Nov. 25, 1952 R. H. SWINGLE 2,619,561

CIRCUIT BREAKER

Filed Feb. 25, 1950

Fig. 1.

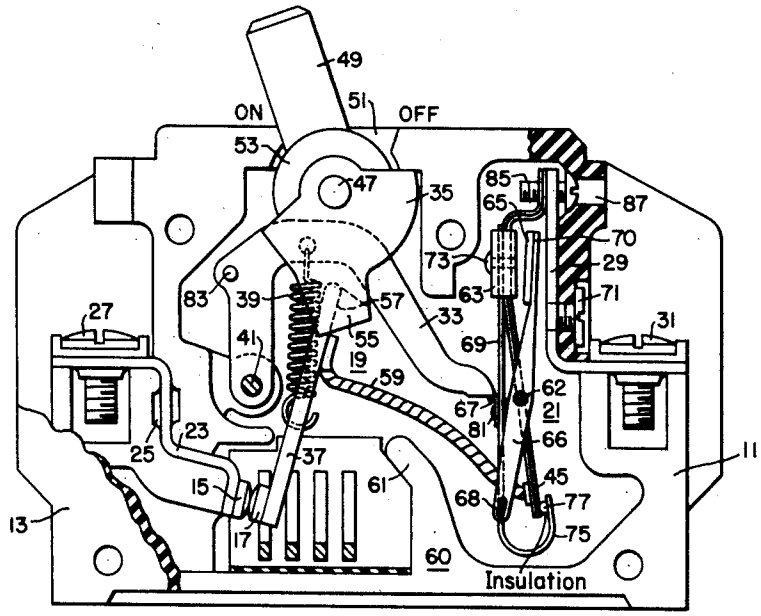


Fig. 2.

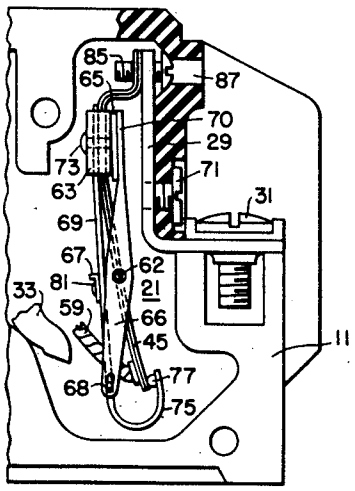
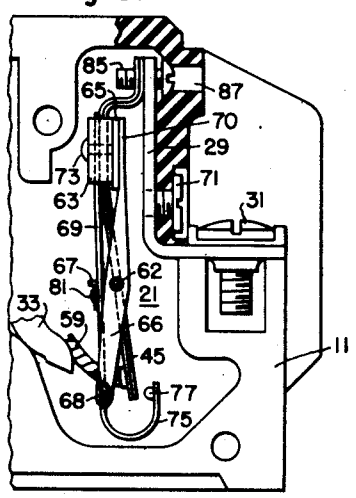


Fig. 3.



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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

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13 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 the magnetically responsive means and thermally responsive means arranged so as to tend to resist tripping of the breaker in response to shocks.

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:

Fig. 1 is a side elevation view, with the cover broken away and partly in section, of a circuit breaker embodying the principles of the invention;

Fig. 2 is a fragmentary elevational view showing the trip device in the tripped open position in response to deflection of the thermally responsive element; and

Fig. 3 is a fragmentary view similar to Fig. 2 but showing the trip device actuated to the tripped position by operation of the magnetically responsive means.

Referring to Fig. 1 of the drawing, the circuit breaker comprises a housing 11 and a cover plate 13 therefor, most of which is shown broken away, both 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 of the

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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 47 molded integral therewith and mounted in a suitable opening in the housing 11 and a matching opening in the cover 13. 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 13.

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 co-operating 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 flexible connection 59 to one end of a thermal element or 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 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 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. 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.

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 83 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.

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 of bimetallic material connected by means of the flexible conductor 59 to the switch arm 37, and electromagnet including a channel-shaped magnetic yoke or core member 63 and a movable armature 65, a latch element 67 and a biased or resilient member 69 rigidly secured to the bimetal element and a trip lever or member 66. 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 channel-shaped core member 63 and the resilient member 69 are secured. The core member 63 and the resilient member or spring 69 are 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 spring 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 spring 69.

The trip member 66 may comprise a pair of spaced parallel levers (only one being shown) disposed one on each side of the bimetal element 45 and joined at their upper ends by a yoke 70 to which the armature 65 is secured preferably by welding. The trip member 66 is pivotally supported on the bimetal element 45 by means of projections 62 extending laterally from the opposite edges thereof and engaging suitable openings in the levers 66 of the trip member. At their lower ends the levers 66 are slotted to receive projections 68 extending laterally from the resilient element or spring 69.

The latch element 67 is secured to the spring 69 by means of a rivet 81 and normally engages and restrains the carrier 33 in operative position as shown in Fig. 1. Upon the occurrence of an overload current above the rated load 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 (Fig. 2). The bimetal element 45, through the insulating button 77, moves the lower end of the spring 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, 100% of normal rated current. Referring to Figs. 1 and 2, it will be seen that, when heated in response to overload currents, the bimetal 45 deflects toward the right, moving the lower end of the spring 69 therewith. Since the lower end of the bimetal and the projections 68 move to the right a greater distance than do the pivot projections 62 adjacent the mid-portion of the bimetal, the effect is to rotate the trip member 66 slightly in a counterclockwise direction about pivots 62 reducing the air gap between the magnetic yoke or core member 63 and the armature 65. This increases the pull on the armature and causes the trip member 66 to assist in the tripping action so that the breaker will trip quicker when the bimetal is hot than when it is cold.

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 yoke or core member 63 a sufficient amount to instantaneously attract and operate the armature 65. This rotates the trip member 66 in a counterclockwise direction about the pivots 62 which, due to the engagement of the lower ends of the trip member with the projections 68 on the spring 69, flexes the spring toward the right as shown in Fig. 3 releasing the carrier 33 and effecting instantaneous opening of the contacts.

Adjusting means is provided whereby the trip device may be adjusted to vary the tripping point of the bimetal element without disturbing the tripping point of the instantaneous 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.

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 the relatively stiff bimetal had to be bent.

The trip device inherently resists tripping of

the breaker in response to shocks or jars. This is effected by the arrangement of the armature 65 and the trip member 66. A shock delivered to the breaker in a direction which would tend to move the spring 69 on which the latch 67 is mounted to the right or in tripping direction also tends to move the armature 65 toward the right. The trip member 66, pivoting at 62 and acting through the projection 68, transmits this movement of the armature to the lower end of the spring 69 opposing tripping movement of the spring. Thus the mass of the armature and that part of the lever 66 above the pivot 62 counterbalances the mass of the spring 69 and the part of the lever below the pivot 62, so that the breaker is not falsely tripped by jars or shocks.

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 including relatively movable contacts, a releasable member operable when released to effect opening of said contacts, a trip device for effecting release of said releasable member comprising a thermal element having one end rigidly supported, a resilient member having one end rigidly supported adjacent the rigidly supported end of said thermal element and having its free end cooperating with the free end of said thermal element, said thermal element deflecting when heated a predetermined amount in response to overload currents to flex said resilient member and effect release of said releasable member, electromagnetic means comprising a magnetic member mounted adjacent the rigidly mounted end of the thermal element, a trip member pivotally supported between its ends on said thermal element and having one end cooperating with said resilient member, and a magnetic member on the other end of said trip member cooperating with the first said magnetic member, and said magnetic members energized by current flowing through said thermal element and operable when energized by currents above a predetermined value to actuate said trip member to instantaneously flex said resilient member and release said releasable member.

2. A circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, current responsive means for effecting release of said releasable means in response to overload currents below a predetermined value comprising a thermal element having one end fixedly supported, a magnetic member rigidly mounted on said thermal element adjacent the fixedly supported end thereof, a trip member pivotally supported on said thermal element between the ends thereof, a second magnetic member mounted on one end of said trip member and adapted to be attracted by said first magnetic member in response to overload currents above said predetermined value, a biased member extending along said thermal element and having latch means thereon for engaging and releasably restraining said releasable means, said thermal element operating said biased member in response to overload currents below said predetermined value to effect release of said releasable means, an operating connection between the other end of said trip member and said biased member, and said second magnetic member being attracted in response to overload currents above said predetermined value to operate said trip member to thereby actuate said biased member against its bias and effect instantaneous release of said releasable means.

3. A circuit breaker having relatively movable contacts and means releasable to effect opening of said contacts, a trip device for effecting release of said releasable means comprising a thermal element rigidly supported at one end, a resilient member having one end rigidly supported adjacent the rigidly supported end of said thermal element, a U-shaped core member rigidly supported adjacent said rigidly supported end of said thermal element to be energized by overload currents flowing through said thermal element, a trip member pivotally supported on said thermal element and having one end operatively connected to said resilient member, an armature mounted on the other end of said trip member cooperating with said core member, said thermal element deflecting when heated in response to overload currents below a predetermined value to flex said resilient member and cause release of said releasable means after a time delay, and said trip member being actuated upon energization of said core member in response to overload currents above said predetermined value to flex said resilient member and cause instantaneous release of said releasable means.

4. A circuit breaker comprising a casing, relatively movable contact means and means releasable to effect 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 thermal element having one end rigidly mounted on the inner end of said conducting member, a biased member and a magnetic core member mounted on said thermal element adjacent the rigidly mounted end of said thermal element, a trip member pivotally mounted on said thermal element between said magnetic core member and the free end of said thermal element, said trip member having one end operatively connected to said biased member adjacent the free end of said biased member, an armature secured to the other end of said trip member cooperating with said core member, said thermal element deflecting when heated in response to overload currents below a predetermined value to actuate said biased member and cause release of said releasable means, and said core member and said armature being energized in response to overload currents above said predetermined value to actuate said trip member to thereby instantaneously actuate said biased member and cause release of said releasable means.

5. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal member heated in response to the flow of current through said breaker, a magnetic yoke supported on said thermal element adjacent one end thereof and energized in response to flow of current through the breaker, a trip member pivotally supported on said thermal member between the ends of said thermal member, an arma-

ture supported on one end of said trip member adapted to be attracted to said yoke upon the occurrence of an overload current of sufficient value, a resilient strip carrying a latching surface engageable by said releasable means, said resilient strip having an operative connection with the other end of said trip member, a main portion of said resilient strip being disposed on the high expansion side of said thermal member and having an abutment at the low expansion side of said thermal member so that the latching surface and the resilient strip are moved bodily by said thermal member as it engages the abutment upon flexing in response to moderate overload currents, said armature actuating said trip member to move said latching surface and said resilient strip relative to said thermal member as the armature is attracted in response to heavy overload and short circuit currents.

6. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal element mounted at one end and movable at the other end and having means movable by said thermal element to cause release of said releasable means, a trip member pivotally mounted intermediate its ends on said thermal element with the ends of the trip member on opposite sides of the thermal element, magnetic means acting on one end of said trip member to cause pivotal movement thereof, and the other end of said trip member being connected to said movable means to cause release of said releasable means.

7. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal element mounted at one end and movable at the other end, means movable by said thermal element to cause release of said releasable means, a trip member pivotally mounted intermediate its ends and crossing over said thermal element, magnetic means including a movable armature on one side of said thermal element connected to move one end of said trip member, and the other end of said trip member on the other side of the thermal element being connected to said movable means to cause movement of said releasable means.

8. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal element mounted at one end and movable at the other end, a biased member movable by said thermal element to cause release of said releasable means, a trip member pivotally mounted intermediate its ends and crossing over said thermal element, a pair of magnetic members on opposite sides of said thermal element adjacent the mounted end thereof and energized by current flow therein, one of said magnetic members being movable and connected to move one end of said trip member, and the other end of the trip member on the side of the thermal element opposite the movable magnetic member being connected to said biased member to cause release of said releasable means.

9. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal element mounted at one end and movable at the other end to cause release of said releasable means, a trip member pivotally mounted intermediate its ends and crossing over said thermal element, a biased member on one side of the thermal element, said biased member being movable by said thermal element and also being movable in the same direction independently thereof, a pair of magnetic members one of which is movable and is on the opposite side of the thermal element from the biased member, said movable magnetic member being connected to move one end of said pivoted trip member, and the other end of the trip member on the side of the thermal element opposite the movable magnetic member being connected to move said biased member and cause release of said releasable means without movement of the thermal element.

10. A circuit breaker having relatively movable contact means and means releasable to effect opening of said contact means, current responsive means for effecting the release of said releasable means in response to an overload current in the circuit through said breaker comprising a thermal element mounted at one end and movable at the other end to cause release of said releasable means, a trip member pivotally mounted intermediate its ends on said thermal element and crossing over said thermal element, a biased member on one side of the thermal element, said biased member being movable by said thermal element and also being movable in the same direction independently thereof, a pair of magnetic members on opposite sides of the thermal element and one of which is movable and is on the opposite side of the thermal element from the biased member, said magnetic members being energized by current flow through said thermal element, said movable magnetic member being connected to move one end of said pivoted trip member, and the other end of the trip member on the side of the thermal element opposite the movable magnetic member being connected to move said biased member and cause release of said releasable means without movement of the thermal element.

11. 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 in the circuit through said breaker comprising a thermal element supported at one end and movable at the other end, a trip member pivoted intermediate its ends, latch means connected at all times to one end of said trip member to move therewith, said latch means releasably restraining said releasable means, said thermal element flexing when heated a predetermined amount and engaging a portion of said latch means to move said latch means and cause release of said releasable means, an armature on the opposite end of said trip member from said latch means, and a magnetic member disposed adjacent the supported end of said thermal element and operative when energized to move said trip member.

12. A circuit interrupter having relatively mov-

able contact means and means releasable to effect opening of said contact means, current responsive means comprising a thermal element supported at one end and movable at the other end, a pivoted trip member pivoted intermediate its ends and having its opposite ends on opposite sides of said thermal element, latch means on one side of said thermal element releasably restraining said releasable means and movable by one end of said trip member to effect release of said releasable means, said thermal element flexing when heated a predetermined amount in response to overload currents of predetermined value to engage a portion of said latch means and move said latch means to cause release of said releasable means, an armature on the other end of said trip member on the opposite side of said thermal element from said latch means, and a magnetic member supported adjacent the supported end of said thermal element cooperating with said armature upon energization thereof in response to overload currents above said predetermined value to actuate said trip member.

13. A circuit breaker having relatively mov-

able contact means and means releasable to effect opening of said contact means, a bimetal element supported at one end and movable at the other end, a trip member pivoted intermediate its ends, an armature on said trip member on the end thereof adjacent the supported end of said bimetal element, said armature being disposed on one side of said bimetal element, a fixed magnetic member supported adjacent the supported end of said bimetal element to be energized by current flowing through said bimetal element, latch means on the opposite side of said bimetal element from said armature releasably restraining said releasable means, said latch means having a portion on the same side of said bimetal element as said armature engageable by said bimetal element to cause release of said releasable means, and said trip member being connected with a portion of said latch means and being movable upon energization of said magnetic member to move said latch means.

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No references cited.