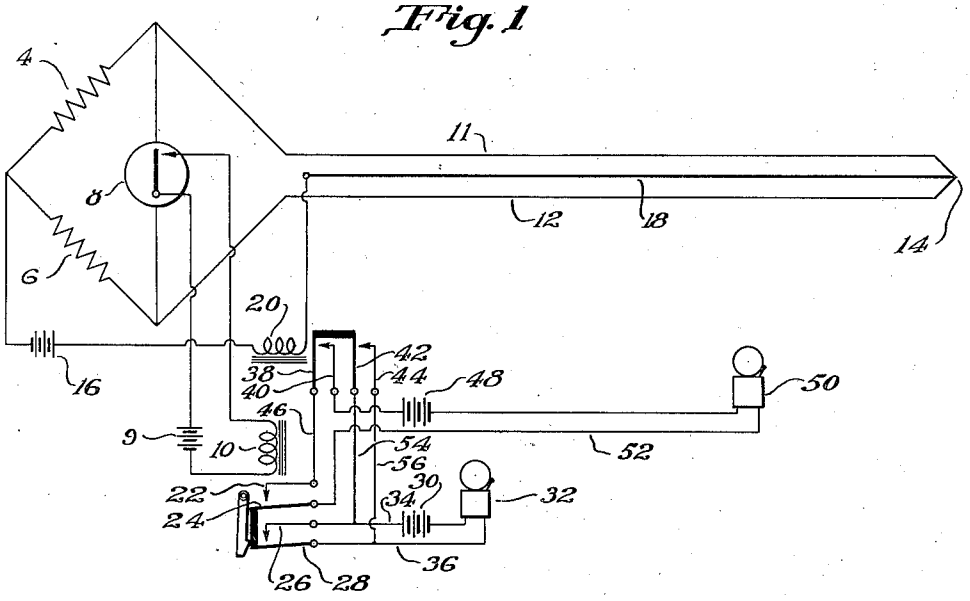
April 1, 1941. F. R. BRIDGES 2,236,891

FIRE ALARM SYSTEM

Filed July 17, 1937

Fig. 1



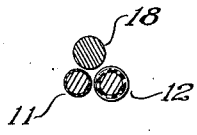


Fig. 2

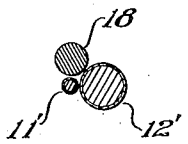


Fig. 3

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FIRE ALARM SYSTEM

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9 Claims. (Cl. 177—355)

The present invention relates to automatic fire protection systems and more particularly to systems arranged to give an alarm or other response upon the occurrence of abnormal fire conditions within the space to be protected.

Automatic fire alarm systems are generally divided into two classes, first, those which operate at a predetermined temperature as by the use of a fusible member, and second, those which operate under a predetermined rate of temperature rise. Neither form has been found entirely satisfactory owing to the difficulty of making the system sufficiently sensitive to detect an incipient fire without making it susceptible to false operation.

A system operable under a fixed high temperature condition usually requires the spacing of fusible members around the walls or ceiling of a room. Since a fire may start at any point in the whole volume of the room, none of the fusible members can respond until the temperature in the vicinity of one of them rises to the necessary value. Accordingly, a fire, which if detected immediately could be easily quenched, may not affect the alarm until it reaches considerable proportions. If the sensitivity of the system is improved by making the fusible members of extremely low melting point, they may be susceptible to false alarms under conditions which should be considered as normal.

The rate of rise indicator can be designed for greater sensitivity of response to small fires, but it has the disadvantage that it is even more susceptible to false alarms. Such systems frequently depend upon the changes of resistance in wires strung around the room or on changes of gas pressure in a tube. Since the incipient fire may affect only a small portion of the device, it is usually necessary to set it for a fairly high degree of sensitivity and this makes it responsive to a moderately rapid change in normal temperature affecting the whole device.

According to the present invention there is provided a combination of means responsive both to rate of rise and fixed high temperature, together with separate alarms operable in different ways depending on the actuation of the response device. In the preferred form of the invention a local alarm is provided which is responsive either to a predetermined rate of rise or to a predetermined high temperature, and another alarm which may be designated as a master alarm is provided for indicating the condition in which both the temperature and the rate of rise exceed the predetermined values. The local alarm may be used simply to summon a watchman or occupant who can disregard a false alarm or put out a small fire if one exists, while the master alarm may be suitably connected with a municipal system to summon the regular fire fighting equipment if a more serious condition exists. As will hereinafter appear, this arrangement provides substantial assurance against false signals on the master alarm while still maintaining adequate coverage of the space to be protected.

Other features of the invention consist of certain novel features of construction, particularly with respect to the response devices hereinafter described and particularly defined in the claims.

In the accompanying drawing Fig. 1 is a diagram of the preferred form of the system according to the present invention and Figs. 2 and 3 illustrate different forms of the rate of rise indicator.

The system illustrated in Fig. 1 comprises a Wheatstone bridge circuit involving resistance arms in the form of wires suitably disposed about the space to be protected, these wires being of different responsiveness to a rise of temperature, together with a fusible conductor adapted to break upon the occurrence of a high temperature condition in the neighborhood of any point along its length.

Referring specifically to Fig. 1 the system comprises a Wheatstone bridge having two fixed arms 4 and 6 across the ends of which is connected a relay or circuit closing galvanometer 8. A sufficient swing of the galvanometer needle closes a circuit which includes a battery 9 and a relay coil 10. The third and fourth arms of the bridge comprise the detector wires 11 and 12 which are connected to the ends of the fixed arms 4 and 6 respectively and are connected together as indicated at 14. The arms 11 and 12 are placed side by side and led about the wall or ceiling of the room to be protected. These arms are of different responsiveness to temperature conditions, as will hereinafter be described in detail. Current is continuously supplied to the bridge by a battery 16, one terminal of which is connected to the junction of the arms 4 and 6, and the other terminal of which is connected to the junction 14 through a conductor 18 which is preferably of fusible metal arranged to break at a predetermined temperature. Between the battery and the conductor 18 is a relay coil 20 which normally is continuously energized.

Associated with the relay coil 10 are contact pairs 22, 24 and 26, 28, the contacts 24 and 28 being movable contacts adapted to close on 22

and 26 respectively when the coil 10 is energized. The contacts 24 and 28 are electrically insulated from each other but mechanically connected together. Preferably a suitable latch mechanism is provided to hold the contacts closed when the movable contacts are attracted. A local alarm circuit including a battery 30 and a bell 32 is provided, this circuit being connected by wires 34 and 36 with the contacts 26 and 28 respectively, so that upon closure of said contacts the alarm is operated.

Associated with the relay coil 20 are contact pairs 38, 40 and 42, 44, the contacts 38 and 42 being movable contacts which are normally held attracted by the coil 20 away from the corresponding fixed contacts 40 and 44. Upon interruption of the circuit through breakage of the fusible wire 18, the contacts 38, 40 and 42, 44 close. A wire 46 connects contacts 32 and 38. Contact 40 is connected in a master alarm circuit which includes a battery 48 and an alarm device as a bell 50, the other side of the master alarm circuit being connected by a wire 52 with the contact 26. The contacts 42 and 44 are connected by wires 54 and 56 respectively with the wires 34 and 36 at opposite sides of the local alarm circuit. The showing is purely diagrammatic and the master alarm device 50 may constitute a connection with a municipal alarm system whereby a coded signal is given when the master alarm circuit is closed.

The local alarm circuit is controlled by the parallel sets of contacts 26, 28 and 42, 44, and hence the local alarm is actuated when either of these sets of contacts is closed. The master alarm circuit is controlled by the contacts 22, 24 and 38, 40 in series, and the master alarm can therefore be operated only when both sets of contacts are closed.

A suitable arrangement of the conductors is shown in Fig. 2. The bridge arms 11 and 12 are of the same material, preferably one having a moderately high specific resistance and a high temperature coefficient of resistance. Pure nickel has been found satisfactory. The wire 11 is provided with an enamel surface which is of high thermal conductivity. The other bridge wire 12 is covered with insulation, such as double cotton covering, of low thermal conductivity and having a low coefficient of surface transmission. The wires 11 and 12 are strung around the wall or ceiling of the room to be protected, and the fusible conductor 18 is associated therewith. With this arrangement a rising temperature adjacent to any part of the conductors 11 and 12 causes an immediate change in the resistance of the unprotected wire 11, while the wire 12 being shielded by the thermal insulation does not have its resistance increased at the same rate. The bridge becomes unbalanced and if the rate of rise of temperature is sufficiently high, the circuit of the relay coil 10 is closed. For convenience and improved appearance the wires 11, 12 and 18 are cabled or twisted together. The conductors are shown in Fig. 2 on a greatly enlarged scale; actually the conductors 11 and 12 may be of #24 wire or smaller.

Another arrangement of conductors is shown in Fig. 3, in which the conductors 11' and 12' are of different cross-sectional areas. The conductors may be of the same material and will then have different mass per unit length. The smaller conductor has a greater surface in comparison with its mass and will therefore respond more rapidly to any changes of external temperature. On a rapid increase of temperature, the bridge will become sufficiently unbalanced to cause energization of the relay 10. In this form of the invention the ratio arms 4 and 6 of the bridge must be of different magnitudes in order that a normal balance may be obtained. As an alternative, the two conductors may be made of different materials, the one of larger cross-section preferably having the higher specific resistance so that the resistance of the separate arms may be made equal or nearly equal. The temperature coefficients of resistance may or may not be equal. Since the conductors have different mass per unit length, and in general have different specific heats, the temperatures of the conductors will increase at different rates for a rise of ambient temperature, thus resulting in unbalancing the bridge.

In operation, the system is responsive to effects arising from an increase in temperature at a certain rate, or to any temperature above a certain level, or to both effects. Normally, the relay 10 is de-energized and the relay 20 is continuously energized.

The abnormal condition most frequently occurring is a rate of change of temperature sufficient to unbalance the bridge and to cause energization of the relay coil 10. The bridge is preferably sensitive enough so that a rate of increase of 25° Fahrenheit per minute in a localized area will close the relay circuit. It will be appreciated that a general rise of temperature of considerably lower rate of increase may serve to unbalance the bridge because all of the conductor wire is exposed to this condition. In any such event, a signal is given on the local alarm. The watchman or occupant may then investigate and if the alarm is false he will simply reset the local alarm without in any way affecting the master alarm. On the other hand, the sounding of the local alarm may be due to an incipient fire which the watchman can easily handle. In this respect the protective feature is of the greatest value since it affords an opportunity for easily quenching a fire which would not actuate the master alarm until it rose to proportions of greater seriousness.

It is also possible that the relay coil 20 may be actuated, that is de-energized, under conditions where the rate of rise relay 10 would not be actuated. For example, a small blaze or a high temperature condition might exist near the fusible wire 18 but so localized that it would not affect any appreciable length of the differential wires 11 and 12. A false alarm through breaking of the fusible wire would be much less frequent than one arising from actuation of the bridge relay 10. However, if operation of the relay 20 alone occurs, it merely operates the local alarm 32 without in any way affecting the master alarm circuit. Again, the watchman may disregard a false alarm thus sounded, or if a small fire exists he may be able to take care of it without summoning the fire department.

It has been found that a fire of serious magnitude usually causes both effects, namely, a rapid rate of rise and an increase to a high temperature level. When there is a condition of both high temperature and rapid rise of temperature, it can rarely be due to normal causes and in that event a special indication should be given. This is afforded through the master alarm 50, the circuit of which is closed only when the relay 10 is energized and the relay 20 de-energized. In its simplest form the master alarm is simply a dif-

ferent device from the local alarm, but as heretofore stated, it may comprise an arrangement for actuation of the municipal fire system. Assuming a fire of some magnitude to break out in the protected space, the rate of rise relay 10 is first actuated and then locked up, the local alarm being first sounded. Shortly thereafter, the fusible wire 18 is broken at some point and the relay 20 is de-energized, thereby closing the master alarm circuit.

The advantages of the present system are that it affords substantial assurance against any false alarms on the master circuit while still affording rapid indication of small fires on the local alarm circuit.

The specific embodiment of the invention described herein is diagrammatic, and it will be understood that the invention may be used in other embodiments and in circuits of different character within the scope of the appended claims.

Having thus described the invention, I claim:

1. An automatic fire alarm system comprising means responsive to rate of temperature rise, means responsive to a predetermined high temperature, separate relays operated by said means, a local alarm circuit including contacts of both of said relays in parallel, and a master alarm circuit controlled by contacts of said relays in series.

2. An automatic fire alarm system comprising a bridge circuit of the Wheatstone type including arms differently responsive to changes of temperature, a relay operated by unbalance of the bridge, a fusible conductor to supply current to the bridge, a second relay controlled by the fusible conductor, an alarm circuit responsive to operation of either of said relays, and a second alarm circuit responsive only to operation of both of said relays.

3. In an automatic fire alarm system two conductors of different thermal responsiveness forming Wheatstone bridge arms to detect an abnormal rate of rise of temperature, and an additional conductor of fusible material, all of the conductors being cabled together.

4. In an automatic fire alarm system, two conductors of different thermal responsiveness to detect an abnormal rate of rise of temperature, and an additional conductor of fusible material, all of the conductors being cabled together.

5. In an automatic fire alarm system, two conductors forming Wheatstone bridge arms and having surfaces of different thermal conductivities, and a fusible conductor insulated therefrom and closely adjacent thereto.

6. In an automatic fire alarm system, two conductors forming Wheatstone bridge arms of different mass per unit length, and a fusible conductor insulated therefrom and closely adjacent thereto.

7. An automatic fire alarm system comprising a Wheatstone bridge circuit including arms differently responsive to changes of temperature, a source of electrical energy, a fusible conductor to supply current from the source to the bridge, a relay operated by unbalance of the bridge, a second relay in series with the fusible conductor, a local alarm circuit and a master alarm circuit, and two pairs of contacts for each relay, the local alarm circuit being connected to a pair of contacts of each relay in parallel and the master alarm circuit being connected to the remaining pairs of contacts of both relays in series.

8. An automatic fire alarm system comprising means responsive to rate of temperature rise, means responsive to a predetermined high temperature, separate relays operated by said responsive means, each relay having two sets of contacts, a local alarm circuit including a set of contacts of one relay in parallel with a set of contacts of the other relay, and a master alarm circuit including the other sets of contacts of both relays in series.

9. An automatic fire alarm system comprising a Wheatstone bridge circuit including two arms having a difference in time lag of heat absorption, a source of electrical energy, a fusible conductor to supply current from the source to the bridge and arranged contiguously with said two arms, a relay operated by unbalance of the bridge, a second relay in series with the fusible conductor, a local alarm circuit and a master alarm circuit, and two pairs of contacts for each relay, the local alarm circuit being connected to a pair of contacts of each relay in parallel and the master alarm circuit being connected to the remaining pairs of contacts of both relays in series.

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