

June 9, 1931.

O. S. JENNINGS

1,809,275

CIRCUIT BREAKER

Filed Nov. 14, 1925

Fig. 1.

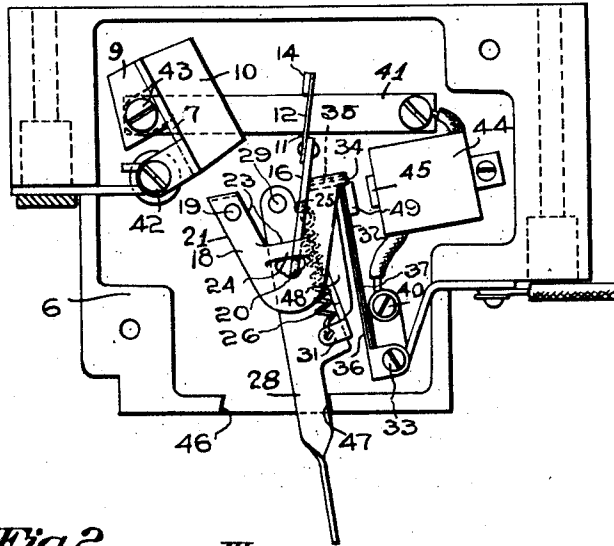


Fig. 2.

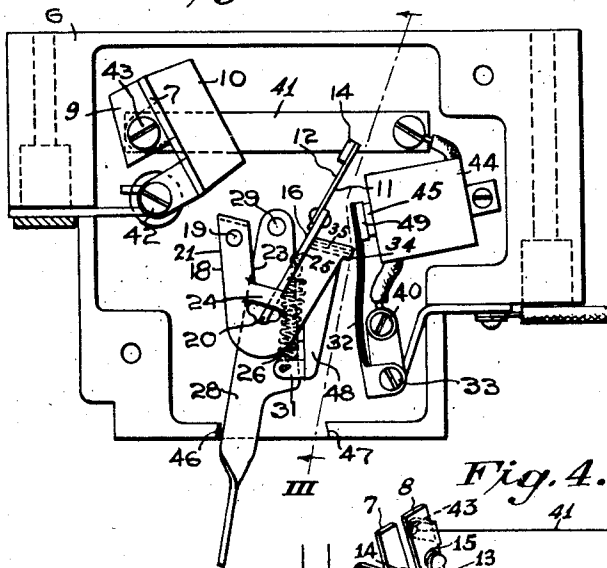


Fig. 3.

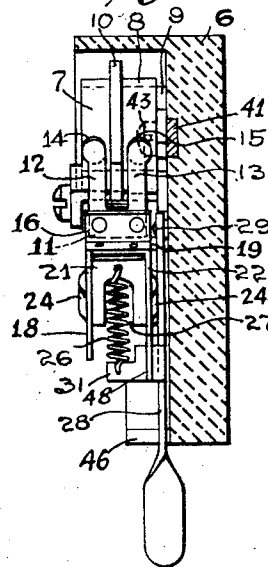
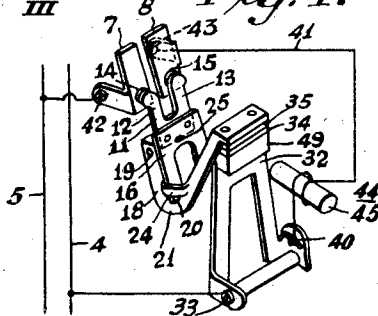


Fig. 4.



WITNESSES:

R. S. Harrison
J. H. Ludwig

INVENTOR

Oliver S. Jennings

BY

Wesley E. Carr
ATTORNEY

UNITED STATES PATENT OFFICE

OLIVER S. JENNINGS, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

CIRCUIT BREAKER

Application filed November 14, 1925. Serial No. 69,030.

My invention relates to electric switches and particularly to motor-starting switches having means for protecting the circuit and apparatus therein against overload and short-circuit conditions.

An object of my invention is to provide a motor-starting switch having a manually operated member that is automatically tripped to open position in response to overload conditions of the circuit after a predetermined period and instantly tripped in response to short-circuit or predetermined overload conditions.

In a co-pending application, of Hubert K. Krantz, Serial No. 752,336, filed November 26, 1924, which became Patent No. 1,726,233 on August 27, 1929, and assigned to the Westinghouse Electric and Manufacturing Company, a motor-starting switch is disclosed that is trip-free of the handle and is controlled by a bi-metal thermal element which releases the switch to open position in response to a predetermined duration of overload conditions. It is an object of my invention to render a switch, having the characteristics embodied in the switch mechanism disclosed in the above noted application, instantaneously responsive to short-circuit or predetermined overload conditions.

These and other objects that will be made apparent throughout the further description of my invention are attained by the switch mechanism hereinafter described and illustrated in the accompanying drawings, wherein

Figure 1 is an elevational view of a switch mechanism embodying features of my invention showing the switch arm in open position.

Fig. 2 is a similar elevational view showing the switch arm in its tripped-open position.

Fig. 3 is a transverse sectional view taken on the line III—III of Fig. 2 and illustrating a part of the switch mechanism in end elevation, and

Fig. 4 is a diagrammatic isometric view of the apparatus, illustrating the manner in which it is connected in an electric circuit.

Referring to the drawings, the switch

mechanism includes an insulating base 6 that may be made of molded insulating material and upon which the switch apparatus is mounted. Stationary contact members 7 and 8 are mounted upon an insulating projection 9 and are disposed on opposite sides of an insulating barrier 10. The contact members 7 and 8 constitute terminals of a circuit that is to be closed by a bridging switch member 11 that comprises a metal plate having two projecting contact arms 12 and 13 provided with contact members 14 and 15 which respectively engage the stationary contact members 7 and 8 when the switch member 11 is moved into the closed position.

The switch member 11 is secured to an insulating switch arm 16 by means of rivets, and the switch arm 16 is pivotally mounted for oscillation upon a metal support member 18 that is, in turn, pivotally mounted for oscillation on a shaft 19 that is secured to the base 6. The supporting member 18 and the switch arm 16 may be considered as an articulated switch member, one portion of which is oscillated for opening and closing the switch for normal operations and both portions of which are movable to open the switch automatically in response to predetermined current conditions in the circuit controlled by the switch.

The supporting member 18 is stamped from a sheet-metal plate and is so formed that two similar portions, 21 and 22 (Fig. 3) are provided that are joined at their upper ends and have deep notches 23 of V-shape for receiving the switch arm 16 that is pivotally mounted for oscillation in the notches about a pivot point 20, as indicated in Figs. 1, 2 and 3. The lower end of the supporting member is provided with off-set cross-braces 24 which serve to prevent lateral displacement of the switch arm 16 with respect to the support member 18. The switch arm 16 is provided with a perforation 25 for receiving one end of an operating spring 26 and the switch arm is also provided with a clearance slot 27 for permitting the switch arm to oscillate between open and closed positions without interfering with the spring.

The other end of the spring 26 is attached

to an operating handle 28 that is pivotally mounted on the base 6 by means of a shaft 29. The operating handle 28 is provided with an off-set or bracket 31 for pivotally receiving the lower end of the spring 26 and for supporting the spring in parallel relation to the base and in central relation to the portions 21 and 22 of the supporting member 18.

The supporting member 18 is maintained in operative position, shown in Fig. 1, by means of a thermal-responsive bi-metallic element 32 of inverted U-shape, the legs of which are adjustably attached, at their spaced ends, to the base by means of a screw 33. The free end of the thermal element 32 engages, under normal operating conditions, a metal stop member 34 that is carried by, and insulated from, the support member 18, the stop member 34 and fastening means therefor being separated from the support member by a suitable insulating plate 35. The bi-metallic thermal element comprises a flat member made of two thin metal strips 36 and 37 (Fig. 1) that are welded together, the strip 36 having a greater co-efficient of expansion than the strip 37, thereby causing the free end of the element 32 to move outwardly or away from the stop member 34 when the temperature of the element is raised to a predetermined degree by an overload condition in the circuit.

Adjustment of the end of the thermal element 32 with respect to the stop member 34 for varying the time required for release of the support member 18 under overload condition may be made by loosening the screws 33 and 40 and adjusting the angular position of the element.

During the normal operation of the switch, current flows, therefore, through the thermal element and through the switch contact member 11 and contact members 7 and 8 to complete the circuit controlled by the switch. The contact arm 11 is normally held in engagement with the contact members 7 and 8 by the over-center spring 26, which continues to hold it in closed contact until the operating handle has moved the spring connected end of the bracket 31 beyond a central line traversing the points of engagement of the spring 26 with the arm 16 and the pivot point 20, about which the switch arm 16 oscillates. The instant that the spring pivot point of the bracket 31 passes the said central line, the over-center spring 26 causes the switch arm 16 to be moved to the open position shown in Fig. 1 with a snap action.

A return movement of the operating handle causes the switch arm 16 to be moved, with a snap action, to closed position after the spring pivot point of the bracket 31 has passed the line traversing the pivot points previously referred to. The movement of the handle is limited by the stop faces 46 and 47 provided in the insulating base 6. Normal

opening and closing operations of the switch are accomplished by simply moving the operating handle to the desired corresponding positions, which may be indicated by legends suitably placed on the cover.

The bi-metal thermal element is connected in series with the bridging switch and, when an overload condition exists in the circuit, the thermal element 32 will be so heated by the abnormal current passing therethrough that the free end thereof will be moved out of engagement with the stop member 34 on the support member 18 after a predetermined duration of the overload. The spring 26, irrespective of its position, exerts a pressure on the support member 18, tending to move it to its inoperative or open position shown in Fig. 2. The instant that the stop member 34 clears the end of the thermal element 32, the support member 18 is moved downwardly by the spring 26 connected to the switch arm 16.

During the downward movement of the support member 18, the direction of application of force of the spring 26 on the switch arm 16 is shifted to move the arm to its extreme open position with respect to the support member 18, as shown in Fig. 2. This combined bodily and angular movement of the switch arm and the angular movement of the support member 18 causes a separation of the switch contact members 14 and 15 from the contact members 7 and 8, the distance of separation being greater, under such conditions, than the normal separation when the switch is actuated manually without movement of the support member.

The opening movement of the support member 18 is entirely independent of the position of the operating handle, and, consequently, the circuit will be interrupted in response to overload conditions even though the handle be held in its closed position by the hand of the operator. The switch, therefore, is trip-free of the operating handle, and the operator can, in no manner, interfere with the automatic opening of the switch.

After the switch has been tripped to open position automatically, it may be restored or reset to normal operating position by moving the operating handle to open position, as shown in Fig. 1. The bracket 31 on the operating handle 28 engages an extension 48 on the portion 22 of the support member 18 and causes the support member to be moved into its operative position, as shown in Fig. 1, when the handle is moved to open position. The bracket 31 also serves to limit the movement of the support member 18 when the member is moved to its inoperative position as shown in Fig. 2.

By reason of the construction above described, a single spring serves to open the switch under overload conditions or when the switch is actuated manually, and the device is

rendered trip-free of the handle without the necessity of providing latches and triggers for connecting the operating handle to the switch member.

5 In order to cause the switch to instantaneously trip to open position, under short-circuit predetermined overload conditions, the bi-metallic thermal element 32 is provided with an iron armature 49 that is disposed adjacent to the core member 45 of the electromagnet 44 which, as indicated in Fig. 4, is connected in series with the thermal element 32 and the switch member 11. Slight overload current, such as the normal starting current, will not attract the armature to release the switch to open position but a short-circuit surge or a predetermined overload of greater value than the starting overload will cause the armature to be instantly attracted to the core and the switch will thus be tripped to open position. By placing the armature on the bi-metal member, that member is rendered both thermally and magnetically responsive to current conditions in the circuit.

25 As indicated in Fig. 4, the thermal element 32, electromagnet coil 44 and bridging switch 11 are connected in series to the circuit 5, current passing from the conductor 4 of the circuit through the terminal screw 33, bi-metal strip 32, terminal screw 40, coil 44, conductor 41 terminal screw 43, contact member 8, bridging switch 11, contact member 7, and terminal screw 42, to conductor 5 of the circuit.

35 The electromagnet coil is so wound that it does not effect movement of the armature except when overload conditions exceed those normally encountered in starting or normal operation of the machine operated by the motor, or when a short-circuit occurs. Overloads below the predetermined maximum value for which the coil is wound may endure for a predetermined time, determined by the characteristics of the bi-metal element, before the circuit is interrupted by movement of the bi-metal element due to the heating thereof. Consequently, starting overloads or overloads of short and harmless duration will not cause the circuit to be interrupted, but the circuit will be interrupted instantly when the overload exceeds a predetermined maximum value or when a short circuit occurs.

While I have shown the electromagnet and thermal element carrying an armature, associated with a switching device, such as illustrated and described, it is obvious that the combined thermal element and electromagnet may function to cause tripping of any form of switch or circuit-breaker mechanism.

60 While I have illustrated but one embodiment of my invention, it will be apparent to those skilled in the art that various changes, modifications, substitutions, additions and omissions may be made in the apparatus illustrated without departing from the spirit

and scope of my invention, as set forth in the appended claims.

I claim as my invention:

1. The combination with a switch and a current-carrying thermal responsive element having one end movable for controlling the switch and connected in series therewith and an armature on the movable end of the element, of an electromagnet connected in the circuit with the switch for actuating the thermal element under predetermined current conditions.

2. The combination with a switch, of controlling means therefor comprising a composite unitary current-carrying element responsive to heating and magnetic characteristics of the current in the circuit controlled by the switch, the said element being affected thermally to initiate opening movement of the switch in response to an overload of predetermined duration and being affected magnetically to initiate instantaneous opening movement of the switch in response to a short-circuit-current surge.

3. The combination with a switch and a thermal element connected in series therewith and having one end movable in response to temperature changes thereof, of an armature carried by the movable end of the thermal element, and an electromagnet connected in series with the thermal element for actuating the armature and thermal element.

4. A circuit breaker comprising a movable switch member and a current-responsive means for releasably retaining the circuit breaker in closed position comprising a bi-metal thermal strip connected in series with the switch member and having one end movable and provided with an armature, and an electromagnet connected in series with the said thermal strip and the switch member for actuating the thermal-strip armature.

5. The combination with a quick-break switch, of a thermally-bendable element for latching said switch in closed position and a magnetically operable release device having a coil in an electrical circuit with said element and having an armature directly associated with said element and cooperating therewith to release said switch on excessive overload in the circuit.

6. The combination of a quick-break switch, a bendable bimetallic latch normally holding the switch parts in closed-circuit positions and an electromagnet coil in series with the bimetallic latch for automatically bending said latch to release the switch on an excessive overload.

7. The combination with a quick-break switch, of a bimetallic thermally-operable latch, a magnetically-operable release means directly cooperating therewith and a manually-operable switch member adapted also to move the quick-break switch to latched position.

8. The combination with a quick-break switch, of a thermally-bendable latch, a magnetically-operable release means for operating said latch, and a hand-operable switch blade in series with said latch and with said magnetically-operable release means.

9. The combination in a switch, of a movable switch member, a spring for automatically moving said switch member, a bendable latch for holding said switch member in closed-circuit position and electro-magnetic and thermal means in series and cooperating therewith for bending said latch gradually or instantaneously, depending upon the overloads.

10. A spring-pressed switch, element, a bendable member for latching said switch element in closed circuit-position, thermal means for bending said member to release the said switch element, and electromagnetically operated means in series with said thermal means for bending said member to release the said switch element.

11. A spring-pressed switch element, a bendable latch for holding said switch element in closed-circuit position, thermal means for bending said latch, electromagnetically-operated means for bending said latch and manually-operable means for relatching said switch element, said thermal means being operable independently of the resistance of said electromagnetically-operated means.

12. A quick-break switch construction including a spring-operated movable switch member, a thermally-bendable latch for holding said switch member in closed position and for releasing said member under predetermined overload conditions, and an electromagnet having a coil in series with said latch and adapted to bend said latch to release said switch member on excessive overload in the circuit, regardless of the thermal condition of said latch.

13. A quick-break switch construction including a movable switch member, a bimetallic latch for holding said switch member in closed position under normal circuit conditions and for releasing said switch member on ordinary overload conditions, and an electromagnet having a coil in series with said latch and having a direct operable connection to said latch to bend it and release said switch member on excessive overload conditions.

14. A quick-break switch construction including a movable switch member, a thermally-bendable latch for holding said switch member in closed position, and an electromagnet positioned immediately adjacent said latch and having a coil in series with it and adapted to bend it to release said switch member on excessive overload conditions in the circuit, regardless of the thermal action of said latch.

15. A quick-break switch construction in-

cluding a spring-pressed switch member, a thermally-operable latch in the electrical circuit for holding said member in closed position under normal circuit conditions and for unlatching said member under ordinary overload conditions, and an electromagnet directly associated with said latch for bending it to unlatch said member in the event of a sudden excessive surge in the circuit:

16. An enclosed-switch construction including a movable switch member, a bendable latch for holding said member in closed position, thermally-operable means for bending said latch to release said switch member, electromagnetically-operable means for bending said latch to release said switch member, and an externally-operable member serving as the only means for resetting said latch.

17. An automatic-switch construction including a spring-pressed movable switch member, a latch for holding said member in closed position, thermal means in the electrical circuit for slowly bending said latch to release said switch, and electromagnetic means for instantly bending said latch to release said switch in response to a sudden excessive surge in the circuit.

18. An automatic-switch construction including a movable switch member, a thermally bendable latch for holding said member in closed-circuit position under normal circuit conditions and for releasing said switch member on ordinary overload conditions, an armature carried by said latch, and an electromagnet cooperating with said armature to bend said latch to release said switch under excessive overload conditions.

19. An automatic-switch construction including a movable switch member, a bimetallic thermally-bendable latch in the electrical circuit for normally holding said member in closed-circuit position and having a free end, and an electromagnet adapted to bend the free end of said latch to release said switch member in the event of a short circuit or sudden excessive overload in the circuit.

20. An enclosed-switch construction including a box, a switch within the box and an external operating handle for said switch, the said switch including a movable contact member, a thermally-bendable latch for holding said contact member in closed position under normal circuit conditions and to release said contact member under other predetermined circuit conditions, and an electromagnet adapted to bend said latch to release said contact member in response to a sudden excessive overloading of the circuit controlled by said contact member.

21. In an electric switch, an insulating body, a switch member pivotally mounted thereon, a spring for moving said switch member to open-circuit position, a bimetallic thermostatic latch member supported by said body and having one end engaging said

switch member to hold the same in closed-circuit position, the other end of said thermostatic latch member being bifurcated, an electromagnet coil having two terminals, one of which is directly connected electrically to one part of said thermostatic latch member, a circuit terminal, and a stationary contact electrically connected to the other terminal of said coil.

22. The combination, in a quick-break switch, of a spring-pressed switch member, a movable bimetallic thermostatic latch therefor, and an electromagnet coil in series with said thermostatic latch, said latch being releasable from closed position by either thermostatic action or by magnetic action.

23. The combination, in a quick-break switch, of a spring-pressed switch member, a bimetallic thermostatic spring latch for holding said switch member in closed position, and an electromagnet in series with said switch member and with said latch, said latch being operable both thermally and magnetically.

24. The combination of an automatically-operable switch member, a thermostatic element for latching said member, and electromagnetic means for releasing said latching element, a manually-operable switch member, and means of connection between said switch members whereby said automatically-operable switch member may be reset by a circuit-opening movement of the manually-operable switch member.

In testimony whereof, I have hereunto subscribed my name this 11th day of November, 1925.

OLIVER S. JENNINGS.

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