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AUTOMATIC RATE OF RISE-RESPONSIVE
FIRE PROTECTION CIRCUIT

3,071,713

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2 Sheets-Sheet 1

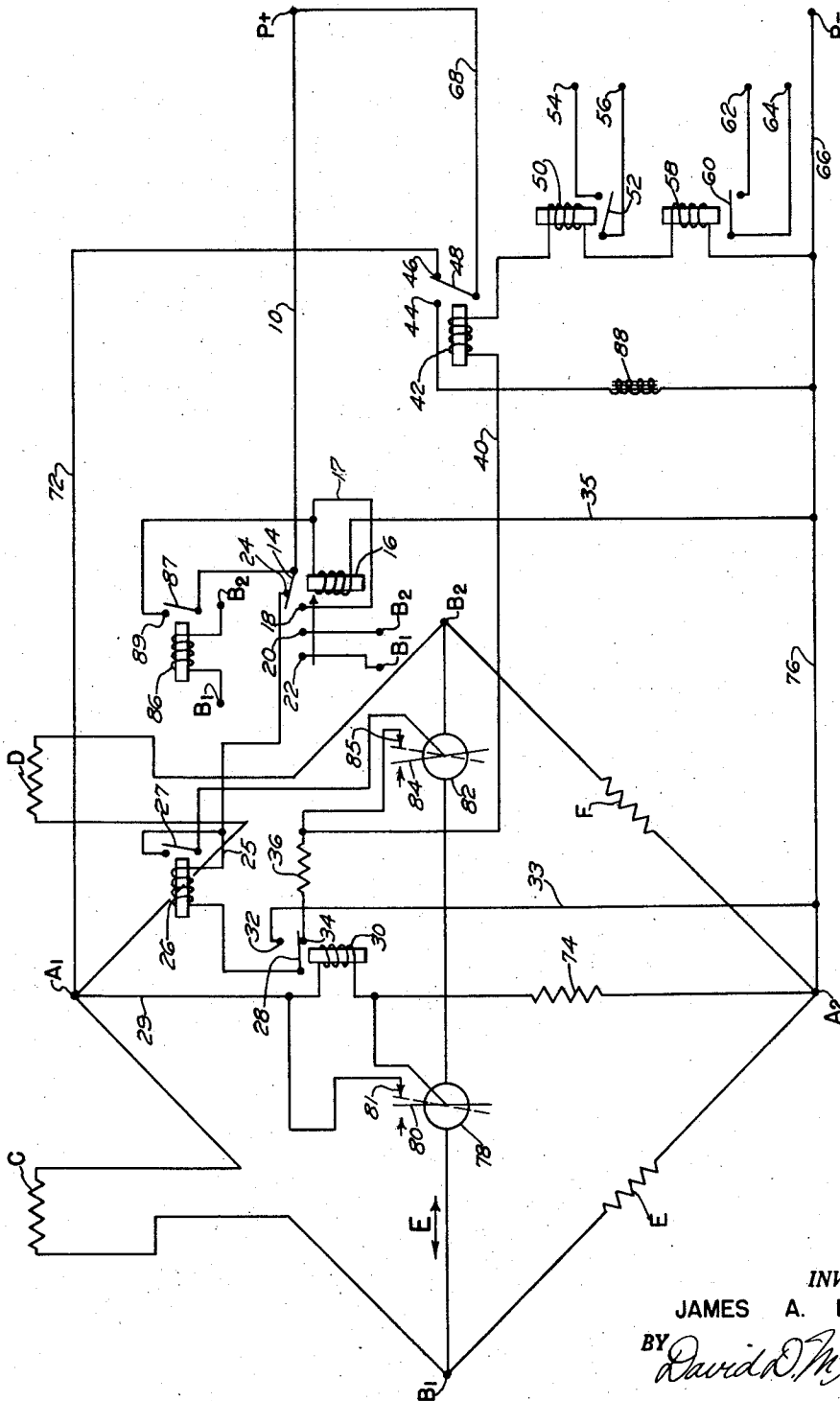


FIG. 1

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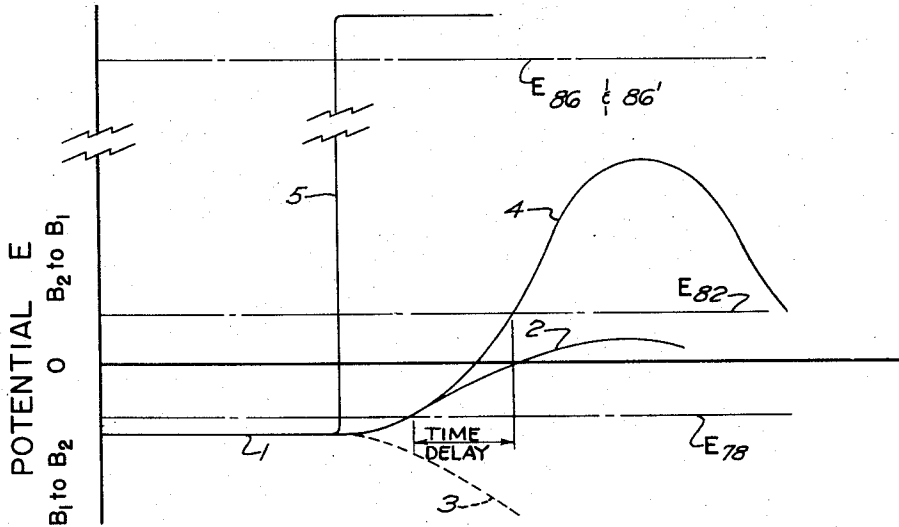


FIG. 2

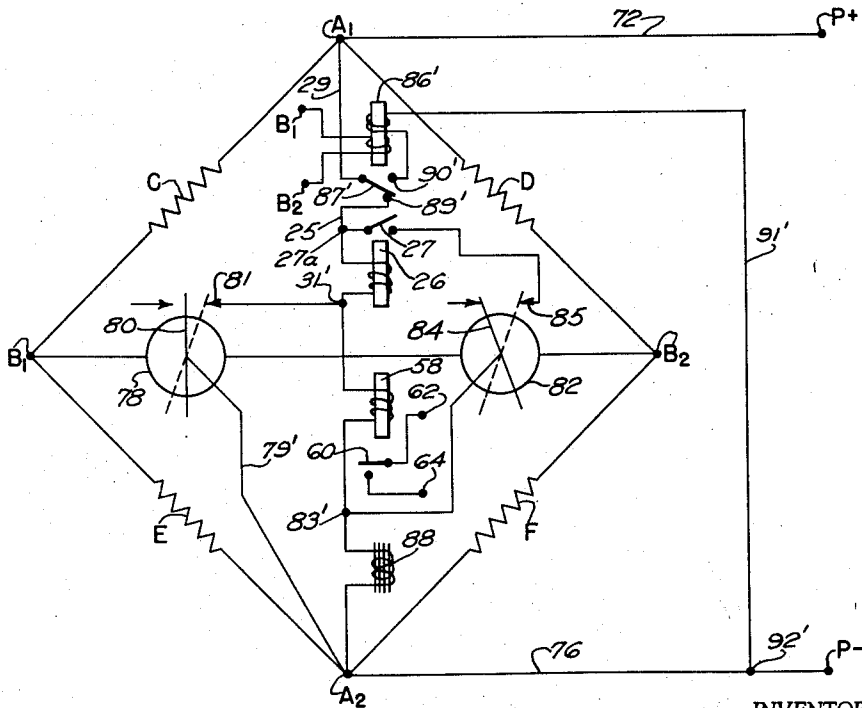


FIG. 3

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AUTOMATIC RATE OF RISE-RESPONSIVE FIRE PROTECTION CIRCUIT

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9 Claims. (Cl. 317-153)

This invention relates to a system which is responsive to the rate of change of a condition to be sensed. In the application of the invention to be herein described the condition to be sensed is the temperature in an area protected from fire. More particularly, this invention relates to a rate-of-rise fire protection system employing a normally balanced electrical bridge circuit which responds differently to different rates of increase in temperature in a protected area caused by a fire and operates an alarm and/or sprinkler system. It also relates to such a system employing supervisory components which also responds to and indicates electrical faults. The system thus discriminates between various rates of change of the condition to be sensed (the temperature in the protected area) and also between the various rates and faults in the system.

In systems of this general type there is distributed in the area to be protected from fire an element which forms a part of a balanced bridge circuit. This element is sensitive to temperature changes and causes an unbalance of the bridge circuit which is proportional to the rate of temperature change while the bridge circuit controls the discharge of a fire extinguishing medium. Such systems, termed rate-of-rise systems, are well known in this art and the distributed element constitutes two of the arms of the bridge circuit.

In previous rate-of-rise systems employing a normally balanced bridge circuit, an element for controlling the discharge of a fire extinguishing medium is customarily coupled with a potential responsive component within the circuit which is responsive to the degree of bridge unbalance, the degree of unbalance in turn corresponding to the rate of change of temperature within the protected area. This element is actuated by this component when the latter responds to a predetermined degree of bridge unbalance. However, this component cannot distinguish between an unbalance due to a large fire and a greater unbalance due to an electrical fault because it responds to both such unbalances. To overcome this difficulty a time-delay relay has been employed in conjunction with the element for controlling the discharge of the fire extinguishing medium and thus introduces a time lag in the response of the system. If then an electrical fault within the circuit occurs, another component in the circuit, which can distinguish between an unbalance due to a fire and an unbalance due to a fault because it is responsive only to the very large unbalances attendant such faults, will have ample time to prevent (by a suitable switching scheme) the actuation of the element which controls the discharge of a fire extinguishing medium.

But while this introduction of a time-delay relay overcomes one problem (that caused by electrical faults) it introduces an undesirable result, for in the event of a large fire it is desirable that there should be little or no time lag in the discharge of the fire extinguishing medium.

If the sensitivity of the potential responsive component is increased in order to begin the "warm-up" period of the time-delay relay sooner, the system would be set in operation with the consequent discharge of the fire extinguishing medium by small fires or the like which could be extinguished by hand. On the other hand, if the sensitivity of the potential responsive component is decreased, then the "warm-up" period of the time-delay relay can-

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not commence until relatively late in the growth of a fire.

This invention relates to a solution of this problem. By virtue of this invention, the "warm-up" period of the time-delay relay is commenced by an extremely sensitive potential responsive component, thus beginning the "warm-up" period sooner, but this action will not result in the discharge of a fire extinguishing medium unless the rate-of-rise of temperature within the protected area is so great that it could only have been due to a large fire.

According to this invention three potential responsive components are employed in a bridge system. The first is responsive to the relatively small bridge unbalances attendant small fires and the initial stage of large fires.

The second component is not responsive to such small unbalances but is responsive to the intermediate bridge unbalances attendant the greater rate of temperature increases which accompany fires which are so large that the rate of temperature increase in the protected area could not have been caused by a small fire or a harmless occurrence. The third potential responsive component, which when actuated prevent the discharge of a fire extinguishing medium, is not responsive to either small or intermediate bridge unbalances but only to large bridge unbalances attendant certain electrical faults. By now causing the time-delay relay to commence its "warm-up" period upon the response of the first potential responsive component, and by coupling the element which controls the discharge of a fire extinguishing medium to both the time-delay relay and the second potential responsive component, the "warm-up" period can commence upon the response of an extremely sensitive (first) potential responsive component but the fire extinguishing medium will not be discharged unless there is a large fire.

Another problem attendant previous rate-of-rise systems has been the lack of satisfactory supervision, many previous systems giving an indication of an electrical fault only upon the opening of relatively few leads or lines. According to one feature of this invention, not only does the above first potential responsive component perform the function indicated, but it initiates an alarm signal in the event of an open lead between the bridge points across which the bridge unbalance is measured and also initiates an alarm signal in the event of an open in other leads.

Accordingly, it is an object of this invention to provide an electrical rate-of-rise bridge circuit protection system which discriminates between the various changes in thermal conditions within the protected area.

It is another object of this invention to provide a rate-of-rise bridge circuit protection system which discriminates between an unbalance in the bridge due to changes in thermal conditions and an unbalance due to electrical faults.

It is another object of this invention to provide a rate-of-rise bridge circuit protection system which discriminates of its leads becomes open.

These and other objects will appear in the following description of the invention.

In the drawings:

FIG. 1 is a diagram of one embodiment of this invention;

FIG. 2 is a diagram showing the relation between the potential across bridge points B_1 and B_2 , this potential corresponding to the rate at which the temperature within the protected area changes, for various thermal conditions within the protected area and time. It also shows the effect of an electrical fault on the potential across these points;

FIG. 3 is a diagram of a second embodiment.

In the following, the description of the two illustrated embodiments will each be divided into four parts.

The first embodiment:

(I) STEADY STATE IN WHICH THE THERMAL CONDITIONS IN THE PROTECTED AREA ARE SUBSTANTIALLY CONSTANT OR ARE CHANGING SLOWLY

Referring to FIG. 1, the current divided at the positive terminal (P+) of the power input, part going along lead 10 and part along lead 68. The current in lead 10 is termed the supervisory current and passes through armature 14 and contact 24 of a relay 16, then along lead 25, through the coil of a time-delay relay 26, through armature 28 and contact 34 of a relay 30, through a resistor 36, along lead 40, through the coils of relays 42, 50 and 58, along lead 66 and thence to the negative terminal (P-) of the power input.

An alarm circuit (not shown) is connected across the terminals 54 and 56 of relay 50 and will be closed by armature 52 if there is a substantial increase in supervisory current through the coil of relay 50.

Another alarm circuit (not shown) is connected across terminals 62 and 64 of relay 58. Its armature 60 is normally held up by the supervisory current but if there is a substantial decrease in this current it will be released and close this alarm circuit.

The current through lead 68 passes through armature 48 and contact 46 of a relay 42. The armature is normally held against contact 46 because the normal supervisory current passing through the coil of this relay is insufficient to pull its armature up against the other contact 44. From contact 46 this current passes through lead 72 to junction A₁ of a bridge circuit.

The bridge circuit includes resistance arms C, D, E and F. Any two adjacent arms may make up the thermally responsive element which is distributed within the protected area. This element may take a variety of forms and depends for its operation upon the principle that when the arms are made of different materials or are differently insulated or the like, the rate of change of its ambient temperature causes the resistance of one of the arms to change at a different rate than that of the other arm. For rapid changes in ambient temperature the resistances of the two arms change at rates which are greater than the rates at which these resistances change for slow changes. One arm may be the core and the other arm the outer winding of a flexible wire cable which is distributed along the protected area. It will be understood that this form of the distributed element is illustrative only. With this arrangement a rapid rate-of-rise of the ambient temperature such as would be caused by a large fire results in resistance of the outer coil increasing at a greater rate than the increase in the resistance of the core. Any unbalance of the bridge due to the above differences in resistance changes manifests itself as a change in the potential between points B₁ and B₂. This potential therefore varies with, or corresponds to, the rate of change of a condition to be sensed, i.e., the rate-of-rise of the temperature within a protected area.

At junction A₁ the current divides, part going through bridge arms C and E, part going through bridge arms D and F and the rest through lead 29 to the coil of a relay 30 and resistor 74. At junction A₂ these three currents recombine and pass along leads 76 and 66 to the negative terminal P- of the power supply.

The bridge parameters are set so that in the normal or steady state there is a very small potential between bridge points B₁ and B₂. This may be done by any of the well known methods of adjusting a bridge. As will be later shown, this small potential provides a supervisory feature of the invention. In series across these points are the coils of two galvanometer-type relays 78 and 82 in each of which the moving coil armature functions as a switch contact arm. The polarity of these relays is such that the small current flowing through their armatures (from junction B₁ to junction B₂) as a result of the steady state potential between these points holds armatures 80 and 84 away from their respective connected con-

tacts 81 and 85. Current flowing the opposite direction (from B₂ to B₁) tends to move these armatures toward their respective contacts. The current required to actually move the armature into engagement with their respective contacts may be varied by the initial angular setting of the moving coil armatures, as is illustrated by the different angular positions of the two armatures 80 and 84. The relay 78 is set so that when a small unbalance of the bridge diminishes the small steady state potential between points B₁ and B₂, the armature 80 engages contact 81 and is "locked" against this contact by a small permanent magnet (not shown). However, relay 82 is set so that such a small unbalance of the bridge which causes a diminution in or even changes slightly the direction of this current flow does not move armature 84 against contact 85. A potential in the opposite direction, from B₂ to B₁, such as would be caused by a larger bridge unbalance will however cause armature 84 to move over and engage contact 85 and be likewise "locked" thereagainst by another permanent magnet (not shown).

If only a single contact is used on each relay 78 and 82, a substantial rate of fall of temperature in the protected area will have no effect on the system. The resultant potential between B₁ and B₂ upon such a rate of fall of temperature will be in a direction opposite to that necessary to move the armature galvanometer relays 78 and 83 against their connected contacts. This is illustrated in FIG. 2 wherein the dashed portion 3 of the curve indicates the direction and magnitude of the current between B₁ and B₂ with a decreasing change of temperature.

A slow increase in temperature within the protected area will not affect the circuit because the resistances of the bridge arms which make up the thermally responsive element will change at substantially the same rate and the bridge will remain balanced.

(II) OPERATION IN RESPONSE TO A GREATER RATE OF INCREASE IN TEMPERATURE

In the event of an increase in temperature in the protected area which is somewhat greater, corresponding to small fires and the initial phase of large fires, the bridge will become slightly unbalanced and there will be a change in potential between the junctions B₁ and B₂. This change in potential will be in such a direction as to oppose the small steady state potential between points B₁ and B₂. This is illustrated in FIG. 2 of the drawing wherein the portion of the curve designated 1 represents the direction and magnitude of the potential E between B₁ and B₂ in the steady state or bridge-balanced condition and wherein the portion of the curve designated 2 represents the change in the direction and magnitude of potential E upon a slight bridge unbalance caused by an increasing temperature change.

Because relay 78 is extremely sensitive, its armature 80 engages contact 81 as the potential E reaches a value designated in FIG. 2 by horizontal line E₇₈, thus shunting the coil of normally closed relay 30. Resistance 74 protects the coil of relay 30 when it is placed directly across the power input terminals. With this latter relay shunted, its armature 28 is released and the supervisory current coming from the coil of time-delay relay 26 passes through armature 28 and contact 32 and thence to the negative terminal of the power supply along leads 33, 76 and 66. Upon movement of the armature 28 from the contact 34 current no longer flows through lead 40 to the coils of relays 42, 50 and 58, and hence the armature 60 of normally energized relay 58 will be released and connect the contacts 62 and 64 thus closing an alarm circuit (not shown).

Upon movement of armature 28 to contact 32 the current in lead 10 increases because the resistor 36 and the coils of relays 42, 50 and 58 are bypassed. This increase is sufficient to initiate the "warm-up" period of time-delay relay 26. This relay is of such a nature that

its contacts close only when excited for a preset continuous period, for example, for two seconds.

Armature 84 of relay 82 will not be moved into engagement with contact 85 by this relatively small rate of increase in temperature because the degree of bridge unbalance is not great enough. This is illustrated in FIG. 2 wherein the value of potential E in the portion of the curve indicated at 2 does not exceed the potential which is needed to operate relay 82, this latter value designated by horizontal line E_{82} .

(III) OPERATION IN RESPONSE TO A LARGE FIRE

In the event of a large fire, the rate of increase of temperature in the protected area will be so great that the resultant potential across B_1 and B_2 , caused by the different rates of change of the thermally responsive element, will change in direction and magnitude and operate relay 82 as well as relay 78. The sensitivity of relay 82 is set so that it will not respond to potentials E less than those caused by large fires. In practice, this sensitivity (as well as that of relay 78) is determined by experiment in a laboratory where fire conditions may be simulated.

The operation of relay 82 will best be understood by reference to FIG. 2. The portion 4 of the curve is shown rising rapidly, corresponding to the relatively rapid rate of temperature increase which could not be caused by small fires. When this portion of the curve crosses the horizontal line E_{82} armature 84 engages contacts 85 of relay 82.

With the contacts of relay 82 closed and after the lapse of the "warm-up" period of time-delay relay 26, part of the supervisory current (in lead 10) will bypass resistor 36 and pass back to the negative side of the power supply through armature 28 and contact 32 of relay 30 and lead 33, while another part passes to lead 40 through a path formed by the closed armatures 27 and 84 of relays 26 and 82. This latter current also bypasses resistor 36 and passes through the coils of relays 42, 50 and 58 and thence to the negative side of the power supply. Because resistor 36 has been bypassed, this latter current is now large enough to operate both relays 42 and 50. The operation of relay 50 causes its armature 52 to connect terminals 54 and 56 and actuate an alarm circuit (not shown). This alarm circuit is similar to the circuit controlled by relay 58 except that it indicates the occurrence of a large fire rather than a small fire. The operation of relay 42 causes the current in lead 68 to pass through armature 48 and contact 44 and energize an actuator element 88, here shown as a solenoid. Energization of solenoid 88 initiates, through a suitable arrangement, the discharge of a fire extinguishing medium in the protected area. By the use of well known valve elements, commonly termed "deluge" or "preaction" valves, this discharge continues irrespective of any subsequent change in the energization of the solenoid.

The excitation of the solenoid and the consequent discharge of fire extinguishing medium cannot therefore occur until both relay 82 and time delay relay 26 have closed their contacts. The former relay closes immediately upon a potential across bridge points B_1 and B_2 corresponding to a large fire while the latter relay cannot respond immediately because it must be "warmed-up" first. But since the "warm-up" period was initiated at the beginning phase of the fire, when portion 2 crossed E_{78} in FIG. 2, the "warm-up" time will almost always have been completed before relay 82 closes so that in effect there is no loss of time in releasing the extinguishing medium. This is indicated by the "Time Delay" interval in FIG. 2.

(IV) OPERATION IN RESPONSE TO AN OPEN OR SHORTED BRIDGE ARM

In the event that one of the resistance arms C, D, E or F becomes open or shorted, the potential between points B_1 and B_2 will be very great, as much as a thousand times as great as that occurring in the event of a large fire, and

with only the circuit components described so far the system would, if the unbalance were in the direction B_2 to B_1 as shown in FIG. 2, initiate the often damaging discharge of the fire extinguishing medium in the protected area after the response of relays 78, 82 and the lapse of the "warm-up" time of relay 26. This is undesirable because a bridge arm may become open or shorted without any fire. In the system of the present invention such discharge is prevented by the action of relay 86.

The coil of relay 86 is connected across the points B_1 and B_2 and one of its contacts 89 is connected to one end of the coil of relay 16. The other contact leads to the armature 14 of relay 16. The sensitivity of relay 86 is such that its armature will be moved into engagement with contact 89 only in the event of a potential E_{86} across junctions B_1 and B_2 which is greater than that which could be caused by a large fire. In the event that this large unbalance is in a direction opposite to that shown in FIG. 2, the system would not respond with excitation of solenoid 88, since, as connected as shown, relays 78 and 82 respond to a unidirectional potential only. Nevertheless it is desirable that an alarm signal be given. Relay 86 will respond regardless of the direction of large unbalance.

With such a large bridge unbalance, relay 86 will be energized and its armature 87 will engage contact 89 and part of the supervisory current in lead 10 will pass through the coil of relay 16, causing its armature 14 to move from contact 24 into engagement with contact 18. This supervisory current then flows through lead 17, the coil of relay 16 and then through lead 35 to the negative side of the power supply with a resultant loss of current through the relay 58, and, as explained previously, an alarm will be actuated whenever there is a loss of current in this relay.

By the illustrated arrangement for causing the supervisory current to pass through armature 14, contact 18, lead 17 and the coil of relay 16 the armature 14 is held in engagement by this current in the coil, and, accordingly, this relay will remain "locked-in" once its armature is moved against contact 18. Contacts 20 and 22, also connected across junctions B_1 and B_2 , are joined by armature 14 whenever it engages contact 18 and serve to protect galvanometers 78 and 82 in cases of large unbalance by shunting them.

Thus in the case of a bridge unbalance which is much larger than that which could be caused by a large fire, and therefore must have been caused by an electrical fault, there is no danger that the solenoid 88 will be energized because relay 86 will respond before the lapse of the "warm-up" time of time-delay relay 26.

Supervision

With regard to the supervision of the circuit, in the event one of the leads 72, 76 or 29 becomes open, the loss in current through the relay 30 will result in an alarm because (as explained earlier) the armature 28 of this relay will move into engagement with contact 32 and bypass the supervisory current to lead 33 whenever relay 30 is unexcited.

If the lead connecting points B_1 and B_2 becomes open, the loss of current through galvanometer relay 78 will cause its contacts to close (because the small steady-state potential between B_1 and B_2 "biases" the relay open) and relay 30 will suffer a loss of current because it is shunted, this loss of current resulting in an alarm as above described.

In the event that either lead 10 or 40 is open, the resultant loss of supervisory current through relay 58 will result in an alarm.

In practice, the power input terminals P+ and P- and the relays 50 and 58 may be located in a "central station" which could be at great distances from the remainder of the system.

From the foregoing description, and with special refer-

ence to FIG. 2, it should be noted that it is not essential that there be a small steady-state potential normally biasing galvanometer relay 78 "open." This relates to a supervisory feature of the invention, i.e., in the case of a lack of potential across the terminals of 78 (corresponding to a break in the lead joining B₁ and B₂) an alarm will result. Thus in FIG. 2 the zero potential axis could be "moved" to or below the portion 1 of the curve. It is to be noted that the inverted shape of the curve portion 4 follows from the fact that this portion (as well as portion 2) represents the decrease in the rate at which the temperature of fires change after attaining their full proportions, the rate at which the temperature of a very large fire changes could be very small even though its temperature was extremely high.

The second embodiment:

In the embodiment shown in FIG. 3, those elements which are common to both modifications have been given the same numerals in order to more clearly show the relationship between FIGS. 1 and 3.

(I) STEADY STATE IN WHICH THE THERMAL CONDITIONS IN THE PROTECTED AREA ARE SUBSTANTIALLY CONSTANT OR ARE CHANGING SLOWLY

Referring now to FIG. 3 of the drawings, the current from the positive terminal P+ of the power input flows through lead 72 to junction A₁ where it divides, part going through bridge arms C and E, part going through bridge arms D and F and the rest going to lead 29. The latter current continues through armature 87' of double-wound relay 86', contact 89', lead 25, the coil of time-delay relay 26, the coil of trouble relay 58, an actuator element 88, again shown as a solenoid, and thence to junction A₂. At junction A₂ these three currents recombine and flow through lead 76 back to the negative terminal P- of the power supply. The steady state current passing through the coil of time-delay relay 26 is insufficient to excite this relay, it is also insufficient to excite the actuator element 88 but is sufficient to energize relay 58 such that its armature 60 is normally held open. An alarm circuit (not shown) is connected across terminals 62 and 64 of relay 58. There is a small potential between bridge points B₁ and B₂ in a direction from B₁ to B₂. The galvanometer relays 78 and 82 operate substantially the same as in the first embodiment.

(II) OPERATION IN RESPONSE TO A GREATER RATE OF TEMPERATURE INCREASE

In the event of a rate increase in temperature in the protected area which corresponds to small fires and the initial phase of large fires, the bridge will become slightly unbalanced. The operation of the galvanometer relays 78 and 82 is here again the same as that of the first described embodiment. When armature 80 of relay 78 engages contact 81 the current from relay 26 now finds a path of less resistance through junction 31', contact 81, armature 80, and lead 79' to junction A₂. Trouble relay 58 now experiences a loss of current through its coils and its armature 60 is no longer held up with the consequent closing of the alarm circuit across terminals 62 and 64. Because relay 43 and actuator element 88 have been bypassed, there will be an increase in current through the time-delay relay 26 and it will commence its "warm-up" period.

(III) OPERATION IN RESPONSE TO A LARGE FIRE

In the event of rate increase of temperature accompanying a large fire, galvanometer relay 82 will perform as described in the first embodiment and current also now flows (after excitation of relay 26 for the time-delay period) from lead 25 through a path defined by junction 27a, armature 27, contact 85, armature 84 and junction 83'. The current at junction 83' divides, part going through relay 58 and part through actuator element 88.

The current flowing through actuator element 88 will be sufficient to operate it because it now receives practically full line voltage. Relay 58 will also pull up. As in the first described embodiment, this element is shown as a solenoid although it will be understood that aside from operating a valve which controls the discharge of a fire extinguishing medium, this element may also, or instead, control any other desired response to a large fire.

(IV) OPERATION IN RESPONSE TO AN OPEN OR SHORTED BRIDGE ARM

In the event of an open or shorted bridge arm, the bridge unbalance again will become very great and the winding of the double-wound relay 86' which is connected across points B₁ and B₂ will be energized sufficiently to cause armature 87' to move away from contact 89' into engagement with contact 90'. When this occurs, the current from the lead 29 will now energize its other coil since it finds a path through contact 90', lead 91' and junction 92' to the negative side P- of the power supply. The armature 87' now becomes "locked-in" and will remain so regardless of any subsequent change in the bridge circuit.

The operation of this second embodiment is explained in the same way as the first by reference to FIG. 2 of the drawings. This embodiment is particularly adapted for use in those installations wherein all of the components of the system are located within the protected area.

It will be understood that this embodiment, as well as the first, may also be utilized to detect a rapid fall of temperature in an area by either changing the polarity of the galvanometer relays 78 and 82 or by using the left-hand contacts. Furthermore, by utilizing both contacts of these relays rates of change of temperature corresponding to either an increase or decrease thereof may be detected.

Supervision

The supervision of this circuit is essentially the same as that described in the first embodiment and hence a detailed description will not here be given.

I claim:

1. A system for detecting rates of change of temperature in an area protected from fire comprising a Wheatstone bridge circuit having at least one of its arms adapted to have its resistance changed by changes in temperature in said area to change the potential of one junction of the bridge circuit with respect to the potential of an opposite junction, first and second means connected between said junctions for detecting changes in potential therebetween, said first and second detecting means being actuated respectively by a first change in potential between said junctions caused by a change in temperature of a lower order of magnitude than that which would be caused by a fire requiring detection and by a second change in potential therebetween which is larger than said first change and which is caused by a change in temperature of a greater order of magnitude such as would be caused by a fire requiring detection, means connected between said junctions and connected to said second detecting means for blocking actuation of said second detecting means, said blocking means being actuated by a third change in potential between said junctions which is larger than said second change and which is caused by a circuit fault, and means connected to said first detecting means and actuated by actuation thereof for delaying the actuating of said second detecting means to permit said blocking means to block the actuation of said second detecting means upon occurrence of said third change in potential regardless of the occurrence of said second change in potential, the time interval of said delay means being greater than the time interval between the actuations of said first and third detecting means when such actuations are caused by a circuit fault.

2. A system for detecting rates of change of temperature in an area protected from fire comprising a Wheat-

stone bridge circuit having at least one of its arms adapted to have its resistance changed by changes in temperature in said area to change the potential of one junction of the bridge circuit with respect to the potential of an opposite junction, first and second means connected between said junctions for sensing changes in potential therebetween, said first and second sensing means being actuated respectively by a first change in potential between said junctions caused by a change in temperature of a lower order of magnitude than that which would be caused by a fire requiring detection and by a second change in potential therebetween which is larger than said first change and which is caused by a change in temperature of a greater order of magnitude such as would be caused by a fire requiring detection, first and second means connected to said first and second sensing means respectively and actuated thereby for signalling said first and second potential changes respectively, means connected between said junctions and actuated by a third change in potential therebetween which is larger than said second change and which is caused by a circuit fault for blocking actuation of said second signalling means, and means connected to said first sensing means and actuated by actuation thereof for delaying the actuation of said second signalling means to permit said blocking means to block the actuation of said second signalling means upon occurrence of a said third change in potential regardless of actuation of said second sensing means, the time interval of said delay means being greater than the time interval between the actuations of said first and third sensing means when such actuations are caused by a circuit fault.

3. The system as set forth in claim 2, the time interval of said delay means further being about the usual time interval between the actuations of said first and second sensing means when such actuations are caused by fire.

4. The system as set forth in claim 2, the time interval of said delay means further being not substantially greater than the usual time interval between the actuations of said first and second sensing means when such actuations are caused by fire.

5. The system as set forth in claim 2, further comprising means connected to said blocking means and actuated thereby for actuating said first signalling means independently of actuation thereof by said first sensing means to indicate said third change in potential.

6. The system as set forth in claim 2, further comprising a third signalling means connected to said blocking means and actuated by actuation thereof to indicate said third change in potential.

7. The system as set forth in claim 2, further comprising means connected to said second sensing means and to said delay means for releasing a fire extinguishing medium upon actuation of said second sensing means and completed actuation of said delay means.

8. The system as set forth in claim 2 wherein at least two of said sensing means are connected in series between said junctions.

9. The system as set forth in claim 2 wherein said first and second sensing means are connected in series between said junctions.

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