

Chapter 2

CONTINUOUS WIRE FIRE DETECTION SYSTEM

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Introduction

1. The continuous wire type of fire detection system differs from a unit type system in that one continuous sensing element replaces a number of separate units. This one element is in the form of a narrow gauge tube running in a loop through or around the potential fire zone. An increase in temperature above a critical setting value at any point along the element causes operation of the system. A subsequent fall in temperature below a certain re-setting value will cause the system to re-set.

2. The system may be energized from either a 115V or 26V, 400 c/s supply. A 24V, d.c. supply is also required for a warning lamp circuit, the lamp lighting when the system operates to give indication of excessive temperature in the potential fire zone.

3. The sensing elements are available in a number of standard lengths, in two marks,

and are provided for use in medium or high temperature zones. The Mk. 2 element is a later type of element, of smaller diameter and lighter in weight than the Mk. 1 which it supersedes. Depending upon the total length of the element, the medium temperature range will cause operation of the system when the ambient temperature in the fire zone rises to within the range of 160°C—270°C. approximately, and the high temperature range when the temperature is within the range of 245°C.—470°C. approximately.

General

4. The complete system consists of one or more standard lengths of sensing elements, coupling units, bulkhead fittings, and a relay box. These components are briefly described in the following paragraphs, but reference should be made to A.P.4343E, Volume 1, Book 3, Sect. 14, and also to A.P.957C, Vol. 1, Part 1, Section 3, Chapter 1 for more

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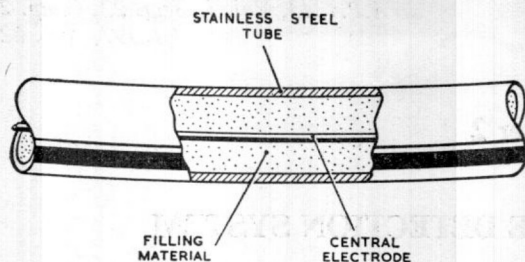


Fig. 1. Sensing element

◀ detailed description of their construction and for information on the installation of the system.

Sensing element

5. The sensing element, which is shown partially sectioned in fig. 1, consists of a stainless steel capillary tube through the centre of which runs a wire electrode, the electrode is insulated from the capillary tube by a filling material. This filling material has a negative temperature coefficient, i.e. the electrical resistance falls with an increase in temperature and rises with a decrease in temperature.

Coupling unit and bulkhead fittings

6. Successive lengths of sensing element may be joined by coupling units, of which there are a number of different types to provide for a variety of mounting. The coupling units provide for the inter-connection of the central electrodes and stainless steel capillary tubes of each element.

7. The bulkhead fittings are used to terminate the ends of the sensing element loop and provide for electrical connection to the remote relay box. ▶ Each fitting is flange mounted and provides an insulated connection from the central wire electrode to a 4 B.A. terminal stud on the remote side of

the fire wall. The outer tube is earthed to the fitting and hence to the fire wall itself, but an earthed 4 B.A. terminal is also provided. The two terminal studs are protected by a cover which is fitted with a gland for cable connection.

8. Both the coupling units and the bulk-head fittings are designed to effect a moisture-proof seal of adequate strength.

Relay box

9. One, two or four separate warning circuits may be employed in this fire detection system, and, to cater for this variety of circuits, there are several types of relay box in service use. For detailed description reference should be made to A.P.4343E, Vol. 1, Book 3, Sect. 14.

10. ◀ A single circuit relay box, Type D879, is shown in fig. 2 and the internal layout of the box in fig. 3. It consists of a cast light alloy box and lid which is hermetically sealed and accommodates the component parts. A circuit diagram of the relay box is given in fig. 4, it should be noted that the 330 ohm resistor in the test circuit is not incorporated in relay box serial number 2974 and subsequent units. ▶

11. A single-pole toggle type test switch and a 6-pole plug are mounted in one face of the relay box. The test switch is biased to rest in one position and is only depressed for test purposes. The 6-pole plug accepts the 400 c/s power supply, pins A and B being used for 115V, and pins C and B for the alternative level of 26V. The remaining pins are spare.

12. A 3-pole and a 6-pole plug are mounted in the other end face of the relay box. The 24V d.c. supply is brought to pins A and B of the 3-pole plug, whilst the other plug takes the connections from the bulkhead fittings.

13. The contents of the relay box (fig. 3) are mounted on a chassis attached to the

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base of the box, and comprise; a tapped-primary transformer for stepping down the 400 c/s input to the system level; a full-wave rectifier which supplies the relay coil; the relay itself; the normally open contacts of which are in the 24V d.c. warning lamp circuit; the test switch; and in early relay boxes a 300 ohm resistor.

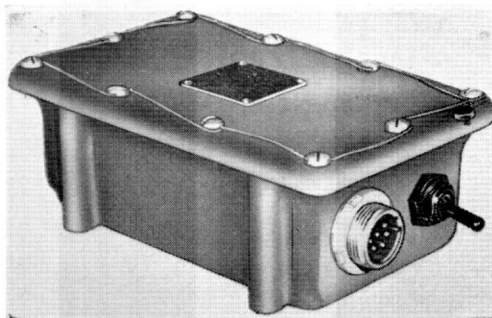


Fig. 2. Relay box

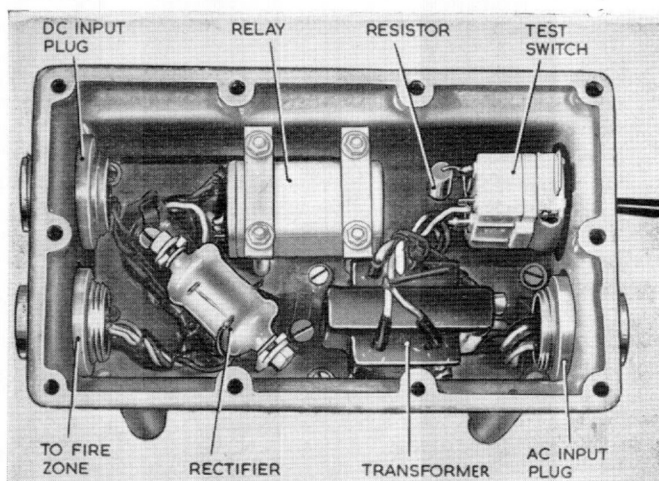


Fig. 3. Contents of relay box

OPERATION

Normal

14. The circuit diagram of a single circuit system is shown in fig. 4. From this diagram it will be seen that, with the test switch in its normal position, both ends of the central electrode of the sensing element are connected in parallel to the rectifier and thence to one side of the secondary winding of the transformer. The return path is through the filling material of the element to its outer tube and thence to the other side of the transformer winding. With this arrangement damage causing a break in the element loop will not immediately affect the circuit.

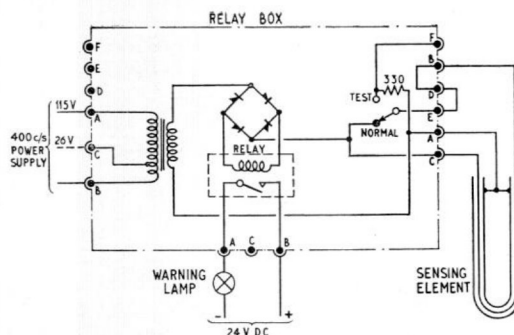


Fig. 4. Circuit diagram

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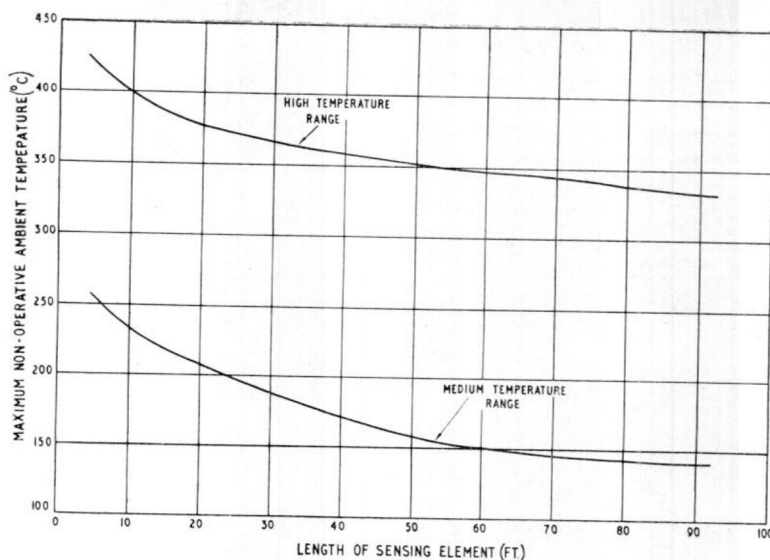


Fig. 5. Characteristic curves

15. Under normal ambient conditions the resistance of the filling material is such that a current of the order of 1 mA will flow between the central electrode and the tube of the sensing element. Under these conditions the rectified current flowing through the relay coil, which is connected across the rectifier, will be insufficient to cause operation. Should the temperature in the potential fire zone rise, however, the resistance of the filling material will fall due to its inverse characteristic, and hence the current in the sensing element will increase. As a result, there will be a greater volt drop across the rectifier with a consequent increase in the rectified current flowing through the relay coil. When the fire zone temperature has risen to such a value that the relay coil current is somewhere in the range of ◀9—17▶ mA, the relay will operate to complete the 24V, d.c. circuit and light the warning lamp.

16. Should the temperature in the potential fire zone subsequently fall, the resistance of the filling material will increase and so cause the relay coil current to decrease. When this current falls to within the range of ◀2—10▶ mA, the relay will drop out and break the warning lamp circuit.

17. The system will operate at a current determined by the relay setting, but the fire zone temperature required to obtain this current will depend upon the length of the element subjected to heating. The curves given in fig. 5 show the relationship between

the length of an element and the maximum non-operative ambient temperature, (i.e. temperature at which no false warning will occur) for high and medium temperature ranges. Well above these temperature ranges are the corresponding operating ranges (*para.* 3). For these curves it is assumed that the whole of the particular element is at the same temperature. Where heating is confined to one particular area of the fire zone, a higher temperature is required to cause operation of the system. Such a condition is, of course, equivalent to that of a shorter length of element subjected to a higher ambient temperature.

Test switch depressed

18. ◀Although the system will continue to function when there is a break in the sensing element loop, the ingress of moisture and dirt may cause corrosion and subsequent spurious warning. It is therefore necessary to detect such a fault at the earliest opportunity, and the test switch in the relay box is provided to enable a continuity check to be made. This type of relay box must therefore be located in an accessible position so that the test switch may be operated.▶

19. Referring to the circuit diagram, when the test switch is depressed the a.c. circuit is completed through the loop of the central electrode instead of only through the filling material to the tube. ◀In early boxes▶ the change-over also inserts a 330 ohms resistor in series to compensate for the reduced im-

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pedance of the element circuit. Provided that there is continuity in the central electrode, the current under these conditions will operate the relay and the warning lamp will be lit. If there is a break in the electrode the lamp will not light up, but it should be borne in mind that a fault in the relay box may also prevent the lighting of the lamp.

SERVICING

20. The servicing of the detection system consists of examination of the components for signs of damage or deterioration, security of connection, attachment or mounting. Reference should be made to A.P.4343E, Volume 1, Book 3, Section 14 for detailed servicing instructions. It should be noted however that no dismantling of the relay box is permissible.

Testing

Functional tests

21. Functional testing of the detection system is restricted to the test carried out by the test switch as detailed in para. 19.

Insulation resistance tests

22. The insulation resistance of the components of the sensing element system should be measured using a standard 250 volt insulation resistance tester.

(1) The insulation resistance of the bulk-head fittings and the coupling units should be not less than 5 megohms when measured between the centre socket and the body of the unit.

(2) The insulation resistance of each individual sensing element measured between the central electrode and the capillary tube should be not less than 20 megohms.

(3) The insulation resistance of the complete detection loop measured between the central electrode and the capillary tube should be not less than 1 megohm.

(4) For the insulation resistance testing of the individual relay boxes reference should be made to the appropriate chapter in A.P.4343E, Volume 1, Book 3, Section 14.

Continuity tests

23. The continuity of the assembled system may be checked by the use of the circuit test switch, where this reveals a fault or a specific continuity check is required further continuity tests can be made using a suitable test meter. The resistance figures for individual elements are given in A.P.4343E, Volume 1, Book 3, Section 14, Chapter 2. ▶

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