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CIRCUIT BREAKER

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Fig.1.

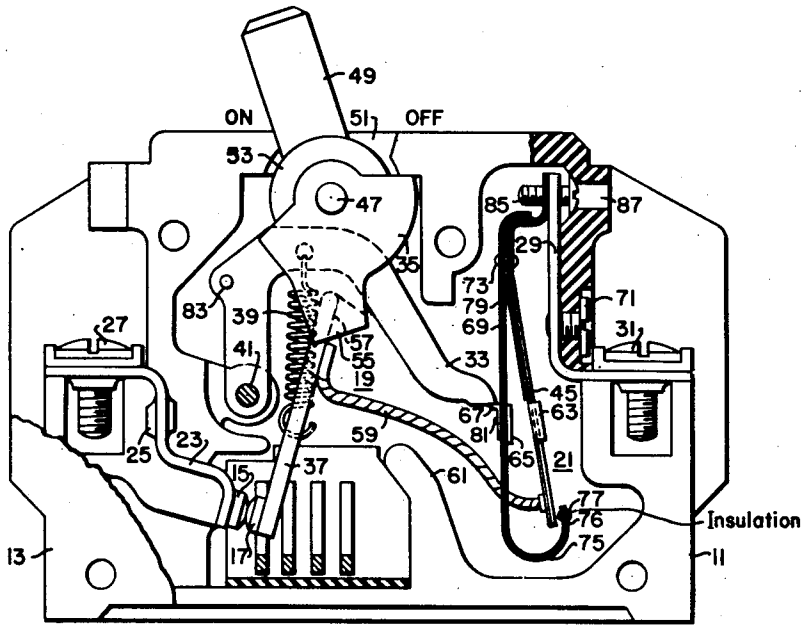
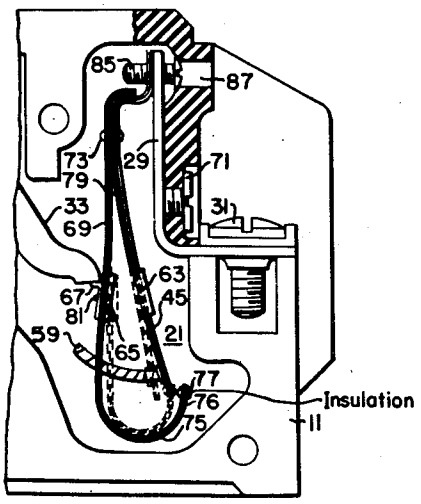


Fig.2.



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CIRCUIT BREAKER

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9 Claims. (Cl. 200—88)

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This invention relates to thermal circuit breakers for controlling lighting and moderate power circuits, and particularly to ambient temperature compensation of the thermal trip device.

An object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device including a temperature compensating trip member wherein the temperature compensating trip member and the magnetically responsive means are supported entirely on the thermally responsive element.

Another object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device having the trip member and the magnetically responsive means supported entirely on the thermally responsive element wherein the trip member comprises an ambient temperature compensating element.

Another object of the invention is to provide a circuit breaker embodying an improved trip device that is simple, reliable in operation and inexpensive to manufacture.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing.

In said drawing:

Figure 1 is a side elevational view, with the cover plate broken away and partly in section, of a circuit breaker embodying the principles of the invention;

Fig. 2 is a fragmentary elevational view of the trip device showing the bimetal elements deflected in response to a predetermined rise in ambient temperature.

Referring to Fig. 1 of the drawing, the circuit breaker comprises generally, a housing 11 and a cover plate 13 therefor, most of which is shown broken away, both being constructed of molded insulating material, stationary contact means 15, movable contact means 17, an operating mechanism 19 and a trip device 21.

The stationary contact 15 is rigidly secured to the inner end of a multi-angular terminal member 23 which is seated in an angular slot 25 molded in the housing 11. The outer end of the terminal 23 is provided with a connecting means 27 for connecting the terminal 23 in an electric

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circuit. At the opposite end of the housing 11 is a terminal 29 which, at its inner end, supports the trip device 21 (to be described later) and which is provided with a connecting means 31 at its outer end for connecting the terminal in an electric circuit.

The movable contact 17 is rigidly secured on the free end of a U-shaped switch arm 37 having its legs 57 supported in recesses in the legs 55 of a U-shaped operating lever 35 of molded insulating material. The operating lever 35 is pivotally supported by means of trunnions 47 molded integral therewith and mounted in an opening in the housing 11 and a companion opening in the cover plate 13. An overcenter operating spring 39 is connected under tension between the bight of the switch arm 37 and a releasable carrier 33 pivoted on a pin 41 supported in companion openings in the housing 11 and the cover plate 13.

The operating lever 35 is provided with an integral operating handle 49 extending through an opening 51 in the housing 11. The operating lever is also provided with an arcuate member 53 integral therewith cooperating with the housing 11 to substantially close the opening 51 in all positions of the handle 49. The switch arm 37 is electrically connected by means of a flexible connection 59 to one end of a tripping bimetal element 45 forming a part of the trip device 21 which is suitably secured, preferably by welding, to the inner end of the terminal 29.

The switch arm 37 is operated to manually open and close the contact means by manipulation of the handle 49. Movement of the handle in a clockwise direction carries the legs 57 of the switch arm 37 across to the left of the line of action of the operating spring 39 which then biases switch arm to the open position and causes movement of the switch arm to the open position with a snap action.

The contacts are manually closed by reverse operation of the handle 49. Counterclockwise movement of the handle 49 from the "off" position to the "on" position moves the legs 57 of the switch arm 37 across to the right of the line of action of the operating spring 39 which, thereupon, acts to close the contacts with a snap action.

The circuit breaker is adapted to be tripped open instantaneously in response to overload currents above a predetermined value, or short circuit currents, and after a time delay in response to lesser overload currents below the predetermined value by means of the trip device 21.

Operation of the trip device 21 releases the carrier 33 whereupon the overcenter spring 39 moves the carrier clockwise about pivot 41, moving the line of action of the overcenter spring 39 to the right of the center line of the switch arm 37. The spring 39 then acts to move the switch arm 37 to the open position with a snap action. The movement of the carrier 33 is arrested by its engagement with a projection 61 integral with the housing 11.

Before the contacts can be closed following an automatic operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 49 clockwise to the full "off" position during which movement the legs 55 of the operating lever 35 engage a pin 83 in the carrier 33 and move the carrier counterclockwise about its pivot 41. Near the end of the counterclockwise movement, the free end of the carrier 33 wipes by a latch member 67, slightly flexing a compensating bimetal element 69. Thereafter, the switch arm is moved to close the contacts 15—17, in the previously described manner, by movement of the handle 49 counterclockwise to the "on" position.

The trip device 21 comprises the tripping bimetal element 45 connected by means of the flexible connection 59 to the switch arm 37, the ambient temperature compensating bimetal element 45, the latch member 67 and an electromagnet comprising a channel-shaped magnetic member 63 and a movable magnetic member 65. The terminal 29 is secured to the adjacent end wall of the housing 11 by means of a screw 71 and the tripping bimetal element 45 is rigidly secured by suitable means, such as welding, to the upper inner end of the terminal 29. Just below the point of attachment of the bimetal element 45 to the terminal 29 the bimetal element 45 is formed inwardly at right angles and then downwardly for a short distance substantially parallel to the terminal 29 to form a flat surface to which the ambient temperature compensating bimetal element 69 is secured. The compensating bimetal element 69 is secured to the tripping bimetal element 45 by welding or, as shown, by means of a rivet 73. Below the point of connection of the compensating bimetal element 69 to the tripping bimetal element 45, the latter extends downwardly at a slight angle to the terminal 29. The lower end of the compensating bimetal 69 is looped as shown at 75 and the upwardly extending end thereof indicated at 76 carries an insulating button 77 for insulating the free end of the tripping bimetal element 45 from the free end of the compensating bimetal 69.

The magnetic member 63 is rigidly mounted on and surrounds three sides of the tripping bimetal element 45 and the magnetic member 65 is rigidly secured to the compensating bimetal element 69 by means of a rivet 81 which also serves to secure the latch member 67 to the bimetal element 69. As shown in the drawing, the latch member 67 normally engages and restrains the carrier 33 in operative position.

With normal rated current flowing through the tripping bimetal 45 the magnetic member 63 is not sufficiently energized to attract the magnetic member 65. Upon the occurrence of an overload current above the rated current but below a predetermined value of, for instance 1000% of normal rated current, the tripping bimetal 45 is heated by the current flow therein and deflects moving its free end toward the right. As the tripping bimetal deflects, it engages the

insulating button 77 and moves the lower end of the compensating bimetal element 69 in the same direction and causes the latch 67 to release the carrier 33 whereupon the operating mechanism functions in the previously described manner to automatically open the contacts.

Upon the occurrence of a heavy overload current on short circuit current of, for example, 1000% or more of rated current, the current flowing through the tripping bimetal element 45 energizes the magnetic member 63 sufficiently to instantaneously attract and operate the armature 65 which flexes the compensating bimetal element 69 toward the right releasing the carrier 33 and effecting substantially instantaneous opening of the breaker contacts.

The tripping bimetal 45 and the compensating bimetal 69 are electrically insulated from each other by an insulating element 79 disposed therebetween at their point of attachment. The high expansion side of the tripping bimetal 45 is on the left and the high expansion side of the compensating bimetal 69 is on the right and on the inside of the looped portion 75 thereof. Consequently, the bimetal element 45 and body of the bimetal 69 are disposed to deflect away from each other in response to an increase in ambient temperature, but, since the high expansion side of the bimetal 69 is on the inside of the loop 75, this portion of the bimetal 69 will tend to straighten out and the free end thereof, which carries the insulating button 77, will move toward the right or in the same direction as the free end of the tripping bimetal 45, thus allowing the tripping bimetal 45 to deflect slightly farther before tripping. The trip device is shown in Fig. 2 with the bimetal elements 45 ad 69 deflected in response to heating by a predetermined rise in ambient temperature. It will be seen by reference to Fig. 2 that the vertical body of the compensating bimetal 69 has deflected slightly to the left causing a slight increase in the latch overlap while the free end 76 of the compensating bimetal 69 has deflected to the right an extent slightly greater than the deflection of the free end of the tripping bimetal 45. The thermal tripping time of the circuit breaker for a given value of overload current will, therefore, be the same regardless of changes in ambient temperature.

Adjusting means is provided whereby the tripping point of the thermal trip may be varied without varying the magnetic air gap of the magnetic members. The adjusting means comprises an adjusting screw 85 threadedly engaging the upper end of the terminal 29 and having its rounded head bearing against a concave seat in the housing 11. An access opening 87 in the housing 11 permits the insertion of a suitable tool for turning the screw 85 to thereby adjust the trip device. The opening 87 may be sealed after adjustment to prevent tampering by unauthorized persons.

The invention provides a circuit breaker of few parts and simple and inexpensive construction having an improved trip device wherein all of the elements are mounted at a single point on one of the terminals of the breaker, the electromagnetic trip device and the compensating bimetal element being mounted entirely on the tripping bimetal element. By this construction the magnetic trip value is not affected by adjustment of the thermal trip element. By looping the free end of the compensating bimetal around the free end of the tripping bimetal with

the high-expansion sides of the bimetal elements facing each other and mounting the latch on the compensating bimetal, the free end of the compensating bimetal element deflect in the same direction as the free end of the tripping bimetal and the latch overlap is varied according to changes in ambient temperature. This results in approximately the same tripping time for an overload current of given value regardless of the temperature of the surrounding atmosphere.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes, structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker having relatively movable contact means and operating mechanism therefor, a trip device comprising a bimetal trip element having one end fixedly mounted and heated in response to the current of the circuit, an ambient temperature responsive bimetal element having one end rigidly mounted adjacent the fixedly mounted end of said current responsive bimetal element and extending along one side of said current responsive bimetal element for compensating said current responsive bimetal element for changes in ambient temperature, one of said bimetal elements having a portion disposed adjacent the other side of the other of said bimetal elements, latch means on said ambient temperature responsive bimetal element engaging and releasably restraining said operating mechanism, and said current responsive bimetal element deflecting when heated a predetermined amount in response to overload currents to operate said ambient temperature responsive bimetal element and cause said latch means to release said operating mechanism.

2. A circuit breaker having relatively movable contact means and operating means therefor releasable to effect automatic opening of said contact means, a trip device comprising a current responsive bimetal trip element heated in response to the current of the circuit, an ambient temperature responsive bimetal element carrying a latching surface and having its high expansion side disposed adjacent the high expansion side of said current responsive bimetal trip element, said ambient temperature bimetal element having an abutment at the low expansion side of said current responsive bimetal element so that said latching surface and said ambient temperature bimetal element are moved bodily by said current responsive bimetal trip element as it engages said abutment upon bending in response to overload currents.

3. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a current responsive bimetal element having one end rigidly supported, an ambient temperature responsive bimetal element having one end rigidly supported on said current responsive bimetal element adjacent the rigidly supported end thereof, said bimetal elements having their high expansion sides disposed adjacent each other and said ambient temperature responsive bimetal element having an abutment disposed adjacent the low expansion side of said current responsive bimetal element, latch means on said ambient temperature responsive bimetal element releasably restraining said releasable means, said current responsive bimetal element deflecting when heated a predetermined amount in response to overload currents to engage said abutment and flex said ambient temperature responsive bimetal element to cause said latch means to release said releasable means.

4. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a current responsive bimetal element having one end rigidly supported, an ambient temperature responsive bimetal element having one end rigidly supported on said current responsive bimetal element adjacent the rigidly supported end thereof, said bimetal elements having their high expansion sides disposed adjacent each other and said ambient temperature responsive bimetal element having an abutment disposed adjacent the low expansion side of said current responsive bimetal element, latch means on said ambient temperature responsive bimetal element releasably restraining said releasable means, said current responsive bimetal element deflecting when heated a predetermined amount in response to overload currents below a predetermined value to engage said abutment and flex said ambient temperature responsive bimetal element to cause said latch means to release said releasable means, electroresponsive means comprising a pair of magnetic members one mounted on said current responsive bimetal element and the other mounted on said ambient temperature responsive bimetal element, said electroresponsive means being energized in response to overload currents above said predetermined value to flex said ambient temperature responsive bimetal and cause said latch means to instantaneously release said releasable means.

5. A circuit breaker including relatively movable contacts, a releasable member operable when released to effect opening of said contacts, trip means including a circuit responsive bimetal element electrically connected to be traversed by current, electroresponsive means comprising a pair of magnetic members on opposite sides of said current responsive bimetal element, one of said magnetic members being mounted on said current responsive bimetal element and energized by current flow therethrough, both of said magnetic members being movable, an ambient temperature responsive bimetal element for compensating said current responsive bimetal element for changes in ambient temperature and having a portion thereof movable to effect release of said releasable member, one of said bimetal elements having an abutment disposed adjacent the low expansion side of the other of said bimetal elements the other of said magnetic members being mounted on said ambient temperature responsive bimetal element and movable magnetically toward said one magnetic member and causing bending movement of said ambient temperature responsive bimetal element against its normal bias to the point where said portion of said ambient temperature responsive bimetal element causes release of said releasable member, said other magnetic member being movable upon thermal bending of said current responsive bimetal element and said bending of said current responsive bimetal also causing movement of said portion of said ambient temperature responsive bimetal element to release said releasable member.

6. In a circuit breaker having relatively mov-

able contacts and a member releasable to effect opening of said contacts, a trip device for effecting release of said releasable member comprising a current responsive bimetal element, an ambient temperature responsive bimetal element having one and rigidly secured to one side of said current responsive bimetal element and having its free end formed to engage the opposite side of said current responsive bimetal element, the high expansion side of said bimetal elements being disposed adjacent each other to compensate said trip device for changes in ambient temperature, latch means on said ambient temperature responsive bimetal element normally restraining said releasable member against operation, said current responsive bimetal element when heated a predetermined amount in response to overload currents below a predetermined value moving said ambient temperature responsive bimetal element to cause release of said releasable member, and electroresponsive means supported by said current responsive bimetal element and operable when energized in response to overload currents above said predetermined value to flex said ambient temperature bimetal element against its normal bias and instantaneously release said releasable member.

7. In an automatic electric circuit breaker having separable contact means and means releasable to effect separation of said contacts, current responsive means for effecting release of said releasable means upon passage of an overload current through said circuit breaker comprising a current responsive bimetallic member heated in response to the flow of current through said breaker, a magnetic yoke supported upon said current responsive bimetallic member and energized in response to the flow of current through said breaker, an armature member also supported upon said current responsive bimetallic member and adapted to be attracted to said yoke upon the occurrence of an overload current of sufficient value, an ambient temperature responsive bimetallic element for compensating said current responsive bimetalic element for changes in ambient temperature, said ambient temperature responsive bimetallic element having a latching surface engageable by said releasable means, a main portion of said ambient temperature responsive bimetallic element being disposed on the high expansion side of said current responsive bimetallic element and having an abutment at the low expansion side of said current responsive bimetallic element so that the latching surface and said ambient temperature responsive bimetallic element are moved bodily by said current responsive bimetallic element as it engages said abutment upon flexing in response to the passage of moderate overload currents, said armature moving said latching surface and said ambient temperature responsive bimetallic element relative to said current responsive bimetallic element as said armature is attracted in response to heavy overload and short circuit currents.

8. A circuit breaker having relatively movable contacts and means releasable to effect opening of said contact means, a trip device comprising a current responsive bimetal element having one end fixedly mounted and heated in response to the current of the circuit, an ambient temperature responsive bimetal element mounted on said current responsive bimetal element but insulated therefrom and having a latching surface thereon engaging said releasable means, said ambient temperature responsive bimetal element having its high expansion said disposed adjacent the high expansion side of said current responsive bimetal element and having an abutment at the low expansion side of said current responsive bimetal element so that said latching surface and said ambient temperature responsive bimetal element are moved bodily by said current responsive bimetal element as it engages said abutment upon bending in response to overload currents, and said ambient temperature responsive bimetal element upon bending thereof in response to changes in ambient temperatures moving said latching surface relative to said releasable means and moving said abutment relative to the current responsive bimetal element to compensate for changes in ambient temperatures.

9. A circuit breaker having relatively movable contact means and means releasable to effect automatic opening of said contact means, a trip device comprising a current responsive bimetal element having one end rigidly supported, an ambient temperature responsive bimetal element having one end rigidly supported adjacent the rigidly supported end of said current responsive bimetal element, said bimetal elements having their high expansion sides disposed adjacent each other, latch means on said ambient temperature responsive bimetal element releasably restraining said releasable means, one of said bimetal elements having an extension thereon cooperating with the low expansion side of the other of said bimetal elements so that thermal bending of the current responsive bimetal element causes flexing of said ambient temperature responsive bimetal element and release of said releasable means.

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