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THERMAL RELAY AND CUT-OUT

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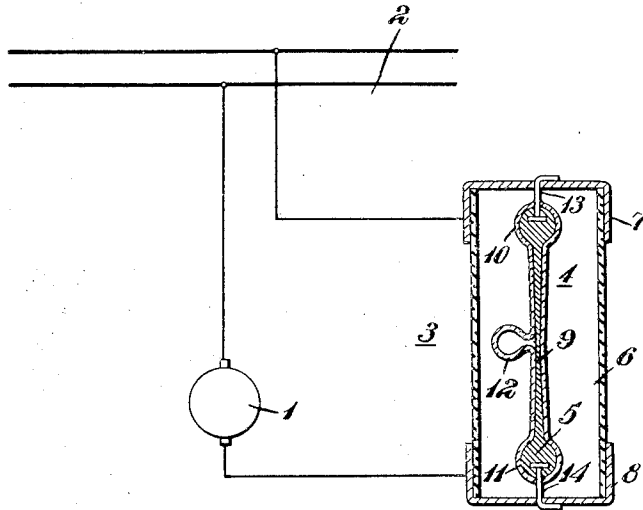


Fig. 1.

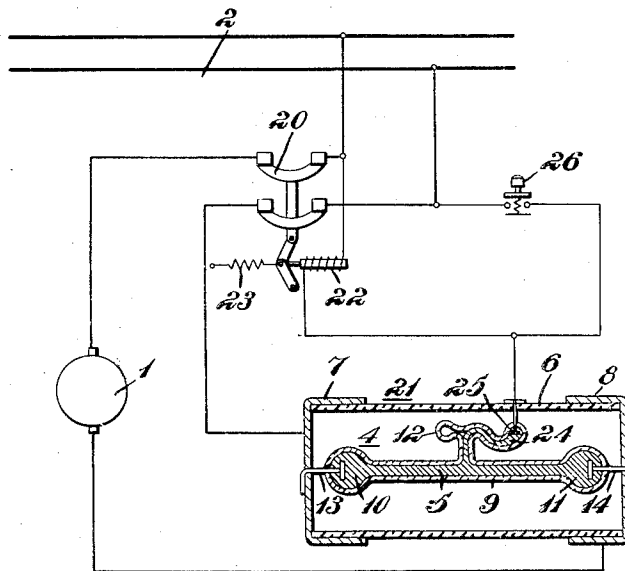


Fig. 2.

WITNESSES:

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NIELS K. ANDERSEN, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

THERMAL RELAY AND CUT-OUT.

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To all whom it may concern:

Be it known that I, NIELS K. ANDERSEN, a subject of the King of Denmark, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Thermal Relays and Cut-Outs, of which the following is a specification.

My invention relates to relays and particularly to thermal relays and cutouts.

One object of my invention is to provide a thermal relay or cutout comprising a thermal element that has a negative coefficient of expansion.

Another object of my invention is to provide a protective device, of the above-indicated character, in which the thermal element decreases in volume at its fusing temperature.

Another object of my invention is to provide a protective device, of the above-indicated character, in which the thermal element ruptures an electric circuit.

A further object of my invention is to provide a protective device, of the above-indicated character, that may be readily inserted in fuse-terminal clips of standard type, and that shall be relatively simple and inexpensive in construction and reliable in operation.

In practicing my invention, I provide a tubular member of insulating material containing a conducting material, such as bismuth, which decreases in volume at its fusing temperature. The tubular member is enclosed in a casing of non-conducting material, such as is ordinarily employed with standard fuses, to retain the heat from the current-heated bismuth. Metallic ferrules, disposed at each end of the casing and electrically connected to the bismuth, provide means whereby the relay may be readily inserted into an electrical circuit.

Figure 1 of the accompanying drawings is a diagrammatic view of an electrical circuit containing a device embodying my invention, and

Fig. 2 is a diagrammatic view of an electrical circuit containing a modified form of protective device embodying my invention.

In Fig. 1, a motor 1 receives energy from a source 2 of electromotive force and is controlled by a protective device 3.

The protective device 3 comprises a tubu-

lar member 4 containing a conducting material 5, such as bismuth, that is adapted to decrease in volume at its fusing temperature. The protective device further comprises an enclosing casing 6 and end ferrules 7 and 8.

The tubular member 4 comprises a capillary tube 9, two end bulbs 10 and 11, an auxiliary bulb 12 that is disposed intermediate the end bulbs 10 and 11, and a plurality of terminal members 13 and 14 that are respectively disposed in the bulbs 10 and 11. The terminal members 13 and 14 are soldered to the end ferrules 7 and 8. The portion of the capillary tube 9 adjacent the bulb 12 is slightly constricted.

The portion of the tubular member 4 between the terminal members 13 and 14 is filled with bismuth or other suitable material, and the auxiliary bulb 12 contains a non-conducting fluid, such as air or other gas. As current traverses the motor and the protective device 3, the bismuth 5 becomes heated in accordance with the value of such current and attains a temperature corresponding substantially to the temperature of the motor 1. Undue dissipation of heat from the heated bismuth is precluded by the enclosing member 6, and the temperature within the protective device 3 thus tends to correspond to substantially the temperature within the motor 1.

As the temperature of the bismuth increases, the temperature of the fluid within the auxiliary bulb correspondingly increases, and, as the portion of the bismuth opposite the bulb 12 begins to fuse, because of the relatively greater resistance at that part of the tube, the increased pressure of the fluid within the bulb 12 tends to decrease the cross-sectional area of the bismuth at that point. The resistance of the bismuth is thus increased at that portion of the path and the heating becomes so concentrated that the bismuth fuses more rapidly at this portion until the cross-sectional area becomes further decreased and the continuity of the bismuth column is finally broken.

The motor 1 is thus protected from overheating and, until the bismuth column is re-established, the motor cannot be reconnected to the circuit 2.

The device shown in Fig. 1 is applicable

to motors having a small current-carrying capacity of such value as may be directly interrupted by a cutout of the type that is described.

5 In Fig. 2 is illustrated a relay of the type that is employed for the protection of electrical apparatus of large current-carrying capacity. The motor 1 receives energy from
10 a source 2 of electromotive force through a circuit interrupter 20, the operation of which is controlled by means of a thermal relay 21.

The interrupter 20 is provided with a holding coil 22 that maintains the interrupter closed against the tension of a spring 23 while the coil is energized. Upon the de-energization of the coil 22, the interrupter is opened by the spring 23. The circuit of the holding coil 22 is controlled by the
20 thermal relay 21, being opened thereby upon the occurrence of abnormal heating conditions within the motor 1.

The relay 21 comprises elements that are similar to those of the relay 3 shown in
25 Fig. 1, and, in addition thereto, an auxiliary capillary tube and bulb portion 24 containing a smaller thread of bismuth and a terminal member 25 that is disposed therein.

As the temperature of the bismuth in the
30 tubular member 9 and, consequently, in the auxiliary portion 24 attains a predetermined value, the fluid within the auxiliary bulb 12 acts upon the small-thread portion of bismuth within the auxiliary portion 24 and
35 interrupts the continuity of that portion in a manner similar to that described above in connection with the device shown in Fig. 1. The circuit of the holding coil 22 is thereupon interrupted and the interrupter per-
40 mitted to open.

When the bismuth re-solidifies, the circuit between the contact members 25 and 13 and 14 is re-established and the holding coil 22 may be re-energized by means of a push-
45 button switch 26 to effect the re-closing of the interrupter 20. When the interrupter 20 is reclosed, the circuit of the holding coil is re-established through the contact members of the interrupter 20, and the push-
50 button switch 26 may be released.

My invention is not limited to the specific arrangement of the apparatus that is illustrated in the accompanying drawings but may be variously modified within the spirit
55 and scope of my invention, as set forth in the appended claims.

I claim as my invention:

1. A thermal relay comprising a closed receptacle containing a conducting material
60 that decreases in volume at its fusing point and means responsive to the temperature thereof for controlling the conductivity of a portion of the material.

2. A receptacle for a thermal-responsive

element of a thermal relay comprising a tu-
65 bular member embodying a bulb at each end thereof and an auxiliary bulbous portion intermediate the ends of the tubular member and communicating with the open-
70 ing through the tubular member, and terminal members in each bulb to be connected to an external circuit.

3. A thermal relay comprising a tubular container, an electrically conducting heat-responsive material therein, terminal mem-
75 bers arranged to include the whole length of the material in circuit therewith and an auxiliary terminal member communicating with the heat-responsive material at a point intermediate the afore-mentioned terminal
80 members.

4. A self-resetting thermal protective device for an electric circuit comprising an element heated in accordance with the cur-
85 rent traversing the circuit and means in direct contact with and directly thermally controlled by said element to cause the element to open a predetermined circuit.

5. A thermal relay comprising a closed receptacle containing a conducting material
90 that decreases in volume at its fusing point, and means associated with said conducting material for causing said decrease in volume to be effected at a predetermined portion of
95 said conducting material.

6. A thermal relay comprising a closed receptacle of electric-insulating material and containing an electric-conducting ma-
100 terial that decreases in volume at its fusing point, and means operatively associated with said electric-conducting material and responsive to the temperature thereof for causing said decrease in volume to be ef-
105 fected at a predetermined portion of said conducting material.

7. A self-resetting thermal protective device for an electric circuit comprising an elongated element that decreases in volume
110 at its fusing point and that is heated in accordance with the current traversing the circuit, and means associated with said element and directly heated thereby to effect
115 fusion thereof at a predetermined point only whereby to open a predetermined circuit.

8. A self-resetting thermal protective device for an electric circuit comprising an elongated current-conducting element that
120 decreases in volume at its fusing point, and means associated therewith and directly heated thereby to effect fusion thereof at a predetermined point only to cause the element to open a predetermined circuit.

In testimony whereof, I have hereunto
125 subscribed my name this first day of August 1921.

NIELS K. ANDERSEN.