

AP 112G-0636-1

(Formerly AP1275A, Vol. 1, Sect. 17, Chap. 17)

**THERMOMETERS, ELECTRICAL
TRANSMITTING
(SMITHS TYPE)**

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL



Ministry of Defence

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ROYAL NAVY by HAD(N)

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Publications authority: ATP/MOD(PE)

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AP(N)140 Chap.1 Annex A (RN)
AP100B-01 Order 0504 (ARMY and RAF)

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

A.L. No.	AMENDED BY	DATE
1	Incorporated	
2	Incorporated	
3	E. I. Curtis	2/6/86
4	E. I. Curtis	2/6/86
5	E. I. Curtis	2/6/86
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PRELIMINARY MATERIAL

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Chapter 1 DESCRIPTION AND OPERATION

Introduction

1. Indicators, temperature, d. c. single ratiometer type, give an indication of temperature, the source of which is a remote thermometer bulb, connected to the indicator by Ducel 7 cable.

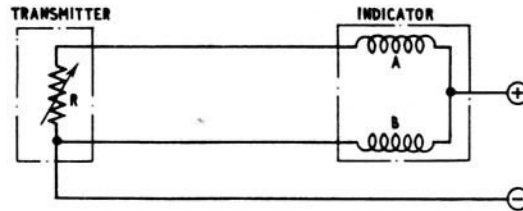


Fig.1 System Circuit

Principle of operation

2. The indicator and thermometer bulb (transmitter) are connected, as shown in fig. 1. The transmitter consists of a variable resistor R, the value of which varies with temperature. The indicator consists of a moving coil movement having two windings A and B; the value of the current flowing through each winding depends upon the value of the resistance of the transmitter. It is the ratio of the currents in A and B which is measured by the indicator.

DESCRIPTION

3. The theoretical circuit of the ratiometer type indicator is given at B of fig. 3. The moving coil assembly, comprises two, coils mounted on a common former and connected so that the torques produced in the two coils are in opposition. The method of winding these two coils is illustrated at C of fig.3. The magnetic circuit is such that the coil in which the greater current flows is in a weaker part of the field than in which the lesser current flows. The assembly will always rotate until the coils are in that part of the field where the torques produced in each coil are equal and opposite, when the assembly will be in a state of equilibrium.
4. The two coils are supplied with power from the same source through a suitable current limiting resistor. In series with one coil is the coil contained in the thermometer bulb (AP112G - 0601-1). The latter coil is of a material which has a high temperature coefficient. Mounted in the instrument case is a second resistance which is in series with the second coil in the former of the moving coil assembly. This resistor is of a material which has a very low temperature coefficient. Any change in resistance in the bulb resulting from variation in temperature, causes a change of current in its associated coil, and the pointer mounted on the pivoted former will move to an equilibrium position which will depend on the ratio of the current in the two coils.
5. The instrument is independent of the supply voltage, since any change of voltage will not alter the ratio of the current in the two coils. A hairspring provides a slight torque so that the pointer moves off-scale when there is no supply voltage (and thus will also indicate failure of the supply). The off-scale position is at the lower end of the scale for oil and radiator thermometers and at the upper end of the scale for air thermometers.

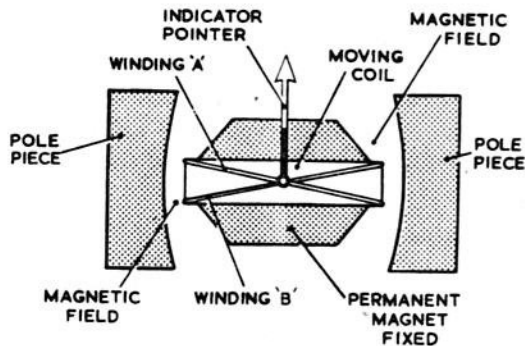


Fig.2 Principle of ratiometer movement

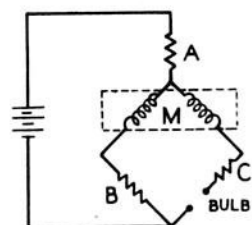
Indicator

6. The indicator is housed in a 2 3/8 in. s.a.e. case. Electrical connections are made either through a terminal block or a pin and socket connector of the Breeze type, and operate on a nominal voltage of 28V d.c. The dial calibration covers 90 deg; the presentation of each type of instrument being illustrated in the appropriate sub-chapter.

7. The movement incorporates two windings wound diagonally to each other on a common former. The moving coil is pivoted on jeweled bearings. The coil is connected directly to the indicator pointer and rotates about a specially-shaped magnet which is stationary and supported on the instrument frame by two pillars and secured by screws. One end of each coil is connected to a common hairspring which acts as a conductor and returns the pointer off-scale when the windings are not energized. The other ends of the coils are connected to shaped ligaments. The ligaments are insulated from each other and from the frame, and terminate in tags to which the calibrating resistors are soldered. A current limiting resistor is fitted in the common connection from the opposite side of the movement. Movements may be calibrated to either the nickel or platinum law depending upon the transmitter in use with a particular indicator.

Servicing

8. If the serviceability of the temperature indicators is suspect, they should be subjected to the standard serviceability test as detailed in Chapter 2.

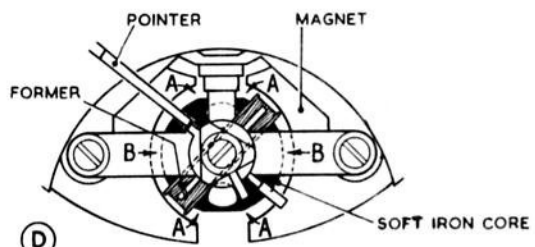
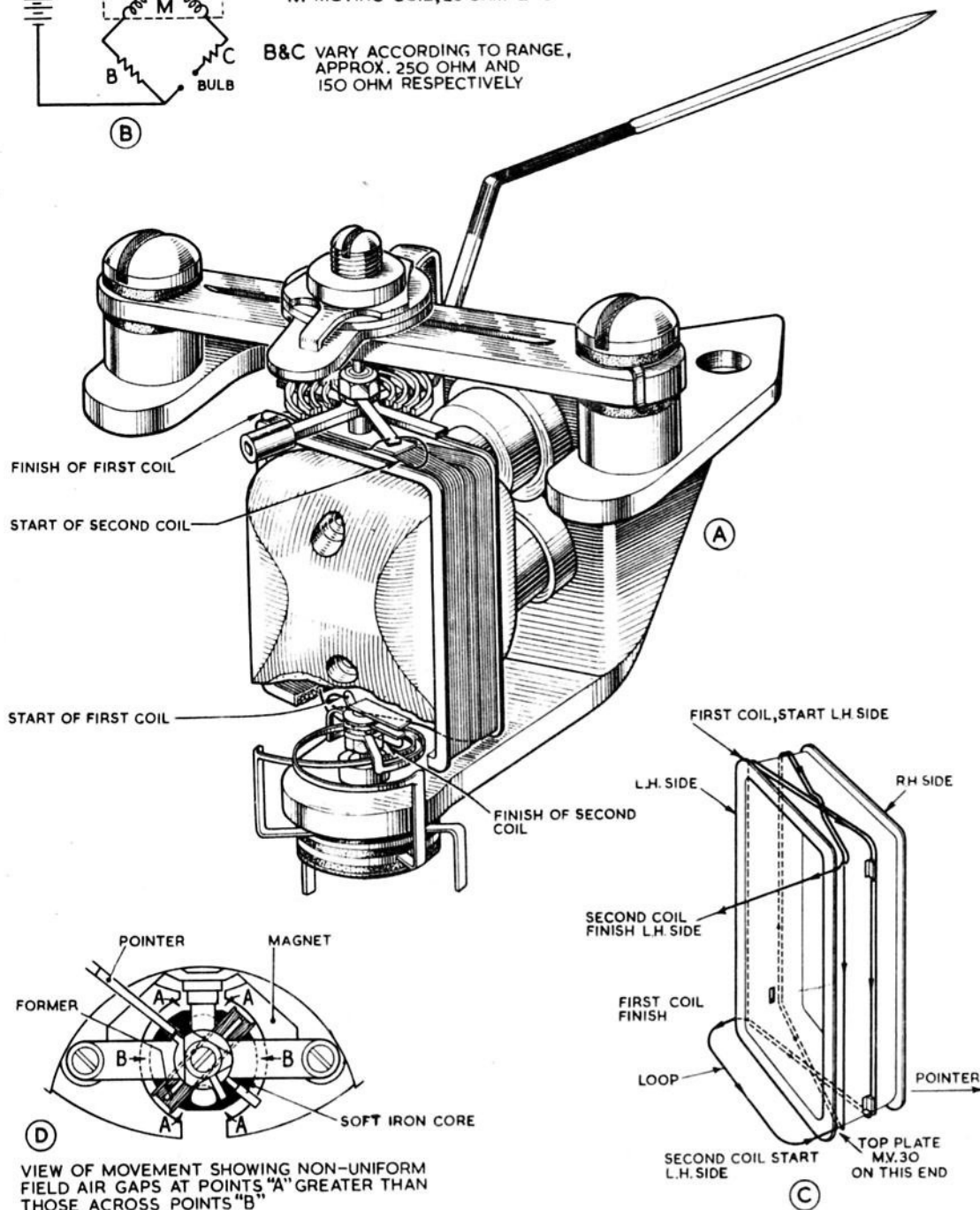


A 12 VOLT - 250 OHM RESISTOR
24 VOLT - 520 OHM

M MOVING COIL, 23 OHM EACH

B & C VARY ACCORDING TO RANGE,
APPROX. 250 OHM AND
150 OHM RESPECTIVELY

(B)



VIEW OF MOVEMENT SHOWING NON-UNIFORM
FIELD AIR GAPS AT POINTS "A" GREATER THAN
THOSE ACROSS POINTS "B"

Fig.3 Mechanism of ratiometer indicator

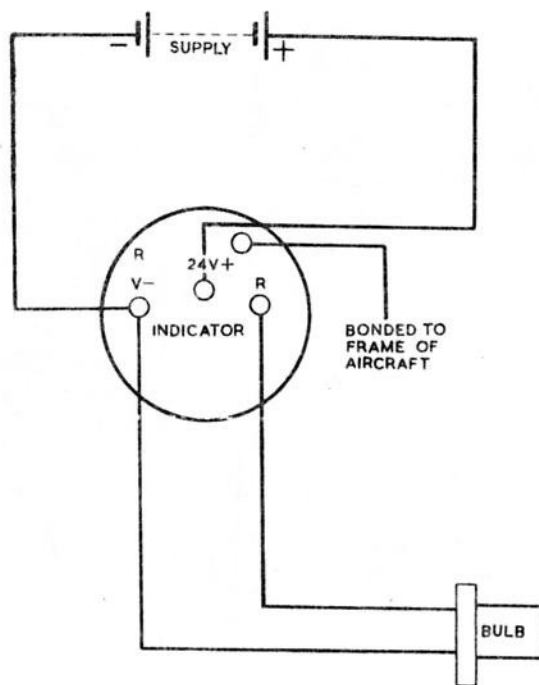


Fig.4 Typical wiring diagram

Chapter 1-1
DESCRIPTION
INDICATOR, TYPE 61MV/SB

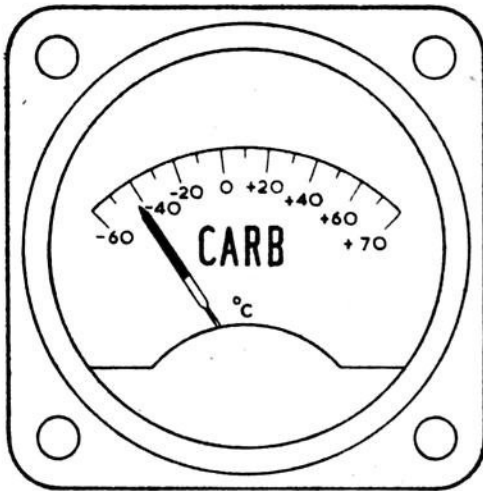


Fig. 1 Dial presentation

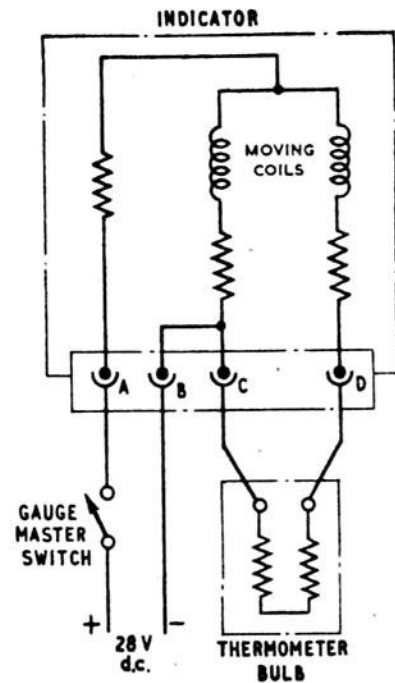


Fig. 2 Circuit diagram

General

1. This indicator (Ref. No. 6A/2868) (fig. 1), is a single ratiometer type instrument housed in a 2.3/8 in s.a.e. case and is calibrated from -60° to $+70^{\circ}\text{C}$. The moving coil is controlled by a standard thermometer bulb and is calibrated to the nickel law.

Circuit and connections

2. The circuit diagram is shown in fig. 2, connection at the indicator being made via a 4-pole plug (Plessey No. CZ1050) with the pins lettered from A to D inclusive.

Chapter 1-2
DESCRIPTION
INDICATOR TYPE 227MV

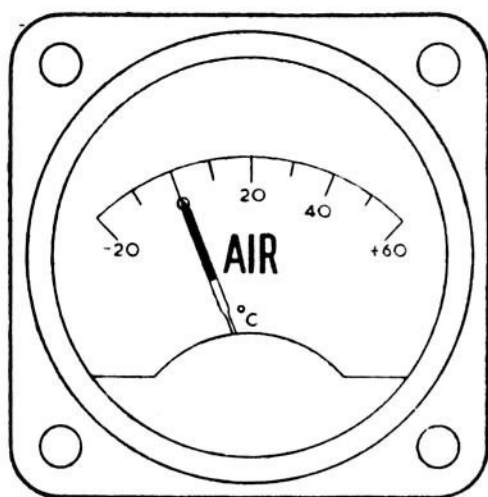


Fig. 1 Dial presentation

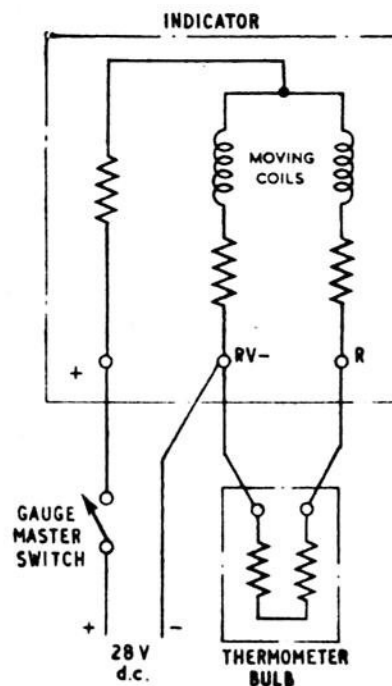


Fig. 2 Circuit diagram

General

1. This indicator (Ref. No. 6A/2975) (fig. 1) is a single ratiometer type instrument housed in a 2.3/8 in s.a.e. case, and is calibrated from -20°C to $+60^{\circ}\text{C}$. The moving coil is controlled by a standard air thermometer bulb and is calibrated to the platinum law.

Circuit and connections

2. The circuit diagram is shown in fig. 2, connection at the indicator being made via a 3-way terminal block.

Chapter 1-3
 DESCRIPTION
 INDICATOR TYPE 475MV

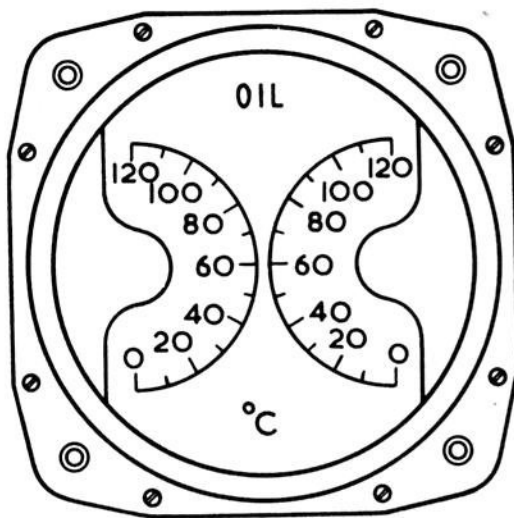


Fig. 1 Dial presentation

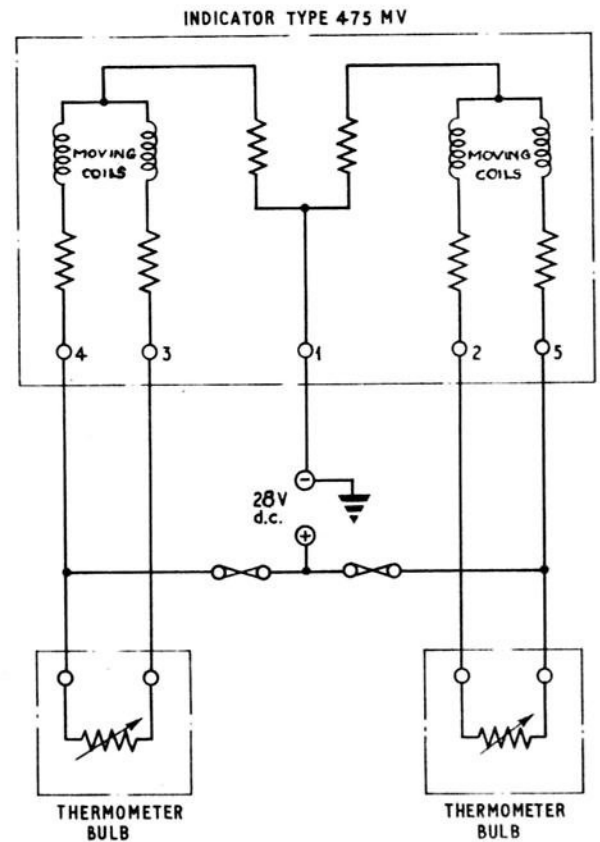


Fig. 2 Circuit diagram

General

1. This indicator (Ref. No. 6A/5485) is a dual ratiometer instrument, designed to indicate temperature. The temperature scale is calibrated from 0 to 120°C and the movement is controlled by two standard thermometer bulbs calibrated to the platinum law. Dial presentation is shown in fig. 1.

Circuit and connections

2. The circuit diagram is shown in fig. 2, connection at the indicator being made via a 5-way terminal block with the terminals numbered from 1 to 5 inclusive.

Chapter 1-4
 DESCRIPTION
 INDICATOR, TYPE 46MV/M

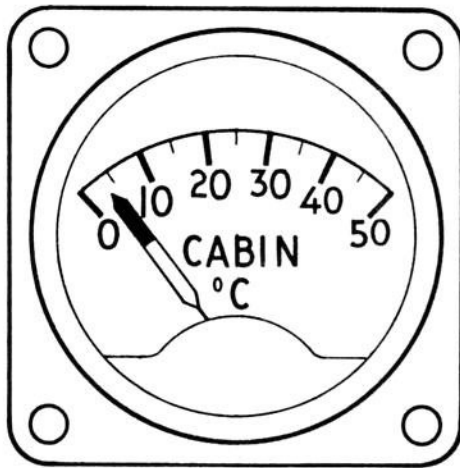


Fig. 1 Dial presentation

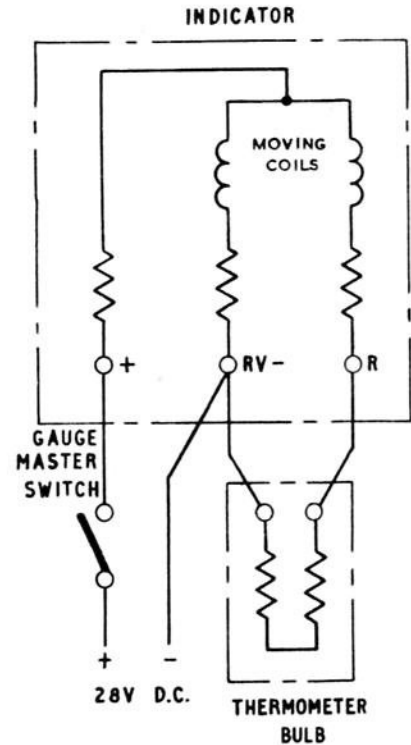


Fig. 2 Circuit diagram

General

1. The indicator (Ref. No. 6A/6503) (fig. 1) is a single ratiometer type instrument housed in a 2.3/8 in s.a.e. case, the dial being calibrated from 0 to 50°C. The instrument is calibrated to the nickel law.

Circuit and connections

2. The circuit diagram is shown in fig. 2, electrical connection being made via a 3-way terminal block.

Chapter 2

STANDARD SERVICEABILITY TEST

1 The following tests are to be applied to the equipment prior to installation in an aircraft or at any time the serviceability is suspect.

Equipment required

2

- 2.1 Tester, insulation resistance (Ref No 5G/1112740).
- 2.2 Decade resistance box (Ref No 10S/6327624).
- 2.3 Single pole on/off switch 28V dc supply.

TESTS

Insulation resistance

3 Using the tester insulation resistance measure the resistance between each terminal of the block, or each plug pin (depending on type of connector) and the instrument case. In each instance the resistance must be not less than 20 megohms at 250V dc.

Range and calibration

4

- 4.1 Connect the indicator to the test equipment as shown in appropriate fig and switch on the power supply.
- 4.2 Set the decade box to bring the indicator pointer to each main scale division in turn from the lowest to the highest and check that the resistance settings are within the limits given in the appropriate Table.

TABLE 1 INDICATOR TYPE 61 MV/SB

Temperature (deg C)	Resistance (ohms)	Temperature (deg C)	Resistance (ohms)
▶ -60	64.73 - 67.03	+10	93.29 - 95.59
-50	68.45 - 70.75	+20	97.85 - 100.15
-40	72.29 - 74.59	+30	102.53 - 104.83
-30	76.29 - 78.59	+40	107.33 - 109.63
-20	80.29 - 82.59	+50	112.25 - 114.55
-10	84.53 - 86.83	+60	117.29 - 119.59
0	88.85 - 91.15	+70	122.45 - 124.75 ◀

TABLE 2 INDICATOR, TYPE 227MV

Temperature (deg C)	Resistance (ohms)	Temperature (deg C)	Resistance (ohms)
-20	118.86 - 120.50	+30	144.55 - 146.19
-10	124.03 - 125.67	+40	149.64 - 151.28
0	129.18 - 130.82	+50	154.72 - 156.36
+10	134.32 - 135.96	+60	159.78 - 161.42
+20	139.44 - 141.08		

TABLE 3 INDICATOR, TYPE 475MV

Temperature (deg C)	Resistance (ohms)
> 0	128.79 - 131.21
30	144.16 - 146.58
60	159.39 - 161.81
90	174.49 - 176.91
120	189.45 - 191.87

TABLE 4 INDICATOR, TYPE 46MV/M

Temperature (deg C)	Resistance (ohms)
0	89.54 - 90.46
10	93.98 - 94.90
20	98.54 - 99.46
30	103.22 - 104.14
40	108.02 - 108.94
50	112.94 - 113.86

TABLE 5 INDICATOR, TYPE 54MV

Temperature (deg C)	Resistance (ohms)	Temperature (deg C)	Resistance (ohms)
> 0	88.78 - 91.22	60	117.22 - 119.66
10	93.22 - 95.66	70	122.38 - 124.82
20	97.78 - 100.22	80	127.66 - 130.10
30	102.46 - 104.90	90	133.06 - 135.50
40	107.26 - 109.70	100	138.58 - 141.02
50	112.18 - 114.62	110	144.20 - 146.64
		120	149.98 - 152.42

INDICATOR TYPE 61 MV/SB

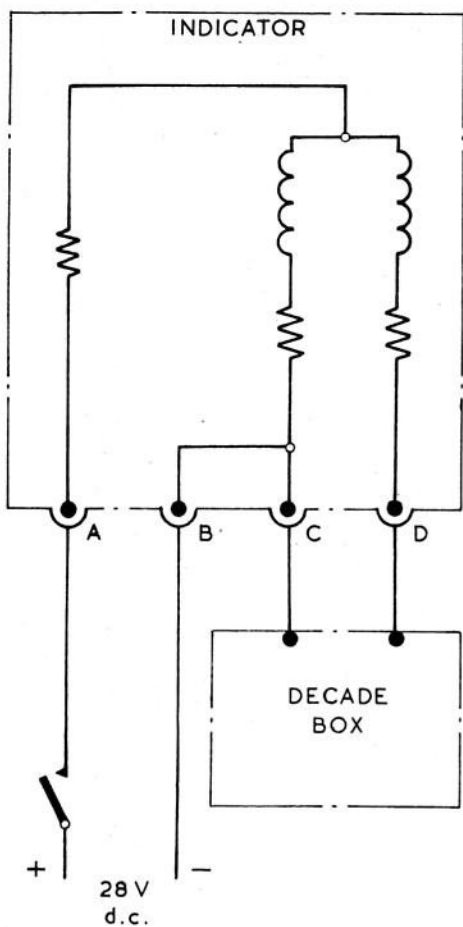


Fig 1 Test connections - indicator Type 61MV/SB

INDICATOR TYPE 227 MV AND 46 MV/M

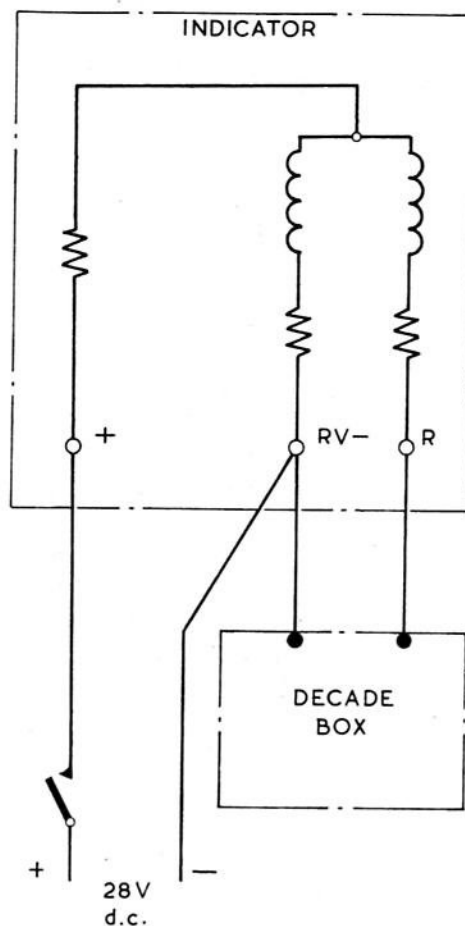


Fig 2 Test connections - indicators, Type 227MV, 46MV/M and 54MV

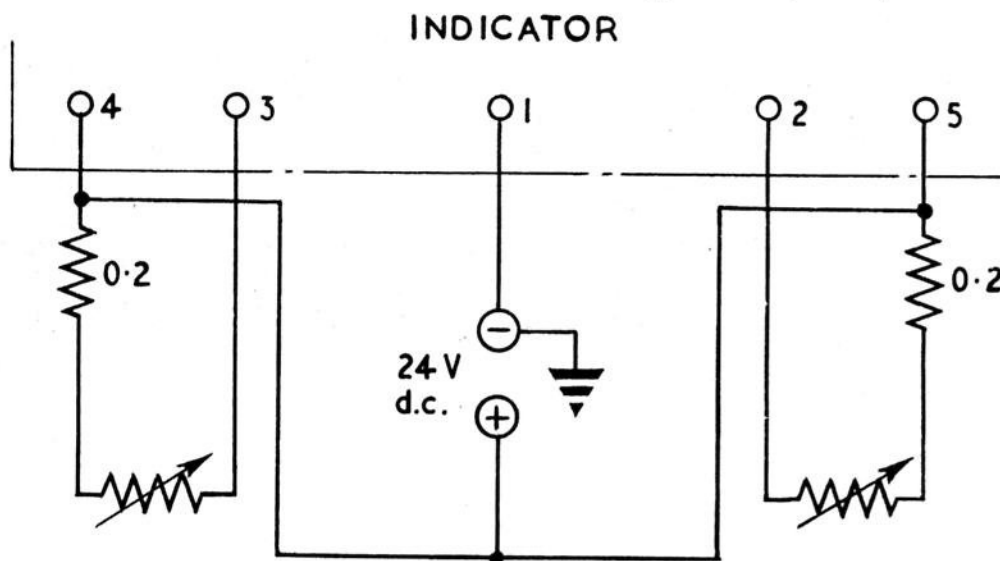


Fig 3 Test connections - indicator, Type 475MV