Feb. 25, 1941. F. G. VON HOORN 2,233,187

CIRCUIT BREAKER

Filed April 14, 1939

Fig. 1.

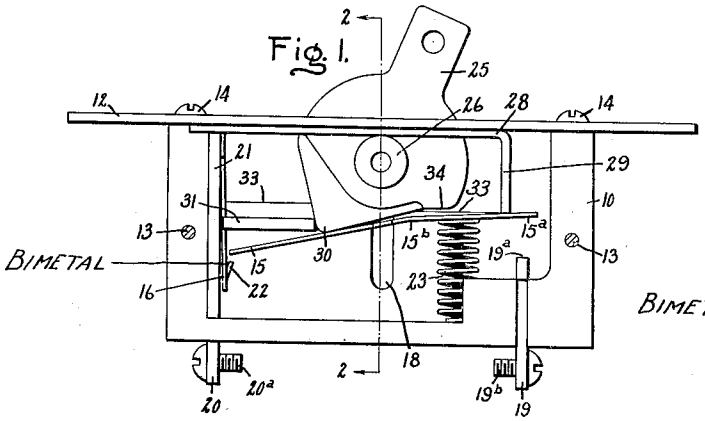


Fig. 2.

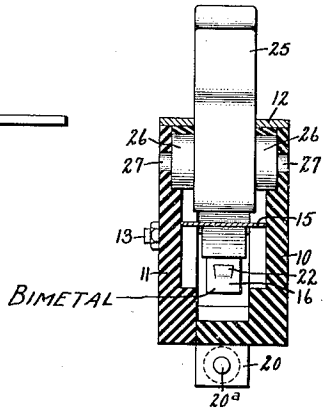


Fig. 3.

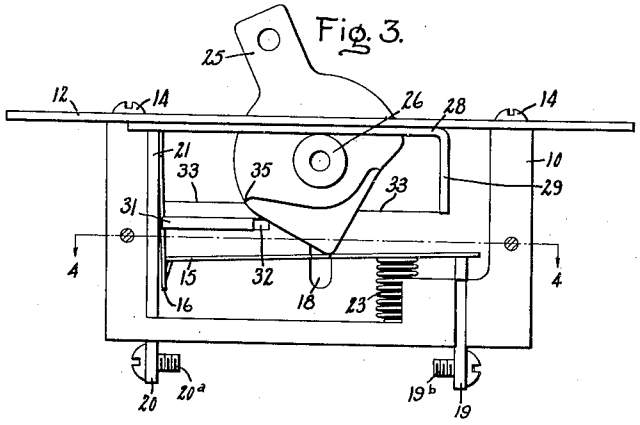


Fig. 5.

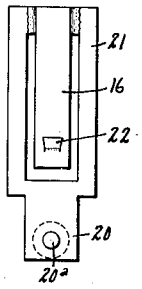


Fig. 4.

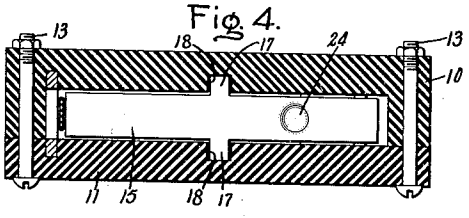
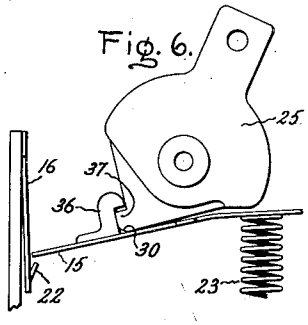


Fig. 6.



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UNITED STATES PATENT OFFICE

2,233,187

CIRCUIT BREAKER

Fred G. von Hoorn, Nichols, Conn., assignor to General Electric Company, a corporation of New York

Application April 14, 1939, Serial No. 267,800

11 Claims. (Cl. 200—116)

My invention relates to circuit breakers, more particularly to automatic electric circuit breakers having current-responsive tripping means, and has for an object the provision of a simple, reliable, and inexpensive device of this character.

This invention which is an improvement of the circuit breakers described and claimed in my copending application Serial No. 148,937, filed June 18, 1937, which issued as U. S. Patent No. 2, 150,013 on March 7, 1939, and application Serial No. 241,395, filed November 19, 1938, has special application to secondary type circuit breakers, for example, such as used in branch electric lighting circuits.

In accordance with my invention, the device here shown is operable manually to open and close a circuit, and is also responsive to excessive current conditions to open the circuit automatically, independently of the operating handle. A simple and inexpensive indicating trip-free mechanism with combination automatic and manual reset is featured; all the metal parts used, excepting the biasing spring, are made from flat blanks, resulting in low manufacturing costs. The parts are nested in suitable grooves in a molded phenolic composition case and prevented from coming out by a mounting strap secured on front, forming an enclosing cover for the case. Special means including a flexible and resilient switch member are provided to obtain a wiping engagement of the contacts and for affording a biasing force tending to hold the operating handle in a closed position when the contacts are engaged.

Further ojects and advantages of my invention will become apparent from the following specification and for a more complete understanding, reference should be had to the accompanying drawing in which Fig. 1 is an elevational view of a circuit breaker enclosed in a casing and shown in the manual open-circuit position, the cover plate of the casing being removed; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 looking in the direction of the arrows; Fig. 3 is an elevational view of the circuit breaker similar to Fig. 1, but showing it in the manual closed circuit position; Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3 looking in the direction of the arrows; Fig. 5 is a detail and Fig. 6 is an elevational view of parts of a circuit breaker illustrating another embodiment of my invention.

Referring now to the drawing, I have shown my invention in one form as a circuit breaker of small physical size, i. e., a secondary circuit breaker for use in branch lighting circuits and the like. Of course, the size and characteristics of the device will be selected to conform with the desired normal current and overload current to be handled in any particular application.

In the form shown, the circuit breaker comprises a casing 10 having a removable side wall 11 and a cover 12. If desired, however, the casing 10 and its side walls including the wall 11 may be molded as a unitary structure. A suitable plastic insulating material, such as a phenolic condensation product, is preferably used for the casing 10, the cover 12, for example, being a flat metal stamping having extending ends serving to mount the casing for use. Fastening means for the wall 11 and the cover or mounting strap 12 comprise the bolts 13 and the screws 14, respectively.

Switching means is mounted in the casing 10 and comprise a switch member 15 of the floating type, i. e., it is mounted for pivotal movement about a plurality of points. A current responsive means, for example, a bimetallic strip 16, positioned at the left end of the switch member 15 serves as a releasable pivot point about which the switch member is normally operable between open and closed circuit positions shown in Figs. 1 and 2, respectively. As best seen in Fig. 4, additional pivot and guide means for both pivotal and vertical movement of the switch member 15 in the casing 10 is provided. As illustrated, the transversely extending guide projections 17 on the switch member 15 are pivotally movable and slidable in appropriate slots 18 in the side walls of the casing 10 and serve to mount and guide the switch member for movement.

The right hand end of the switch member 15 serves as a movable contact 15a for engaging the upper face of a terminal member 19 serving as a fixed contact 19a. If desired, special contact surfaces may be provided on these members. The lower portion of the terminal member 19 projects exteriorly of the casing for connection with a circuit to be controlled by means of a terminal screw 19b; its upper portion is secured between the side walls of the casing 10, recesses in the walls being provided for that purpose. A terminal member 20 secured likewise, but in the left hand side of the casing 10, has an upper portion 21 extending vertically in the casing to support the current responsive means 16. Its lower projection is provided with the terminal screw 20a.

Referring to Fig. 5, the upper portion 21 of the terminal member 20 is slotted, the bimetallic strip

16 being suitably secured by welding or brazing thereon at the upper end of the slot and extending downwardly for lateral movement in the slot. The releasable pivot carried by the current responsive means, hereinbefore mentioned, for the left hand end of the switch member comprises a projection 22 on the bimetallic strip 16. As seen in Fig. 3, the projection 22 normally supports the switch member 15 in the closed circuit position. Heating of the bimetallic strip 16 by a condition of excessive current in the circuit breaker causes it to deflect to the left, i. e., away from the left end of the switch member 15. In this manner, the pivot support of the projection 22 is withdrawn, and, as will be more fully explained hereinafter, operation of the switch member to the open circuit position occurs. The electrical circuit through the circuit breaker comprises the terminal member 19, the fixed contact 19*a*, the movable contact 15*a*, the switch member 15, the bimetallic strip 16, and the terminal member 20.

Suitable biasing means for the switch member 15, for example, a helical spring 23, is located under the switch member to exert a biasing force substantially parallel to the direction of the slots 18. The spring 23 has its lower end disposed in a molded well or recess (not shown) in the bottom of the casing 10; its upper end engages a seating projection 24 on the switch member 15 positioned between the guide projections 17 and the right hand or contact carrying end of the switch member. The force of the spring 23 normally biases the switch member to the open position, as shown in Fig. 1. In the closed position shown in Fig. 3, this spring force biases the switch member 15 for movement about the pivot point 22 to the open position and simultaneously serves to bias the switch member for movement, upon release of the pivot point by deflection of the bimetallic strip 16, to the open circuit position, as will be more fully described hereinafter.

For actuating the switch member manually between open and closed circuit positions, a pivoted actuating handle 25 is provided. Its upper end projects exteriorly of the casing 10 through a suitable aperture in the mounting strap or cover 12. The handle 25 is pivoted on a pair of trunnions 26 mounted in semi-circular recesses in the casing walls. If desired, a fastening and pivot bolt may be inserted in the openings 27 in the casing walls and through handle 25. I prefer to secure the handle 25 in position against the upwardly directed force of the spring 23 by means of an insulating liner 28 positioned in a suitable recess in the casing walls, the liner 28 being held therein by the cover 12. The left end of the liner 28 serves to insulate the terminal 20 from the cover plate 12, its right end being bent to project downwardly into the casing 10, forming a pivot projection 29 for automatic resetting of the switch member 15, as described hereinafter.

At its lower end, the handle 25 has an operating projection or cam face 30 a predetermined distance from its center of rotation 27, the cam face 30 being in operating relation to move the switch member 15 between its open and closed positions. The handle 25 is movable between an open or "off" position, shown in Fig. 1, and a closed or "on" position, shown in Fig. 3. Movement of the handle 25 clockwise to the extreme "off" position causes its lower end adjacent the cam face 30 to slidably move a slide member 31 to the left for likewise moving the bimetallic strip 16. The slide member 31 is mounted in a pair of parallel and horizontally disposed recesses 32 in the casing walls. It engages and moves the bimetallic strip 16 to the left for enabling resetting of the switch member 15, if the bimetallic strip 16 cools and returns to its normal latching position before the left end of the switch member is automatically positioned for reset. The use of the slide member 31 for enabling resetting of the switch member 15 is generally only necessary when the actuating handle 25 is inadvertently held in the "on" position during automatic operation of the circuit breaker. If a unitary casing structure, as before mentioned, is used, the slide member 31 may rest on a pair of ledges on the casing walls, being held in place by a suitable projection from the liner member 28.

Before proceeding with a description of the operation, it would be well to understood more fully the function and character of the switch member 15. As shown in Fig. 1, this member comprises a metallic stamping normally deformed slightly and having a bend or bent portion 15*b* disposed between the guide projections 17 and the spring seat 24 thereon. Because of the bent portion 15*b*, the ends of the switch member 15 form an angle with each other so that the underside of the switch member encompasses an angle of less than 180 degrees.

The switch member 15 is formed of a suitable resilient and flexible material, for example, a metallic material such as copper. The bent or angular form of the switch member 15 serves to exert a biasing force on the handle 25 tending to bias and hold the handle in the "on" position when the switch member is flexed in the closed position thereof. In addition, this flexure of the switch member in its closed position serves to cause a translational movement of the right hand or contact end 15*a* of the switch member on the fixed contact 19*a* for providing a wiping engagement of these contacts.

As seen in Fig. 3 in the closed position, the switch member 15 assumes a substantially plane configuration having been flexed from its normal deformed or angular configuration shown in Fig. 1. From the open position in Fig. 1, movement of the handle 25 to the closed position causes pivotal movement of the switch member in a clockwise direction about the pivot point 22 on the bimetallic strip 16. Upon engagement of the contacts 15*a* and 19*a*, continued movement of the handle in the counterclockwise direction further lowers the cam face 30 and causes the normally deformed switch member to flex downwardly. As a result of this flexure, a translational movement of the contact 15*a* across the contact 19*a* occurs, the bimetallic strip 16 preferably being stiff enough to assist the switch member 15 in maintaining its position so that the translational movement does not transpire to any great extent at the left hand end of the switch member 15. As shown in the drawing, small clearances are provided between the projections 17 of the switch member 15 and the sides of the slots 18 also to assist in retaining the switch member positioned longitudinally and thereby effect a substantial displacement or translation of the right end 15*a* when the flexure occurs. Simultaneously, the handle 25 is biased on the closed or "on" position by the force of the flexed switch member 15 directed against the cam face 30 and toward the center of rotation 27 of the handle 25. Suitable ledges 33 are provided on the casing walls to limit the angular movement of the handle

between its "off" and "on" positions. These ledges engage the stop projections 34 and 35 of the handle 25 and thereby determine, respectively, the extreme "off" and "on" positions of the handle.

Although I prefer to deform the switch member 15 initially, as shown in Fig. 1, it is obvious that other forms may be used without departing from the scope of my invention, and, therefore, I do not wish to be limited to the particular structure illustrated.

As hereinbefore stated, the switch member 15 is normally operated between the closed and open-circuit positions by moving the actuating handle 25 between its "on" and "off" positions. During such normal operation, the switch member pivots about the projection 22 on the bimetallic strip 16 to close and open the contacts 15a and 19a. The engagement of these contacts is first made with the switch member 15 in its deformed condition. Further movement of the actuating handle 25 counter-clockwise to the "on" position for engaging the stop projection 35 with the ledge 33 in the extreme "on" position causes downward flexure of the switch member 15 to a substantially plane configuration, shown in Fig. 3, by reason of the downward movement of the cam face 30. Simultaneously, the contact 15a is translated to the right across the contact 19a and the flexed switch member 15 biases and retains the actuating handle 25 in the extreme "on" position.

To open the circuit breaker, the actuating handle 25 is rotated clockwise for raising the cam face 30. The flexed switch member 15 first returns to its deformed shape and then is pivoted counter-clockwise by the spring 23 for disengaging the contacts 15a and 19a. The upwardly directed spring force pivots the switch member 15 on the projection 22 and also raises it bodily to the open position, shown in Fig. 1, the right hand end of the switch member finally engaging the reset projection 29 for a slight pivotal movement thereabout in a clockwise direction. The extreme "off" position of the handle 25 is determined by engagement of the stop projection 34 and the ledge 33, but normally this extreme position is not reached since the left side of the cam face 30 engages the slide member 31 which abuts the bimetallic strip 16.

Automatic operation of the switch member 15 in the closed position to the open position occurs upon release of the pivot point 22 by a deflection of the bimetallic strip 16 to the left upon a condition of excessive current through the circuit breaker, the bimetallic strip being heated by the flow of current therethrough. Upon release of the left hand end of the switch member 15, the force of the spring 23 pivots the switch member in a counter-clockwise direction about the cam face 30 on the actuating handle 25 to disengage the contacts 15a and 19a. Immediately, the right hand end of the switch member 15 strikes the reset projection 29 in the casing 10. At this point in the operation, the switch member 15 has again assumed its normally deformed configuration and is now inclined at a considerable angle with its former closed circuit position. Although still engaging the cam face 30, the switch member 15 in the inclined position no longer exerts a force directed through the center of rotation 27 of the handle 25, but rather, its force tends to rotate the handle clockwise to the "off" position. Clockwise rotation of the handle 25 permits the left end of the switch member 15 to rise in the casing 10. Thereupon, the spring 23 rotates the switch member 15 in a clockwise direction about the resetting projection 29 to the manual "off" or closed-circuit position shown in Fig. 1, the handle 15 simultaneously being returned to its "off" position. Upon cooling sufficiently, the bimetallic strip 16 again deflects to the right to the normal position, and the circuit breaker is ready for switching to the closed-circuit position.

During the occurrence of automatic circuit opening and resetting just described, if the handle 25 is retained in the "on" position, the switch member 15 cannot automatically return to the reset position until the handle is released. If the switch member 15 is retained in the inclined position, after counter-clockwise rotation about the cam face 30, until the bimetallic strip 16 is cooled and returned to its normal position, the projection 22 interferes with the upward movement of the left hand end of the switch member and automatic resetting is thwarted. To enable resetting of the switch member 15 to the normal open-circuit position, it is necessary to rotate the handle 25 clockwise to the extreme "off" position. Such rotation moves the slide member 31 to the left, by reason of its engagement with the cam projection 30, and also forces the bimetallic strip 16 to the left. The path of movement of the hand end of the switch member 15 is thereby cleared, and the spring 23 pivots the switch member clockwise about the resetting projection 29 to the normal open-circuit position. Manual switching of the switch member 15 may then be undertaken.

Fig. 6 illustrates a further embodiment of my invention wherein different means are provided to enable the switch member 15 to be returned to the reset position, if automatic resetting is thwarted by cooling of the bimetallic strip 16. As shown, the switch member 15 is provided with a hook-shaped projection 36 suitably fastened on the upper face thereof adjacent its left-hand or pivoted end. The handle 25 is provided with a co-operating hook-shaped projection 37 adjacent its cam face 30 adapted to engage the projection 36 for bodily lifting the left end of the switch member upwardly, when the handle is rotated clockwise in the "off" position. In this way, the left end of the switch member 15 itself engages the projection 22 on the bimetallic strip 16 to force the strip 16 to the left and out of the path of the rising switch member. Once the path is cleared, the spring 23 may again pivot the switch member to a reset position, as shown in Fig. 1. During normal automatic resetting of the switch member, its operation is similar to that explained in connection with Figs. 1 and 2.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and 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 flexible and resilient switch member mounted for pivotal movement between an open and a closed circuit position, circuit controlling means operated by said switch member, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a

pivot point about which said switch member is normally rotatable between open and closed circuit positions, means biasing said switch member and a pivoted actuating member operatively connected with said switch member to move said switch member about said pivot point between open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member in said closed position to a deformed condition for causing a wiping engagement of said circuit controlling means.

2. A circuit breaker comprising a flexible and resilient switch member mounted for pivotal movement between an open and a closed circuit position, circuit controlling means operated by said switch member, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a pivot point about which said switch member is normally rotatable between open and closed circuit positions, means biasing said switch member and a pivoted actuating member operatively connected with said switch member to move said switch member about said pivot point between open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member in said closed position for causing a wiping engagement of said circuit controlling means and thereby simultaneously biasing and holding said actuating member in said closed position by the spring force of said flexed switch member.

3. A circuit breaker comprising a stationary contact, a co-operating movable contact, a flexible and resilient switch member for moving said movable contact between open and closed circuit positions, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a pivot point about which said switch member is normally rotatable between open and closed circuit positions, a spring applying a biasing force to move said switch member about said pivot point to one of said positions when said switch member is in said closed circuit position and at the same time biasing said switch member to move upon release of said pivot point by said current responsive means and move said movable contact toward said open circuit position, and a pivoted actuating member operatively connected with said switch member to move said switch member about said pivot point between open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member in said closed position to a deformed condition for causing a wiping engagement of said contacts.

4. A circuit breaker comprising a stationary contact, a co-operating movable contact, a flexible and resilient switch member for moving said movable contact between open and closed circuit positions, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a pivot point about which said switch member is normally rotatable between open and closed circuit positions, a spring applying a biasing force to move said switch member about said pivot point to one of said positions when said switch member is in said closed circuit position and at the same time biasing said switch member to move upon release of said pivot point by said current responsive means and move said movable contact toward said open circuit position, and a pivoted actuating member operatively connected with said switch member to move said switch member about said pivot point between open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member for biasing said contacts into engagement and thereby biasing said actuating member in said closed position by the spring force of said flexed switch member.

5. A circuit breaker comprising a stationary contact, a co-operating movable contact, a flexible and resilient switch member for moving said movable contact between open and closed circuit positions, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a pivot point about which said switch member is normally rotatable between open and closed circuit positions, a spring applying a biasing force to move said switch member about said pivot point to one of said positions when said switch member is in said closed circuit position and at the same time biasing said switch member to move upon release of said pivot point by said current responsive means and move said movable contact toward said open circuit position, and a pivoted actuating member operatively connected with said switch member to move said switch member about said pivot point between open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member in said closed position for causing a wiping engagement of said contacts, said flexed switch member biasing said contacts into engagement and thereby simultaneously biasing and holding said actuating member in said closed position by the spring force of said fixed switch member.

6. A circuit breaker comprising switching means including a member mounted for pivotal movement, current responsive means normally serving as a pivot point about which said member is movable between open and closed circuit positions, said current responsive means being releasable when said member is in said closed position, means biasing said member in said closed position for movement to said open position and for automatic resetting of said member adjacent said pivot point upon release of said member by said current responsive means, actuating means for actuating said switching means, and means operable independently of said member and solely by said actuating means for moving said current responsive means thereby to enable resetting of said member for movement on said pivot point when said automatic resetting of said member is thwarted.

7. The combination in a circuit breaker having a current responsive means serving as a releasable pivot point of switching means including a member normally operable about said pivot point between an open and a closed circuit position, actuating means movable between open and closed positions for operating said member, means biasing said member in said closed position for movement to said open position and for automatic resetting of said member adjacent said pivot point upon release of said pivot point by said current responsive means, and means including a slidable element operable independently of said member and solely by the movement of said actuating means in said open position to engage and move said current responsive means out of the path of said member when said automatic resetting of said member is thwarted, said biasing

means thereupon again disposing said member in position for pivotal movement on said pivot point.

8. The combination in a circuit breaker provided with a casing and having a current responsive means serving as a releasable pivot point of switching means including a floating member having one end disposed adjacent said releasable pivot point for pivotal movement thereon and having its other end operable about said pivot point between normal open and a closed circuit positions, actuating means movable between predetermined open and closed positions for operating said member about said pivot point to said normal circuit positions, means biasing said member in said closed position for pivotal movement about a point on said actuating means to an open circuit position upon release of said pivot point by said current responsive means, a resetting projection serving as another pivot point about which said member is movable by said biasing means to said normal open circuit position after release by said releasable pivot point, means including a slidable element operable independently of said member and solely by movement of said actuating means beyond said predetermined open position to move said current responsive means out of the path of said one end of said member, said biasing means thereupon pivoting said switch member on said resetting projection and again disposing said member in position for pivotal movement between said normal circuit positions, and guide means in the walls of said casing slidably mounting said element.

9. A circuit breaker comprising switching means including a member mounted for pivotal movement, current responsive means normally serving as a pivot point about which said member is movable between open and closed circuit positions, said current responsive means being releasable when said member is in said closed position, means biasing said member in said closed position for movement to said open position and for automatic resetting of said member adjacent said pivot point upon release of said member by said current responsive means, actuating means for actuating said switching means, and means including a projection on said actuating means and a projection on said member engageable to return said member in position for movement on said pivot point when said automatic resetting of said member is thwarted.

10. The combination in a circuit breaker having a current responsive means serving as a releasable pivot point of switching means including a floating member having one end disposed adjacent said releasable pivot point for pivotal movement thereon and having its other end operable about said pivot point between normal open and closed circuit positions, actuating means movable between predetermined open and closed positions for operating said member about said pivot point, means biasing said member in said closed position for pivotal movement about a point on said actuating means to an open circuit position upon release of said pivot point by said current responsive means, a resetting projection serving as another pivot point about which said member is automatically movable by said biasing means to said normal open circuit position after release by said releasable pivot point, and means including a projection on said actuating means and a projection on said member engageable to move said member for forcing said current responsive means out of the path of said one end of said member when said automatic movement of said member is thwarted and thereby to return said member in position for movement of said pivot point.

11. A circuit breaker comprising a flexible and resilient switch member mounted for pivotal movement between an open and a closed circuit position, circuit controlling means operated by said switch member, current responsive means for releasably retaining one point of said switch member in a predetermined position serving as a pivot point about which said switch member is normally rotatable between open and closed circuit positions, means biasing said switch member, and an actuating member operatively connected with said switch member to move said switch member about said pivot point between said open and closed circuit positions, said actuating member moving said switch member to said closed position and thereupon flexing said switch member in said closed position to a deformed condition whereby the spring force of said flexed switch member biases and holds said actuating member in said closed position.

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