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TRIP DEVICE FOR CIRCUIT BREAKERS

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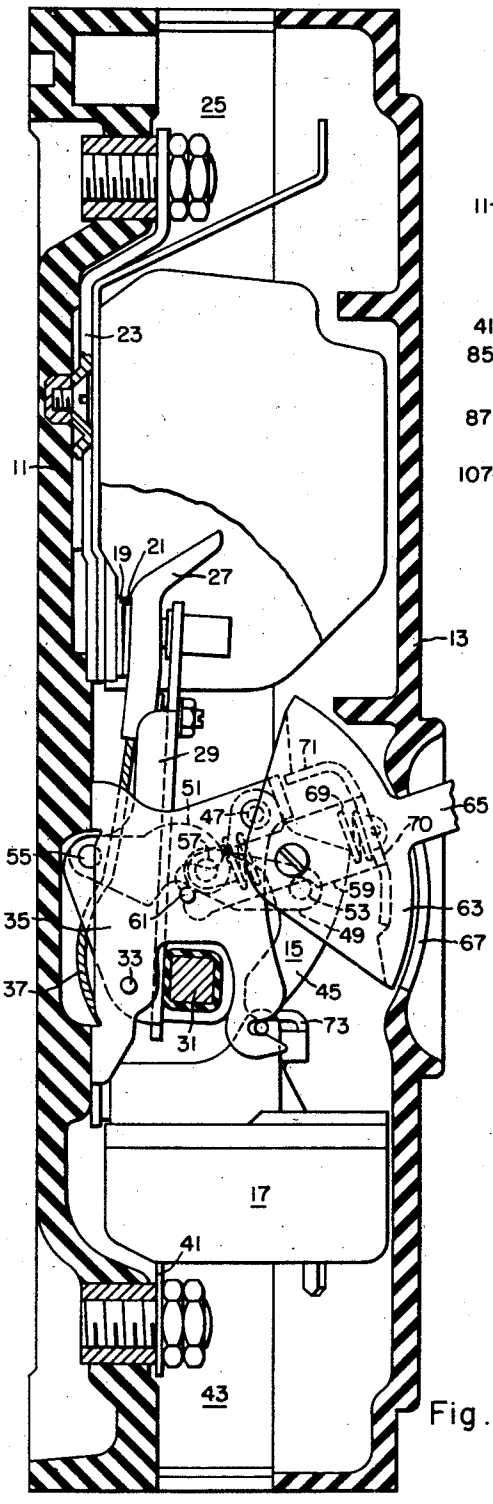

Fig. 1.

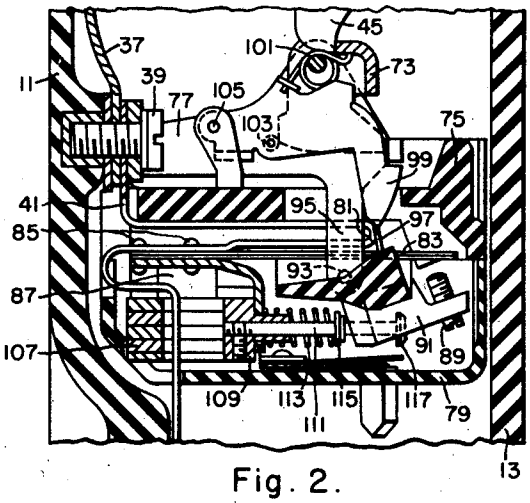

Fig. 2.

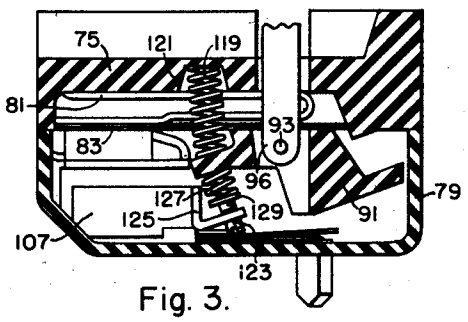

Fig. 3.

INVENTORS
Alexander C. Bires, Jr. &
Thomas W. Slebodnik.
BY
Ralph W. Swingle
ATTORNEY

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TRIP DEVICE FOR CIRCUIT BREAKERS

Alexander C. Bires, Jr., and Thomas W. Slebodnik, Beaver, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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This invention relates to circuit breakers and more particularly to circuit breakers embodying thermal and/or electromagnetic tripping means for tripping the circuit breaker in response to overload currents.

In certain installations of circuit breakers the breaker and the trip devices thereof are often subjected to shocks and jarring forces of such magnitude as to cause movement of the trip mechanism sufficient to effect undesirable opening of the breaker. In such event the circuits controlled by the breakers are opened and remain open until an authorized person closes the affected breaker or breakers. Under such conditions serious consequences may result from such unwanted interruption of the circuits controlled by the circuit breaker so affected.

In some instances the circuit breaker has a strong snap-acting spring for opening and closing the contacts with a quick make and break, and the jarring force of the snap action in opening the breaker may cause a tripping operation of the current-responsive latch, with the result that the breaker cannot be reclosed without first resetting it to re-engage the trip latch.

In certain types of circuit breakers having a common trip bar that is movable to effect tripping of the breaker, the means for determining and adjusting the position of the trip bar comprises an adjusting screw threaded into the trip bar and having an end bearing against a portion of the framework of the breaker. A shock delivered to the base or framework is transmitted through the adjusting screw causing sufficient movement of the trip bar to effect tripping of the breaker.

An object of the invention is to provide a circuit breaker with means for preventing tripping of the breaker in response to shocks or jarring forces.

Another object of the invention is to provide a circuit breaker embodying a trip device having an element movable to effect tripping of the breaker with means for preventing tripping movement of said element in response to shocks or jarring forces but which will allow movement of said element in response to predetermined circuit conditions.

The invention both as to structure and operation, together with additional aspects 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 vertical sectional view of a circuit breaker embodying the principles of the invention;

Fig. 2 is a sectional view on an enlarged scale of the trip device;

Fig. 3 is a sectional view on an enlarged scale of the trip device, taken on a different plane than Fig. 2 and showing the shock-proof arrangement.

The invention is illustrated as applied to a circuit breaker of the type shown in U. S. Patent 2,586,326, issued February 19, 1952, to George G. Grissinger, Ture Lindstrom and Jerome Sandin, and assigned to the assignee of the present invention.

Referring to Fig. 1 of the drawing, the circuit breaker is of the multi-pole type and comprises a base **11** and a cover **13** both made of molded insulating material, operating mechanism indicated generally at **15** and a trip device indicated generally at **17** having electroresponsive tripping means for at least two poles of the breaker. Each pole of the breaker is provided with a stationary contact **19** and a cooperating movable contact **21**. The stationary contact **19** is mounted on the lower end of a conductor **23** secured to the base **11** of the breaker and having a terminal **25** at its outer end.

The movable contact structures for the several poles are the same, for which reason only the movable contact structure for the center pole has been shown and will be described. The movable contact for the center pole is secured to a contact arm **27** which is loosely supported on a channel-shaped switch arm **29**. The channel-shaped switch arms are rigidly fastened for unitary movement by means of a tie bar **31** which extends transversely across all of the poles of the breaker. By means of the tie bar **31**, all of the switch arms **29** are mechanically inter-connected so that all of the switch arms are operated by a single operating mechanism. The channel-shaped switch arm **29** for the center pole is pivotally supported on a pin **33** mounted in a U-shaped frame **35** suitably secured to the base **11**. The pin **33** forms a pivot for all of the mechanically connected switch arms **29**.

The upper end of a flexible conductor **37** is connected to the contact arm **27** and the lower end of the flexible conductor is connected by means of a screw **39** to a conductor **41** (Figs. 1 and 2) which forms the energizing means for the trip device **17**. The conductor **41** is provided at its lower end with a terminal **43**.

The operating mechanism **15** comprises a releasable member **45** pivoted on a pin **47** in the frame **35** and connected to the channel-shaped switch arms **29** for the center pole of the breaker by a toggle comprising toggle links **49** and **51**. The toggle link **49** is connected by means of a pin **53** to the releasable member **45** and the toggle link **51** is connected to the channel-shaped center pole switch arm **29** by a pin **55**. The toggle links **49** and **51** are pivotally connected together by a knee pin **57**.

A U-shaped operating lever **59** has its legs pivotally mounted on pins **61** (only one being shown) projecting from the frame **35** and a handle **63** mounted on the outer end of the operating lever has a finger piece **65** extending out through an opening **67** in the cover **13**. An overcenter spring **69** is connected under tension between the yoke portion **70** of the operating lever **59** and the knee pin **57** of the toggle **49**, **51**. The yoke portion **70** of the operating lever is provided with a formed portion **71** for the purpose of energizing and resetting the releasable member **45** to its latched position following an automatic opening operation. The releasable member **45** is normally restrained in the position shown in Fig. 1 by a latch **73** of the trip device, which engages a latching portion of the releasable member.

The circuit breaker is operated manually to the open position by movement of the handle clockwise from the position in which it is shown in Fig. 1 to the "off" position. During this movement the line of action of the overcenter spring **69** is carried over center below the pivot pin **53** at which time the spring **69** causes collapse of the toggle **49**, **51** and opening of the contacts with a snap action. The circuit breaker is closed by manual movement of the handle back to the "on" position which movement carries the line of action of the spring **69** over center above the pivot pin **53** at which time the spring **69** straightens the toggle **49**, **51** and closing the breaker contacts with a snap action.

The circuit breaker is tripped open automatically in

response to overload currents by operation of the trip device 17. When the latch 73 is released by the trip device, it frees the releasable member 45 and permits the spring 69 to rotate the releasable member 45 in a counterclockwise direction, thus causing collapse of the toggle 49, 51 and movement of the channel-shaped switch arms 29 and the movable contacts for all of the poles of the breaker to the open circuit position. The breaker cannot be closed following a tripping operation until the mechanism is reset and relatched which is effected by moving the handle to its fully open position. Thereafter the handle may be moved to the closed position to close the contacts.

The trip device is mounted on an insulating base 75 (Fig. 2) secured to an angle bracket 77 which is, in turn, secured to the base 11 of the breaker. A cover 79 of insulating material is provided to enclose the trip device. The electroresponsive tripping means for all of the poles are the same for which reason only the parts for the center pole will be described. The energizing conductor 41 has a loop 81 therein forming a heater element, the upper leg of which is disposed adjacent to the base 75. A bimetal element 83 has an end secured to rivets 85 to the lower leg of the loop, the rivets also serving to secure both the lower loop of the heater element 81 and the bimetal element 83 to a bracket 87 mounted on the electromagnetic trip means. The bimetal element 83 extends towards the right (Fig. 2) and has its free end disposed adjacent an adjusting screw 89 in an insulating trip bar 91.

The trip bar 91 is pivotally mounted by pins 93 in the trip bar engaging bearing projections 95 (Fig. 2) and 96 (Fig. 3) which extend downward from the bracket 77. In the normal position of the trip bar 91, a latch member 97 thereon engages a latch 99 to releasably restrain the latter in latching position. Thermal bending of the bimetal element 83 causes the free end thereof to engage the screw 89 and move the trip bar 91 clockwise about its pivot 93. This movement of the trip bar disengages the latch 97 from the latch 99 thus freeing the latch 99 which, in turn, frees the latch 73 causing an opening operation of the breaker mechanism in the previously described manner. The latch 99 is pivoted on a pin 105 in the bracket 77, and the latch 73 is pivoted on a pin 101 in the bracket 77.

It will be noted that the latch 99 restrains the latch 73 with a large moment arm and the latch 97 restrains the latch 99 with a large moment arm thereby effecting a large mechanical advantage and an extremely light latch load on the trip bar.

The trip device is also provided with electromagnetic means for at least two of the poles responsive to overload currents above a predetermined value, or short circuit currents, to instantaneously actuate the trip bar 91 and cause automatic opening of the circuit breaker. The electromagnetic means comprises a fixed U-shaped magnet yoke 107 mounted on the base 75. An armature 109 is threaded onto one end of a rod 111 and locked in place by a set screw. The rod 111 is slidable in an opening in a part of the bracket 87 and the armature 109 is biased to its retracted position against the bracket by means of a spring 113 compressed between the bracket and a collar 115 secured to the rod. The rod 111 extends through an open slot in the trip bar 91 and the end of the rod has a head 117 thereon which, upon movement of the armature to attracted position engages and rotates the trip bar 91 clockwise about pivot 93 to trip the breaker.

It is necessary to adjust the latch member 97 (Fig. 2) relative to the latch 99 in order to calibrate the trip device. In the past, this adjusting means was usually in the form of an adjusting screw threadedly engaging a portion of the trip bar, and the trip bar was biased so that the end of the screw bore against a fixed part of the breaker such, for instance, as the base 75 of the trip device. The difficulty with this arrangement is that shocks or jarring forces delivered to the base of the breaker are transmitted through the adjusting screw to the trip bar and could cause false tripping of the breaker. This difficulty is overcome by providing a resilient stop or spring between the adjusting screw and the trip bar which spring absorbs and prevents the shock from being transmitted to the trip bar.

Referring to Fig. 3 of the drawing, a spring 119 is disposed between a spring seat 121 on the base 75 of the trip device and a part of the trip bar biasing the trip bar in a counterclockwise direction. An adjusting screw 123 threadedly engages a bracket 125 rigidly mounted on the fixed magnet yoke 107 for one of the poles of the breaker and a resilient stop or spring 127 is disposed between a collar 129 on the adjusting screw 123 and the trip bar 91. By turning the adjusting screw 123, the tension of the springs 119, 127 will be varied and, due to the difference in the strength of the springs, the initial position of trip bar 91 will be varied.

It will be seen that any shock to which the circuit breaker is subjected will be absorbed by the springs and thus prevented from reaching the trip bar to cause false tripping of the breaker.

Having described the invention in accordance with the provision of the patent statutes, it is to be understood that various changes and modifications may be made in the structural details and arrangement of parts thereof without departing from the spirit of the invention.

We claim as our invention:

1. A circuit breaker comprising relatively movable contacts, a trip device for effecting automatic opening of said contacts, said trip device comprising a trip member movable to effect opening of said contacts, thermally responsive means comprising a bimetal element extending along one side of said trip member and operable when heated in response to overload currents to engage a portion on said trip member and move said trip member in tripping direction, means comprising a pair of springs biasing said trip member in opposite directions for opposing false movement of said trip member and opening of said contacts in response to sudden shocks, and adjusting means for adjusting one of said springs to thereby vary the initial position of said trip member.

2. A circuit breaker having relatively movable contacts, a trip device for effecting automatic opening of said contacts comprising a pivoted trip member movable to effect opening of said contacts, electromagnetic trip means including an armature operable to move said trip member in tripping direction, spring means free of said trip member biasing said armature to unattracted position, spring means normally maintaining said trip member in an initial position and biasing said trip member when moved in either of two opposite directions to return to said initial position, said spring means opposing false movement of said trip member in response to sudden shocks, and adjusting means for adjusting said spring means to thereby vary the initial position of said pivoted trip member.

3. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member normally restraining said releasable means and movable to release said releasable means, means comprising a pair of springs disposed on opposite sides of said trip member biasing said trip member in opposite directions to an initial position in which it restrains said releasable means, said springs being disposed to oppose false movement of said trip member and release of said releasable means in response to sudden shocks, a bimetal element operable when heated by overload currents to move said trip member against the bias of one of said springs, and an adjusting screw co-acting with the other of said

springs to vary the tension of both of said springs to thereby vary the initial position of said trip member.

4. A circuit breaker having relatively movable contacts, a trip device for effecting automatic opening of said contacts comprising a pivoted trip bar movable to effect opening of said contacts, a bimetal element having one end supported and the other end free, thermal bending of said bimetal causing the free end thereof to engage a portion of said trip bar and move said trip bar in tripping direction, means comprising a pair of compression springs disposed one on each side of said trip bar for opposing false movement of said trip member and opening of said contacts in response to sudden shocks, and an adjusting screw mounted in a fixed member for adjusting one of said springs to vary the initial position of said trip bar.

5. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member normally restraining said releasable means and movable to a tripped position to release said releasable means, an electromagnet including an armature normally free of said trip member and operable to engage and move said trip member to said tripped position, a spring biasing said trip member away from said tripped position, and a resilient stop for determining the position to which said trip member is biased by said spring.

6. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member normally restraining said releasable means and movable to a tripped position to release said releasable means, thermally responsive means comprising a straight strip of bimetal operable when heated by overload currents to move said trip member to said tripped position, a spring biasing said trip member away from said tripped position, a resilient stop for determining the position to which said trip member is biased by said spring, and adjusting means for adjusting said resilient stop to vary the position to which said spring biases said trip member.

7. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member having latch means thereon for normally latching said releasable means in operative position, an electromagnet including an armature operable to engage and move said trip member to unlatching position to release said releasable means, spring means free of said trip member normally biasing said armature to unattracted position, spring means biasing said trip member to latching position, and a resilient stop for determining the latching position of said trip member.

8. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member having latch means thereon for normally latching said releasable means in operative position, said trip member being movable to unlatching position to release said releasable means, spring means biasing said trip member to latching position, a bimetal element operable when heated in response to overload currents to move said trip member to a nonlatching position, a resilient stop for determining the latching position of said trip member, and adjusting means for adjusting said resilient stop to vary the latching position of said trip member.

9. A circuit breaker having relatively movable contacts and means releasable to effect automatic opening of said contacts, a trip device comprising a trip member normally restraining said releasable means and movable to a tripped position to release said releasable means, thermally responsive means operable when heated in response to overload currents below a predetermined value to move said trip member in tripping direction, electromagnetic means including an armature operable in response to overload currents above said predetermined value to instantaneously move said trip member in tripping direction, spring means free of said trip member biasing said armature to unattracted position, a spring connected at a point between its ends to said trip member biasing said trip member in opposite directions to an initial position, said spring opposing false tripping movement of said trip member and opening of said contacts in response to sudden shocks, and adjusting means for adjusting said spring to vary the initial position of said trip member.

10. A circuit breaker having relatively movable contacts, a trip device comprising a trip member movable to effect automatic opening of said contacts, spring means normally maintaining said trip member in an initial position and biasing said trip member when moved in either of two opposite directions to return to said initial position, said spring means opposing false movement of said trip member in response to sudden shocks, and thermally responsive means operable when heated in response to overload currents to move said trip member in tripping direction.

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