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INDICATORS, OIL PRESSURE AND TEMPERATURE, ADR SERIES

GENERAL AND TECHNICAL INFORMATION

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L. T. Dunnett

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AMENDMENT RECORD SHEET

To record the incorporation of an Amendment List in this publication, sign against the appropriate A.L. No. and insert the date of incorporation.

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LIST OF CHAPTERS

INDICATORS, OIL PRESSURE AND TEMPERATURE, ADR SERIES

MODIFICATION STATE

Manufacturers Mod No	Manufacturers Service Bulletin Leaflet No	Brief details
01	473	Rheostat changed. This has been incorporated in all units, restrospectively.
02	482	Modification to magnetic screen. This has been incorporated in all units retrospectively.
03	474	Change of pinion and sector material. This has been incorporated in all units, retrospectively.
04	487	The spring jewels in the eccentric jewel and front movement jewel bearings of the d. c. ratiometer are replaced by solid mounted jewels. This has been incorporated in all units, retrospectively.
05	518	Magnet assembly and return spring changed. This has been incorporated in all units, retrospectively.
06	79-3	Copper wire used in place of aluminium wire for coil of d. c. movement. This has been incorporated in all units, retrospectively.
07	79-25	Obsolete selenium rectifiers replaced by standard silicon junction diodes.

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Chapter 1

INDICATORS, OIL PRESSURE AND TEMPERATURE, ADR SERIES DESCRIPTION AND OPERATION

Introduction

1. The ADR series of a.c./d.c. ratiometer indicators (fig. 1) are designed to indicate liquid pressure and temperature. They work in conjunction with a transmitter, described in A.P.112G-0553-1, and a resistance thermometer bulb. The two instrument movements housed in the instrument case are:

(1) An a.c. ratiometer to indicate pressure

(2) A d.c. long scale, geared ratiometer to indicate temperature

2. All ADR series indicators and all transmitters used with them operate from a 26V, 400 c/s supply. With the exception of the 21 ADR indicators this supply is obtained from an external auto-transformer which is connected into the normal 115V, 400c/s supply (fig. 4 and 5). The auto-transformer is described in A.P.112G-0517-1. The 21 ADR indicators have an internal auto-transformer and hence are connected directly to the 115V, 400c/s supply (fig. 6).

3. A metal rectifier contained in the indicator provides the d.c. supply needed to operate the temperature indicator movement.

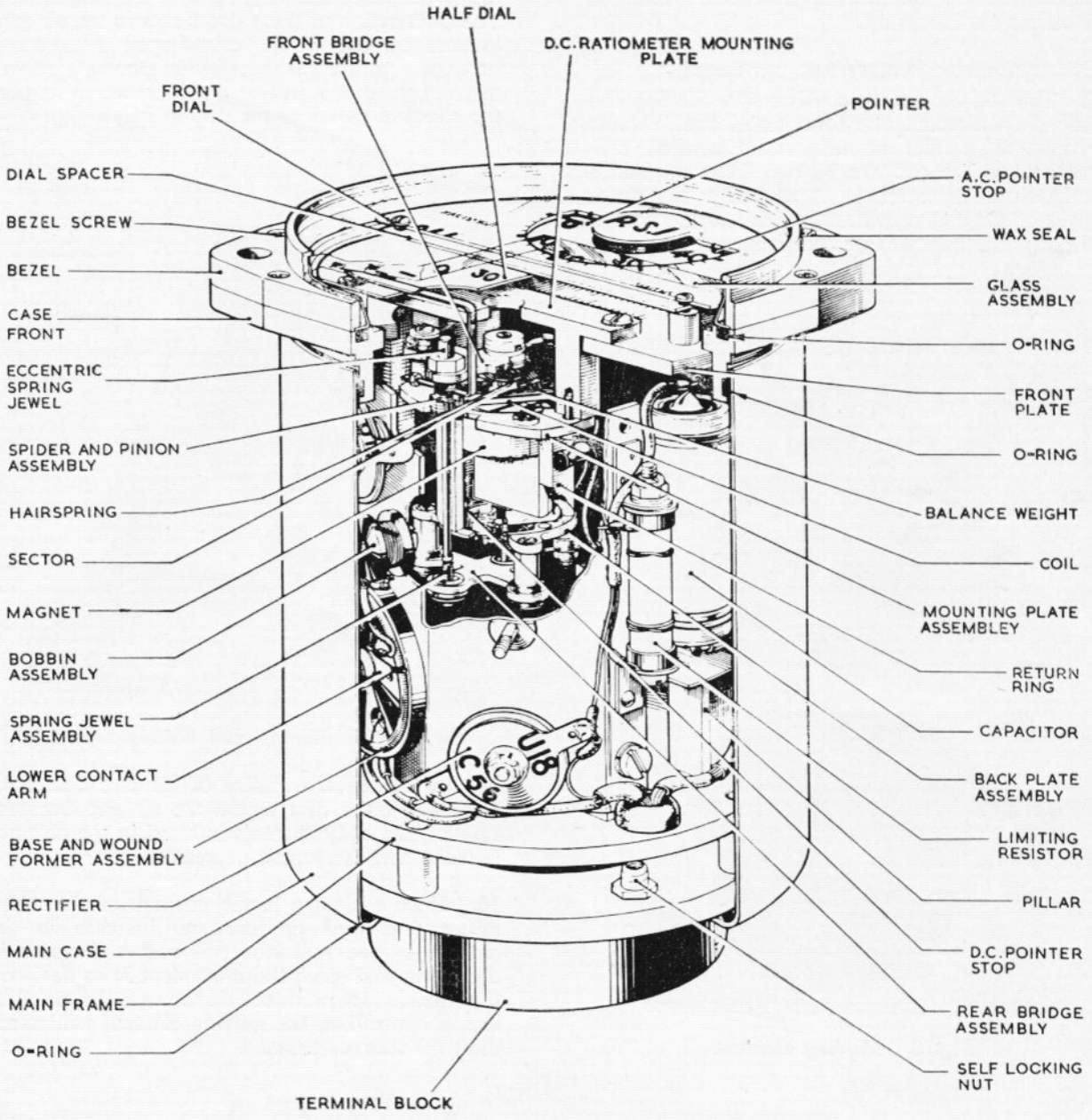

Fig. 1. A.C./D.C. ratiometer indicator

DESCRIPTION

A.C. ratiometer (pressure movement)

4. The movement (fig. 2 and 3) consists basically of a non-magnetic element free to move about a central axis, and an electro-magnetic circuit with air gaps in which the element rotates. The moving element consists of two cam-shaped discs and a circular disc, cemented to a tubular shaft. The front end of the shaft carries the indicator pointer. The cam-shaped discs are so spaced that the periphery of each disc rotates in the air gap of its associated lamination and bobbin assembly. The circular disc is positioned to lie between the poles of a permanent magnet and serves as a damping device.

5. Two capacitors are used to reduce the effect of frequency changes. To reduce temperature errors a resistance is placed in parallel with the induction coils. The instrument pointer is returned to zero by a hairspring.

D.C. ratiometer (temperature movement)

6. The d.c. movement consists of a moving coil wound on a rectangular former and free to rotate around a permanent magnet. Electrical connections to the coil are by two ligaments and a hairspring. A sector mounted below the upper pivot of the coil provides the drive to the pointer via a pinion mounted on the pointer shaft.

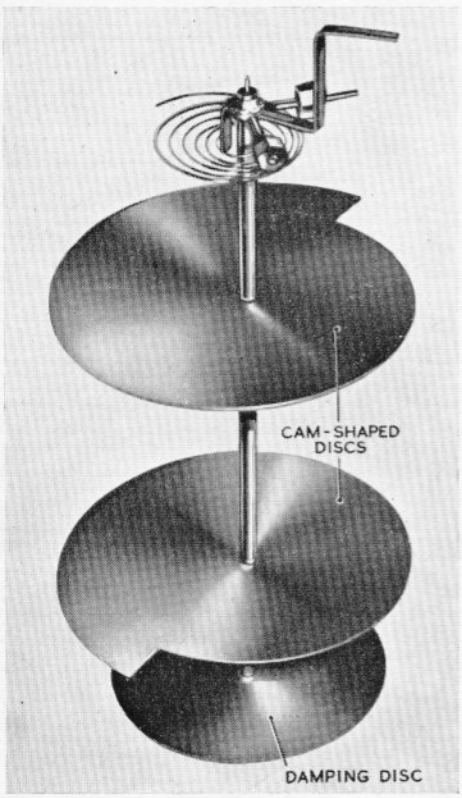

Fig. 2. Moving element

OPERATION

A.C. ratiometer

7. When the indicator is connected to the transmitter and an a.c. supply (fig. 4, 5 and 6), the two coils wound on the lamination and bobbin assemblies form a bridge circuit with the two inductances in the transmitter. Thus, when a change in the pressure being measured causes a change in the inductance of the transmitter a differential change of current in the other two arms of the bridge occurs.

8. The current flowing in each coil of the indicator circuit produces an alternating flux in the laminations, which induces eddy currents in the shading rings. The eddy currents in turn produce a flux which opposes the main flux and which causes a phase lag between that portion of the flux passing through the shading rings and that in the unshaded major portion of the laminations. The inter-action of these two fluxes in the air gap, induces currents in the cam-shaped discs which produce a torque on the moving element. Movement of the disc is in that direction which reduces the effective radius of the disc in its air gap.

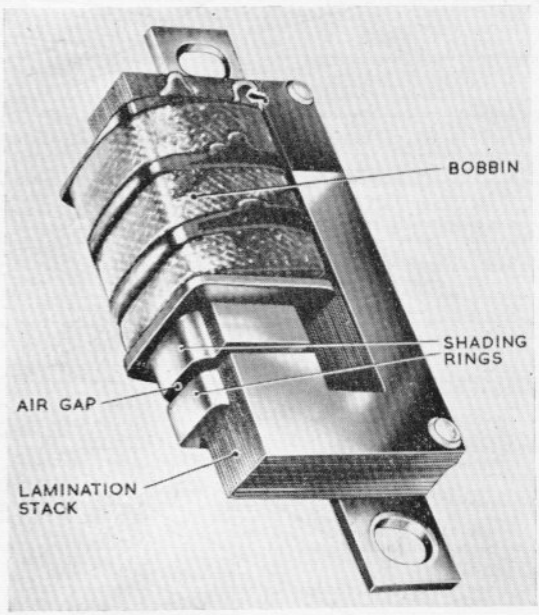

Fig. 3. Lamination and bobbin assembly

9. As the effective radius of the disc decreases, the area of the disc within the air gap becomes smaller, the eddy currents induced in the disc are reduced and the torque decreases.

10. Since a change in the position of the transmitter armatures produces an increase in the current in one indicator coil and a decrease in the other, and since the movement is so designed that the torques produced on the cam-shaped discs are in opposition, the moving element will rotate until the torques balance.

11 A capacitor is fitted across each coil to minimize the effect of the change of inductive reactance which occurs with a change of supply frequency. Resistance R3 is fitted to minimize the effects of change of temperature in the lamination and coil assemblies.

DC ratiometer

12 The principle of the dc ratiometer is fully described in AP 3280B, Sect 3, Chap 6. Calibration of the movement in the ADR series indicators is effected by the presence in the coil circuit of calibration resistors R1 and R2 and variable resistors R5 and R6.

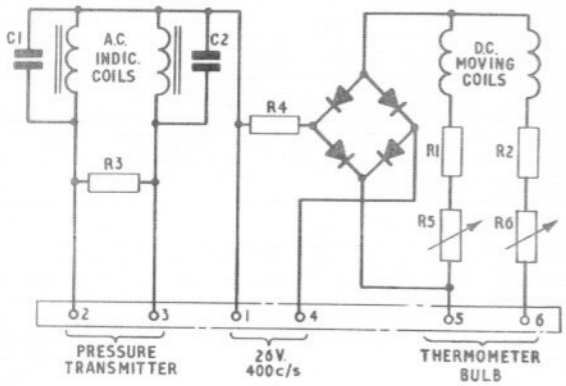

Fig 4 11 ADR circuit

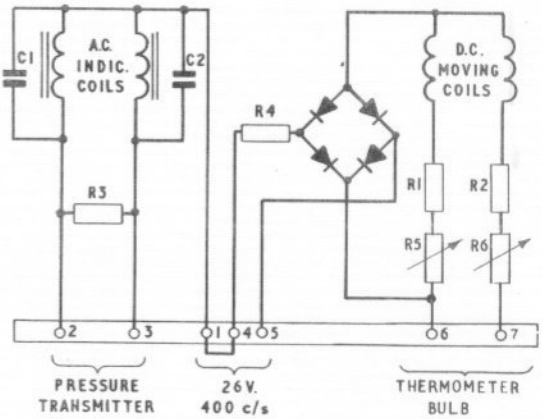

Fig 5 ADR circuit

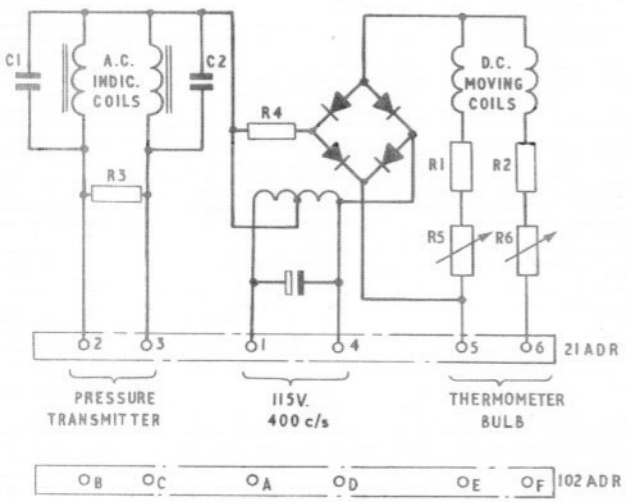

Fig 6 21 ADR and 102 ADR circuit

TABLE 1 EQUIPMENT AVAILABLE

Range Pressure lb/in^2	Range Temperature ^oC	Type	Code	Temp Cal Law	Ref No
0 - 40	-30 +120	Oil	11/1ADR	Platinum	6A/6500
0 - 150	0 +120	Oil	11/8ADR	Platinum	7998
0 - 40	-20 +100	Oil	12/1/ADR/SB	Nickel	6378
0 - 60	-40 +120	Oil	PW11/2ADR	Nickel	7115
0 - 40	-15 +120	Oil	PW11/12ADR	Platinum	8809
▶ 0 - 75	-60 +120	Oil	PW102ADR/CP/1	Platinum	4339489 ◀
0 - 75	-60 +130	Oil	PW102ADR/CP/2	Platinum	7858
0 - 40	-30 +130	Oil	PW21/5ADR/BU	Platinum	8808

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Chapter 2

INDICATORS, OIL PRESSURE AND TEMPERATURE, ADR SERIES

STANDARD SERVICEABILITY TEST

Introduction

1. The tests described in this chapter are to be applied immediately prior to installation in an aircraft and at any time the serviceability of the instrument is suspect. The tolerances quoted are not to be exceeded.

Test equipment

2. The following test equipment is required:—

(1) Insulation resistance tester, Type C (Ref. No. 5G/152).

(2) Test set, Type 84TE/1 (Ref. No. 6C/2138) or, Pressure gauge calibrator, Mk. 3 (Ref. No. 6C/1130) and Inductor pressure transmitter, Smiths type, of known accuracy and appropriate range.

(3) Auto-transformer 115/26V (Ref. No. 6A/2715).

(4) Resistance box (Ref. No. 10S/16237) or equivalent . . . 2 off.

(5) Pressure transmitter (Ref.No. 6C/7772634)

Power supplies

3. ADR series indicators require either a 115V 400Hz single-phase or a 26V 400Hz single-phase a.c. supply (see Table 1). The 26V power supply may be derived from an auto-transformer.

Method of test

4. The instrument is to be mounted with the dial upright in the vertical plane. The instrument is to be lightly tapped before each reading is made. When used, the test transmitter is to be mounted in a suitable fixture of local manufacture, with the pressure union downwards.

TESTING

Insulation resistance

5. Using the insulation resistance tester, measure the resistance between each pole of the plug and the case of the instrument. In each case the resistance is to be not less than 20 megohms.

Accuracy check

6. Check the accuracy of the pressure movement as detailed in para. 7 or 8 as appropriate.

Pressure movement, using the test set Type 84TE/1

7. Connect the indicator to the test set and to the appropriate supply. Set the test set selector switch to ZERO, MID-POINT and FULL SCALE in turn. Check that at each position, the indicator pointer corresponds to the position selected within ± 2% of the full scale angular deflection.

Pressure movement, using inductor pressure transmitter

► 8. Connect a transmitter, of known accuracy and of the correct range, via the pressure trnasmitter (Ref.No.6C/7772634), to the pressure gauge calibrator, Mk.3 and to the indicator. Connect the indicator to the appropriate power supply. Apply pressures corresponding to the indicator zero, mid-point and full scale positions in turn. Check that at each pressure the indicator pointer corresponds to the pressure applied, to within ±5% of the full scale deflection. ◄

Temperature movement

9. Connect the power supplies as appropriate, and the resistance boxes in parallel, as in Table 1.

TABLE 1

Supply and resistance box connections

Type	Supply	Supply pins	Resistance Box pins
11ADR	26V	1 and 4	5 and 6
12ADR	26V	4 and 5	6 and 7
21ADR	115V	1 and 4	5 and 6
102ADR	115V	A and D	E and F

For resistance box settings see Table 2 or 3 as appropriate. A tolerance of ± 2% of the full scale reading is permissable.

TABLE 2

Platinum law indicators

R1 (Ohms)	R2 (Ohms)	Indicator (C°)
115	Disconnect	−30
131	29200	0
147	17900	+30
161	Disconnect	+60
177	34600	+90
192	40700	+120
196	Disconnect	+130

Note . . .

Where an indicator data plate shows a valve for an external resistance, that value resistance must be added to the test circuit for the resistance figures in Table 2 to be correct.

TABLE 3

Nickel law indicators

R1 (Ohms)	R2 (Ohms)	Indicator (C°)
74	9000	−40
82	13300	−20
90	Disconnect	0
99	Disconnect	+20
109	23600	+40
119	23500	+60
130	15200	+80
141	16400	+100
152	28700	+120