

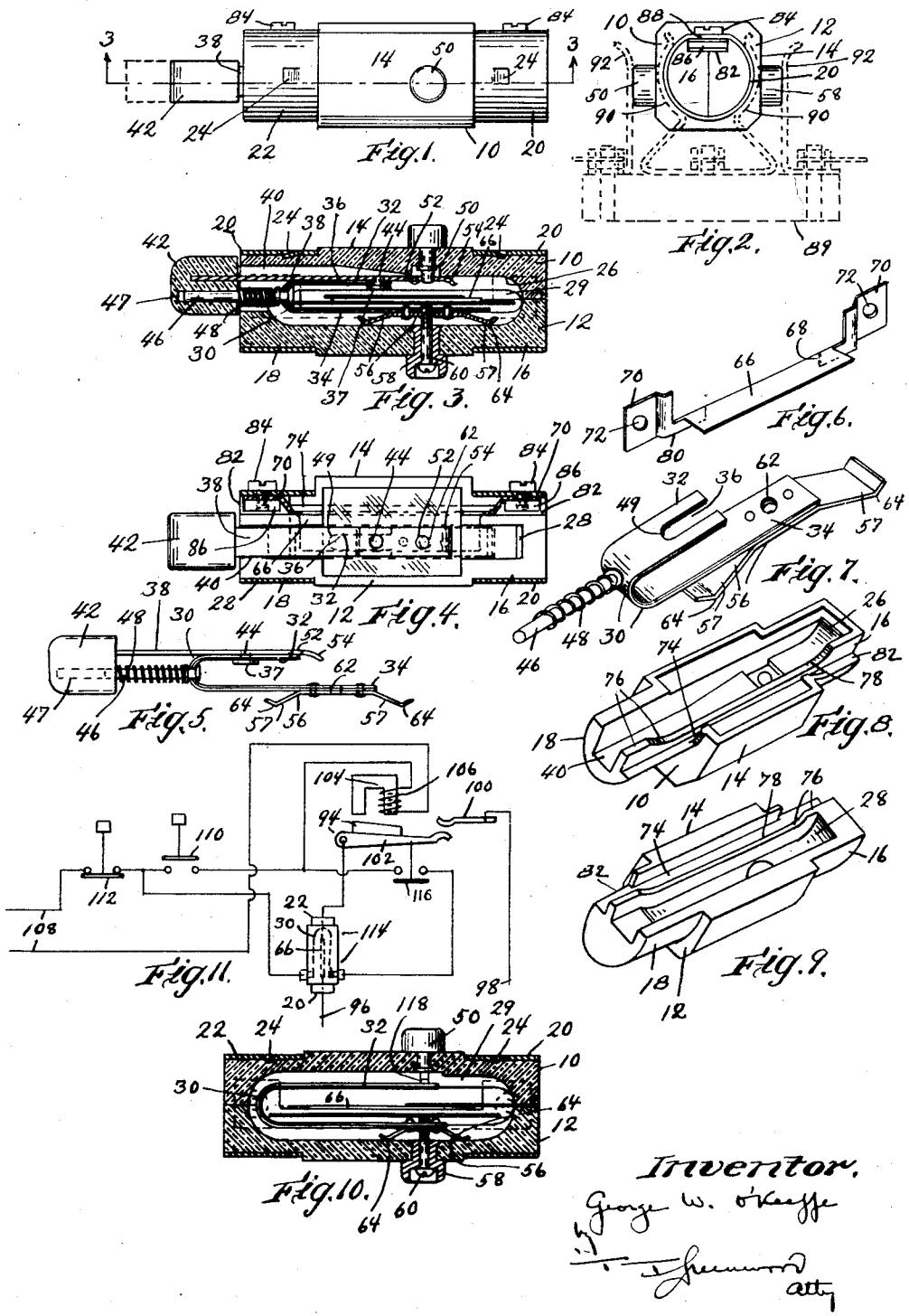
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G. W. O'KEEFFE

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## THERMORESPONSIVE DEVICE

Filed Feb. 17, 1930



## UNITED STATES PATENT OFFICE

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## THERMORESPONSIVE DEVICE

Application filed February 17, 1930. Serial No. 428,910.

This invention relates to thermo-responsive devices and especially to thermal relays of the type comprising an electrically heated expansible element that operates to control an electric circuit which, usually, is the control or pilot circuit for an electrically operated circuit interrupter, and a heating element for heating said expansible element that is included or is responsive to overload currents in the power circuit, as a motor circuit, which is controlled by said circuit interrupter.

One of the objects of the invention is the provision of an improved thermal relay of the tubular or cartridge type wherein the casing is divided longitudinally into two sections, one of which sections provides a support for the thermally expansible member and a movable contact member associated therewith and the other of which sections carries the cooperating fixed contact member.

A further object of the invention is the provision of a thermally expansible member having a movable contact member associated therewith which is biased for movement into a position in which it projects from the casing, and having resetting means for said contact member disposed outside the casing and also having the contact biasing means therefor disposed largely externally of the casing.

A further object of the invention is the provision of a thermo-responsive device having preferably a bimetallic thermo-responsive member that has reflexed portions, and wherein in the heating element therefor is located between the reflexed portions and is in heat-transferring relation with both portions.

A yet further object of the invention is the provision of a thermal relay having a thermally expansible element and an electrical circuit which is located closely ad-

member and having a longitudinal heat-radiating grid portion disposed along and between the arms of said thermally expansible member.

A yet further object of the invention is the provision of a thermal relay including a U-shaped thermally expansible member having a spring urged movable contact member slidably supported thereon, and a heating element having a grid for heating said expansible element disposed between the spaced arms of said expansible element, the spring for urging said movable contact being located externally of said U-shaped member.

A still further object of the invention is generally to improve the construction and operation of thermal relays.

Fig. 1 is a side elevation of a thermal relay embodying the invention.

Fig. 2 is an end elevation of the relay and the supporting base therefor.

Fig. 3 is a longitudinal sectional elevation of the relay along line 3—3 of Fig. 1.

Fig. 4 is a longitudinal sectional view of the relay taken along the line of division of the two casing sections.

Fig. 5 is a detail showing the U-shaped expansible member, the movable contact member carried thereby and the resetting means for the movable contact member.

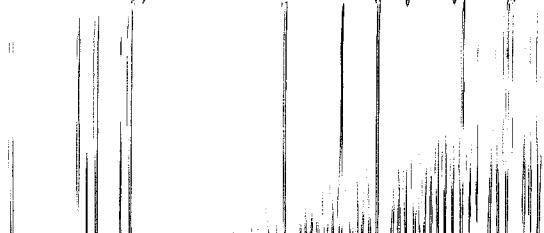
Fig. 6 is a perspective view of the heating element.

Fig. 7 is a perspective view of the thermally expansible element.

Figs. 8 and 9 are perspective views of the two casing sections.

Fig. 10 is a modified form of relay adapted for automatically resetting when it has operated.

Fig. 11 is a single phase wiring diagram illustrating the manner of associating the re-



lay with the power circuit and the electric switch.

The relay here shown includes a generally tubular enclosing casing of the so-called cartridge type consisting of two complementary insulating sections 10 and 12 which en-

close the expansible member, but is electrically isolated therefrom; and, more specifically, to provide a relay of the cartridge type having an expansible member comprising a flat strip which is bent back upon itself to

the switch again completes the auxiliary circuit through the protective relay.

The modified form of thermal relay illustrated in Fig. 10 is essentially the same as that above described except that it lacks the movable contact plate 38 and the resetting means therefor and is arranged automatically to re-establish the auxiliary circuit after the relay has operated. To this end, the upper leg 32 of the thermally expansible element extends beneath the fixed contact member of the upper casing section, and is provided with a contact member 118 which operates with the fixed contact member 50. As the thermally expansible element 30 becomes heated, the leg 32 thereof is adapted to flex downwardly and away from the contact member 50 to break the auxiliary circuit. When the thermally expansible element has become sufficiently cool it will flex in the opposite direction and will again make contact with the fixed contact member 50.

Some of the features of the relay herein described are described and claimed in my co-pending application, Serial No. 364,149, filed May 18, 1929.

Various modifications may be made in the construction and arrangement of the parts without departing from the scope of the invention.

I claim:

1. A thermal relay including an insulating enclosing casing having end terminals and a pair of intermediate terminals, a U-shaped thermally expansible element having spaced parallel legs normally connecting said intermediate terminals, a heating element electrically connecting said end terminals and located alongside said expansible element, said heating element having a grid portion extended laterally therefrom and disposed between the arms of said U-shaped expansible element.

2. A thermal relay including an insulating enclosing casing having end terminal members and intermediate terminal members, a U-shaped thermally expansible element normally connecting electrically the intermediate terminal members, a heating element for said expansible element electrically connecting the end terminal members and disposed alongside and closely adjacent said expansible element, said heating element having an angularly related grid portion which is disposed between the parallel arms of said U-shaped expansible element.

3. A thermal relay including an insulating enclosing casing having end terminal members and intermediate terminal members, a U-shaped thermally expansible element normally connecting electrically the intermediate terminal members, a heating element for said expansible element electrically connecting the end terminal members and disposed alongside and closely adjacent said expansible

element, said heating element having an angularly related grid portion which is disposed between the parallel arms of said U-shaped expansible element, and insulating means disposed between the grid portion of said heating element and the inner surface of said U-shaped expansible element.

4. A thermal relay including an insulating enclosing casing, ferrules comprising line terminals of the relay carried by the ends thereof, opposed terminal studs extended through opposite walls of said casing comprising auxiliary circuit terminals, a U-shaped thermally expansible element having one end thereof electrically connected with one of said auxiliary studs and having its outer and free end normally electrically connected with the other of said auxiliary studs, a heating element for said thermally expansible element comprising a strip of resistance metal which is located alongside said expansible element and is electrically connected at its end with said line terminal ferrules, said heating element having a struck-out angularly-related grid portion along the length thereof which is disposed between the parallel arms of said U-shaped expansible element.

5. A thermal relay including an insulating enclosing casing having end ferrules comprising line terminal members, and auxiliary terminals located intermediate said line terminals on opposite sides of said casing and electrically insulated from said line terminals by said casing, a U-shaped thermally expansible element having one leg thereof electrically connected at one end with one of said intermediate terminal members and having the similar end of its other leg normally electrically connected with the other of said intermediate terminal members, a heating element for said thermally expansible element including a strip of resistance material electrically connected between said end ferrules and located alongside said U-shaped expansible member, said heating element having a struck-out grid portion which extends longitudinally thereof and which is disposed in alignment with and between the U-shaped legs of said expansible element.

6. A thermal relay including an insulating enclosing casing having main end terminals and oppositely disposed auxiliary terminals located between said end terminals and insulated therefrom, a thermally expansible element including a U-shaped bimetallic strip having flat parallel top and bottom legs, a heating element comprising a strip of resistance material located alongside said U-shaped expansible element and connected electrically between said end terminal members, said heating element having a flat grid portion laterally extended therefrom and disposed between and parallel with the flat legs of said thermally expansible element.

7. A thermal relay including an insulat-

ing enclosing casing having end terminal members comprising the main line terminals of the relay, and oppositely disposed intermediate terminal members comprising auxiliary circuit terminals of the relay, a U-shaped thermally expansible element having flat parallel legs one end of which element is fixedly electrically connected with one of said intermediate terminal members and the other and free end of which is detachably electrically connected with said other intermediate terminal member, a heating element for heating said expansible element electrically connected between said end terminals comprising a strip of resistance material disposed alongside said expansible member and in a plane normal to the flat legs thereof, said heating element having a laterally extended grid portion which is disposed between and parallel with the flat legs of said thermally expansible element.

8. In a thermal relay, an enclosing casing, separable contact members located therein, means including a U-shaped thermally expansible element arranged to control the engagement and separation of said contact members, a heating element having a grid disposed between the U-shaped legs of said expansible element, and means including a resetting member located externally of said casing to effect the reengagement of said contact members after they have separated.

9. In a thermal relay, an enclosing casing, separable contact members located therein, means including a U-shaped thermally expansible element arranged to control the engagement and separation of said contact members, a heating element disposed alongside and closely adjacent said expansible element and having a grid portion extended laterally therefrom and disposed between the legs of said U-shaped expansible element, and means including a resetting member which is located externally of said casing arranged to effect the resetting of the contact members after they have operated.

10. In a thermal relay, an enclosing casing, separable contact members located therein, means including a U-shaped thermally expansible element arranged to control the engagement and separation of said contact members, a heating element disposed alongside and closely adjacent said expansible element and having a grid portion extended laterally therefrom and disposed between the legs of said U-shaped expansible element, and means including a resetting member which is located externally of said casing arranged to effect the resetting of the contact members after they have operated and means normally biasing said resetting member into a contact separated position thereof.

11. In a thermal relay, an enclosing casing, a fixed contact member located in said casing, a U-shaped thermally expansible ele-

ment located in said casing and fixed at one end to said casing, said expansible element having a movable contact member at its other and free end, said contact member having means normally holding it in engagement with said fixed contact member, means carried by said expansible element normally biasing said movable contact member into a contact separating position, means including a resetting member located externally of said casing arranged to effect the re-engagement of said contact members after they have operated, and a heating element disposed alongside said expansible element and having a grid portion thereof located between and parallel with the flat legs of said expansible element.

12. In a thermal relay, an enclosing casing, separable contact members located therein, means including a U-shaped thermally expansible member arranged to control the engagement and separation of said contact members, and a heating element including a flat strip of resistance material having a longitudinal struck-out portion along one side thereof which is angularly-related to the plane of said strip and having a longitudinal cut away portion along the opposite side thereof which is shorter than said struck-out portion, said struck-out portion adapted to lie between the spaced parallel legs of said U-shaped expansible element.

13. In a thermal relay, the combination of an enclosing casing, a fixed contact member carried thereby, a U-shaped thermally expansible member having a support at one end of said casing and having a contact member at its other end which is movable into and out of engagement with said fixed contact member, said movable contact member having an extension which is located externally of said casing when said contact members are separated, means including a resetting member carried by said extension externally of said casing, and a compression spring having one end in engagement with said resetting member and its other and opposite end in engagement with said expansible element and constantly biasing said movable contacts for disengagement from said fixed contact.

14. In a thermal relay, the combination of an enclosing casing, a fixed contact member carried thereby, a U-shaped thermally expansible member having a support at one end on said casing and having a contact member at its other end which is movable into and out of engagement with said fixed contact member, said movable contact member having an extension which is located externally of said casing when said contact members are separated, means including a resetting member carried by said extension externally of said casing, and a compression spring having one end in engagement with

said resetting member and its other and opposite end in engagement with said expansible element and constantly biasing said movable contact for disengagement from said fixed contact, and means including a stud fixed to said thermally expansible member and slidably extended into a recess in said resetting member, for retaining said spring in position.

10 15. In a thermo-responsive device, the combination of a flat bimetallic thermally-expansible strip having a pair of spaced thermally-expansible sections disposed in generally parallel relation with their flat faces confronting each other and connected and spaced by an intermediate reflexed portion, and a heater element therefor comprising a flat strip of resistance material which is disposed perpendicularly to said flat bimetallic strip and is located beside the similar edges of said expansible sections and extends lengthwise of said sections and has an intermediate heater section that is reflexed at right angles to said heater strip and is located between and extends longitudinally of said expansible sections and confronts the flat faces of both of said sections.

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In testimony whereof, I have signed my name to this specification.

30 GEORGE W. O'KEEFFE.

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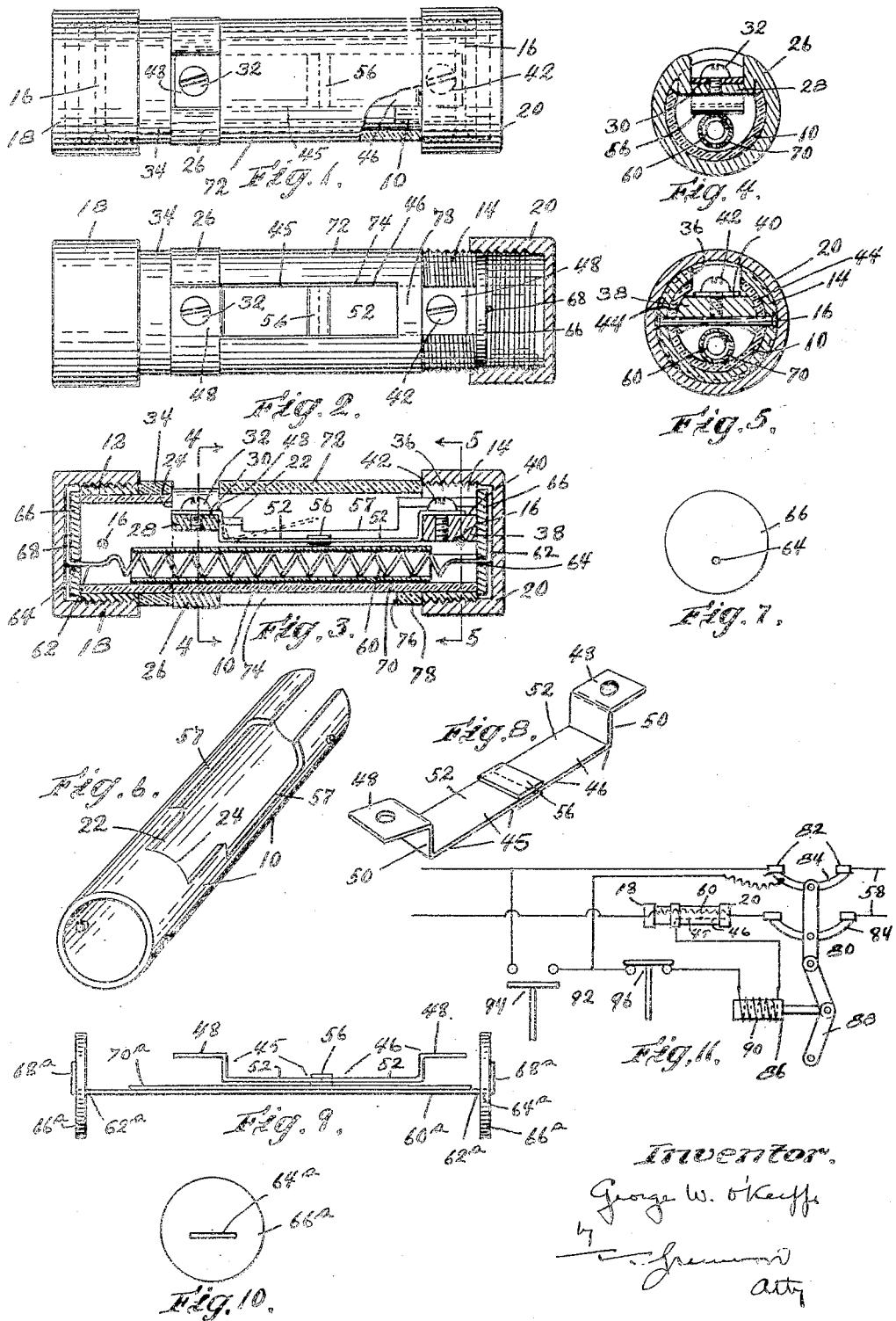
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#### THERMAL RELAY AND CUT-OUT

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