0-Meter and test record L 096 and should only be done by an authorised service station.

Fig. 13 Anti-skating Force

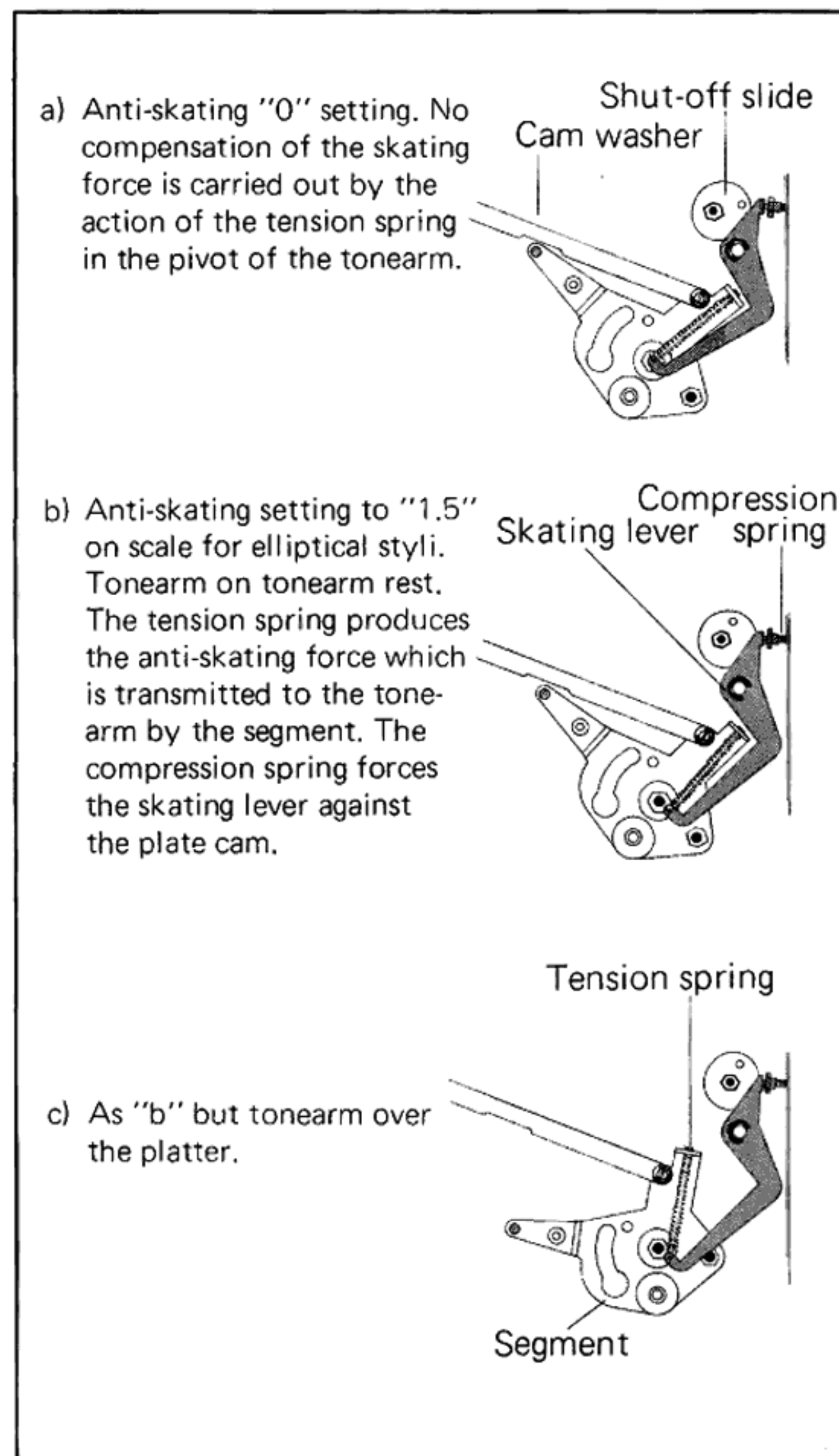
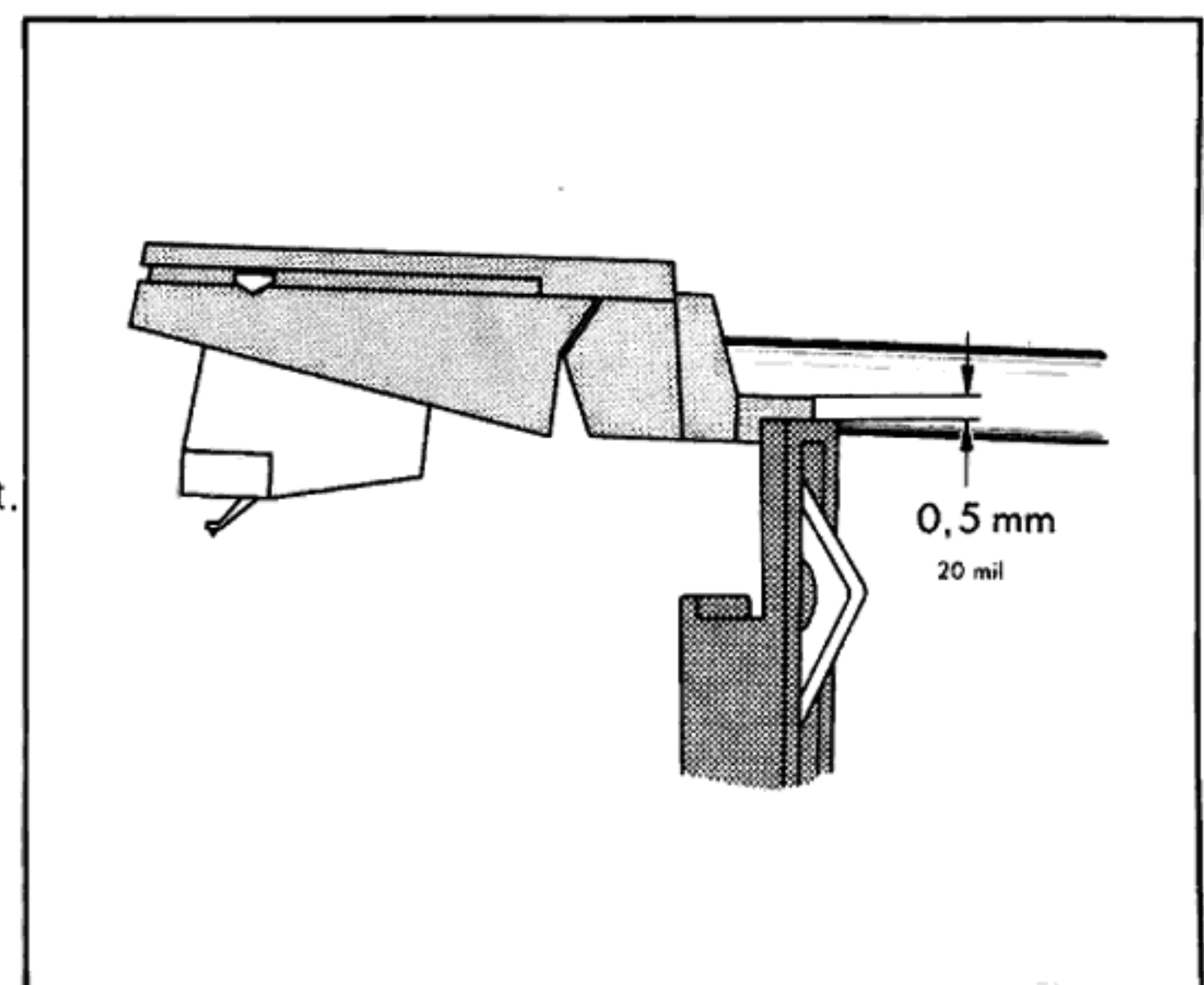


Fig. 14



Defect

Horizontal movement of tonearm impeded on set down.

Cause

Adjusting screw (68) or adjusting sleeve (61) out of adjustment.

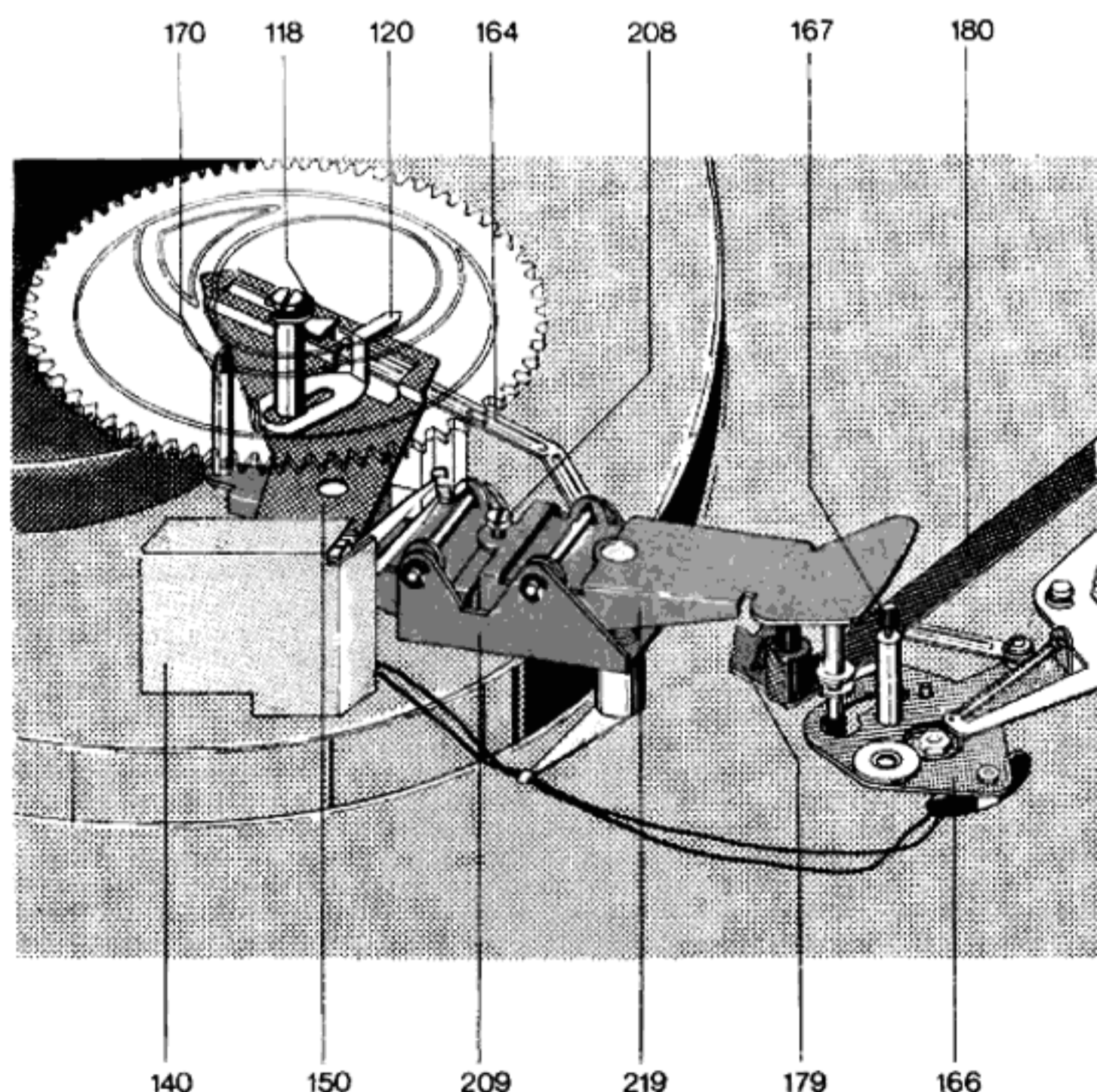
Remedy

Lift tonearm and adjust screw (68) so that the bottom edge of the tonearm head is flush with the top edge of the tonearm rest.

Then, turn adjusting sleeve (61) so that with main lever (219) pushed up there is play of approximately 0.1 mm between stud and contact face of tonearm. (Measured at tonearm head approx. 0.5 mm). (Fig. 14).

Defect	Cause	Remedy
Stylus slips out of playing groove	a) Tonearm is not balanced	a) Balance tonearm
	b) Tonearm tracking force is too low	b) Adjust tracking force to the value stated by the cartridge manufacturer
	c) Anti-skating setting incorrect	c) Correct anti-skating setting
	d) Stylus tip worn or chipped	d) Renew stylus
	e) Excessive bearing friction in tonearm bearing	e) Check tonearm bearings. Both bearings must have slight, just perceptible play. The adjustment of the vertical bearing should only be carried out with the left-hand bearing screw (grub screw 51), that of the horizontal bearing by means of grub screw (39). The horizontal tonearm bearing is correctly adjusted when on anti-skating setting "0.5" (first of all accurately balance tonearm) the tonearm slides out without resistance.
	f) Steel ball (165) of shut-off bar missing	f) Renew steel ball (165)
Vertical tonearm movement shows resistance during set-down	a) Bearing friction excessive	a) Eliminate friction by adjusting the bearing screw (grub screw 51) and check balance.
	b) Lift pin (47) sticks in guide tube	b) Remove tonearm complete with tonearm suspension (described on page 12), detach control stud (59) on lift pin (47), remove ideal washer (60), detach adjusting sleeve (61) and remove second washer (62). Withdraw lift pin. Clean lift tube and lift pin. Smear lift pin evenly with "Wacker Silicone Oil AK 300 000". Reassemble components.

Fig. 15 Tonearm Control



Tonearm Control

Automatic movement of the tonearm is initiated by the control cams on the inside of the cam wheel (118) on rotating through 360°. The control elements for raising and lowering are the control lever (170), the main lever (219) and the lift pin (47), for horizontal movement of the tonearm control lever (170), main lever (219) and the coupling pin on segment (166). The automatic tonearm set-down is designed for 30 cm and 17 cm records and is coupled to the platter speed changeover. When set to platter speed of 33 1/3 rpm the tonearm sets down in the lead-in groove of 30 cm long playing records, when set to 45 rpm in the lead-in groove of 17 cm records.

Limitation of the horizontal movement (set-down point) of the tonearm is produced by the pin of segment (166) contacting the stop (179) attached to the slide bar (180).

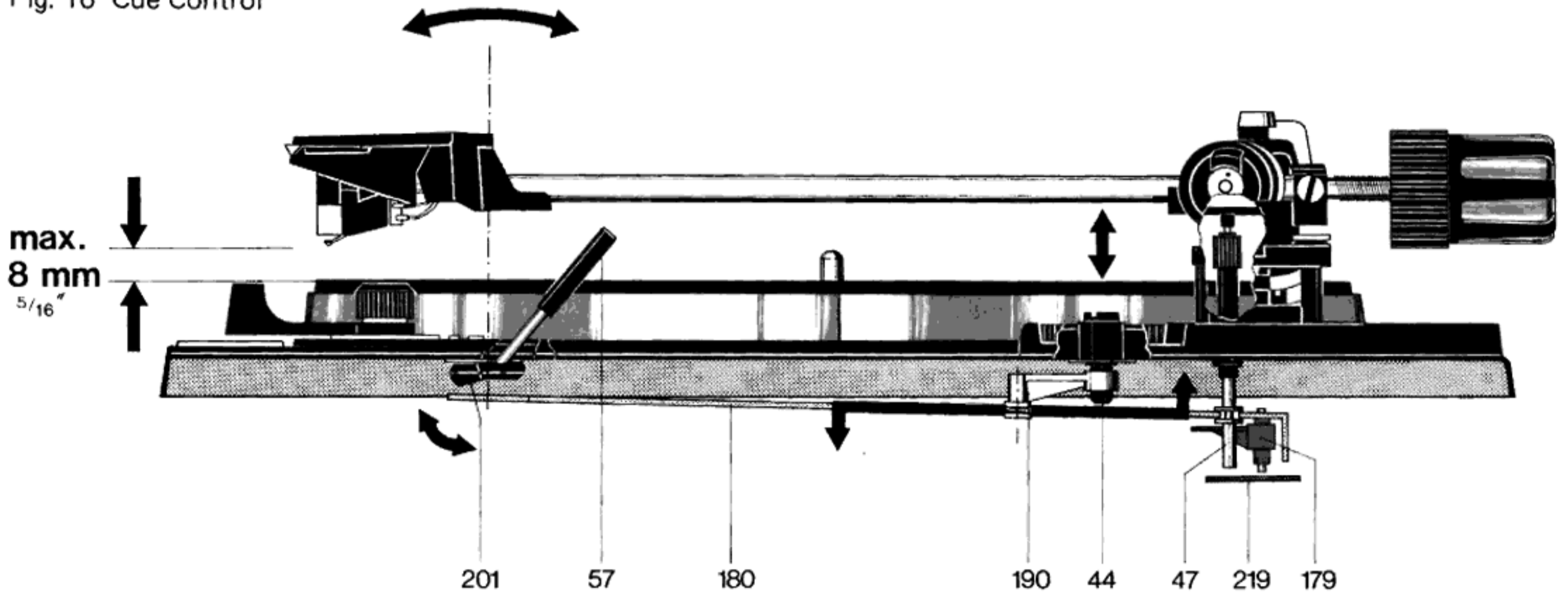
Only during set-down does main lever (219) lift the slide bar (180) and the stop (179) attached to it which, as a result, moves into the swivel range of the stop pin fitted on segment (166). After completion of set down (lowering of the tonearm onto the record) slide bar (180) is released again and returns to neutral position. As a result, stop (179) moves out of the swivel range of the stop pin so that unimpeded horizontal movement of the tonearm is possible for playing.

Cue Control

The cue control permits gentle set-down of the tonearm at any desired point (outside the shut-off range) on the record. By moving the lever (moving forwards) lift cam (201) rotates. The slide bar (180) connected to it transmits this movement to the lift pin (47) which then raises the tonearm. After moving the tonearm into the required position on the record, the lever is released by gently moving to the rear. As a result, slide bar (180) is released whereby as a result of

the action of the compression spring (46) lift pin (47) is returned to neutral position and thus lowers the tonearm. Lowering of the tonearm is damped by silicone oil in the lift tube. The height of the stylus above the record can be varied by turning adjusting screw (44). The distance is increased by turning clockwise and the distance between record and stylus can be reduced by turning anti-clockwise.

Fig. 16 Cue Control



Defect	Cause	Remedy
Tonearm does not set down at the edge of the record	<ul style="list-style-type: none"> a) Record size setting incorrect b) Tonearm set-down point is incorrectly set c) Record non-standard d) Friction face of tonearm coupling dirty 	<ul style="list-style-type: none"> a) Carry out necessary adjustment with the righthand control hand control lever (55). b) Adjust tonearm set-down point in accordance with the data in the Operating Manual so that the tonearm sets down approximately 1.5 mm from the record edge. (Adjustment is only carried out for 30 cm records and is obtained automatically for 17.5 cm records). c) Use standard record d) Clean friction face.
Tonearm does not set down on record after operating cue control	Excessive damping in the lift tube as a result of contamination of the silicone oil	Remove tonearm complete with tonearm suspension (described on page 12), detach control stud (59) on lift pin (47), remove washer (60), detach adjusting sleeve (61) and remove second washer (62). Withdraw lift pin. Clean lift tube and lift pin. Smear lift pin evenly with 'Wacker Silicone Oil AK 300 000'. Reassemble components.
Tonearm lowers onto record too quickly when cue control is operated	Damping insufficient as a result of unsuitable addition of lubricant to damping compound	Remove tonearm complete with tonearm suspension (described on page 12), detach control stud (59) on lift pin (47), remove washer (60), detach adjusting sleeve (61) and remove second washer (62). Withdraw lift pin. Clean lift tube and lift pin. Smear lift pin evenly with 'Wacker Silicone Oil AK 300 000'. Reassemble components.
Tonearm returns to rest after manual set-down immediately after the platter starts to turn	Position of shut-off has altered during transport of the unit.	After fitment and each time after transport the unit should be started once with tonearm secured for automatic adjustment of automatic shut-off (control switch to "Start").

Starting

Change lever (162) is rotated clockwise when the lefthand control lever (55) is operated. This results in the following functions being initiated:

- a) The control arm (138) connected to change lever (162) operates the power switch which then starts the platter rotating. Simultaneously, pawl (146) coupled to the change lever by a tension spring engages and retains it in this position.
- b) The change lever presses the shut-off lever (122) towards the dogs on the motor pinion and thus causes camwheel (118) to rotate. The pawl (146) then moves deflection lever (115) into starting position.

After fitment and each time after transport the unit should be started once with the tonearm secured. By this means the shut-off lever (122) which may have assumed a different position as a result of transport will be automatically adjusted.

Manual Start

The pawl (134) coupled to control arm (138) engages behind the square end attached to the chassis when the tonearm is moved inwards by hand and retains the control arm in this position.

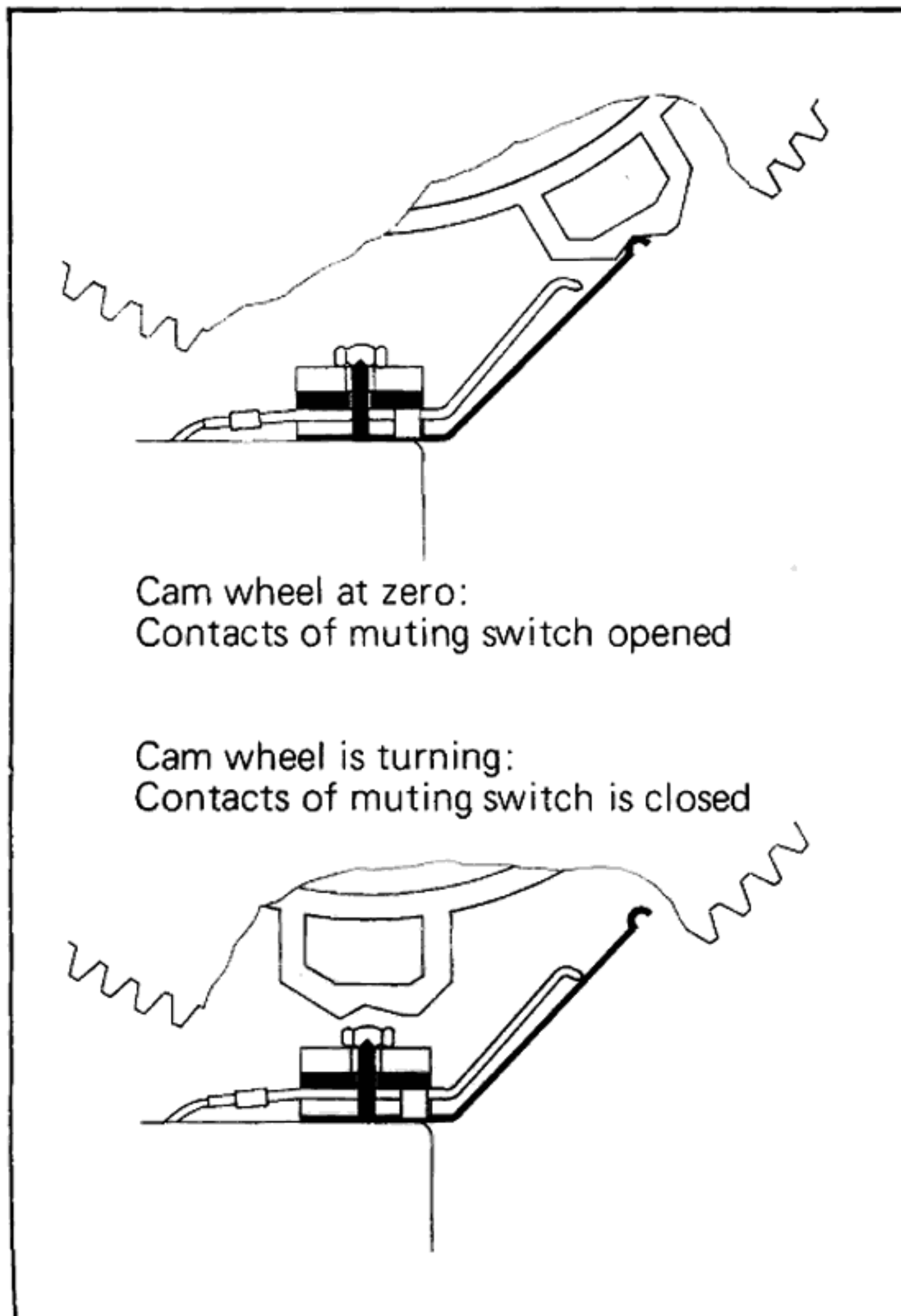
The power switch is operated by the control arm and thus the platten starts to rotate.

After reaching the run-out groove of the played record return of the tonearm and shut-off of the unit take place automatically. If, on the other hand, the tonearm is lifted off the record before playing is completed and is moved on to the rest by hand, the pin of the segment disengages the pawl (134) so that the control arm is returned to its starting position. As a result, the power switch shuts off the power supply.

Stopping

When control lever (55) is set to "stop" position the change lever (162) is turned anti-clockwise. The shut-off lever (122) moves towards the dogs on the platter pinion and the camwheel starts to rotate. The change lever remains in stop position.

Fig. 17 Short Circuiter



Short Circuiter

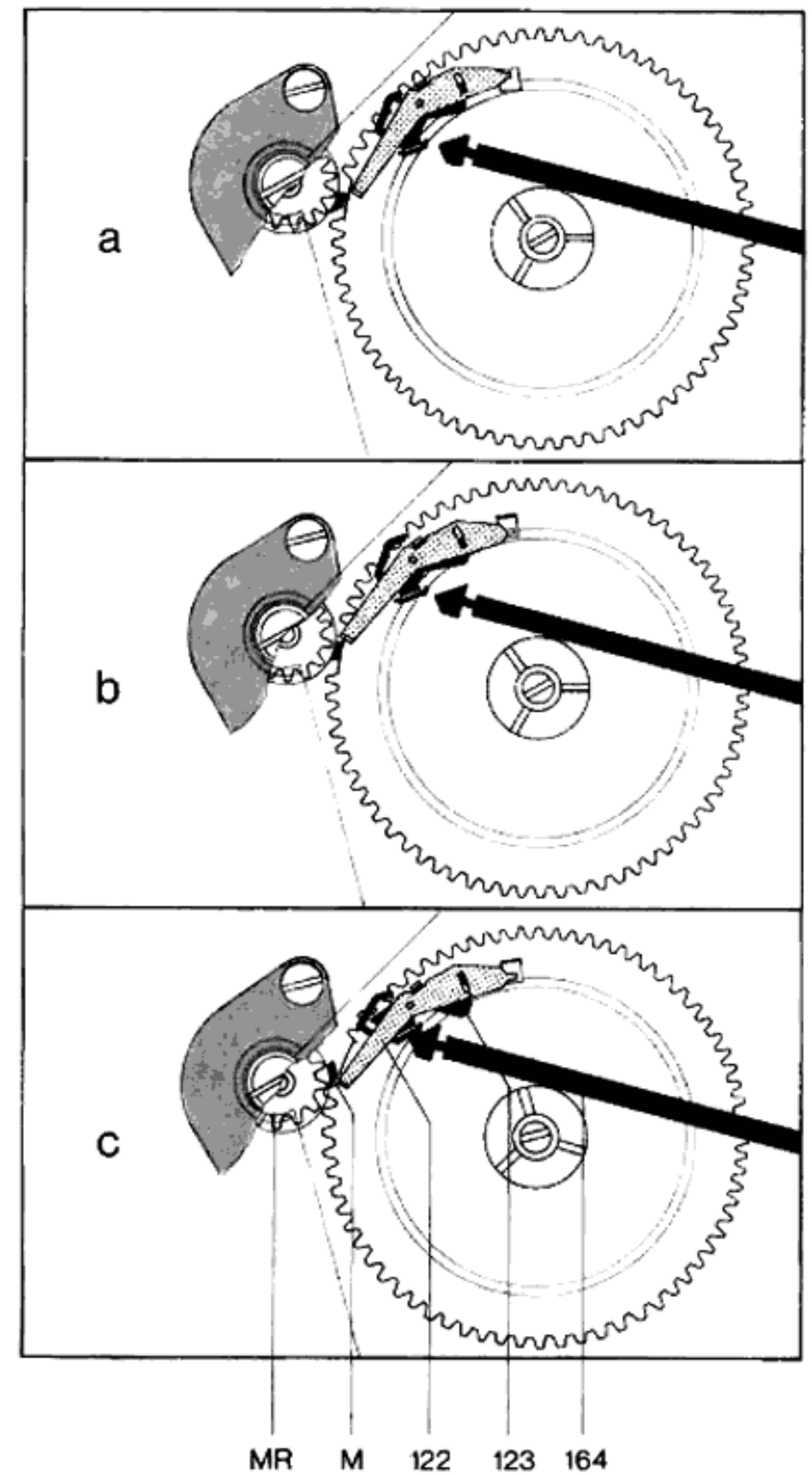
To prevent disturbing noises during automatic operation of the tonearm the unit is fitted with a short circuiter. Control of the switch springs for both channels is effected by the camwheel. With the unit in neutral state the short circuit of the pick-up leads is eliminated.

Shut-off

The functions of automatic set-down and shut-off are determined by the position of the deflection lever (115). The deflection lever is only moved out of stop position during starting by the pawl (146). Initiation of shut-off after playing the record is brought about by the dog (M) of the motor pinion and the shut-off lever (122). The shut-off lever (122) is guided onto the dog by the movement of the tonearm when playing the record with the aid of the shut-off bar (164) proportionate to the groove lead. The eccentrically-mounted dog forces the shut-off lever (166) back with each revolution as long as the advance of the tonearm only amounts to the width of 1 groove (Fig. 18a).

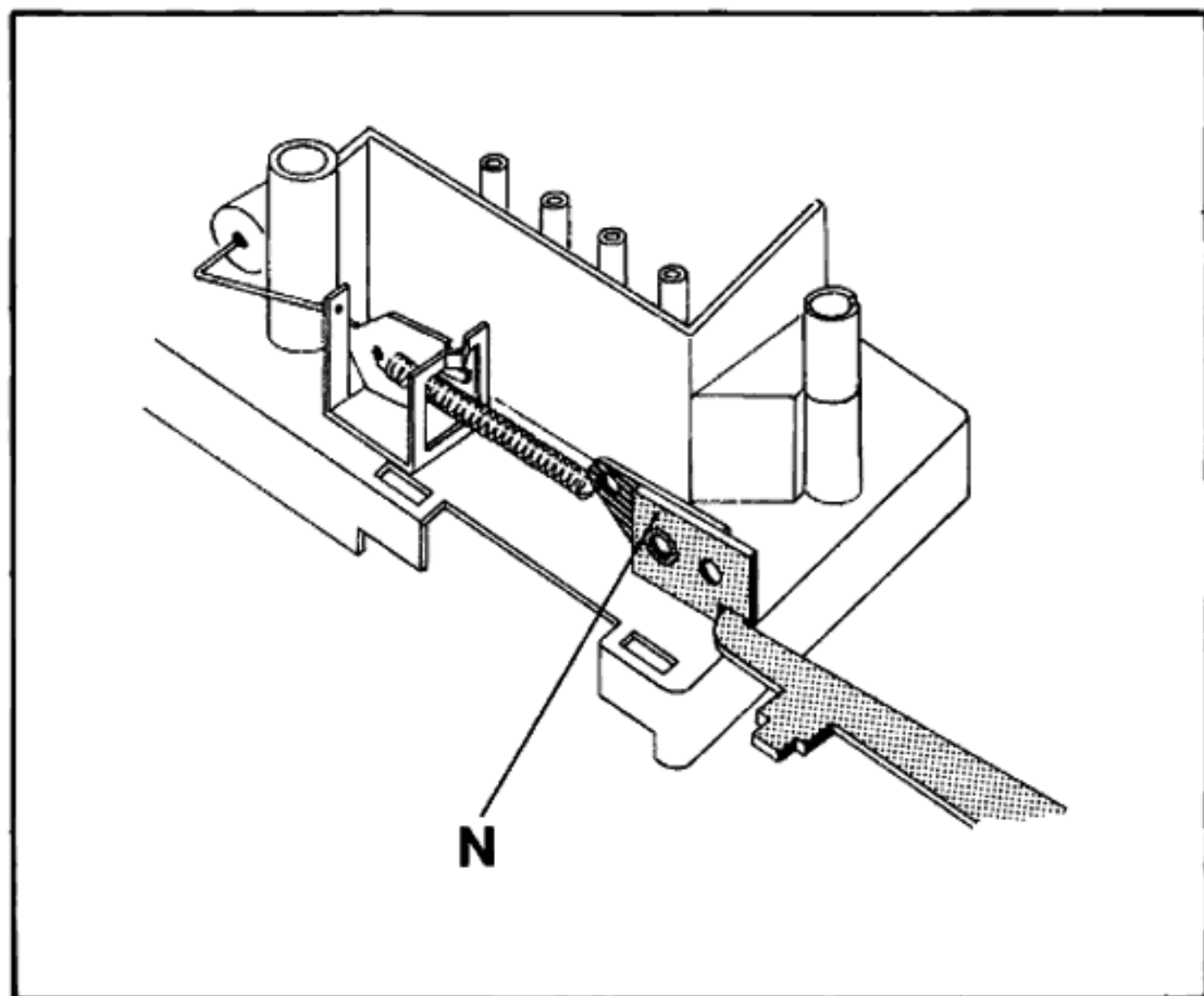
Only the runout groove with its increased lead guides the shut-off lever (164) onto the dog at a higher rate so that the shut-off lever is picked up and moved along (Fig. 18 b). The camwheel (118) is thus moved out of zero position into engagement with the pinion of the motor (Fig. 18c).

Fig. 18 Initiation of Shut-off Function



Defect	Cause	Remedy
Tonearm moves with tracking force and anti-skating scale in 0 position:		
a) outwards	a) Anti-skating device out of adjustment	a) Adjust skating lever so that skating spring acts exactly at the tonearm pivot
b) inwards	b) Excessively tight tonearm leads produce a torque	b) Loosen tonearm leads.
During automatic operation of tonearm disturbing noises are perceptible	Short circuiter out of adjustment. The distances between the slide springs and the short circuit strips on the short circuiter are excessive.	By bending the short circuit strips. Adjustment is correct when, with the camwheel in neutral position, the distance between the slide springs and the short circuit strips on the short circuiter is approximately 0.5 mm. Spray contact springs with preservative (e.g. Kontakt 61) and check adjustment of short circuit strips.
No reproduction. The short circuit of the pick-up leads is no longer being eliminated.	Distance between the slide springs and the short circuit strips on the short circuiter is absent or insufficient.	By adjusting the short circuit strips. Adjustment is correct when, with the camwheel in neutral position, the distance between the slide springs and the short circuit strips on the short circuiter is approximately 0.5 mm.
Motor does not shut off when tonearm sets down on rest.	Suppression capacitor (in power switch) is defective (short circuit).	Replace suppression capacitor in power switch with new component (10 000 pF/700 V).
Acoustic feedback	a) Chassis components (e.g. also connecting leads) are rubbing on cutout b) Connecting leads are too tight	a) Line up cutout in accordance with data in fitting instructions. Move leads. b) Slacken or lengthen cable.

Fig. 19



Defect

Platter remains stationary after automatic set-down of tonearm on record.

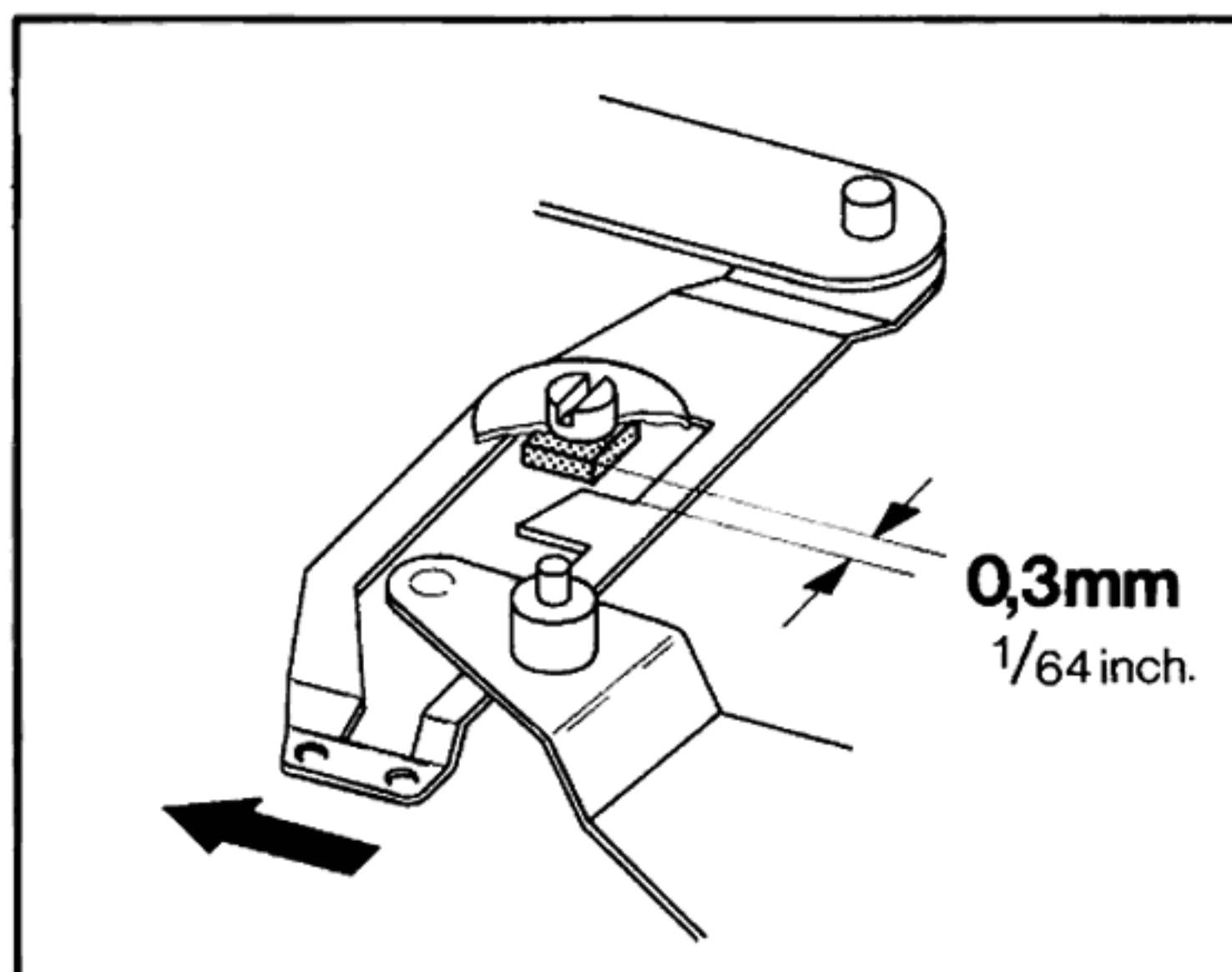
Cause

- a) Power switch has interrupted power supply (has switched off)
- b) Square end not secured in correct position. Pawl can disengage.

Remedy

- a) When the tonearm moves into position the control arm (138) must have overrun of 0.3 – 0.5 mm. If necessary, adjust lug (N) of control arm (138) in power switch.
- b) Slacken bolt. Press pawl firmly against square end (135) and tighten bolt.

Fig. 20



Defect

Tonearm remains suspended just outside the 30 cm record when moved in or out.

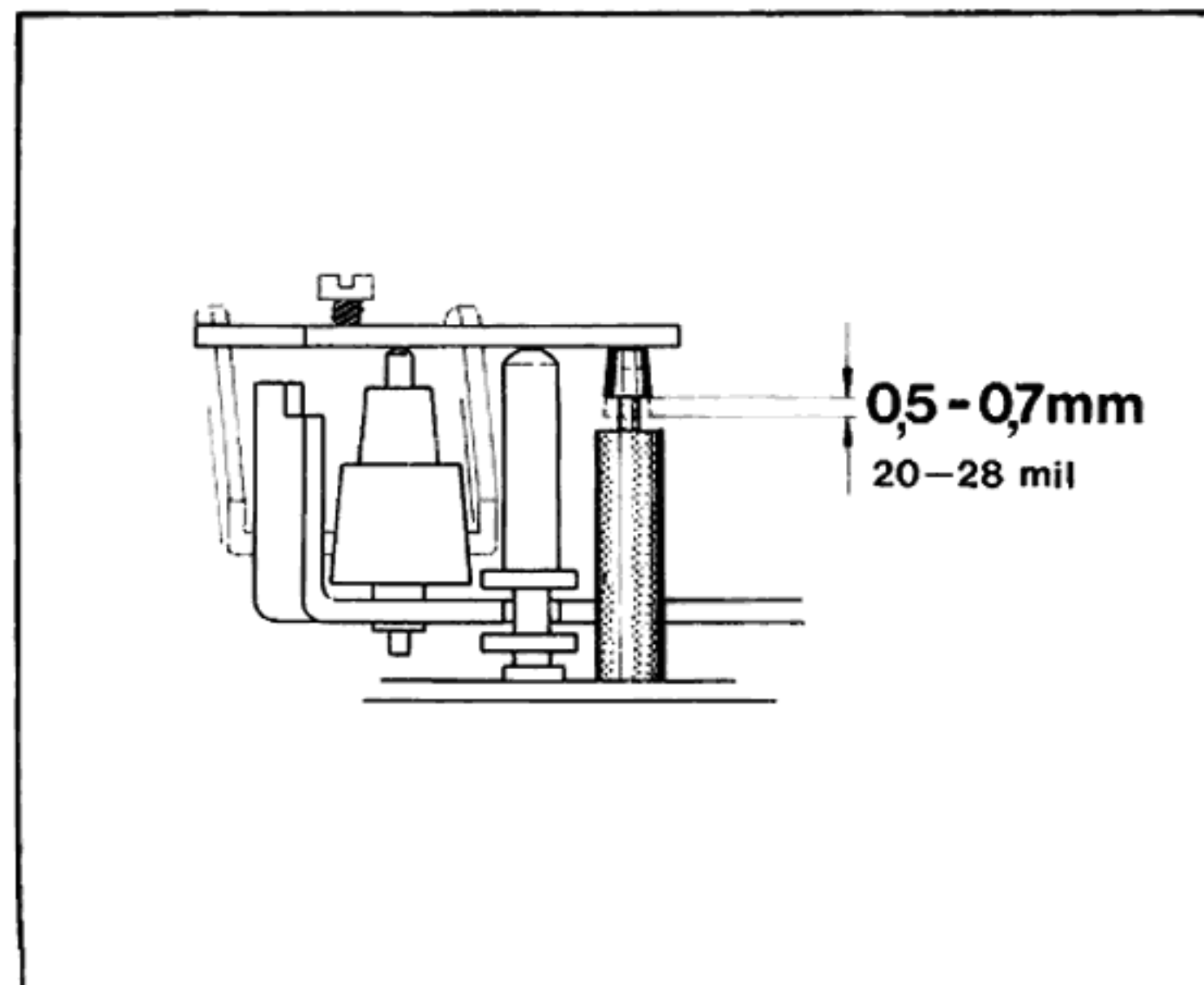
Cause

Control arm out of adjustment. Pawl resting on square pin.

Remedy

Adjust by rotating the eccentric of the control arm (138). Adjustment is correct if, when the tonearm moves into position and the camwheel is turned by hand, the pawl is 0.3 mm away from the square end (135), screwed in the chassis (Fig. 20).

Fig. 21



Defect

Tonearm does not move into position when control lever is operated.

Cause

- a) Control lever (55) not pressed onto stop.
- b) Control stud (167) worn.
- c) Overrun of main lever (219) insufficient.

Remedy

- a) Push control lever onto stop.
- b) Renew control stud (167).
- c) Lift main lever (219) by means of camwheel control. With the adjusting screw (208) on the main lever press the coupling pin with control stud (167) down by 0.5 – 0.7 mm (Fig. 21).

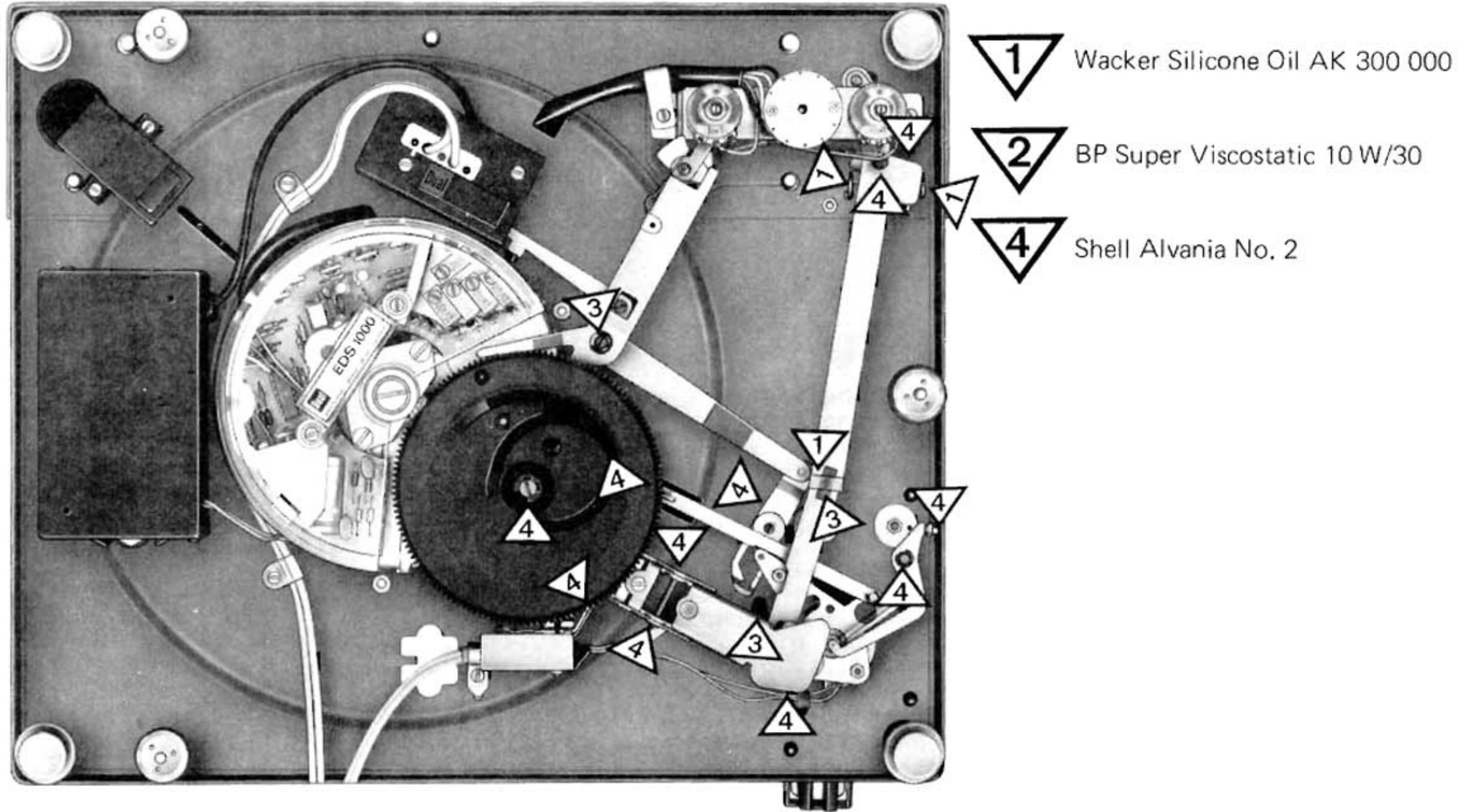
Lubricating Instructions

All bearing and friction points of the unit are adequately lubricated at the works. Replenishment of oil and grease is only necessary after approximately 2 years of normal use of the record player as the most important bearing points (motor bearings) have sintered metal bushes.

Bearing points and friction faces should be lubricated sparingly rather than generously.

When using different lubricants, chemical decomposition can often take place. To prevent lubrication failure we recommend using the original lubricants stated below. The following lubricants should be used for subsequent lubrication:

Fig. 22



Spare parts

Ref. No.	Part. No.	Description	Quantity	Price group
1	229 068	Turntable mat complete with washer	1	052
2	229 064	Turntable complete with mat	1	078
3	210 516	Machine screw M 4 x 8	3	012
4	228 558	Electronic direct drive system EDS 1000 compl. .	1	Price of strain relief
5	229 065	Case compl.	1	050
6	210 469	Machine screw M 3 x 3	2	012
7	229 047	Case upper part compl.	1	029
8	227 165	Deflecting prism	1	024
9	225 321	Tubular glim lamp	1	030

Ref. No.	Part. No.	Description	Quantity	Price group
10	229 033	Case lower part compl.	1	046
11	228 103	Special screw, short	3	021
12	229 069	Shipping screw assembly	3	023
13	227 155	Rest ring, compl.	1	015
14	210 516	Machine screw M 4 x 8	2	012
15	201 632	Rubber washer	3	013
16	200 713	Washer	3	014
17	200 712	Spring cup	3	015
18	220 213	Centering disc	1	Mdse.gp.E.
19	227 345	Washer	1	041
20	210 624	Washer 4.2/7/0.3	6	012
21	200 718	Compression spring	3	014
22	210 624	Washer 4.2/7/0.3	6	012
23	200 711	Lockwasher	3	011
24	227 194	Ring compl.	1	028
25	229 067	Blind compl.	1	064
26	210 362	Hex nut M 3	1	012
27	227 535	Lift	1	017
28	210 182	Bowed lockwasher	1	013
29	210 630	Washer 4.2/8/0.5	1	012
30	210 197	Ring	1	012
31	210 225	Threaded pin M 3 x 5	2	012
32	227 439	Flat head screw M 3 x 3	3	013
33	210 361	Hex nut M 3	1	011
34	200 721	Threaded piece	4	015
35	200 728	Compression spring right	2	019
	227 855	Compression spring left red	2	014
36	200 723	Rubber damping block	4	018
37	200 722	Steel cup	4	019
38	227 589	Locknut	1	021
39	221 486	Threaded pin, long	1	016
40	229 048	Frame, compl.	1	044
41	229 072	Contact plate compl.	1	041
42	229 077	Tonearm head compl.	1	050
43	215 430	Cartridge mount TK 14 compl.	1	Mdse.gp.E.
44	227 049	Locating screw for pin	1	023
45	229 025	Dress plate	1	035
46	216 853	Compression spring	1	013
47	227 051	Lifting bolt complete	1	024
48	229 066	Installation plate complete	1	064
49	229 070	Spring mounted footing, compl. (1 set = 4 pieces)	1	Mdse.gp.E.
50	216 831	Locknut	1	018
51	216 830	Threaded pin, short	1	016
52	210 644	Washer 4.2/12/1.5	1	012
53	229 063	Knob complete with threaded pin	2	030
54	227 305	Hex nut M 6	2	015
55	225 874	Switch lever	2	029
56	227 117	Dial	2	025
57	227 600	Lever complete	1	022
58	210 353	Hex nut M 2	1	011
59	216 844	Guide	1	014
60	210 143	"C" washer 1.5	2	011
61	218 318	Positioning sleeve	1	014
62	210 143	"C" washer 1.5	2	011
63	229 074	Tonearm complete	1	061
64	229 139	Weight complete	1	051
65	227 569	Strain screw	1	022
66	229 071	Spring housing complete	1	033
67	227 591	Bearing screw complete	1	023
68	217 600	Locating screw	1	019
69	218 894	Bowed lock washer 3.2/8	1	012
70	229 024	Bearing rack complete	1	051
71	229 062	Rest complete	1	029
72	210 362	Hex nut M 3	1	012
73	227 150	Knob complete for anti-skating	1	024
74	216 867	Bowed lockwasher 5.2/10	1	012
75	225 176	Cam washer	1	018
76	210 361	Hex nut M 3	1	011
77	213 471	Machine screw B 2.9 x 6.5	4	013

Fig. 23 Exploded view, above chassis

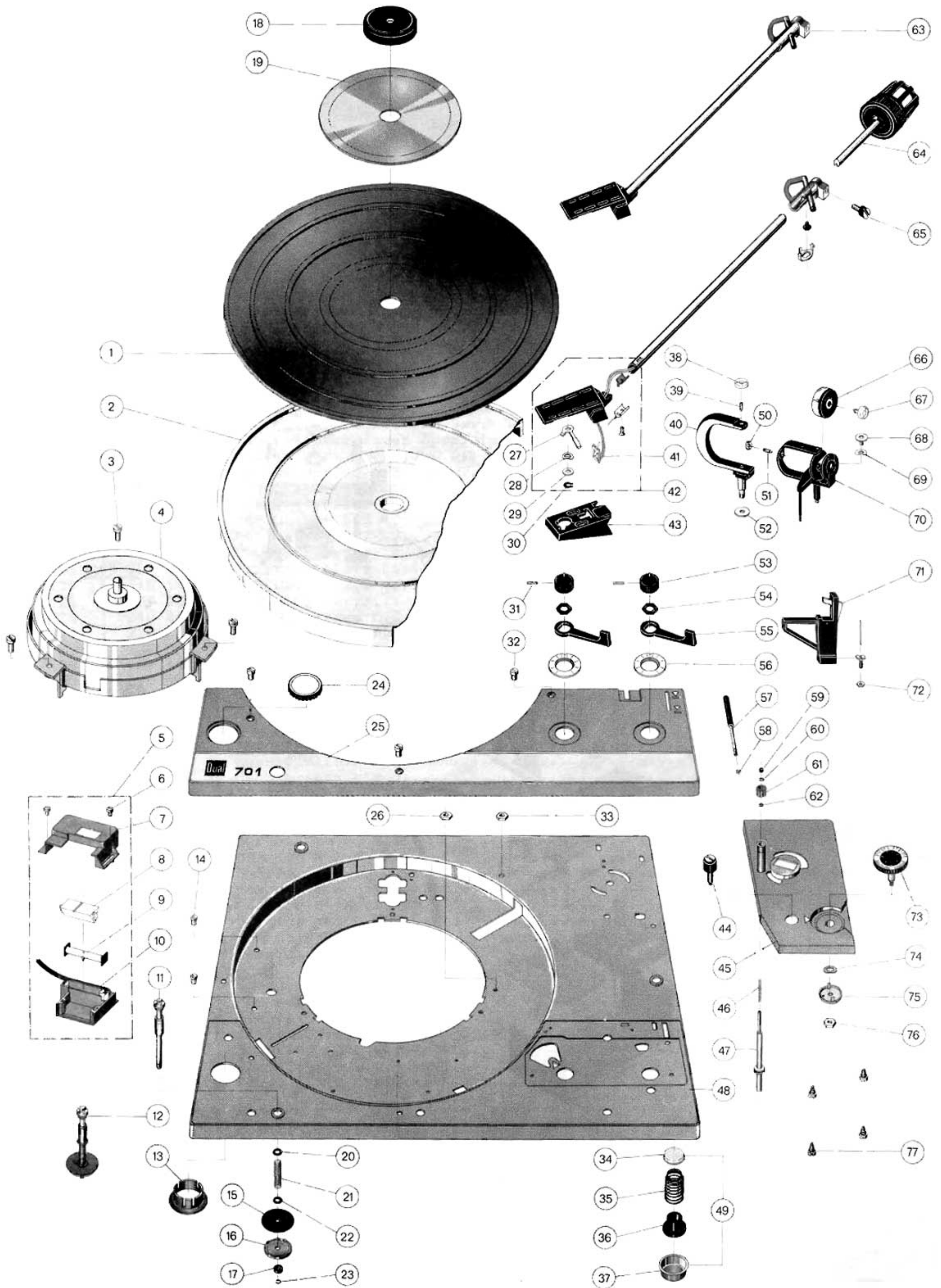
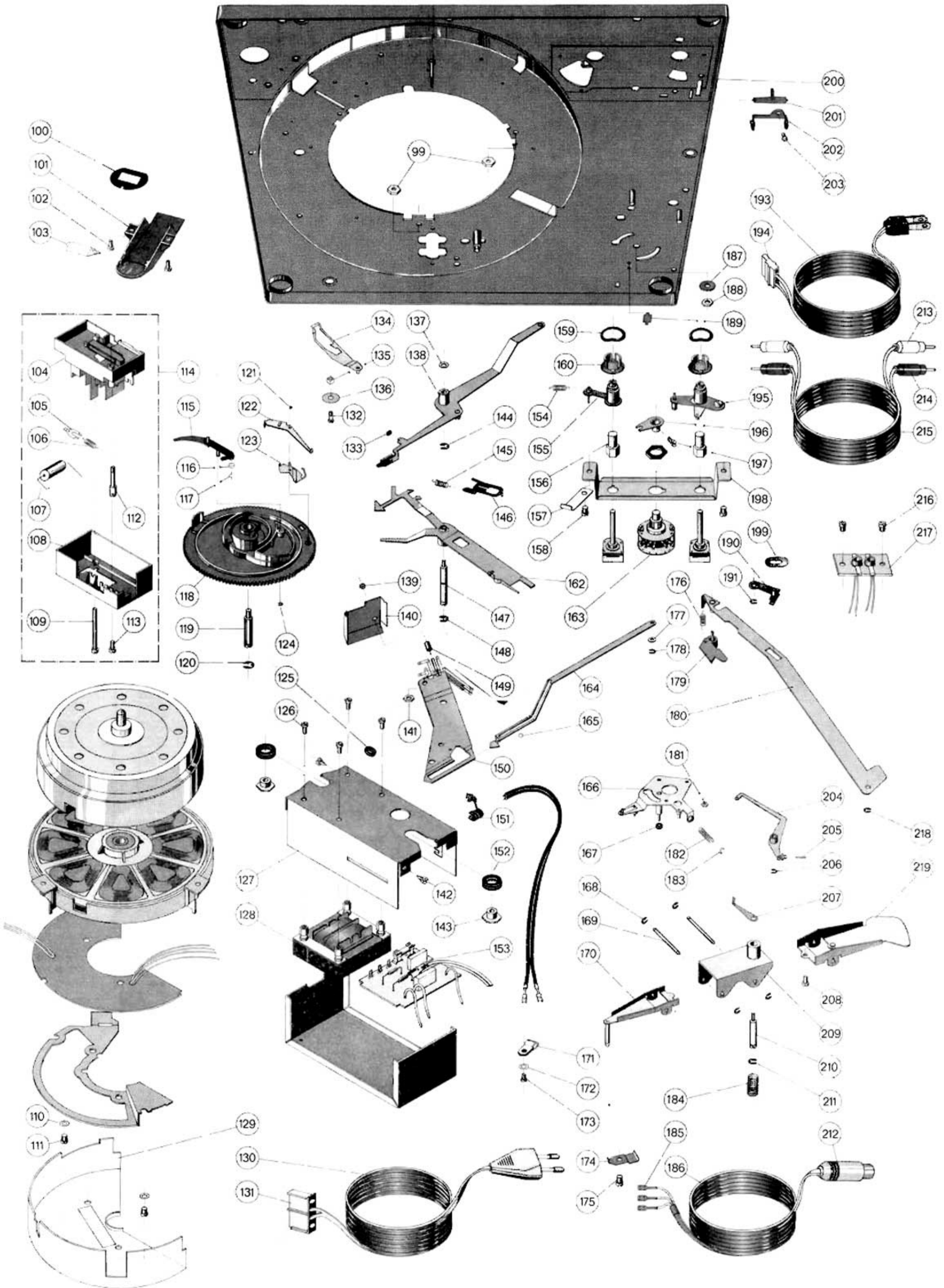


Fig. 24 Exploded view, below chassis



Ref. No.	Part. No.	Description	Quantity	Price group
99	210 365	Hex nut M 4	2	011
100	227 163	Ring trimplate	1	013
101	229 049	Manhole complete	1	034
102	210 469	Machine screw M 3 x 3	2	012
103	227 162	View prism	1	024
104	227 214	Wiring board complete without voltage selector	1	043
	229 019	Wiring board complete without voltage selector with SEMKO-capacitor	1	041
105	219 200	Toggle spring	1	015
106	227 209	Tension spring	1	014
107	223 603	Foil capacitor 10 nF/1000 V	1	020
	223 633	SEMKO-capacitor	1	020
108	229 020	Cover for power switch, plug housing 5 poles	1	025
	229 018	Cover for power switch AMP	1	025
109	210 501	Machine screw M 3 x 35	1	013
110	210 586	Washer 3.2/7/0.5 St	2	011
111	210 271	Special screw M 3 x 4	2	011
112	224 183	Screw bolt	1	020
113	210 480	Machine screw M 3 x 6	1	012
114	229 021	Power switch complete without voltage selector with SEMKO-capacitor	1	045
	229 022	Power switch complete without voltage selector for socket housing	1	045
	229 023	Power switch complete without voltage selector AMP	1	045
115	227 103	Cam follower lever complete	1	020
116	200 650	Rubber sleeve	1	016
117	200 522	Toggle spring	1	019
118	229 075	Cam wheel complete	1	039
119	227 092	Bearing pillar	1	017
120	210 148	"C" washer 5.0	1	011
121	210 142	"C" washer 1.2	1	011
122	218 787	Shut-off lever	1	014
123	227 108	Friction plate complete	1	020
124	210 145	"C" washer 2.3	1	011
125	209 934	Sleeving	1	014
126	210 480	Machine screw M 3 x 6	4	012
127	229 051	Supply unit complete	1	065
128	229 058	Power transformer complete	1	057
129	227 172	Dress plate	1	025
130	220 142	Power cable complete, Dual plug housing, 5 poles	1	034
	207 312	Power cable complete, AMP plug housing, 4 poles	1	031
131	213 980	Dual plug housing, 5 poles	1	018
	213 982	AMP plug housing, round	1	016
132	227 060	Threaded bolt	1	014
133	200 650	Rubber sleeve	1	016
134	216 791	Handle complete	1	020
135	219 049	Square piece	1	015
136	219 083	Washer 3.2/13/0.5	1	012
137	210 586	Washer 3.2/7/0.5	1	011
138	229 059	Switch arm complete	1	027
139	227 450	Hex nut M 2.6	1	012
140	227 101	Shield	1	017
141	210 366	Hex nut M 4	1	011
142	213 471	Machine screw B 2.9 x 6.5	2	013
143	227 159	Joining nut M 4	2	018
144	210 147	"C" washer 4	1	011
145	227 045	Tension spring	1	013
146	227 094	Paul	1	015
147	216 778	Grooved shaft	1	018
148	210 147	"C" washer 4	1	011
149	227 100	Sleeve	1	013
150	229 076	Intermediate plate complete	1	036
151	223 811	Sleeving with strain relief	1	016
152	209 939	Sleeving	2	014
153	229 073	Power plate complete	1	046
D 51	225 247	Silicon diode BY 183/300	1	Mdse. gp. E.
R 51	225 916	Carbon resistor 22 kΩ/0.25 W/ 5 %	1	016
R 52	225 915	Carbon resistor 2.7 kΩ/0.125 W/ 5 %	1	016
C 51	225 322	Foil capacitor 68 nF/400 V/10 %	1	017
C 52	224 886	Paper capacitor 47 nF/250 V/20 %	1	022
154	227 045	Tension spring	1	013
155	227 041	Start lever compl.	1	023
156	227 030	Separating sleeve	2	019
157	227 110	Clamping spring	1	015

Ref. No.	Part. No.	Description	Quantity	Price group
158	210 469	Machine screw M 3 x 3	2	012
159	227 027	Bowed lockwasher 13.3/19	2	013
160	227 026	Clamping ring	2	014
P 1/2	227 340	Potentiometer 100 Ω	2	036
R 28	227 380	Carbon resistor 1 kΩ/0.125 W/5 %	1	016
R 29	227 381	Carbon resistor 910 Ω/0.125 W/5 %	1	016
162	229 061	Switch lever complete	1	028
163	227 341	Turn switch 2 poles	1	036
164	227 093	Shut-off slide	1	019
165	209 358	Ball 4.0	1	014
166	229 050	Segment complete	1	030
167	216 844	Guide	1	014
168	210 145	"C" washer 2.3	4	011
169	216 864	Shaft	2	014
170	227 083	Control lever complete	1	022
171	220 152	Plastic clamp	2	015
172	210 586	Washer 3.2/7/0.5	2	011
173	210 475	Machine screw M 3 x 5	2	012
174	200 447	Cable clamp	1	013
175	210 475	Machine screw M 3 x 5	1	012
176	227 072	Tension spring	1	014
177	201 187	Friction washer	1	013
178	210 145	"C" washer 2.3	1	011
179	227 069	Buffer complete	1	018
180	227 065	Adjusting rod complete	1	023
181	210 362	Hex nut M 3	1	012
182	201 183	Tension spring	1	015
183	201 184	Adjusting washer	1	014
184	227 087	Tension spring	1	012
185	209 436	Socket for flat prong	3	014
186	207 303	Audio cable complete with miniature plugs and socket for flat prong	1	Mdse. gp. E.
187	210 644	Washer 4.2/18/1.5	1	012
188	210 366	Hex nut M 4	1	011
189	200 687	Stop spring	1	014
190	227 068	Rotation bearing	1	015
191	210 145	"C" washer 2.3	1	011
193	207 311	Power cable complete with ground wire, AMP and US flat prong plugs, 4 poles	1	033
	213 984	Power cable complete with ground wire, Dual flat prong, 5 poles	1	033
194	209 457	Inner housing for AMP-plug	1	021
195	227 031	Adjusting piece	1	027
196	227 038	Contact assembly	1	021
197	210 472	Machine screw M 3 x 4	1	012
198	229 060	Control bridge complete	1	063
199	223 146	Fuse spring	1	013
200	229 066	Installation plate complete	1	059
201	227 048	Lift cam	1	015
202	227 046	Support bracket	1	015
203	210 469	Machine Screw M 3 x 3	1	012
204	227 073	Skating lever compl. with adjusting screw	1	012
205	227 077	Compression spring	1	012
206	210 146	"C" washer 3.2	1	011
207	227 079	Cable holder	1	014
208	227 303	Flat head screw M 3 x 6	1	012
209	227 080	Bearing support complete	1	022
210	227 078	Bearing bold	1	015
211	210 146	"C" washer 3.2	1	011
212	209 424	Miniature plug for audio cable	1	Mdse. gp. E.
213	209 425	RCA-type plug, white	2	Mdse. gp. E.
214	209 426	RCA-type plug, black	2	Mdse. gp. E.
215	207 299	Audio cable complete with RCA-type plug	1	Mdse. gp. E.
216	210 469	Machine screw M 3 x 3	2	012
217	227 254	RCA-type socket plate	1	028
218	210 146	"C" washer 3.2	1	011
219	227 086	Main lever	1	021
**	214 120	Hardware for cartridge mounting		021
**	229 321	Packing carton 701 complete		060
**	229 320	Packing carton 701 with socket complete		055
**	229 319	Packing carton CS 70 complete		060
**	227 280	Mounting instructions		-
**	227 281	Operating instructions 4 languages		-
**	227 283	Operating instructions UAP		-

Spare parts Motor electronic

Ref. No.	Part. No.	Description	Quantity
	230 598	Motor electronic, complete	1
IC 1	223 308	Integration switching circuit 709	1
T 1	229 493	Transistor BD 138	1
T 2	209 862	Transistor BC 172 C	2
T 3	209 862	Transistor BC 172 C	2
T 4	228 899	Transistor AC 188 K	5
T 5	228 899	Transistor AC 188 K	5
T 6	228 899	Transistor AC 188 K	5
T 7	228 899	Transistor AC 188 K	5
T 8	228 899	Transistor AC 188 K	5
T 9	227 374	Transistor BC 261 B	2
T 10	227 374	Transistor BC 261 B	2
T 11	209 846	Transistor BC 108 C	1
D 1	227 344	Diode 1 N 4001	4
D 2	227 344	Diode 1 N 4001	4
D 3	227 344	Diode 1 N 4001	4
D 4	227 344	Diode 1 N 4001	4
D 5	227 360	Z-Diode ZPD 7.5	1
D 6	227 369	Diode AA 143	4
D 7	227 369	Diode AA 143	4
D 8	227 369	Diode AA 143	4
D 9	227 369	Diode AA 143	4
R 1	227 358	Carbon resistor 33 k Ω /0.125 W/5 %	1
R 2	227 361	Carbon resistor 1.5 k Ω /0.125 W/5 %	3
R 3	227 362	Carbon resistor 4.7 k Ω /0.125 W/5 %	1
R 4	227 590	Carbon resistor 3.9 k Ω /0.125 W/5 %	1
R 5	227 363	Adjusting control 2.2 k Ω /lin.	1
R 6	227 380	Metal carbon resistor 1 k Ω /0.125 W/5 %	2
R 7	227 365	Adjusting control 10 k Ω /lin.	2
R 8	227 365	Adjusting control 10 k Ω /lin.	2
R 9	227 380	Metal carbon resistor 1 k Ω /0.125 W/5 %	2
R 10	227 367	Carbon resistor 100 Ω /0.125 W/5 %	3
R 11	227 368	Adjusting control 100 Ω /lin.	4
R 12	227 370	Carbon resistor 1 k Ω /0.125 W/5 %	2
R 13	227 367	Carbon resistor 100 Ω /0.125 W/5 %	3
R 14	227 368	Adjusting control 100 Ω /lin.	4
R 15	227 368	Adjusting control 100 Ω /lin.	4
R 16	227 372	Adjusting control 1 k Ω /lin.	1
R 17	227 373	Carbon resistor 68 Ω /0.125 W/5 %	1
R 18	227 368	Adjusting control 100 Ω /lin.	4
R 19	227 370	Carbon resistor 1 k Ω /0.125 W/5 %	2
R 20	227 367	Carbon resistor 100 Ω /0.125 W/5 %	3
R 21	227 375	Carbon resistor 2.2 Ω /0.5 W/5 %	1
R 22	227 376	Carbon resistor 270 Ω /0.125 W/5 %	1
R 23	227 361	Carbon resistor 1.5 k Ω /0.125 W/5 %	3
R 24	227 377	Carbon resistor 680 Ω /0.125 W/5 %	1
R 25	227 378	Carbon resistor 6.8 k Ω /0.125 W/5 %	1
R 26	227 379	Adjusting control 470 Ω /lin.	2
R 27	227 379	Adjusting control 470 Ω /lin.	2
R 30	227 382	Carbon resistor 47 Ω /0.125 W/5 %	1
R 31	227 383	Carbon resistor 3.3 k Ω /0.125 W/5 %	1
R 32	227 384	Carbon resistor 110 k Ω /0.125 W/5 %	1
R 33	227 361	Carbon resistor 1.5 k Ω /0.125 W/5 %	3
R 34	228 813	Carbon resistor 12 k Ω /0.25 W/1 %	1
R 35	227 386	Carbon resistor 18 k Ω /0.125 W/1 %	1
R 36	228 814	Carbon resistor 1.8 k Ω /0.5 W/1 %	1
R 37	229 525	Thermistor 250 Ω	1
R 38	228 815	Carbon resistor 220 Ω /0.125 W/5 %	1
C 1	222 760	Ceramic disc capacitor 20 nF/ 50 V ..	2
C 2	222 760	Ceramic disc capacitor 20 nF/ 50 V ..	2
C 3	230 013	Electrolytic capacitor 470 μ F/ 40 V ..	1
C 4	220 265	Electrolytic capacitor 37 μ F/ 16 V ..	1
C 5	216 410	Tantal electrolytic capacitor 0.47 μ F/ 35 V ..	2
C 6	216 410	Tantal electrolytic capacitor 0.47 μ F/ 35 V ..	2
C 7	227 389	Tantal electrolytic capacitor 3.3 μ F/ 16 V ..	1
C 8	227 390	Ceramic disc capacitor 1 nF/ 63 V/20%	2
C 9	227 390	Ceramic disc capacitor 1 nF/ 63 V/20%	2
C 10	213 498	Ceramic disc capacitor 47 pF/500 V/10%	1
	227 391	Relaey ROD, 12 V SGS	1
	227 447	Base for diode	2
	210 487	Machine head screw 3 x 10	5
	220 086	Mica washer	1
	227 178	Cramp	1
	227 176	Support	2

** Not illustrated

Alterations reserved

Fig. 25 Pick-up Connection Diagram

