Chapter 2

POSITION INDICATORS (Desynn type)

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

Introduction

1. The Desynn indicating system is used in aircraft to give indication of remote mechanisms or control surfaces such as cowl gills, flaps, rudder and elevator trimming tabs, etc. The system consists of a transmitter and an indicator and requires a 24-volt d.c. supply.

2. Transmitters use the d.c. potentiometer principle for supplying currents to the indicator. One type of transmitter has an adjustable arm, the output of which varies in relation to a gear ratio; in another type the output varies according to the change in linear position of a push rod.

3. The indicators used in this system, although basically the same, differ in their application and may have a double or single dial.

Equipment available

4. The equipment available is given in Table 1 and typical indicator dials are shown in fig. 1. All instrument dials are fluorescent. Variations of case size are $2\frac{1}{2}$ in., $2\frac{1}{2} \times 1\frac{1}{4}$ in., $2\frac{3}{8}$ in., and $3\frac{1}{4}$ in. For certain applications single movement instruments are enclosed in a $1\frac{3}{4}$ in., hermetically sealed, case (*fig.* 6 *and* 7) and are identified by the suffix HSD.

DESCRIPTION

Transmitter, adjustable arm

5. The mechanism shown in fig. 2 represents a typical transmitter of the adjustable arm type; although there may be external differences, the internal mechanism of all transmitters is similar and consists of the following main parts:—

(1) Light alloy casting
(2) Adjustable lever arm
(3) Sector gear and pinion
(4) Insulated crank and pin
(5) Spiral spring
(6) Toroidal resistor and brush (wiper) assembly
(7) Bakelite moulding

6. The toroidal coil resistor is tapped at points 120 degrees apart, and is cemented into a recess in the Bakelite moulding. On one side the moulding has five shrouded terminals (*fig.* 10) which screw into moulded-in inserts. The inserts extend through the moulding and are connected to the resistor and wiper (or brush) gear on the other side (*fig.* 2). Mounted on the centre pin, which is an extension of the central insert, and free to rotate, are two wiper arms which are insulated from each other and wipe the resistor coil at points diametrically opposite. One wiper is in electrical contact with the central pin and is thereby connected to one pole of the electrical supply via the central terminal. The other wiper is connected to the other pole of the supply via a metal collar with which it is in electrical contact. The metal collar rides on a three fingered spring metal ring (*fig.* 2). This metal ring is connected to a terminal which is specially marked to prevent it being confused with the other terminals which are connected to the three tappings from the resistor coils. A pictorial view and a theoretical view of the electrical circuit are shown in fig. 8 and 9 respectively.

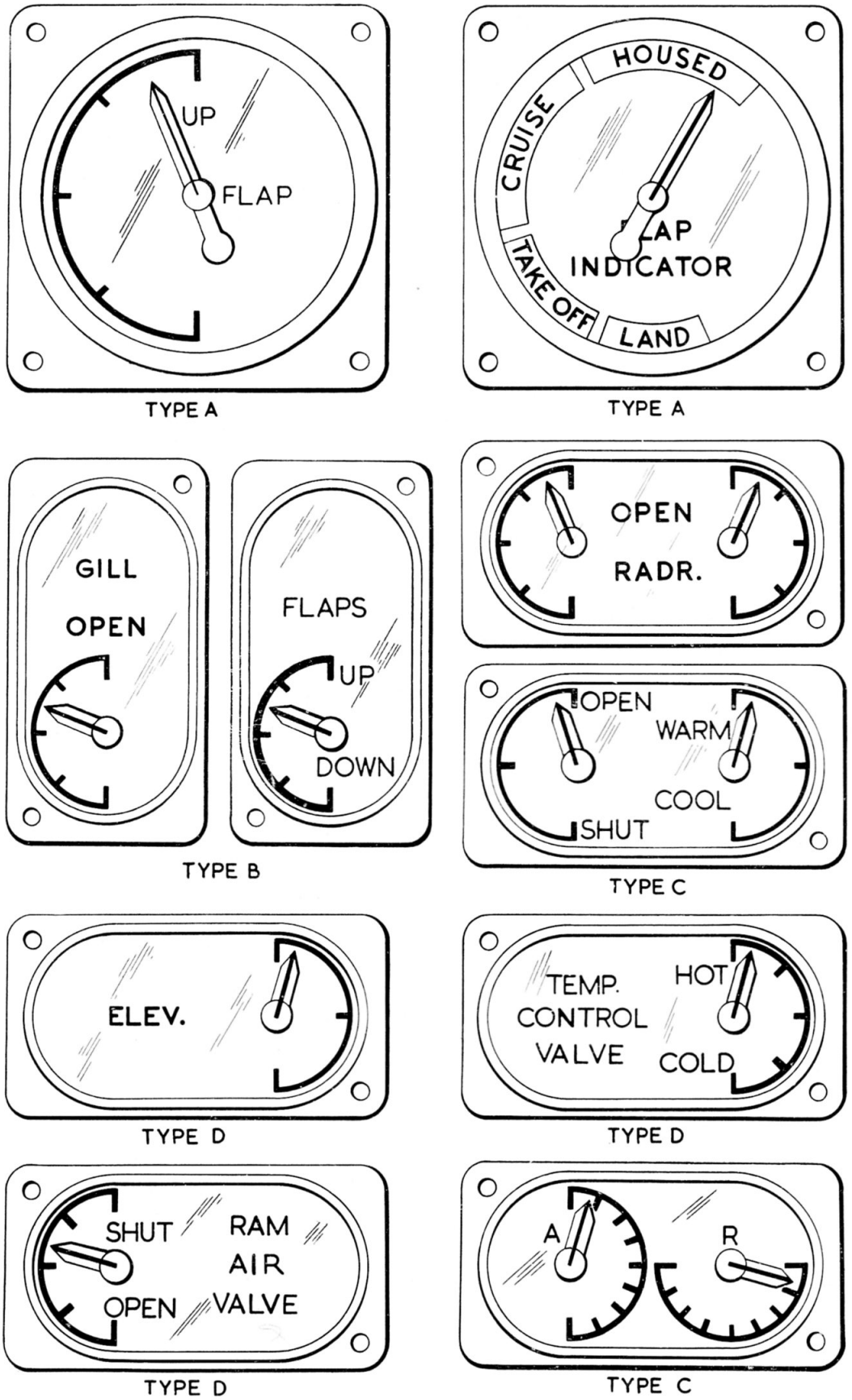


Fig. 1. Types of indicator dials

TABLE 1

Equipment available

Equipment	Application	Stores Ref.	Part No.
Transmitter	(Naval use)	6A/2085	227 FL
Transmitter, Type A		6A/2131	126 FL
Transmitter, Type B		6A/2132	129 FL
Transmitter, Type C		6A/2133	132 FL
Transmitter, Type D		6A/2134	135 FL
Transmitter		6A/2843	300 FL
Transmitter		6A/3241	458 FL
Transmitter	Aileron trim	6A/3576	471 FL
Transmitter		6A/3735	470 FL
Transmitter		6A/4455	568 FL
◀ Transmitter		6A/5808	815 FL
Transmitter		6A/5547	280 FL ▶
Indicator	Oil cooler shutter	6A/1908	145 FL
Indicator	Flap	6A/2084	200 FL/SB
Indicator, Type A	Flap	6A/2136	144 FL
Indicator, Type B	Flap	6A/2138	150 FL
Indicator, Type D	Elevator	6A/2142	153 FL
Indicator, Type C	Aileron and rudder trim	6A/2144	155 FL
Indicator, Type C	Cowl gill	6A/2148	123 FL
Indicator, Type C	Flap, twin dial (Naval use)	6A/2150	152 FL
Adjustable link		6A/2151	141 FL
Indicator	Flap	6A/2153	201 FL
Indicator	Cowl gill, port	6A/2154	209 FL
Indicator	Cowl gill, starboard	6A/2155	210 FL
Indicator, Type C	Radiator shutter	6A/2200	157 FL
Indicator	Flap	6A/2562	228 FL
Indicator	Oil cooler shutter	6A/2590	263 FL
Indicator	Oil cooler shutter	6A/2591	264 FL
Indicator	Flap	6A/2668	26 FL
Indicator	Air mixer valve	6A/2713	289 FL
Indicator	Flap (Naval use)	6A/2842	300 FL
Indicator	Flap (Naval use)	6A/2879	201 FL/SB
Indicator	Oil cooler shutter	6A/2884	336 FL
Indicator	Flap	6A/2924	218 FL
Indicator	Gen. purpose twin dial horizontal case $2\frac{1}{2} \times 1\frac{1}{4}$	6A/3090	448 FL
Indicator	Gen. purpose single dial horizontal case $2\frac{1}{2} \times 1\frac{1}{4}$	6A/3091	449 FL
Indicator	Aileron trim	6A/3160	430 FL
Indicator	Rudder trim	6A/3161	431 FL
Indicator	Tail plane incidence	6A/3205	432 FL
Indicator	Flap	6A/3271	533 FL
Indicator	Cabin air valve	6A/3272	443 FL
Indicator	Flap	6A/3283	374 FL
Indicator	Elevator and rudder	6A/3284	295 FL
Indicator	Aileron and rudder trim	6A/3292	521 FL
Indicator	Rudder feel control	6A/3293	523 FL
Indicator	Tail plane incidence	6A/3345	460 FL
Indicator	Rudder trim	6A/3346	461 FL
Indicator	Flap (Naval use)	6A/3349	452 FL
Indicator	Flap (Naval use)	6A/3375	462 FL

TABLE 1—*continued*

Equipment	Application	Stores Ref.	Part No.
Indicator	Cowl gill	6A/3550	221 FL
Indicator	Flap	6A/3567	473 FL
Indicator	Tail plane incidence	6A/3568	472 FL
Indicator	Aileron and rudder trim	6A/3569	501 FL
Indicator	Rudder trim	6A/3667	496 FL
Indicator	Tail plane incidence	6A/3668	485 FL
Indicator	Stabilizer trim	6A/3669	418 FL
Indicator	Aileron and rudder	6A/3781	426 FL
Indicator	Oil cooler shutter	6A/3783	234 FL
Indicator	Tail plane incidence	6A/3848	499 FL
Indicator	Mass flow control	6A/3929	525 FL
Indicator	Ram air valve	6A/3930	422 FL
Indicator	Temperature control valve	6A/3931	423 FL
Indicator	Ram air and cabin temperature	6A/3936	502 FL
Indicator	Air valve	6A/3942	505 FL
Indicator	Elevator trim	6A/3950	520 FL
Indicator	Aileron feel control	6A/3951	522 FL
Indicator	Flap	6A/4154	513 FL
Indicator	Elevator trim	6A/4162	534 FL
Indicator	Aileron and rudder trim	6A/4163	535 FL
Indicator	Dual flap	6A/4429	561 FL
Indicator	Tail plane incidence	6A/4463	584 FL
Indicator	Cabin air and tail plane incidence	6A/4541	581 FL
Indicator	Elevator change gear	6A/4574	477 FL/SB
Indicator	Flap	6A/4575	495 FL/SB
Indicator	Flap	6A/4709	589 FL
Indicator	Tail plane, incidence	6A/4741	587 FL
Indicator	Air brake (Naval use)	6A/5063	3 HSD
Indicator	Oil cooling flap	6A/5161	586 FL
Indicator	Flap	6A/5861	7 HSD
Indicator	Tail heating control	6A/5165	516FL
Indicator	Wing anti-icing	6A/5166	527FL
Indicator	Trim position	6A/5169	526FL
Indicator	Flap position	6A/5650	1 HSD
Indicator	Rudder trim	6A/5652	9 HSD
Indicator	Aileron trim	6A/5651	11 HSD
Indicator	Flap	6A/5952	19 HSD
Indicator	Tail plane	6A/NIV	211 FL
Indicator	Flap	6A/2924	218 FL
Indicator	Flap	6A/2084	200 FL

P28678 275084/6936 8/58 3250 C & P **Gp. 1**

7. The body of the transmitter is a light alloy casting (*fig.* 2), suitably flanged for mounting purposes. The driving spindle (*fig.* 3) is carried in a self-lubricating bush in the end of the casing and in a bush in a bearing plate within the transmitter. The operating lever arm is serrated and is positioned on the driving spindle by means of a serrated plate, plain plate and self-locking nut in the manner shown in fig. 3. An adjustable link is usually employed between the end of the operating arm and the movable surface. Within the transmitter a sector gear (for 6 to 1 gear ratios) or a plain gear (for 3 to 1 gear ratios) is locked to the driving spindle and engages with a pinion mounted on a shaft concentric with the casing. An insulated crank at the upper end of the pinion shaft carries a pin which engages a slot in the wiper arm assembly. A spiral spring on the pinion shaft is fitted to take up backlash in the gearing. Transmitters may have gear ratios of 6 to 1 or 3 to 1 with either clockwise or anti-clockwise rotation. In transmitters having a gear ratio of 3 to 1, a 60 degree operating arm movement causes the wiper arms, and hence the indicator pointer, to move through 180 degrees. Similarly, a 30 degree arm movement causes a 180 degree pointer movement in the case of 6 to 1 ratio transmitters.

8. Colour marking of terminal blocks indicates the system voltage in which the instrument is used; yellow for a 24-volt, and green for a 12-volt system; in the green system the indicator or associated circuit has a series resistor inserted to reduce the voltage at the terminals. The following main types

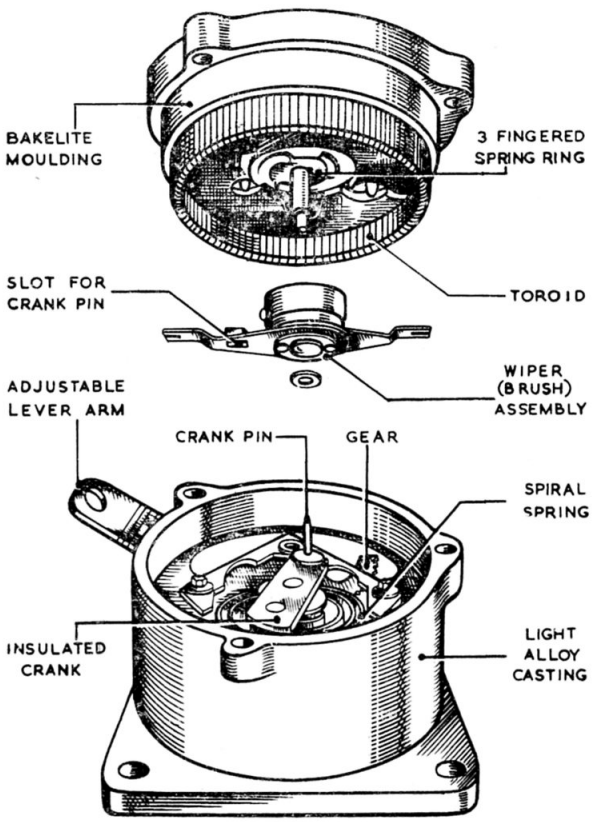


Fig. 2. Transmitter, with adjustable arm, partly dismantled

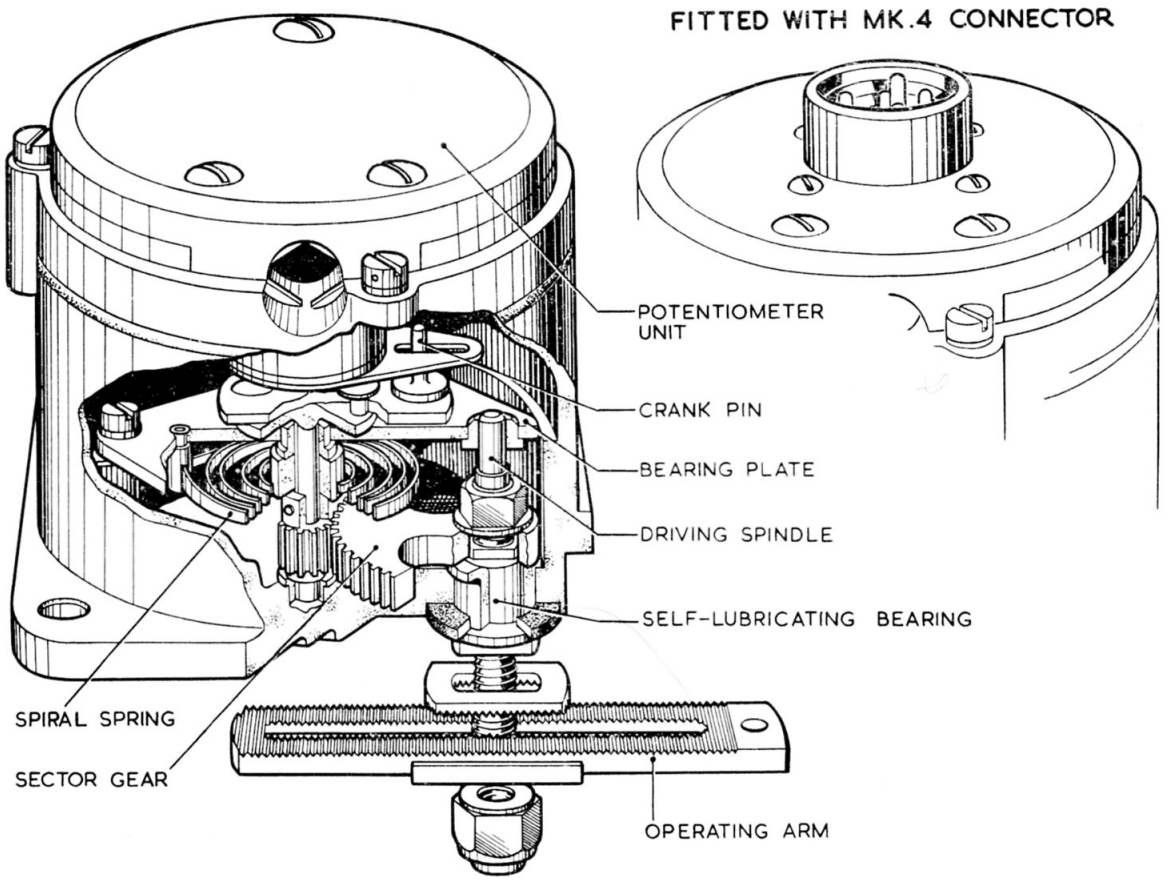


Fig. 3. Part sectional view of transmitter with adjustable arm

of transmitter assembly used on a 24-volt supply are available.

Type A ratio 6 to 1 Clockwise

Type B ratio 6 to 1 Anti-clockwise

Type C ratio 3 to 1 Clockwise

Type D ratio 3 to 1 Anti-clockwise.

Some transmitters have Mk. 4 connectors fitted, as shown in the inset to fig. 3. These transmitters have a manufacturer's suffix /SB.

Transmitter, linear position

9. This transmitter (*fig.* 4) consists of an actuating mechanism housed in a casting which is spigoted to one end of the main tubular casing and is secured by three screws. The actuating mechanism operates the electrical transmitter which is attached to the other end of the main casing by a circular clamp ring, and is covered by a conical cover, protecting the wiring connections and supporting the cable.

10. The mechanism consists of a steel push rod supported in two self-lubricating bushes pressed in housings in the casting. The outer end of each housing is closed by a pressed-in cap, that at the push rod end enclosing a synthetic rubber sealing ring. A straight rack cut along part of the length of the push rod engages with a pinion, whilst a slot opposite to the rack, engages a fixed screw in the side of the casting and limits the travel of the push rod.

11. The pinion is secured to one end of a central shaft, the other end of which carries a slotted arm which drives the contact assembly. The central shaft is carried in two self-lubricating flanged bushes in the end casting. Backlash in the mechanism is taken up by a flat spiral spring, one end of which is attached to the bush carrying the slotted driving arm, the other end being secured to the casting.

12. The transmitting element consists of a toroidal resistor cemented in an annular groove in the metal end cap and insulated from the metal by means of mica strips. Tappings taken from three equally spaced points on the resistor are soldered to inserts passing through an insulated terminal plate cemented into the back of the end cap.

13. The contact assembly rotates about a fixed central pin, formed by an extension of the negative battery terminal fixed in the centre of the terminal plate. The positive supply terminal is soldered to a plate which is formed into two spring contacts in contact with a slip ring fixed to the insulated body of the assembly.

14. Two leaf contacts, with platinum iridium contact points, operate diametrically opposite to each other on the toroid. One contact has a tab soldered to the slip ring and is therefore connected to the positive supply terminal, whilst the other contact is in electrical connection with the central pin and hence the negative supply terminal. These leaf contacts are insulated from each other by a bakelized fabric operating arm carrying the operating pin which engages with the slot in the driving arm (*para.* 11). The operating arm, two leaf contacts, and the slip ring assembly are located by two insulated projecting pegs which are part of the body of the assembly, and are retained on the central pin by a special circlip.

15. Linear movement of the push rod will rotate the pinion and the slotted driving arm, which engages with the operating pin and rotates the contact assembly to move the contacts over the toroidal resistance. Mod. 01 models have a special washer between the circlip and contact assembly to minimize wear on the bearing bush.

16. The gear ratio is such that a push rod travel of 0·654 in. produces 180 deg. movement of the potentiometer contacts with a minimum overtravel of 3 deg. at each end of the range, as a safeguard against damage.

Indicator

17. The indicator consists of the following main assemblies:—

(1) Bakelite case, dial, glass and bezel

(2) Terminal block

(3) Desynn movement

18. Referring to fig. 5, the Desynn movement consists of a soft iron stator (10) carrying a star-connected three-phase winding so arranged that, when supplied with current through a transmitter using the Desynn principle, it produces a magnetic field which rotates in relation to the position of the brushes while maintaining a sensibly constant value over the complete 360 degrees. The 2-pole permanent magnet rotor (3) aligns itself with this field and gives a true indication of the position of the brushes.

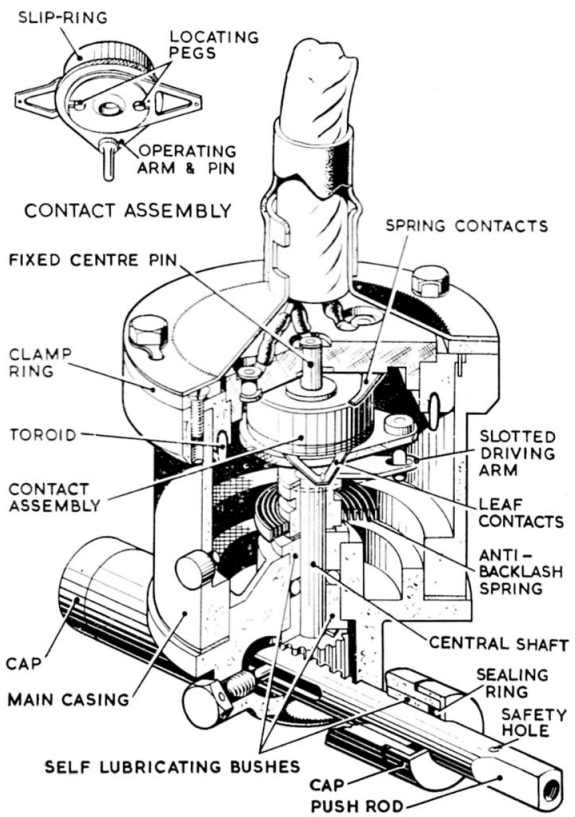
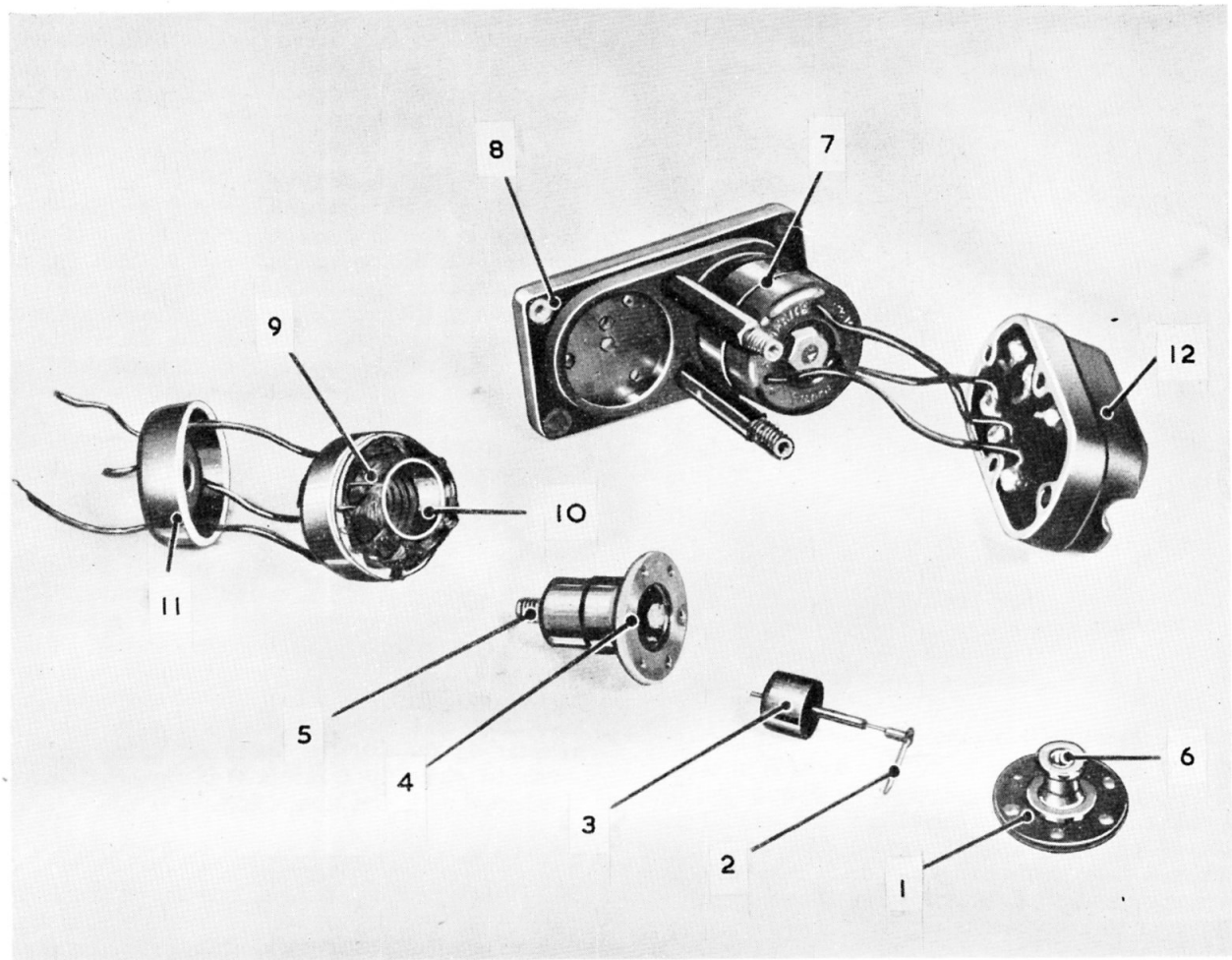


Fig. 4. Part sectional view of linear position transmitter



1 ROTOR HOUSING COVER PLATE
2 INDICATOR POINTER
3 ROTOR
4 ROTOR HOUSING
5 ROTOR BEARING (lower)
6 WEAK MAGNET
7 COMPLETE DESYNN MOVEMENT ASSEMBLED
8 BAKELITE MOULDING
9 WINDINGS
10 STATOR
11 STATOR COVER PLATE
12 TERMINAL BLOCK

Fig. 5. Indicator, dismantled

19. The rotor (3) is securely mounted on a spindle which carries the indicator pointer (2). This assembly is accurately balanced and free to rotate within the rotor housing (4). The lower bearing (5) is located in the rotor housing; the upper bearing is contained in the rotor housing cover plate (1). The rotor housing (4) and rotor (3) are contained inside the stator (10). When completely assembled the indicator is secured to the Bakelite moulding (8) by three countersunk screws. A complete Desynn movement mounted on the Bakelite moulding (8) is shown at (7).

20. The three separate windings (9) are star-connected, one set of ends being connected together, and the other ends taken separately from the three windings to terminals 1, 2 and 3 on the terminal block. A weak magnet (6), on an extension of the rotor housing cover plate, constitutes a "no-voltage" device causing the rotor to return to a fixed position at which the pointer is off-scale when the stator windings are not energized. Thus, if the electrical supply to the instruments is interrupted in flight, the pointer will move off the indicator scale altogether and provide a warning that the system is not functioning. This permanent magnet does not cause any serious distortion in the electro-magnetic field and consequently does not affect the normal working of the indicator.

21. Colour coding of the terminal blocks is the same as that on transmitters, and leads from the windings are coloured: "A"—red, "B"—green (12 V.) or yellow (24V.), and "C"—blue. The leads from the stator winding are connected to the terminal block of the transmitter and are so arranged that when the phases are energized in sequence of red, green or yellow and blue (shown on the terminal block) a clockwise rotation of the magnetic field is obtained. Reverse direction of movement of the indicator with respect to the transmitter is required on some installations. This is achieved by the transposition of terminals 2 and 3 in the transmitter terminal block (*fig.* 10), thereby causing reverse movement of the brushes, i.e., over tapping points 1, 2 and 3 in that order. When

clockwise rotation of the transmitter driving arm (viewed from the terminal cover block) moves the brushes over tapping points 1, 2 and 3 consecutively, rotating the indicator pointer in a clockwise direction, the transmitter is said to be clockwise.

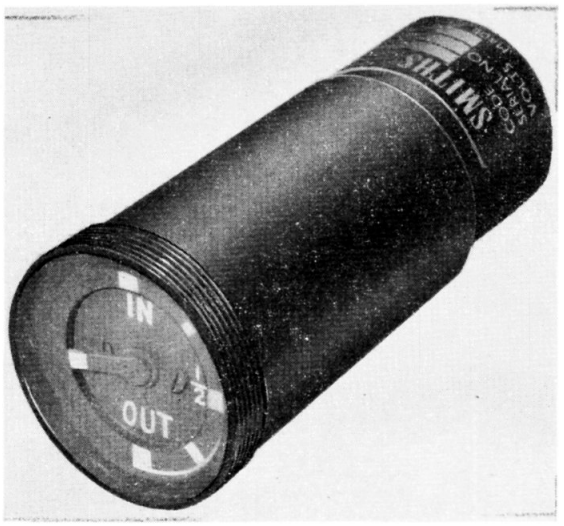


Fig. 6. Indicator, Type 3 H.S.D.

Indicator, Type HSD ($1\frac{3}{4}$ in. case)

22. The Type HSD indicator (*fig.* 6 *and* 7) consists of a single Desynn movement (7, *fig.* 5) and (*fig.* 7) fitted in a hermetically sealed, flangeless, case. The case is of metal with the front glass assembly soldered into it, forming an air-tight seal. A securing clamp (Ref. 6A/3823) is used to secure the indicator to the instrument panel.

23. Referring to fig. 7, the Desynn movement, inserted from the rear, is held in position by a light coil spring and the base which is soldered to the case. On assembly, two coils of rubber string and several coils of metal wire are inserted between the base and outer case to ensure an airtight seal.

24. Fitted to the base is a small capillary tube through which the case is evacuated and filled with gas. The tube end is sealed off when the filling operation has been completed.

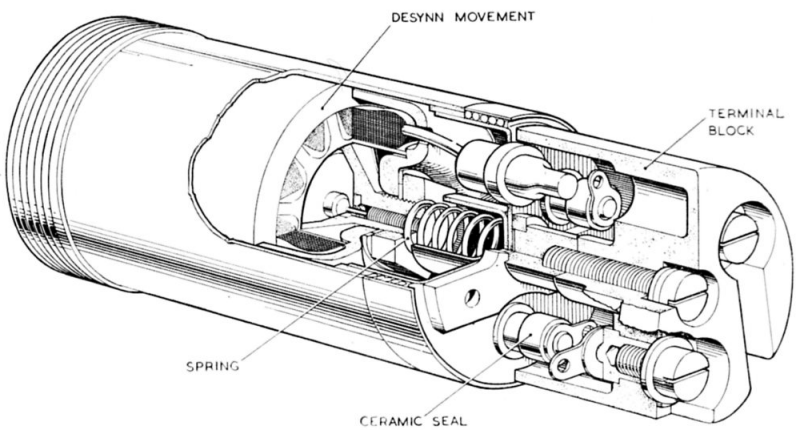


Fig. 7. Part sectional view of Type H.S.D. indicator

25. The Desynn movement electrical connections are located in ceramic seals in the base and sealed off with solder. Leads are then soldered between tags on the ceramic seals and inserts in the terminal block. The terminal block is fitted to the rear of the case and external electrical connections are made via the terminal screws provided.

OPERATION

26. When d.c. voltage is applied to the two brushes of the transmitter, the position of the brushes will determine the voltages at the three equally spaced tappings. Fig. 8 and 9 give an indication of this principle. These voltages, applied in turn to the 3-phase connections of the indicator stator, will set up a resultant magnetic field in the stator and the permanent magnet rotor will align itself with the field. Rotation of the transmitter brushes will produce a similar rotation of the magnetic field in the indicator stator, thus causing the indicator rotor, and hence the pointer, to move in synchronism with the brushes.

27. The indicating system is suitable for continuous operation and is entirely automatic. The contact arm of the transmitter rotates in relation to the movement of the aircraft controls. This movement is electrically communicated from the transmitter through a multi-cored cable to the indicator, and causes the indicator pointer to register on the dial the "position" of the mechanism to which the transmitter is connected (e.g., flaps, cowl gills, elevators, etc.).

INSTALLATION

28. The indicator is mounted on the instrument panel, and the transmitter is connected to the aircraft control either by a standard adjustable link or by a coupling provided by the aircraft manufacturers.

29. The instrument should be handled carefully at all stages before and during the actual fitting, and the following points should be carefully noted.

30. The electrical setting of the instrument may be altered if the transmitter contact arm is allowed to spring back against its stop. A violent impact of the contact arm against the stop, under the influence of the spiral spring (*fig.* 3), would probably necessitate re-setting and re-calibration of the instrument.

31. When adjusting controls, proceed as follows. Set the control to one extreme position and adjust the link or coupling until the indicator pointer reads correctly, then set the control in the other extreme position. If the indicator overshoots the correct mark on the indicator dial, lengthen the lever arm; if it fails to reach it, shorten the lever arm. In the case of trimming tabs, the mid-position should be adjusted first as this is the most important. When the indicator registers the control movement correctly, lock all adjustments.

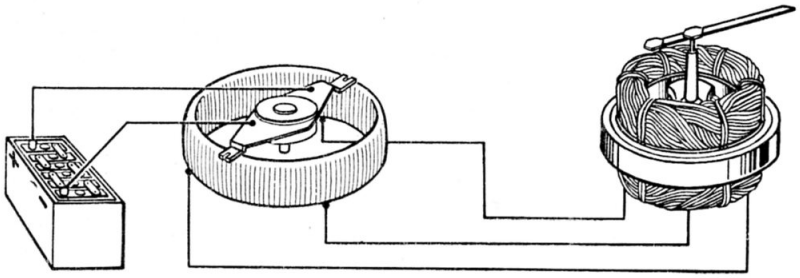


Fig. 8. Pictorial view of electrical circuit

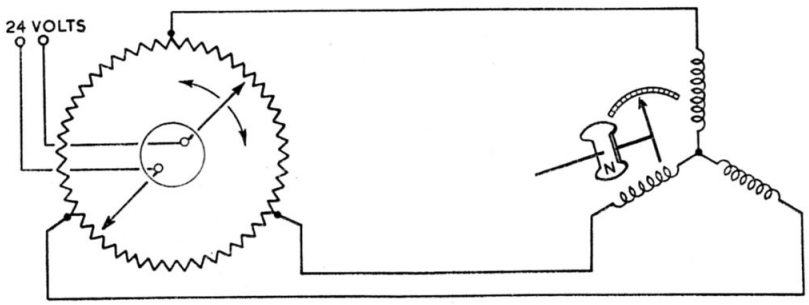


Fig. 9. Theoretical view of electrical circuit

Transmitter, linear position

32. The transmitter is secured by a metal strap having a small hole which engages with a peg secured to the casing. The end of the push rod is drilled and tapped axially to permit attachment of the linkage from the component the position of which is to be indicated. Means of adjusting the linkage will be embodied in the aircraft components, but the installation should be so adjusted that the side thrust imposed on the push rod, at any position within the operating range, is negligible After coupling the unit, check that the screwed connecting rod used projects beyond the safety hole (*fig.* 4) in the push rod and that a 4 B.A. lock nut is fitted.

33. Adjustment should be effected so that, when the component being tested is moved, the extreme limits of travel correspond with the maximum indications of the position indicator and that the movements of the pointer is in the correct direction.

SERVICING

General

34. Servicing should normally be limited to visual checking for security and signs of external damage.

35. Both the transmitter and the indicator may be electrically tested for accuracy without removing either from the aircraft, using the Desynn tester (Stores Ref. 6C/470). This tester and the method of using it are described in A.P.1275T, Vol. 1, Sect. 5, Chap. 1.

Insulation test

36. Using a 250-volt insulation resistance tester (Stores Ref. 5G/152), check the insulation resistance of indicator and transmitter individually between each terminal, and between terminals and case. The resistance must not be less than 20 megohms.

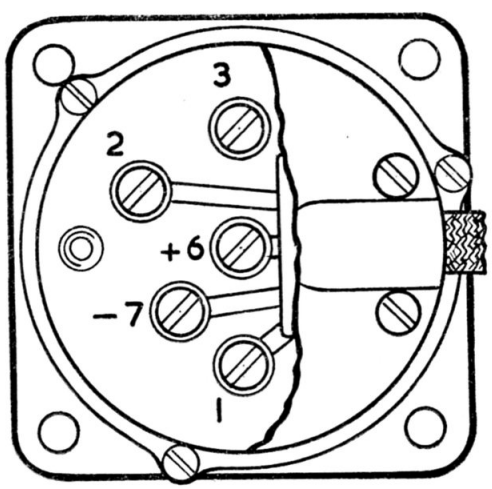


Fig. 10. Transmitter terminal block (anti-clockwise rotation)