

**TACHOMETER INDICATOR
JAEGER**

Pt No 64510-900-1 and 64510-901-1

**GENERAL AND TECHNICAL INFORMATION
ILLUSTRATED PARTS CATALOGUE**

BY COMMAND OF THE DEFENCE COUNCIL



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AMENDMENT RECORD SHEET

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AL No.	Amended by	Date
1	<i>POS.</i>	1/79
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4	<i>S. P. M. C. S. E. J.</i>	11/10/93
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RECORD OF ADVANCE INFORMATION LEAFLETS (AIL)

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Prelim.

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Prelim.

MODIFICATION/EQUIPMENT AMENDMENT RECORD

This publication is technically up-to-date in respect of the modifications and equipment amendments listed below.

Aircraft Mod.No.	Equipment		AL No.	Remarks
	Mod.No.	Amdt.No.		
403	—	—	—	Introduction of unit Part No.64510-901-1.
—	—	—	2	Replacement of diodes OA200 by diodes IN4148.
—	—	—	2	6 pole magnet now adhered to core using araldite.

Chapter 1

TECHNICAL DESCRIPTION

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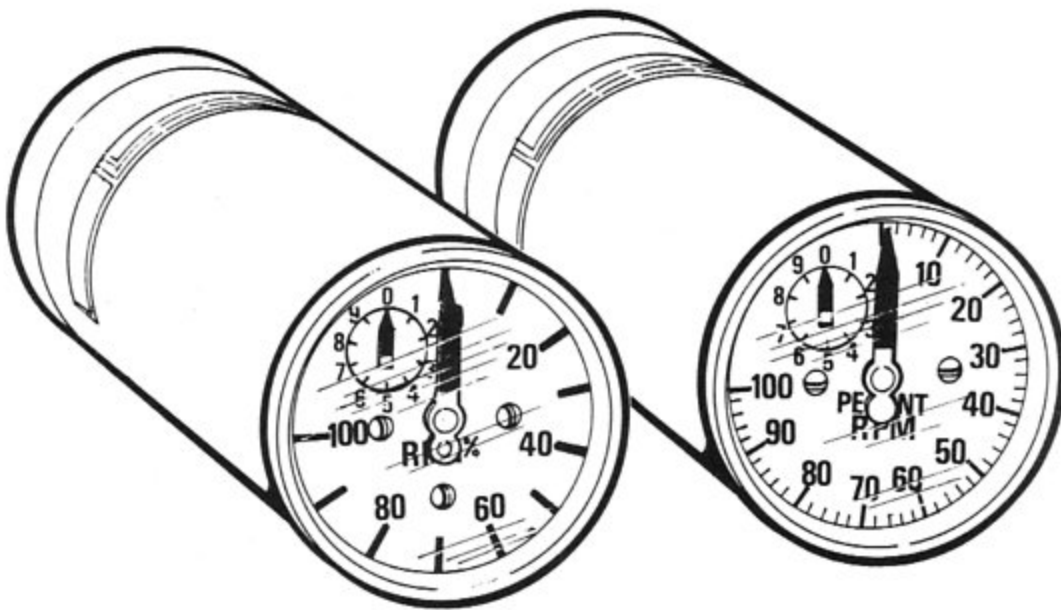
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Introduction

1. This instrument (fig.1) is designed to operate in conjunction with an associated three-phase generator. It measures and indicates engine speed, the indication being shown by two pointers moving before a graduated dial. The indicator has an additional device which transmits (for instance, to a recorder) square wave output signals of a frequency proportional to the speed of rotation of the engine.

2. It essentially consists of a three-phase synchronous type of motor with a combined polarised and hysteresis rotor, which turns a permanent magnet within a drum attached to the handstaff. Eddy currents set up in the drum by movement of the magnet cause rotation of the drum. This rotation is restrained by a hairspring, and the resultant torque is transposed as pointer indication. The main pointer of the indicator is read against an outer scale graduated 0-100 per cent, while a second pointer makes one revolution of a subsidiary dial for every 10 per cent movement of the main pointer.

3. In addition to the normal speed presentation, the indicator is fitted with a pulse generator which provides an output of rectangular waveform and is proportioned to engine speed, i.e. 4200 pulses/sec at 100 per cent. This pulse generating system is not being utilized on the UK Jaguar fit and is only explained briefly in this publication.



Pt. No.64510-900-1 Pt. No.64510-901-1

Fig.1. General view

◀ (Pt.No.64510-901-1 added) ▶

◀ Note . . .

The tachometer indicators Pt. No.64510-900-1 and 64510-901-1 differ only in dial presentation. ▶

Operating limitations

4. (1) Tachometer

Range : 15 to 110%.

The instrument is calibrated to give 100 per cent indication, when the generator is running at 4,200 rev/min. The small hand makes one revolution of the sub-dial every 10 per cent movement of the large hand. Allowance is made for increase above nominal maximum engine speed, up to 110 per cent indication; this is achieved by using the sub-dial for the last 10 per cent. Dial and pointer finish : Fluorescent DTD 573.

(2) Pulse Generator

Frequency : 4,200 pulses/sec at 100%.

Waveform : Rectangular

Amplitude : Positive, constant with speed

Peak voltage (on 1000 ohm resistive load) : 2 V

(3) Overall dimensions (including electrical connector)

Dimensions (inches)			Wt (lbs)
L	W	H	
5.75 (146mm)	2 (50,8mm)	2 (50,8mm)	1.08 (490 g)

DESCRIPTIONGeneral

5. The indicator consists of the following three groups:

- (1) a mechanism assembly:
- (2) a pulse generator:
- (3) a case assembly.

Mechanism assembly

6. The mechanism assembly comprises the following main sub-assemblies: a motor assembly and a movement assembly.

Motor assembly (fig.3 to 5)

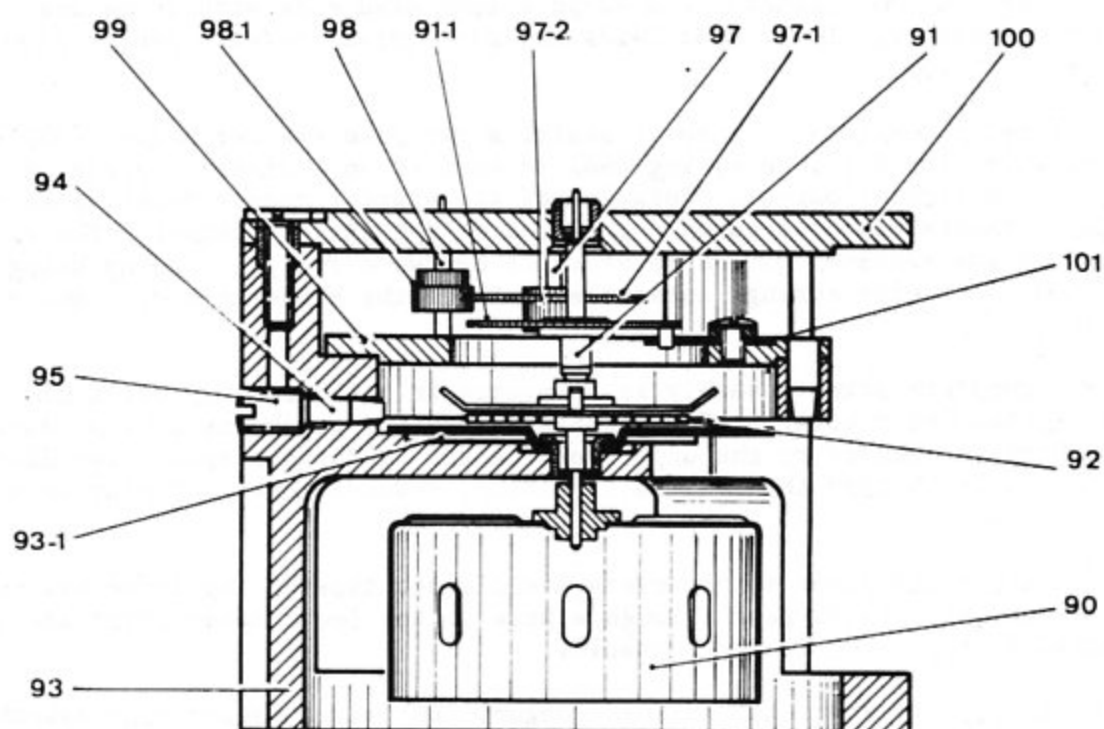
7. The two-pole synchronous motor comprises a three-phase stator (80) and a combined polarized and hysteresis rotor, these being enclosed within an upper motor cover (64) and a lower motor cover (81).
8. The stator (80) consists of a 12-pole laminated core with three star connected windings. The output leads are each colour coded: red, yellow and black (fig.3).
9. The rotor consists of a motor shaft, a two-pole starter magnet (70) and a hysteresis disc (72). A spring (68) is mounted on a distance piece in front of the starter magnet. Rotation of the starter magnet relative to the spring is restrained by a catch dog fitted to the starter magnet. The rotor components are retained on the motor shaft by two circlips, loading being exerted by four disc springs interposed between the hysteresis disc and a holder.
10. The complete rotor assembly is supported in ball bearings which are housed in the motor covers. The front ball bearing is enclosed by a bearing plate which is secured to the upper motor cover by three screws. Two disc springs, fitted behind the rear ball bearing, reduces rotor end play to a minimum.
11. The upper and lower motor covers are clamped together by three braces (82). The stator leads pass through a hole in the lower motor cover and are connected to the electrical receptacle.
12. A six-pole cylindrical permanent magnet (60) and a keeper ring assembly are mounted, by means of a special nut (61), at the forward end of the motor shaft, adjacent to the movement assembly. The keeper ring assembly consists of a shield (62) containing a slotted magnetic cup (62-1). A strap (62-2), tightened by three grub screws, clamps the magnetic cup in position in the shield (62). During calibration, the grub screws and clamp can be slackened thus allowing the magnetic cup (62-1) to be rotated.

Movement assembly (fig.2)

13. The movement assembly, as shown in fig.2, comprises a handstaff assembly (91) mounted in jewelled bearings, which are housed in a frame (93) and a top plate (100).
14. The handstaff assembly includes a drum (90), the open end of which rotates in the air gap between the motor shaft magnet and its keeper ring, a restraining hairspring (92) and a gear wheel (91-1). The large hand is mounted on the forward end of the handstaff (91) whilst the small hand is mounted on a separate handstaff (98) which is driven from the main handstaff via a gear assembly (97).

Schematic gear train layout

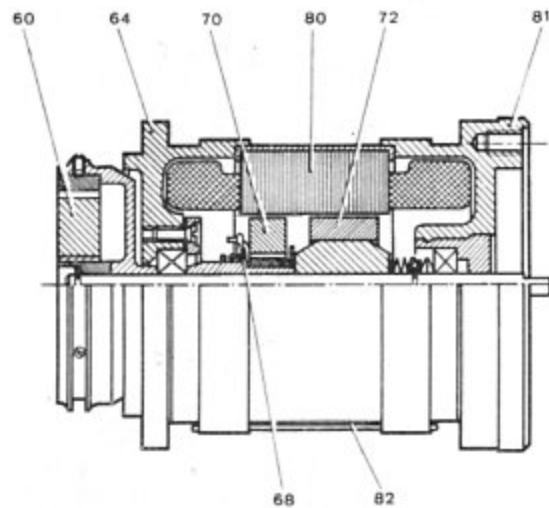
Main handstaff (large hand)	(91)	Wheel, 84 T (91-1)	
Gear assembly	(97)	Wheel, 70 T (97-1)	Pinion, 21 T (97-2)
Subsidiary handstaff (small hand)	(98)		Pinion, 21 T (98-1)



90	Drum	97	Gear assembly
91	Handstaff assembly	97-1	Gear wheel, 70 T
91-1	Gear wheel, 84 T	97-2	Pinion, 21 T
92	Hairspring, restraining	98	Handstaff, subsidiary
93	Frame	98-1	Pinion, 21 T
93-1	Plate adjusting	99	Plate, bottom
94	Pin, locking	100	Plate, top
95	Screw, set	101	Stop

Fig.2 Sectional view of movement

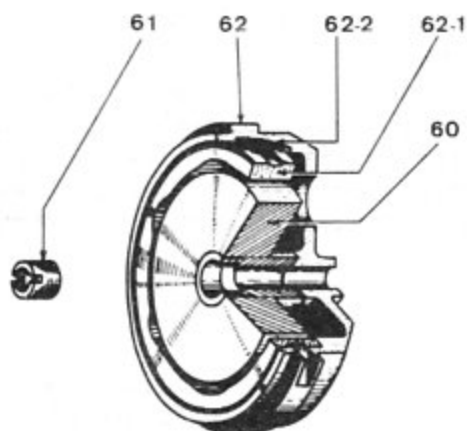
15. The outer end of the hairspring is anchored to a post which is mounted on an adjusting plate (93-1) integral with the frame (93). This adjusting plate is rotated to regulate the range of indication and locked by the set-screw (95) acting through the locking pin (94). The hairspring restrains the rotation of the handstaff and assists the return of the pointers to zero indication. A shield is also fitted to the handstaff so that its arms lie forward of the hairspring. The shield and the adjusting plate of the frame prevent the hairspring coils from possible damage when the tachometer is being operated at maximum range. A stop (101) attached to the bottom plate (99) limits handstaff rotation at maximum range.



KEY

- | | | | |
|----|------------------------|----|------------------|
| 60 | MAGNET, 6 POLE | 72 | DISC, HYSTERESIS |
| 64 | COVER, UPPER MOTOR | 80 | STATOR, 3 PHASE |
| 68 | SPRING | 81 | COVER, LOWER |
| 70 | MAGNET, 2 POLE STARTER | 82 | BRACE MOTOR |

Fig.3 Partly sectioned view of motor assembly



KEY

- | | |
|------|-----------------------|
| 60 | MAGNET, 6 POLE |
| 61 | NUT, SPECIAL |
| 62 | SHIELD |
| 62-1 | CUP, SLOTTED MAGNETIC |
| 62-2 | STRAP |

Fig.4 Keeper ring assembly

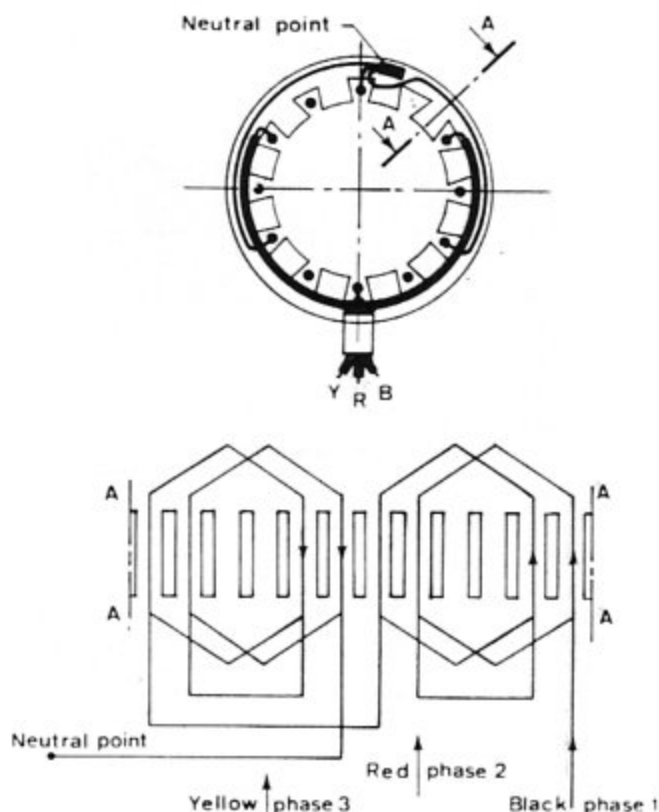


Fig.5 Diagram of phase windings

16. Jewelled bearings are used throughout the movement to reduce friction to a minimum. The indicator is compensated so that changes of temperature within specified limits do not affect its accuracy. This has been achieved by making the drum from a special manganese alloy, with a low temperature coefficient. The hairspring also provides additional temperature compensation for the mechanism.

Case assembly (fig.6)

17. The complete mechanism is housed within a 2 in diameter metal case (33) painted black and fronted by a glass window which is secured in position with araldite. The case is designed to be held in the instrument panel by a special mounting clamp.

18. The electrical leads from the stator and pulse generator (15) are connected to the pins of the receptacle (10) which is attached, with a washer, to a cover plate (7) by a nut. The cover plate seats against a back plate (12) mounted on top of four pillars. These pillars provide the means of attaching the pulse generator to the mechanism.

19. Fitted to the back of the case is an engraved cover (1) which is fixed to the cover plate, with spacers interposed, by two screws.

20. The presentation comprises a main dial (30) secured to the top plate of the movement by three screws (31), and a sub-dial (32) visible through a window in the main dial. Indication is given by the large hand (28) against the main dial and by the small hand (29) in conjunction with the sub-dial. The pointers, graduations and figures are finished in Fluorescent Compound DTD 573.

21. After the instrument is slid into its case, it is held in position by a snap ring (13) locating in a groove machined in the periphery of the case, between the back plate (12) and the cover plate (7). The mechanism is held concentrically within the case by three locating springs (27). A sealing washer (9) is interposed between the cover plate and the open edge of the case.

Operation

Tachometer (fig.7 and 8)

22. The three-phase voltage produced in the engine driven generator energizes the stator of the tachometer indicator and so produces a rotating field, the frequency of which is controlled by the speed of generator. Attraction between the rotating magnetic field and the starter magnet causes the magnet to revolve until it engages with the hysteresis rotor. This initial movement overcomes the inertia in the motor shaft to revolve. At high speed the magnet has little effect and the motor operates as a synchronous motor.

23. Rotation of the permanent magnet on the end of the motor shaft induces eddy currents in the handstaff drum, thus causing torque (fig.10); this is directly proportional to the speed of rotation of the rotor. This torque causes the handstaff to rotate until it is balanced by an equal and opposite torque exerted by the handstaff hairspring (fig.11). Since the hairspring torque is directly proportional to the speed of the rotor and hence to that of the related tachometer generator. Indication is given by the large hand against the main dial and by the small hand in conjunction with the sub-dial.

SERVICING

24. No servicing is permitted on the tachometer indicator other than the standard serviceability tests detailed in Chapter 2.

- KEY
- 1 COVER, ENGRAVED
 - 7 PLATE COVER
 - 8 SCREW
 - 9 WASHER, SEALING
 - 10 RECEPTACLE
 - 12 PLATE, BACK
 - 13 RING, SHAP
 - 14 SCREW, PILLAR
 - 15 GENERATOR, PULSE
 - 17 HOLDER, LAMP
 - 18 LAMP
 - 20 DISC, TOOTHED
 - 22 HUB
 - 27 SPRING, LOCATING
 - 28 HAND, LARGE
 - 29 HAND, SMALL
 - 30 DIAL, MAIN
 - 31 SCREW
 - 32 DIAL, SUB-
 - 33 CASE

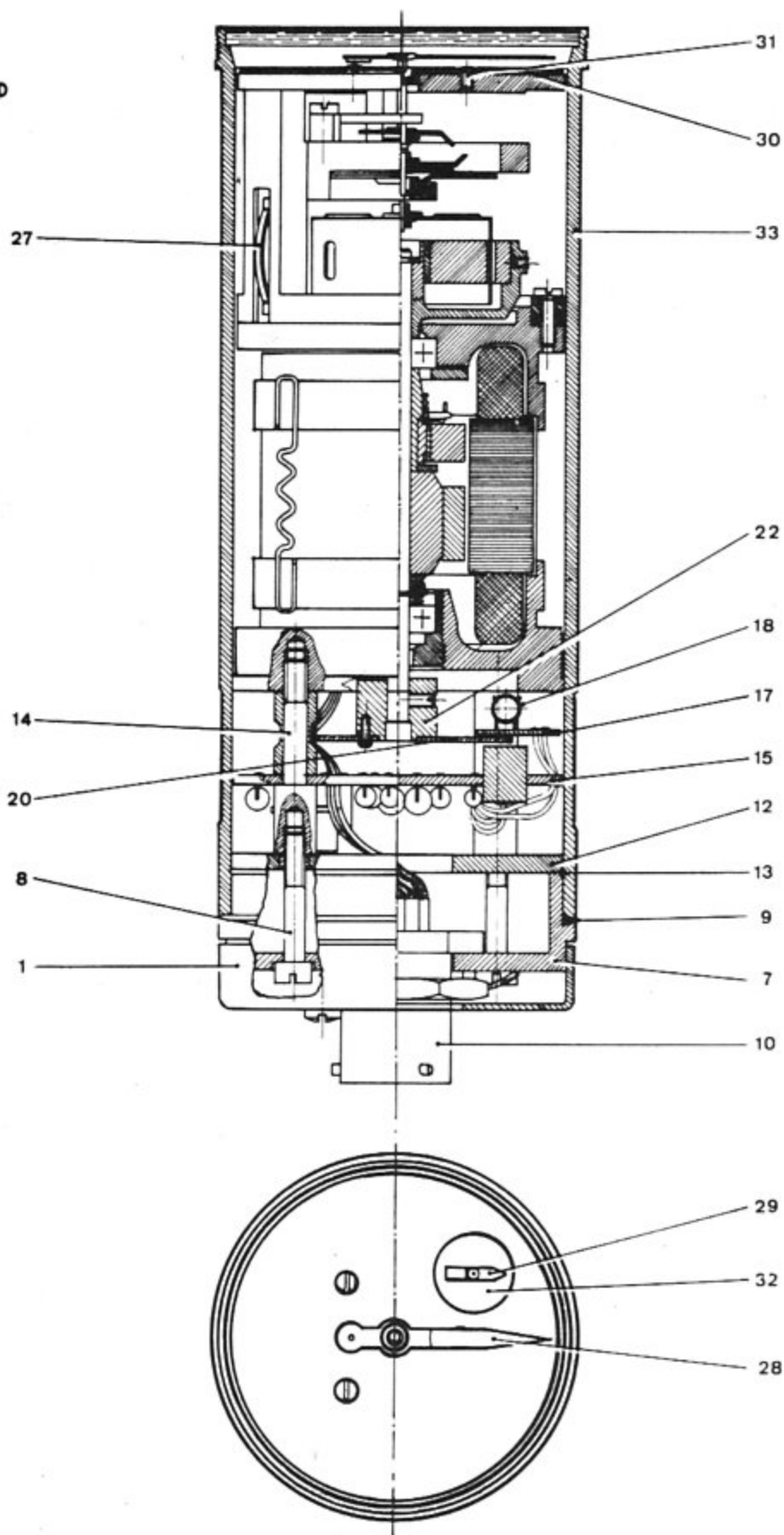


Fig.6. Sectional view of indicator mechanism

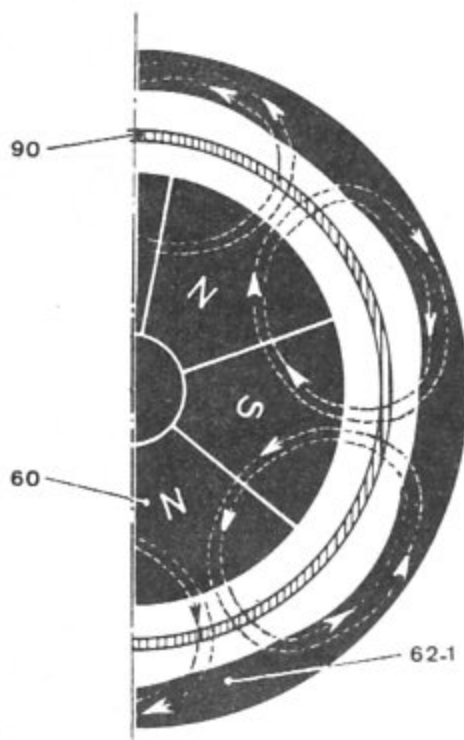


Fig. 7 Magnetic circuit

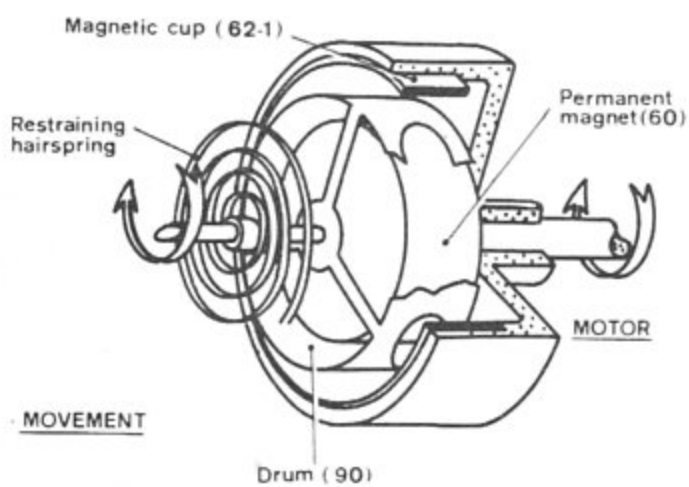


Fig. 8 Torque transmission