Nov. 26, 1929. H. E. WHITE 1,736,989

THERMAL CIRCUIT CONTROLLER

Filed April 28, 1927

Fig. 1.

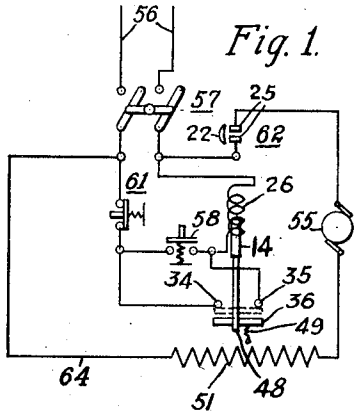


Fig. 5.

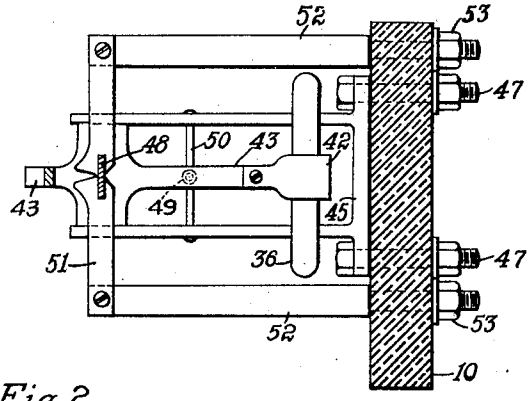


Fig. 2.

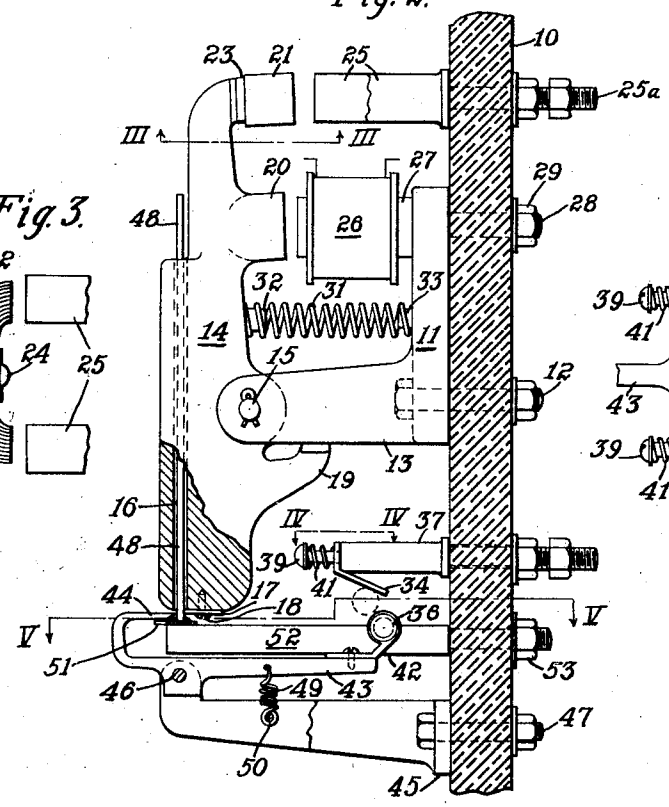
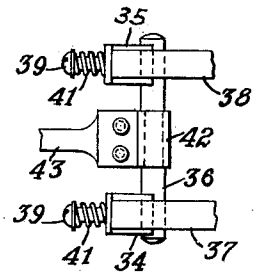


Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE

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THERMAL-CIRCUIT CONTROLLER

Application filed April 28, 1927. Serial No. 187,144.

My invention relates to circuit-controlling devices and particularly to thermally-responsive circuit-protective means therefor.

An object of my invention is to provide a circuit-controlling device that shall have means embodied therein for causing a circuit to be interrupted when the said circuit is traversed by a current of a predetermined value.

Another object of my invention is to provide a thermal element for a circuit-controlling device, having main and auxiliary circuit interrupters, that shall be operable by the main interrupter to actuate the auxiliary interrupter to a circuit closing position; and

Another object of my invention is to provide a thermal element for a circuit interrupter that shall be of simple construction and easily manufactured.

In practicing my invention, I provide a main circuit interrupter, an auxiliary interrupter, and means responsive to a condition to be controlled, carried by the main interrupter for actuating the auxiliary interrupter to a circuit-closing position upon the actuation of the main interrupter to a circuit-closing position. A magnet coil is provided for actuating the main interrupter to a circuit-closing position, the circuit of which is controlled by the auxiliary interrupter. Normally, the auxiliary interrupter operates to maintain a permanent energizing circuit through the coil when conditions in a translating device controlled by the main interrupter are normal. If abnormal current conditions have continued in the translating device for a certain period of time, the thermal element is operable to release the auxiliary circuit interrupter to the circuit-interrupting position, whereby the magnet coil is deenergized and the main interrupter actuated to a circuit-opening position, thus deenergizing the translating device controlled thereby.

In one embodiment of my invention, the thermal element consists of a fusible strip, that is disposed within a magazine or slot carried by the main circuit interrupter, having one end thereof in engagement with the auxiliary circuit interrupter and a heating means. The heating element may energize in accordance with the current traversing the main circuit interrupter for heating a portion of the thermal element to such a temperature that the forces imposed thereon by the main and auxiliary circuit interrupters causes a portion of the thermal element to be sheared off, thereby releasing the auxiliary interrupter to a circuit opening position.

In the drawings,

Fig. 1 is a schematic illustration of circuits and apparatus embodying my invention.

Fig. 2 is a view, mainly in side elevation but partially in section, of the device embodying my invention.

Fig. 3 is a detail view looking upward at line III—III of Fig. 2, parts being broken away and in section.

Fig. 4 is a detail plan view looking downward at the line IV—IV of Fig. 2.

Fig. 5 is a detail plan view looking downward at the line V—V of Fig. 2.

In the drawings, a base 10 of insulating material has mounted thereon a bracket 11. The bracket 11 is preferably made of a magnetic material and may be secured to the base by a bolt 12, the bracket being provided with a pair of laterally extending arms 13 (only one of which is shown) between which an armature 14 may be pivotally mounted.

As shown, the armature 14 is pivotally secured to the arms 13 by a bolt 15. The outer portion of the armature is provided with a hollow portion or magazine 16 for a purpose to be hereinafter set forth. To the lower end of the armature 14 a knife blade 17 is secured by means of a screw 18 or any other equivalent. The inner portion of the armature 14, between its lower end and the bolt 15, is provided with an inwardly projecting lug 19 that is adapted to engage the arms 13 in order to limit the turning of the armature in a counter-clockwise direction.

Intermediate the upper end of the armature 14 and the bolt 15, an inwardly projecting lug 20 is disposed for completing a magnetic circuit to be hereinafter set forth. The upper end of the armature 14 is provided with a brush 21 that comprises a plurality of relatively thin metallic strips 22 of substantially C-shape (see Fig. 3). The strips 22 may be insulated from the armature 14 by a strip 23

of insulating material, the laminations being secured to the armature by a bolt 24 that extends through the laminations and the strip 23 and into the armature with which it may have screw-threaded engagement.

A pair of stationary contacts 25 are secured to the base 10 by means of studs 25*a*, which may be integral with the poles, and co-operating nuts. The switch contacts 25 may be so spaced apart that their outer ends are in alinement with the ends of the brush 21. The brush 21 and the switch contacts 25 constitute what may be termed a main switch or circuit interrupter.

In order that the brush 21 may be actuated into engagement with the switch contacts 25 and held firmly in an engaged or circuit-making position, a magnet coil 26 is provided. The magnet coil may be mounted on a core 27 having a bolt portion 28 that extends through the bracket 11 and the base 10, the coil being held in the position illustrated in the drawings by means of the bolt portion and a co-operating nut 29. The core 27 of the coil is disposed in alinement with the lug 20 of the armature in order that a magnetic circuit, that comprises the armature 14, the bracket 11 and the core 27, may be completed when the main switch is in a circuit-making position.

In order that the armature 14 may be biased towards the position illustrated in Fig. 2 of the drawings, a coil spring 31 may be disposed, as shown, between the armature and the bracket 11, the armature and the bracket being respectively provided with lugs 32 and 33 for holding the spring in a fixed position.

In order that a permanent holding circuit may be established for the coil 26, an auxiliary switch having stationary contact bars or blades 34 and 35 and a movable contact bridging member 36 is provided.

The contacts 34 and 35 may be secured to studs 37 and 38 by screws 39, the studs being provided with bolt portions that project through the base 10 in order that the contacts may be supported in a relatively fixed position. Between the heads of the screws 39 and the contacts 34 and 35 springs 41 are disposed in order that the contact blades may be resiliently mounted on the studs. The contacts 34 and 35, as shown, are of substantially L-shape, portions thereof projecting downwardly at an angle to engage the contact bridging member 36 when the latter has been actuated upwardly through a predetermined distance.

The contact-bridging member 36 may be secured to, and insulated from, a clip 42 that is carried at the right-hand end of a lever 43. The left-hand end of the lever 43 is provided with a portion of substantially C-shape having a knife blade 44, located adjacent to the knife blade 17. As shown, the lever 43 may be pivotally supported on a rod 46 between the arms of a bracket 45 that is secured to the base 10 by bolts 47.

In order that the lever 43 may be turned in a counter-clockwise direction to cause the bridging member 36 to engage the contacts 34 and 35, a fusible strip 48 is so disposed in the magazine 16 that the lower end thereof is located between the knife blades 17 and 44. It is evident, therefore, that, when the armature 14 is actuated in a clockwise direction, the lower end of the fusible strip will engage the knife blade 44 to cause the lever 43 to turn in counter-clockwise direction.

In order that a shearing force may be imposed on the fusible strip 48, between the knife blades 17 and 44, a spring 49 is provided, the spring being secured to the lever 43 and to a pin 50, carried by the arms of the bracket 45.

When the value of the current traversing the main switch is below a predetermined value, the fusible strip 48 possesses sufficient strength or hardness to withstand the shearing force between the knife blades 17 and 44. However, it is desirable that the strip be heated to a predetermined temperature when a current of a predetermined value traverses the main switch, at which temperature the strip is caused to be softened or partially fused and caused to be sheared off or severed by the knife blades.

In order that the fusible strip may be heated in accordance with the current traversing the main switch, a heating element or resistor 51 is provided, the heating element being supported by, and electrically connected to, a pair of studs 52. The studs may be provided with screw portions at the right-hand ends thereof that extend through the base 10, the screw portions having engagement with co-operating nuts 53 for securing the studs to the base.

As shown in Fig. 5, the heating element 51 is provided with an irregularly shaped middle portion of reduced section in order that local heating may be produced directly beneath the fusible strip or at the point of contact between it and the heating element. The middle portion of the heating element 51 projects to the left, as illustrated, in order that the fusible strip 48 may remain in position on it.

In practice, the studs 37 and 38 may be electrically connected in the circuit of the holding coil 26 and the studs 52 connected in circuit with the contacts 25 of the main switch.

When the coil 26 is energized and the armature 14 attracted to that position in which the main switch and the auxiliary switch are in their circuit-making positions, and so long as the current traversing the main switch is below a predetermined value, the heat generated by the resistor 51 will be insufficient to cause the strip 48 to fuse or

soften to such a degree that it will be sheared off by the shearing force set up between the knife blades 17 and 44. If, however, the current traversing the main switch attains a predetermined maximum value, the heat generated by the element 51 will be sufficient to partially fuse the strip 48 or to soften it to such a degree that it will be sheared off by the knife blades.

The moment the lower portion of the strip 48 is sheared off, the spring 49 operates to actuate the contact-bridging member 36 out of engagement with the contacts 34 and 35, thereby effecting deenergization of the coil 26 and a release of the armature 14 to the position illustrated in Fig. 2 of the drawings. Thus, the circuit controlled by the main switch is interrupted.

When the strip 48 has been sheared off and the main and auxiliary switches returned to their circuit-breaking positions, the fusible strip may be caused to be returned to the position illustrated in the drawings either by gravity or manually.

In Fig. 1 of the drawings, the device embodying my invention is illustrated schematically as applied to the protection and control of an electric motor 55. The motor 55 may be energized from a pair of supply conductors 56. As shown, a manually operable switch 57, is provided for connecting the motor and the associated circuits to the conductors 56. In order that the motor 55 may be energized, a starting switch 58 is provided for energizing a relay coil 26.

With the switch 58 in a circuit-making position, the coil is then connected to one of the conductors 56 through the switch 57, a stop-switch 61, starting switch 58, the coil 26, and the switch 57 to the other of the conductors 56. When the coil 26 is energized, the main switch including contact members 22 and 25 is actuated to a circuit closing position and the motor connected to one of the conductors 56, the energizing circuit of the motor comprising one leg of the switch 57,, the main switch, motor 55, a heating element 51, conductor 64, the other leg of the main switch 57 and the other supply conductor 56. When the magnet coil 26 is energized, an armature 14 is attracted thereby to actuate a contact bridging member 36, into engagement with the stationary contacts 34 and 35 against the opposing force of springs 49. A holding circuit or permanent energizing circuit is thereby established for the coil 26, so that the switch 58 may be released to the position illustrated in Fig. 1.

When a current of a predetermined value has traversed the motor for a predetermined length of time, the heating element 51 causes the fusible member 48 carried by the armature and engaging the member 44, to be severed substantially in the manner set forth hereinbefore.

Upon the severing of the fusible strip 48, the contact bridging member 36 is released to the position illustrated and the circuit of the coil 26 broken to effect deenergization of the motor 55. The switch 61 is provided for deenergizing the circuit including the coil 26 in case it is desired to deenergize the motor at any time.

Various modifications may be made in the device embodying my invention, as the specific illustration shown in the drawings is merely descriptive of one of its forms. It is desired, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and the appended claims.

I claim as my invention:

1. In a circuit-protective device, the combination with a main switch, a magnet coil for actuating said switch, and an auxiliary switch for controlling the circuit of the magnet coil, of a fusible member carried by the main switch for actuating the auxiliary switch to a circuit-making position when the main switch is actuated to its circuit-making position.

2. In a circuit-protective device, the combination with a main switch, a magnet coil for actuating said switch, and an auxiliary switch for controlling the circuit of the magnet coil, of a fusible member carried by the main switch for actuating the auxiliary switch to a circuit-closing position, thereby establishing an energizing circuit through the magnet coil, means responsive to a current of a predetermined value traversing the main switch for partially fusing said fusible member, and means for severing said member when it becomes partially fused, whereby said auxiliary switch is released to a circuit-interrupting position to effect deenergization of the magnet coil.

3. The combination with a main switch and an auxiliary switch, of a fusible member actuable by said main switch and means for transmitting a movement from the main switch, through said fusible member, to the auxiliary switch.

4. The combination with a pivotally mounted main switch, and a pivotally mounted auxiliary switch, said switches being normally biased to circuit-opening positions, of a fusible member disposed in operative engagement with the said switches, whereby a movement of the main switch to a circuit-closing position causes a movement of the auxiliary switch to a circuit-closing position, heating means responsive to a current of a predetermined value traversing said main switch for causing a portion of said fusible member to partially fuse, and means for severing said portion to effect a release of the auxiliary switch to its biased position.

5. The combination with a pivotally mounted main switch, and a pivotally mounted auxiliary switch, said switches be-

ing normally biased to circuit-opening positions, of a fusible member disposed in operative engagement with the said switches, whereby a movement of the main switch to a circuit-closing position causes a movement of the auxiliary switch to a crcuit-closing position, and heating means responsive to a current of a predetermined value traversing said main switch for causing a portion of said fusible member to partially fuse, and shearing mechanism operable by said switches for severing said partially fused portion to effect a release of the auxiliary switch to its biased position.

6. The combination with a main switch, an auxiliary switch, said switches being normally biased to circuit-opening positions, a fusible member connecting said switches said fusible member being disposed for actuation by the main switch and to actuate the auxiliary switch whereby said auxiliary switch may be actuated to a circuit-closing position when said main switch has been closed, means for heating said fusible member in accordance with a current of a predetermined value traversing said switch, and co-operating members having knife edges thereon for severing said fusible member when a predetermined temperature obtains therein, thereby to release the auxiliary switch to its open-circuit position.

7. A circuit-controlling device comprising a main switch, an auxiliary switch, said switches being normally biased to circuit-opening positions, a fusible member controlled by the main switch for actuating the auxiliary switch to a circuit-closing position upon the actuation of the main switch to a circuit-closing position, means for causing a portion of said fusible member to partially fuse when a current of predetermined value traverses said main switch, knife-edge members for severing said partially fused portion and means for causing an unfused portion of the fusible member to reengage said auxiliary switch upon the release of said switches to their biased positions.

8. In a controlling device, in combination, a main switch, an auxiliary switch, members carried by said switches, said members having knife edges thereon and being so positioned as to constitute a shear mechanism, a fusible member located between said edges in position to be severed thereby, means for causing said members to impose a shearing force on the fusible member when said switches are in circuit-closing positions, and means for heating said member to a predetermined temperature whereby a severing of said fusible member and a release of the switches to circuit-interrupting positions are effected.

In testimony whereof, I have hereunto subscribed my name this 21st day of April, 1927.

HAROLD E. WHITE.