Feb. 21, 1939. D. HAYS 2,148,295

CIRCUIT BREAKER

Filed Aug. 27, 1936

Fig. 1.

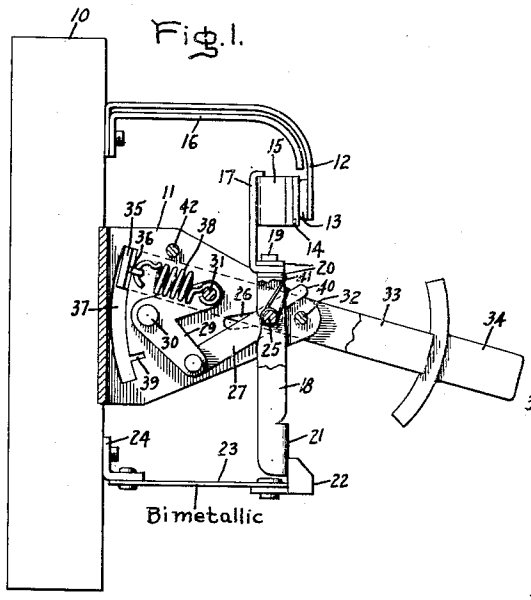


Fig. 2.

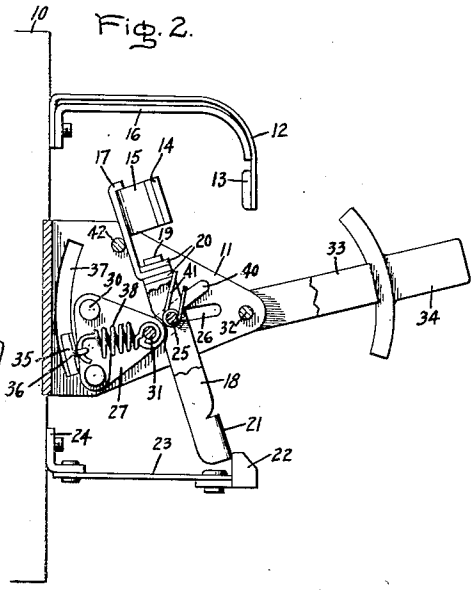


Fig. 4.

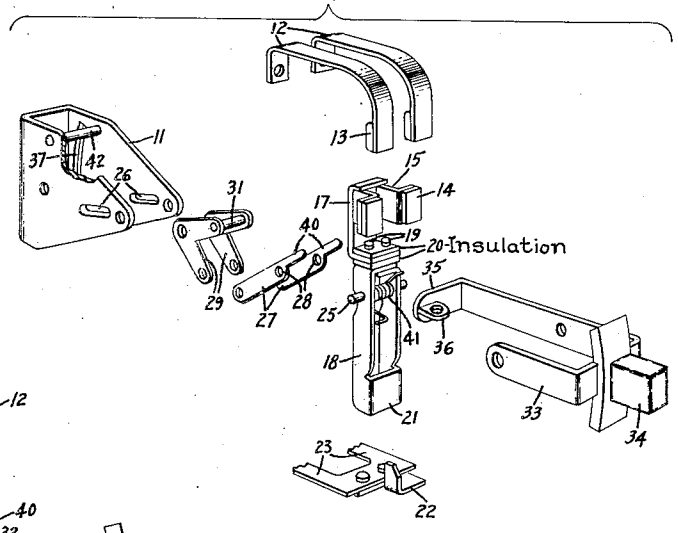
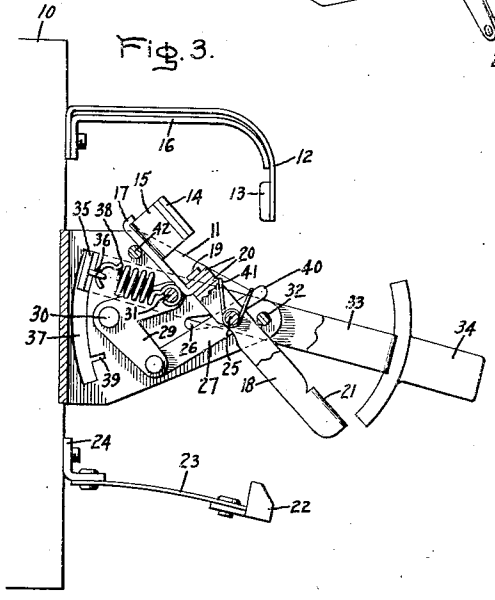


Fig. 3.



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UNITED STATES PATENT OFFICE

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CIRCUIT BREAKER

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Application August 27, 1936, Serial No. 98,136

10 Claims. (Cl. 200—116)

My invention relates to electric switches or circuit breakers, more particularly to trip-free switches or circuit breakers which are manually operable between open and closed circuit positions, and are automatically operable to open circuit position in response to predetermined current conditions, and has for an object the provision of a simple, reliable, and inexpensive device of this character.

Various circuit breakers of this general type have heretofore been proposed, many of which are to a large extent satisfactory for the purposes intended. Something is yet to be desired, however, in devices of this type which are extremely reliable in their operation, which are inexpensive to construct, and which consist of a minimum number of parts compactly arranged.

In carrying out my invention in one form, I provide a floating switch member having movable pivot means, current-responsive latch means for normally engaging the switch member, and snap-acting toggle means for moving the pivot means so as to operate the switch member between open and closed circuit positions, the switch member pivoting about the latch means. Biasing means are also provided for rotating the switch member about the pivot means to the open circuit position when the switch member is released by the current-responsive latch means on the occurrence of predetermined current conditions.

For a more complete understanding of my invention, reference should now be had to the drawing in which Fig. 1 is an elevational view, partly in section, of a circuit breaker embodying my invention; Figs. 2 and 3 are similar views illustrating the circuit breaker parts in different operating positions; and Fig. 4 is an exploded perspective view of the operating mechanism of the circuit breaker shown in Fig. 1.

Referring now to the drawing, I have shown my invention as applied to a circuit breaker having a base 10 formed of suitable insulating material on which is mounted a U-shaped frame 11 which supports the operating mechanism. Supported on the base 10 adjacent the frame 11, I provide a pair of flexible conducting members 12, each of which supports at its outer end a contact member 13 in a position to be engaged by cooperating movable contacts 14 which are carried on the opposite ends of a U-shaped bridging member 15, the bridging member 15 forming part of a floating switch member, the construction and operation of which will be fully described hereinafter. In order to minimize rebound of the contacts when the movable contacts 14 are operated into engagement with the stationary contacts 13, the conductors 12 are formed of resilient material and are maintained slightly under tension when the circuit breaker is in its open circuit position by supporting members 16, as shown best in Figs. 2 and 3. Although only one supporting member 16 is shown in the drawing, it will be understood of course that a separate supporting member is provided for each of the resilient conductors 12.

As shown best in Fig. 4, the bridging member 15 is carried on a supporting member 17 which is secured to a framelike member 18 in any suitable manner, for example, by rivets 19, and is insulated from the member 18 by suitable insulating plates 20. Adjacent its opposite end, the framelike member 18 is provided with a cross-portion 21 which is arranged to be engaged by a latch 22 supported on the yoke portion of a U-shaped bi-metallic thermal element 23 (Fig. 4), each leg of the U-shaped thermal element being secured to a terminal member 24, which terminal member is secured to the base 10.

Intermediate its ends, the floating switch member which is formed by the frame 18 and the member 17 is provided with a crosswise extending pivot pin 25, the opposite ends of which extend into suitable slots 26 formed in the legs of the U-shaped frame 11.

Arranged between the sides of the member 18 and the legs of the U-shaped frame 11, I provide a pair of supporting toggle links 27 which are provided with suitable apertures 28 through which the ends of the pivot pin 25 extend. Pivotally connected to the respective opposite ends of the links 27, I provide a pair of bell-crank levers 29, each of which is pivoted on a pin 30 which extends inwardly from one of the legs of the U-shaped frame 11. As shown, the bell-crank levers 29 are connected together by a pin 31 to form a unitary structure, and it will thus be apparent that the links 27 and 29 form a toggle mechanism which supports and guides the pivot pin 25 of the floating switch member for movement along the slots 26.

Pivotally mounted on a pin 32 which is supported on the outermost ends of the U-shaped frame 11, I provide a substantially U-shaped operating lever 33, the yoke portion of which carries a handle 34 formed of suitable insulating material. As shown best in Fig. 4, one leg of the U-shaped operating lever 33 extends beyond the pivot point of the lever and is provided with an inwardly extending finger 35 which carries a suitable lug 36. As shown in Figs. 1, 2 and 3,

when the operating mechanism of the circuit breaker is assembled, the finger 35 on the operating lever extends inwardly through a slot 37 formed in one leg of the U-shaped frame 11, and an over-center spring 38 is provided, one end of which is connected to the lug 36 and the other end of which engages the pin 31 carried by the bell-crank levers 29. In order to provide for assembly of the operating lever 33 relative to the frame 11, the slot 37 may be formed with sufficient width to permit the lug 36 to pass therethrough, or a suitable notch 39 (Figs. 1 and 3) may be provided along one side of the slot 37 to permit passage of the lug 36 when the finger 35 is inserted into the slot 37.

Each of the toggle links 27 is provided, as shown, with an extending finger 40, and a suitable torsion spring 41, which surrounds the pivot pin 25 between the opposite sides of the framelike member 18, is arranged with one end engaging the framelike member 18 and the other end engaging one of the fingers 40. Thus the switch member which carries the movable contacts 14 is biased for movement in a counterclockwise direction, as viewed in the drawing, about the pivot pin 25 and is normally maintained in the positions shown in Figs. 1 and 2 by engagement of the latch member 22 with the cross-member 21.

It is now believed that a complete understanding of my invention may be had from a description of the operation. It will be understood of course that the circuit breaker may be connected in an external circuit to be controlled by connecting one of the flexible conductors 12 to an external terminal, and by connecting one of the terminals 24 of the bi-metallic element 23 to a similar external terminal, a suitable conductor, not shown, serving to connect the other flexible conductor 12 to the other terminal 24 of the thermal element. Thus when the circuit breaker is in its closed position shown in Fig. 1, a circuit is completed which extends from one of the conductors 12 by way of the contacts 13 and 14 and the bridging member 15 to the other flexible conductor, by way of the above-referred to connection, not shown, to one terminal of the thermal element 23, and through the thermal element to the other one of the terminals 24.

In Fig. 1, the circuit breaker is shown in its closed circuit position, in which position the spring 38 biases the crank levers 29 to the position shown, so as to maintain the pivot pin 25 in the extreme right-hand end of the slot 26, and the latch 22 restrains the switch member against rotation about the pivot pin 25 so that the movable contacts 14 are held in engagement with the stationary contacts 13. In order to open the circuit breaker manually, it is necessary only to move the handle 34 upwardly from the position shown in Fig. 1 toward the position shown in Fig. 2. As the handle 34 is moved upwardly, the operating lever 33 rotates in a counterclockwise direction about its pivot 32 and, accordingly, the finger 35 moves downwardly in the slot 37, so as to carry the spring 38 overcenter relative to the pivot pin 30. When the line of action of the spring 38 passes across the pivot pin 30, the bias on the bell-cranks 29 is reversed and, accordingly, the bell-cranks 29 are rotated in a clockwise direction from the position shown in Fig. 1 to the position shown in Fig. 2. Rotation of the bell-cranks 29 to this position is of course effective to move the links 27 in a left-hand direction and thus operate the switch member to the open-circuit position shown in Fig. 2, the pivot pin 25 moving along the slot 26, and the switch member pivoting about its point of engagement with the latch 22. Reclosure of the circuit breaker may be effected simply by returning the handle 34 to the position shown in Fig. 1, the spring 38 thereupon passing overcenter in the opposite direction and rotating the bell-cranks 29 so as to move the links 27 and the pivot pin 25 to the position shown in Fig. 1.

It will thus be seen that the crank lever 29 and the links 27 constitute toggle means for moving the pivot pin 25 along the slots 26. Although in the embodiment of my invention shown, the toggle does not move to a completely locked position, it will be apparent that if it is desired that the switch member be locked in its closed circuit position, the links 29 and 27 may be so arranged that in the closed circuit position, the pivotal connection therebetween will assume a position directly in line with the pivot pins 25 and 30 when the circuit breaker is in its closed circuit position.

It will now be assumed that the circuit breaker is in its closed-circuit position and that a current flows through the circuit breaker of sufficient magnitude and duration to cause the bi-metallic thermal element 23 to flex to the position shown in Fig. 3. This flexure of the bi-metallic element withdraws the latch 22 from engagement with the cross-member 21 on the floating switch member, and the switch member is immediately rotated in a counterclockwise direction about the pivot 25 by the torsion spring 41 from the closed circuit position shown in Fig. 1 to the open-circuit position shown in Fig. 3.

In this open-circuit position, the supporting member 17 which forms part of the floating switch member engages a suitable stop pin 42 which extends crosswise between the legs of the U-shaped frame 11, and in order to reclose the circuit breaker after an automatic operation to its open-circuit position, it is necessary only to move the handle 34 from the position shown in Fig. 3 to the off position shown in Fig. 2, whereupon the overcenter spring 38 will operate the toggle links 29 and 27 so as to move the switch member to the position shown in Fig. 2. As soon as the thermal element 23 has cooled sufficiently to reengage the latch 22 with the cross-member 21, the circuit breaker may be reclosed by operating the handle 34 from the position shown in Fig. 2 to the position shown in Fig. 1.

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 floating switch member, movable pivot means for said member, current-responsive latch means normally engaging said switch member, a pair of links, a movable pivot connection joining said links to form a toggle, a connection between one end of said toggle and said pivot means, spring means for operating said toggle with a snap action to thereby move said pivot means between two positions with a snap action whereby said

switch member is pivotally moved about said latch means between open and closed circuit positions, and a second spring means biasing said switch member for rotation about said pivot means to an open-circuit position upon release of said latch means in response to predetermined current conditions.

2. A circuit breaker comprising a floating switch member, movable pivot means for supporting said member intermediate its ends, current-responsive latch means normally engaging one end of said switch member, a pair of links, a movable pivot connection joining said links to form a toggle, a connection between one end of said toggle and said pivot means, spring means for operating said toggle with a snap action to thereby move said pivot means between two positions with a snap action whereby said switch member is pivotally moved about said one end between open and closed circuit positions, and a second spring means biasing said switch member for rotation about said pivot means to an open-circuit position upon release of said latch means in response to predetermined current conditions.

3. A circuit breaker comprising a floating switch member, movable pivot means for said member, a bi-metallic thermal element having a latching portion abuttingly engaging said switch member remote from said pivot means, a pair of links, a movable pivot connection joining said links to form a toggle, a connection between one end of said toggle and said pivot means, spring means operating said toggle with a snap action for operating said pivot means between two positions whereby said switch member is pivoted about said latching portion of said thermal element between open and closed circuit positions, and a second spring means biasing said switch member for rotation about said pivot means to an open-circuit position, said thermal element upon the occurrence of predetermined current conditions releasing said switch member for movement about said pivot means.

4. A circuit breaker comprising a floating switch member, a pair of links, a movable pivot connection joining said links to form a toggle, a fixed pivot for one end of said toggle, pivot means connecting the other end of said toggle to said switch member, means biasing said switch member for rotation about said pivot means, current responsive latch means normally engaging said switch member for restraining said member against rotation about said pivot means, and means for operating said toggle to thereby move said pivot means whereby said switch member is pivotally moved about said latch means between open and closed circuit position, said current responsive latch means being arranged to release said switch member for rotation about said pivot means to an open circuit position independently of said toggle upon the occurrence of predetermined current conditions.

5. A circuit breaker comprising a frame, a floating contact lever having a pivot pin intermediate its ends, guide means on said frame for guiding said pivot pin, spring means biasing said switch member for rotation about said pivot pin, thermal means for releasably latching said switch member against rotation about said pivot pin, toggle means including a pair of links pivotally connected together and movable with relation to each other to move said pivot pin along said guide means to operate said switch member between open and closed circuit positions independently of said thermal means, and a second spring means for operating said toggle means with a snap action to snap said switch member from each position to the other, said thermal means being arranged to release said switch member in response to predetermined current conditions, whereupon said switch member rotates about said pivot pin to an open circuit position independently of said toggle means.

6. A circuit breaker comprising a frame having a slot therein, a floating switch member having a pivot pin guided in said slot, toggle means including pivotally connected links one of which pivotally engages said pivot pin and another of which is pivotally supported on said frame, a torsion spring the respective ends of which engage said one toggle link and said switch member for biasing said switch member for rotation about said pivot pin, current responsive means for releasably restraining said switch member against rotation about said pivot pin, overcenter spring means for rotating said other toggle link about its pivot whereby said one toggle link moves said pivot pin along said slot to operate said switch member between open and closed circuit positions, said current-responsive means being arranged to release said switch member upon the occurrence of predetermined current conditions whereupon said torsion spring operates said switch member to an open circuit position.

7. A circuit breaker comprising a frame having a guide slot therein, a floating switch member having a pivot pin extending into said slot, a bell-crank lever pivoted on said frame, a link pivotally connected to one leg of said bell-crank lever and to said pivot pin, means including a torsion spring engaging said link and said switch member for biasing said switch member for rotation about said pivot pin, current-responsive means releasably restraining said switch member against rotation about said pin, means including an overcenter spring connected to another leg of said bell-crank lever for operating said bell-crank lever to move said pivot pin along said guide slot, whereby said switch member is operated between open and closed circuit positions, said current-responsive means releasing said switch member upon the occurrence of predetermined current conditions, whereupon said torsion spring rotates said switch member about said pivot pin to open circuit position.

8. A circuit breaker comprising a U-shaped frame having guide slots in the opposite legs thereof, a switch member nesting between said frame legs and having a pivot pin extending into said guide slots, said pivot pin being intermediate the ends of said switch member, toggle means for moving said pin along said slot including a first link pivoted on said frame and a second link connected to said first link and to said pivot pin, a pivoted operating lever, overcenter spring means connected between said operating lever and said first toggle link for operating said toggle to move said pivot pin along said slot in response to movement of said operating lever, thermal means normally restraining one end of said switch member against movement whereby the other end of said switch member is operated between open and closed circuit positions as said pivot pin moves along said slot, and biasing means for operating said switch member about said pivot pin to an open-circuit position independently of said operating lever when said one end

of said switch member is released by said thermal means.

9. A circuit breaker comprising a floating switch member, means pivotally supporting said switch member intermediate its ends, said pivot means being mounted for limited movement in a direction substantially at right angles to said switch member so as to provide for movement of said switch member between open and closed circuit positions, means biasing said switch member for rotation about said pivot means, current responsive latch means normally engaging one end of said switch member to secure said switch member against rotation about said pivot means, and overcenter spring operating means connected to said switch member for operating said switch member with a snap action about said one end between its open and closed circuit positions, said current responsive latch means being arranged to release said one end of said switch member upon the occurrence of predetermined current conditions whereupon said switch member is rotated by said biasing means about said pivot means to an open circuit position.

10. A circuit breaker comprising a current carrying switch member, pivot means supporting said switch member intermediate its ends, a switch contact carried by one end of said switch member, means biasing said switch member for rotation about said pivot means to an open circuit position, a bimetallic thermal current responsive element having a latching portion normally engaging the other end of said switch member to restrain said member against rotation about said pivot means to said open circuit position, a guide for said pivot means providing for limited movement of said switch member about said other end as a pivot between open and closed circuit positions, and overcenter spring operating means connected to said switch member for operating said switch member with a snap action between said open and closed circuit positions.

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