Oct. 28, 1924. 1,513,247

H. D. JAMES

ELECTRICAL PROTECTIVE DEVICE

Filed July 5, 1919

Fig. 1.

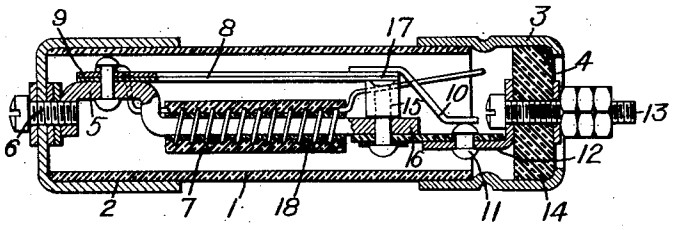


Fig. 2.

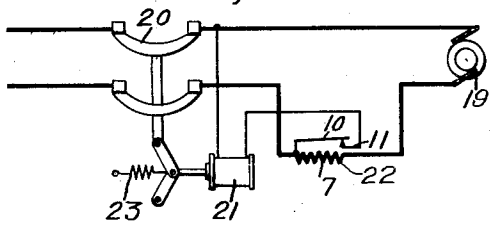


Fig. 3.

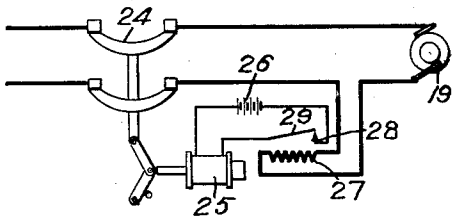


Fig. 4

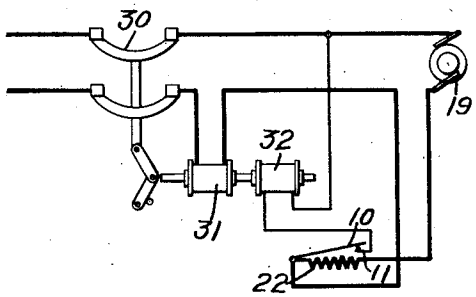


Fig. 5.

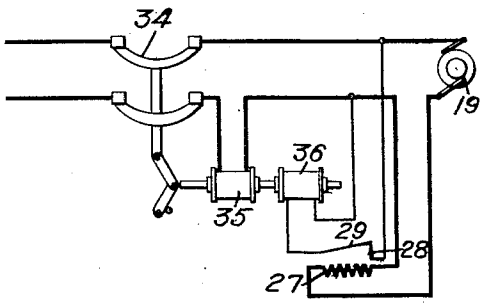
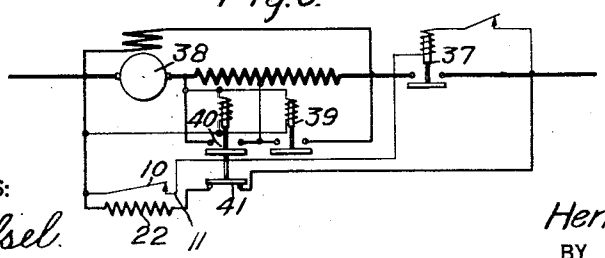


Fig. 6.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL PROTECTIVE DEVICE.

Application filed July 5, 1919. Serial No. 308,723.

To all whom it may concern:

Be it known that I, HENRY D. JAMES, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Protective Devices, of which the following is a specification.

My invention relates to electrical protective devices and particularly to thermal relays.

One object of my invention is to provide a thermal relay that shall have sufficient time interval in the operation thereof to effect protection of electrical apparatus against overloads.

Another object of my invention is to provide a thermal relay, of the above indicated character, that shall have means whereby the contact members thereof are quickly actuated under predetermined conditions.

A further object of my invention is to provide a relay, of the above indicated character, that shall be adapted to be used in ordinary standard cartridge-type fuse clips, be relatively inexpensive to construct and reliable and effective in its operation.

In practicing my invention, I provide an enclosed cylindrical casing having connecting ferrules at the ends thereof to be received in the ordinary cartridge-type fuse clips. A magnetizable member is disposed in the receptacle and is surrounded by a heat-lagged winding that is adapted to be connected in circuit with the apparatus to be protected. A bimetallic member is disposed adjacent the winding and is normally so attracted by the magnetizable member as to maintain the co-operating contact members closed. The winding and the magnetizable member have such heat-storage and heat-radiating capacity as to require a predetermined interval of time after the winding is traversed by a predetermined current before the contact members are disengaged. Since the magnetizable member normally attracts the bimetallic member, the disengagement of the contact members will be effected with a snap action. The time lag in the operation of the device is of such value as to adequately protect the apparatus to which it is connected. Of course, the ideal case would be to cause the winding to have the same temperature characteristics as the apparatus to be protected but, for commercial reasons, this is impracticable and, consequently, the winding is so heat-lagged as to provide a safe time limit, and approaches nearly the temperature gradient of the apparatus to be protected. The device is easily installed in standard fuse clips and may be used to open or close a circuit as desired to control a tripping magnet or other circuit controlling device.

Figure 1 of the accompanying drawings is a detail sectional view of a thermal relay embodying my invention, and Figs. 2, 3, 4, 5 and 6 are diagrammatic views of electrical circuits illustrating the application of my invention for protection thereof.

A cylindrical casing 1 is provided with a ferrule 2 at one end and a ferrule 3 having an opening 4 therein at the other end thereof. A magnetizable member 5 is secured by a screw 6 to the ferrule 2, and is surrounded by a winding 7 one terminal of which is connected to the member 5 and the other terminal of which is connected to the ferrule 3. A bimetallic member 8 is secured at one end 9 to the member 5 and is provided with a contact member 10 at the other end thereof that is adapted to engage a stationary contact member 11 which is mounted on a member 12. The member 12 is secured by a screw 13 to an insulating member 14 and thus is maintained out of engagement with the ferrule 3. A pole piece 15 is secured to one end 16 of the magnetizable member 5 and cooperates with the end 17 of the bimetallic member 8 for normally attracting the same.

The bimetallic member 8 is preferably constructed with one of its component members, of ferric material in order that it may form an armature for the magnetizable member 5. The winding 7 is heat-lagged with a covering 18 to provide sufficient time interval between the passage of current therethrough and the operation of the bimetallic member 8 to ensure that its heating characteristics follow somewhat the characteristics of the device to be protected. The magnetizable member 5 constitutes, of course, a heat-storage member and, since the member 5 and the winding 7 are disposed in the casing 1, any desired time-temperature characteristic may be obtained. When

the winding 7 has heated the member 8 to a predetermined degree, the bending moment of the member 8 will overcome the magnetic pull or attraction of the magnetizable member 15, and thus the contact member 10 will disengage the member 11 with a snap action.

Since the bimetallic member 8 comprises a ferric element as one of its component members, and is disposed to constitute a portion of the magnetic path that is energized by the winding 7, the heating of the bimetallic member 8 by the heat conducted thereto from the heat storage member 5 will be augmented by the hysteretic and eddy current losses developed therein. The bending moment of the bimetallic member 8 is therefore a function of the heating, magnetic and hysteretic effects of the current traversing the circuit.

In Fig. 2 of the drawings, a motor 19 is provided with a circuit interrupter 20 that is held in its closed position by a low-voltage coil 21. A thermal relay 22, substantially shown in Fig. 1 of the drawings, is connected to the motor and is adjusted to open the circuit of the low-voltage coil 21 and thus permit the spring 23 to open the interrupter 20 whenever a predetermined load traverses the motor 19 for a predetermined period of time. This period of time is, of course, controlled by the temperature gradient of the motor and its facility for cooling. However, for commercial reasons, it is not believed desirable to have the device 22 exactly represent the heating characteristic of the motor 19, but to be just sufficiently time-lagged to ensure that the interrupter 20 will not be opened on a momentary disturbance such as when the motor is started but only on sustained overloads which if not removed would cause overheating.

In Fig. 3 of the drawings, the motor 19 is provided with a circuit interrupter 24 having an overload trip coil 25, the circuit of which is adapted to be closed through a source 26 of electromotive force by a modified form of relay 27 embodying my invention. That is, the relay 27 is adapted to close its contact members 28 and 29 a predetermined interval of time after a predetermined overload traverses the motor 19.

In Fig. 4 of the drawings, the motor 19 is protected by a circuit interrupter 30 having an overload trip coil 31 and a shunt coil 32 that normally oppose each other. The thermal relay 22 is connected in circuit with the relay 32 and thus opens the circuit of the relay 32 only when an overload has traversed the motor 19 for a predetermined period of time. With this arrangement, direct series tripping of the interrupter 30 may be obtained.

In Fig. 5 of the drawings, the circuit interrupter 34 is provided with an overload trip coil 35 and a shunt trip coil 36 that are adapted to trip the interrupter only when both are energized. In this instance, the thermal relay 27 is provided with contact members 28 and 29 which are adapted to be closed only when an overload traverses the motor 19 for a predetermined period of time.

In Fig. 6 of the drawings, a line switch 37 is used to protect the circuit of a motor 38. The relay 22 in this instance is connected in shunt to the motor 38 and is adapted to cause its contact members 10 and 11 to separate to thus open the armature circuit of the motor when the acceleration of the motor is prolonged for a predetermined period of time. In such systems, the switches 39 and 40 that are actuated in accordance with the counter-electromotive force fail to operate under certain conditions and when they fail to operate a predetermined period of time after the switch 37 is closed the switch 37 is automatically opened by reason of the operation of the relay 22. The switch 40 is interlocked with a switch 41 that opens the circuit of the relay 22 after the switch 40 is closed.

The relay 22 is adapted to be constructed along the general lines of a cartridge fuse and may be installed in standard cartridge-fuse clips. The mechanism of the relay is a unit and may be attached to the cartridge casing by easily removable end screws, thus permitting ease of inspection and adjustment.

My invention is not limited to the applications illustrated nor to the structure of the relay per se, as various modifications may be made therein and it may be adapted to protect various devices without departing from the spirit and scope of the invention, as set forth in the appended claims.

I claim as my invention:

1. A thermal relay for electrical apparatus comprising an enclosing casing, a bimetallic member, and means for controlling the bimetallic member comprising a heat-lagged winding connected to the electrical apparatus for heating the bimetallic member and for controlling the magnetic attracting force thereon to cause it to be actuated with a snap action when it is heated to a predetermined degree.

2. A thermal relay for a translating device comprising a magnetizable heat-storage member, means in circuit with the translating device for heating the same, a thermal-responsive member magnetically attracted by the magnetizable member and adapted to be actuated quickly under predetermined conditions.

3. A thermal relay comprising an enclosing casing having connecting ferrules at the ends thereof, a magnetizable member, a winding disposed around the magnetizable

member, a bimetallic member having a portion thereof attracted by the magnetizable member, and contact members adapted to be separated quickly when the temperature of the bimetallic member reaches a predetermined value.

4. A thermal relay for electrical apparatus comprising an enclosing casing, a thermal-responsive device, a winding connected in circuit with the electrical apparatus, and means for precluding the operation of the thermal-responsive device until the thermal-responsive device is heated by the winding to a predetermined degree.

5. A thermal relay for electrical apparatus comprising an enclosing casing, a thermal-responsive device, a winding connected in circuit with the electrical apparatus, and means for ensuring quick operation of the thermal-responsive device when the winding has heated the thermal-responsive device to a predetermined degree.

6. A thermal relay comprising a casing, a magnetizable member therein, a heat-lagged winding disposed around the magnetizable member, a bimetallic member associated with the magnetizable member and adapted to be actuated with a snap action when a predetermined degree of heat has been imparted thereto.

7. A thermal relay comprising a casing, a magnetizable heat-storage member therein, a winding associated with the magnetizable member and operatively connected to an external translating device, and a bimetallic member, heated by the winding and normally attracted by the magnetizable member, for controlling the translating device.

8. A thermal relay for a translating device comprising an enclosing casing, a magnetizable heat-storage member therein, a winding associated therewith and traversed by the current traversing the translating device, and a thermal-responsive member associated with the magnetizable member adapted to be quickly actuated under predetermined thermal conditions therein to control the translating device.

9. A thermal relay for a translating device comprising an enclosing casing, a magnetizable heat-storage member therein, a winding associated therewith and traversed by the current traversing the translating device, and a thermal-responsive member associated with the magnetizable member adapted to be quickly actuated under predetermined load conditions to disconnect the translating device.

10. A thermal relay for electrical apparatus comprising a bimetallic actuating member, a lagged heat-storage member for heating the actuating member by conduction, a casing therefor and ferrules at the ends thereof to facilitate inserting the same in standard cartridge fuse clips.

11. A thermal relay comprising as a unit, a magnetizable heat-lagged heat-storage member and a bimetallic member secured to one end of the heat-storage member to be heated by conduction and normally magnetically held by the other end of the magnetizable member until the bimetallic member is heated to a predetermined degree.

12. A unitary device for a thermal relay comprising a magnetizable member, a winding disposed therearound and a bimetallic member secured at one end to the magnetizable member to be heated by heat conducted thereto from the magnetizable member.

13. The combination with a cartridge casing, of a unitary device therefor comprising a magnetizable heat-storage member, a winding disposed thereon and a bimetallic member secured to the magnetizable member, said unitary device being adapted to be removably secured in the cartridge casing.

14. A thermal relay for electrical apparatus, comprising a bimetallic actuating member, a heat-storage member for controlling the heating and the subsequent operation of the bimetallic member, a heating coil therefor, a casing therefor, ferrules carried on the ends of the casing to facilitate the insertion of the casing in standard cartridge-fuse clips, and electrical connections between the heating winding and the ferrules.

15. A unitary device for a thermal relay comprising a magnetizable member, a winding disposed therearound, and a bimetallic member directly secured at one end to the magnetizable member and having its other end adapted to normally close an auxiliary circuit.

16. A thermal relay for electrical apparatus comprising a heat-lagged heat-storage member, a winding therefor, a casing therefor, ferrules carried on the ends of the casing, electrical connections between the winding and the ferrules, a bimetallic member having one of its ends connected to one of said ferrules and its other end connected to an auxiliary circuit, independently of the other ferrule.

17. A thermal relay for electrical apparatus, comprising a heat-storage member, a heating winding, a casing therefor, ferrules carried on the ends of the casing to facilitate the insertion thereof in fuse clips, electrical connections between the winding and the ferrules, a thermal element having one of its ends connected to one of the ferrules and its other end normally connected to an auxiliary circuit that extends into the casing through the other ferrule.

18. A unitary device for a thermal relay comprising a magnetizable member, a winding disposed therearound and a bimetallic member directly secured to the magnetizable member at one end and controlled by the magnetizable member at its other end.

19. A protective relay for an electric circuit comprising a magnetizable heat-conducting member, a winding for heating and magnetizing the same, a bimetallic member embodying a magnetizable element, the bimetallic member being mechanically secured to one end of the heat-conducting member and being magnetically controlled by the other end of the magnetizable heat-conducting member.

In testimony whereof, I have hereunto subscribed my name this 23rd day of June, 1919.

HENRY D. JAMES.