

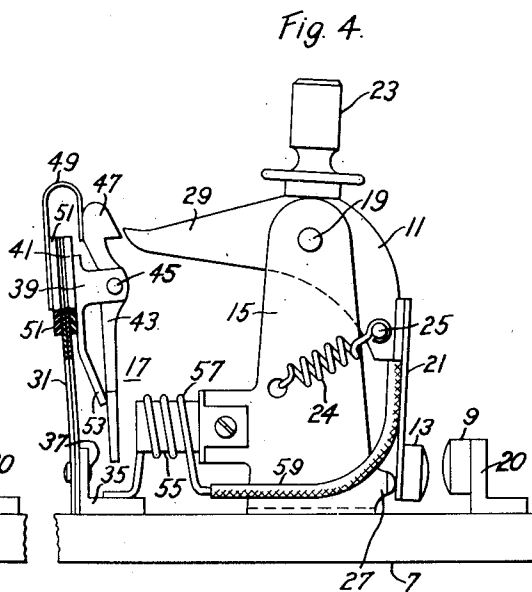
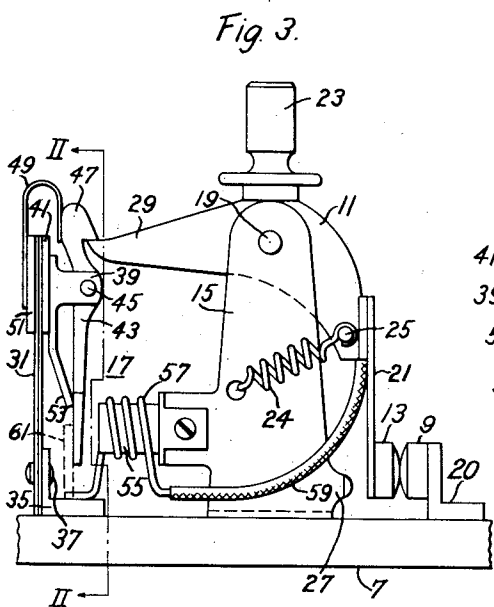
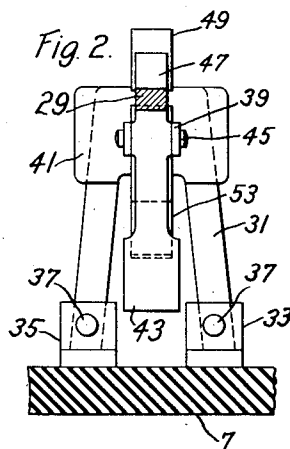
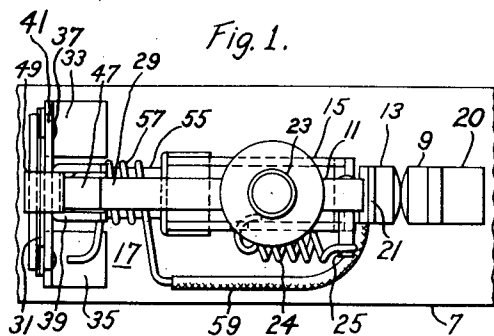
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2,114,845

CIRCUIT INTERRUPTER

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2,114,845

CIRCUIT INTERRUPTER

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The invention relates to circuit interrupting devices in general and more particularly to circuit breakers of the type in which the breaker is manually operable to close the circuit and is automatically operable to open the circuit in response to predetermined overload conditions.

One object of the invention is the provision of a circuit breaker having an improved trip mechanism capable of opening the breaker in response to a moderate overload of predetermined duration in the controlled circuit, and capable of opening the breaker immediately upon the occurrence of a heavy overload or short circuit condition in the controlled circuit.

Another object of the invention is the provision of a circuit breaker with an improved trip mechanism of the type having an electromagnetic trip means for opening the breaker upon the occurrence of higher magnitude overloads and short circuit conditions and a bimetallic trip means for opening the breaker in response to lower magnitude overloads of predetermined duration, the two trip means being arranged in a novel manner so that their effect is additive whereby a faster tripping action takes place on heavy overloads and the trip mechanism is more sensitive and faster in operation in response to overloads of intermediate magnitude.

Another object of the invention is the provision of an improved circuit breaker of the previously mentioned type which is simple, safe and reliable in operation, and which is inexpensive to manufacture.

Another object of the invention is the provision of an improved circuit breaker of the previously mentioned type which is more compact, occupies less space, and requires fewer parts than breakers of the same general class that have heretofore been known or used.

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 best be understood from the following detailed description of a specific embodiment thereof when read in connection with the accompanying drawing, in which:

Figure 1 is a plan view of the circuit breaker embodying the features of the invention;

Fig. 2 is a vertical sectional view of the breaker taken substantially on the line II—II of Fig. 3 looking in the direction of the arrows, illustrating certain structural details of the trip mechanism;

Fig. 3 is a side elevational view of the breaker

showing the trip mechanism in the normal position and the breaker in the closed circuit position; and

Fig. 4 is a side elevational view similar to Fig. 3 showing the breaker in the tripped open position following operation of the bimetallic trip means in response to an overload in the controlled circuit.

Referring to the drawing, the circuit breaker illustrated, which embodies the features of the invention, comprises in general a base 7 of suitable insulating material, a stationary contact 9, a movable switch member 11 provided with a movable contact 13 for cooperating with the stationary contact, a main frame 15 for pivotally supporting the switch member, and a trip means indicated generally at 17.

The stationary contact 9 is mounted on the base 7 by means of an angle bracket 19, the contact being secured to the vertical leg of the bracket so as to face the main frame 15.

The main frame 15 is U-shaped in section, and has its bight portion secured in any suitable manner to the base 7, so that its two parallel leg portions extend upwardly from the base.

The switch member 11 consists of a flat plate of suitable material, preferably metal, and formed in the shape shown in Figs. 3 and 4. The switch member 11 is pivotally mounted on the frame 15 by means of a transverse pivot pin 19, which extends through the side walls of the main frame 15 and through the body portion of the switch member 11. The right-hand end of the switch member 11 has a contact arm 21 of resilient material secured thereto, the movable contact 13 being secured to the free end of the contact arm 21 for cooperation with the stationary contact 9. An operating handle 23 is secured to the upper edge of the switch member directly over the pivot pin 19 for manually operating the switch member to closed circuit position, in which the movable contact 13 engages the stationary contact 9.

The switch member 11 is biased in a clockwise direction about its pivot pin 19 to the open circuit position shown in Fig. 4 by means of a tension spring 24, which has one end secured to a pin 25 carried by the switch member, and its other end secured to a projection carried by the frame 15. The clockwise movement of the switch member 11 about the pivot pin 19 is limited by a stop member 27 formed on the frame 15 adjacent the base 7. This stop member is adapted to be engaged by the resilient contact arm 21 in the open circuit position of the breaker.

The switch member 11 is provided with a latch portion 29 extending to the left of the pivot pin 19, which is adapted to be engaged and releasably held by a latch lever of the trip means when the circuit breaker is closed, so that the switch member is held in closed circuit position against the biasing force exerted by the spring 24.

The trip means indicated generally at 17 normally holds the switch member in closed circuit position, and is operable in response to predetermined overload conditions to release the switch member to allow the biasing spring 24 to move the same to open circuit position. The trip means comprises a U-shaped strip 31 of bimetallic material mounted on the base 7 by means of a pair of angle brackets 33 and 35, the lower ends of the legs of the bimetal strip being secured to the brackets 33 and 35 by means of rivets 37. A yoke-shaped bracket 39 is secured to the bimetal strip adjacent the upper free end thereof, and is insulated from the strip by means of an insulating spacer 41.

A latch lever 43 of magnetic material is pivotally supported intermediate its ends on the yoke-shaped bracket 39 by means of a pivot pin 45. The upper end of the latch lever is formed to provide a latch projection 47, which normally engages and releasably holds the latch portion 29 of the switch member 11 as shown in Fig. 3. The latch lever 43 is biased to its latching position in which it engages the portion 29 of the switch member 11 by means of a resilient strip 49 secured to the upper end of the bimetallic strip 31 and insulated therefrom by an insulating spacer 51. The yoke-shaped bracket 39 has a depending angular projection 53, which forms a stop member for limiting clockwise rotation of the latch lever 43 about its pivot pin 45.

The bimetallic strip 31 is designed to flex in a direction away from the frame 15 when heated a predetermined amount in response to an overload of predetermined magnitude and duration. When the bimetallic strip 31 flexes in response to predetermined overload conditions, it carries with it latch lever 43 to effect release of the switch member 11 and opening of the breaker. When the bimetallic strip 31 flexes in a direction away from the frame 15 in response to the overload condition, the pivot pin 45 is moved to the left, as shown in Fig. 4. The friction between the latch projection 47 and the latch portion 29 of the switch lever 11 would ordinarily tend to rotate the latch lever 43 in a clockwise direction about its pivot pin 45 during flexing movement of the bimetallic strip 31, were it not for the stop member 53. The stop member 53 prevents clockwise movement of the latching lever 43 during flexing of the bimetallic strip 31, so that the latching lever 43 is moved bodily with the free end of the bimetallic strip 31 during flexing of the strip.

The bimetallic strip 31 provides a time delay upon the occurrence of lower or moderate magnitude overloads in the circuit controlled by the breaker, due to the fact that it requires a certain amount of time to heat the strip a sufficient amount to effect release of the switch member, so that the breaker will not be opened unless the overload continues long enough to heat the bimetallic strip the predetermined amount necessary to effect release of the switch member 11. This time delay feature thus prevents the circuit breaker from being opened in response to lower magnitude overloads, which are only of a transitory nature.

In order that the contacts may be opened immediately upon the occurrence of a heavy current magnitude overload or short circuit condition in the circuit controlled by the breaker, there is provided an electromagnetic trip means which comprises the latching lever 43, which is of magnetic material, a core 55 of magnetic material, and a winding 57 for the core. The core 55 is secured to the main frame 15 in any suitable manner, and extends to a position adjacent the lower end of the latching lever 43. The winding 57 for the core is adapted to be connected in series circuit with the contacts 9 and 13 of the breaker, so that when a heavy magnitude overload or short circuit condition occurs in the circuit controlled by the breaker, the pull exerted by the magnet becomes sufficient to move the latch lever 43 in a counter-clockwise direction about its pivot pin 45 to the released position to effect release of the switch member 11 and opening of the breaker. The pull exerted by the electromagnet comprising the core 55 and the winding 57 is not sufficient on lower magnitude overloads to move the latching lever 43 about its pivot pin.

The circuit for the breaker extends from one terminal (not shown) to the angle bracket 33 through the bimetallic strip 31 to the angle bracket 35 which supports the opposite leg of the strip 31, through the winding 57 of the electromagnetic trip means, through a flexible shunt conductor 59 to the movable contact 13 and stationary contact 9, and from the stationary contact to the opposite terminal of the breaker.

The operation of the circuit breaker is briefly as follows: To close the circuit breaker, the operating handle 23 is moved to the left so as to rotate the switch member 11 in a counter-clockwise direction about the pivot pin 19 to its closed circuit position, in which the movable contact 13 engages the stationary contact 9. The switch member 11 is moved a limited amount after the contact 13 engages the contact 9, so that the latch portion 29 of the switch member is moved under the latch projection 47 of the latching lever 43. This limited movement of the switch member 11 after the contacts are engaged is permitted by the resilient contact carrying arm 21, which flexes. During this movement of the switch member 11 to latched position, the nose of the latch portion 29 of the switch lever 11 forces the latch projection 47 to the left as it moves past the nose portion thereof, this movement of the latch projection 47 to the left being permitted by the resiliency of the spring strip 49 and the natural resiliency of the bimetallic strip 31. The overlapping engagement of the latch projection 47 of the latching lever 43 with the latch portion 29 of the switch lever 11 maintains the switching lever in closed circuit position against the force exerted by the biasing spring 24 which tends to move the switch lever to open circuit position.

When an overload of lower magnitude and predetermined duration occurs in the circuit controlled by the breaker, the bimetallic strip 31 is heated a sufficient amount to cause it to flex in a direction away from the main frame 15. This flexing of the bimetallic strip away from the main frame 15 moves the latch lever 43 with it to the left to effect release of the switch member 11. After the switch member is released, the biasing spring 24 moves the same to open circuit position, as shown in Fig. 4.

When the breaker is closed and an extremely

heavy overload or short circuit condition occurs in the circuit controlled by the breaker, the pull exerted by the electromagnet comprising the core 55 and the winding 57 becomes sufficient to attract the lower end of the latching lever 43 so that the latching lever is rotated in a counter-clockwise direction about its pivot pin 45 to effect release of the switch member 11. When the switch member 11 is released, the biasing spring 24 rotates the same in a clockwise direction about the pivot pin 19 to the open circuit position. In the case of a short circuit condition, the electromagnet moves the latching lever to released position immediately to open the breaker before the bimetallic element has been heated an appreciable amount, so that the bimetallic element is thus protected from the short circuit current.

When the breaker is closed and an overload of intermediate or heavy magnitude occurs, both the bimetal strip 31 and the electromagnet will act on the latching lever 43 to move the same to its released position to permit the breaker to open. The action of the bimetallic strip 31 in the case of intermediate or heavy overloads is the same as that previously described in connection with the lower magnitude overload except that the action is much faster. At some predetermined value of the current in this range of overloads, the electromagnet comprising the core 55 and the winding 57 will exert sufficient pull to move the latching lever 43 about its pivot pin 45 toward released position, so that for all current values above this predetermined value, the latching lever is moved by the combined action of the bimetallic strip 31 and the electromagnet so that a faster tripping action is provided in this range of overloads. This combined or additive effect of the bimetallic strip and the electromagnet in the intermediate range of overloads renders the breaker much more sensitive to such overloads, and provides a faster tripping action.

If desired, the stop member 53 instead of being carried by the yoke-shaped bracket 39 may be secured to the base, as indicated by the dotted lines at 61 in Fig. 3. In such instance, the movement of the latching lever 43 to its released position caused by the flexing of the bimetallic strip 31 will be much faster than in the embodiment of the invention previously described. When the stop member 61 is secured to the base, the breaker is rendered even more sensitive to the intermediate ranges of overload, since as the bimetal strip becomes heated in response to the overload and flexes, the lower end of the latching lever 43 is moved closer to the core 55 of the electromagnet. Under such conditions, the pull exerted by the electromagnet is increased so that it will respond to overload currents of a magnitude slightly below the predetermined value of current for which the electromagnet was designed in the case of the first described embodiment of the invention.

It will be noted that the various parts of the breaker are all mounted in alignment on the narrow base member 7 in a plane perpendicular to the base member, so that a very compact circuit breaker structure is provided which occupies a very small amount of space. This structure permits a large number of circuit breakers to be mounted on a small control panel side by side.

The advantages of the circuit breaker designed according to the invention over circuit breakers of the same general type are its great simplicity, ruggedness and safety of operation. The im-

proved trip means is simple and reliable in operation and provides a more sensitive and tripping action in response to overloads of intermediate and heavy magnitude.

While the invention has been shown and described in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details thereof may be made without departing from the spirit of the invention. For example, the novel thermal and magnetic trip device 17 may be used with a circuit breaker mechanism in which the handle may normally open and close the contacts and in which the contacts open on overload trip-free of the handle, such as shown in Von Hoorn Patent No. 1,786,796, issued December 30, 1930, by merely substituting the complete trip device disclosed herein for the bimetal latch of the Von Hoorn patent. It is desired, therefore, that the invention be limited only by the reasonable construction of the appended claims and by the prior art.

I claim as my invention:

1. In a circuit breaker, relatively movable contacts for opening and closing the circuit, a movable member biased to open said contacts, trip means comprising a thermally responsive element heated in response to the current flowing in the circuit, a latch member pivotally mounted on said element for normally engaging and restraining said movable member against opening movement, said element when heated a predetermined amount in response to overloads of predetermined magnitude and duration moving said latch member to release said movable member, and electromagnetic means energized in response to the current flowing in the circuit for moving said latch member about its pivot axis to release said movable member in response to overloads of higher predetermined magnitude.

2. In a circuit breaker, relatively movable contacts for opening and closing the circuit, a movable member biased to open said contacts, trip means comprising a bimetallic element connected in the circuit with the contacts, a latch member having at least a portion of magnetic material pivotally mounted on said element for normally engaging and holding said movable member against opening movement, said element when heated a predetermined amount in response to overloads of predetermined magnitude flexing so as to move said latch member to release said movable member, and electromagnetic means energized in response to the current flowing in the circuit for moving said latch member about its pivot axis to release said movable member in response to overloads of higher predetermined magnitude.

3. In a circuit breaker, relatively movable contacts for opening and closing the circuit, a movable member biased to open the contacts, trip means for normally holding said movable member against opening movement and for releasing the same in response to predetermined overload conditions comprising a bimetallic element heated in response to the current flowing in the circuit, a latch member having at least a portion of magnetic material pivotally mounted on the bimetallic element for normally engaging and releasably holding the movable member against opening movement, said bimetallic element when heated a predetermined amount in response to an overload moving said latch member to release said movable member, and an electromagnet energized in response to the current flowing in the

circuit for moving said latch member about its pivot to release said movable member in response to higher magnitude overloads.

4. In a circuit breaker, relatively movable contacts for opening and closing the circuit, a movable member biased to open the contacts, trip means comprising a thermally responsive trip element heated in response to the current flowing in the circuit, a lever pivotally mounted intermediate its ends on said trip element, said lever having a latch portion adjacent one end for engaging and releasably holding said movable member against opening movement, means biasing said lever to engage said movable member, a stop cooperating with the opposite end of said lever so that when said bimetallic element is heated a predetermined amount and flexed in response to an overload in the circuit said lever is moved to release said movable member.
5. In a circuit breaker having relatively movable contacts for opening and closing the circuit, a movable member biased to open the contacts, trip means comprising a bimetallic trip element heated in response to the current flowing in the circuit, a lever pivotally mounted intermediate its ends on said bimetallic element adjacent the free end thereof, said lever having a latch portion adjacent one end thereof for normally engaging and releasably holding said movable member against opening movement and a portion of magnetic material adjacent its other end, means biasing said lever to engage said latch portion with said movable member, a stop engaging the lever on the opposite side of its pivot from said latch portion so that when said trip element is heated a predetermined amount and flexed in response to an overload said lever is moved to release said movable member, and an electromagnet energized by the current flowing in the circuit cooperating with magnetic portion of the lever for moving said lever about its pivot axis to release said movable member in response to an overload of higher magnitude.
6. In a circuit breaker having relatively movable contacts for opening and closing the circuit and a movable member biased to open said contacts, a trip device comprising a bimetallic trip element heated in response to the current flowing in the circuit, a lever pivotally mounted intermediate its ends on said trip element adjacent the free end thereof, said lever having a latch portion adjacent one end for engaging and releasably holding said movable member against opening movement, means carried by said element for biasing said lever to latching position to hold said movable member, a stop carried by said trip element for engaging the lever on the opposite side of its pivot from its latch portion, said trip element when heated a predetermined amount in response to an overload of predetermined magnitude flexing in a direction to move said lever to release said movable member, said stop causing said latch member to follow the movement of the free end of said trip element when the same is flexed, and electromagnetic means responsive to higher magnitude overloads for moving said lever about its pivot to release said movable member.
7. In a circuit breaker having relatively movable contacts for opening and closing the circuit and a movable member biased to open said contacts, a trip device comprising a bimetallic trip element heated in response to the current flowing in the circuit, an armature of magnetic material pivotally mounted intermediate its ends on said bimetallic element adjacent the free end

thereof, said armature having a latch portion adjacent one end for engaging and releasably holding said movable member against opening movement, means biasing said armature about its pivot to latching position, a stop for engaging said armature on the opposite side of its pivot from the latch portion so that when said trip element is heated a predetermined amount and flexed in response to an overload of predetermined magnitude said armature is moved to release said movable member, and an electromagnet responsive to the current flowing in the circuit for moving said armature about its pivot axis to release said movable member in response to overloads of higher predetermined magnitude.

8. In a circuit breaker, contact means for opening and closing the circuit, a member movable to cause opening of said contact means, a thermally responsive element, a trip member mounted on said thermally responsive element to be moved thereby and being movable relative thereto, means for causing said trip member to move relative to the thermally responsive member, and said trip member when moved causing movement of said movable member to open the circuit.

9. In a circuit breaker, contact means for opening and closing the circuit, a member movable to cause opening of the contact means, a thermally responsive trip element, a trip member having at least a portion of magnetic material, means mounting said trip member on said trip element for movement thereby and also for movement relative thereto, and electromagnetic means for moving said trip member relative to said trip element, said trip member when moved causing movement of said movable member to open the circuit.

10. In a circuit breaker, contact means for opening and closing the circuit, a member biased for movement to cause opening of said contact means, a bimetallic thermally responsive trip element, an armature of magnetic material mounted on said element for movement thereby and also for movement relative thereto, said armature normally engaging and releasably holding said movable member against opening movement, and electromagnetic means for moving said armature relative to said trip element, said armature when moved effecting release of said movable member to open the circuit.

11. In a circuit breaker, relatively movable contacts for opening and closing the circuit, means releasable to cause opening of said contacts to interrupt the circuit, a thermally responsive trip element, a trip member having at least a portion of magnetic material, said trip member being mounted on said trip element for bodily movement thereby and for movement relative thereto, electromagnetic means operable in response to predetermined overload conditions to move said trip member relative to said trip element to effect release of said releasable means, said trip element being operable in response to other predetermined overload conditions to bodily move said trip member to effect release of said releasable means.

12. In a circuit breaker having relatively movable contacts and a means releasable to cause opening of said contacts to interrupt the circuit, the combination of a thermal trip element heated in response to the current flowing in the circuit, a trip member having at least a portion of magnetic material, said trip member being pivotally mounted on said thermal trip element for bodily movement thereby and for pivotal movement relative thereto, electromagnetic means energized by

the circuit operable in response to predetermined overload conditions to move said trip member about its pivot to effect release of said releasable means, said trip element when heated a predetermined amount causing bodily movement of said trip member to effect release of said releasable means.

13. In a circuit breaker, having relatively movable contacts, and means releasable to cause opening of the contacts to interrupt the circuit, the combination of a bimetallic trip element heated in response to the current flowing in the circuit, an armature pivotally mounted on said trip element for bodily movement thereby and pivotal movement relative thereto, electromagnetic means energized by the circuit operable in response to predetermined overload conditions to move said armature about its pivot to effect release of said releasable means, said trip element being operable in response to other predeter-

mined conditions to bodily move said armature to effect release of said releasable means.

14. In a circuit breaker, contact means for opening and closing the circuit, a member releasable to cause opening of said contact means, a bimetallic trip element heated in response to the current flowing in the circuit, a trip member having at least a portion of magnetic material mounted on said trip element for bodily movement thereby and for movement relative thereto, electromagnetic means energized by the circuit operable in response to predetermined current conditions to move said trip member relative to said trip element to effect release of said releasable member, said trip element being operable in response to other predetermined current conditions to bodily move said trip member to effect release of said releasable member.

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