AIR PUBLICATION

112G-0542-1

(Formerly A.P.1275A, Vol.1,
Sect.16, Chap.3)

PRESSURE GAUGES
(SMITHS DESYNN TYPE)

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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(Ministry of Defence)

FOR USE IN THE
ROYAL NAVY
ROYAL AIR FORCE

(Prepared by the Ministry of Aviation Supply)

Issued Nov. 70

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

Chapter 1
DESCRIPTION AND OPERATION

Introduction

General

1. Pressure gauges (Smiths Desynn Type) are used in an aircraft to indicate the pressure of fluids or gases. They consist of a transmitter, connected into a hydraulic or pneumatic system, and an indicator, connected to the transmitter, by a three wire electrical system.

2. The transmitter is identified by a colour code, red for fuel, yellow for oil and blue for coolants. This identification is on a band adjacent to the union body. Electrical connection between the transmitter and indicator is made via a terminal block or plug connector. The latter is identified by a suffix SB to the manufacturers part number.

3. A list of units is given in Chapter 1-1.

Types of transmitter

4. The four types of transmitter available use a standard micro-transmitter; the differences between the four types is the actuation of the micro-transmitter, and may be identified as follows:-

(1) Low pressure systems (up to 200 lb/in^2). A standard single bellows actuates the micro-transmitter.

(2) High pressure systems (over 300 lb/in^2). A Bourdon tube actuates the micro-transmitter.

(3) Differential pressure systems. A pair of bellows actuates the micro-transmitter.

(4) On power units a directly mounted flange unit is used. The severe operating conditions of this unit necessitates a reduced operating voltage.

Indicator

5. Indicators have star-connected, three-phase winding stators and two-pole magnet rotors. Their dials are suitably marked to indicate their particular application. Flange mounted indicators operate from lower voltages and cannot be used with transmitters of a different type.

DESCRIPTION

Standard transmitters

6. The standard transmitter (fig. 1) consists of a micro-transmitter and a bellows assembly mounted on a body casting.

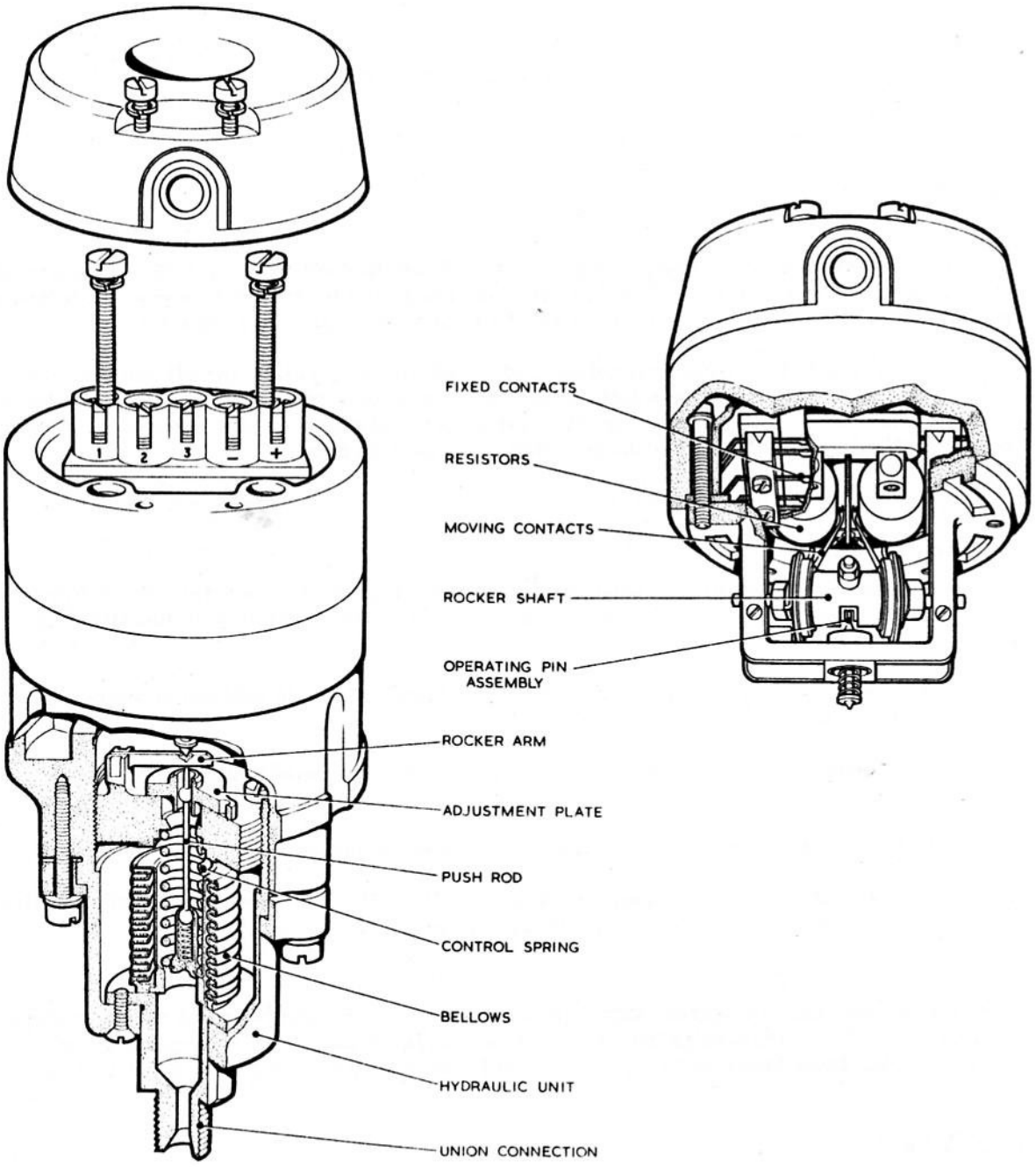

Fig. 1 General arrangement, standard transmitter hydraulic unit and micro-transmitter unit

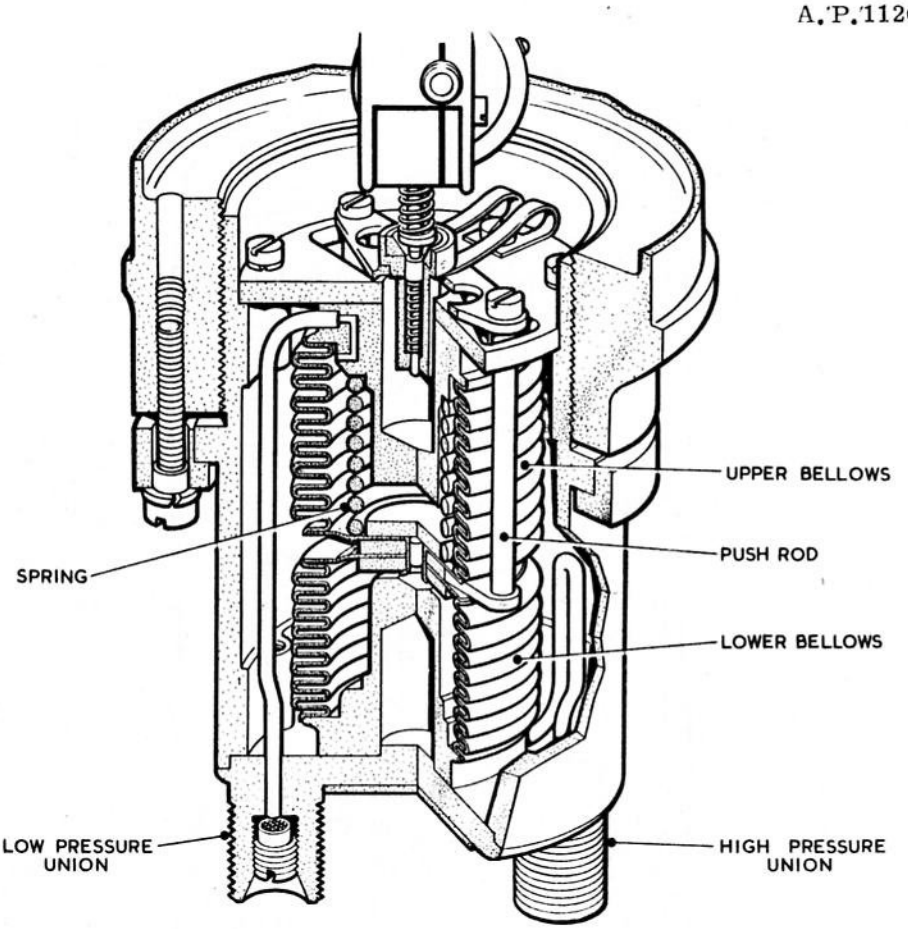

Fig. 2 General arrangement, differential transmitter hydraulic unit

Bellows assembly

7. The bellows assembly is screwed into the bottom of the body casting and comprises a bellows and push rod assembly. A flanged tube inside the bellows accommodates a control spring. This spring, which compresses the bellows, is in contact with an internal flange in the body. A push rod is located between the bottom flange tube and the rocker arm. A recess in the rocker arm engages the operating push-pin of the micro-transmitter. Calibration of the unit is effected by lateral movement of the adjustment plate, which shifts the point of contact of the push-rod and rocker arm and thus varies the vertical movement of the rocker arm.

Micro-transmitter

8. The micro-transmitter incorporates the terminal block or plug connector. It seats in a recess at the top of the body and comprises two resistance assemblies and a moving contact assembly mounted in a specially shaped casting.

9. The resistors are wound on cylindrical formers; nine fixed spring fingers make contact with the windings. Electrical connection between the fixed spring fingers form the equivalent circuit to two toroidal resistors. Two moving contact fingers are attached to a rocker shaft supported by bearings in the U-frame, which forms part of the alloy casting.

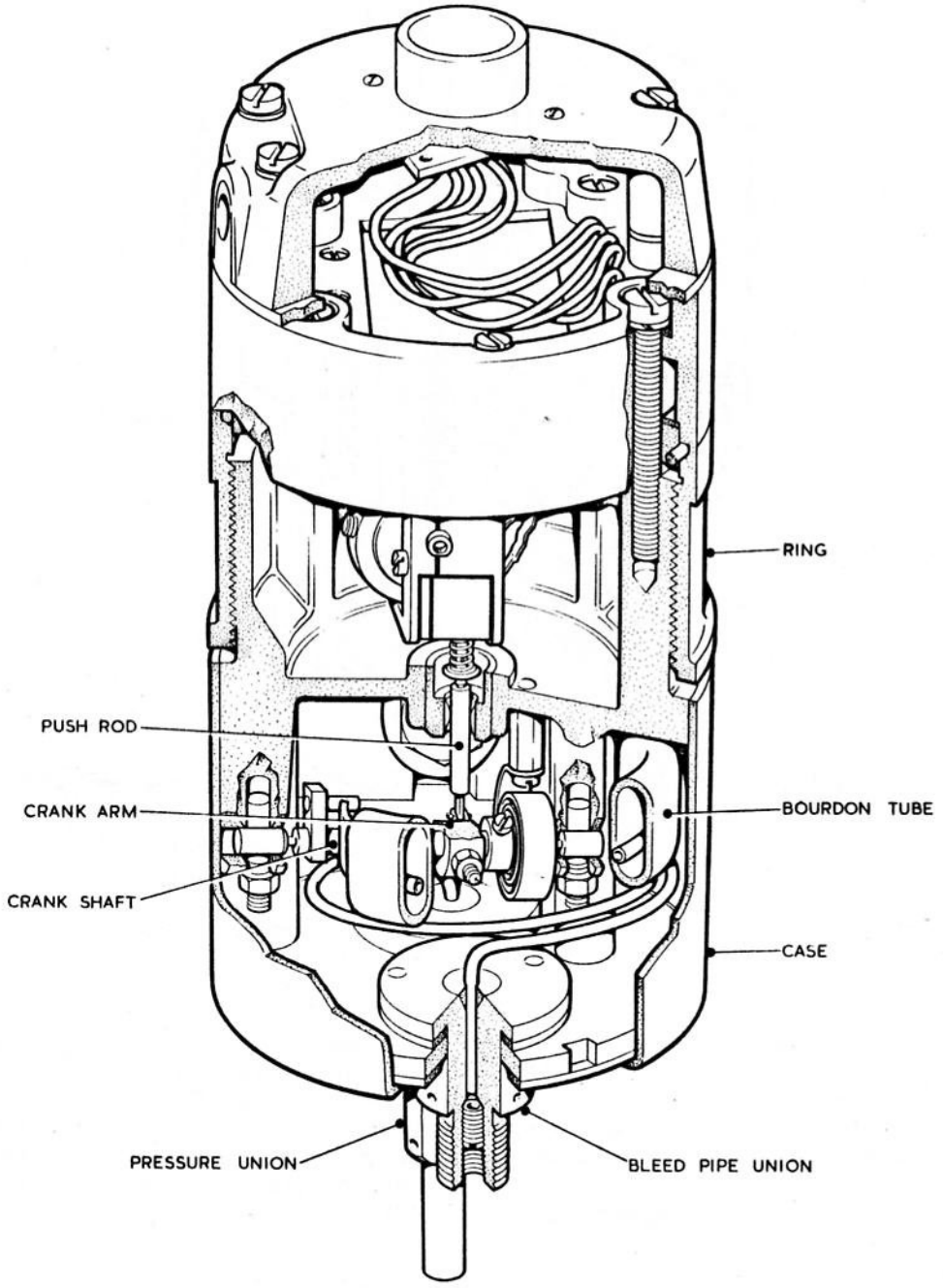

Fig. 3 General arrangement, Bourdon tube transmitter hydraulic unit

10. Mounted in the bottom of the U-frame is the operating push-pin. The top end of the push-pin engages with the crank pin at the centre of the rocker shaft. The lower end of the push-pin is held by a compression spring, thus ensuring engagement of the spring against the rocker arm. The moving contacts cover an arc of approximately 45 deg. over the complete range of the transmitter. Limits stops are fitted to the U-frame. Input voltage is applied to the micro-transmitter via beryllium copper springs on the rocker shaft.

Differential transmitter

11. The differential transmitter comprises a micro-transmitter (para. 8 to 10) and a bellows assembly on a light-alloy body casting.

Bellows assembly

12. The bellows assembly (fig. 2) consists of a pair of pressure sensitive bellows arranged in opposition. The resultant movement of the centre-piece joining the free ends of the bellows, is proportional to the difference of pressure within them and independant of atmospheric pressure. The pressure acts against a control spring contained in the upper bellows. Pressure is admitted to the bellows by capillary tubing connected to the low pressure, and high pressure unions at the base of the unit. Two push rods are connected between the centre and a yoke positioned above the upper bellows. At the centre of the yoke is an insert, spring loaded against the push-pin of the micro-transmitter.

Bourdon tube transmitter (fig. 3)

13. The Bourdon tube is mounted horizontally in the lower portion of the unit. It is connected to the pressure via a capillary tube. A second union, connected to the base, is also coupled to the Bourdon tube to enable the tube to be cleaned and bled. The free end of the Bourdon tube has attached a tag, which bears against a crank pin mounted on a crank shaft. The shaft is supported in bearings and is fitted with a hair spring to hold the crank pin in contact with the tube tag. At the centre of the crank shaft is an adjustable crank arm which is linked with the push-rod. A push-pin is held in contact with the push-rod by a spring and collar.

14. Depth of engagement of the push-rod and push-pin is adjusted by the screwed ring.

Flange mounted transmitter (fig. 4)

15. The flange mounted transmitter is similar in construction to the standard transmitter described in para. 6. Except that the bellows unit casing is flanged to fit directly onto power units. Depth of engagement of the push-pin and push-rod is made via the screwed ring.

16. The micro-transmitter is modified, in that the rocker shaft rotates between ball bearings and the spring contact fingers have platinum/iridium wire brushes. A resistor reduces the operating voltage to 9.5V

Anti-vibration mounting (fig. 5)

17. In all but flange-mounted transmitters, a groove on the body casing locates the transmitters in the anti-vibration mounting. The mountings are designed for either horizontal or vertical suspension of the transmitter.

Indicator

18. The basic movement of the indicator is a 2-Pole magnet rotor pivoted inside a star-connected, 3-phase stator. The laminated stator is slotted to accommodate the three windings, and a soft iron ring is pressed over the middle of the stator. The rotor is pivoted inside a rotor housing inserted into the stator. A moulded cap fits over the rear of the stator and the connecting leads to the stator windings pass through the cap. The end of the spindle, to which the pointer is attached, protrudes through the mounting plate of the indicator.

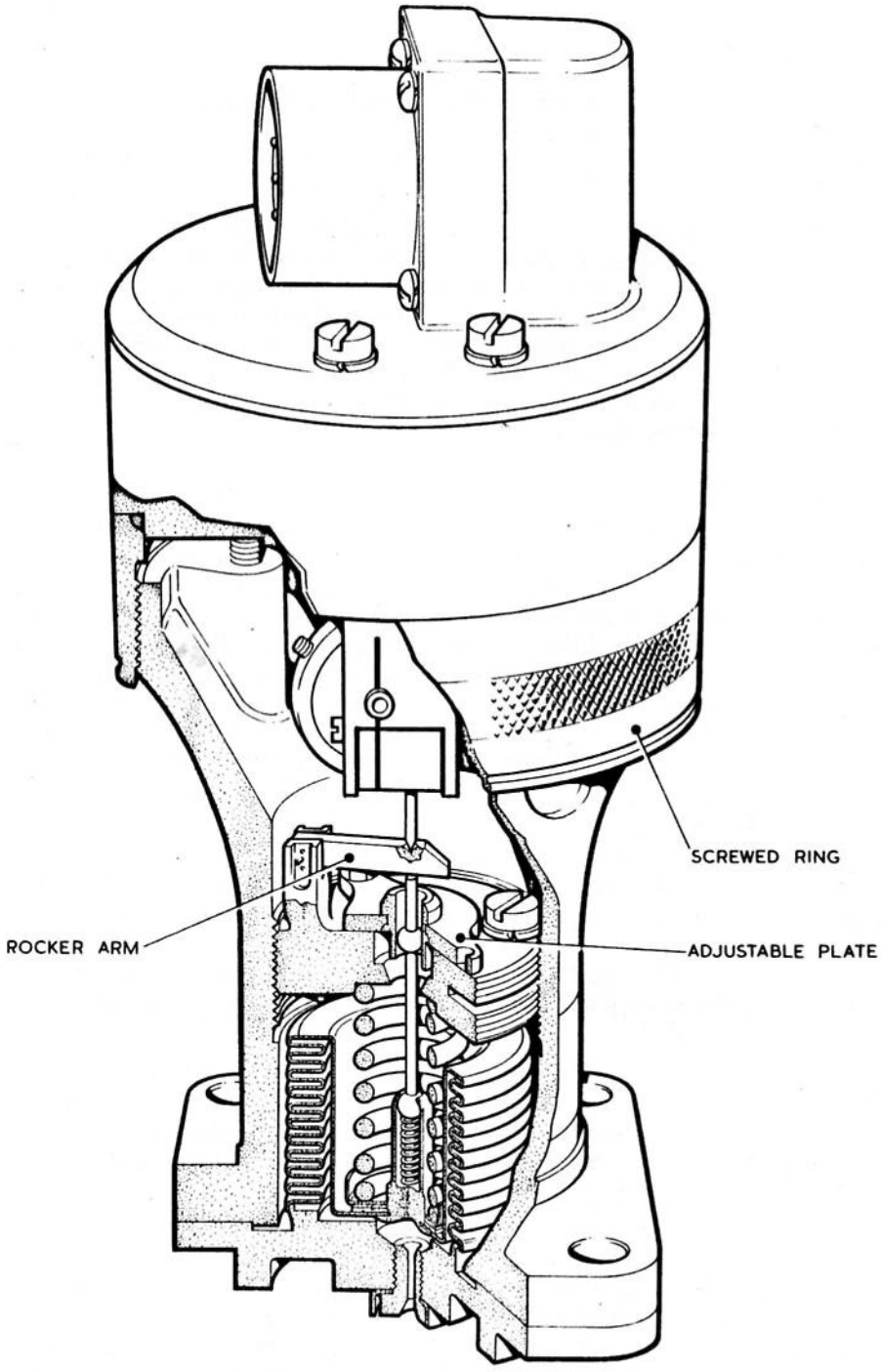

Fig. 4 General arrangement, flange mounted transmitter hydraulic unit

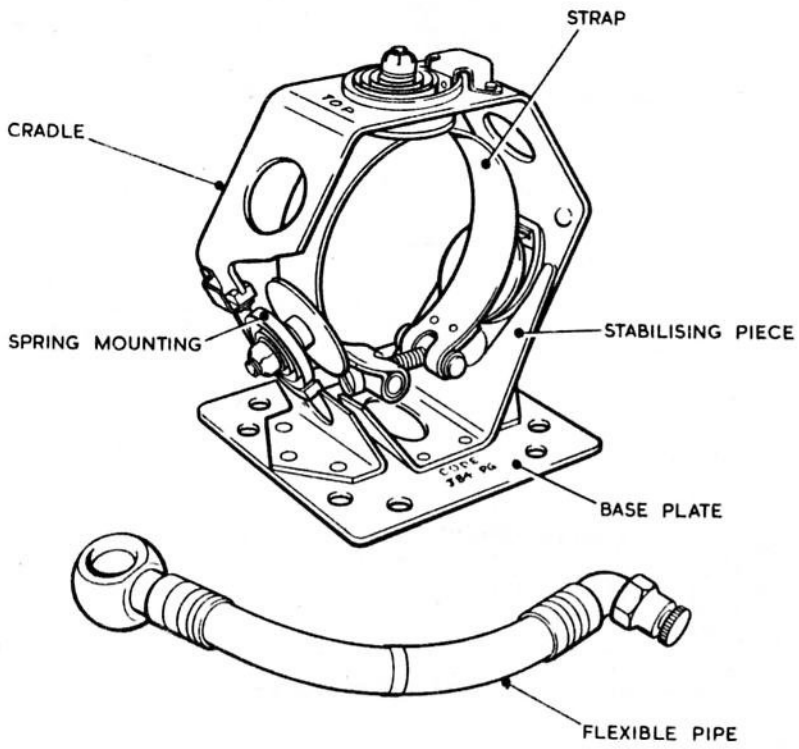

Fig. 5 Anti-vibration mounting and flexible pipe

OPERATION

Bellows type transmitter (fig. 6)

19. Increase in pressure expands the bellows, operating the push-rod, push-pin and rocker shaft to move the spring contact fingers over the surface of the resistance windings. A current applied applied to the resistors via the spring contact fingers, is fed from the resistors to the three windings on the indicator stator. This current change in the indicator windings alters the direction of the magnetic field across the indicator stator. The magnet rotor aligns itself to this change in magnetic field and thus gives movement to the indicator pointer.

Bourdon tube transmitter (fig. 7)

20. The operation is similar to that described in para 26 except that the push-rod is motivated by the expansion of the Bourdon tube.

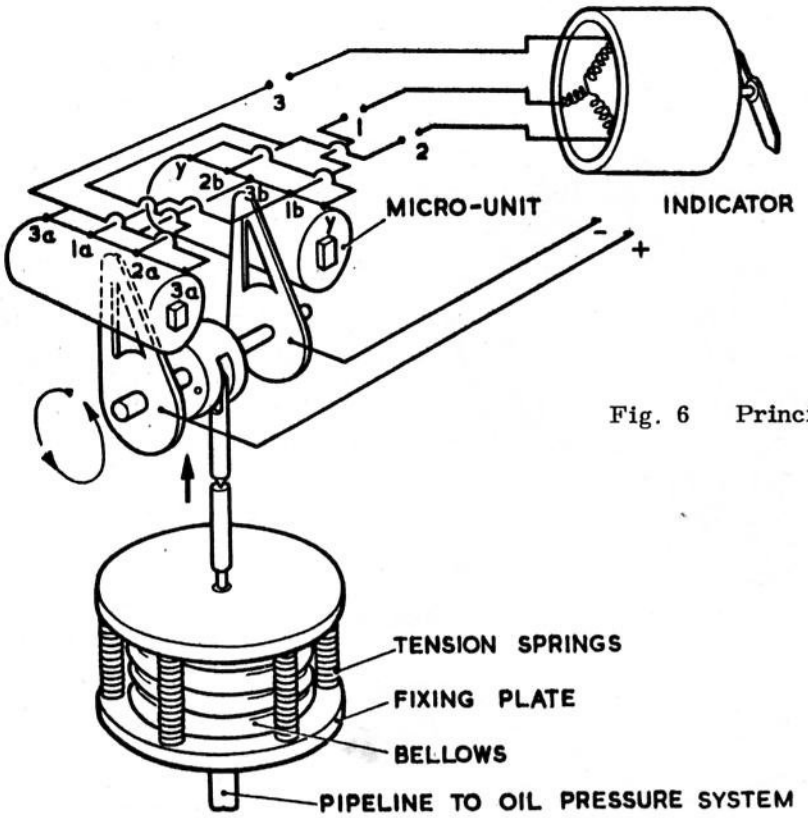

Fig. 6 Principle of bellows type transmitter

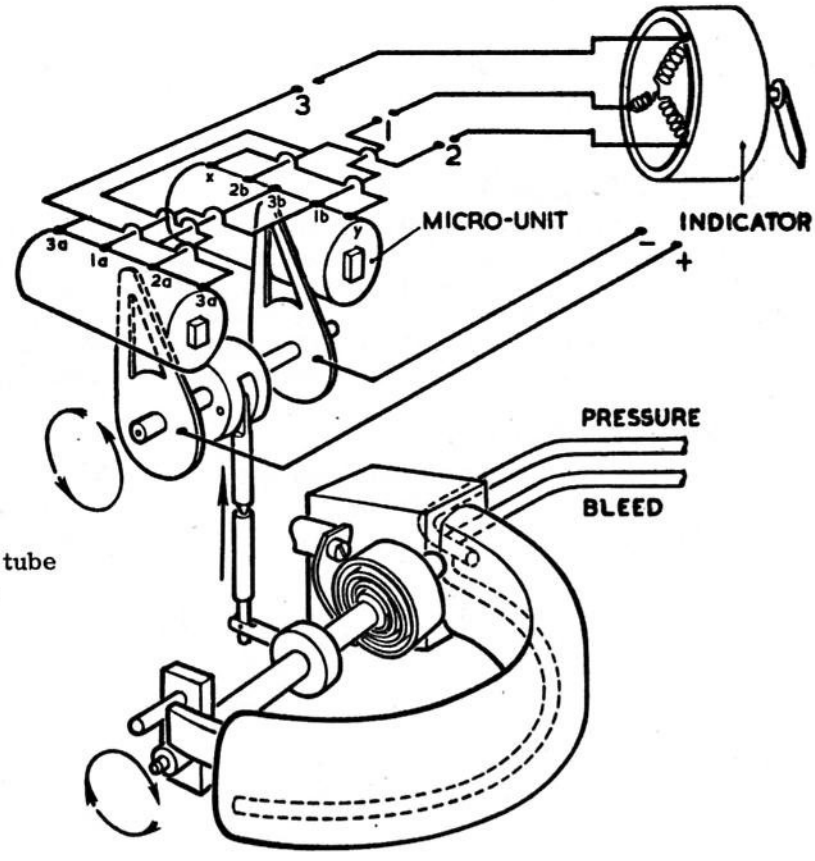

Fig. 7 Principle of Bourdon tube type transmitter

Chapter 1-1

LIST OF UNITS

TABLE 1

Low-pressure types

Description	Range (lbf/in^2)	Ref. No.	Part No.
Indicator, fuel	0 to 40	6A/2168	277PG
Transmitter, differential	0 to 10	3933	181PG
Mounting (a.v.), standard oil and fuel, horizontal		2626	420PG
Indicator, fuel	0 to 10	6054	679PG
Transmitter, fuel	0 to 10	1670	164PG
◀ Transmitter, standard	0 to 40	4332880	266PG/SB ▶
Indicator, fuel	0 to 40	2075	274PG/SB
Indicator, fuel	0 to 40	3298	D274PG/SB

TABLE 2

High-pressure types

Description	Range (lbf/in^2)	Ref. No.	Part No.
Indicator, nitrogen	0 to 2000	6A/3924	379PG
Transmitter, nitrogen	0 to 2000	3925	365PG/SB
Mounting (a.v.), differential and high pressure, vertical		3288	423PG
Indicator, torquemeter	0 to 600	6501	660PG

Chapter 2

STANDARD SERVICEABILITY TEST

Introduction

1. The tests detailed in this chapter are to be applied to the units listed in Chap. 1-1 prior to their installation in an aircraft or whenever their serviceability is suspect.

Method of test

2. The units under test are to be mounted in their normal position, i.e. with the dial of the indicator upright and with the axis of the transmitter vertical and the pressure connection at the bottom.

TEST EQUIPMENT

3. The following test equipment is required:-

(1) Tester, insulation (Ref. No. 5G/1621).

(2) Test set, Desynn (Ref. No. 6C/470).

(3) Calibrator, pressure gauge, Mk. 1, 2 or 3, as appropriate, (Ref. No. 6C/84, 6C/656 and 6C/1130, respectively).

(4) Micromanometer, null reading, Mk. 1 (Ref. No. 6C/865).

(5) Mounting plate, pressure connection, flange mounting transmitters.

TEST PROCEDURE

Complete instrument (non-differential) calibration check

4. Connect the pressure gauge indicator to the transmitter and the transmitter to a 24V d.c. supply. Connect the transmitter to the pressure gauge calibrator, either by the flexible pipe supplied and a standard hollow bolt connection, or by a suitable length of copper pipe with the necessary nipples and nuts.

5. Check the calibration at four widely-spaced points throughout the range, one point of which must be zero, withthe pressure both increasing and decreasing. The errors must be within the tolerances given in Table.1.

Complete differential instrument calibration check

6. Connect the differential gauge indicator to the transmitter and the transmitter to 24V d.c. supply. Connect the two pressure unions of the transmitter to two separate sources of pressure, either by flexible pipes and hollow bolt connections or by suitable lengths of copper pipes with the necessary nipples and nuts. The pressure gauge calibrator, Mk. 2 and a second pressure source with a pressure gauge and controls is suggested. For low-pressure transmitters, the micromanometer Mk. 1 should be used.

7. With the pressure in the low-pressure line equivalent to the minimum scale reading, check the calibration by increasing the pressure in the high-pressure line to values equal to selected cardinal points of the scale up to maximum scale reading and observe the indicator readings. Reduce the pressure in the high-pressure line to the same cardinal points and again observe the indicator readings.

8. Increase the pressure in both lines to a value equal to the maximum scale reading of the transmitter applying pressure through the high-pressure line first. Reduce the pressure in the low-pressure line checking the indicator readings at the points where the pressure difference corresponds to the selected cardinal points of the indicator scale.

9. Errors occurring in the procedures detailed in para. 7 and 8 must be within the tolerances given in Table 1.

Overload tests

Non-differential transmitters (0 to 200 lb/in^2 pressure).

10. Non-differential transmitters with a range up to 60 lb/in^2 must be subjected to an overload of 150% of full load pressure for a period of approximately 5 minutes. At the end of this period, pressure should be reduced to zero and the transmitter rested for one hour before being tested for accuracy of calibration with its associated indicator or using the Desynn test set (para. 14 to 16).

11. Non-differential transmitters with a range from 60 to 200 lb/in^2 must be similarly subjected to an overload of 450 lb/in^2 and then rested before being tested for accuracy of calibration.

Differential transmitters

12. The transmitter is tested in the same manner as the non-differential type with an overload pressure of 150% of full load pressure.

High-pressure transmitters (above 300 lb/in^2)

13. Apply an overload pressure of 150% of full load pressure for five minutes and rest the transmitter at zero pressure for one hour before testing for accuracy of calibration. If the tolerances given are not satisfied rest the transmitter for up to 24 hours and recheck the calibration before rejecting the transmitter as unserviceable.

Calibration check - non-differential transmitters only

14. Connect the transmitter and a 24V d.c. supply to the Desynn test set and set the ON/OFF switch to ON and the rotary switch to TRANS. Connect the transmitter to the pressure gauge calibrator as described in para. 4 and load the calibrator until the pointer on the test set indicator reads 120°. Increase the loading until the pointer reads 240°. The loading required to set the indicator pointer to these positions must be within the limits given in Table 1.

15. The zero position of the transmitters used with other than fuel can be checked by estimation from the size of the green or yellow coloured sectors on the Desynn test set. At the zero position, the permissible error on the oil pressure transmitter is $\pm 3^{\circ}$. Each sector on the dial of the Desynn test set occupies 4°, therefore the permissible error is equal to $\frac{3}{4}$ of the width of the sector on either side of the 30° mark. The top scale position of the transmitter can be similarly checked where each sector on the dial again occupies 4°; the transmitter limits are approximately double the length of the sector on either side of the 330° mark. Set the ON/OFF switch on the Desynn test set to OFF and disconnect the transmitter under test.

Calibration check - differential transmitter only

16. Connect the transmitter and a 24V d.c. supply to the Desynn test set and set the ON/OFF switch to ON an the rotary switch to TRANS. Connect the transmitter to the pressure sources (para. 6), and operate the transmitter over its complete range. Ensure that the test set meter indicates smoothness of operation.

17. With the low-pressure line at zero pressure, load the high-pressure line until the pointer on the indicator test set reads 120° and then increases the loading until the pointer reads 240°. Repeat the test by reducing the pressure in the high-pressure line to minimum. Admit maximum pressure to both low and high-pressure sides and then reduce the low-pressure side until the pointer on the indicator reads 120° and 240°. The loading required to set the pointer to 120° and 240° should be within the limits given in Table 1.

18. At all positions of the scale the permissible error of the differential transmitter is $\pm$ 7° i.e. approximately double the length of the 4° sectors either side of the 30° and 330° marks.

19. Set the ON/OFF switch on the Desynn test set to OFF and disconnect the transmitter under test.

Indicator calibration test

20. Connect the indicator and a 24V d.c. supply to the Desynn test set and set the ON/OFF switch to ON and the rotary switch to METER.

Note . . .

Indicator, Type 330PG (Ref.No. 6A/2814) is a special type and must be tested with a 9·5V d.c. supply.

21. Slowly rotate the test set transmitter and check the pointer indications of the indicator under test against the limit blocks on the right-hand side of the test set. When the indicator under test reads zero, the dial on the left-hand side of the test set must read 30° within a limit equivalent to $\pm$ 1.1/4 times the width of the sector on either side of the 30° mark. Similarly when the indicator under test reads full-scale, the dial on the left-hand side of the test set must read 330° within a limit equivalent to $\pm$ 1·1/4 times the width of the sector on either side of the 330° mark.

22. Throughout the tests given in para. 21 the pointer of the indicator under test should move smoothly without jerking.

Insulation resistance

Transmitter

23. The insulation resistance between all terminals of the transmitter, connected together, and the metal body is to be checked using the insulation tester. The insulation resistance must not be less than 20 megohms at 500V d.c.

Indicator

24. The insulation resistance between all terminals of the indicator, connected together, and the metal case is to be checked using the insulation tester. The insulation resistance must not be less than 20 megohms at 500V d.c.

TABLE 1

Transmitter calibration

Transmitter	Range lbf/in^2	Ref. No. 6A/	Permissible error (lbf/in^2) At zero	Permissible error (lbf/in^2) Above zero	Loading to give 120° Min	Loading to give 120° Max	Loading to give 240° Min	Loading to give 240° Max
					(All in lbf/in^2)			
160PG	0 to 120	1572	± 3¼	± 5	32	37	83	89
266PG	0 to 40	5454	± 1¾	± 1¾	11	12½	28	30
266PG/SB	0 to 40	4332880	± 1¾	± 1¾	11	12½	28	30
276PG	0 to 40	2161	± 1¾	± 1¾	11	12½	28	30
288PG	0 to 200	2162	± 5	± 8¾	53	61½	136½	148
333PG/SB	0 to 60	2815	± 1¾	± 2½	16	18½	41½	45½
181PG	0 to 10	3933	± ½	± ½	2½	3	7	7½
383PG	0 to 1500	3287	± 37½	± 65	400	462½	1030	1112½
428PG	0 to 300	3815	± 7½	± 13	80	92½	206	222½
389PG/SB	0 to 4000	3923	± 40	± 70	1060	1230	2730	2960
365PG/SB	0 to 2000	3925	± 20	± 35	530	615	1365	1480
1054PG	0 to 60	5912	± 1½	1½	16½	19½	40	43½
164PG	0 to 20	1670	± ¼	½	5½	6	14	14½

Chapter 3

SERVICING

Introduction

1. Servicing of the standard and Bourdon tube transmitters is confined to the renewal of the micro-transmitter and, in the case of the Bourdon tube only, cleaning may be necessary. The flange-mounting and differential transmitters, and all indicators, must be renewed completely when found to be unserviceable.

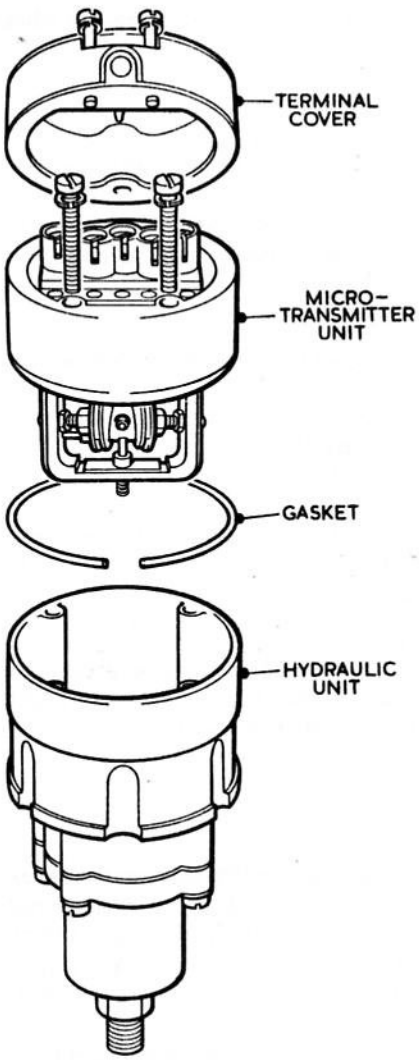

Fig. 1 Standard transmitter, removal of micro-transmitter

Test equipment and materials

Test equipment

2. The following test equipment is required:-

(1) Tester, insulation (Ref. No. 5G/152)

(2) Desynn test set (Ref. No. 6C/470)

(3) Calibrator, pressure gauge, Mk. 1, 2 or 3, as appropriate (Ref. No. 6C/84, 6C/656 and 6C/1130, respectively).

Materials

3. Trichlorethane (Ref. No. 14N/371) is suitable for cleaning the Bourdon tube.

Dismantling (fig. 1)

Standard transmitter

4. Remove the screws securing the terminal cover and remove the cover and sealing washer.

5. Remove the four cheese-head screws securing the micro-transmitter to the main body casting and remove the micro-transmitter and the rubber gasket.

Bourdon tube transmitter

6. Remove the screws securing the terminal cover and remove the cover and sealing washers.

7. Remove the four cheese-head screws securing the micro-transmitter to the hydraulic unit and remove the micro-transmitter and the rubber gasket. Ensure that the ring on the hydraulic unit is not moved during removal of the micro-transmitter.

8. Remove the two screws securing the hydraulic unit case to the base plate and remove the case.

Inspection and cleaning

9. Inspect the unit generally for signs of deterioration. In particular, examine high-pressure transmitters used in oxygen or combustible gas systems for signs of oil or grease. If the presence of oil or grease is suspected in the Bourdon tube it should be thoroughly cleaned with trichlorethane and then dried with clean, dry compressed air.

Assembly

Standard transmitter

10. Assemble the new rubber gasket on the micro-transmitter. Hold the main body with the union connection downwards and verify that the rocker arm is horizontal and in contact with its push-rod. Fit the micro-transmitter to the main body, taking care that the micro-transmitter's operating push-pin engages in the depression in the rocker arm and, if necessary, rotate the micro-transmitter to align the four screw holes with the threaded holes in the body.

11. Insert the four chees-head fixing screws with spring washers into the screw holes but do not fully tighten them at this stage.

Bourdon tube transmitter

12. Replace the case over the hydraulic unit and secure with two screws.

13. Replace the micro-transmitter as detailed in para. 10 ensuring that the operating push-pin locates on the locating bush in the centre of the hydraulic unit internal flange. Again ensure that the ring on the hydraulic unit is not moved from the position it held when the unit was dismantled or the operating range of the micro-transmitter will be affected.

14. Connect the transmitter and a 24V d.c. supply to Desynn test set, and set the test set ON/OFF switch to ON and the rotary switch to TRANS.

15. Tighten the four fixing screws on the micro-transmitter in stages while observing the pointer on the test set indicator which should move slightly as the operation proceeds, thus indicating that the components are correctly engaged.. Fully tighten the fixing screws.

Setting of standard transmitter calibration

16. Connect the transmitter and a 24V d.c. supply to the Desynn test set, set the test set ON/OFF switch to ON and the rotary switch to TRANS. Tighten the fixing screws as detailed in para. 15.

17. Slacken the three screws securing the hydraulic unit to the base of the main body. Turn the hydraulic unit a few times in both directions, tapping the transmitter and test set indicator lightly The pointer of the test set indicator must rise and fall as the hydraulic unit is screwed in and out, which proves that the unit has been correctly assembled.

18. Tighten the three screws sufficiently to allow the hydraulic unit to be turned against the friction provided by the locking ring. By rotating the hydraulic unit, adjust its position until, after lightly tapping the transmitter and test set indicator, the indicator pointer registers between 27^{o} and 29^{o}. Fully tighten the three screws and lightly tap the transmitter and test set indicator. The pointer will rise slightly and should register 30^{o}. If necessary, repeat the procedure until the test set indicator is at exactly 30^{o}. (corresponding to zero pressure).

TESTING

19. Check the calibration of the transmitter in accordance with the instructions given in Chap. 2

TABLE 1

List of spare parts

Stores Ref	Item
6A/2605	Desynn micro-transmitter, complete
6A/2615	Desynn micro-transmitter, less terminal cover captive screws and sealing washer.
6A/2646	Terminal cover
6A/2609	Sealing washer
6A/2647	Screw
6A/2608	Washer
6A/2610	Screw securing micro-transmitter to hydraulic unit
6A/2671	Spring washer
6A/2613	Terminal screw and captive washer
6A/2514	Screw for locking ring
6A/2718	Gasket

Printed in England for Her Majesty's Stationery Office by Flight Refuelling Ltd., Wimborne. Dmd. 714784.4/71.171