Dec. 20, 1949 J. SANDIN ET AL 2,492,009

RESILIENT STOP AND POSITION LIMITING MEANS FOR CIRCUIT INTERRUPTERS

Filed Dec. 11, 1943

Fig. 1.

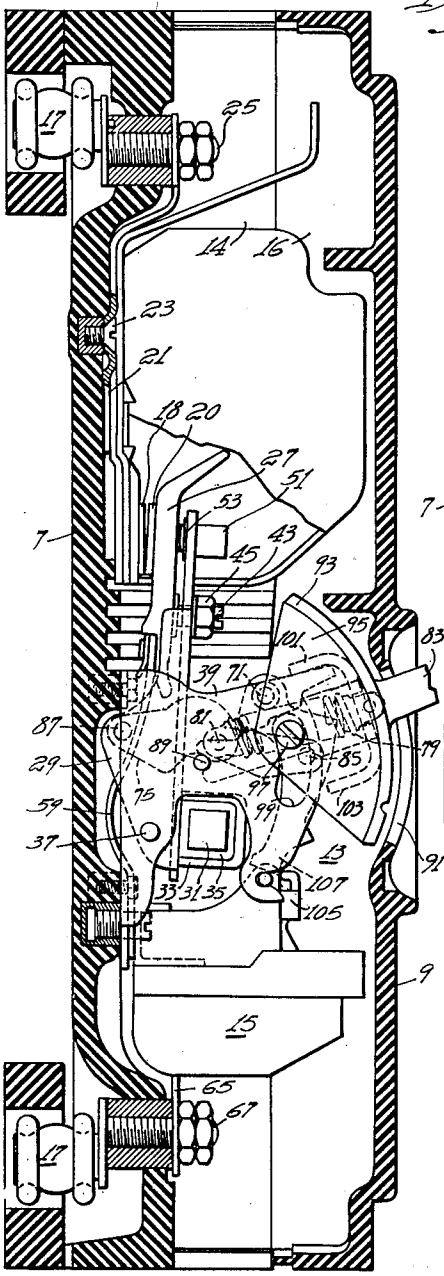
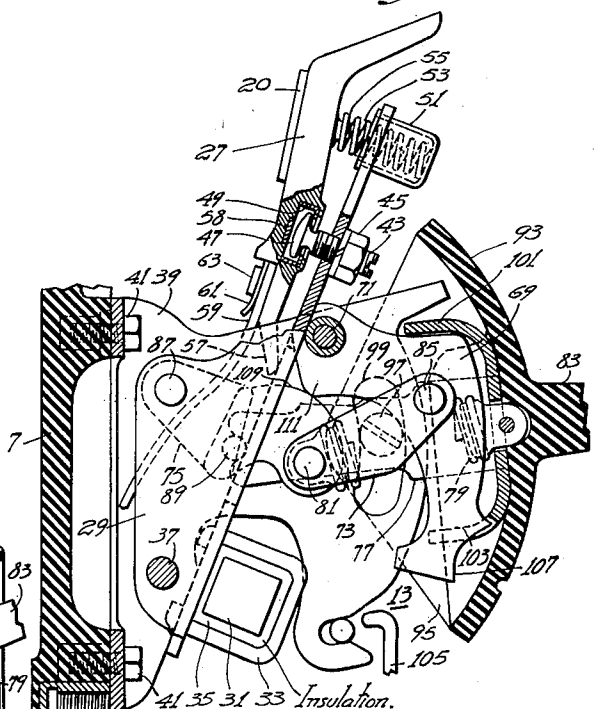


Fig. 2.



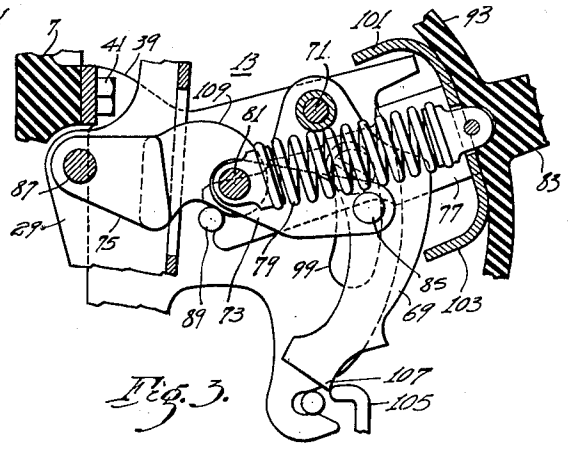


Fig. 3.

WITNESSES:

E. C. Reiding

Paul H. Hallen.

INVENTORS

Ture Lindstrom and

Jerome Sandin.

BY

Ralph H. Swingle

ATTORNEY

Patented Dec. 20, 1949 2,492,009

UNITED STATES PATENT OFFICE

2,492,009

RESILIENT STOP AND POSITION LIMITING MEANS FOR CIRCUIT INTERRUPTERS

Jerome Sandin, Forest Hills, and Ture Lindstrom, Edgewood, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 11, 1943, Serial No. 513,869

10 Claims. (Cl. 200—89)

1

This invention relates to circuit interrupters, and more particularly to air circuit breakers of the trip-free type provided with a trip device automatically operable in response to predetermined overload conditions to trip the circuit breaker open irrespective of the position of the closing mechanism.

Certain features disclosed but not claimed in this application are fully disclosed and claimed in co-pending divisional application Serial No. 569,184, filed December 21, 1944, by Jerome Sandin and Ture Lindstrom, and assigned to the assignee of the instant application.

In certain installations of circuit interrupters, the operating mechanism of the interrupters are frequently subjected to shocks of such magnitude as to cause movement of the operating handle to the open position, thereby causing undesirable opening of the interrupter. In such cases, the circuit controlled by the interrupter is opened and will remain open until manually reclosed. Serious consequences may result from such unwanted interruption of the circuit.

An object of the invention is to provide a circuit interrupter with an improved operating mechanism which will prevent opening of the interrupter by shocks or jars.

Another object of the invention is to provide a circuit breaker having an improved shock-proof structure which will prevent opening of the breaker mechanism by jars as shocks but which will allow automatic opening of the breaker in response to abnormal conditions in the circuit.

Another object of the invention is to provide a circuit interrupter having a novel operating mechanism wherein the operating spring acts as a resilient stop for the operating handle to prevent movement of the handle to open position as a result of shocks or jarring forces.

Another object of the invention is to provide a novel operating mechanism for a circuit breaker which inherently absorbs shocks and jarring forces originating externally of the breaker and prevents movement of the mechanism to open position without the use of additional devices.

Another object of the invention is to provide a circuit breaker with a novel operating mechanism in which means is provided for maintaining the operating spring under predetermined tension when the breaker is in the automatically tripped open position.

Another object of the invention is to provide a circuit breaker with an improved operating mechanism having means for maintaining the knee of the operating toggle in a predetermined position

2

when the breaker is in the tripped open position.

Another object of the invention is to provide a circuit breaker with improved contact mounting and adjusting means. A further feature lies in the fact that the adjusting means permits easy removal of the contact arm and the conductor connected thereto.

Another object of the invention is to provide a circuit breaker with an improved contact structure wherein novel means is provided for preventing the contacts from blowing open upon the passage of high current through the circuit of the breaker.

Another object of the invention is to provide an improved shock-proof circuit breaker which is simple, reliable in operation, and relatively inexpensive to manufacture.

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

Fig. 1 is a vertical longitudinal sectional view of a circuit breaker embodying the invention, the breaker being shown in the closed position.

Fig. 2 is an enlarged view, partly in section of the operating mechanism in the tripped open position.

Fig. 3 is a detailed view of a part of the operating mechanism showing the operating springs in the closed position resting against a fixed stop to act as a resilient stop for the handle.

Referring to Fig. 1 of the drawing, the three-pole circuit breaker comprises a base 7 of molded insulating material, a cover 9 also of insulating material secured to the base by means of bolts (not shown), operating mechanism indicated generally at 13, and a trip device indicated generally at 15. The casing formed by the base 7 and cover 9 is divided into three longitudinal compartments at the upper end thereof by partition walls 14, only one of which is shown, molded integral with the base, and matching partition walls 16 molded integral with the cover and cooperating with the partition walls 14. Each of the compartments is adapted to receive a stationary contact 18 and a cooperating movable contact 20 which, with their corresponding terminals and connecting conductors, collectively form the three poles of the breaker.

Each pole of the circuit breaker is provided with

end terminals 17 disposed in suitable openings formed in the base at each end thereof.

The respective stationary contacts 18, one for each pole, are each mounted on the lower end of a conductor 21 secured, by means of a screw 23, to the base 7. At its upper end the conductor 21 is connected by means of a bolt 25 to the respective terminal 17.

The movable contact structures for the several poles are the same, for which reason only the one for the center pole will be described. The movable contact 20 for the center pole is secured to a contact arm 27 which is loosely supported on a channel-shaped switch-arm frame 29 (Fig. 2), only the one for the center pole being shown. The three channel-shaped frames are rigidly fastened for unitary movement by means of a metal tie bar 31 which extends across all of the poles of the breaker. The tie bar 31 is secured to the frames 29 adjacent the pivoted ends thereof by means of metal straps 33 which loop about the bar and have their ends projecting through openings in the frames and clinched thereagainst. The tie bar 31 is encased in an insulating tube 35 in order to prevent short circuiting the poles of the breaker. The tie bar serves to mechanically interconnect all of the channel-shaped frames 29 so that all three of the frames are operated by a single actuating mechanism hereinafter described. The channel-shaped frame 29 of the center pole is pivotally supported on a pin 37 mounted in a U-shaped main frame 39 secured to the base 7 by means of screws 41. The pivot pin 37 forms the common pivot for the three mechanically connected switch arms or frames 29.

Each of the contact arms 27, to which the movable contacts 20 are secured, is attached to its corresponding channel-shaped frame 29 by means of a headed-adjusting bolt 43 threadedly engaging the channel member and locked in adjusted position by nuts 45. The head 47 of the bolt 43 loosely engages an inwardly extending flange on a sleeve 49 rigidly secured, by swedging or any suitable means, in a recess in the contact arms 27. A cup-shaped spring retainer 51 disposed in an opening near the upper end of the channel member 29 receives one end of a compression spring 53 having its other end engaging a spring guide 55 on the contact arm 27. The open end of the cup 51 is flanged outwardly to retain it in position on the channel member. The spring 53, in the open-contact position of the breaker, biases the contact arm 27 counterclockwise about the head 47 of the bolt 43, the movement being limited by a tail portion 57 of the contact arm engaging the channel member 29. In the closed position, the spring 53 provides the contact pressure.

A flexible conductor 59 is electrically and mechanically connected to the lower end of the contact arm by means of a clamp 61 of magnetic material and a rivet 63. The lower end of the flexible conductor 59 is connected to a conductor 65 which, in turn, is connected by means of a bolt 67 to the lower terminal 17 completing the circuit through the center pole of the breaker. The circuits for the two outer poles are the same as the circuit for the center pole, consequently, only the circuit for the center pole will be traced. This circuit extends from the upper terminal 17 through the bolt 25, conductor 21, stationary and movable contacts 18—20, contact arm 27, flexible conductor 59, conductor 65 and bolt 67 to the lower terminal 17.

The movable contact arm 27 is adjusted relative to the stationary contact by turning the adjusting bolt 43 so that in the fully closed position, the bottom edge of the contacts are in engagement and the upper or arcing portion of the contacts are slightly separated as shown in Fig. 1. In the closed position of the contacts, the head 47 of the adjusting bolt 43 is in engagement with a steel insert 58 in the bottom of the recess in the contact arm 27 which receives the head 47. When the channel-shaped member 29 rotates in clockwise or opening direction, as will be hereinafter described, the bolt 43 moves therewith permitting the spring 53 to rotate the contact arm 27 counterclockwise about the point of engagement of the contacts 18—20 bringing the arcing portions of the contacts into engagement. Continued opening movement of the channel-shaped member causes the lower or main contact portion of the contacts to separate, and finally, when the head 47 engages the flanged portion of the sleeve 49, causes the contacts to completely separate.

When the channel member 29 moves in counterclockwise or closing direction, the arcing upper portions of the contacts are the first to touch. Thereafter, as the closing movement continues, the head 47 engages the insert 58 and causes the contact arm 27 to rotate clockwise about the point of engagement of the insert with the head 47 of the bolt 43. During the latter part of this movement of the contact arm, the faces of the contacts are brought into parallel engagement and then the arcing upper portions of the contacts separate. By use of the swivel mounting at the head 47, the contacts are self-aligning. Also the contact arm 27 and conductor 59 may be easily removed and replaced if damaged by simply removing nut 45 and the screw at the lower end of the conductor.

By making the clamp member 61, which serves to clamp the flexible conductor 59 to the contact arm of magnetic material, the clamp serves also as an armature for preventing the contacts from blowing apart upon the occurrence of a sudden high current in the circuit of the breaker. The magnetic circuit comprises the clamp member 61 and the steel channel-shaped member 29 which supports the contact arm. The current passing through the flexible conductor 59 and the contact arm 27 provides sufficient energization of the magnetic circuit to hold the tail portion 57 in close to the channel-shaped member 29 and prevent the contact from being blown open.

The movable contact structure comprising the channel-shaped member 29, the tie bar 31 and the contact arm 27 for all three poles of the breaker, is adapted to be operated to open position and to closed position by the common actuating mechanism 13. This mechanism comprises a carrier or support member 69 pivotally mounted by means of a pin 71 on the main frame 39, a pair of toggle links 73 and 75 interconnecting the carrier 69 and the center-pole switch-arm frame 29, a U-shaped operating lever 77, overcenter springs 79 for connecting the operating lever 77 to the knee pivot pin 81 of the toggle links 73 and 75, and an insulating operating handle 83 for the operating lever.

The toggle links 73 are pivotally connected by means of a pin 85 to the carrier 69, while the toggle links 75 are pivotally connected by means of a pin 87 to the channel-shaped frame 29 for the center pole of the breaker. The two legs of the operating lever 77 are disposed adjacent the inner sides of the main frame members and are pivotally supported on pins 89 projecting inwardly from said frame members. The operat-

ing handle 83 projects through a slot 91 in the cover 9 and has an arcuate protective portion 93 and side plates 95 integral with the portion 93. The side plates 95 of the handle straddle the main frame 39 and are secured to the two legs of the operating lever 77 by means of screws 97 which extend through slots 99 in the adjacent frame members and threadedly engage the respective legs of the operating lever. The connecting portion of the operating lever is provided with formed-over portions 101 and 103. The portion 101 is for the purpose of engaging and resetting the carrier 69 to its latched position by movement of the operating handle as far as it will go in opening direction, in order to reset the mechanism following a tripping operation of the breaker. The carrier 69 is normally held in latched position as shown in Figure 1 by a latch 105 of the trip device 15, which engages the latch portion 107 of the carrier.

The operation of the circuit breaker operating mechanism is as follows: with the parts in the position shown in Fig. 1, in which position all of the contact means are closed and the carrier 69 is held in latched position; if the operating handle 83 is moved from the position shown in a clockwise direction to the opposite end of the slot 91 to rotate the operating lever 77 in a clockwise direction, the overcenter springs 79 will snap overcenter below the center line 81—85 and cause the toggle links 73—75 to collapse thereby causing simultaneous movement of all of the channel-shaped frames 29 and the movable contacts 20 to the open-circuit position with a snap action. The mechanism is made more shock proof by arranging the pivot points so that the handle must be moved almost to the "off" position before the spring is snapped overcenter. To reclose the breaker, the operating handle is moved in the opposite direction back to the position shown in Fig. 1. This movement of the handle will cause the overcenter springs to snap over in the opposite direction and move the toggle to the in-toggle position to simultaneously close all of the contact means with a snap action.

The circuit breaker is opened automatically in response to overload currents occurring in the circuit of any pole of the breaker, by operation of the trip device 15. The trip device may be of any suitable type, preferably of the type disclosed and claim in the copending application, Serial No. 513,868, filed December 11, 1943, by G. G. Grissinger, J. Sandin and Ture Lindstrom, and assigned to the assignee of the instant invention. Such trip devices are provided with thermally-responsive means operable to release the latch 105 after a time delay in response to overload currents below a predetermined value and are also provided with electro-responsive means operable to instantaneously release the latch in response to overload currents above a predetermined value, or in response to short circuits.

When the latch 105 is released by the trip device in response to an overload current, it frees the carrier 69 and permits the springs 79 to rotate the carrier in a counterclockwise direction about its pivot 71, thus causing collapse of the toggle links 73—75 and movement of the channel-shaped member 29 and the movable contacts to the open-circuit position shown in Fig. 2. The breaker cannot be reclosed until the operating handle has been moved to full open position in order to reset and relatch the carrier 69 with latch 105. After the carrier has been relatched,

the operating handle may then be moved to its closed-circuit position to effect closing of the contacts.

In circuit breakers of the type disclosed, the operating lever in the closed-circuit position, heretofore rested against a solid stop comprising a fixed part of the breaker structure. The operating lever was thus subjected to the reactive forces of sudden shocks or jarring forces transmitted thereto through the base and framework of the breaker including the fixed stop for the lever. These shocks are frequently of such magnitude as to cause movement of the operating handle to the open position and thereby cause undesirable opening of the circuit breaker. An important feature of the invention is the particular arrangement of the parts of the actuating mechanism in a manner to prevent the operating lever from being moved to open position as a result of shocks or jarring forces without the use of lock-in devices or additional shock-proof devices, all of which have proved undesirable in service.

Referring to Fig. 3 of the drawing, it will be seen that the operating lever 77 in the closed circuit position does not rest against a fixed stop, but that the overcenter springs 79 rest against the pin 71 thus providing a resilient stop for the operating lever and the handle. In this position any shocks or jarring forces relayed through the breaker structure will be absorbed by the springs 79 without communicating to the operating lever a sufficient force to cause movement of the lever to the open position as a result of shocks.

Means is provided to hold the knee 81 of the toggle 73—75 a sufficient distance away from the pivot 71 of the carrier, when the breaker is in the tripped open position (Fig. 2), in order to maintain sufficient force in the springs 79 to hold the channel-shaped switch arm 29 for the center pole firmly against the stop 71. By holding the knee of the toggle a predetermined distance from the pin 71, sufficient tension is maintained in the springs to control the position of the handle and thereby indicate the position of the breaker mechanism. When the breaker is tripped open automatically in response to overloads and the handle is held in the closed position, the springs 79 apply a force to the toggle 73—75 tending to straighten it and move the switch arm in closing direction. This is prevented by holding the knee of the toggle away from the pin 71 thereby holding the toggle in collapsed condition. The knee of the toggle 73—75 is held in the position shown in Fig. 2 when the breaker has been automatically tripped open, by a curved surface 109 on the toggle link 75 engaging a projection 111 on the carrier 69 adjacent the pivot 71 of the carrier.

In the closed position of the breaker mechanism (Fig. 1) there is a slight clearance between the surface 109 and the projection 111. When the carrier is released by the trip device, and starts to move in a counterclockwise direction, the toggle 73—75 moves outwardly therewith away from the base of the breaker. During this movement the surface 109 on the toggle link 75 engages the projection 111 and is thereby cammed downwardly to the position shown in Fig. 2. The pin 71 comprises a fixed point and since position of the pin 87, in the open position (Fig. 2), is fixed by engagement of the channel member 29 with the pin 71, the position of the knee pin 81 as well as its distance from the pin 71 is also fixed. This prevents further collapse of the toggle 73—75 and

further shortening of the springs 79, thereby maintaining the springs under tension.

From the foregoing description, it will be apparent that there is provided a novel circuit breaker operating mechanism which is inherently shock-proof without the use of additional devices for locking the mechanism in closed position. There is also provided a novel mechanism for maintaining a substantial tension in the operating springs. The invention also provides a novel contact structure wherein the contacts are prevented from blowing open by the forces generated by the passage of high currents through the breaker, and in which the contacts are self-aligning.

Having described a preferred embodiment of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made therein without departing from some of the essential features of the invention. It is, therefore, desired that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a circuit breaker, contact means, a switch member movable to an open position and to a closed position to open and close said contact means, operating mechanism for said switch member including an operating lever movable to an open and to a closed position, a releasable member operable when released to cause automatic movement of the switch member to open position, a toggle operatively relating the switch member to the releasable member, said toggle being operable upon release of said releasable member to cause automatic opening movement of the switch member, resilient means operable by said operating lever for operating said toggle to move the switch member to open and closed positions, said resilient means in the closed position acting to reduce the possibility of movement of said operating lever to open position in response to shocks or jarring forces, and means on said releasable member engageable with said toggle when said toggle is operated to open position to maintain said toggle in a predetermined position.

2. In a circuit breaker, contact means, operating mechanism for said contact means including an operating lever movable to an open position and to a closed position to open and close said contacts, a member releasable to cause automatic opening of said contact means irrespective of the position of said operating lever, a toggle connecting said releasable member and said contact means, resilient means operable to effect opening of said contact means, and means on said releasable member engaging said toggle at a point intermediate its ends to maintain said toggle in a predetermined position to thereby maintain said resilient means under predetermined tension in the open position of the breaker.

3. In a circuit breaker, contact means, operating mechanism for said contact means including an operating lever movable to open and closed positions to open and close said contact means, a member releasable to cause automatic opening of said contact means, a linkage connecting said contact means to said releasable member and operable to effect opening of said contact means, means comprising an overcenter spring for operating said linkage, and means on said releasable member cooperating with said linkage at a point intermediate the ends of said linkage upon release of said releasable member to maintain said linkage in a predetermined position in the open position of said breaker.

4. In a circuit breaker, contact means, operating mechanism for said contact means including an operating lever movable to open and closed positions to open and close said contact means, a member releasable to cause opening of said contact means, a linkage connecting said contact means to said releasable member and operable to effect opening of said contact means, means comprising an overcenter spring for operating said linkage, and a projection on said releasable member cooperating with said linkage at a point intermediate the ends of said linkage upon release of said releasable member to maintain said linkage in a predetermined position to thereby maintain said overcenter spring under predetermined tension.

5. In a circuit breaker, a supporting frame, stationary contact means, a switch member movable to open and closed positions, operating mechanism for said switch member including an operating lever movable to open and closed positions, a member releasable to cause automatic opening movement of said switch member, a linkage operatively relating said switch member to said releasable member and operable to cause movement of the switch member to open position, an over-center spring operable by said operating lever to operate said linkage, and means on said releasable member cooperating with said linkage in the open position of the breaker to maintain said overcenter spring in predetermined stressed condition, said overcenter spring in the closed position of said operating lever cooperating with said supporting frame to provide a resilient stop for said operating lever to thereby reduce the possibility of movement of said operating lever to open position in response to shocks or jarring forces.

6. In a circuit breaker, a supporting frame, stationary contact means, a switch arm movable to open and closed positions, operating mechanism including a toggle operable to cause movement of said switch arm to open and closed positions, an operating lever movable to open and closed positions, an overcenter spring operable by said operating lever to operate said toggle, releasable means operable to cause opening movement of the switch member irrespective of the position of said operating lever, said releasable means when released cooperating with said toggle to maintain said toggle in a predetermined position to maintain said overcenter spring under predetermined tension, and said overcenter spring in the closed position of the breaker cooperating with said supporting frame to prevent movement of the operating lever to open position in response to shocks or jarring forces.

7. In a circuit interrupter, a supporting frame, contact means, operating means for said contact means, including a manual lever movable to open and closed positions to open and close said contact means, a releasable member operable when released to effect automatic opening of said contact means, resilient means disposed between said operating lever and said releasable member and operable by said manual lever to effect manual opening and closing of said contact means, said resilient means being operable upon release of said releasable operating means to effect automatic opening of said contact means, and said resilient means in the closed position of the interrupter preventing engagement of said supporting frame with said manual lever to reduce

the possibility of movement of said manual lever by said frame to open position in response to shocks or jarring forces to thereby prevent false opening of said contact means.

8. In a circuit interrupter, contact means, operating mechanism for said contact means including a manual operating lever movable to an open position and to a closed position to manually open and close said contact means, a releasable member operable when released to effect automatic opening of said contact means, means operatively connecting said releasable member and said contact means, resilient means operatively relating said connecting means and said manual operating lever, said resilient means being operable by said operating lever to effect manual opening and closing of said contact means, a fixed member, and said resilient means in the closed positions of said operating lever engaging said fixed member to space said operating lever away from said fixed member to thereby render unlikely false movement of said operating lever by said fixed member to open position in response to sudden shocks.

9. In a circuit breaker, contact means, releasable operating mechanism for said contact means, a trip device normally restraining said operating mechanism in operative position and operable to effect automatic opening of said contact means, an operating lever movable from a closed position to an open position to effect manual opening of said contact means, collapsible thrust transmitting means operatively relating said releasable operating mechanism and said contact means, resilient means operatively connecting said thrust transmitting means and said operating lever, said resilient means being operable to effect collapse of said thrust transmitting means and opening of said contact means, means on said releasable operating mechanism engageable with said thrust transmitting means during automatic opening operations to maintain said thrust transmitting means in predetermined position to thereby maintain said resilient means under predetermined tension by restricting contraction of said resilient means, a fixed stop, and said resilient means in the closed position of said operating lever engaging said fixed stop to space said operating lever from said fixed stop to prevent movement of said operating lever in opening direction far enough to cause collapse of said thrust transmitting means and opening of said contact means in response to sudden shocks.

10. In a circuit breaker, a rigid supporting frame, stationary and movable contact means, a switch member mounting said movable contact means and movable to open and closed positions for opening and closing said contact means, a manual operating lever mounted on said frame and movable to open and closed positions, releasable operating mechanism for said contact means, means mechanically connecting said operating mechanism to said switch member operable upon release of said operating mechanism to effect automatic opening movement of said switch member irrespective of the closed position of said operating lever, tripping means for effecting release of said releasable operating mechanism, an overcenter spring tensioned between said connecting means and said operating lever and operable by said operating lever to actuate said connecting means and effect manual opening and closing movement of said switch member, said overcenter spring in the closed positions of said operating lever resting against said frame and spacing said operating lever away from said frame to thereby prevent movement of said operating lever to open position in response to sudden shocks transmitted to said frame, and cam means on said operating mechanism engageable with said connecting means upon automatic opening operations of said operating mechanism to maintain said overcenter spring under predetermined tension during automatic opening operations and in the tripped open position of said operating mechanism by restricting the contraction of said overcenter spring.

JEROME SANDIN.
TURE LINDSTROM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,459,494	Benjamin	June 19, 1923
1,501,148	Terhorst et al.	July 15, 1924
1,512,235	Perry	Oct. 21, 1924
1,892,008	Ross	Dec. 27, 1932
2,015,633	Dorfman	Sept. 24, 1935
2,050,285	Dorfman	Aug. 11, 1936
2,134,565	Leonard	Oct. 25, 1938
2,255,115	Helle	Sept. 9, 1941