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by
His Attorney.
My invention relates to thermal elements for switch mechanisms and more particularly for circuit breakers of the type which automatically opens the electric circuit therethrough upon a continued slight overload or upon a sudden heavy overload in the circuit protected thereby and which may be operated manually to open or close its circuit or to reset it after an automatic opening thereof.

In one arrangement employed for a circuit breaker of this type, the relatively movable contacts of the circuit breaker are controlled by a tripping member which is held in operating position by a thermostatic latch comprising a bimetallic strip through which the circuit breaker current flows. When this thermostatic latch is warped a predetermined amount in response to heating by current flow therethrough during a prolonged moderate overload or during a sudden heavy overload in the circuit protected thereby, the tripping member of the circuit breaker which is engaged by this latch is released so that a bias imparted thereon moves the tripping member to a position which causes the circuit breaker contacts to open. In this and other types of switch mechanism it is desirable to provide a thermostatic element which, for a given current rating, is of smaller size and has a greater deflection for a given temperature rise than is obtainable with a single bimetallic strip. It is also desirable to have a thermal element which will respond immediately to short circuit current flow therethrough and magnetic arrangements forming part of the thermal element have been proposed for this purpose. Furthermore, when the thermal element also acts as a mechanical latch it must at times be made responsive to low current values and yet have a physical structure of sufficient size to perform its mechanical functions as a latch.

It is an object of my invention to combine a plurality of bimetallic strips in the thermally responsive element of a switch controlling mechanism to obtain for a given current rating a structure of smaller size and greater deflection for a given temperature rise than is obtainable with a single bimetallic strip.

It is another object of my invention to provide a bimetallic circuit breaker latch which is of sufficient size mechanically to serve its intended purpose as a latch and in which two bimetallic strips are directed responsive to fault current flow therethrough and are made responsive to prolonged overloads at low current values by an electrically conductive heater element which is in close proximity thereto and electrically connected in circuit therewith.

It is also an object of my invention to provide for a switch controlling mechanism, a thermally responsive element in which a plurality of bimetallic strips and an electrically conductive heater element therefor are assembled for movement relative to one another in response to magnetic forces generated by short circuit current flow therethrough to provide instantaneous response of the element without the delay required for its thermal response to this current flow.

It is a further object of my invention to provide an improved bimetallic latch system in which a pair of bimetallic strips, assembled for deflection in the same direction in response to current flow therethrough, are electrically connected in series circuit with the folds of a flat strip electrically conductive heater element positioned between these bimetallic strips and insulated therefrom to provide a multilayer assembly of the desired mechanical strength and of the desired sensitivity to current values which are insufficient to secure the desired deflection of the bimetallic strips when acting on these strips alone.

Further objects of my invention will become apparent from the following description thereof taken in connection with the accompanying claims.

In accordance with one embodiment of my invention, the thermostatic latch of a thermal circuit breaker comprises a parallel pair of bimetallic members and a flattened loop electrically conductive heater element located therebetween. The bimetallic members have juxtaposed fixed ends adapted for mounting on a support and juxtaposed movable ends deflectable in the same direction in response to heating and the heater element has juxtaposed terminals each of which is electrically and mechanically connected to a different one of the movable ends of the bimetallic members. Means are provided for electrically insulating the heater element from itself and from the bimetallic members and for connecting the fixed ends of the bimetallic member in circuit with the contacts of the circuit breaker of which the thermostatic latch forms a part. The movable end of one of the bimetallic members is provided with a latch pin which cooperates with the latch portion of the tripping member of switch operating mechanism for automatically controlling the opening of the contacts of the circuit breaker upon prolonged moderate overloads or sudden heavy overloads in the circuit controlled thereby. The sides of the flattened loop.
heater elements are separable from one another and deflectable with the movable ends of the bimetallic members to which its terminals are attached in response to the magnetic forces acting thereon upon short circuit current flow there through. The expansion of the latch produced by the flow of short circuit current thethere through imparts sufficient deflection to the bimetallic element in the latch pin to secure instantaneous release of the tripping member of the switch operating mechanism without encountering the delay required for thermal response of the latch to this short circuit current. The switch mechanism embodying my improved thermostat latch may be of any suitable type and by way of example I have illustrated in the accompanying drawing, the particular arrangement of parts shown and described in United States Letters Patent 2,455,793, Benjamin E. Getchell, granted December 7, 1949 for Thermal Circuit Breaker.

Fig. 1 of this drawing is a side view and partial section illustrating a switch mechanism provided with a thermostatic latch having a construction in accordance with my invention, and Fig. 2 is an enlarged perspective view of the thermostatic latch shown in Fig. 1.

In the arrangement shown in the drawing, the electrically conducting parts of the circuit breaker are enclosed in a housing having a base 1 and a cover 2, both of which are formed of electrically insulating material. The movable and fixed contacts 3 and 4 of the circuit breaker are controlled by a mechanism 5 which is both manually operable and automatically operable in response to the deflection or warpage of a thermostatic latch 6 forming part of the switch mechanism. This latch 6 is connected in circuit with the switch contacts 3 and 4 between terminals 7 and 8 of the circuit breaker through the agency of a conductive strap 9, whose terminals are connected to one circuit breaker terminal 7 and one terminal 10 of the thermostatic latch, a flexible conductor 11, one terminal of which is connected to the other terminal 12 of the thermostatic latch 6 and the other terminal of which is connected to the movable contact 3 of the switch contacts, and a conductive strap 13, one terminal of which is connected to the fixed switch contact 4 and the other terminal of which is connected to the other circuit breaker terminal 8. Thus, while the switch contacts 3 and 4 are closed, as shown in Fig. 1 of the drawing, current flow through the circuit breaker passes through the thermostatic latch 6, which due to heating will warp a sufficient amount under prolonged moderate overloads or sudden heavy overloads in the circuit breaker circuit to release a tripping member forming part of the switch mechanism.

The switch mechanism comprises a frame 14 which is mounted on the base 1 of the circuit breaker enclosure. This frame provides a support for a releasable tripping member 15 which is pivoted at 16 in frame 14 and has at its outer end a latch 17 which is electrically insulating thermally. This latch engages a latch pin 18 forming part of the thermostatic latch 6. A switch arm 19 of the switch mechanism is pivoted at 20 in frame 14 and serves as a mounting for the flexible spring support 21 on the outer end of which the movable contact 3 of the circuit breaker is mounted. This arm 19 is provided with a stop projection 22 which, in the open position of the switch contacts, engages a fixed stop 23 mounted on frame 14. Arm 19 is also provided with an operating projection 24 to which one end of a toggle link 25 is connected by a pivot pin 26. The other end of this toggle link 25 is connected through a second toggle link 27 to tripping member 15 through the knee pivot 28 of the toggle linkage 25, 27 and a pivot pin 29 on member 15 which engages a bayonet latch 30. Each of a pair of throwing springs 31 has one end connected to the knee pivot 28 of toggle 25, 27 and its other end connected to a lug 32, forming part of an operating lever 33 having at its outer end a finger piece 33 by which it is moved about as a pivot 34 mounted in frame 14 by its slotted inner end. This operating lever 32 is limited in its movements by a stop not shown for the position of the parts illustrated in the drawing and by a stop 35 when the mechanism has been operated to open switch contacts 3, 4. In the tripped position of the circuit breaker, tripping member 15 has a shoulder portion 36 which engages a shoulder portion 37 of frame 14. Operating lever 33 is also provided with a shoulder portion 38 which engages another shoulder portion 39 of tripping member 15 for moving it to its set position, illustrated in the drawing, when lever 32 is moved to the left by finger piece 33 to secure this resetting operation.

When tripping member 15 is released by warpage of thermostatic latch 6 to the left so that its latch pin 18 disengages latch 16 of member 15, this member swings in a clockwise direction about its pivot 16 under the bias imparting there to by throwing springs 30 acting on member 15 through the toggle linkage 25, 27. When this member thus swings to its biased position, the toggle linkage 25, 27 collapses causing switch arm 19 to rotate counterclockwise about its pivot 20 to open switch contacts 3, 4. As previously stated, tripping member 15 comes to rest in its tripped position with its shoulder 36 resting against shoulder portion 37 of frame 14.

In view of the description above given of the switch mechanism, its operation is believed to be apparent. As previously stated, when thermostatic latch 6 moves latch pin 18 from engagement with latch 16, tripping member 15 swings in a clockwise direction to collapse toggle linkage 25, 27 and secure opening of switch contacts 3, 4. The switch contacts may also be opened by moving finger piece 33 to the left which will also cause collapse of toggle linkage 25, 27 and secure opening of switch contacts 3, 4. If the tripping member has been automatically released by operation of latch 6, it may be reset by moving the finger piece 33 to the left so that shoulder 38 of operating lever 33 engages a shoulder on tripping member 15 which is then moved to the latched position shown in the drawing. Thereafter upon moving the finger piece 33 to the right the toggle will be set with the parts as shown in the drawing in order to secure closure of switch contacts 3, 4.

Thermostatic latch 6 of Fig. 1 has been shown in perspective in Fig. 2 of the drawing. It comprises a multilayer assembly in which the outer layers 39, 40 are a parallel pair of flat bimetallic strips each having juxtaposed fixed ends 41 and 42 which are turned outwardly at right angles to the body portion of the bimetal strips to provide supports by which the latch assembly is mounted on base 1 of the circuit breaker by screws passing through holes 43 therein. As shown in Fig. 1, these screws 44 make a threaded engagement with bushings 45 which are mounted in the
The juxtaposed movable ends of these bimetallic strips 39 and 40 are connected mechanically and electrically by resistance spot welds 46 to the juxtaposed terminals of a flattened loop electrically conductive strip heater element 47 which is positioned between bimetallic strips 39 and 40. The folds of the heater strip 47 are insulated from one another and from the bimetallic strips 39 and 40 by flat strips of insulating material 48. One of the bimetallic strips 46 is longer than the other bimetallic strip 39 and constitutes a support for the latch pin 18 of the thermostatic latch. The construction of the thermostatic latch and its connection in the circuit breaker is such that current flows through the bimetallic strips in series circuit with the heater element 47. Furthermore, the thermostatic strips 39 and 40 are so constructed and assembled that each of them are deflected in the same direction when subjected to heating which, in the arrangement illustrated, will be to the left. This current flow through the bimetallic strips and the heater element 47 will produce direct heating of the bimetallic strips and indirect heating thereof through the effects of heater element 47. The multilayer assembly provided permits effective conductive transfer of the heat from the heater element 47 to the bimetallic strips 39 to 40 and consequently makes the bimetallic strips responsive to small values of current flow which in themselves would be insufficient to produce the heat required to deflection of these strips by an amount which would release the latch pin 18 from latch 17. On the other hand, when heavier overload currents flow through the assembly the bimetallic strips 39 and 40 are directly heated by the current flow therethrough by an amount sufficient to warp the latch sufficiently to release the tripping member 15 of the switch mechanism. Thus at the lower values of overload current flow about 90% of the heat required for operation of the latch is supplied by the heater element while at the higher values of overload current flow, the heating of the bimetallic strips themselves by current flow therethrough is in itself responsible for operation of the latch. In cases of short circuits, however, the assembly opens up due to the magnetic forces acting on its elements and causing deflection of that one of the bimetallic strips which carries the latch pin by an amount sufficient to trip the latch mechanism.

The latch has been shown greatly enlarged in each of the figures of the drawing. Actually it is quite small in size, the overall thickness of the several layers thereof being about \(rac{1}{8}\) of an inch. Thus the bimetallic strips may be about .020 inch in thickness, the heater strip about .004 inch in thickness, and each of the strips of insulation about .003 inch in thickness. For a given temperature rise the deflection of a bimetallic strip varies inversely with its thickness and it is consequently apparent that with my improved latch construction full advantage is taken of this characteristic to obtain a latch of small size and greater deflection than would be obtainable by using a single strip of bimetal.

It is, of course, apparent that various kinds of bimetal thermostats may be used in practicing my invention and that the heater element 47 may be formed of any of the usual metallic resistance materials. Selection and size of these parts will depend on the rating of the circuit breaker. The thermostat may be formed of strips of Invar and Monel metal, Invar and steel or Invar and nickel-chromium steel which are welded or otherwise bonded to one another. Invar is a ferrous alloy containing 35% nickel, with minor amounts of manganese, silicon and carbon amounting to less than 1% in all, the Monel metal is a copper-nickel alloy. The heater element may be formed of Nichrome, German silver, iron or the like. Nichrome is a ferrous alloy containing 16-18% chromium, 50-62% nickel, 24% iron and .1% carbon. German silver is an alloy of 60% copper, 25% zinc and 15% nickel. The strips of insulating material 48 may be formed of mica, but again it is also obvious that other types of insulation may be employed. The insulating strips 48 may be secured in place by suitable adhesives provided strip 48 between the folds of the flattened loop heater element 47 is attached along one side only so that this loop may freely expand under the action of the magnetic forces acting thereon. Other arrangements may be provided for holding the insulating strips in place in the assembly while accommodating the separating movement of the bimetallic strips and the folds of the heater element loop under the action of the magnetic forces resulting from short circuit current flow therethrough. Thus the heater element loop 47 may be coated with an insulating material except at its terminals which are attached to and make electric contact with the movable ends of bimetallic members 39 and 40. Furthermore, the connection between the movable ends of the bimetallic strips and the terminals of the heater may be secured by means other than the spot welds described. Thus the terminals may be joined by brazing or by the use of a mechanical connection which may extend through or about the ends of the members, such as by using rivets or clips.

It is, of course, apparent that my invention is not limited in its application to circuit breakers of the type above described. It may be utilized as part of any thermal responsive switching device. Thus the thermal element above described or its equivalent may act directly on one of a pair of switch arms to assure separation of a pair of contacts mounted thereon and biased into contact with one another. Furthermore, the bimetallic elements may be made of different thicknesses. Thus strip 39 may be made thinner than strip 40 to intensify its pushing effect on strip 40 which carries trip pin 18 and consequently must be of a size to accommodate the mechanical loading applied thereto through this pin by the tripping member 18 which it engages.

The above recited and other modifications of the construction particularly described will be obvious to those skilled in the art and it is to be understood that such changes and modifications may be made without departing from my invention in its broadest aspects. Consequently, I aim to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim is new and desire to secure by Letters Patent of the United States 1. A thermally responsive member for controlling mechanisms employed for operating a pair of switch contacts, said member comprising a pair of bimetallic members each having juxtaposed fixed ends adapted for mounting on a support and juxtaposed movable ends deflected in the same direction in response to heating, an electrically conductive heater element located between said bimetallic members and having juxtaposed termi-
nals each of which is electrically and mechanically connected to a different one of the movable ends of said bimetallic members, means for electrically and mechanically connecting said heater element from contact with itself and with said bimetallic members except at its said terminals, and means for connecting the fixed ends of said bimetallic members in circuit with said switch contacts.

2. A thermally and magnetically responsive member for controlling mechanisms employed for operating a pair of switch contacts, said member comprising a pair of bimetallic members each having juxtaposed fixed ends adapted for mounting on a support and juxtaposed movable ends deflectable in the same direction in response to heating, a flattened loop electrically conductive heater element located between said bimetallic members and having each of its open ends electrically and mechanically connected to a different one of the movable ends of said bimetallic members, the sides of said flattened loop heater element being separable from one another and deflectable with the movable ends of said bimetallic members in response to the magnetic forces acting thereon upon short circuit current flow therethrough, means for electrically insulating the said flattened loop heater element from one another and from said bimetallic members opposite thereto, and means for connecting the fixed ends of said bimetallic members in circuit with said switch contacts.

3. In an electric circuit breaker having separable switch contacts and a releasable tripping member movable automatically to separate said contacts, a thermostatic latch connected in the switch circuit, normally restraining said movable tripping member, and adapted to release said movable tripping member in case of a predetermined change in the condition in the circuit in which said switch contacts are connected, said thermostatic latch comprising a pair of bimetallic members each having juxtaposed fixed ends adapted for mounting on a support and juxtaposed movable ends deflectable in the same direction in response to heating, an electrically conductive heater element located between said bimetallic members and having juxtaposed terminals each of which is electrically and mechanically connected to a different one of the movable ends of said bimetallic members, means in contact with said heater element and said bimetallic members for electrically insulating said heater element, and means for connecting the fixed ends of said bimetallic members in circuit with said switch contacts.

4. In an electric circuit breaker having separable switch contacts and a releasable tripping member movable automatically to separate said contacts, a thermostatic latch connected in the switch circuit, normally restraining said movable tripping member, and adapted to release said movable tripping member in case of a predetermined change in the condition in the circuit in which said switch contacts are connected, said thermostatic latch comprising a pair of bimetallic members each having juxtaposed fixed ends adapted for mounting on a support and juxtaposed movable ends deflectable in the same direction in response to heating, an electrically conductive heater element located between said bimetallic members and having juxtaposed terminals each of which is electrically and mechanically connected to a different one of the movable ends of said bimetallic members, means in contact with said heater element and said bimetallic members for electrically insulating said heater element, and means for connecting the fixed ends of said bimetallic members in circuit with said switch contacts.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,975,041</td>
<td>Guett</td>
<td>Sept. 25, 1934</td>
</tr>
<tr>
<td>2,160,421</td>
<td>Leonard</td>
<td>Nov. 21, 1939</td>
</tr>
</tbody>
</table>