L. E. WARNER.

THERMAL RELAY.

APPLICATION FILED FEB. 1, 1918.

1,429,660. Patented Sept. 19, 1922.

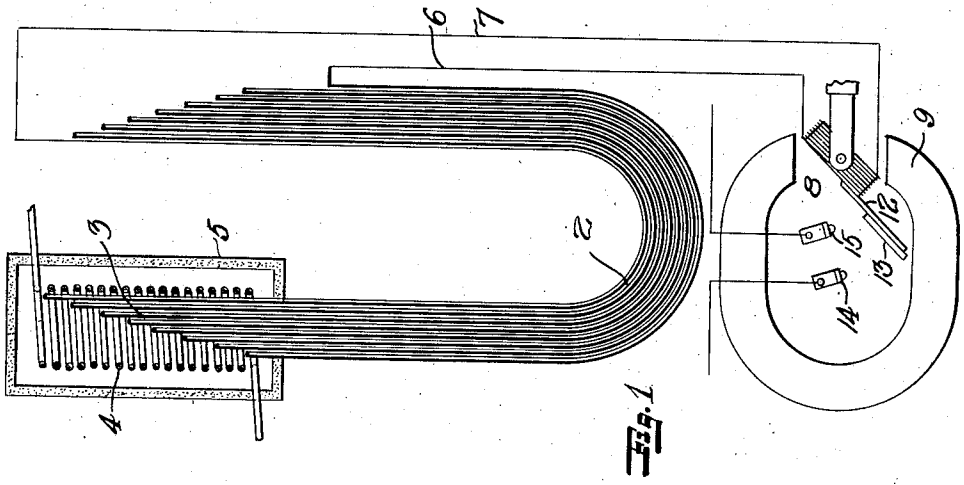


Fig. 1.

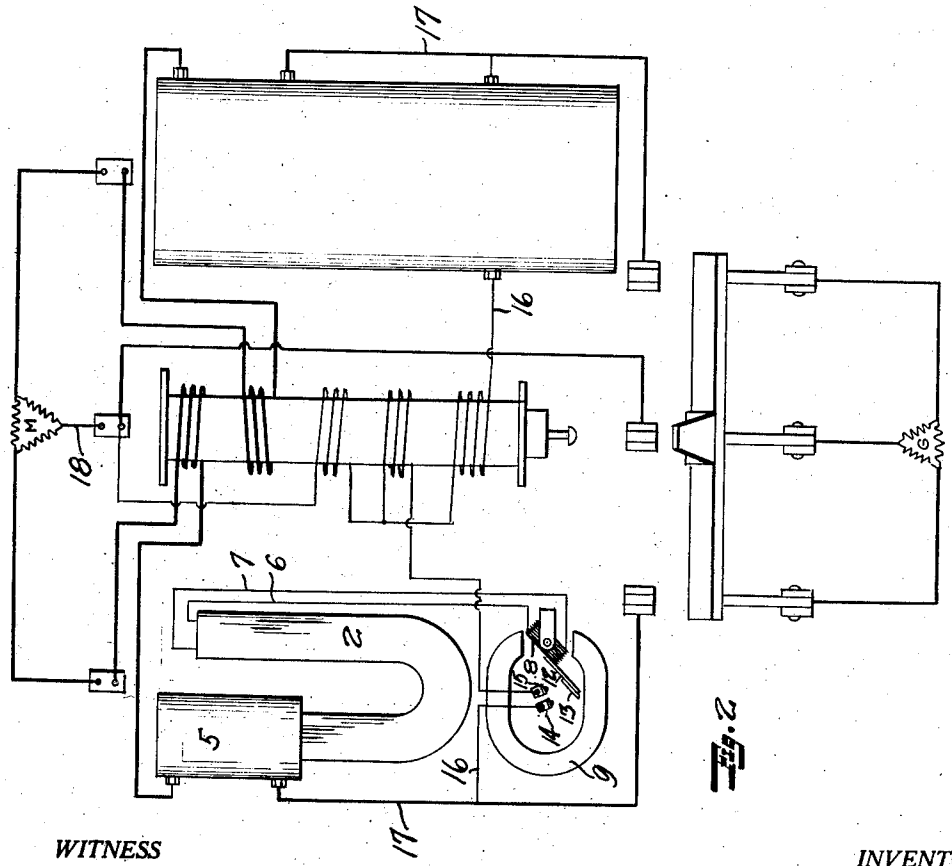


Fig. 2.

WITNESS

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ATTORNEYS

Patented Sept. 19, 1922. 1,429,660

UNITED STATES PATENT OFFICE.

LAWRENCE E. WARNER, OF BERKELEY, CALIFORNIA, ASSIGNOR TO MOTOR PROTECTOR MANUFACTURING COMPANY, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

THERMAL RELAY.

Application filed February 1, 1918. Serial No. 214,912.

To all whom it may concern:

Be it known that I, LAWRENCE E. WARNER, a citizen of the United States, and a resident of Berkeley, county of Alameda, and State of California, have invented a certain new and useful Thermal Relay, of which the following is a specification.

The invention relates to devices which are operated by variations in temperature to close or open an electric circuit.

An object of the invention is to provide a self-contained thermal relay.

Another object of the invention is to provide a relay which is operated by current generated within the relay, the amount of current generated being proportional to the temperature variations.

The invention produces other advantageous features, some of which, with the foregoing, will be set forth at length in the following description where I shall outline in full, that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown one form of the relay of my invention, but it is to be understood that I do not limit myself to such form, since the invention as expressed in the claims may be embodied in a plurality of forms.

Referring to said drawings:

Figure 1 is a diagrammatical representation of the relay of my invention.

Figure 2 is a diagrammatical representation of the relay of my invention associated with a solenoid operated electric switch.

The relay of my invention may be employed for a plurality of purposes and its showing in connection with a solenoid operated switch is merely indicative of one of its uses. The relay consists of a thermopile, the opposite ends of which are subjected to different temperatures, whereby a current is generated, and a dynamo electric machine, preferably constructed in the same manner as a moving coil galvanometer, in which the generated current is utilized to produce motion, the motion serving to open or close an electric circuit.

The thermopile 2 is formed of a plurality of strips of different metal arranged alternately in series and so disposed that the alternate junctures of the two metals are bunched together. Any two dissimilar metals in the thermo-electric scale may be used, such as bismuth and antimony, German-silver and iron, copper and iron, etc. The strips of metal, which are soldered, welded, or otherwise connected together in series, are disposed so that the alternate junctures are grouped together, forming two groups of junctures, spaced from each other. By producing a different temperature at one group of junctures than at the other, a current is generated in the thermopile.

Surrounding or otherwise arranged adjacent one group 3 of junctures is a heating element, preferably in the form of a coil 4, which when the relay is used in connection with an electric motor or other electric apparatus, is arranged in series in the current lead, so that the same current which passes through the motor, passes through the heating coil. The heating coil is surrounded with a jacket 5 of heat-insulating material and the size of the wire in the coil and the heat insulating qualities of the jacket are such that the temperature of the enclosed end of the thermopile corresponds directly with the temperature of the hottest portion of the motor. The current generated in the thermopile, therefore, increases in proportion to the increase in temperature of that portion of the motor windings which have the least heat emissivity. The other group of junctures of the strips in the thermopile are preferably exposed to the air so that for the purpose of operation the temperature of that group may be considered as constant.

Connected to the two strips at the extremes of the thermopile are the conductors 6—7 which connect the thermopile with the low resistance rotatable coil 8. The coil 8 is preferably mounted for rotation about a horizontal axis which lies in the path of the flux from the permanent magnet 9. Secured to the coil is an arm 12 carrying the contact 13 at its outer end and the arm normally holds the coil at an angle to the lines of force of the magnet. The arm is also normally inclined to the horizontal, so that the force required to raise the arm increases as it approaches the horizontal. When current flows in the coil the axis of the coil tends to aline itself with the lines of force, causing the coil to swing and raise the arm. Arranged adjacent the contact 13

and in position to be engaged thereby when the arm is raised, are the separated contacts 14—15. The contacts 14—15 are so positioned with relation to the arm that when the maximum permissible temperature is reached in the motor or other electric apparatus the current generated in the thermopile is sufficient to cause the coil to rotate sufficiently to bring the contact 13 into engagement with the contacts 14—15. The spaced contacts 14—15 are arranged in the solenoid circuit and when the circuit is closed at the contacts, the solenoid is energized, the switch holding latch is released, and the switch springs open, breaking the motor circuit. In Figure 2 I have shown the relays of my invention used for protecting a three-phase motor against overheating. For this purpose, two relays are provided, either or both of which may operate to close the solenoid circuit. The conductor 16, in which the contacts 14—15 are arranged, is connected to the feed wire 17 and to the solenoid coil, and the solenoid coil is connected at its other end to the feed wire 18.

I claim:

1. A protective device for an electric circuit, comprising a heating element in said circuit, means operative by an increase in temperature of the heating element for generating an electric current, and means operative by an increase in said current to a predetermined magnitude to open said circuit.

2. A protective device for an electric circuit containing electrical apparatus, comprising a thermopile, a heating element in circuit with said apparatus and arranged adjacent one end of the thermopile, and means operative by the current generated in the thermopile for opening said circuit.

3. The combination with an electrical apparatus, of a heating element arranged to produce a temperature corresponding to the temperature in a selected portion of the apparatus, means for generating a current in accordance with the heat produced by said element, and means operative by the generated current for precluding a further temperature rise above a predetermined value in said selected portion.

4. The combination with an electrical apparatus, of current generating means in which the current generater varies with the temperature of a selected portion of the apparatus, and means operative by the generated current for precluding a further temperature rise above a predetermined value in said selected portion.

5. The combination with an electrical apparatus, of means for generating a current in accordance with the heating of said apparatus, and means operative by the generated current to open the apparatus circuit.

6. The combination with an electric current-carrying apparatus, of a heating coil traversed by the current flowing through said apparatus, means operative by the temperature produced by the heating coil for generating a current proportional to said temperature, and means operative by a generated current of predetermined value for opening the apparatus circuit.

7. A protective device for an electric circuit containing electric apparatus, comprising an element adapted to be heated in proportion to the load on the apparatus, a thermopile associated with said element, the current generated in the thermopile being proportional to the temperature of said element, and means operative by the increase of said generated current to a predetermined value for opening said circuit.

In testimony whereof, I have hereunto set my hand at San Francisco, Cal., this 7th day of January, 1918.

LAWRENCE E. WARNER.

In presence of—
H. G. PROST.