Chapter 14

SENSING ELEMENTS, TYPE FHG

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Introduction

1. Sensing elements, Type FHG, are low mass, temperature sensitive resistance elements, used in conjunction with aircraft temperature control systems, and are installed in the ducting carrying the air to the region where the temperature is being controlled. The elements react to variations in the temperature of the air by a change in resistance value, and this change is translated by an amplifier or sensitive-relay control unit, into movement of the aircraft temperature control valve.

2. The elements fall into two distinct types, wire wound or thermistor, and therefore for a detailed description of each type reference must be made to the appropriate appendix. The principle of operation is, however, identical for both types.

DESCRIPTION

3. Fig. 1 shows three typical sensing elements but for a detailed description reference must be made to the appropriate appendix.

OPERATION

4. Sensing elements react to temperature variations by a change in resistance value, the wire wound types vary directly, and the thermistor types inversely. Used in conjunction with suitable components, the elements can be used to sense the variations, and to initiate the necessary compensating sequence. The operation of the elements must therefore contain reference to the associated components. It should be noted that certain sensing elements are fitted with a shroud (*refer to appendices*).

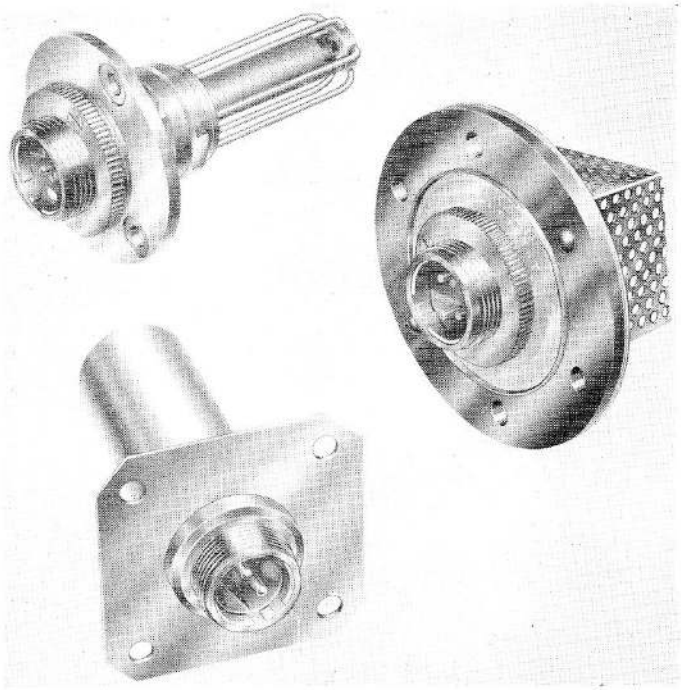

Fig. 1. Typical sensing elements

5. Fig. 2 illustrates in schematic form a typical cabin temperature control system in which unshrouded and shrouded elements are used. The elements have the same resistance value, and are included in a Wheatstone bridge network which contains a setting potentiometer, a cabin element, and certain fixed resistors which are usually incorporated in the control unit.

6. The desired temperature is selected by adjustment of the setting potentiometer, and this controls the balance point of the bridge. As long as the temperature remains as selected, the system is quiescent. Assume, however, that the temperature falls. The temperature sensitive cabin element will decrease in resistance, and thus unbalance the bridge and develop a voltage across its output. This operates the 'to heat' circuits of the control unit, and the control valve actuator will commence to open the valve.

7. A greater volume of hot air is thus allowed to pass through the ducting and into the aircraft cabin. As the two sensing elements are placed side by side within the ducting, they will react to the increasing temperature : the unshrouded one will react rapidly, and the shrouded one more slowly as the air over its windings is metered through the holes in the shroud. The unshrouded element soon nullifies the unbalance produced by the cabin element, and the control valve is arrested in a new position.

8. Meanwhile the increased volume of hot air is mixing with that in the cabin, and so raising its temperature with a consequent increase in cabin element resistance. Should

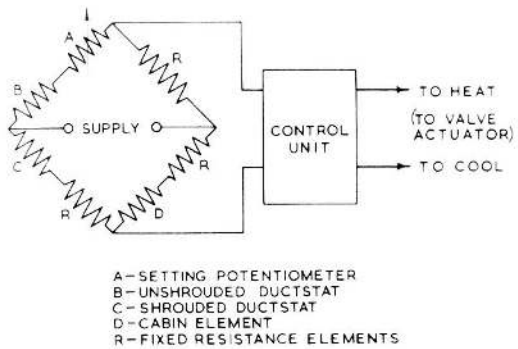

Fig. 2. Schematic diagram of control system

there be no other reaction within the bridge this would produce a further movement of the control valve, and due to the time lags, considerable hunting could occur until the compensating setting has been achieved. The function of the shrouded element is to prevent this hunting, for its response rate is matched to that of the cabin element, and the sensing element increases its resistance in step with the cabin element.

9. Eventually, the shrouded element will attain the same resistance as the unshrouded element and they will balance each other out. Should the cabin temperature still be off the desired point, the cabin element will initiate a further cycle.

INSTALLATION

10. Before installing a sensing element, refer to the appropriate aircraft handbook. Shrouded elements must be mounted with the air inlet hole in the wall of the shroud facing upstream. It must be ensured that elements do not come into contact with sulphurous vapours or compounds.

SERVICING

General

11. The following tests are to be applied, before a sensing element is installed in an aircraft, at any time when the serviceability of an element is in doubt, and at the appropriate re-examination periods.

12. Clean the air holes in the shroud with a blast of low pressure air.

Test equipment

13. The following equipment will be required:—

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

(2) Thermometer testing bath (Ref. No. 6C/795).

(3) Suitable resistance measuring instrument.

Insulation test

14. The insulation resistance between the frame and each pole of the plug must be not less than 5 megohms.

Functional test

15. With the sensing element immersed in oil, the resistance between the terminal poles must be within the limits for the test temperature stated in the appropriate Leading Particulars (*refer to Appendices*).

Appendix 1

SENSING ELEMENTS, TYPE FHG (WIRE WOUND)

LEADING PARTICULARS

Type	Ref. No.	Shroud	Mounting plate	Resistance (ohms)	Temperature (°C)	Illustration (fig.)
FHG/A/7	5CZ/—	Shrouded	Square	100±0·5	20	1
8	5668	Unshrouded	Square	100±0·5	20	1
14	—	Unshrouded	Square	1000±1	165	2
21	—	Unshrouded	Square	150±1	165	2
26	—	Unshrouded	Square	500±3	165	2
35	5494	Unshrouded	Square	500±3	20	1
41	5669	Shrouded	Square	100±0·5	20	1
44	5843	Unshrouded	Round with gasket	760±3	145	1
49	5670	Unshrouded	Square, capped	150±1	20	1
52	5566	Unshrouded	Square	500±3	20	1

Introduction

1. All the elements listed in the Leading Particulars are basically similar, but they may be fitted with a shroud, and they may have slight variations in the type of mounting plate fitted. Fig. 1 shows an element with a round mounting plate complete with gasket, but most elements have a square mounting plate and the gasket is not supplied. Another type of capped square mounting plate is shown in fig. 1, and a slightly different type of clamp ring assembly is shown in fig. 2. Reference to the Leading Particulars will indicate these variations, and also which illustration is applicable for each element.

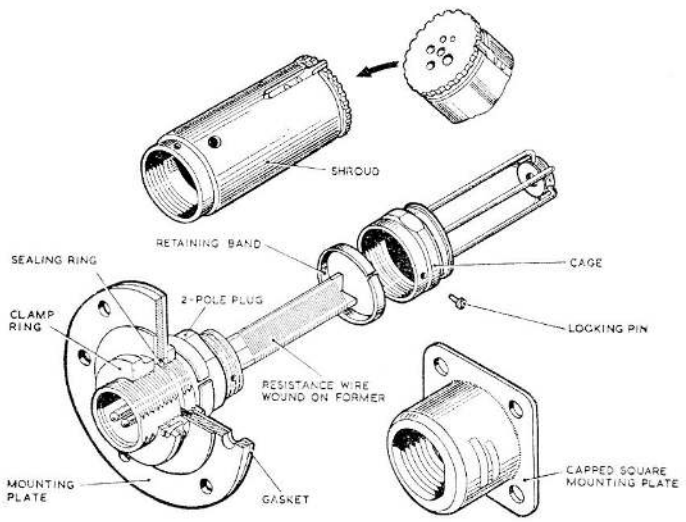

Fig. 1. Sensing elements, Type FHG (Wire Wound)

DESCRIPTION

2. The sensing element is comprised of silk covered, enamelled nickel resistance wire, wound on a moulded former. The flanged base of the former is assembled to a 2-pole plug, to which both ends of the wire coil are connected, and clamped in position by a ring. The ring is locked to the plug by a dowel pin, located in a cross-hole drilled through both items, and the pin is retained by a spring steel band fitted into a groove on the ring.

3. Unshrouded elements have a light alloy cage screwed over the external thread on the rear of the plug. The two items are locked to each other by a dowel pin which is retained by a spring steel band.

4. On shrouded elements the cage is replaced by a moulded tube which is located and locked in the same manner as the cage. An inlet hole is drilled in the side of the tube, or shroud, and allows air to flow over the windings. The end cap of the shroud carries a brass disc having five progressively sized orifices. Rotation of the disc will align one of the orifices with a hole drilled through the end cap and thus a restriction is applied to the outlet flow of the air through the unit. The disc has a knurled edge which is engaged by a spring index riveted to the side of the shroud, and maintains the disc in its set position.

5. A light alloy mounting plate is fitted over the end of the plug and is secured by a clamp ring. The ring has a saw cut in one section and a countersunk head screw, positioned through the saw cut, enables the threads of the locking ring to pinch the threads of the plug to give a positive lock. The joint is sealed by a synthetic rubber washer. Some elements have a skid washer under the clamp ring (*fig.* 2).

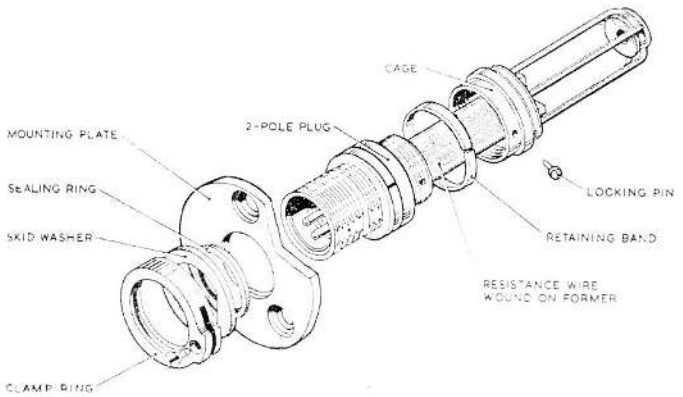

Fig. 2. Sensing element with modified clamp ring

Appendix 2

SENSING ELEMENT, TYPE FHG (THERMISTOR)

LEADING PARTICULARS

Type	Ref. No.	Shroud	Mounting plate	Resistance (ohms)	Temperature (°C)	Illustration (fig.)
FHG/A/43	5CZ/5495	Unshrouded	Round with gasket	2 × 500	20	1

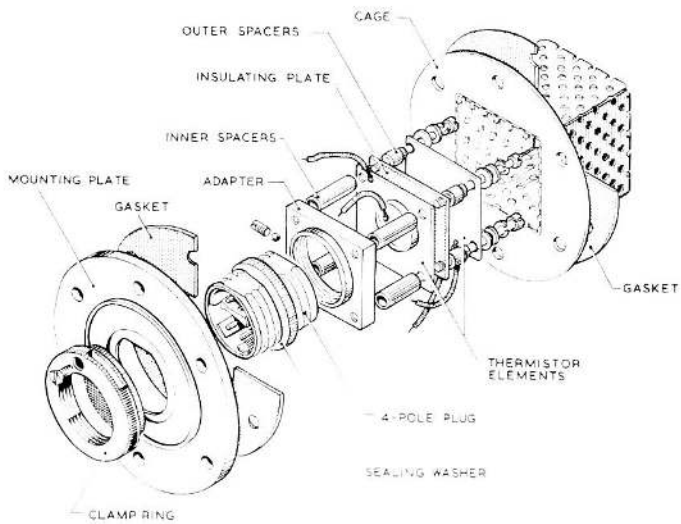

Fig. 1. Sensing element, Type FHG (Thermistor)

Introduction

1. Thermistor type sensing elements consist of two separate resistances manufactured from a special metal oxide compound. This compound has a characteristic such that as the temperature rises, the resistance value falls, and vice versa.

DESCRIPTION

2. Two metal oxide compound blocks are mounted on rectangular metal plates, and positioned one behind the other by spacer tubes. Four cheese head screws secure the metal plates, an insulating plate, and the spacers, to a light alloy adapter plate. The adapter plate is screwed over a 4-pole plug, and is locked to the plug by a grub screw which bears on a lead pellet. Two leads from each thermistor block are connected to the poles on the plug, to establish two separate electrical circuits.

3. A flat mounting plate is positioned over the plug, and retained by a knurled clamp ring which is locked by a countersunk head screw passing through a saw cut section in the ring; this enables the ring to pinch the threads on the plug. The thermistors are protected by a light alloy, rectangular, perforated cage. The cage is flanged to match the mounting plate and is temporarily secured to it by two rivets. A gasket is interposed between the cage and the mounting plate.