Feb. 26, 1957 R. T. CASEY 2,783,330

AUTOMATIC CIRCUIT BREAKER

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Fig. 1.

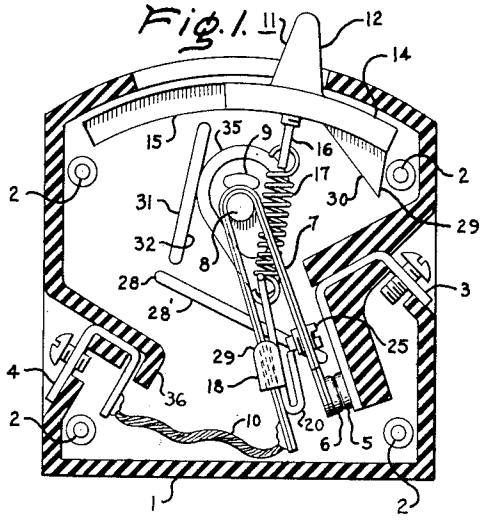


Fig. 2.

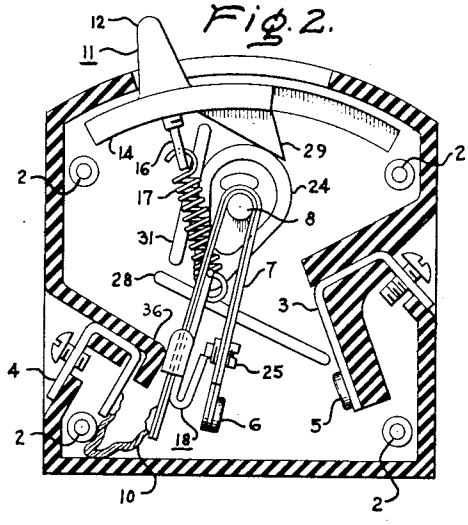


Fig. 3.

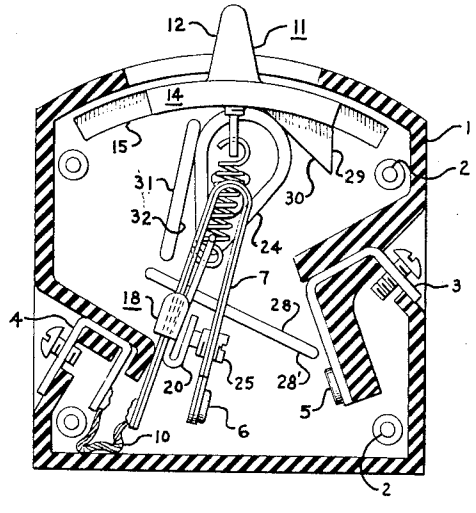
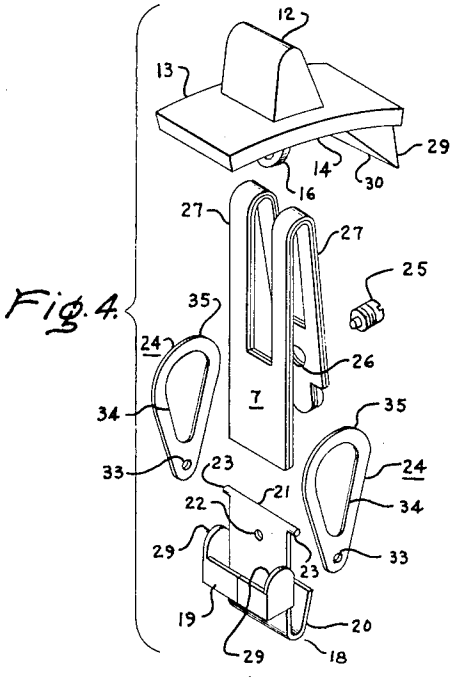


Fig. 4.



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2,783,330

AUTOMATIC CIRCUIT BREAKER

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11 Claims. (Cl. 200—116)

My invention relates to automatic electric circuit breakers and, more particularly, to small air circuit breakers of the type used for control of light and power circuits in residential electrical systems.

One object of my invention is to provide such a circuit breaker in which the current responsive element may be calibrated or adjusted prior to its assembly relative to other components of the circuit breaker, thus facilitating manufacture, assembly and adjustment of the circuit breaker.

Another object of my invention is to provide such a circuit breaker in which the current responsive element is also used as the switching member, thereby reducing the number of parts required.

A further object of my invention is to provide a circuit breaker utilizing a thermal current-responsive element comprising a bimetallic strip, wherein the bimetallic strip has an inherent electromagnetic assisting action.

A still further object of my invention is to provide a circuit breaker having a mechanism adapted to utilize portions of the casing walls so as to permit reduction in the number of mechanical parts required.

In general, in accordance with the important features of the invention I provide a circuit breaker comprising an elongated U-shaped strip of bimetallic material having a releasable trip member slidably supported on one leg thereof. A latch member is carried by the other leg adjacent the open end of the U and the trip member is normally latched thereon but is released when the outer ends of the U-shaped strip deflect away from each other upon heating. Upon its release the trip member engages specially provided cam surfaces carried by the casing and is deflected thereby to cause opening of the contacts of the breaker.

My invention will be more readily understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Figure 1 is a side elevation view of a circuit breaker embodying my invention, the casing being shown partially in section, and the mechanism being shown in the normal "on" condition.

Figure 2 is a view similar to Figure 1, the mechanism being shown in the "off" condition.

Figure 3 is a view similar to Figure 1, the mechanism being shown in the "tripped" condition, the handle being unrestrained and having moved to a "trip-indicating" position.

Figure 4 is an exploded view in perspective of the essential moving parts of the circuit breaker of Figure 1.

Referring now to the drawing, I have shown my invention as embodied in a circuit breaker comprising a generally rectangular open-sided insulating casing 1 adapted to be closed by a suitable side cover (not shown) which may be retained by suitable means such as by screws or rivets passing through openings 2. Terminals 3 and 4 are provided for connecting the circuit breaker in a circuit to be controlled, the terminal 3 normally being connected to a "line" or source of power, and the terminal 4 normally being connected to a "load" or power consuming device. The "line" and "load" terminals 3 and 4 are preferably formed of conductive strips formed as shown and set into suitable recesses in the casing 1. The line terminal 3 is provided with a relatively stationary or "line" contact 5. A movable or "switching" contact 6 is supported on one end of a generally U-shaped bimetallic switching member 7. The bimetallic member 7 is pivotally supported adjacent its bight in the casing 1 by bearing surfaces of supporting bosses comprising cylindrical boss 8 and the arcuate boss 9. The other end of the bimetallic strip 7 has attached thereto one end of the flexible braid 10, the other end of which is connected to the load terminal 4. The circuit through the circuit breaker when in the closed position may, therefore, be traced as follows—from a source of power (not shown) to line terminal 3, to line contact 5, to switching contact 6, to bimetallic strip 7, to flexible braid 10, to load terminal 4, to power consuming device (not shown).

The bimetallic strip member 7 and its switching contact 6 are adapted to be moved from the "on" or closed-circuit position of Figure 1 to the "off" or open-circuit position of Figure 2 and vice versa with a "snap" action, and also to be moved to the automatically opened or "tripped" position of Figure 3 by operating mechanism to be described. An operating handle 11 of insulating material is provided having a manually engageable portion 12 and arcuate side flange portions 13 and 14 adapted to ride in corresponding arcuate tracks 15 in the inner surfaces of the side walls of the casing 1. The handle 11 is further provided with a hook-eye 16 which may be screwed or molded into the handle 11 and which serves as an anchor for the upper end of tension spring 17.

A releasable trip member 18 is slidably supported on one leg of the U-shaped bimetallic strip 7. As may be seen more easily from Figure 4 the trip member 18 comprises a rectangular sleeve portion 19, a hook or latch portion 20, and a tongue portion 21 having a hole 22 therein through which the lower end of the tension spring 17 is adapted to pass. Trip member 18 also has oppositely-directed cylindrical lug portions 23 which serve to mount the flat cam members 24 pivotally thereon in a manner to be described. A latch screw or calibrating screw 25 is mounted in threaded engagement in the tapped hole 26 in the opposite leg of the strip 7, and normally engages and restrains the releasable trip member 18 from upward movement. It will be appreciated that although the engagement of calibrating screw 25 and trip member 18 provide a current path which is electrically in parallel with bimetal 7 such current is relatively small due to the relatively high resistance of this parallel path. In any event the amount of current passing through bimetal 7 always varies directly with the total current through the breaker and, therefore, the function of bimetal 7 as a current-responsive element is not impaired by such parallel path.

It will be seen that so long as the releasable trip member 18 is held by calibrating screw 25 in the lower position as shown in Figure 1, the tension spring 17 may be used to exert force on the trip member 18 in the direction indicated in Figure 1 tending to move the bimetallic member 7 counterclockwise and into engagement with the stationary contact. When the handle member 11 is moved to the left, as shown in Figure 2, the line of action of the spring 17 crosses the pivotal axis of the bimetallic strip 7 and thereafter biases it in a clockwise direction to the open-circuit position and against a suitable stop in the casing 1 such as boss 36.

The central portion of the bimetallic member 7 is cut away, leaving two generally parallel spaced-apart por-

tions 27 having a space between them which provides clearance for the tension spring 17. The height of the bosses 8 and 9 is made about equal to the width of the side portions 27, and these bosses therefore do not project into the central space between these side portions.

For the purpose of cooperating with the releasable member 18 in causing the parts to move to the "tripped" position, I provide elongated bosses 28, integral with the opposite side walls of the casing 1 and having cam surfaces 28' (only one shown) for cooperation with the cam surfaces 29, the releasable member 18 is provided with cam follower shoulder portions 29.

The bimetallic strip member 7 is arranged so that upon being heated by the current passing therethrough, it deflects outwardly, so as to move its end portions away from each other. When this action occurs to a predetermined extent, the latch portion 20 of the releasable member 18 becomes disengaged from the tip of the calibrating screw 25 and the releasable member 18 is thereupon moved upwardly along the arm of the bimetallic strip 7 by the tension spring 17. When this movement has proceeded only a very short distance, however, the cam follower surfaces 29 of the releasable member 18 engage the cam surfaces 28', and ride therealong to the position shown in Figure 3. The action of the cam follower surfaces 29 in riding along the cam surfaces 28', as described, is such as to cause the releasable member 18 to move to the left as indicated during the course of its movement upwardly, under the influence of the tension spring 17. Thus it will be observed that although the direction of bias of the tension spring 17 upon the releasable member 18 is such that in the normal "on" position it is biased toward the relatively stationary contact 5, upon release of the latch 20 from the calibrating screw 25 the releasable member is moved along a path which becomes increasingly remote from the relatively stationary contact 5, thereby moving the bimetallic member 7 to the open-circuit position. This motion takes place regardless of the manual retention of the handle member 11 in the "on" position.

During the course of movement of the releasable member 18 from the "on" position of Figure 1 to the tripped position of Figure 3, the over-all length of the tension spring 17 becomes shortened, but its direction is also changed relative to the casing, so that it crosses the center line of the arcuate tracks 15 and thereafter biases the handle 11 toward the open position. By this means, the handle is moved to the mid- or trip-indicating position in which position it is restrained in a manner to be described.

In order to reset the releasable member 18 so that the latch portion 20 is once again in engagement with the calibrating screw 25, it is necessary to move the releasable member 18 downwardly along the leg of the bimetallic strip 7. In accordance with my invention, I provide means whereby this may be done while the handle 11 is moved from the trip-indicating or mid position of Figure 3 back to the open-circuit or "reset" position of Figure 2. For this purpose I provide a cam member 29, preferably integral with the handle member 11 and having a sloping cam surface 30, and elongated bosses 31 (only one shown) to the inner surface of the opposite side walls of the casing 1 and having cam surfaces 32. I further provide flat cam follower members or "pushers" 24, each having two openings 33 and 34 therein. The cam follower pusher members 24 are pivotally supported on cylindrical lugs 23 on the tongue portion 21 of the releasable trip member. The enlarged openings 34 in the cam follower members 24 provide clearance around the projecting bosses 8 and 9 during the course of the various movements of the members 24. The cam follower members 24 are loosely trapped in place between the edges of the bimetallic strip 7 and the inner side walls of the casing, and their motion is limited in a flatwise direction by the bosses 8 and 9. Each of the cam members 24 is also provided with an upper rounded edge portion 35.

When tripping occurs and the releasable trip 18 moves upwardly along the leg of the bimetallic member 7, the cam members 24 also are moved upwardly and to the position of Figure 3, in which position they limit the return movement of the handle member 11 because of the engagement of the cam member 29 with the cam surfaces 35. In order to reset the trip member 18, the handle member 11 is moved from the mid- or trip-indicating position of Figure 3 to the extreme left or reset position of Figure 2. During this movement the cam surface 30 of cam 29 rides along the rounded cam follower surfaces 35 of the cam member 24 forcing the cam follower members 24 to the extreme downward or relatched position. During this resetting movement the cam follower members also ride along and are guided by the cam surface 32 of the elongated boss 31. The action of the cam surfaces 30 and 32 on the cam member 24 is a cooperative one and may be termed a "squeeze out" action comparable to that by which an orange pip is ejected when squeezed between the fingers. It will be appreciated, however, that this resetting action takes place against the bias of tension spring 17 and stretches the spring 17 to its original length.

The release point of the releasable trip member 18 from the calibrating screw 25 is dependent only upon the spacing between these two members, which in turn is determined by the spacing between the outer ends of the bimetallic strip 7. This spacing is independent of dimensional variations in the casing 1 and may, therefore, be preset before the bimetallic strip 7 is assembled into the casing 1.

Since the current in one leg of the strip 7 is traveling in a direction opposite to that in the closely-spaced parallel leg, there will be a tendency of these portions of the strip 7 to repel each other due to the action of the magnetic fields associated with the currents. While this force is negligible with normal current values, on high short-circuit currents the force is such as to cause an "instantaneous" or "magnetic" tripping action which supplements the slower thermal tripping action of the strip 7.

While I have shown a particular embodiment of my invention, it will be understood that I do not wish to be limited thereto since many modifications thereof may be made. I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A circuit breaker comprising a generally U-shaped bimetallic strip, a releasable trip member carried by one leg of said bimetallic strip and biased for movement relative to said leg to cause automatic opening of said circuit breaker, a latch projection carried by the other leg of said bimetallic strip and normally restraining said releasable trip member from said movement, said bimetallic strip being arranged so that its legs deflect outwardly upon heating so as to cause release of said releasable trip member from said latch projection.

2. A circuit breaker as set forth in claim 1 also comprising a pair of terminals and means for connecting said bimetal strip electrically in circuit with said terminals.

3. A circuit breaker comprising a generally U-shaped bimetallic strip, a releasable trip member slidably carried by one leg of said bimetallic strip, a latch projection carried by the other leg of said bimetallic strip and normally restraining said releasable trip member, said bimetallic strip being arranged so that its legs deflect outwardly upon heating so as to cause release of said releasable trip member from said latch projection, said latch projection being carried adjacent the free end of said one leg of the bimetallic member and said breaker also comprising spring means biasing said trip member for movement toward the bight portion of said bimetallic member.

4. A circuit breaker comprising at least two relatively

movable contacts, a generally U-shaped bimetallic strip pivotally supported adjacent its bight portion and movable between open- and closed-circuit positions and operatively connected to one of said relatively movable contacts, a releasable trip member slidably carried by one leg of said bimetallic strip, a latch projection carried by the other leg of said bimetallic strip and releasably restraining said trip member, said bimetallic strip being arranged so that its legs deflect outwardly upon heating so as to cause release of said trip member from said latch projection.

5. A circuit breaker comprising an insulating casing, a pair of contacts movable relative to one another, a generally U-shaped elongated bimetallic strip member pivotally supported adjacent the bight thereof in said casing, said bimetallic strip member and one of said contacts being movable together between "on" and "off" positions, a releasable trip member slidably carried by one leg of said U-shaped bimetallic strip and having a latch portion thereon, a latch projection carried by the opposite leg of said bimetallic strip adapted to engage and restrain said latch portion of said releasable trip member, and means operative upon the release of said releasable trip member from said latch projection to cause opening movement of said contacts.

6. A circuit breaker as set forth in claim 5 and also comprising a pair of terminals for connecting said circuit breaker in an electric circuit and means for connecting the leg portions of the bimetallic strip electrically in series with each other and between one of the relatively movable contacts and one of said terminals whereby current in said circuit passes through said leg portions in opposite directions.

7. A circuit breaker comprising an insulating casing, a relatively stationary contact, a relatively movable contact, operating means for moving said relatively movable contact between open- and closed-circuit positions, said operating means including a manually operable handle and a tension spring having one end thereof connected to said handle and having the other end thereof normally remote from said handle, a releasable member releasable upon the occurrence of predetermined current conditions in said circuit breaker to cause automatic opening of said contacts, the remote end of said tension spring being connected to said releasable member, said remote end of said spring moving toward said handle member upon release of said releasable means, and means for returning said releasable member and said remote end of said spring to normal position, said means comprising a stationary cam surface carried by said insulating casing, a movable cam surface carried by said handle member, said movable and said stationary cam surfaces being inclined toward each other at an angle less than 90°, and a movable cam follower member operatively connected to said releasable member and adapted to be moved by the cooperative action of said stationary cam surface and said movable cam surface as said operative handle is returned toward its open-circuit position.

8. A circuit breaker comprising an insulating casing, a stationary contact, a cooperable movable contact, a movable switch member for moving said movable contact between "on" and "off" positions, a first terminal

connected to said stationary contact, a second terminal connected to said movable contact, manually operable means for moving said switch member between said "on" and "off" positions, said manually operable means comprising a handle of insulating material, means supporting said insulating handle for arcuate movement in said casing, trip means releasable to cause automatic opening movement of said switch member when in said "on" position, said trip means including a latching portion normally engaged and held by a current responsive latch member and a second portion movable upon release of said latching portion in a direction toward said handle, and resetting means for manually returning said latching portion to its normal latched position, said resetting means comprising a cam follower member connected to said second portion of said trip means and a cooperating cam carried by said insulating handle.

9. A circuit breaker comprising an insulating casing, a pair of contacts carried by said casing, at least one of said contacts being movable between "open" and "closed" positions, a manually operable member carried by said casing and movable between "on" and "off" positions, a switch member pivotally mounted in said casing and adapted to move said one of said contacts between said "open" and "closed" positions, a releasable trip member carried by said switch member, a tension spring interconnecting said manually operable member and said trip member, said tension spring passing across the pivot point of said switch member as said manually operable member is moved from "on" to "off" position to provide a snap action, said tension spring biasing said trip member for movement toward the pivot point of said switch member when said switching member is in said "on" position, current responsive latching means for preventing said movement of said trip member, a relatively stationary cam surface carried by said casing, said trip member being adapted to engage said cam surface upon its release from said latching means and to have its movement thereafter directed thereby so as to carry said switch member toward "open" position and to carry said tension spring across the pivot of said switch member.

10. A circuit breaker as set forth in claim 9 wherein the switch member comprises a generally U-shaped strip of bimetallic material pivoted adjacent the bight portion thereof.

11. A circuit breaker as set forth in claim 10 wherein the trip member comprises a sleeve slidable along one leg of the U-shaped bimetallic member.

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