Aug. 27, 1946. H. D. DORFMAN 2,406,325

CIRCUIT INTERRUPTER

Filed April 29, 1942

Fig. 1.

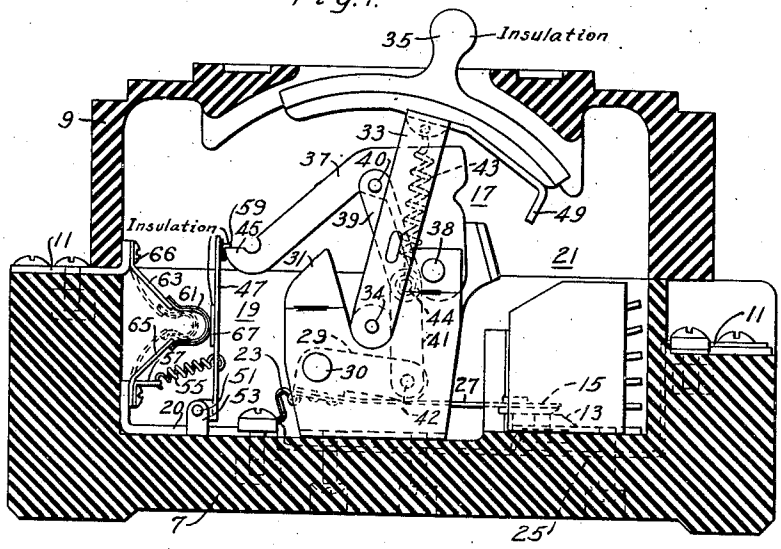


Fig. 2.

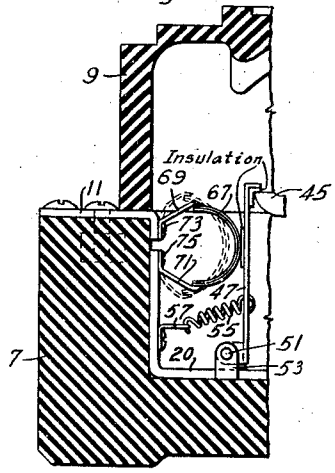
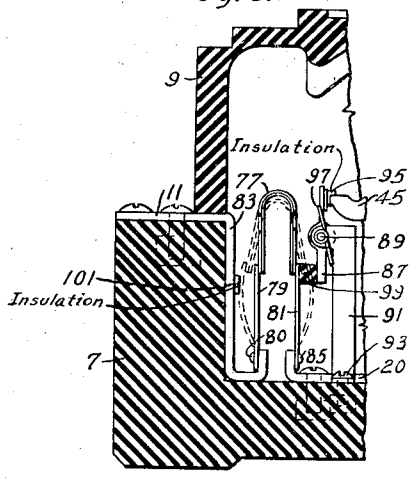


Fig. 3.



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CIRCUIT INTERRUPTER

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11 Claims. (Cl. 200—116)

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This invention relates to circuit interrupters of the type having a thermally responsive trip element of bimetallic material for causing automatic opening of the interrupter in response to predetermined conditions.

An object of the invention is to provide a circuit breaker having an improved thermal trip device wherein a bimetal trip element is mounted at each end of resilient support members which flex in response to deflection of the bimetal element to effect tripping of the breaker.

Another object of the invention is to provide a circuit breaker having an improved thermal trip device comprising a generally U-shaped bimetal element having both legs supported on resilient support members which are adapted to be flexed, when the bimetal deflects, and to displace the bimetal element to effect tripping of the breaker.

Another object of the invention is to provide a circuit breaker having an improved thermal trip device comprising a generally U-shaped bimetal element adapted when heated to move the legs thereof relative to each other, the legs of the bimetal being mounted on resilient support members which bend when the bimetal element deflects and causes movement of the bimetal bodily to effect tripping of the breaker.

Another object of the invention is to provide a circuit breaker having an improved thermal trip device comprising an arcuate bimetal element the ends of which are disposed to deflect outwardly when heated, the ends of the bimetal element being mounted on resilient support members arranged to flex upon deflection of the bimetal element to effect tripping of the breaker.

Another object of the invention is to provide a circuit breaker having an improved trip device including a U-shaped bimetal element having its ends mounted on substantially parallel resilient support members, the bimetal element being disposed to deflect laterally when heated to effect tripping of the breaker.

Another object of the invention is to provide a circuit breaker with a novel trip device wherein excessive current flowing in opposite directions through the parallel legs of a U-shaped bimetal and the resilient support members for the legs of the bimetal produces an electromagnetic force to instantaneously trip the breaker on heavy overloads.

Another object of the invention is to provide a circuit breaker with a novel trip device comprising a U-shaped bimetal element having its legs supported on resilient support members

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wherein the bimetal deflects laterally when heated by persistent low overloads to trip the circuit breaker after a time delay and in which excessive current flowing in opposite directions through the bimetal element and its support members generates an electromagnetic force to instantaneously trip the breaker on heavy overloads.

Another object of the invention is to provide a circuit breaker with an improved trip device wherein a thermal element in the form of a loop is supported at each end while relative movement therebetween is permitted.

Another object of the invention is to provide a circuit breaker with an improved thermal trip means comprising a bimetallic loop with the distance between the sides thereof variable upon change of temperature, and means supporting each end of said bimetallic element while permitting relative movement therebetween.

Another object of the invention is to provide an improved circuit breaker comprising a member biased to effect opening of the breaker with an improved trip means comprising a U-shaped bimetal element having the distance between its sides variable upon change of temperature for restraining and releasing the biased member, and means supporting each end of the bimetal element to oppose release of the biased member in response to sudden shocks.

Another object of the invention is to provide a circuit breaker with a novel thermal trip device which is simple in construction, reliable and efficient 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 description of several embodiments thereof when read in conjunction with the accompanying drawing, in which:

Figure 1 is a vertical section view of a circuit breaker embodying an improved current responsive bimetallic control device constructed in accordance with the invention.

Figs. 2 and 3 are fragmentary sectional views showing modifications of the improved current responsive bimetallic control device.

The circuit breaker illustrated in Fig. 1, with the exception of the trip device, is substantially the same as that disclosed in Patent 1,802,758, issued to H. D. Dorfman on April 28, 1931, and

assigned to the assignee of this invention, for which reason only a brief description of the structure of the circuit breaker will be given herein. For the details of construction reference may be had to the above referred to patent.

The circuit breaker, as illustrated in Fig. 1, comprises a base 7, and a cover 9 of molded insulating material, end terminals 11, a stationary contact 13, a movable contact 15, operating mechanism indicated generally at 17, a current responsive trip device indicated generally at 19 and an arc extinguisher 21.

The circuit for the breaker extends from the left hand terminal 11, through the current responsive trip device 19, a conducting strip 20 through a flexible shunt conductor 23, a resilient contact arm 27, the movable contact 15, the stationary contact 13, and a conducting strip 25 to the right-hand terminal 11.

The movable contact 15 is secured to the resilient contact arm 27 which is secured by means of rivets or other suitable means to a channel-shaped frame 29 pivotally supported by means of a pivot pin 30 on a U-shaped main frame 31.

The operating mechanism 17 comprises a U-shaped operating lever 33 having an operating handle 35 of molded insulating material secured thereto, a cradle 37, a toggle comprising a pair of toggle links 39 and 41 and a pair of overcenter springs 43 (only one being shown). The operating lever 33 is pivotally mounted on pivot pins 34 on the sides of the frame 31, and the cradle 37 is pivoted on a pin 38 also supported in the frame 31. One end of the toggle link 39 is pivotally connected to the cradle 37 by a pin 40, and the toggle link 41 is pivotally connected to the free end of the channel shaped-member 29 by means of a pin 42. The toggle links 39 and 41 are pivotally connected together by a knee pivot pin 44. The overcenter springs 43 are tensioned between the knee pin 44 of the toggle 39—41 and the outer end of the operating lever 33. The cradle 37 is provided with a latch portion 45 with which a pivoted latch member 47 is adapted to cooperate to releasably restrain the cradle 37 in the position shown. The operating member 33 is provided with an extension 49 which is adapted to cooperate with the cradle in order to reset the cradle after the breaker has been tripped.

The trip device 19 includes the latch member 47 which is pivotally mounted by means of a pivot pin 51 supported in a bracket 53 formed on the conducting strip 20. The latch member 47 is biased in unlatching direction by a spring 55 having one end connected to the latch member and the other end hooked to a spring clip 57 secured to an upturned portion of the strip 20. A latch 59 mounted on the free end of the latch member 47 but suitably insulated therefrom cooperates with the latch portion 45 of the cradle 37. The latch member 47 is normally restrained in latching position against the bias of the spring 55 by a U-shaped bimetallic element 61 (Fig. 1). Each leg of the bimetal element 61 is secured by welding or by other suitable means to resilient support members 63 and 65 of conducting material. The resilient members are secured one to the inner end of the terminal 11, and the other to the upturned end of the conducting strip 20 by means of screws 66. The bimetal element 61 is insulated from the latch member 47 by means of a strip 67 of insulating material secured to the latch member.

The bimetal element 61 is constructed from a straight strip of material and is formed to substantially the shape shown in Fig. 1 with the high expansion side facing the latch member. When the bimetal element is heated a predetermined amount in response to abnormal current traversing the circuit of the breaker, the legs of the bimetal element move inwardly toward each other flexing the resilient supports 63 and 65 which results in moving the bimetal bodily to the position shown in dotted lines in Fig. 1. When this occurs, the spring 55 moves the latch member 47 in a counterclockwise or unlatching direction disengaging the latch 59 from the cradle 37. This allows the overcenter springs 43 to rotate the cradle 37 in a clockwise direction during which rotation the line of action of the springs 43 is changed to cause collapse of the toggle 39—41 and opening of the contacts in a manner well known in the art.

Before the contacts may be closed, it is necessary to reset the cradle 37 to its latched position. This is accomplished by rotating the operating lever 33 in a counterclockwise direction by means of the operating handle 35. During this movement, the extension 49 engages and rotates the cradle 37 in the same direction to reengage the latch portion 45 of the cradle with the latch 59 on the latch member 47. The contacts can now be closed by moving the handle 35 and the operating lever 33 to their extreme right hand positions, which movement changes the line of action of the overcenter spring 43, so as to straighten the toggle 39—41 and thus effect closing of the contacts with a snap action.

The breaker may be opened manually by moving the handle 35 toward the left during which movement the line of action of the springs 43 is moved to the left of the pivot pin 40. The springs thus exert a force on the toggle 39—41 in a direction to cause its collapse which results in movement of the movable contact 15 with a snap action to the open position. The contacts are closed in the previously described manner.

The short bimetal element 61 (Fig. 1) provides a low electrical resistance and is particularly adapted for use where currents of higher rating, for instance, above 70 amperes are to be controlled by the breaker. In such circumstances it is desirable that the resilient supports 63 and 65 be made of low resistance material such as bronze or copper.

In the modification illustrated in Fig. 2, the arcuate bimetal element 67 is considerably longer to provide greater electrical resistance which is necessary for lower currents, for instance fifty amperes or less. In this modification, the high expansion side of the bimetal 67 is one the inside of the arc. Support members 69 and 71 of resilient conducting material are secured to the ends of the bimetal by welding, brazing, or by other suitable means. The resilient support member 69 is secured by means of a screw 73 to the inner end of the left hand circuit breaker terminal 11, and the resilient support member 71 is similarly secured by means of a screw 75 to the upper end of the conductor strip 20 which in this case is extended upwardly a greater distance than in Fig. 1.

When the bimetal element 67 (Fig. 2) is heated a predetermined amount by overload currents traversing the circuit controlled by the breaker, it tends to straighten itself. This causes the resilient support members 69 and 71 to flex and the parts assume the shape substantially as shown by dotted lines (Fig. 2), the bimetal moving away

from the latch member 47 permitting the spring 55 to disengage the latch from the cradle 37. In the Fig. 2 embodiment of the invention, the support members 69 and 71 for the bimetal element for lower current ratings may serve as heater elements for the bimetal by constructing them of suitable resistance material.

According to the modified embodiment of the invention illustrated in Fig. 3, the bimetallic trip element 77 is U-shaped and the legs thereof are suitably secured to resilient support members 79 and 81. The support member 79 is secured by means of a screw 89 to a conducting strip 83 extending downwardly from the terminal 11, and the support member 81 is secured by means of a screw 85 to the formed end of the conductor 20. The high expansion side of the bimetal element 77 is on the inside and when the bimetal is heated a predetermined amount in response to overload currents below a predetermined value, the legs of the bimetal element spread apart or separate, flexing the resilient support members 79 and 81. This spreading action is utilized to operate a latch member 87 to release the breaker mechanism. The latch lever 87 is pivotally supported on a pivot pin 89 mounted in a pair of brackets 91 (only one being shown) secured to the base 7 of the breaker by screws 93. The upper end of the latch lever 87 carries a latch 95 which is insulated from the latch lever and cooperates with the latch end 45 of the cradle 37 to releasably restrain the operating mechanism 17 in closed circuit position. The latch lever 87 is biased in latching direction by means of a spring 97 coiled about the pin 89 and having one end bearing against the brackets 91 and the other end bearing against the upper end of the latch lever. The lower arm of the latch lever 87 carries an insulating button 99 with which the thermal element cooperates to operate the latch lever. The spreading movement of the support member 79 may be limited in one direction by a stop member 101 of insulating material secured to the conductor 83.

When the U-shaped bimetal element 77 is heated a predetermined amount in response to persistent overloads, it flexes and moves its legs away from each other as indicated by dotted lines in Fig. 3. This spreading action rotates the latch lever 87 counterclockwise to release the cradle 37 and cause opening of the contacts after a time delay in the previously described manner. On overloads above the predetermined value or on short circuits, the magnetic repelling force generated by the heavy current flowing in opposite directions through the support members 79 and 81 and the legs of the bimetal element 77 is sufficient to cause flexing of the legs of the bimetal element and the support members to substantially instantaneously operate the latch lever 87 to trip the breaker.

It will be seen from the foregoing description that there is provided an improved thermal trip device for a circuit breaker which comprises a U-shaped bimetal element having both legs thereof mounted on resilient support members. This construction, while reliable in operation in response to overload currents, is sufficiently rigid to oppose tripping of the breaker in response to physical shocks or jars. By selecting the material for the support members from a group of materials having various resistance characteristics, it is obvious that the tripping characteristic of the breaker may be suited to various current ratings. Another advantage of the invention resides in the provision of a bimetal element mounted in a manner to effect tripping of the breaker after a time delay on persistent overloads of low value and substantially instantaneously on sudden heavy overloads or short circuits. The bimetal element of each of the modifications illustrated may be made from a flat strip of bimetallic material and is, therefore, inexpensive to manufacture.

Having described several embodiments of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made therein without departing from some of the essential features of the invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

I claim as my invention:

1. A circuit breaker comprising relatively movable contacts, operating mechanism for said contacts, a trip device including a generally U-shaped current responsive bimetal element disposed to deflect when heated a predetermined amount, and resilient support means for independently supporting both ends of said bimetal element, said support means flexing when the bimetal deflects to cause an operation of the operating mechanism to open the contacts.

2. A circuit breaker comprising separable contacts, operating mechanism including a member releasable to cause opening of the contacts, latch means for releasably restraining said member, a trip device comprising a bimetal element disposed to deflect when heated a predetermined amount by excessive current, and a plurality of resilient support means for supporting both ends of the bimetal element and for connecting said bimetal element in the circuit of the breaker, said support means flexing when the bimetal deflects a predetermined amount to effect release of said releasable member.

3. A circuit breaker comprising separable contacts, operating mechanism for said contacts including a member biased to cause opening of the contacts, a latch for releasably restraining said member, said latch being biased in unlatching direction, a trip device comprising a generally U-shaped bimetal element for restraining the latch in latching position, and resilient support means for resiliently supporting both legs of said bimetal element, said bimetal element deflecting when heated a predetermined amount by excessive current in the circuit of the breaker, and said resilient support means flexing when the element deflects to cause the latch to release the said member of the operating mechanism for an opening operation.

4. A circuit breaker comprising relatively movable contacts, operating mechanism including a member biased to cause opening of said contacts, trip means for releasing said member, said trip means comprising a generally U-shaped bimetal element disposed to deflect in a direction to move its ends toward each other, and resilient support members for supporting both ends of said bimetal element, said resilient support members flexing when the bimetal deflects for moving the bimetal to cause release of the operating mechanism.

5. A circuit breaker comprising relatively movable contacts, operating mechanism including a member biased to cause opening of said contacts, and trip means for releasing said members, said trip means comprising a generally U-shaped bimetal element disposed to deflect in a direc-

tion to separate its ends, resilient support members for supporting both ends of said bimetal element, said resilient support members flexing when the bimetal deflects for moving the bimetal to cause release of the operating mechanism.

6. The invention according to claim 1 characterized by the fact that the resilient support members comprise heater elements for heating the bimetal element.

7. In a circuit breaker, the combination of a releasable operating mechanism for the breaker, a latch member for releasably restraining the operating mechanism, a U-shaped thermal element having both legs thereof supported on resilient support members, the legs of the thermal element and said resilient support members being physically disposed substantially parallel to each other and being electrically disposed in series relation with each other in the circuit of the breaker and being responsive to overload currents to operate the latch member.

8. In a circuit breaker, releasable operating mechanism for the breaker, a pivoted latch member operable to release the operating member, a trip device including a bimetal element heated in response to the current of the circuit, and resilient support members for resiliently supporting both ends of said bimetal element, said support members flexing when the bimetal element deflects to physically displace the bimetal element and thereby cause operation of the latch.

9. A circuit breaker comprising relatively movable contacts, operating mechanism for said contacts, a trip device comprising a bimetal element in the form of a loop with the distance between the sides thereof variable upon change of temperature and having a portion intermediate the ends of the loop movable upon a predetermined change in temperature to effect operation of said operating mechanism, and means for supporting each end of said bimetal element while permitting relative movement therebetween.

10. A circuit breaker comprising relatively movable contacts, operating mechanism for said contacts including a member biased to cause opening of said contacts, trip means comprising a U-shaped bimetal element having the distance between the sides of the U variable upon change of temperature, said bimetal element acting at a point intermediate its ends to normally restrain said biased member and being operable when heated a predetermined amount to release said biased member to effect opening of said contacts, and means supporting each end of said bimetal element to oppose release of said biased member in response to sudden shocks or jarring forces.

11. In a circuit breaker comprising relatively movable contacts, operating mechanism for said contacts including a member biased to effect opening of said contacts, latch means restraining said biased member against operation, a trip device for effecting operation of said latch means comprising a U-shaped bimetal element having the distance between its ends variable upon change of temperature, said bimetal element being operable when heated a predetermined amount to effect release of said biased member and opening of said contacts, and means supporting each end of said bimetal element to oppose operation of said latch in response to sudden shocks.

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