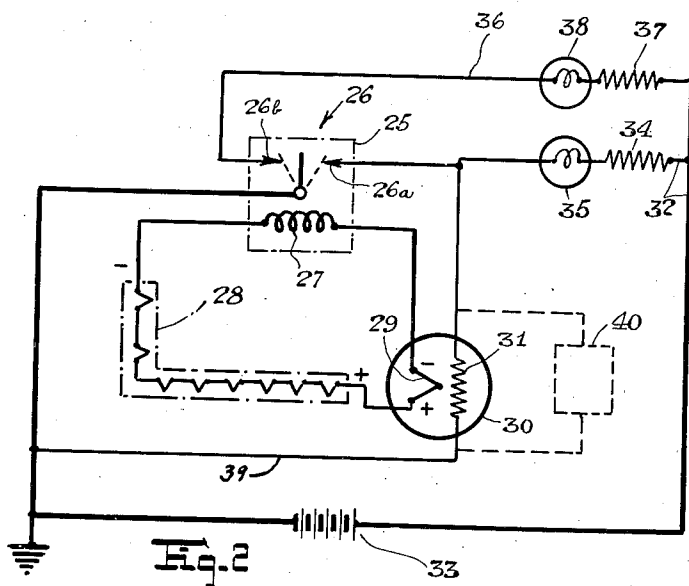
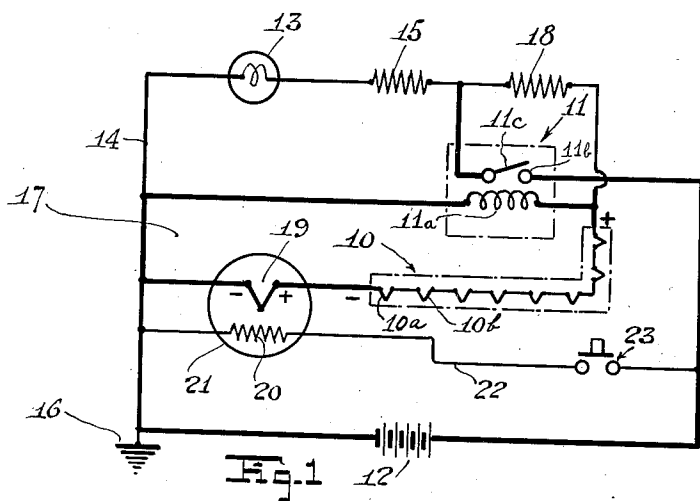


June 21, 1949.

W. B. M. CLARK
FIRE ALARM SYSTEM
Filed Nov. 20, 1945

2,473,940



INVENTOR.
Winslow B.M. Clark
BY
Henry Lawson
ATTORNEY

UNITED STATES PATENT OFFICE

2,473,940

FIRE ALARM SYSTEM

Winslow B. M. Clark, West Orange, N. J., assignor
to Thomas A. Edison, Incorporated, West
Orange, N. J., a corporation of New Jersey

Application November 20, 1945, Serial No. 629,849

4 Claims. (Cl. 177—311)

1

This invention relates to automatic fire alarm systems and more particularly to improved fire alarm systems of the thermocouple type.

My invention is particularly useful in alarm systems for detecting fires on aircraft, and is an improvement in the fire alarm system of the Jones Patent No. 2,376,920, issue May 29, 1945, and having a common assignee with the present application; it will however be understood that no unnecessary limitation of my invention to aircraft is intended.

My invention is particularly concerned with novel and improved means and methods for testing fire alarm systems of the thermocouple type. It is of course essential that fire alarm systems be maintained in operating condition without fail. Especially in aircraft applications, because of the adverse operating conditions caused by heavy vibration, wide variations in temperature, humidity, etc., to which the equipment is subjected, it is necessary that the pilot, or other attendant, be able to check the system quickly whenever desired to determine if it is in working condition.

It is an object of my invention to provide an improved, and improvements in, thermocouple-type fire alarm systems whereby an absolutely positive check can be made, under conditions simulating those of actual operation, to determine at any instant as desired whether or not the fire alarm system is in operable or working condition.

It is another object to provide an improved means for testing fire alarm systems of the thermocouple type which will not normally of itself affect the operability of the system.

It is another object to provide improved means for positively checking the operability of thermocouple-type fire alarm systems, which is highly simple and economical in its construction.

It is a further object to provide an improved fire alarm system which is adapted to indicate continuously whether or not it is in operable or working condition.

Other objects and features of my invention will more fully appear from the following description and the appended claims.

In the description of my invention reference is had to the accompanying drawings, of which:

Figure 1 is a diagrammatic view of circuits and mechanism illustrating an improved fire alarm system according to my invention; and

Figure 2 is a view similar to Figure 1 illustrating a second embodiment of my invention.

In Figure 1 there is shown a fire alarm system

2

according to my invention which comprises, as main components thereof, a thermopile 10, a relay 11 typically of a highly-sensitive type, a battery 12 and an alarm device 13 which may be simply a signal light as shown, the light typically being one which will give a red signal when lit. These components are herein diagrammatically shown because my invention is not particularly concerned with them individually. The thermopile may for example comprise one or more thermocouple units 10a, 10b, etc., connected in series at intervals as described in my pending application Serial No. 604,394, filed July 11, 1945. The relay is typically of the so-called meter type—i. e., one employing a sensitive meter movement for its actuating means. This relay comprises an actuating coil 11a and a single-pole single-throw switch including a semistationary contact 11b and a movable contact 11c. When the coil 11a is energized the movable contact is swung into engagement with the stationary contact 11b to close the switch. Preferably, I employ a meter relay of the moving-magnet type such as is described in my pending application Serial No. 623,795, filed October 22, 1945.

This alarm system comprises an alarm circuit 14 which serially includes the battery 12, switch 11b—11c, a resistor 15 and the signal light 13, a function of the resistor 15 being to limit the initial current through the signal light when it is cold and its resistance is low so as to avoid undue wear of the contacts of the switch 11b—11c. This alarm circuit is grounded at one side of the battery as at 16. In this alarm system there is also a control circuit 17 which serially includes the thermopile 10 and relay coil 11a. One end of the coil is connected by way of the alarm circuit 14 directly to the ground 16. The thermopile is adapted to supply a sufficient thermal current to the coil 11a to close the switch 11b—11c upon any one of the thermocouple units being subjected to a dangerously high temperature—say a temperature of 2000 F.—the thermopile being herein referred to as being “energized” when any one or more of the units are so heated.

A resistor 18 is connected between the alarm and control circuits, from a point between the signal light 13 and switch 11b—11c to the end of the coil 11a opposite the ground 16 above-mentioned. The purpose of this connection between the alarm and control circuits is to feed supplementary current to the relay coil from the battery 12 upon closure of the relay switch. This current assures that the switch contacts are

held closed positively, notwithstanding heavy vibration or other influences tending to open the switch, so long as the thermopile supplies a thermal current to the relay coil of a value which will cause the relay contacts to initially close.

In fire alarm systems of the thermocouple type the relay is required to close in response to very little power input, typically the power generated by a single thermocouple when exposed to a dangerously high temperature. Typically, a single thermocouple will generate 40 millivolts as a maximum. As a practical matter, however, it is necessary for dependable operation that the system give an alarm when a substantially lower thermal voltage—say 15 millivolts—is generated by the thermopile. To work the relay by such low voltage the resistance in the control circuit must ordinarily be limited to a total of not more than 5 or 6 ohms, of which typically 2 ohms is comprised in the thermopile.

Because the operating power which is available is so small, it is necessary that none shall be lost in order to maintain a dependably operating system. In airplane applications, particularly in detecting engine fires, the thermopile is subjected to all kinds of weather and tends to develop leakage paths across the respective thermocouples thereof and to ground. When this occurs a higher generated thermal voltage than the 15 millivolts abovementioned is required in the control circuit to initiate an alarm. The minimum effective leakage resistance which can be tolerated is prescribed by the limitation that a single thermocouple of the thermopile shall be able to generate effectively the prescribed minimum operating voltage—say 15 millivolts as abovementioned. In addition to leakage, there is in aircraft applications a strong tendency for the circuits to develop "opens" in view of the heavy vibration to which the equipment is subjected. It is accordingly highly important that fire alarm systems as here described be so arranged that they can be tested reliably for operability, both as to leakage and continuity, and that this test can be made quickly whenever desired.

By my invention I am enabled to make this operability test under the exact conditions in which the system is used without interposing any components, such as switch contacts, in the system which would themselves affect the operability of the alarm system should they become defective. This operability test is exact according to my invention because it is done by determining positively whether a single thermocouple of the thermopile is capable of initiating an alarm. This is accomplished by connecting permanently in the control circuit 17 an auxiliary thermocouple 19 and associating therewith a heater 20, the thermocouple 19 and heater 20 being preferably provided as a unit in an enclosed envelope 21 which is preferably gas-filled so as to obtain a close thermal coupling between the thermocouple and heater. The heater is connected in a circuit 22 through a normally open push-button switch 23 to the battery 12, the heater being adaptable when connected across the battery to heat the thermocouple 19 to a sufficiently high temperature to cause it to generate a thermal voltage in the control circuit which is substantially equivalent to that generated by a single thermocouple of the thermopile 18 when the same is subjected to a dangerously high temperature. This test is one for both continuity and leakage in and from the control circuit, as well as for any other defect

in the system, such as might cause the system to fail under actual operating conditions, and is obtained with a minimum of apparatus and with a maximum degree of reliability since it does not require that any switching be done in any vital circuit of the alarm system.

In Figure 2 I show a modified alarm circuit according to my invention, which includes means to give a continuous indication as to whether or not the system in operable condition. This system eliminates the need for periodic testing. In this system I employ a relay 25 having a switch 26 of the single-pole double-throw type that is operated magnetically by a coil 27. The switch may be biased to a neutral position, the position for example shown in full lines, and is adapted to close with one contact 26a when current is passed through the coil 27 in one direction and with the other contact 26b when the current in the coil is reversed. In series with the coil 27 is a thermopile 28 and a thermocouple 29 of a test unit 30 which includes a heater 31 as above described. An alarm circuit 32 is provided which serially includes a battery 33, a current-limiting resistor 34, a signal light 35 (typically one to give a red light) and the section of the relay switch 26 including the contact 26a. Paralleling a portion of the alarm circuit is an operability-indicating circuit 36 serially including a current-limiting resistor 37, an operability-indicating signal light 38 (typically one giving a green light) and the section of the relay switch including the contact 26b.

The heater 31 is connected permanently across the battery 33 by way of the signal light 35 and the circuit 39. The current drawn by the heater is insufficient to light the signal light 35, but is adapted to heat the thermocouple 29 sufficiently to cause it to generate a thermal voltage in the control circuit which is sufficient in magnitude to hold the relay switch closed with the contact 26b provided the thermopile 28 is not energized. Thus, so long as there is no fire to which the thermopile is exposed a green signal will be given by the light 38 to indicate that the system is in operable condition. This is a true indication not only as to continuity and leakage with respect to the control circuit but also as to continuity of the signal light 35 since the heater current is drawn through this light.

The thermopile 28 is polarized in a reverse direction from that of the thermocouple 29 and is adapted when energized to generate a sufficient thermal voltage in the control circuit, in a direction opposite to that of the thermocouple 29, to close the switch 26 with the contact 26a. Thus upon outbreak of a fire causing energization of the thermopile 28 the switch 26 will be thrown from the contact 26b to the contact 26a to put out the green light and to give an alarm by lighting the red light 35. When the fire is extinguished and the thermopile is no longer energized, the constantly-generated thermal voltage of the thermocouple 29 will return the switch to the contact 26b and restore the green signal light provided, of course, that the system is still in working condition.

In order to maintain a constant current through the heater 31, with varying battery voltage, a suitable voltage regulator may be employed, or preferably a compensating shunt 40 of the "thermistor" type may be connected across the heater as shown in Figure 2.

While I have herein described certain preferred embodiments of my invention, these embodiments will be understood to be illustrative and not nec-

5

essarily limitative of my invention since the same are subject to changes and modifications without departure from the scope of my invention, which I endeavor to express according to the following claims.

I claim:

1. In a fire alarm system including a thermopile, a relay controlled by said thermopile and an alarm circuit controlled by said relay and including a source of potential: the combination of a permanently-closed control circuit serially including a coil of said relay, a plurality of thermocouples for fire-detecting purposes and a test thermocouple; a heater closely thermally associated with said test thermocouple; and circuit means including a switch for supplying energizing current from said potential source to said heater at will.

2. In a fire alarm system including a thermopile, a relay controlled by said thermopile and an alarm circuit controlled by said relay: the combination of a control circuit serially including a coil of said relay, a plurality of thermocouples for fire-detecting purposes and a test thermocouple, one end of said coil being connected to ground and said test thermocouple being connected between ground and said plurality of detecting thermocouples, each of said detecting thermocouples being adapted to generate a thermal voltage in said control circuit sufficient to actuate said relay upon the thermocouple being subjected to a dangerously high temperature and upon the effective leakage resistance in the control circuit being above a predetermined threshold value; and means for heating said test thermocouple to produce a thermal voltage in said control circuit for testing purposes which is of the order of magnitude of the said thermal voltage of each of said detecting thermocouples.

3. In a fire alarm system including a thermopile, a relay controlled by said thermopile and an alarm circuit controlled by said relay: the combination of a control circuit serially including a

6

coil of said relay and said thermopile, said circuit having a connection to ground at one end of said coil; and means for testing said system for operability comprising a test thermocouple connected permanently in said control circuit between said thermopile and ground, a heater thermally associated with said test thermocouple, and means for energizing said heater at will.

4. In a fire alarm system including a thermopile, a relay including a coil and a pair of contacts, and an alarm circuit including said contacts, an alarm device and a source of potential, said source having connection to ground: the combination of a control circuit serially including said coil and thermopile, one end of said coil being connected to ground; circuit means connected between the end of said coil opposite to ground and said alarm circuit for supplying supplementary current from said alarm circuit to said coil upon closure of said relay contacts; and means for testing said system for operability, including testing said thermopile for continuity and leakage resistance to ground, comprising a test thermocouple permanently connected in said control circuit between said thermopile and ground, a heater thermally associated with said test thermocouple, and circuit means including a switch for supplying energizing current to said heater from said potential source at will.

WINSLOW B. M. CLARK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
706,177	Heaphy	Aug. 5, 1902
989,420	Reichel	Apr. 11, 1911
2,063,703	Sidall et al.	Dec. 8, 1936
2,376,920	Jones	May 29, 1945