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2,866,027

CIRCUIT BREAKER

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Fig. 3.

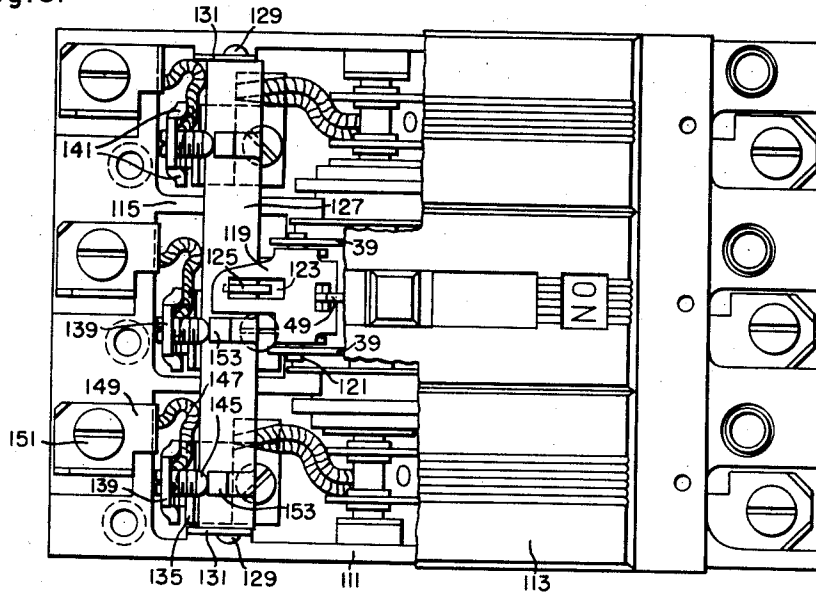
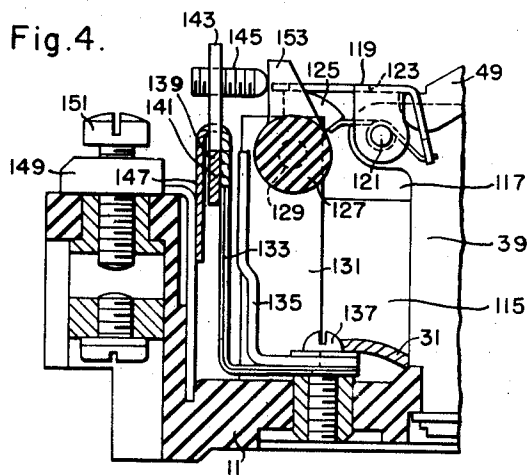


Fig. 4.



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CIRCUIT BREAKER

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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 trip device.

Another object of the invention is to simply reduce the cost of a circuit breaker embodying a trip device comprising a tripping bimetal element and an improved electromagnetic trip means.

It is a further object of the invention to use a shorter piece of bimetallic material without substantially reducing the amount of thermal deflection, and to eliminate the need for a separate terminal member by which the flexible current conductor is connected to the bimetal.

An additional object of the invention is to combine the terminal for the flexible conductor and the armature of the magnetic trip in a single piece and to use an extension of the same piece to trip the breaker. The magnetic trip is energized by the current flow partly in the bimetal and partly in the flexible conductor which are each welded or brazed to the armature near each other to form a continuous current path between the armature and the stationary magnetic member of the magnetic trip.

The invention, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

Figure 1 is a vertical sectional view of a circuit breaker embodying the principles of the invention;

Fig. 2 is a perspective view showing the improved trip device;

Fig. 3 is a top view of a multiple circuit breaker with the cover partly broken away to show the improved trip device as applied to a multiple circuit breaker; and

Fig. 4 is an elevational sectional view of the improved multiple trip device of Fig. 3, only the trip device for the center pole being shown.

Referring to Fig. 1 of the drawings, the circuit breaker comprises generally a base 11 and a cover 13 both of molded insulating material, a stationary contact 15, a movable contact 17, an operating mechanism 19 and a trip device 21. The stationary contact 15 is mounted on the inner end of a conducting strip 23 to the outer end of which is secured a terminal connector 25.

The movable contact 17 is rigidly mounted on the free end of a spring contact arm 27 which is secured to a U-shaped movable switch member 29. The movable contact 17 is electrically connected by means of a flexible conductor 31 to the trip device 21, as will be hereinafter described. The trip device 21 is, in turn, connected to the inner portion of a conducting strip 33 which at its outer end is connected to a terminal connector 35.

The movable switch member 29 is pivotally mounted on a pin 37 supported in the sides of a generally U-shaped frame 39 secured to the base 11 of the housing. A stop

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pin 41 is mounted in the sides of the frame 39 and co-operates with projections 43 on the U-shaped switch member 29 to limit the opening travel of the switch member.

The operating mechanism 19 is mounted in the frame 39 and comprises a U-shaped operating lever 45 having its legs pivoted on the pivot members 47 (only one being shown) integral with the sides of the frame 39, a releasable carrier 49 pivoted on a pin 51 in the frame 39, a pair of toggle links 55 and 57 and overcenter springs 59, only one of which is shown. The toggle links 55, 57 are pivotally connected together by means of a knee pivot pin 61. The inner end of the toggle link 55 is pivotally connected by a pin 63 to the U-shaped switch member 29, and the outer end of the toggle link 57 is pivotally connected to the releasable carrier lever 49 by a pin 65. The overcenter springs 59 have their outer ends connected to the bight portion of the U-shaped operating lever 45 and their inner ends are connected to the knee pivot pin 61 of the toggle 55, 57. An operating handle 67 of molded insulating material is secured to the outer end of the operating lever 45 and is provided with a handle portion which extends out through an opening 69 in the cover 13. The operating handle is also provided with an arcuate portion 71 which serves to substantially close the opening 69 in all positions of the handle. Lugs 73 struck out from the sides of the frame 39 serve as stops to limit the opening and closing movement of the operating lever 45.

The breaker contacts are opened manually by counterclockwise movement of the operating handle from the "on" position in which it is shown in Fig. 1 to the "off" position. This movement carries the line of action of the overcenter springs 59 over to the left of the pivot pin 65 whereupon the force of the springs causes collapse of the toggle 55, 57 thereby moving the switch arm 27 to the open contact position with a snap action. The contacts are closed by reverse movement of the operating handle back to the "on" position which moves the line of action of the overcenter springs 59 over to the right of the pin 65, at which time the springs actuate the toggle 55, 57 to its extended overset position and closes the contacts with a snap action.

The trip device 21 (Figs. 1 and 2) comprises a relatively short bimetal element 75, a stationary magnetic member 77 and a movable magnetic member or armature 81. The bimetal element 75 and the stationary magnetic member 77 are each provided with a mounting foot and are rigidly secured to the base 11 by a screw 79. The main portions of the bimetal 75 and the stationary magnetic member 77 extend upwardly at right angles to their respective mounting feet and are spaced from each other.

The armature 81 is mounted on and extends beyond the free end of the bimetal 75 instead of being mounted at a point spaced below the free end of the bimetal as in conventional trip devices of this type. In such prior devices where the armature is mounted at a point intermediate the ends of the bimetal, the portion of the bimetal from the edge of the armature nearest the mounted end of the bimetal to the free end of the bimetal contributes very little to the tripping effort of the bimetal. This is because (1) the very top of the bimetal may not be traversed by the current, (2) it is kept cooler by the heat absorbing capacity of the armature and terminal; and (3) its small motion is not amplified as is the motion nearer the foot of the bimetal. By mounting the lower portion of the armature at the free end of the bimetal a shorter piece of bimetal can be used without substantially reducing the amount of thermal deflection of the bimetal.

The armature is provided with pole pieces 83 and a portion 85 of the armature extends upwardly therefrom

and has means thereon in the form of an adjustable latch 87 for initiating release of the releasable carriers 49.

Another feature of the invention is to eliminate the separate terminal member usually mounted on the bimetal by which the flexible conductor is attached to the bimetal. This is accomplished by attaching one end of the flexible conductor directly to the armature. A flexible conductor 89 has one end attached to the armature 31 at the lower end thereof and adjacent the free end of the bimetal by any suitable means, such for instance, as by welding or brazing. The flexible conductor 89 extends upwardly between the stationary magnetic member 77 and the armature 31 and has its other end secured to the conducting strip 33. The magnetic trip is energized by the current flow mostly in the flexible conductor. The latch member 87 and the portion 85 of the armature 31 normally engage in a latch piece 91 secured to but insulated from the carrier lever 49 to releasably restrain the carrier lever in the operative position as shown.

The circuit through the circuit breaker extends from terminal conductor 25 through the conducting strip 23, the stationary and movable contacts 15, 17, the flexible conductor 31, bimetal element 75, the magnetic member 81 and the flexible conductor 89 to the conducting strip 33 and terminal 35. The bimetal element 75 is heated by the current of the circuit, and when heated a predetermined amount in response to a low persistent overload current, bends toward the left and after a time delay disengages the latch member 87 from the latch 91, thus effecting release of the releasable carrier. When the carrier 49 is released, the force of the overcenter springs 59 acting through the toggle link 57 rotates the carrier clockwise about its pivot 51. This movement carries the pivot pin 65 over to the right of the line of action of the springs 59, whereupon the springs cause collapse of the toggle 55, 57 and opening of the contacts with a snap action.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and re-latch the carrier 49. This is accomplished by movement of the handle and operating lever 45 to its full counterclockwise position. During this movement, a projection 93 on the operating lever 45 engages a shoulder 95 on the carrier lever 49 and rotates the carrier lever in a counterclockwise direction. Near the end of this movement the latch 91 wipes by the latch member 87 slightly bending the bimetal element 75 which thereafter springs back to its latching position. The contacts are then closed in the previously described manner.

The end 89' of the flexible conductor 89, which extends between the pole pieces 83 of the magnetic member 81, forms a single turn coil which, upon the occurrence of a heavy overload current or a short circuit current, energizes the magnetic member 81 sufficiently to cause it to be instantaneously attracted to the fixed magnetic member 77. This bends the bimetal element 75 and causes the latch member 87 to disengage the latch 91 and effect instantaneous opening of the contacts.

Figs. 3 and 4 illustrate the invention as applied to a three-pole circuit breaker. The circuit breaker comprises a housing including a base 111 and a cover 113 of molded insulating material. This housing is divided lengthwise into compartments by means of matching barriers 115 and 117 molded respectively in the base and cover. The operating mechanism for the three-pole breaker is the same as that shown in Fig. 1 and is mounted in the center compartment. The releasable carrier 49, as shown in Figs. 3 and 4, is somewhat shorter than it is in Fig. 1 and is engaged and releasably restrained by a latch member 119 pivotally mounted on a pivot pin 121 supported in the frame 39 (Fig. 3). The latch member 119 has an opening 123 therein, one edge of which engages an arcuate latch 125 molded in a trip bar 127 which extends across all of the poles of the breaker. The trip bar 127 is of molded insulating material and is mounted

for rotation by means of pins 129 molded in the ends of the trip bar engaging openings in brackets 131 in the outer compartments.

Each pole of the breaker is provided with a trip device comprising a relatively short bimetal element 133 and a fixed magnetic member 135, each having a mounting foot rigidly secured by means of a screw 137 to the base 111 of the breaker. The main portion of the bimetal 133 extends upwardly at a right angle from its mounting foot and has a movable magnetic member or armature 139 rigidly secured adjacent its lower edge to the upper or free end of the bimetal. By terminating the bimetal 133 adjacent the lower edge of the armature, a shorter piece of bimetal can be used without substantially reducing the amount of thermal deflection.

The armature 139 has spaced pole pieces 141 formed thereon and an upwardly extending portion 143 of the armature serves to initiate release of the carriers 49 by means of an adjusting screw 145 mounted thereon.

The armature 139 also serves as a terminal for connecting a flexible conductor 147 to the bimetal, thus eliminating the separate terminal that is usually mounted on the free end of the bimetal for this purpose. The flexible conductor 147 has one end attached to the armature 139 between the armature and the stationary magnetic member 135 and adjacent the free end of the bimetal element. The flexible conductor 147 extends upwardly between the pole piece 141 and between the armature and the stationary magnetic member and has its other end attached to a conducting strip 149, which extends out of the breaker housing and has a terminal connector 151 at its outer end. The current flow through the portions of the bimetal and the flexible conductor between the armature 139 and the stationary magnetic member 135 energizes the magnetic trip.

When the bimetal 133 is heated a predetermined amount in response to a low overload current, it deflects in a direction to cause the screw 145 to engage a projection 153 on the trip bar and actuate the trip bar to effect release of the carriers 49 after a time delay. Energization of the magnetic trip by a high overload current energizes the magnetic trip sufficiently to cause it to bend the bimetal and, through the screw 145, actuate the trip bar to effect instantaneous release of the carrier 49 and opening of the breaker.

The invention provides an improved trip device for a circuit breaker which uses a shorter bimetal than heretofore without substantially reducing the amount of thermal deflection and eliminates the need for a separate terminal member for connecting the flexible conductor to the bimetal by combining in a single piece the armature for the magnetic trip and the terminal member for the flexible conductor. The flexible conductor has one end secured to the armature adjacent the free end of the bimetal and, together with a portion of the bimetal serves as a single turn coil for energizing the magnetic trip.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes and modifications may be made in the structural details and combination of elements disclosed without departing from the spirit of the invention.

I claim as my invention:

1. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end fixedly supported and the other end free, electromagnetic means comprising a fixed magnetic member and a movable magnetic member, said movable magnetic member being rigidly attached to the free end of said bimetal element and extending longitudinally beyond the free end of said bimetal, a portion on said movable magnetic member beyond the free end of said bimetal for initiating release of said releasable means, thermal bending of said bimetal element causing said portion to effect

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release of said releasable means, and said electromagnetic means when energized bending said bimetal to cause said portion to effect instantaneously release of said releasable means.

2. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixed magnetic member adjacent one side of said bimetal element, a movable magnetic member rigidly attached to the free end of said bimetal element, a projection on said movable magnetic member extending longitudinally beyond the free end of said bimetal element, thermal bending of said bimetal element causing a portion on said projection extending longitudinally beyond the free end of said bimetal element to effect release of said releasable means after a time delay, and said electromagnetic means when energized, bending said bimetal element to effect instantaneous release of said releasable means.

3. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixed magnetic member adjacent one side of said bimetal element, a movable magnetic member rigidly secured to the free end of said bimetal element, pole pieces on one of said magnetic members extending toward the other magnetic member, a projection on said movable magnetic member extending longitudinally beyond the free end of said bimetal element, thermal bending of said bimetal element causing a portion of said projection on said movable magnetic member extending longitudinally beyond the free end of said bimetal element to effect release of said releasable means after a time delay, and said electromagnetic means when energized bending said bimetal element and causing said portion of said projection on said movable magnetic member to effect instantaneous release of said releasable means.

4. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixedly mounted magnetic member extending along one side of said bimetal element, a movable magnetic member rigidly secured to the side of said bimetal element on the side thereof adjacent said fixed magnetic member and extending longitudinally beyond the free end of said bimetal element, an adjustable latch surface on the extending portion of said movable magnetic member engaging and releasably restraining said releasable means, thermal bending of said bimetal element moving said latch surface to effect release of said releasable means, pole pieces on said movable magnetic member adjacent said fixed magnetic member, energizing means for said electromagnetic means comprising a flexible conductor having an end electrically connected to said movable magnetic member between said pole pieces and adjacent the free end of said bimetal element, and said electromagnetic means when energized bending said bimetal element to move said movable magnetic member and effect release of said releasable means.

5. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixed magnetic member at one side of said bimetal element, a movable magnetic member rigidly mounted on and extending longitudinally beyond the free end of said bimetal element, said movable magnetic member having a reduced portion extending longitudinally beyond the main body of said movable magnetic member for initiating release of said releasable means, adjustable means on said reduced portion for varying the

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tripping time, thermal bending of said bimetal element moving said movable magnetic member to cause said reduced portion to effect release of said releasable means, spaced pole pieces on said movable magnetic member extending toward said fixed magnetic member, energizing means for said electromagnetic means comprising a flexible conductor having an end electrically connected to said movable magnetic member between said spaced pole pieces and at a point adjacent the free end of said bimetal element, and said electromagnetic means when energized moving said movable magnetic member to cause said reduced portion to effect release of said releasable means.

6. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixed magnetic member and a movable magnetic member, said movable magnetic member being rigidly mounted on the free end of said bimetal element and having a portion extending longitudinally beyond the free end of said bimetal element, adjustable means on said portion of said movable magnetic member for initiating release of said releasable means, spaced pole pieces on one of said magnetic members, energizing means for said electromagnetic means comprising a flexible conductor having an end connected to said movable magnetic member between said spaced pole pieces and at a point adjacent the free end of said bimetal element, and said electromagnetic means when energized moving said movable magnetic member to initiate release of said releasable means.

7. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromagnetic means comprising a fixed magnetic member, a movable magnetic member rigidly mounted on the free end of said bimetal element and extending longitudinally beyond the free end of said bimetal element, said movable magnetic member having a reduced portion on which is adjustably mounted means for initiating release of said releasable means, spaced pole pieces on one of said magnetic members extending toward the other of said magnetic members, energizing means for said electromagnetic means comprising a flexible conductor having one end connected to said movable magnetic member between said spaced pole pieces and at a point adjacent the free end of said bimetal element, said flexible conductor extending outwardly away from the free end of said bimetal element between said spaced pole pieces, and said electromagnetic means when energized moving said movable magnetic member to effect release of said releasable means.

8. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end fixedly supported and the other end free, electromagnetic means comprising a fixed magnetic member and a movable magnetic member, said movable magnetic member being rigidly attached to the free end of said bimetal element and extending longitudinally beyond the free end of said bimetal, a portion on said movable magnetic member beyond the free end of said bimetal for initiating release of said releasable means, thermal bending of said bimetal element causing said portion to effect release of said releasable means, energizing means for said electromagnetic means comprising a flexible conductor having one end attached to said movable magnetic member, and said electromagnetic means when energized bending said bimetal to cause said portion to effect instantaneously release of said releasable means.

9. A circuit breaker comprising relatively movable contacts and means releasable to effect opening of said contacts, a trip device comprising a bimetal element having one end supported and the other end free, electromag-

netic means comprising a fixed magnetic member adjacent one side of said bimetal element, a movable magnetic member rigidly secured to the free end of said bimetal element, pole pieces on one of said magnetic members extending toward the other magnetic member, a projection on said movable magnetic member extending longitudinally beyond the free end of said bimetal element, thermal bending of said bimetal element causing a portion of said projection on said movable magnetic member extending longitudinally beyond the free end of said bimetal element to effect release of said releasable means after a time delay, energizing means for said electromagnetic means comprising a flexible conductor having one end connected to said movable magnetic member between said pole pieces, and said electromagnetic means

when energized bending said bimetal element and causing said portion of said projection on said movable magnetic member to effect instantaneous release of said releasable means.

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