Aug. 20, 1929. C. H. HODGKINS 1,725,518

THERMAL RELAY

Filed Feb. 20, 1926 2 Sheets-Sheet 1

Fig. 1.

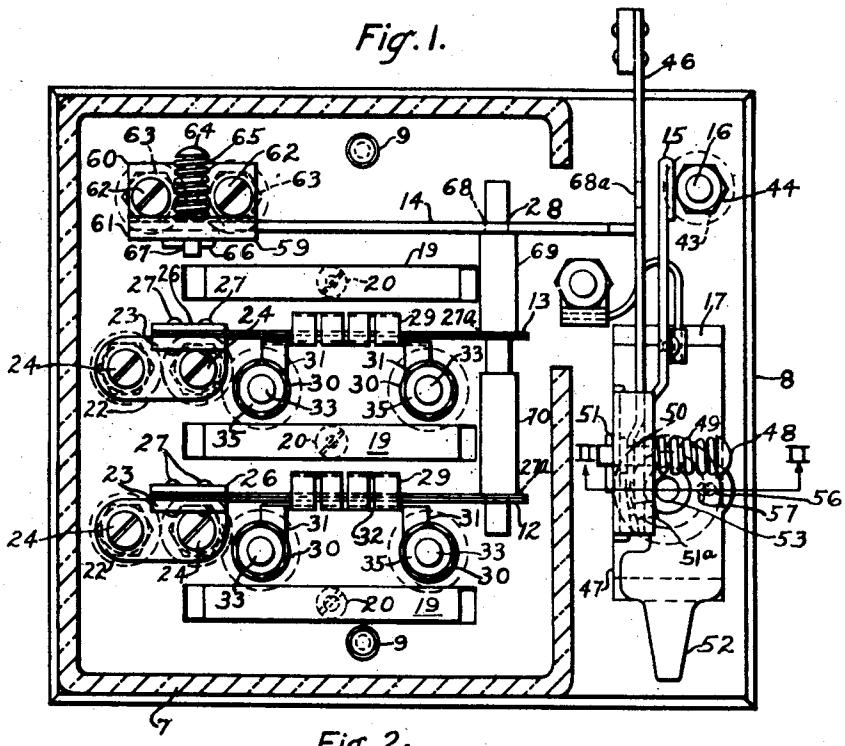
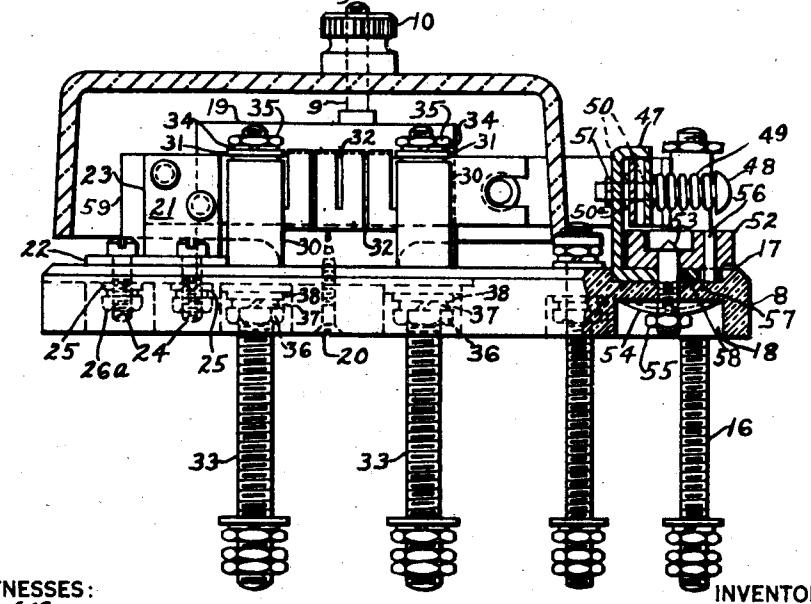


Fig. 2.



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Filed Feb. 20, 1926 2 Sheets-Sheet 2

Fig. 3.

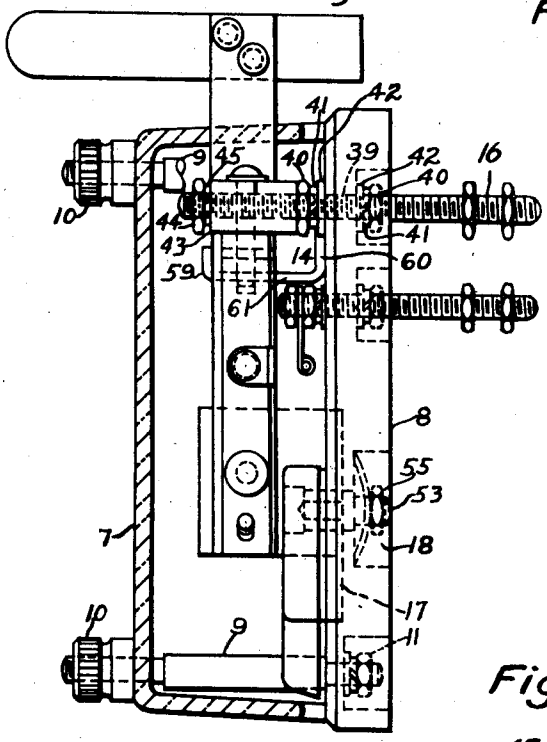


Fig. 7.

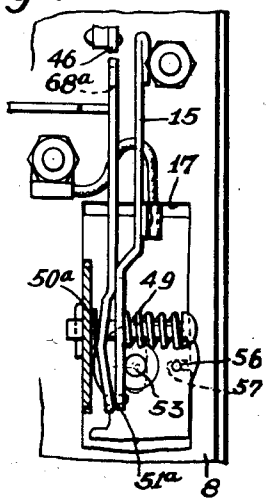


Fig. 8.

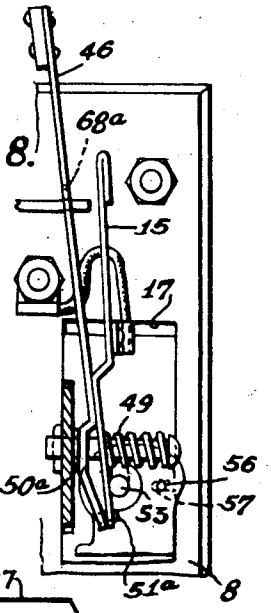


Fig. 4.

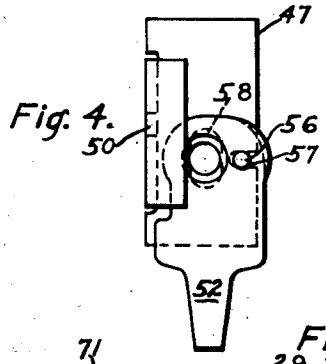


Fig. 5.

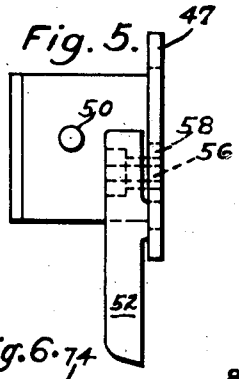
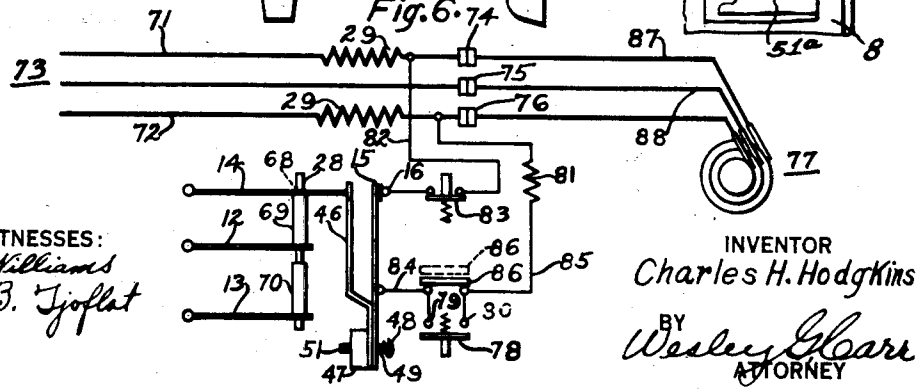


Fig. 6.



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Patented Aug. 20, 1929. 1,725,518

UNITED STATES PATENT OFFICE.

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THERMAL RELAY.

Application filed February 20, 1926. Serial No. 89,604.

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

An object of my invention is to provide a simple and compact device for electric translating apparatus that shall limit the temperatures incident to electric currents flowing therein to substantially predetermined values.

Another object of my invention is to provide adjusting means for a thermally responsive device whereby the device shall be operable at different predetermined values of temperature.

Another object of my invention is to provide individual resistors for the thermal responsive members of a thermally responsive device that shall be removable and interchangeable according to the current and thermal capacities required for the operation of said thermal responsive members.

In practicing my invention, I provide one or more thermally responsive members which may have one of their ends fixed while the other ends are free to move. I also provide a pre-shaped resistor member for each of the thermally responsive members and terminals therefor, in order that each of the resistors may be individually traversed by current to produce the thermal energy necessary to cause the thermal responsive members to operate. A pair of contact members, one of which is stationary and the other of which is movable, is also provided. An operating member is employed to transmit motion from the thermally responsive members to the contact members, whereby the movable contact member is caused to disengage the stationary contact member. The aforesaid elements are mounted on an insulating base in operative relation to each other.

In the accompanying drawing,

Figure 1 is a top plan view, partially in section, of a device embodying my invention,

Fig. 2 is an end elevational view of the device illustrated in Fig. 1 with a partial vertical section taken along the lines II—II thereof,

Fig. 3 is a side view in elevation of the device illustrated in Fig. 1,

Fig. 4 is a detail top plan view of an adjusting member.

Fig. 5 is a side view of the adjusting member,

Fig. 6 is a schematic diagram of a thermal relay embodying my invention as applied to an electrical translating device.

Fig. 7 is a partial view, partially in section, of the device illustrated in Figs. 1, 2 and 3, showing the contact members in a circuit-closing position, and

Fig. 8 is a similar view in which the contact members are in a circuit-opening position.

Referring more particularly to Figs. 1, 2 and 3 of the drawings, a thermal relay embodying my invention comprises a cover 7 that is secured to an insulating base 8 by bolts 9 and nuts 10, and 11, a pair of thermally responsive elements 12 and 13, a latch 14 and a pair of contact members 15 and 16.

The rectangular base 8 may be made of suitable insulating material, such as micarta. A groove 17 is provided in the top surface of the base 8 along one edge thereof and a second groove 18 is provided directly therebeneath in the bottom surface. A plurality of insulating barriers 19 are secured to the base 8 by screws 20. The members 19 extend laterally along the base 8 and are substantially parallel with respect to each other.

The thermally-responsive elements 12 and 13 are attached to and supported by members 21 that have integral portions 22 and 23 extending substantially at right angles to each other. The members 21 are secured to the base 8 by screws 24, which extend through the portions 22 and the base 8, washers 25 and nuts 26*a*. The members 12 and 13 are attached to the portions 23 of the members 21 by members 26 and rivets 27. The free ends of the members 12 and 13 are provided with slots 27*a* of substantially U-shape which register with a cylindrical insulating member 28.

A pair of resistors 29 are mounted on insulating members 30 and supported by the terminals 31 thereof. The resistor members 29 may be made from flat pieces of nickel chromium steel which have been punched and bent into desired shape. The particular resistor members 29 illustrated in Figs. 1 and 2 have parallel, oppositely extending slots 32 therein in order to approximate a

resistor that is relatively long and small in cross section. The flat slotted resistors are bent so as to be substantially of channel or U-shape in their final form. The ends of the flat piece of nichrome steel are bent out to form the terminals 31 thereof. The resistors 29 are secured to the insulating members 30 by bolts 33, lock washers 34 and nuts 35. The bolts 33 extend through the base 8 and the insulating members 30 and are firmly held in engagement therewith by nuts 36, lock washers 37 and washers 38.

The contact member 16 extends through the base 8 at 39 and is provided with nuts 40, lock washers 41 and washers 42 for holding it firmly in place. A carbonaceous cylinder 43 is provided to fit over the contact member 16 which extends upwardly above the base member 8 to engage the contact member 15. Nuts 44 and a washer 45 are provided to hold the cylinder 43 securely in place.

The contact member 15 is actuated by a bar 46. The members 15 and 46 are attached to a movable member 47 by a bolt 48 which has a spring 49 mounted concentric therewith. The holding member 46, the movable member 47, and the contact member 15 are provided with coaxial holes 50 through which the bolt 48 is inserted. A washer 50*a* is located on the bolt 48 between the members 46 and 47, and a cotter pin 51 is provided to hold the member 48 in position. The spring 49 produces a required pressure on the holding member 46 to bias the contact member 15 to the open position (see Fig. 7). The ends of the members 15 and 46 may be held in alinement by means of a pin 51*a* secured to the member 46.

An adjusting member 52 is mechanically connected to the movable member 47, in order that the movable member may be moved along the slot 17, and is held in operative relation thereto by a bolt 53, a spring 54 and a nut 55. A pin 56 is attached to the adjusting means 52 at a suitable radius from the bolt 53 and engages an aperture 57 in the movable member 47. An elongated aperture 58, through which the member 53 extends, is provided in the movable member 47 whereby it may be moved along the slot 17 relatively to the member 52.

A supporting member 59, having two integral portions 60 and 61 which extend substantially at 90° with each other, is attached to the base 8 by screws 62 which extend through the portions 60, the base 8, and nuts 63.

The latch 14 is resiliently and pivotally secured to the portion 61 of the member 59 at one end by a bolt 64 which has a spring 65 mounted coaxially therewith, and which extends through said latch and the portion 61. A cotter pin 66 is located in the end 67 of the member 64 which protrudes through the portion 61 in order that the spring 65 may be held under compression to bias the latch 14 to substantially a horizontal position. An aperture 68 is provided near the end of the latch 14 which engages the member 28. The latch 14 is adapted to register with an aperture 68*a* in the holding member 46.

When the end of the latch 14 registers with the opening 68*a* in the member 46, the spring 49 is released, thereby causing the members 15 and 46 to move to the left, the latter pivoting on the washer 50*a* (see Fig. 8). When the latch 14 engages the member 46, as shown in Fig. 7, the movable contact 15 is held in engagement with the stationary contact 16.

Mechanical connection between the latch member 14 and the thermally responsive elements 12 and 13 is made through the cylindrical insulating member 28. The cylindrical member 28 is provided with enlarged portions 69 and 70 in order that said cylindrical member may rest on the members 12 and 13 in operative relation therewith.

The operation of my device is best illustrated by reference to the schematic diagram of Fig. 6 and the partial views thereof shown in Figs. 7 and 8. The resistor members 29 are in series with a pair of power supply lines 71 and 72 of a polyphase power supply circuit 73. A circuit interrupter or three pole switch comprises switches 74, 75 and 76 for connecting a motor 77 to the power supply circuit 73.

When a start button 78 is pressed to bridge a pair of contacts 79 and 80, and operating coil 81 for the circuit interrupter is energized by the completion of a circuit extending from the conductor 71 through conductor 82, stop button 83, contact members 15 and 16, conductor 84, start button 78, conductor 85 and coil 81 to conductor 72. When the coil 81 has been energized, the switches 74, 75 and 76 are closed, as illustrated in Fig. 6. An interlock 86 is closed mechanically upon the closing of switches 74, 75 and 76 in order to maintain a holding circuit through the coil 81 when the start button 78 is released. Also, when the switches 74, 75 and 76 open, the member 86 is moved to a position indicated by broken lines to open the circuit through the coil 81.

If the motor 77 has been operating under a predetermined overload for a predetermined length of time, the resistor members 29 will then have generated a sufficient amount of thermal energy to cause the bimetallic elements 12 and 13 to bend upwardly thereby causing the latch member 14 to release the holding member 46. When the holding member 46 has been released, the contact member 15 is opened by the pressure of the spring member 49 and the circuit through the holding coil 81 is broken. When the holding coil 81 is deenergized the switches 74, 75 and 76 are opened whereby

the motor 77 is deenergized so that further increase in the temperature of the windings thereof will be prevented.

If it is desirable to let the motor 77 operate at the same overload for a longer period of time than the case just mentioned, the adjusting means 52 is turned about the member 53 in a counter-clockwise direction, whereby the contact member 15 and the holding member 46 are moved vertically upwards. Since the top of the holding member 46 is moved further away from the latch member 14, the time required for the bimetallic elements 12 and 13 to flex sufficiently to disengage the latch 14 from the holding member 46 will be longer and obviously the motor 77 will be permitted to operate for a longer period of time at the new setting of the adjusting means 52.

In the operation of polyphase translating devices such as the three-phase motor 77, it frequently happens that one of the phases of the motor, or possibly one of the lines connecting the motor is accidentally opened. When one phase is open, in a case of this kind, the remaining operative phases will be carrying excessive currents, particularly if the motor is operating at full-load or overload conditions when all the phases are connected. If the phase represented by the line conductor 71 of Fig. 6 is opened because a conductor 87 is disconnected from the motor 77, the current through the resistor 29 in line conductor 72 will increase.

The increase in current would be sufficient, under normal full-load conditions, to generate the required thermal energy to cause the thermal element 13 to flex the required amount independently of the thermal element 12 to cause the latch 14 to release the contact members 15 and 16 in the circuit of the coil 81. The opening of the circuit of the coil 81, as has been pointed out, will open the switches 74, 75 and 76 to deenergize the motor.

If the conductor 88 of the motor 77 should open, then the current will increase in both of the resistors 29. The increase of thermal energy generated by said resistors will be sufficient to flex both of the thermal elements 12 and 13 sufficiently to release the latch 14 from the holding member 46, whereby the circuit of the coil 81 is opened to release the switches 74, 75 and 76.

A particular advantage in having the resistor members 29 removable from the thermal responsive device embodying my invention is that they may be replaced by other resistors which have larger current and thermal capacities, or vice versa, so that various sizes of electrical translating devices, particularly motors, may be protected by one type of thermal relay such as embodies my invention.

Various modifications and changes may be made in the device embodying my invention without departing from the spirit and scope thereof. I, therefore, desire that only such limitations shall be placed thereon as are imposed by the prior art.

I claim as my invention:

1. A thermally responsive device comprising a pair of contact members, and adjusting means for moving one of said contact members relative to the other comprising a slidable member having one of said contact members resiliently mounted thereon, and a rotatable member, said rotatable member having a pin member thereon for engaging said slidable member for moving said slidable member.

2. A thermally responsive device comprising a slidable member, a second member having an aperture therethrough and having one end thereof resiliently attached to said slidable member, a latch resiliently held at one end and engaging said second member at its free end, and a plurality of bimetallic members for individually and jointly moving said latch until it registers with the aperture in said second member in accordance with a predetermined temperature of said bimetallic members.

3. In a thermally responsive device, the combination with a base member, thermally-responsive means mounted thereon, a movable member slidably mounted on said base member, a contact member resiliently mounted on said movable member, said contact member being actuated to one position in accordance with the temperature of said thermally responsive means, and means for heating said thermally responsive means, of means for adjusting the position of said movable member relatively to said thermally responsive means in accordance with the temperature at which said thermally responsive means shall be operable to actuate said contact member.

4. In a thermally responsive device, the combination with an insulating base member, contact members mounted thereon, thermally responsive members attached to said base member, and means actuable by said thermally-responsive members for actuating said contact members, of heating means substantially enclosing a portion of said thermally responsive members, said means being laterally removable therefrom.

5. In a thermally responsive device, the combination with an insulating base member, contact members mounted thereon, thermally responsive members attached to said base member, and means actuable by said thermally responsive members for actuating said contact members, of a laterally removable resistor member of channel shape substantially inclosing a predetermined portion of said thermally responsive members.

6. In a thermally responsive device, the

combination with an insulating base member, contact members mounted thereon, a thermally responsive member attached to said base member, and means actuable by said thermally responsible members for actuating said contact member, of laterally removable channel-shape resistor members, inclosing a portion of said thermally responsive members, said resistor members being supported on said base member independently and out of mechanical engagement with said thermally responsive members.

7. In a thermally responsive device, the combination with a base member, contact members mounted thereon, thermally responsive members attached to said base member, and means actuable by said thermally responsive device for actuating said contact members, of independently removable resistor members of substantially U-shape in lateral section inclosing a predetermined portion of said thermally responsive members.

8. In a thermally responsive device, the combination with an insulating base member, contact members mounted thereon, thermally-responsive members attached to said base member, and means adapted to be actuated in accordance with either individual or joint operation of said thermally-responsive members for actuating said contact members, of independently removable resistor members of substantially U-shape in lateral section inclosing a portion of said thermally responsive members, said resistor members being independently current traversed.

In testimony whereof, I have hereunto subscribed my name this 11th day of February, 1926.

CHARLES H. HODGKINS.