Chapter 1

PRESSURE TRANSMITTERS, S122 and S243 SERIES

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

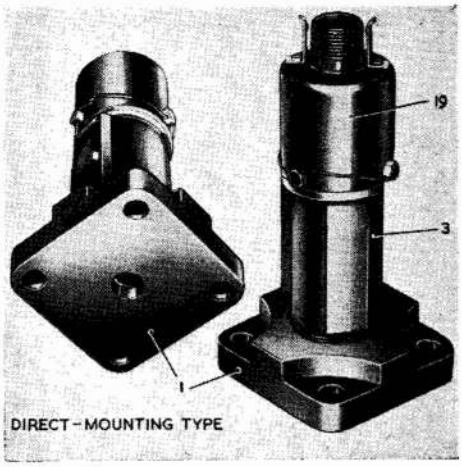
Introduction

1. This chapter deals with the basic model pressure transmitters. Each instrument has a manufacturer's code number which is made up of three parts; a typical code number is S122/1/41 of which, S122 is the model number, /1/ is the "form" number representing the salient features of the model, and 41, the suffix number, represents the application to which the transmitter is adapted (pressure range etc.). Table 1 shows a complete list of the Sangamo Weston pressure transmitters in Service use with liquid oxygen.

2. Of the various transmitter models, three basic types emerge, they are the medium-pressure transmitter S122 forms 1 and 3 operating to a maximum pressure of 120 lb/in², the high-pressure transmitter S122 form 4 operating at pressures between 400 and 6000 lb/in² and the S243 form 1 low-pressure transmitter. The essential difference between these transmitters lies in the method of operation. The medium-pressure transmitter is operated by a bellows and spring transmission, and in the high-pressure model, a Bourdon tube system is used. The low-pressure version, S243 has a capsule and diaphragm system which enables the transmitter to be used as a differential pressure transmitter if required.

Principle

3. In all systems pressure is applied to a flexible container which extends in proportion to the pressure applied. Extension of this container operates a linkage to which is attached an arm operating a variable resistor; thus a pressure may be transmitted in terms of electrical current to a ratiometer type instrument bearing a suitably engraved dial. Pressure indication in terms of lb/in² may be obtained directly from the indicator scale.



1 MOUNTING BLOCK
3 HOUSING
19 COVER

Fig. 1. Medium-pressure transmitter (form 3)

DESCRIPTION

Medium-pressure transmitters S122

4. These transmitters are supplied in the two forms illustrated in fig. 1; the direct mounting type (form 3) has a flange provided with four holes used to couple the transmitter directly to the source of pressure. The other form of transmitter (form 1) is connected to the source of pressure by means of a flexible tube, and the body is connected to the mounting flange by four anti-vibration mountings and an earthing cable. Apart from the methods of mounting, both forms of transmitter are of similar construction.

5. The transmitter is secured by the mounting block (1, fig. 2) into which is screwed the housing (3), the bellows (4), the spring (5), the plunger rod (6) and the plunger. Pressure applied to the orifice in the block (1) moves the plunger (7) against the reaction of the spring (5), and the sliding contact (10) is caused to traverse the variable resistor winding (13) by an amount dependent upon the magnitude of the pressure applied.

6. A variable resistance winding is connected in the circuit as illustrated in fig. 11; alteration in resistance produces a variation in current in the coil windings of the indicator. All of the electrical assembly is enclosed within an anodized aluminium dome which provides a mounting for the 3-pole plug or terminal block connected to the variable resistor. A 3-pole socket, moulded into a cable, forms the connection between the transmitter and the indicator for plug connected transmitters.

High-pressure transmitters S122

7. Form 4, 6, 8, 10 and 11 transmitters (fig. 4 and 6) consist of a machine-finished die-cast light-alloy base (27), with an integral spigot supporting the electrical assembly, a Bourdon tube with a plunger rod operating the variable resistance, a main cover (26), and a cylindrical cover (19) for the electrical assembly.

8. The Bourdon tube assembly consists of a brass pressure chamber (33, fig. 6) secured to the base by the three-hex. hd. screws, and a phosphor-bronze Bourdon tube (43) soldered into the chamber at one end and secured to a brass support block at the other. The pressure chamber inlet (28) has an externally threaded portion, to accommodate a $\frac{1}{8}$ in. B.s.p. connecting union. A slotted grub-screw with a centrally disposed 0·020-in. hole is incorporated in the pressure chamber, functioning as a choke to reduce the pressure rate.

9. Referring to fig. 6, a spring (41), attached to the base, maintains the Bourdon tube support block in the horizontal position but allows lateral movement. Also mounted upon this block is a bracket (42) supporting a plunger rod (35) which in turn is secured to a larger diameter rod inserted in a guide tube (36) mounted on the base casting. A contact arm (10) is attached to the plunger rod (35) so that when pressure is applied to the inlet orifice imparting longitudinal movement to the Bourdon tube, the contact arm moves over the resistance winding (13) in the electrical assembly.

10. When the main cover (26) is assembled to the body, two washers (44) (one steel spring and one paxolin) are interposed between the inlet shoulder and the cover for sealing purposes. The cover (26) is secured to the base by two csk.hd. screws with cylindrical spacers (34) and two csk.hd. screws in the sides of the cover at the electrical end of the transmitter.

Form

11. Differences between the various "forms" of S122 high pressure transmitters are as follows:—

Form	Details
4	3-pole plug connector
6	3-terminal screw connector
8	3-terminal screw connector
10	3-pole plug connector. Transmitter fitted with external separator, the line pressure being transmitted to the Bourdon tube via a diaphragm.
11	3-terminal screw connector and external separator.

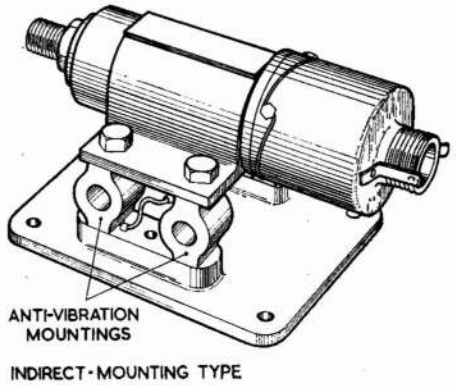
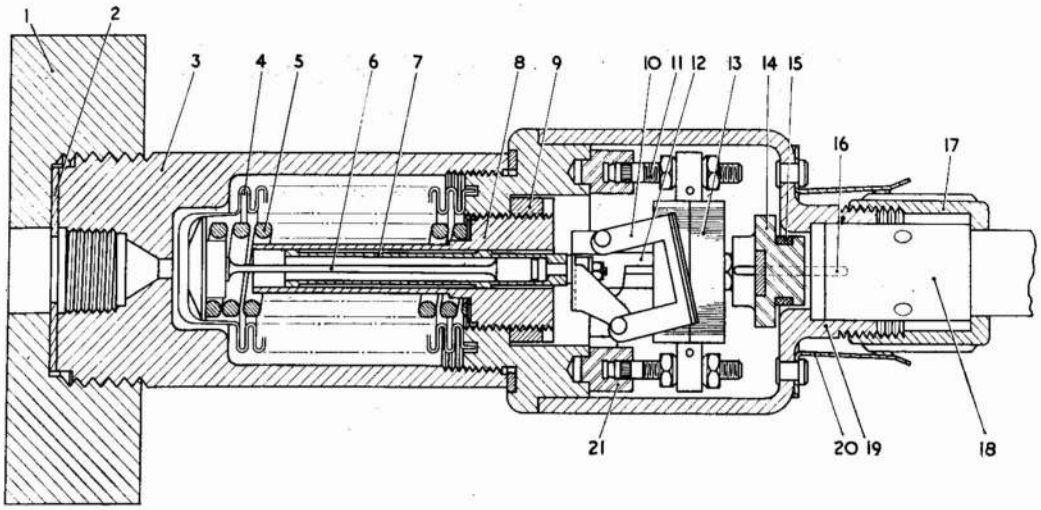
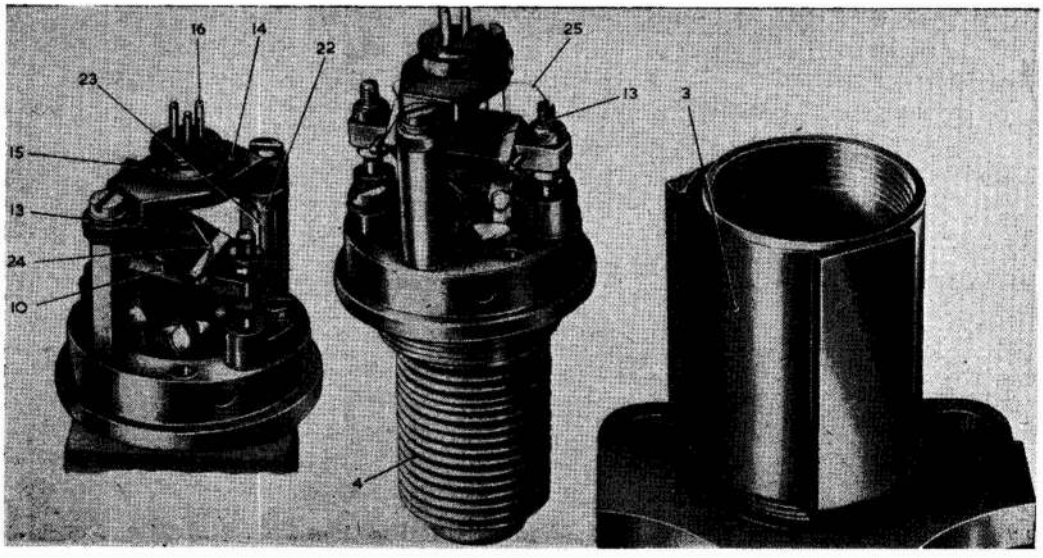


Fig. 1A. Medium-pressure transmitter (form 1)



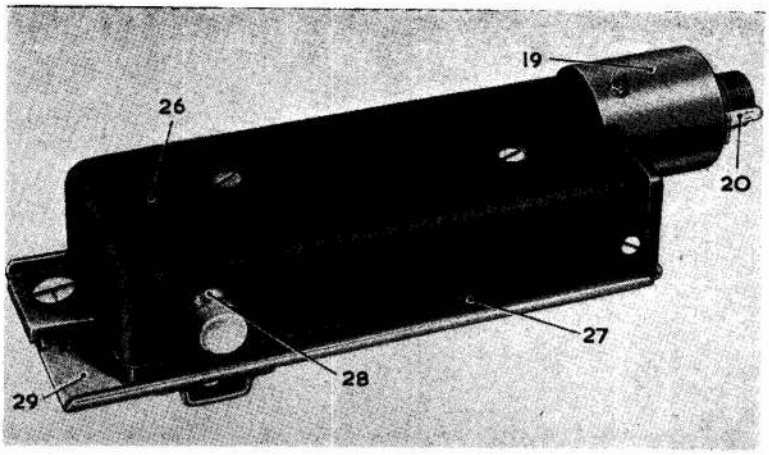
1 MOUNTING BLOCK
2 GASKET
3 HOUSING
4 BELLOWS
5 BELLOWS SPRING
6 PLUNGER ROD, OPERATING CONTACT (10)
7 PLUNGER
8 RETAINER FOR SPRING
9 LOCK NUT
10 SLIDING CONTACT
11 TWO RESISTOR SUPPORTS
12 TWO PILLARS
13 RESISTOR
14 SUPPORT
15 TEMPERATURE COMPENSATING WINDING
16 THREE CONNECTING PINS
17 CABLE NUT
18 CONNECTING PLUG
19 COVER
20 TWO SPRING FINGERS
21 TWO INSULATORS

Fig. 2. Sectional view of S122 "form" 3 transmitter



3 HOUSING
4 BELLOWS
10 SLIDING CONTACT
13 RESISTOR
14 SUPPORT
15 TEMPERATURE COMPENSATING WINDING
16 THREE CONNECTING PINS
22 INSULATING SHEATH
23, 24, 25 } THREE LIGAMENTS

Fig. 3. Components of "form" 3 transmitter



26 MAIN COVER
19 CYLINDRICAL COVER
20 SPRING FINGERS
27 BASE
28 PRESSURE INLET
29 MOUNTING BASE PLATE

Fig. 4. High-pressure transmitter

12. The normal working pressure of high pressure transmitters must not exceed $\frac{2}{3}$ of the figure for maximum pressure stamped on the front plate of the transmitter.

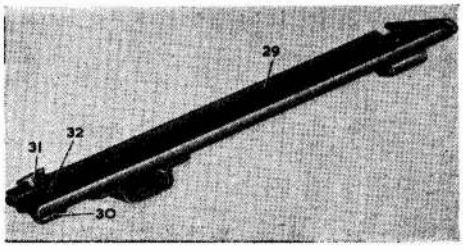
Low-pressure transmitters, S243

13. Low-pressure transmitters are capsule operated and may also be used for differential pressure measurement. They differ from the S122 versions mechanically, but the electrical operation is identical.

14. The transmitter consists of a large s.a.e. Bakelite casing containing the capsule-operated potentiometer, with pitot and static connections and a 3-pole, Mk. 4 plug for the electrical connection (pins 1 and 3 connected to the resistance winding, pin 2 to wiper). Sealing of the casing is effected by the use of a rubber "O" ring fitted between a stepped light-alloy plate and the annular recess in the casing flange; the sealing plate is retained by a closing plate secured by eight screws.

Mechanism

15. The capsule and linkage assembly (fig. 7) is secured to the casing by a $\frac{1}{8}$ in. B.s.p. nut screwed on to the threaded pitot connection which extends through the rear of the casing. A bonded seal, between the inner wall of the casing and the $\frac{1}{8}$ in. B.s.p. special nut (i.e. greater depth) seals the casing at both pitot and static entries.



29 MOUNTING BASE PLATE
30 SELF-LOCKING NUT
31 CSK/HD SCREW
32 SPRING-LOADED BLOCK ASSEMBLY

Fig. 5. Mounting plate

16. On the front face of the capsule is mounted a 12 B.A. screw to which is attached the wiper arm mechanism described in para. 17 to 18. As the pressure in the capsule increases, the diaphragm extends, causing the wiper arm to move across and along the resistance winding, thus varying the resistance applied to the associated indicator.

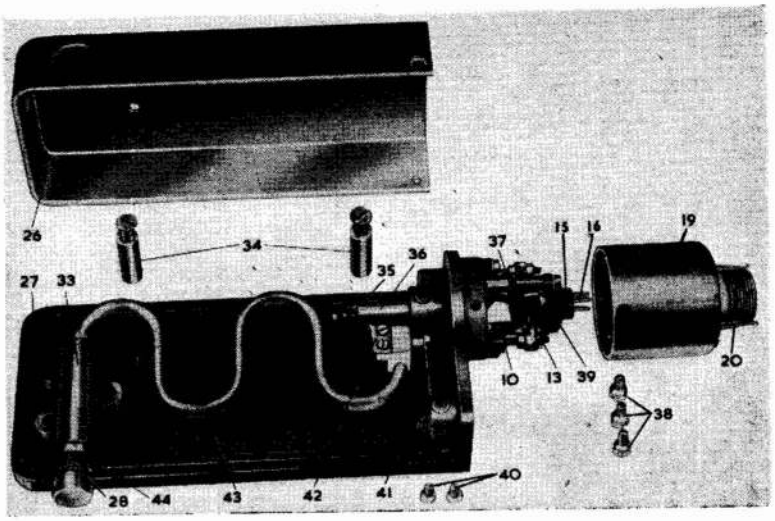
Electrical assembly (fig. 6)

17. The following description is common to all transmitters. The resistance element (13) is wound on a square-section former supported between two insulated threaded studs; initial adjustment in relation to the contact arm is achieved by adjusting two nuts on each stud. Three pins (16), provided for external electrical connections, and a temperature compensating resistor (15) are mounted on an insulated bridge-piece (39) supported on two pillars. The sliding contact arm (10) is connected to the upper pin, which is located in an insulated washer (14); the variable resistance and temperature compensating resistance (15) are connected in series across the other two pins.

18. Secured to the base by three hex.hd. screws (38) is the cylindrical shaped cover (19); the threaded portion of the cover forms the connection for the three-pole plug. An internal keyway provides location for the external cable connection and the cable is retained by a gland nut which is secured in position by two spring fingers (20).

TESTING

19. All transmitters are tested in conjunction with a known serviceable indicator of the correct



26 MAIN COVER
19 CYLINDRICAL COVER
20 SPRING FINGERS
27 BASE
28 PRESSURE INLET
33 PRESSURE CHAMBER
34 SECURING SCREWS AND SPACERS
35 PLUNGER ROD
36 GUIDE TUBE
37 INSULATED WASHER
15 TEMPERATURE COMPENSATING RESISTANCE
16 THREE CONNECTING PINS
38 CYLINDRICAL COVER SECURING SCREWS
39 BRIDGE PIECE
13 RESISTOR
10 SLIDING CONTACT
40 MAIN COVER SECURING SCREWS
41 SPRING
42 BRACKET
43 BOURDON TUBE
44 TWO WASHERS

Fig. 6. High-pressure transmitter (covers removed)

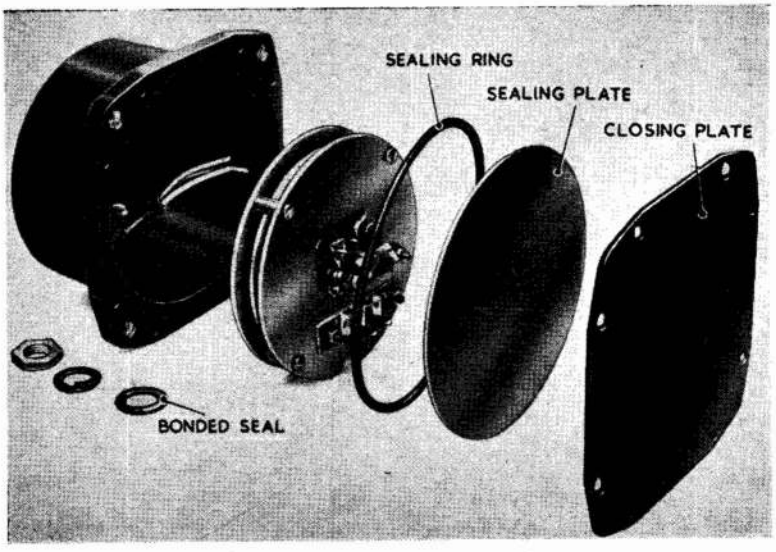


Fig. 7. S243 low-pressure transmitter

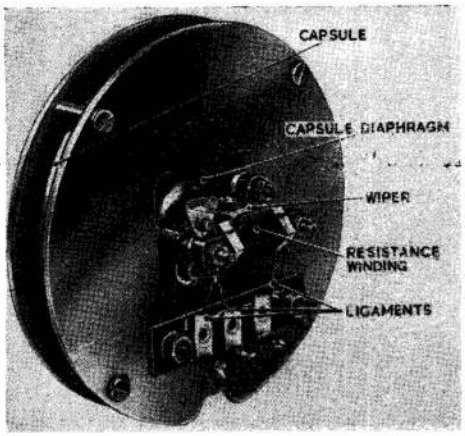
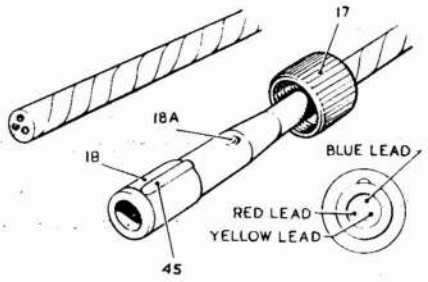


Fig. 8. S243 transmitter (casing removed)



17 CABLE NUT
18 CONNECTING PLUG
18A CABLE NUT RETAINING PROJECTIONS
45 CABLE LOCATING KEY

Fig. 10. Connecting cable for S122

pressure range; the test pressure is applied to the transmitter by means of the pressure gauge calibrator Mk. 3 (Ref. No. 6C/1130) or Micromanometer, cistern, null reading (Ref. No. 6C/865) according to range.

S122 transmitters

20. Assemble the Mk. 3 Calibrator test equipment as described in A.P.1275T, Vol. 1, Sect. 3, Chap. 36, para. 6.

(1) After assembly of the test equipment, attach the pressure transmitter under test to the appropriate gauge adapter installed in the test equipment.

(2) Connect the pressure transmitter, electrically, to its associated pressure indicator (tested in accordance with A.P.1275A, Vol. 1, Sect. 16) or to a suitable proven pressure indicator of the appropriate range.

(3) Operate the test equipment and apply pressure to the transmitter according to its range. At least four test points should be made over the full range of the transmitter. The error must not exceed ± 5 per cent of full scale deflection at zero or ± 3 per cent full scale deflection at all other cardinal points of the test indicator. However, if the indicator used for testing is associated with the transmitter, a system tolerance of ± 7 per cent full scale deflection at zero or ± 5 per cent full scale deflection over the range is permissible.

(4) After testing is completed, disconnect the transmitter from test equipment and remove any residue carbon tetrachloride from the Bourdon tube using compressed air.

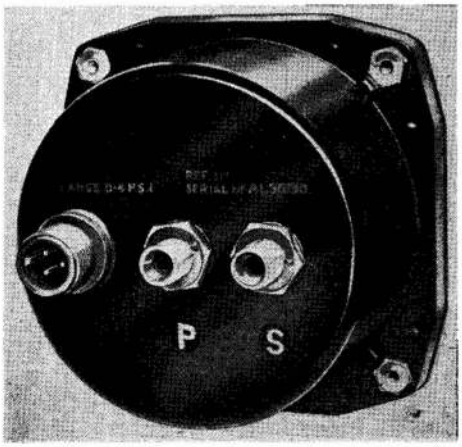


Fig. 9. S243 transmitter (rear view)

S243 transmitters

21. Connect and adjust the Micromanometer test equipment as described in A.P.1275T, Vol. 1, Sect. 3, Chap. 7; connect, electrically, the appropriate pressure indicator (tested in accordance with A.P.1275A, Vol. 1, Sect. 16) to the transmitter under test.

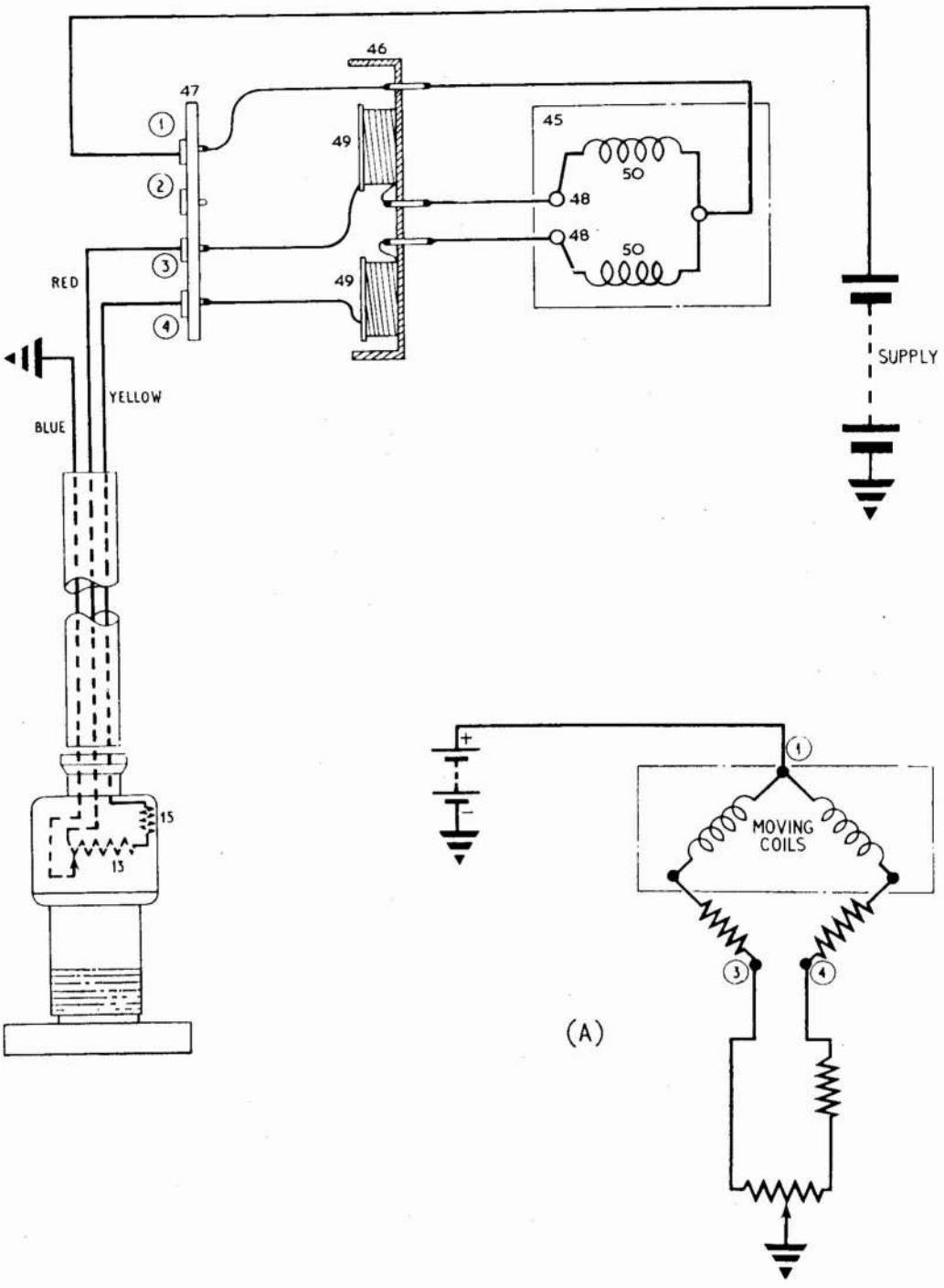
(1) Operate the Micromanometer to apply pressure to the transmitter over the working range and note the reading of the pressure indicator.

22. At least four test points should be selected and the error must not exceed ± 7 per cent of full scale deflection at zero, or, ± 5 per cent full scale deflection at all other cardinal points of the test indicator. However, if the indicator used for testing is associated with the transmitter, a system tolerance of ± 9 per cent full scale deflection at zero or ± 7 per cent full scale deflection over the range is permissible.

TABLE 1

Transmitter details

Part No.	Ref. No.	Range lb/in²
S122/6/105	6D/2711	0 to 400



13 RESISTOR
15 TEMPERATURE COMPENSATING RESISTANCE
45 MAGNET
46 INDICATOR SPOOL MOUNTING
47 REAR COVER
48 MOVING COIL LIGAMENT CONNECTIONS
49 RESISTANCE SPOOLS
50 TWO MOVING COILS

Fig. 11. Circuit diagram (transmitter and indicator)

Printed for H M Stationery Office by Chorley & Pickersgill Ltd Leeds