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TEMPERATURE RESPONSIVE SYSTEM
OF THE BRIDGE CIRCUIT TYPE
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Fig. 1

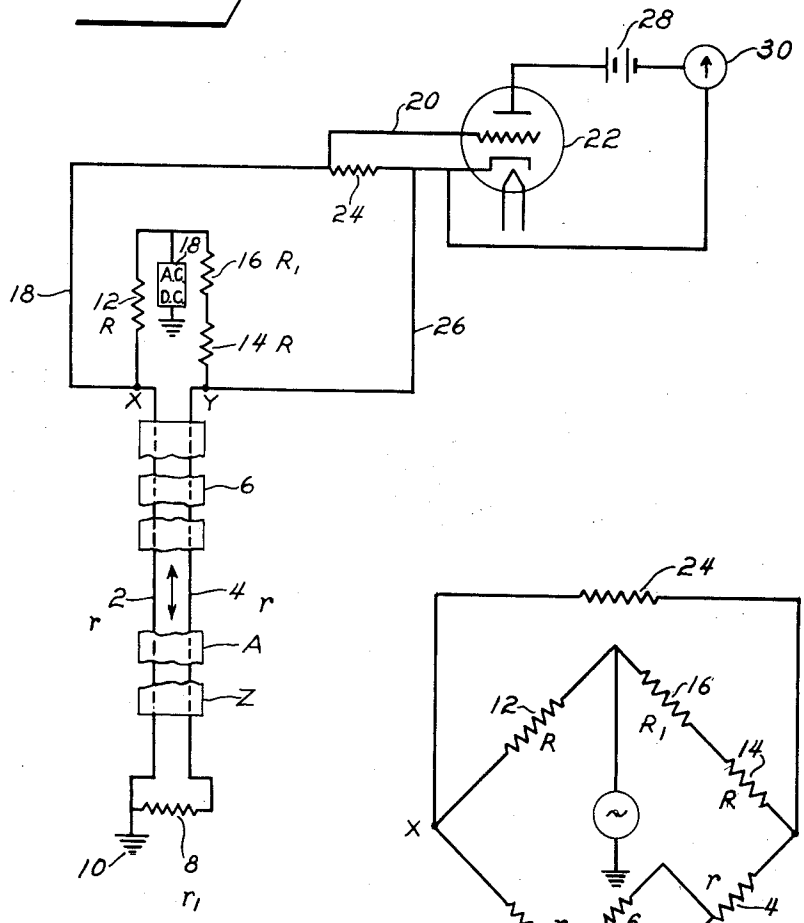


Fig. 2

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TEMPERATURE-RESPONSIVE SYSTEM OF THE BRIDGE CIRCUIT TYPE

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1 Claim. (Cl. 73—362)

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This invention relates broadly to devices and systems which are responsive to an increase in the ambient temperature, to a predetermined temperature, to cause the operation of some indicating or control means or other operating device, and more particularly the invention has to do with such devices and systems which operate by reason of the change in electrical conductivity of an element with increase in temperature. Such devices and systems are useful to effect control operations, to indicate that a predetermined temperature has been reached, or otherwise, and for purposes of illustration only the invention will be described in this application as a fire detecting system.

By this invention I have provided a fire detector system comprising a bridge circuit which is normally in balance, thus providing a certain indication on a suitable indicating instrument, but which is unbalanced by the effect of rise of ambient temperature to a predetermined degree to change the indication of the instrument to indicate the existence of the predetermined ambient temperature.

A system according to my invention is illustrated in the drawing and described in the specification of this application, it being understood that the same is only illustrative of the invention, which may take all other forms within the scope of the claims to the invention.

In the drawings of this application,

Fig. 1 is a circuit diagram of a fire detecting system according to the invention, and

Fig. 2 is a schematic circuit diagram illustrating the electrical relations of various parts of the system of Fig. 1.

In the fire detector system illustrated in Fig. 1 of the drawing the letter A represents a temperature-responsive element comprising two spaced, parallel, electrically conductive wires 2, 4, each of which has resistance r, and which are spaced apart and surrounded by beads 6 formed of thermistor material, by which is meant material which has a substantially greater electrical resistance at normal temperatures than it has at a predetermined higher temperature. This temperature responsive element is fully disclosed in my co-pending application, Serial No. 90,881 and may, if desired, be manufactured by the method disclosed in my co-pending application Serial No. 2,344 now Patent No. 2,495,867. The two conductors 2, 4 of element A are connected at their one ends through resistor 8, which has resistance r_1, one side of which, e. g. at its connection with conductor 2, is grounded at 10. At

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the other end of element A conductor 2 is connected in series with a resistance 12 having value R, while conductor 4 is connected in series with resistance 14, 16 having values R and R_1, respectively, the resistance R_1 of resistor 16 being large with respect to the resistance R of resistors 12, 14. A source of electrical energy 18 which may be A. C. or D. C. is connected between ground and the connection between resistors 12, 16. The connection between conductor 2 and resistor 12, which is designated X, is connected by leads 18, 20 to the grid of a vacuum tube 22 and is also connected through resistance 24 to the cathode of the tube. The connection between conductor 4 and resistors 14, 16, which is designated Y, is connected through lead 26 to the cathode of tube 22 at a point between the cathode and resistor 24. A source of electrical energy 28 is connected between the anode of tube 22 and an indicator on signal device 30, the second terminal of which is connected to the cathode of tube 22.

The described elements constitute a bridge circuit which is shown schematically in Fig. 2. Each of the resistances has such a value that the relation of the resistance, reference being made to the numerals identifying them, is:

$$\frac{2}{4+8}=\frac{12}{14+16}$$

or

$$\frac{r}{r+r_1}=\frac{R}{R+R_1}$$

It will be seen that so long as this relation of resistance is maintained the bridge will be balanced and there will be no potential difference between the equi-potential points X and Y which are, respectively, the point of connection between resistor 2 and resistor 12, and the point of connection between resistors 4, 8 and resistors 14, 16. As resistor 24 is connected across these two points there will be no voltage drop across the resistor so long as the balanced bridge condition is maintained and, under this condition, the grid of the tube 22 will prevent the passage of current through the tube and in the circuit which includes the tube and the signal device 30.

The detector element A is led through a space which is to be monitored, such as a room or the nacelle of an aircraft engine and the balanced bridge conditions described above will obtain so long as the ambient temperature of the monitored space is normal, maintaining substantially infinite resistance of the beads 6. If, however,

the ambient temperature of the monitored space increases to a predetermined temperature the resistance of the beads, at the locale of the increased temperature, will decrease to a predetermined lower value, thus establishing electrical connection between the conductors at that point. For purposes of illustrating the invention it will be assumed that the rise in temperature occurs at the bead marked Z in Fig. 1. When this occurs the resistor 8, which is in parallel with the bead or beads in region Z, will cause the current flow in 8 and Z to be inversely proportional to their resistance. This in substance is the same as changing the resistance of 8 which unbalances the bridge circuit and causes a potential difference between X and Y, and consequently across resistor 24. This actuates the grid of tube 22, completing the signal circuit through the tube and operating the signal. Upon reduction of the temperature at Z, the resistance of Z increases until the current flow through Z may be neglected compared to the current flow through 8 which again balances the circuit. With balancing of the circuit the potential different between X and Y is reduced to zero and the current flow through resistor 24 to zero, so that the potential difference between the grid and cathode of the tube is zero, thus opening the signal circuit.

While I have illustrated and described one form of the invention, it will be evident to those skilled in the art that other forms, as well as modification thereof, 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 attached claim.

What is claimed is:

A temperature-responsive system comprising an element adapted to be positioned in a space subject to variations of temperature to indicate a predetermined abnormal high temperature therein, said element comprising two spaced conductors of electricity each having a known finite resistance r and being spaced apart by material having such a high resistance at normal temperatures that it effectively insulates the two

conductors and having such a low resistance at a pre-determined higher temperature that it forms a conductor of electricity between the two conductors, a known resistance r_1 connected in series with the first of said conductors to form one arm of a balanced bridge circuit the second arm of which is formed by the resistance of the second conductor and the connection between said arms being grounded, the third arm of said bridge being formed by a known resistance R in series with the second conductor and the fourth arm being formed by a resistance $R+R_1$ greater than resistance R connected in series with the first conductor, the connection between said third and fourth arms being grounded through a source of electric energy and the resistances of the arms of the bridge when in balance having the following relation:

$$\frac{r}{r+r_1}=\frac{R}{R+R_1}$$

when only said element is subjected or responsive to temperature variation, a circuit including an operating device, a source of electric energy and means controlled by voltage across the balanced points of said bridge for maintaining said circuit de-energized when the bridge is balanced and for energizing the circuit when the bridge is unbalanced.

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