March 25, 1952 E. J. WALKER 2,590,663

CIRCUIT BREAKER

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Fig.1.

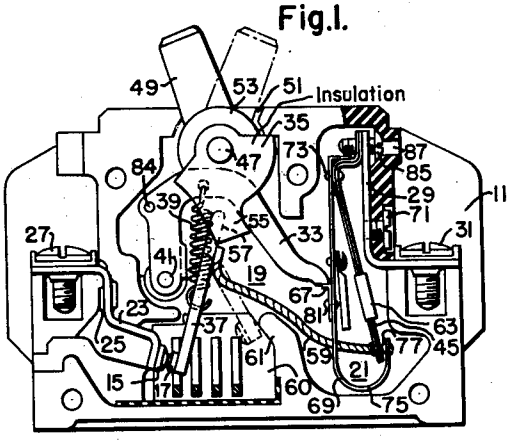


Fig.2.

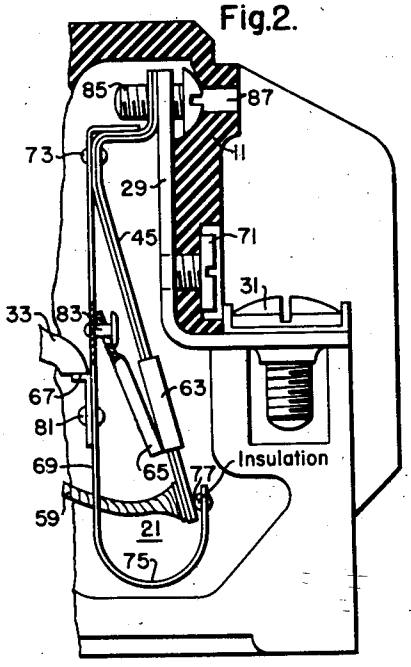
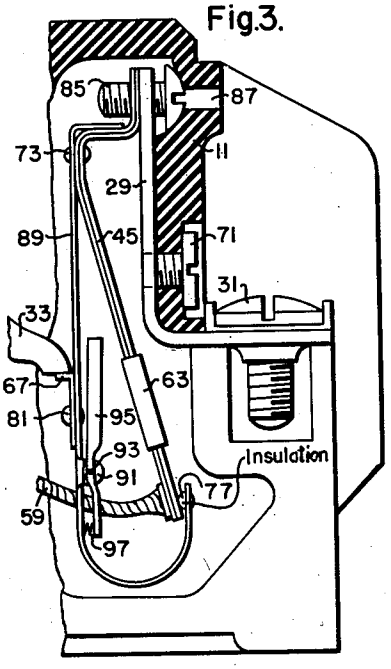


Fig.3.



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CIRCUIT BREAKER

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6 Claims. (Cl. 200—88)

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This invention relates to circuit breakers and more particularly to circuit breakers for controlling lighting and moderate power circuits.

An object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device wherein the trip member and the magnetically responsive means are supported entirely by 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 one of the magnetic members mounted on the thermally responsive means, and the other magnetic member mounted on a biased member.

A further object of the invention is to provide a circuit breaker embodying an improved thermally and magnetically responsive trip device wherein the magnetically responsive means is supported entirely on the thermally responsive means and which cooperates with the thermally responsive means to trip the breaker in response to overload currents within a predetermined intermediate range of overload currents.

Another object of the invention is to provide a circuit breaker embodying an improved trip device which 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 elevation view, with the cover removed and partly in section, of a circuit breaker embodying the principles of the invention;

Figure 2 is a fragmentary elevational view of the trip device, and

Figure 3 is a fragmentary view similar to Figure 2 but showing a modification of trip device.

Referring to Figure 1 of the drawing, the circuit breaker comprises a housing 11 and a cover plate therefor (not shown) 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 in the molded housing 11. The outer end

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of the terminal 23 is provided with a connecting means 27 for connecting the terminal 23 in an electric circuit. At the opposite end of the housing 11 is a terminal 29 which at its inner end supports the trip device (to be later described) and which is provided with a connector 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 projections molded integral therewith and mounted in a suitable opening in the housing 11 and a matching opening in the cover. An 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.

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

The switch arm 37 is operated to manually open and close the contacts 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 the switch arm to the open position and causes movement of the switch arm to open position with a snap action.

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

An arc extinguisher 60 is provided to quickly extinguish the arc drawn when the circuit is interrupted. The arc extinguisher may be of any suitable type, the one illustrated comprising a series of slotted plates into which the arc is drawn and extinguished.

The circuit breaker is adapted to be tripped open instantaneously in response to overloads above a predetermined value, or a short circuit, and after a time delay on lesser overloads by means of the trip device 21. Operation of the trip device 21 releases the carrier 33 whereupon the overcenter spring moves the carrier clockwise moving the line of action of the overcenter spring 39 to the right of the center line of the switch arm 37. Thereafter the spring 39 acts to move the switch arm to open position with a snap action. The movement of the carrier 33 is arrested by engagement with a projection 61 of the housing 11.

The operating mechanism is more fully described and claimed in application Serial No. 592,446, filed May 7, 1945, by H. S. Gano and G. J. Freese and assigned to the assignee of this invention.

The trip device 21 comprises the thermal element 45 connected by means of the flexible conductor 59 to the switch arm 37, an electromagnet including a channel-shaped magnetic member 63 and a movable magnetic member 65, a latch element 67 and a biased or resilient member 69 rigidly secured to the bimetal element. The terminal 29 is secured to the end wall of the casing 11 by means of a screw 71 and the 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 to the terminal 29 the bimetal element 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 resilient member 69 is secured. The resilient or biased member 69 is secured to the bimetal element by means of a rivet 73. Below the rivet 73 the bimetal extends downwardly at a slight angle to the terminal 29. The lower end of the biased member 69 is looped as shown at 75 and the upwardly extending end thereof carries an insulating button 77 for insulating the free end of the bimetal element 45 from the free end of the biased member 69.

The magnetic member 63 is rigidly mounted on and surrounds three sides of the thermal member 45. The magnetic member 65 is loosely mounted on a shouldered and headed stud 83 riveted to the biased member 69 so as to permit limited movement of the magnetic member 65 relatively to the biased member and toward the magnetic member 63.

The latch element 67 is secured to the biased member 69 by means of a rivet 81 and normally engages and restrains the carrier 33 in operative position as shown in Figure 1. With normal rated current flowing through the bimetal element 45 the magnetic member 65 is in the position shown in Fig. 1. Upon the occurrence of an overload current above the rated current and below a predetermined value of, for instance, 1000% of normal rated current, the bimetal element 45 is heated by the current flow therein and deflects moving its free lower end toward the right (Figure 2). The bimetal element 45, through the insulating button 77, moves the lower end of the biased member 69 in the same direction and causes the latch element 67 to release the carrier 33 whereupon the operating mechanism functions in the previously described manner to automatically open the contacts.

The arrangement of the elements of the trip device is such that it provides a cooperative tripping action in response to overload currents in the higher range of overload currents below the predetermined value of, for instance, 1000% of normal rated current. This is effected by loosely mounting the magnetic member 65 on the biased member. In the low range of overload current up to, for instance, 400% of normal rated current, the energization of the magnetic means moves the lower end of the magnetic member towards the member 63 but is insufficient to attract and move the upper end of magnetic member 65 from the position in which it is shown in Figure 2. Because of the loose mounting of the armature 65 on the shoulder of the stud 83, this preliminary movement to reduce the airgap takes place without requiring the magnetic force to be large enough to move the strip 69 against its bias. However, upon the occurrence of an overload current as, for instance, between 400% and 1000% of rated current, the magnetic member 65 is attracted and its upper end moved toward the member 63 thereby reducing the airgap between the magnetic members 63 and 65. The reduced airgap increases the pull on the magnetic member 65 and on the biased member 69 so that a smaller force will oppose movement of the bimetal and the breaker will trip quicker by action of the thermal element, than would be the case if the armature 65 were rigidly fastened to the strip 69.

Upon the occurrence of a heavy overload or short circuit, such for example as 1000% of rated current or over, the current flowing through the bimetal element 45 energizes the magnetic member 63 a sufficient amount to instantaneously attract and operate the armature 65. This causes the upper end of the armature to act on the stud 83 and flexes the biased member 69 toward the right releasing the carrier 33 and effecting instantaneous opening of the contacts.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the handle 49 clockwise to the full open position during which movement the leg 55 of the operating lever 35 engages a pin 84 in the carrier 33 and moves the carrier counterclockwise about its pivot 41. Near the end of its counterclockwise movement, the free end of the carrier 33 wipes by the latch member 67, slightly flexing the spring 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 closed position.

Adjusting means is provided whereby the trip device may be adjusted to vary the tripping point of the thermal trip. 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 permits the insertion of a suitable tool for turning the screw 85 to thereby adjust the trip device. This opening may be sealed after adjustment is made to prevent tampering.

According to the modification of the invention shown in Figure 3, a biased member 89, secured to the thermal element 45 in the same manner as the biased member 69 of the Figure 2 modification, is provided with ears 91. The ears 91 support a pivot pin 93 upon which is pivotally mounted a magnetic member 95 for limited movement. A spring 97 biases the magnetic member 95 to its unattracted position.

The operation of the Figure 3 modification is

essentially the same as the modification shown in Figures 1 and 2. On low overload currents up to about 400% of rated current the thermal element **45** deflects and bends the biased member **89** to release the breaker mechanism, but does not energize the magnetic members **63—95** sufficiently to cause the member **95** to move toward the member **63**.

On overload currents in the intermediate range but below 1000% of rated current the magnetic member **95** is attracted toward the member **63** reducing the magnetic airgap and assisting the thermal element **45** in the tripping action.

Upon the occurrence of a heavy overload current or short circuit, such for instance as 1000% or more of rated current, the magnetic member **95** is instantaneously attracted to the magnetic member **63** flexing the biased member **89** toward the right thus releasing the carrier **33** and causing instantaneous separation of the contacts **15—17**.

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 being mounted entirely on the bimetal trip element. By this construction the magnetic trip values are not affected by adjustment of the thermal trip element. By use of the resilient member carrying the latch, the bimetal element can be made stiffer without affecting the relatching effort, and magnetic tripping can take place at a lower value of current than if a relatively stiff bimetal had to be bent.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, 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 contact means and means releasable to effect opening of said contact means, a trip device for effecting release of said releasable means comprising a bimetal element supported at one end and having the other end free, a resilient element having one end rigidly supported adjacent the supported end of said bimetal element, said resilient element having a portion on one side of said bimetal element extending at an angle thereto, connecting means connecting said elements so that thermal bending of said bimetal element in response to overload currents of certain value below a predetermined value causes bending of said resilient element to release said releasable means, electroresponsive means comprising a first magnetic member mounted on said bimetal element, and a second magnetic member mounted on said resilient element, a stud on said resilient element loosely supporting one end of said second magnetic member for limited movement relative to said resilient element, said second magnetic member moving freely relative to said resilient element when said electroresponsive means is energized by overload currents of certain other value below said predetermined value to reduce the magnetic air gap and increase the pull of said second magnetic member on said resilient element, and said electroresponsive means when energized by overload currents above said predetermined value bending said resilient element to cause instantaneous release of said releasable means.

2. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting release of said releasable means in response to overload currents below a predetermined value comprising a thermally responsive element having one end supported and the other end free, a first magnetic member rigidly mounted on said thermally responsive element, a biased element movable to release said releasable means comprising a strip of resilient material having one end supported adjacent the supported end of said thermally responsive element, said resilient strip having a main portion disposed along one side of said thermally responsive element and having an abutment adjacent the opposite side of said thermally responsive element, said thermally responsive element when heated by certain overload currents below said predetermined value bending said resilient strip to effect release of said releasable means, a second magnetic member loosely mounted at one end on said resilient strip for limited movement relative to said resilient strip and being moved relative to said resilient strip in response to certain other overload currents below said predetermined value to reduce the magnetic air gap and assist said thermally responsive element to bend resilient strip, and said second magnetic member being attracted when energized by overload currents above said predetermined value to bend said resilient strip and effect instantaneous release of said releasable means.

3. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device for effecting release of said releasable means comprising a thermally responsive element rigidly supported at one end and having the other end free, a resilient member having one end rigidly supported adjacent the supported end of said thermally responsive element, said resilient member having a main portion extending along one side of said thermally responsive element and having an abutment disposed at the opposite side of said thermally responsive element adjacent the free end thereof, a magnetic member rigidly mounted on said thermally responsive element to be energized by overload currents flowing through said element, an armature having one end loosely supported on said resilient member for movement relative to said resilient member and cooperating with said magnetic member in response to certain overload conditions below a predetermined value to reduce the magnetic air gap, said thermally responsive element when heated a predetermined amount in response to certain other overload conditions below said predetermined value engaging said abutment to bend said resilient member and effect release of said releasable means after a time delay, and said armature being actuated upon energization of said magnetic members in response to overload currents above said predetermined value to bend said resilient member and effect instantaneous release of said releasable means.

4. A circuit breaker comprising a casing, relatively movable contact means and means releasable to effect automatic opening of said contact means, a conducting member extending into said casing and rigidly secured thereto, a trip device operable to effect release of said releasable means comprising a thermally responsive ele-

ment having one end rigidly supported on the inner end of said conducting member and the other end free, a resilient member rigidly supported on said thermally responsive element adjacent the supported end thereof, said resilient member having a main portion extending along one side of said thermally responsive element and having a looped portion forming an abutment disposed at the opposite side of said thermally responsive element adjacent the free end thereof, electroresponsive means comprising a first magnetic member rigidly mounted on said thermally responsive element, a second magnetic member having one end loosely supported on said resilient member for movement relative thereto, said thermally responsive element deflecting when heated in response to certain overload currents below a predetermined value to engage said looped portion and bend said resilient member to cause release of said releasable means after a relatively long time delay, said second magnetic member being moved relative to said resilient member upon energization of said electroresponsive means by certain other overload currents below said predetermined value to reduce the magnetic air gap and assist said thermally responsive element in bending said resilient member to thereby release said releasable means quicker when said thermally responsive element is hot than when it is cold, and said electroresponsive means bending said resilient member in response to overload currents above said predetermined value to instantaneously release said releasable means.

5. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, current responsive means for effecting release of said releasable means in response to overload currents in the circuit through the breaker comprising a bimetal element having one end supported and the other end free, said bimetal element being heated in response to the flow of current through the breaker, a magnetic member supported on said bimetal element, a resilient strip mounted on said bimetal element and having a latching surface thereon, said resilient strip having a main portion extending along the high expansion side of said bimetal element and having an abutment at the low expansion side of said bimetal element adjacent the free end thereof, thermal bending of said bimetal element in response to overload currents of low value causing the free end of said bimetal element to engage said abutment and bend said resilient strip and cause said latching surface to release said releasable means, an armature mounted on said resilient strip, a support member on said resilient strip supporting said armature thereon with a lost motion, said magnetic member and said armature cooperating to bend said resilient strip when energized by overload currents of high value and short circuit currents, and said lost motion support permitting movement of said armature relative to said resilient strip in response to moderate overload currents.

6. A circuit breaker comprising relatively movable contact means and means releasable to effect opening of said contact means, a trip device for effecting release of said releasable means comprising a thermally responsive element having one end supported, a biased element having a portion on one side of said thermally responsive element and having one end supported adjacent the supported end of said thermally responsive element, means on one of said elements connecting said elements for movement together upon movement of said thermally responsive element, said thermally responsive element deflecting when heated a predetermined amount in response to overload currents of certain values to move said biased member and effect release of said releasable means, electromagnetic means comprising a first magnetic member rigidly mounted to be energized by current flow in said thermally responsive element, and a second magnetic member mounted on said biased member, said second magnetic member being mounted for limited movement relative to said biased member without moving said biased member and being moved relative to said biased member in response to overload currents of certain other values below said predetermined value to reduce the magnetic air gap while said biased member remains stationary, and said magnetic members being energized by current flow in said thermally responsive element and operable when energized by overload currents above said predetermined value to move said biased member and instantaneously release said releasable means.

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