Chapter 1-0

INDICATORS, TYPE S196 SERIES

Introduction

1. The model S196 temperature indicator is constructed for use with a thermocouple circuit, the cold junction incorporated within the indicator movement and the hot junction situated at the heat source to be monitored. Basically, the instrument is a milliammeter and has an ambient temperature compensation device for the cold junction of the circuit incorporated within the movement of the instrument.

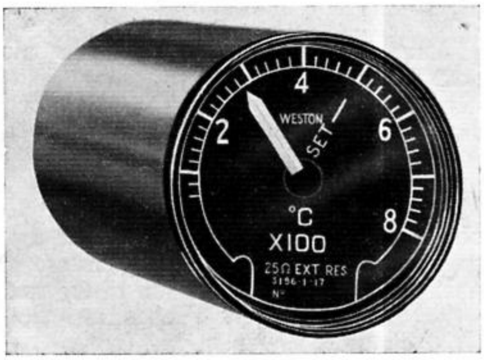

Fig. 1. Indicator, Type S196/1/15

2. Each instrument (fig. 1) has a manufacturer's code number which is made up of three parts. A typical code is S196.1.15 where S196 is the model number, .1 is the "form" (i.e. type of terminals, etc.) and .15, the suffix number, represents the application to which the instrument is adapted.

Suffix number

3. The suffix number of the three part code represents the instrument application; each instrument will have a different number if used for more than one purpose. It should be noted that where indicators have been provided by the aircraft contractor, the relative spare indicator provided by Service Stores may bear a different suffix number. Sub-chapters of this information unit give details of dial presentation and circuit diagrams for each variant. A standard serviceability test, applicable to all variants, is given in Chapter 1-1.

Principle

4. The principle on which the instrument operates is that of a normal voltmeter or ammeter where the movement of the moving coil in relation to the field of the permanent magnet is proportional to the voltage or current applied to the coil. An external series resistor is used in conjunction with the instrument; this resistor provides for control of total external resistance of the circuit.

DESCRIPTION

5. The movement is enclosed within an hermetically sealed 2 in. casing terminated by a back plate on which is mounted a terminal block and the zero adjusting screw; the front of the casing is designed to accommodate an adapter for conversion to S.A.E. pattern.

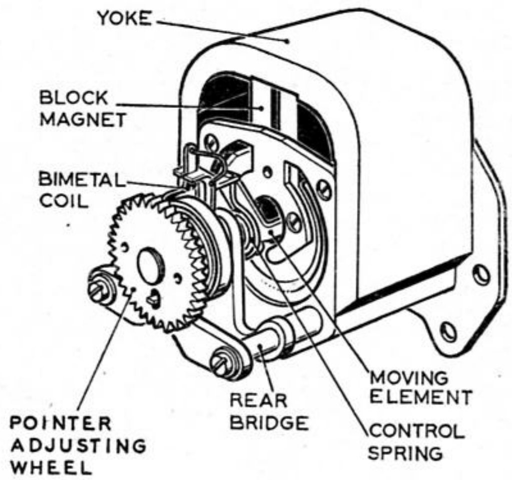

Fig. 2. Rear view of movement

Magnet and movement assembly

6. The magnet and movement assembly (fig. 2 and 4) comprises a magnet, a soft-iron pole-piece, a core, a coil winding mounted without a former, a rear bearing bridge and a front bearing bridge. Each bridge is supported by two pillars secured to the soft-iron pole-piece. Pivots attached to the coil former are mounted between spring-loaded jewel screws which are located in the front and rear bridge. The pointer, attached to the coil former, is controlled by the interaction of the magnetic flux and the field surrounding the coil winding; the pointer is set at zero when no current flows. Pointer balance is maintained by two weights (fig. 4), and pointer travel is limited in both directions by spring stops.

7. The scale is secured in position by two screws at the bottom of the scale. Connections to the moving-coil system are made by one cable connected to the rear bearing bridge, which is insulated from the magnet assembly by bushes, and the second is earthed to the front plate by a tag and securing screw. Final connection to the coil is made by two hairsprings.

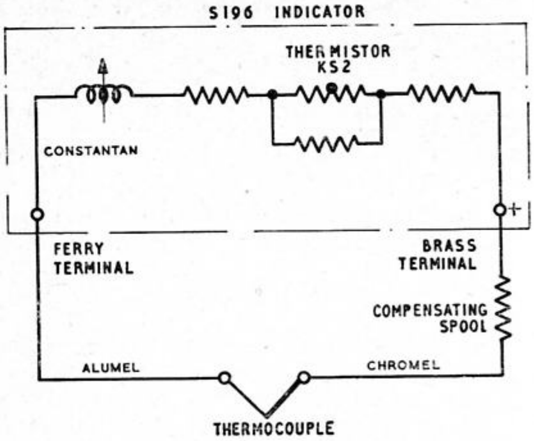

Fig. 3. Circuit diagram

8. The terminals of the indicator to which the external circuit is connected, consist of a brass terminal and a ferry terminal. Connection from the ferry terminal to the front bridge, consists of a constantan cable terminating in the cold junction of the system formed by the constantan/ copper joint of cable and hairspring anchor. On the rear bridge of the moving-coil assembly is fitted a bi-metal coil; the function of this coil is to achieve compensation for ambient temperature variations of the cold junction.

9. A thermistor (fig. 4) incorporated in series with the moving coil winding, compensates for changes in the resistance of the indicator circuit due to changes in the ambient temperature (where the resistance of a thermistor decreases with increase in temperature). The value of the shunt resistor across the thermistor is calculated in combination with the thermistor, series resistance and moving coil resistance, so that compensation is maintained over the full ambient temperature range.

Operation

10. The total resistance of the external circuit (cables and thermocouple) is adjusted to that value of resistance shown on the scale of the indicator (fig. 1). With the "chromel" cable connected to the positive terminal (brass) and the "alumel" cable connected to the negative terminal (ferry), heat is applied to the thermocouple which produces an e.m.f. causing a current to flow in the circuit.

11. Interaction of the current in the moving coil and flux of the permanent-magnet field produces a torque which causes the moving coil to be displaced, thus, the pointer, attached to the moving coil, moves over the scale.

12. The outer end of the bimetallic compensating coil is engaged with the free end of the rear hairspring; change in ambient temperature causes bi-metal contraction or expansion of the coil and thus moves the pointer independently of the electrical circuit.

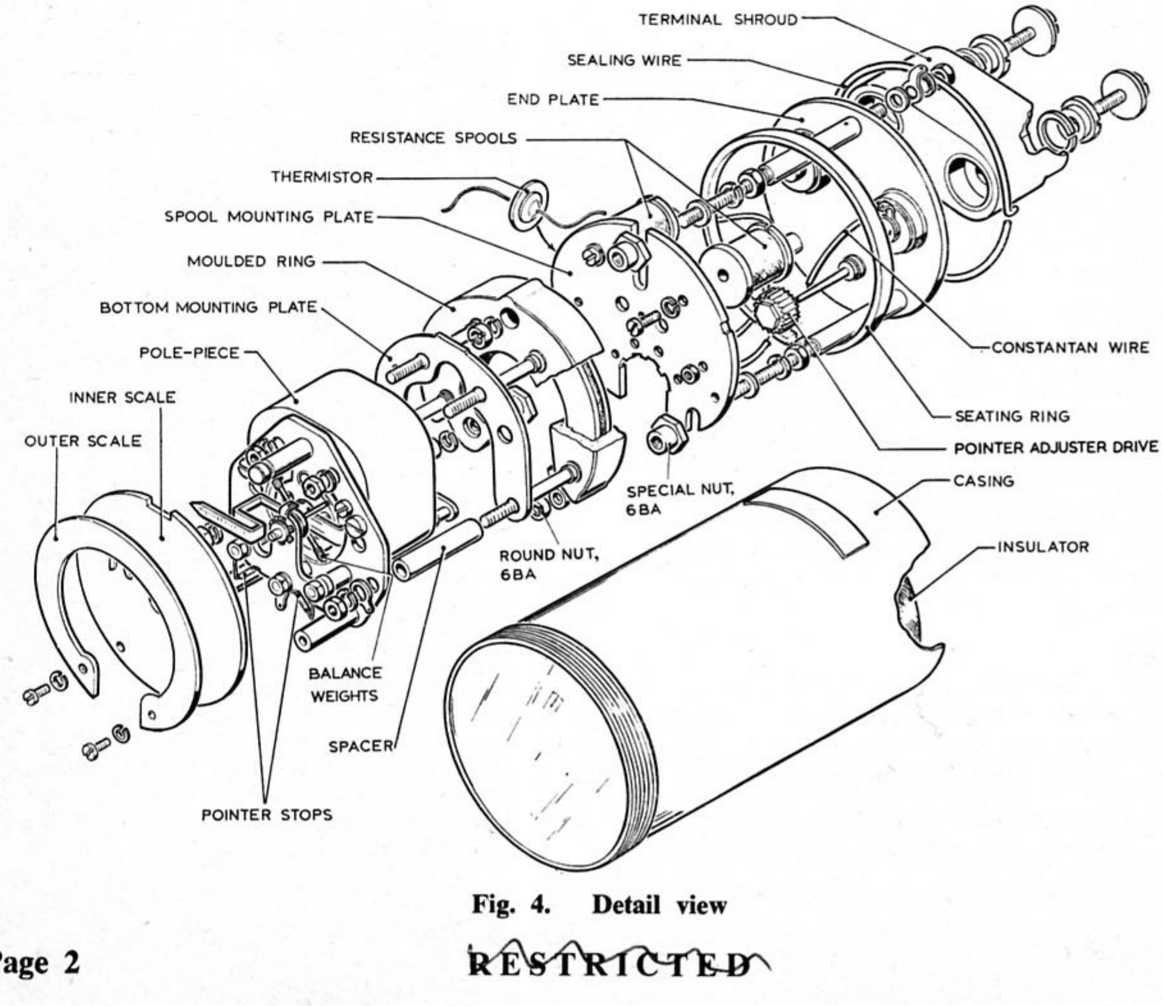

Fig. 4. Detail view

13. The torque ratio of the hairsprings, and the torque of the bi-metal coil, are arranged to give a pointer movement corresponding to the loss or gain of spurious e.m.f. generated by the couple formed at the point where the cable connection is made to the moving-coil assembly. Thus, an increase in ambient temperature will increase the spurious e.m.f., which causes current to flow in the opposite direction to the current produced by the external couple. The pointer deflection will therefore tend to indicate below the true temperature value of the external thermocouple (hot junction), but movement of the bi-metallic coil, due to expansion, will compensate for this loss by moving the hairspring anchor position. Thus, the pointer continues to show the true temperature of the external couple.