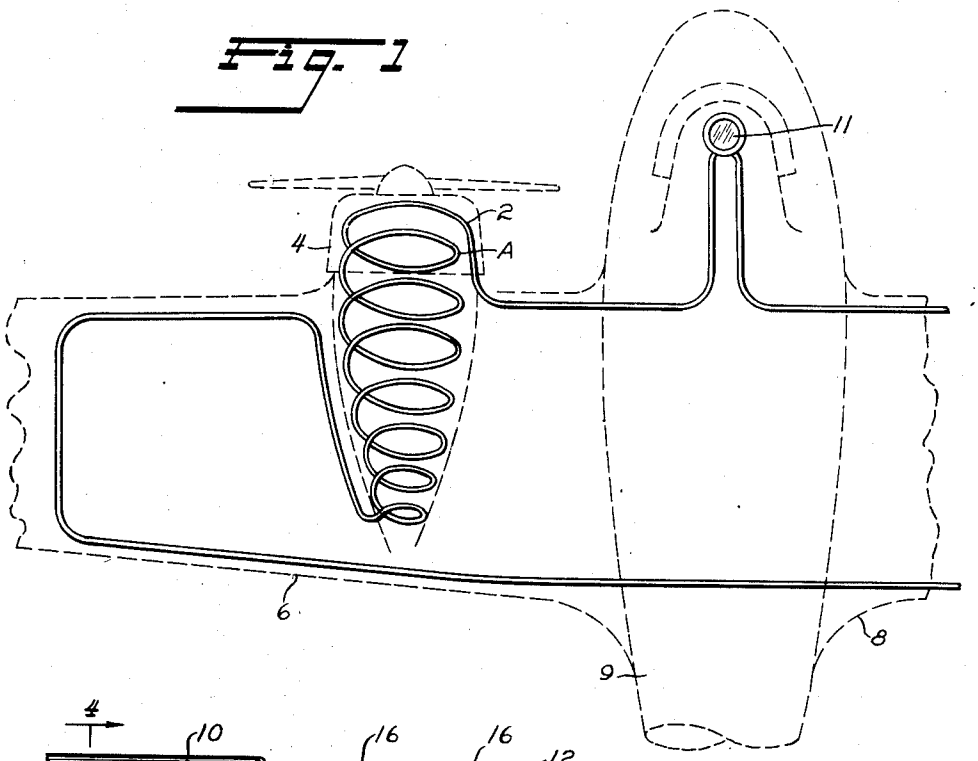
Nov. 10, 1953 M. F. PETERS 2,659,067

FIRE DETECTION SYSTEM

Original Filed May 2, 1949

Fig. 1



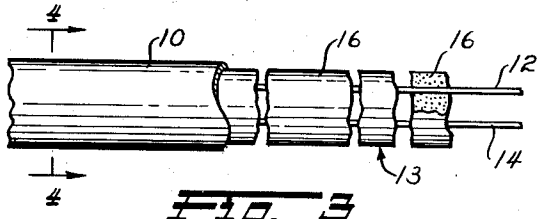
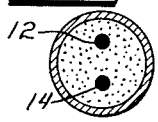


Fig. 3

Fig. 4



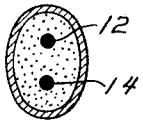


Fig. 5

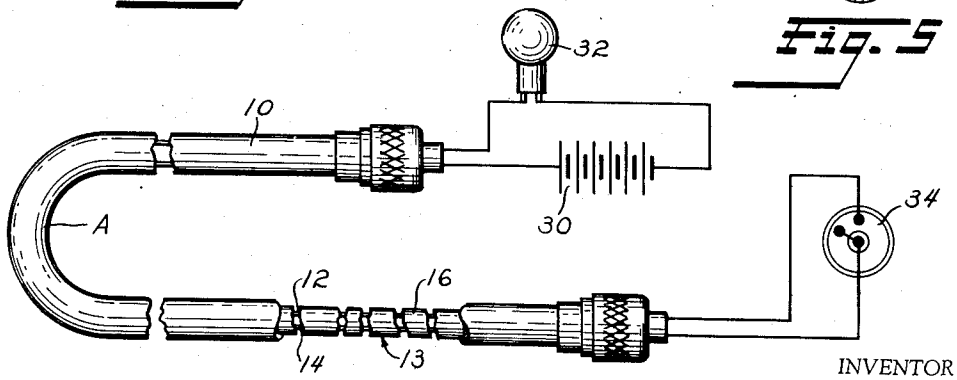


Fig. 2

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2,659,067

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FIRE DETECTION SYSTEM

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Original application May 2, 1949, Serial No. 90,881, now Patent No. 2,586,252, dated February 19, 1952. Divided and this application January 15, 1952, Serial No. 266,563

The portion of the term of the patent subsequent to February 19, 1969, has been disclaimed

3 Claims. (Cl. 340—227)

1

This application is a division of my co-pending application Serial No. 90,881, filed May 2, 1949, now Patent #2,586,252, for Fire Detector Element, which is itself a continuation in part of my application Serial No. 2,345, filed January 14, 1948, for Fire Detector Element, which is now abandoned.

This invention relates broadly to fire detecting systems and devices which are placed within a space which is to be monitored for fires and which operate to provide a signal or alarm when combustion occurs. More particularly, the invention has to do with that class of such devices which operate on an increase, to some predetermined value, in the ambient temperature within the monitored space and applied to a part of the system or device, as distinguished from fire detecting devices which are caused to operate by the light emitted by a flame, or by the effect of smoke on a photoelectric cell, or in other known manner.

The invention consists in the provision of a fire detector in the form of a readily bendable tubing element of indefinite continuous length having within it and spaced from it and from each other two continuous un-insulated electrically conductive wires which are maintained in spaced relation to each other and to the surrounding tubing by a discontinuous element which fills the tubing and surrounds and engages the conductors and which is formed of a material which is non-conductive to electricity at normal temperatures but becomes electrically conductive at some predetermined abnormal temperature such as that of the combustion of some selected material. The two conductors are connected in an alarm or signal system which is closed to operate the signal or alarm by completion of the circuit between the two conductors when the normally non-conductive material becomes conductive on heating.

Other results, advantages and new features of my invention will be made apparent by the description and drawings forming part hereof but which are solely for the purpose of describing one embodiment of my invention and therefore impose no limitation on the invention not specifically stated in the claims.

In the drawings,

Fig. 1 illustrates part of an airplane, showing a fire detector element led through parts thereof;

Fig. 2 illustrates a detector element according to this invention included in the circuit of an electric fire detection system;

Fig. 3 illustrates part of a fire detector element according to this invention, part of the protective

2

casing being broken away, and part of one of the beads being broken away;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3, and

Fig. 5 is a cross-sectional view similar to Fig. 4 but showing a modified form of the invention.

In Fig. 1 of the drawings there is shown, for illustration only, how a continuous fire detector element such as that provided by the invention may be employed to monitor a space in which fire may occur. The fire detector element 2 is here shown as being led through the engine nacelle 4, wings 6, 8 and fuselage 9 of an aircraft and, upon undesired increase in the ambient temperature at any point along the length thereof, will operate in the manner described hereinafter to operate a signal or alarm 11 providing a warning to the pilot. Obviously any other type of structure or space, such a room, baggage hold, etc. may be monitored with the same apparatus and with the same results.

The fire detector element 2 is shown in Figs. 2, 3 and 4 and comprises a readily bendable tube 10 of indefinite continuous length within which are two spaced, parallel, electrically conductive wires 12, 14, which are surrounded, supported and held permanently in space relation to each other and to the tubing 10 by a dis-continuous element 13 filling the tube throughout its length and consisting, in effect, of a plurality of separate beads 16 which are formed on and fused to the conductors, are spaced along the length thereof, and which are of such size as to fill the tubing. The conductors 12, 14 are preferably made of stainless steel or Inconel but may be formed of other suitable material. The tube 10 may be formed of any material which is a good heat conductor.

The discontinuous element which supports and spaces the two conductors is made of a material which is electrically non-conductive at normal temperatures but which becomes electrically conductive at some abnormal high temperature, such as the temperature of combustion of gasoline. The beads of this element may be fused to the conductors in any satisfactory manner but are preferably formed and fused to the conductors by the method disclosed and claimed in my United States Letters Patent No. 2,495,867 dated January 31, 1950, and in the drawing they are shown as they are actually formed by such method. In such a method, the two conductors are encased in a cylinder of thermistor material which includes an inert ceramic ingredient such as steatite and an ingredient which is removed by

heating. Alternatively, the cylinder may comprise thermistor material together with the inert ceramic compound, the thermistor material taking the form of one or more metallic organic compounds which dissociate on heating. In either event, when the cylinder is subjected to heat, the ceramic material shrinks into the form of closely spaced beads, which firmly adhere to the conductors to provide good contact therewith. The small spacing between adjacent beads permits the beads to accommodate themselves to bending of the casing about small or large radii while at the same time the beads cover the greater parts of the lengths of the two wires. The tubing and beads are preferably circular in cross section but may be made elliptical, in which case the wires are placed within the major axis of the beads as clearly shown in Fig. 5.

In an embodiment of the invention which has been constructed and is operated successfully, two Inconel conductors, each of which is .010 inch in diameter, are embedded in beads having an outside diameter of .050 inch. In this element the conductors are spaced .010 inch wall to wall, and the minimum distance between the periphery of each conductor and the outer surface of the beads is .010 inch. Such an element is so thin that it may be bent on very small radii without difficulty and without danger of breaking the conductors or loosening them from the surrounding beads. If the spacing of the wires is materially increased above that stated above it may be desirable, but perhaps not necessary, to make the tubing and beads elliptical in cross-section, placing the conductors in the major axis of the cross-section, as shown in Fig. 5. In such an embodiment of the invention, the elliptical beads may have exterior dimensions of .060 inch and .040 inch, and the conductors may be .010 inch in diameter. By making the beads elliptical in cross-section resistance to bending about any axis other than one parallel to the major axis is created and in all normal, unforced bending of the elliptical detector element only such bending will take place, thus insuring equal bending of the conductors.

As illustrated in Fig. 2 the conductors **12**, **14** of the detector element may form part of an electric circuit including battery **30**, signal **32** and test switch **34**. In normal operation and use the test switch is left open and the signal **32** is therefore normally de-energized. If any part of the element, for example part A, is subjected to a predetermined temperature, which may be that of combustion of gasoline, the electrical resistance of the material of which the beads are formed is so reduced that electric energy flows through the bead or beads, and thus between the two conductors, at location A, completing the circuit through battery **30**, signal **32** and those parts of the conductors **12**, **14** between location A and the battery and signal, thus energizing the signal. When the predetermined temperature at location A is removed, for example by putting out the fire, the resistance of the beads will revert to its normal high value and no current will flow in the alarm circuit. The enclosing and protective tube **10** may or may not be grounded. In either case small parasitic currents will flow between each conductor and the tube on operation by heating but these will not in any way affect the operation of the device or the system.

The term "normal temperature" is used herein as defining a temperature lower than that which is generally known in the art as "flame temperature," and the term "abnormal temperature," as defining "flame temperature" or a temperature higher than the same, or a predetermined temperature which is to be detected and which is higher than the "normal temperature."

While I have described and illustrated but one embodiment of the invention, it will be apparent to those skilled in the art that other embodiments, as well as modifications of those disclosed, may be made without departing in any way from the spirit or scope of the invention, for the limits of which reference must be made to the appended claims.

What is claimed is:

1. A system for indicating the existence of a predetermined abnormal high temperature comprising a readily bendable cable-like element of indefinite continuous length comprising a bendable tubing element formed of material of relatively high heat conductivity, a unitary assembly disposed within the tubing element and being in heat-transfer relation thereto but being separate therefrom and comprising two electrically conductive uninsulated wires which are substantially co-extensive in length with the tubing element and are spaced therefrom and from each other throughout their lengths, and a member formed of a material which is substantially non-conductive to electricity at normal lower temperatures and which becomes conductive to electricity at abnormal higher temperatures surrounding and adhered to said wires and which maintains them in closely spaced relation to each other and tightly engages the interior surface of the tubing element to provide an electrically conductive path between the wires in substantially instantaneous response to abnormal higher ambient temperatures to which the exterior of the tubing element may be subjected, while electrically insulating the wires from each other at normal lower temperatures, a source of electric energy and an indicating means electrically connected to each other and to said wires at one end of said element whereby the existence of a pre-determined high ambient temperature at any location along the length of the cable-like element will cause the temperature responsive member thereof to establish an electrically conductive path between the wires at said location to complete a circuit through the temperature responsive member, the wires, the source of electric energy and the indicating means to energize the indicating means.

2. A system for indicating the existence of a predetermined abnormal high temperature comprising a readily bendable cable-like element of indefienite continuous length comprising a bendable tubing element formed of material of relatively high heat conductivity, a unitary assembly disposed within the tubing element and being in heat-transfer relation thereto but being separate therefrom and comprising two electrically conductive uninsulated wires which are substantially co-extensive in length with the tubing element and are spaced therefrom and from each other throughout their lengths, and a member formed of a material which is substantially non-conductive to electricity at normal lower temperatures and which becomes conductive to electricity at abnormal higher temperatures surrounding and adhered to said wires and which maintains them in closely spaced relation to each other and tightly engages the interior surface of the tubing element to provide an electrically conductive path between the wires in substantially instan-

taneous response to abnormal higher ambient temperatures to which the exterior of the tubing element may be subjected, while electrically insulating the wires from each other at normal lower temperatures, indicating means, a source of electric energy normally unconnected to said indicating means but connected thereto through said member to energize the indicating means upon increase to a pre-determined degree of the temperature at any location along the length of the cable-like element to establish an electrically conductive path through said member between the wires at said location.

3. A system for indicating the existence of a pre-determined adnormal high temperature comprising a readily bendable cable-like element of indefinite continuous length comprising a bendable tubing element formed of material of relatively high heat conductivity, a unitary assembly disposed within the tubing element and being in heat-transfer relation thereto but being separate therefrom and comprising two electrically conductive inunsulated wires which are substantially co-extensive in length with the tubing element and are spaced therefrom and from each other throughout their lengths, and a member formed of a material which is substantially nonconductive to electricity at normal lower temperatures and which becomes conductive to electricity at abnormal higher temperatures surrounding and adhered to said wires and which maintains them in closely spaced relation to each other and tightly engages the interior surface of the tubing element to provide an electrically conductive path between the wires in substantially instantaneous response to abnormal higher ambient temperatures to which the exterior of the tubing element may be subjected, while electrically insulating the wires from each other at normal lower temperatures, a source of electric energy, and indicating means connected to be energized by said source by electrical connection of said wires through an electrically conductive path through the temperature responsive means by reason of the existence of a predetermined high ambient temperature at any location along the length of said cable-like element.

MELVILLE F. PETERS.

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Number	Name	Date
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2,586,252	Peters	Feb. 19, 1952