Oct. 12, 1954 J. A. DROBNEY ET AL 2,691,708

CIRCUIT BREAKER

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Fig. 1.

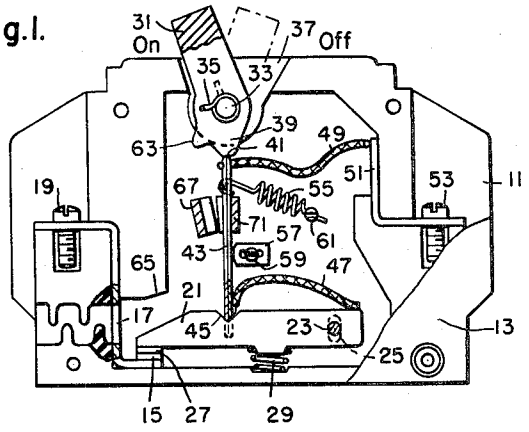


Fig. 2.

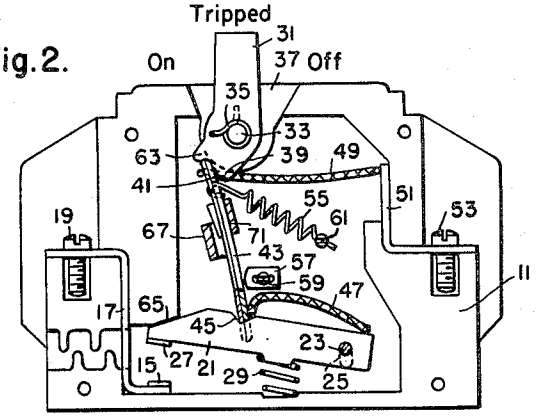
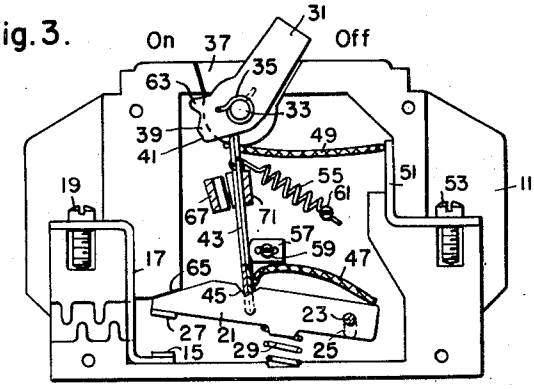


Fig. 3.



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CIRCUIT BREAKER

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This invention relates to circuit breakers and more particularly to circuit breakers which are manually operated to open and close the circuit and which are automatically operated to open the circuit in response to predetermined abnormal conditions.

An object of the invention is to provide a small, compact circuit breaker which is simple in construction and inexpensive to manufacture.

Another object of the invention is to provide a circuit breaker having a thermal trip element forming an operating connection between a breaker switch arm and operating handle.

Another object of the invention is to provide a circuit breaker having a thermal trip element forming an operating connection between a breaker switch arm and operating handle without being positively connected to either the switch arm or handle.

Another object of the invention is to provide a circuit breaker as described in the preceding paragraphs wherein the thermal trip element is also actuated by electromagnetic means to trip the breaker.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, both as to construction and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing.

In said drawing:

Fig. 1 is an elevational view partly in section of the circuit breaker with the cover plate removed and the parts shown in the closed position.

Fig. 2 is a view similar to Fig. 1 but showing the parts in the tripped opened position.

Fig. 3 is a view similar to Fig. 1 but showing the parts in the manually opened position.

Referring to the drawing, the circuit breaker comprises a casing 11 and a cooperating cover plate 13 a fragment of which is shown in Fig. 1 broken away. A stationary contact 15 is mounted on a terminal 17 of conducting material which extends through an opening in one end wall of the casing 11 and has a terminal connecting means 19 at its outer end. A movable switch member or arm 21 has a pin 23 fixedly mounted therein adjacent one end thereof the ends of which extend into corresponding slots 25 (only one being shown) in the side wall of the casing 11 and the cover plate 13. The switch arm 21 at its other end carries a movable contact 27 for

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cooperating with the stationary contact 15 and the switch arm is biased open by means of a spring 29 compressed between a spring seat in the casing 11 and a spring guide on the switch arm.

An operating handle 31 of molded insulating material has opposed trunnions 33 molded integral therewith which engage in suitable bearing openings (not shown) in the cover plate 13 and in the side wall of the casing 11 to pivotally mount the handle. The handle 31 is biased in a clockwise or opening direction, by means of a relatively light spring 35, and extends outwardly through an opening 37 in the casing 11. The inner end of the handle 31 is provided with a projection 39 having a slightly concave surface 41 which, in the closed position of the breaker, engages the rounded upper end of a bimetal element 43. The lower end of the bimetal element is bifurcated and the rounded bight thereof is seated in a V-shaped notch 45 in the upper edge of the movable switch arm 21.

The lower end of the bimetal element 43 is connected by means of a flexible conductor 47 to the movable switch arm 21. A flexible conductor 49 connects the upper end of the bimetal element 43 to the inner end of a conducting terminal 51 which extends through an opening in the end wall of the casing 11 and has a connecting means 53 on its outer end.

The bimetal element 43 is biased by means of a spring 55 to a normal position against an adjustable stop 57 secured by means of a screw 59 to the side wall of the casing 11. The spring 55 has one end attached to the bimetal element 43 at a point near its upper end and the other end of the spring is attached to a screw 61 in the side wall of the casing.

The electrical circuit through the breaker extends from the terminal 17 through the stationary and movable contacts 15—27, movable switch arm 21, flexible conductor 47, bimetal element 43, and the flexible conductor 49 to the terminal 51.

In the normal or closed position of the parts, the bimetal element 43 together with the handle 31 forms a toggle which is biased by the spring 55 to a position slightly overcenter to the right of a line drawn through the center of the pivot 33 and the apex of the notch 45 in the movable switch arm 21.

Upon the occurrence of an overload current below a predetermined value of, for instance, ten times normal rated current, the bimetal element 43 becomes heated in response to the excessive

current and when heated a predetermined amount bends toward the left. This action, assisted by the spring 35, rotates the handle clockwise moving the knee of the toggle 39—43 overcenter to the left of the line 33—45 and, after a predetermined movement the upper end of the bimetal element which is biased upwardly by the spring 29 slips out of the concave surface 41, whereupon the spring 29 moves the switch arm 21 clockwise to the open position and thrusts the bimetal element 43 upwardly to the position shown in Fig. 2. As the bimetal element 43 moves upwardly and to the left, the upper end thereof engages a projection 63 on the handle 31 and rotates the handle to the position shown in Fig. 2 which indicates the tripped open position of the breaker. The opening movement of the switch arm 21 is limited by engagement thereof with a surface 65 on the one end wall of the casing 11.

In order to close the contacts following a tripping operation, the handle 31 is moved clockwise from the Fig. 2 position to the full "off" position as shown in Fig. 3. During this movement the projection 39 on the handle wipes by the upper end of the bimetal element 43 which is then moved clockwise by the spring 55 about the pivot point in the notch 45 to a position against the stop 57. The parts are then in the position shown in Fig. 3. The switch arm 21 is then moved to close the contacts by counterclockwise movement of the handle from the "off" position (Fig. 3) to the "on" position (Fig. 1) during which movement the handle cams the bimetal element 43 downwardly until the rounded upper end of the bimetal element drops into the concave surface 41 on the inner end of the handle. After the moving contact 27 engages the stationary contact 15 during the closing movement, the switch arm 21 pivots slightly about the contacts moving the pin 23 downwardly in the slot 25. In this position (Fig. 1) the spring 29 biases the switch arm 21 counterclockwise about its point of engagement with the bimetal element 43 to provide contact pressure.

Electromagnetic means is provided to instantaneously trip the breaker in response to overload currents above the predetermined value of ten to twenty times normal rated current or in response to short circuit currents. This means comprises a fixed magnetic member 67 supported in a notch in the side wall of the casing 11 and a matching notch (not shown) in the cover plate 13, and an armature 71 secured to the bimetal element 43 to be energized by current flowing in the bimetal element.

Upon the occurrence of an overload current of, for example, ten to twenty times normal rated current or a short circuit current, the electromagnetic means is energized by the current flowing in the bimetal element 43 and the fixed magnetic member 67 attracts the armature 71 moving the bimetal element 43 counterclockwise about its pivot point in the notch 45 thus moving the toggle 39—43 overcenter to the left. This action effects opening movement of the switch arm 21 by the spring 29 in the previously described manner.

The contacts are closed following an instantaneous tripping operation in the manner previously described by first moving the handle clockwise to the "off" position and then counterclockwise to the "on" position.

Manual opening of the contacts is effected by moving the handle clockwise from the "on" position (Fig. 1) to the "off" (Fig. 3). The friction between the upper end of the bimetal element and the handle is not sufficient to overcome the biasing force of the spring 55. Consequently, when the handle is moved to the "off" position, the spring 29 moves the switch arm 21 to the open contact position and moves the bimetal element 43 to the position shown in Fig. 3. During this movement the spring 55 maintains the bimetal element 43 in contact with the stop 57.

The contacts are closed following a manual opening operation by reverse movement of the handle as previously described. The normal overcenter position of the toggle 39—43 is adjusted by loosening the screw 59, moving the stop toward or away from the bimetal element to the desired position and then tightening the screw. The tension of the spring 55 which resiliently maintains the toggle 39—43 in its overcenter position may be varied by loosening the screw 61 which clamps the straightened end of the spring in position, adjusting the tension of the spring and then tightening the screw.

The circuit breaker comprises a minimum number of parts which are mounted in the casing without the use of any frame other than the casing itself, most of the parts being inserted through the open side of the casing into recesses molded therein and held in proper positions by the walls and surfaces of the recesses. These features provide a circuit breaker that is simple and rugged in construction, reliable in operation and inexpensive to manufacture.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle movable to an open position and to a closed position, a bimetal element heated by the current of the circuit and cooperating with said handle and with said switch member to normally hold said switch member in closed position, one end of said bimetal element releasably engaging said handle and the other end of said bimetal element abutting against said switch member, and stop means constraining said bimetal element to bend when heated in response to overload currents in a direction to cause release of said one end of said bimetal element from said handle and permit longitudinal movement of said bimetal element to effect opening movement of said switch member.

2. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle movable to effect opening and closing movement of said switch member, a bimetal element heated by the current of the circuit and having one end abutting against said switch member, the other end of said bimetal element releasably engaging said handle, said bimetal element and said handle cooperating to form a toggle for normally restraining said switch member in closed position, and stop means constraining said bimetal element to bend when heated in response to overload currents in a direction to cause collapse of said toggle to permit automatic opening movement of said switch member.

3. A circuit breaker comprising a pivoted switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle movable to an open position and to a closed position to effect manual opening and closing movement of said switch member, a bimetal element disposed in compression between said handle and said switch member having one end releasably engaging said handle and the other end engaging said switch member for normally releasably restraining said switch member in closed position, stop means limiting transverse movement of said bimetal element in one direction, spring means biasing said bimetal element against said stop means, and thermal bending of said bimetal element when heated in response to overload currents causing release of said bimetal element from said handle to permit longitudinal movement of said bimetal element and opening movement of said switch member.

4. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, a pivoted handle movable to an open position and to a closed position to effect manual opening and closing movement of said switch member, a bimetal element having one end releasably engaging said handle and the other end pivotally engaging said switch member, said bimetal element bending when heated in response to overload currents below a predetermined value in a direction to rotate said handle and cause release of said one end thereof from said handle and effect opening movement of said switch member, and electroresponsive means operable in response to overload currents above said prdetermined value to cause pivotal movement of said bimetal element about the other end thereof in a direction to cause release of said one end of said bimetal element from said handle and instantaneous opening movement of said switch member.

5. A circuit breaker comprising a switch member biased open and movable to open and close the circuit through the breaker, a pivoted operating handle movable to effect opening and closing movement of said switch member, a bimetal element having one end pivotally engaging said switch member and having the other end releasably engaging said operating handle, said bimetal element and said operating handle coacting to form an overset toggle normally restraining said switch member in closed position, adjustable stop means for determining the overset position of said toggle, means biasing said toggle to said overset position against said stop, and thermal bending of said bimetal element when heated in response to overload currents causing overcenter movement and collapse of said toggle to permit opening movement of said switch member.

6. A circuit breaker comprising a switch member biased open and movable to open and close the circuit through the breaker, a pivoted operating handle movable to effect opening and closing movement of said switch member, a bimetal element having one end pivotally engaging said switch member and having the other end releasably engaging said operating handle, said bimetal element and said operating handle coacting to form an overset toggle normally restraining said switch member in closed position, adjustable stop means for determining the overset position of said toggle, means biasing said toggle to said overset position against said stop, and thermal bending of said bimetal element in respone to certain overload currents causing overcenter movement and collapse of said toggle to permit opening movement of said switch member, and electroresponsive means operable in response to certain other overload currents to cause pivotal movement of said bimetal element about said one end to effect collapse of said toggle and opening movement of said switch member.

7. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle operable to effect opening and closing movement of said switch member, a bimetal element connected in said circuit to be heated by current and disposed in compression between said handle and said switch member for normally releasably restraining said switch member in closed position, means pivotally supporting one end of said bimetal element on said switch member, the other end of said bimetal element releasably engaging said handle, a stop member for said bimetal element, spring means biasing said bimetal against said stop member, adjusting means for adjusting said stop means to vary the initial position of said bimetal element, and thermal bending of said bimetal element in response to overload currents causing said other end of said bimetal element to be released from said handle to permit longitudinal movement of said bimetal element and opening movement of said switch member.

8. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle operable to effect opening and closing movement of said switch member, a bimetal element connected in said circuit to be heated by current and disposed in compression between said handle and said switch member for normally releasably restraining said switch member in closed position, means pivotally supporting one end of said bimetal element on said switch member, the other end of said bimetal element releasably engaging said handle, a stop member for said bimetal element, spring means biasing said bimetal against said stop member, means for adjusting the tension of said spring to vary the tripping point of said breaker, adjusting means for adjusting said stop means to vary the initial position of said bimetal element, and thermal bending of said bimetal element in response to overload currents causing said other end of said bimetal element to be released from said handle to permit longitudinal movement of said bimetal element and opening movement of said switch member.

9. A circuit breaker comprising a switch member movable to open and close the circuit through the breaker, biasing means biasing said switch member to open position and providing contact pressure in the closed position, an operating handle movable to effect opening and closing movement of said switch member, a current carrying bimetal element heated by the current of the circuit and disposed between said handle and said switch member having one end releasably engaging said handle, means pivotally supporting the other end of said bimetal element on said switch member, a stop member for said bimetal element, spring means biasing said bimetal element against said stop member, said bimetal element when heated a predetermined amount in response to overload currents below

a predetermined value bending away from said stop member in a direction to effect release of said bimetal element from said handle to permit said biasing means to move said switch member to open position, electromagnetic means comprising a fixedly supported magnetic member and an armature supported on said bimetal element, said electromagnetic means being operable in response to overload currents above said predetermined value to move said bimetal element in a direction to instantaneously release said bimetal element from said handle, and means for adjusting said stop means to vary the initial position of said bimetal element and said aramture.

10. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle having a plurality of projections thereon and movable to effect opening and closing movements of said switch member, a bimetal element disposed to be heated by the current of the circuit and having one end normally releasably supported on one of said projections, the other end of said bimetal element being pivotally supported on said switch member, said bimetal element when heated a predetermined amount bending in a direction to cause disengagement of said one end thereof from said one projection on said handle to permit longitudinal movement of said bimetal element and opening movement of said switch member, and longitudinal movement of said bimetal element causing said one end thereof to engage another of said projections and actuate said handle to an indicating position.

11. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle movable to an open position and to a closed posotion, a bimetal element disposed in compression between said handle and said switch member normally releasably restraining said switch member in closed position, one end of said bimetal element having a notch therein seated in a recess in the switch member and the other end of said bimetal element releasably engaging said handle, and said bimetal element bending when heated in response to overload currents to release the other end of said bimetal

element from said handle and permit longitudinal movement of said bimetal element to effect opening movement of said switch member.

12. A circuit breaker comprising a switch member biased to open position and movable to open and close the circuit through the breaker, an operating handle movable to an open position and to a closed position, a bimetal element disposed between said handle and said switch member having one end releasably supported on said handle, the other end of said bimetal element having a recess therein pivotally engaging a recess in said switch member, a flexible conductor connecting said other end of said bimetal element to said switch member, and thermal bending of said bimetal element effecting release of said one end of said bimetal element from said handle to permit opening movement of said switch member.

13. A circuit breaker comprising a switch member biased to an open position and movable to open and close the circuit through the breaker, an operating handle movable to an open position and to a closed position, a bimetal element having one end releasably supported on said handle and the other end abutting said switch member to releasably hold said switch member in closed position, a first flexible conductor connecting said one end of said bimetal element in the circuit of the breaker, a second flexible conductor connecting the other end of said bimetal element to said switch member, and thermal bending of said bimetal element causing release of said one end of said bimetal element from said handle to permit opening movement of said switch member.

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