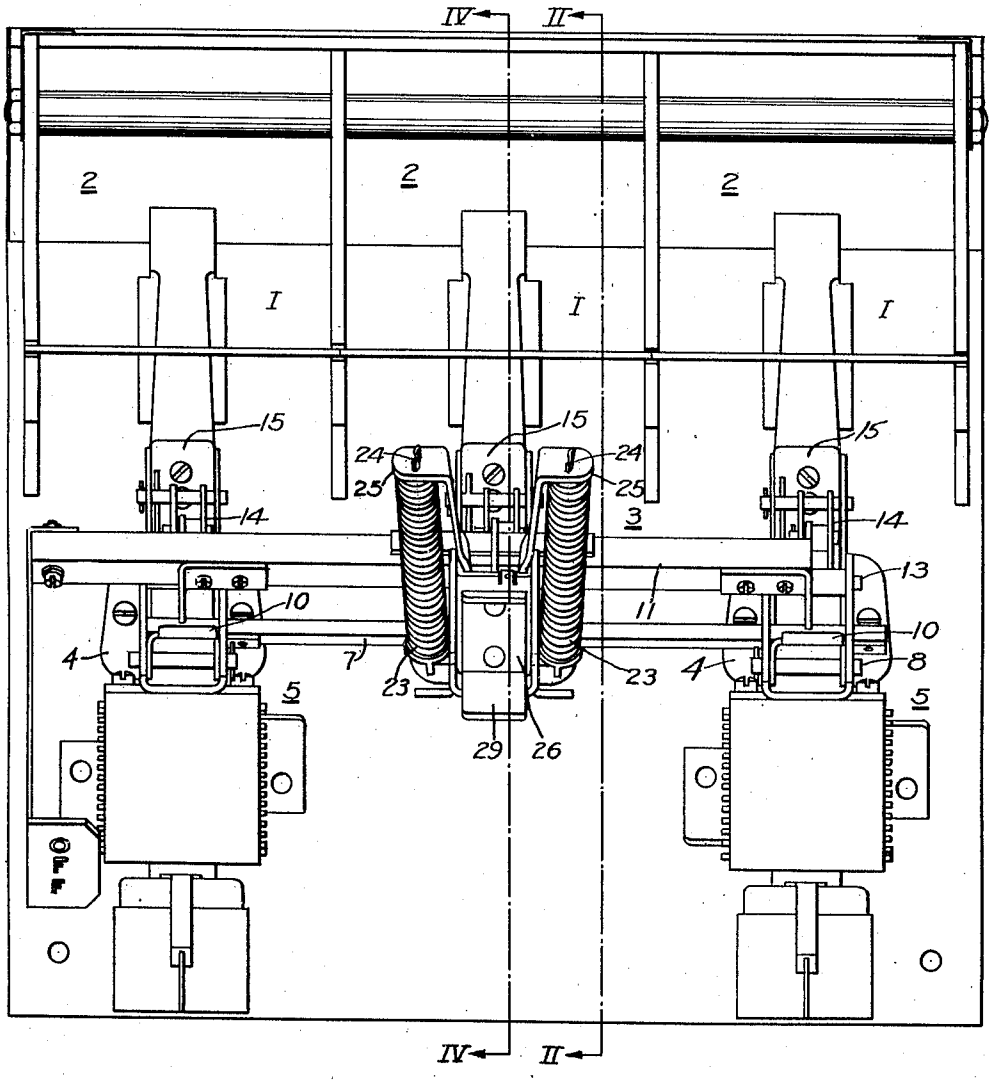
Nov. 10, 1936. J. SANDIN 2,060,472

CIRCUIT BREAKER

Filed April 22, 1927 5 Sheets-Sheet 1

Fig. 1.



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Nov. 10, 1936. J. SANDIN 2,060,472

CIRCUIT BREAKER

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Fig. 2.

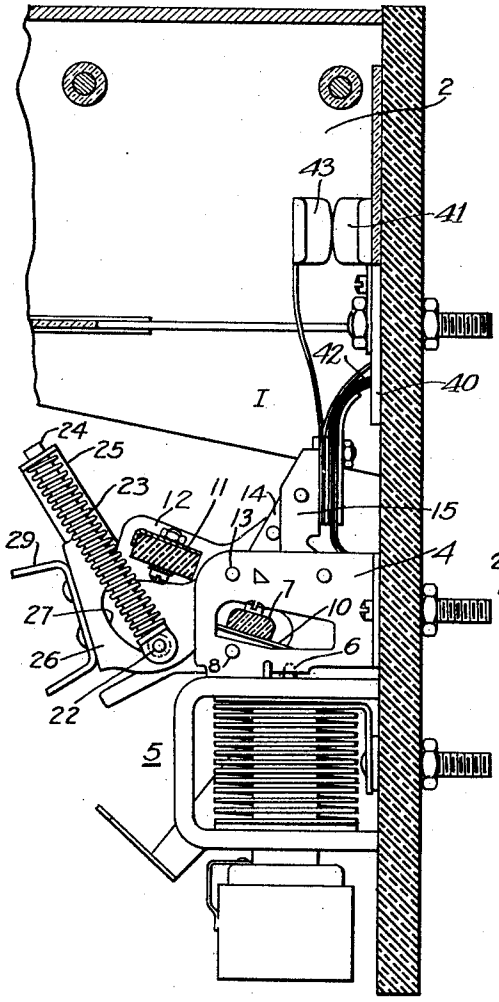
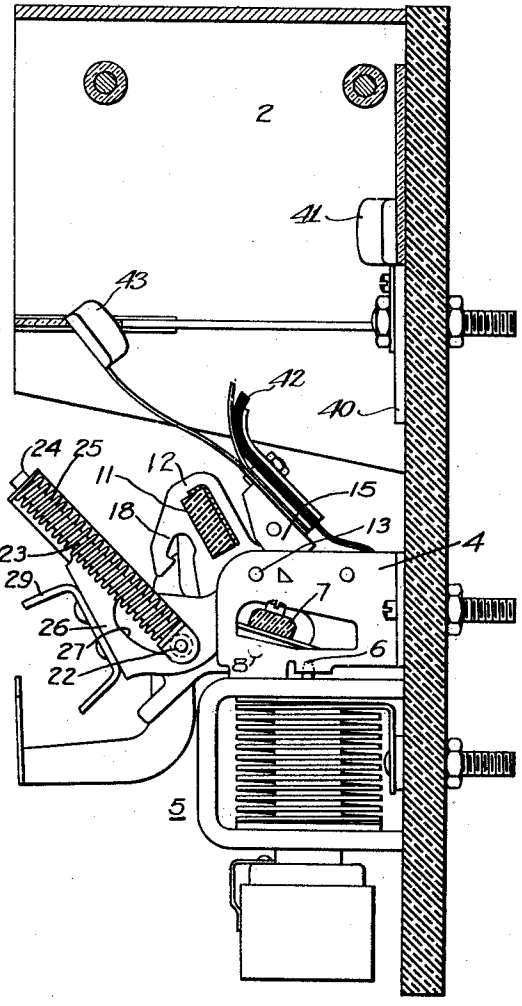


Fig. 3.



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Nov. 10, 1936. J. SANDIN 2,060,472

CIRCUIT BREAKER

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Fig. 4.

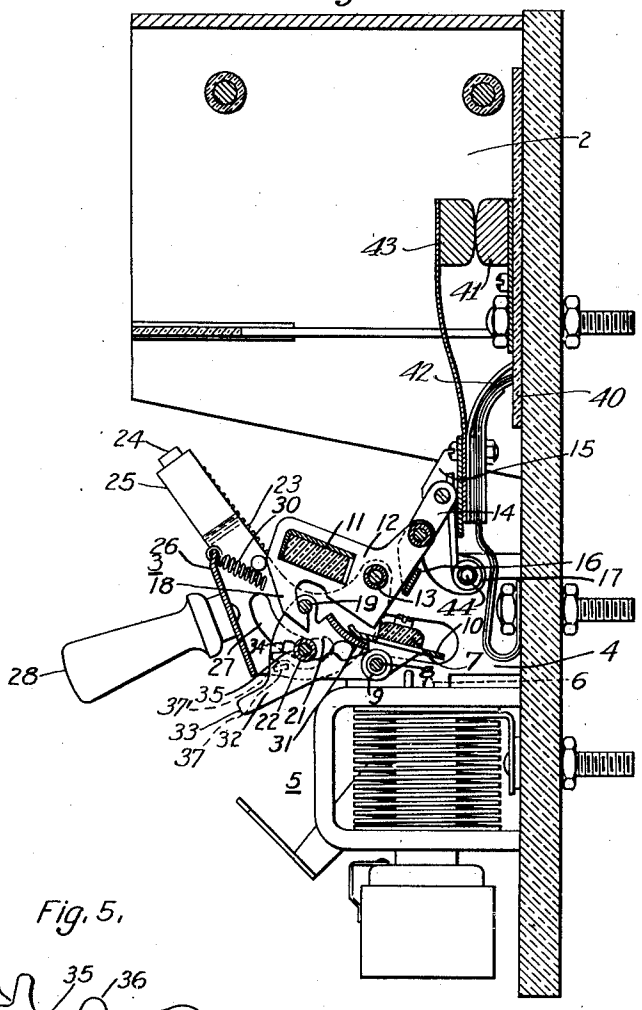
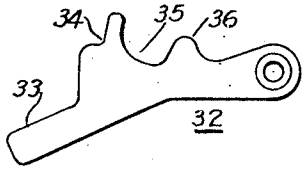


Fig. 5.



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Nov. 10, 1936. J. SANDIN 2,060,472

CIRCUIT BREAKER

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Fig. 6. Fig. 7.

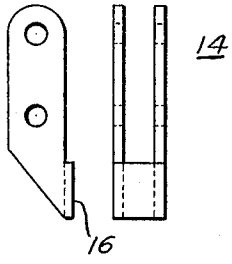


Fig. 8.

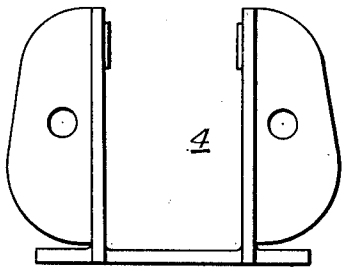


Fig. 9.

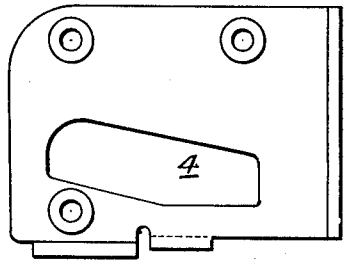


Fig. 11.

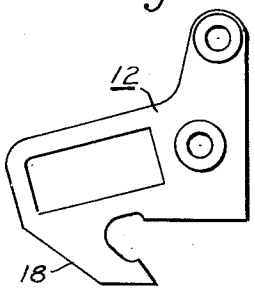


Fig. 12.

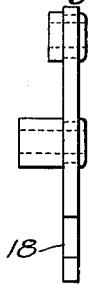


Fig. 10.

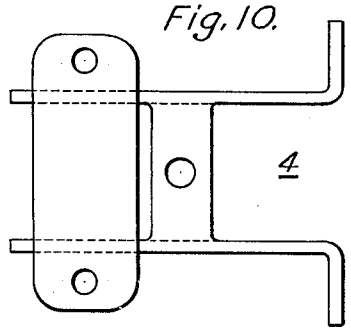


Fig. 13.

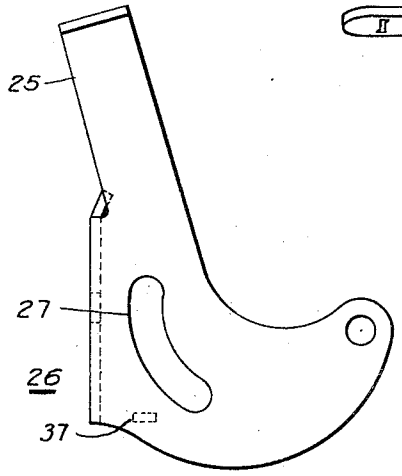


Fig. 14.

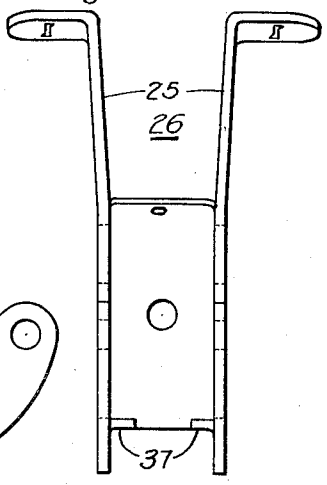


Fig. 15.

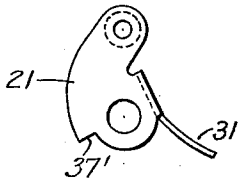


Fig. 16.

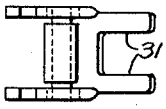


Fig. 17.

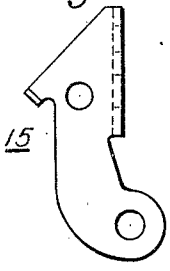


Fig. 18.

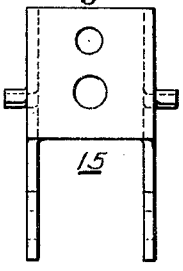


Fig. 19.

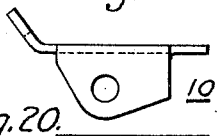
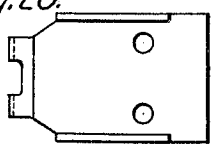


Fig. 20.



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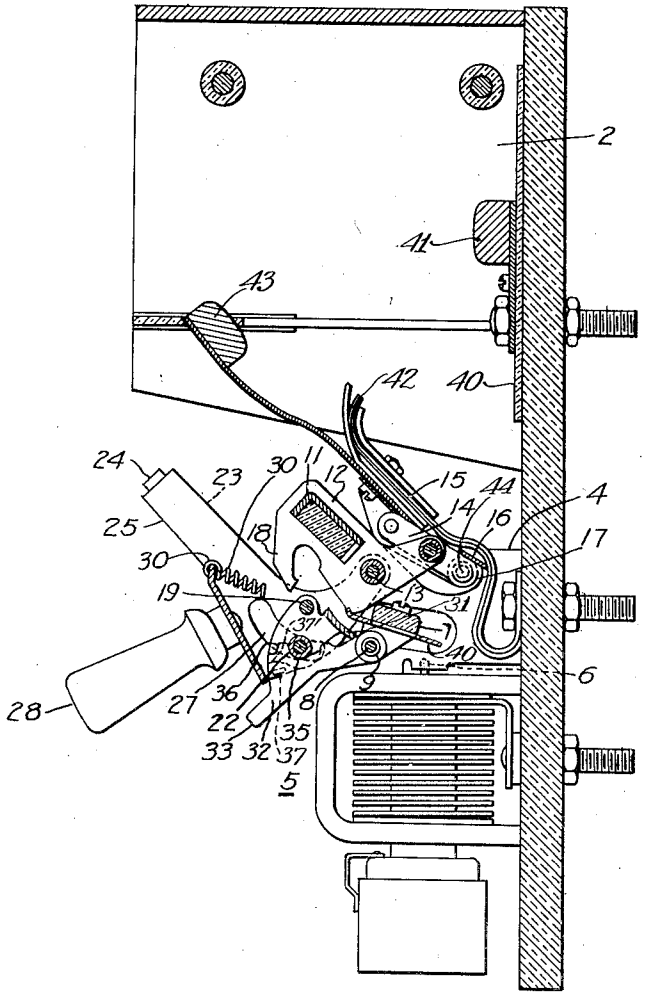
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CIRCUIT BREAKER

Filed April 22, 1927 5 Sheets-Sheet 5

Fig. 21



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Patented Nov. 10, 1936

2,060,472

UNITED STATES PATENT OFFICE

2,060,472

CIRCUIT BREAKER

Jerome Sandin, Wilkins Township, Allegheny County, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Application April 22, 1927, Serial No. 185,678

34 Claims. (Cl. 200—89)

My invention relates to electrical protective devices and particularly to circuit breakers.

One object of my invention is to provide a circuit interrupter that shall both make and break circuit with a snap action.

Another object of my invention is to provide a circuit interrupter that shall move to its closed circuit position by distinct steps, the last step taking place with a snap action.

It is a further object of my invention to provide a circuit interrupter that shall move to its circuit closing position in two distinct steps and in which a spring is positively stressed in the interval between steps in order that the final closing movement of the switch may take place with a positive snap action.

In circuit interrupters, as heretofore constructed, considerable attention has been paid to the opening of the circuit with a snap action. Such a snap action was found desirable in order to avoid pitting at the contact points by reason of chattering or long continued arcs due to a slow speed of contact separation. Little attention has been paid to the speed at which the contact members come together when the circuit is being closed. I have found that pitting may occur when the contacts are brought together slowly. Furthermore, the arcing terminals of such circuit breakers, which engage each other in advance of the engagement of the main contact terminals, are frequently called upon to carry excessive amounts of current during the interval preceding the engagement between the main contact members. By providing a snap-in movement of the contact members into circuit closing position, I am enabled to secure substantially simultaneous engagement between the arcing terminals and the main contact terminals. I have also provided means for causing the contact terminals to separate with a snap action.

In the accompanying drawings,

Figure 1 is a face view of a three-pole circuit breaker embodying my invention,

Fig. 2 is a view, partially in elevation and partially in section, taken along the section line II—II of Fig. 1 showing the circuit breaker in closed position,

Fig. 3 is a similar view showing the circuit breaker in open position,

Fig. 4 is a view, partially in elevation and partially in section, of a circuit interrupter taken along the section line IV—IV of Fig. 1,

Figs. 5 to 20, inclusive, are views of details, and

Fig. 21 is a view similar to Fig. 4, showing the circuit breaker in open position,

My invention comprises, in general, a plurality of circuit breakers 1 that are mounted in suitable arc chutes 2 connected to form a three-pole circuit breaker that is actuated by a common operating mechanism 3 mounted in a supporting frame 4 upon which may be attached a pair of overload release devices 5.

The structural details of the circuit breaker 1 may be of any preferred type of carbon circuit breaker having fixed contacts 40 and 41 and moving contacts 42 and 43 except insofar as specific structural details are necessary to complete the combinations hereinafter described. The arc chutes 2 may be of any conventional type, although I prefer to use those shown and described in my copending application, Serial No. 54,920, filed September 8, 1925. The overload release devices 5 may be of any preferred type having a plunger 6 for actuating an adjacent tripping lever 10. The several tripping levers 10 are connected to a common bar 7 that extends transversely of the circuit breakers 1 and through the operating mechanism 3. The tripping levers 10 (Figs. 19 and 20) are pivotally mounted on a shaft 8 and are biased in a clockwise direction by a coil spring 9 on the shaft 8 into position for engagement with the plungers 6, as is shown in Fig. 4.

The several circuit breakers 1 are also connected by a second bar 11. The bar 11 extends through openings in levers 12 (Figs. 11 and 12) that are pivoted, as at 13, to the frames of the individual circuit breakers 1. The bar 11, accordingly, constitutes a rigid connection between the mechanisms of the several circuit breakers 1.

Referring particularly to Fig. 4, each of the levers 12 is pivotally connected to a second lever 14 (Figs. 6 and 7) that, in turn, is pivotally connected to a moving contact brush support 15 shown in Figs. 17 and 18 of each circuit breaker 1. The link 14 is provided with a stop 16 that prevents the toggle constituted by the lever 12, the link 14, and the brush support 15, from going past dead center. The brush support 15 is biased about pivot 44 in a counter-clockwise direction, or into its circuit opening position, by a coil spring 17 of rather stiff material. Accordingly, the brush support 15 is held in closed position against the spring 17 by the toggle constituted by itself the lever 12, the link 14 and the stop 16, the toggle operating as a whole about the shaft 13.

The lever 12 is provided with a downwardly extending latch portion 18 that engages a shaft 19 supported in a frame or actuating element 21

(Figs. 15 and 16) that, in turn, is mounted on a movable pivot member 22.

Referring particularly to Figs. 1, 2 and 3, the shaft 22 is normally held in a depressed position by a pair of compression springs 23, which are wound about guide rods 24 that are confined by outer extending arms 25. The arms 25 constitute portions of the saddle or handle portion 26 of the operating mechanism 3, said saddle 26 being mounted on the stationary pivot 13 and forming the operating member for both opening and closing the circuit breaker manually. The shaft 22 moves in a slot 27 formed in the saddle member 26 for a purpose to be hereinafter described, and since the frame or actuating element 21 is movable bodily in the slot 27, due to the fact that it has no fixed pivot point, it is a floating member. The saddle or operating member 26, an enlarged view of which is shown in Figs. 13 and 14, is made from stamped sheet metal and may be actuated by a handle 28, as shown in Fig. 4, or by a clasp 29, as shown in Figs. 2 and 3, for the reception of an actuating bar (not shown).

Referring particularly to Figs. 4 and 21, the frame or actuating element 21 has a depending tail piece 31 disposed below the lever 12 and the bar 7. The frame 21 is biased in a counter-clockwise direction by a coil spring 30 attached thereto and to the saddle or operating member 26, whereby the tail piece 31 is normally held out of engagement with a latch member 32, which is pivotally mounted on the shaft 8 and which is biased in a clockwise direction by the coil spring 9.

Referring particularly to Fig. 5, the latch 32 has an outwardly extending arm 33 and relatively deep seated notches 34 and 35 and a projection 36. The notch 34 is so shaped as to engage the shaft 22 when the saddle member 26 is moved downwardly after having reset the shaft 19 in the latch 18 and hold it in fixed position until the arm 33 is moved by the saddle 26 a sufficient distance to release the shaft 22 from the notch 34. The shaft 22 is engaged thereafter by the notch 35 to retain the contact brush 15 in closed position. The saddle 26 is provided with an inwardly extending lug 37 that serves as a stop member to prevent overtravel of the frame 21 about the shaft 22 under the influence of the spring 30.

Assuming the circuit interrupter to be in the open position, the clip 29 or handle 28 is manipulated to move the saddle member 26 downwardly, which operation causes the arms 25 to compress the springs 23 and to move the shaft 22 downwardly, carrying with it the frame 21 and the lever 12 by reason of the connection between the shaft 19 and the latch 18. This movement continues until the shaft 22 is seated in the notch 34 when further movement of the latter is prevented.

The initial turning movement of the arm 12 causes the toggle comprising the arm 12, the link 14 and the brush support 15 to move the latter to a partially closed position. Upon engagement of the notch 34 by the shaft 22, further downward movement of the latter is prevented and it remains stationary in the slots 27, while the saddle 26 continues its downward movement with the result that the springs 23 are placed under increasing compressive forces.

The compression of springs 23 continues until the saddle 26 turns far enough to engage the arm 33 on the latch 32 and depresses it against the spring 9 until the shaft 22 is free from the notch 34. The shaft 22 being freed, the springs 23 expand and carry the frame 21 downwardly within the saddle 26, with the result that the lever 12 is given a quick counter-clockwise movement about the pivot 13, resulting in the toggle, comprising the arm 12, link 14 and brush support 15, being straightened so that the brush support 15 is driven to its circuit closing position against the spring 17 with a snap action. The latch 32 snaps back into position under the influence of the spring 9 and the shaft 22 is engaged in the notch 35 with the result that the shaft 22 is held therein, or in the circuit closing position.

If it is desired to open the switch manually, the saddle 26 is moved upwardly, allowing stop 37 to engage projection 37' and rotate the frame 21 in a clockwise direction about the shaft 22, resulting in the shaft 19 moving out of engagement with the latch 18, whereupon the toggle collapses under the influence of the springs 17 and the circuit breakers 1 snap to their open position.

Referring to Fig. 4, with the circuit breaker 1 in closed position, upon the occurrence of an overload effecting any overload device 5, the corresponding plunger 6 will be raised and strike the tripping lever 10, giving the latter a counter-clockwise movement. This movement is imparted to the tail piece 31 and the frame 21 is turned in a clockwise direction about the shaft 22 with the result that the shaft 19 is moved out of engagement with the latch 18. As soon as the latch 18 is freed from the shaft 19, the spring 17 is able to cause the collapse of the toggle constituted by the lever 12, the link 14 and the brush support 15 and the brush support 15 snaps to its open position. It will thus be seen that the circuit breaker 1 is full automatic in operation since the brush support 15 can be released without the movement of the saddle member 26.

After the brush support 15 is in its opening position, the saddle member 26 must be raised to permit the pin 19 to engage the latch 18 in order to be in position to again close the breakers 1. The shaft 22 must first be released from the notch 35, which release is automatically accomplished by the raising of the saddle member 26. The stop 37, carried upward by the saddle member 26, engages the projection 37' on the frame 21, imparting a clockwise movement thereto about the pin 22, until the tail piece 31 engages the projection 36 of the latch 32 imparting a counter-clockwise movement to the latch 32 allowing the pin 22 to become disengaged from the notch 35. Further upward movement by an operator will allow the latch 18 to pass behind the shaft 19 and engagement is made therebetween by reason of the tension in the spring 30. The circuit breakers 1 are again in position to be closed by manipulation of the operating mechanism 3 as heretofore described.

It will thus be seen that I have provided a circuit breaker that is characterized by a snap action both in its circuit making and circuit breaking operation. I have also devised a circuit breaker that moves to closed position in two distinct operations. The first operation causes the movable contact member to advance part way. Further progress is temporarily retarded by a latch mechanism during the period in which compression springs are placed under stress. The latch mechanism is then released and the compression springs drive the movable contact member the remainder of the distance to closed position with a snap action.

It is to be understood that such changes may be made in the relative location, disposition, size

and arrangement of the several parts as shall fall within the scope of the appended claims.

I claim as my invention:

1. In a switch structure, the combination with means movable for opening and closing the circuit, of an actuating mechanism for said movable means including a single operating member for both opening and closing the circuit, retaining means, a spring exerting a biasing force on the actuating mechanism in switch closing direction at all times, means for increasingly stressing said spring against said retaining means during the initial movement of the operating member in one direction to close the circuit, and means for releasing the retaining means at a predetermined point in the movement of the operating member as it continues to move in the same direction whereby the movement is automatically completed by the spring with a snap action.

2. In a switch, the combination with a pair of separable contact members, of an actuating mechanism for one of said contact members, an operating member for the actuating mechanism, a spring connecting the operating member to the actuating mechanism and applying a biasing force to the actuating mechanism in switch closing direction at all times, means for holding the actuating mechanism against movement during a portion of the movement of the operating member in one direction during which the spring is stressed, and means operable upon further movement of the operating member in the same direction to release the actuating mechanism from the action of the holding means, whereupon the actuating mechanism moves with a snap action under force of said spring.

3. A manually and automatically actuable switch having fixed and movable contacts, said movable contact being pivoted about an axis fixed relative to said fixed contact, means including a handle member and a spring to actuate manually said movable contact to both open and closed positions with a snap action, a current responsive member and a member movable upon movement of said current responsive member to actuate automatically said movable contact, said member movable to actuate automatically said movable contact being carried by said handle member but capable of movement independent thereof upon occurrence of overload.

4. A manually and automatically operable switch having fixed and movable contacts, a U-shaped switch frame, a U-shaped manual operator pivoted on said frame, a U-shaped auxiliary operator pivoted to said manual actuator, a U-shaped carrier for said movable contact pivoted in said frame, and spring means to cause engagement and disengagement of said contacts with a snap motion.

5. In a circuit breaker, a fixed contact member, a movable contact carrying arm pivoted about an axis fixed relative to said fixed contact, a pivoted handle member movable manually to actuate said movable contact carrying arm to both open and closed positions, an actuating member movably mounted on said handle member eccentric to the pivot thereof, said actuating member being movable independently of said handle member and causing actuation of said movable contact carrying arm to open position, and current responsive means for initiating movement of said actuating member upon the occurrence of overload.

6. In a circuit breaker, a fixed contact member, a movable contact carrying arm pivoted about an axis fixed relative to said fixed contact, a pivoted handle member, a spring for storing energy during a portion of the movement of said handle member and then releasing said stored energy to move said movable contact carrying arm to closed position with a snap action, an actuating member pivotally mounted on said handle member eccentric to the pivot of said handle member, said actuating member being movable independently of said handle member and causing actuation of said movable contact carrying arm to open position, and current responsive means for initiating movement of said actuating member upon the occurrence of overload.

7. In a circuit breaker, a fixed contact member, a movable contact carrying arm pivoted about an axis fixed relative to said fixed contact, a pivoted handle member, a spring for storing energy during a portion of the movement of said handle member and then releasing said stored energy to move said movable contact carrying arm to closed position with a snap action, an actuating member pivotally mounted on said handle member eccentric to the pivot of said handle member, said actuating member being movable independently of said handle member and causing actuation of said movable contact carrying arm to open position, and current responsive means for initiating movement of said actuating member upon the occurrence of overload, and said movable contact carrying arm being movable to open position upon the energization of said current responsive means irrespective of the position of said handle member.

8. In a circuit breaker, a contact movable for opening and closing the circuit, a pivoted handle member manually movable for normally causing both opening and closing movement of said contact, a spring stressed during movement of said handle to close the circuit for moving said contact to closed position with a snap action, an actuating member carried by said handle member and pivotally movable about a pivot point eccentric to the pivot point of said handle member when the contact is in closed position, and means for causing movement of said actuating member without a corresponding movement of the handle member and thereby causing movement of said contact to open position.

9. In a circuit breaker, a contact movable for opening and closing the circuit, a pivoted handle member manually movable for normally causing both opening and closing movement of said contact, a spring stressed during movement of said handle to close the circuit for moving said contact to closed position with a snap action, an actuating member carried by said handle member and pivotally movable about a pivot point eccentric to the pivot point of said handle member when the contact is in closed position, said pivotal movement of the actuating member causing said contact to move to open position, current responsive means for initiating movement of said actuating member, and said movement of the actuating member causing said contact to move to open position irrespective of the position in which the handle member may be held.

10. In a circuit breaker, a contact movable for opening and closing the circuit, operating means having a handle portion movable for normally causing both opening and closing of the circuit, an element movable for causing opening of the circuit upon the occurrence of predetermined

conditions, an actuator for said contact movable in the same direction both upon movement of said operating means to normally cause opening of the circuit and upon movement of said element movable to cause opening of the circuit in response to said predetermined conditions, said opening of the circuit by said element taking place irrespective of the position in which said handle portion may be held, a spring having one end connected to said operating means and the other end connected to cause movement of said actuator, said spring being increasingly stressed and storing energy upon movement of said handle portion of the operating means during a portion of its travel toward closed position and then releasing said stored energy whereby said contact is moved to closed position with a snap action.

11. In a circuit breaker, a contact movable in opposite directions for opening and closing the circuit, operating means including a handle portion manually movable in opposite directions for normally causing both opening and closing of the circuit, a current responsive element for causing opening of the circuit upon the occurrence of predetermined electrical conditions in the circuit, a movable element for actuating said contact, said movable actuating element being movable upon movement of the handle portion of said operating means to cause both normal opening and closing of the circuit and also being movable upon movement of said current responsive element to open the circuit, said movement of the actuating element to cause opening of the circuit taking place in the same direction whether initiated by movement of said handle portion or by movement of said current responsive element, a spring having one end connected to said operating means and the other end connected to said movable actuating element, said spring forming a resilient connection through which movement of the handle portion of the operating means to close the circuit is transmitted to said movable actuating element to move said contact to closed position, said spring being increasingly stressed and storing energy upon movement of said handle portion of the operating means during a portion of its travel toward closed position and then releasing said stored energy to move said contact to closed position with a snap action, and said current responsive element causing movement of said contact to open position irrespective of the position in which said handle portion of the operating means may be held.

12. In a circuit breaker, a contact portion movable in opposite directions between two extreme positions in one of which the circuit is open and in the other of which the circuit is closed, operating means having a handle portion movable in opposite directions between two extreme positions in one of which the circuit is normally open and in the other of which the circuit is normally closed, an element movable for causing opening of the circuit upon the occurrence of predetermined conditions, an actuator for the contact portion, said actuator being movable upon movement of said operating means to normally cause movement of said contact portion from either one to the other of its extreme positions and being movable upon movement of said element responsive to predetermined conditions to cause movement of said contact portion from its extreme position in which the circuit is closed to its extreme position in which the circuit is open, said handle portion remaining in its extreme position in which the circuit is normally closed when said contact portion moves to its extreme position in which the circuit is open upon movement of said element responsive to predetermined conditions, and a spring having one end connected to cause movement of said actuator and the other end to said operating means, said spring being charged with energy during a portion of the travel of said handle portion between its extreme positions and releasing said energy to cause movement of said contact portion with a snap action to its extreme position in which the circuit is closed.

13. In a circuit interrupter, contact means movable for opening and closing the circuit, an operating member movable between an open and a closed position, a floating member for actuating said contact means to both open and close the circuit, a trip member responsive to predetermined conditions, a slot and pin connection between said operating member and said floating member, said operating member causing movement of said floating member to close the circuit upon movement of said operating member to closed position, and causing movement of said floating member to open the circuit upon movement of said operating member to open position without movement of said trip member, and said trip member upon the occurrence of predetermined conditions causing said floating member to move and thereby open the circuit irrespective of the position in which said operating member may be held.

14. In a circuit interrupter, contact means movable for opening and closing the circuit, an operating member movable between an open and a closed position, a floating member for actuating said contact means to both open and close the circuit, a trip member responsive to predetermined conditions, said floating member having two supporting points when the circuit interrupter is in closed position, one of said supporting points comprising a slot and pin connection with said operating member and means for holding the pin adjacent one end of the slot when said operating member is in closed position, said holding means permitting movement of the pin to the other end of the slot upon movement of the operating member to open position, and the other of said supporting points being movable to cause opening of the circuit upon movement of said trip member upon the occurrence of predetermined conditions.

15. In a circuit interrupter, contact means movable for opening and closing the circuit, an operating member movable between an open and a closed position, a floating member for actuating said contact means to both open and close the circuit, a trip member responsive to predetermined conditions, said floating member having two supporting points when the circuit interrupter is in closed position, one of said supporting points comprising a slot and pin connection with said operating member and means for holding the pin adjacent one end of the slot when said operating member is in closed position, said holding means permitting movement of the pin to the other end of the slot upon movement of the operating member to open position and said movement of the operating member to open position causing movement of said contact means to open the circuit without movement of said trip member to tripped position, and the other

of said supporting points being movable to cause opening of the circuit upon movement of said trip member upon the occurrence of predetermined conditions, said movement of the trip member causing movement of said contact means to open the circuit irrespective of the position in which said operating member may be held.

16. In a circuit interrupter, contact means movable for opening and closing the circuit, a pivoted operating member movable between an open and a closed position, said operating member having a slot therein, a floating member having a pin engaging in said slot, said pin being movable in said slot toward one end thereof upon movement of said operating member to closed position and causing movement of said floating member to actuate said contact means to close the circuit, means for holding said pin in fixed position adjacent one end of said slot when said contact means are closed and said pin being movable to the other end of the slot upon movement of the operating member to open position, said movement of the operating member to open position causing movement of said contact means to open the circuit, a trip member movable to tripped position only upon the occurrence of predetermined conditions, said floating member having a point thereon movable without movement of said pin in its slot to cause actuation of said contact means to open the circuit and movement of said point on the floating lever being caused by movement of said trip member to tripped position, and said movement of the trip member causing movement of said contact means to open the circuit even though said operating member may be held in closed position.

17. In an electrical switch, the combination of a pair of cooperating separable contact members, means for biasing one of said contact members to open-circuit position, operating means for said contact member, a disengageable latch forming a trip connection between said operating means and said contact member, said operating means including a spring through which switch-closing force is transmitted to the contact member and a disengageable latch operative to withhold transmission of switch-closing force from the spring to the contact member during a portion of the switch closing movement of the operating means and then to release said force to effect closing of the switch with a snap action, and said operating means being movable to release said trip connection and cause opening of the switch with a snap action, and current responsive means for releasing said trip connection to permit the biasing means to move said one contact member to open-circuit position independently of the action of the operating means.

18. In a switch structure, the combination with a pair of separable contact members one of which is movable relative to the other, of an actuating mechanism for said movable contact member, an operating member for the actuating mechanism, a spring connecting the operating member to the actuating mechanism, the bias applied by said spring to the actuating mechanism being at all times in the direction of switch-closing movement of the latter, a latch adapted upon switch closing movement of the operating member to cause the spring to be stressed, and means operated by the operating member for releasing said latch near the end of its movement in switch closing direction, whereupon the actuating mechanism moves the movable contact member to closed position with a snap action under force of said spring, and latch means for retaining the actuating mechanism in closed-circuit position.

19. In a switch structure, the combination with a pair of separable contact members, one of which is movable relative to the other, of an actuating mechanism for the movable contact member including a spring biasing the movable contact member to open-circuit position, an operating member for the actuating mechanism, a spring connecting the operating member to the actuating mechanism, the bias applied by the last-mentioned spring to the actuating mechanism being at all times in the direction of switch-closing operation of the latter, a latch member arranged to retain the actuating mechanism against movement during a portion of the switch closing movement of the operating member in one direction during which the second-mentioned spring is stressed, said latch member being actuated by the operating member upon further movement in the same direction to release the actuating mechanism, whereupon the actuating mechanism moves the movable contact member to closed position with a snap action under force of the second-mentioned spring.

20. In a switch structure, the combination with a pair of separable contact members, one of which is movable relative to the other, of an actuating mechanism for the movable contact member including a spring biasing the movable contact member to open-circuit position, an operating member for the actuating mechanism, a spring connecting the operating member to the actuating mechanism, the bias applied by the last-mentioned spring to the actuating mechanism being at all times in the direction of switch-closing operation of the latter, a latch member arranged to retain the actuating mechanism against movement during a portion of the switch closing movement of the operating member in one direction during which the second-mentioned spring is stressed, said latch member being actuated by the operating member upon further movement in the same direction to release the actuating mechanism, whereupon the actuating mechanism moves the movable contact member to closed position with a snap action under force of the second-mentioned spring, said latch member then serving to retain the operating member in closed-circuit position.

21. In a circuit interrupter, a pair of separable contact members, a movable operating member, an actuating element for moving one of said contact members, biasing means forming part of a connection between said operating member and said actuating element, and the bias applied by said biasing means to the actuating element being at all times in the direction of contact closing movement of the actuating element, means for restraining said biasing means from moving said actuating element when said operating member is moved, means for releasing said restraining means to enable said biasing means to move said actuating element, and means for tripping said moving contact free of said actuating element.

22. In a circuit interrupter, a pair of separable contact members, a movable operating member, an actuating element for moving one of said contact members, biasing means forming part of a connection between said operating member and said actuating element, and the bias applied by said biasing means to the actuating element being at all times in the direction of contact closing

movement of the actuating element, means for restraining said biasing means from moving said actuating element when said operating member is moved, in one direction to stress said biasing means, and means actuated by further movement of said operating member in the same direction for releasing said restraining means to enable said biasing means to move said actuating element.

23. In a circuit interrupter, a pair of separable contact members, a single movable operating member, an actuating element for moving one of said contact members, biasing means forming part of a connection between said operating member and said actuating element, and the bias applied by said biasing means to the actuating element being at all times in the direction of contact closing movement of the actuating element, means for restraining said biasing means from moving said actuating element when said operating member is moved, means for releasing said restraining means to enable said biasing means to move said actuating element, to cause closing of said separable contacts with a snap action and means whereby movement of said operating member causes opening of said separable contacts.

24. In a circuit interrupter, a pair of separable contact members, a single movable operating member, an actuating element for moving one of said contact members, biasing means forming part of a connection between said operating member and said actuating element, and the bias applied by said biasing means to the actuating element being at all times in the direction of contact closing movement of the actuating element, means for restraining said biasing means from moving said actuating element when said operating member is moved, in one direction to stress said biasing means, and means actuated by further movement of said operating member in the same direction for releasing said restraining means to enable said biasing means to move said actuating element to cause closing of said separable contacts with a snap action, means for causing opening of said separable contact upon movement of said operating member in the reverse direction, and means responsive to predetermined conditions for automatically tripping said moving contact free of said actuating element and causing said moving contact to move to open position.

25. In a circuit interrupter, a contact actuating member movable for opening and closing the circuit, said contact actuating member when in closed position being biased to open position, an operating member movable from "off" to "on" position, energy storing means connected to said operating member, said operating member during a portion of its travel to "on" position causing energy to be stored in said energy storing means and thereafter causing release of said stored energy to move said contact actuating member to closed position with a snap action, rigid means for applying contact pressure and positively holding said contact actuating member in closed position, said rigid means including a pair of toggle links in substantially straightened position and means for causing collapse of said toggle links upon movement of said operating member to "off" position and thereby initiating movement of said contact actuating member to open position due to said bias to open position.

26. In a circuit interrupter, a frame having mounted thereon a contact carrying member movable to open and close the circuit, a pair of toggle links for normally actuating said contact carrying member, an operating member movable from "off" to "on" position, a spring stressed during at least a portion of the travel of the operating member from "off" to "on" position, and said spring being effective to move said toggle links from collapsed to straightened position and thereby actuate said movable contact carrying member to closed position with a snap action, means including said toggle links for holding said contact carrying member in said position to which it is actuated with a snap action and preventing rebound therefrom, said holding means comprising rigid members only through which any force tending to move said contact member back to open position is transmitted to and opposed by said frame, and current responsive means for causing said contact member to move to open position, said current responsive means causing said movement irrespective of the position in which said operating member may be held.

27. In a circuit interrupter, a contact carrying member movable for opening and closing the circuit, an operating member movable from "off" to "on" position, a pair of toggle links movable from collapsed to straightened position upon each movement of said operating member to "on" position, means for storing energy during a portion of the travel of said operating member to "on" position, said means for storing energy thereafter releasing said stored energy to move said toggle links to straightened position and said contact carrying member to closed position with a snap action, and said toggle links forming part of rigid means for applying contact pressure and positively holding said contact carrying member in closed position, and means for causing collapse of said toggle links upon the occurrence of predetermined electrical conditions and thereby causing said contact member to open the circuit.

28. In a circuit interrupter, a frame having mounted thereon a pair of contact members one of which is movable to open and close the circuit, an operating member movable from "off" to "on" position, a spring connected to said operating member and being increasingly stressed thereby during the first portion of the travel of the operating member from "off" to "on" position, and means effective during the latter portion of the movement of the operating member to cause said spring to actuate said movable contact member to closed position with a snap action, and means for holding said contact member in closed position, said holding means comprising a plurality of members including a pair of toggle links in substantially straightened position through which any force tending to move said contact member back to open position is transmitted to and opposed by said frame, and all of said members through which said force is transmitted to said frame being rigid, said toggle links being caused to collapse upon movement of said operating member to "off" position to allow said movable contact member to open the circuit, and means responsive to the current in the circuit for causing collapse of said toggle links to allow said movable contact member to open the circuit irrespective of the position in which said operating member is held.

29. In a circuit interrupter, a contact carrying member movable for opening and closing the circuit, an operating member movable from "off" to "on" position, a pair of toggle links movable from collapsed to straightened position, means for stor-

ing energy during a portion of the travel of said operating member to "on" position, said means for storing energy upon the release of said stored energy moving said toggle links to straightened position and thereby moving said contact member to closed position with a snap action, and rigid means including said toggle links for positively holding said contact means in said closed position to which it is moved with a snap action and preventing rebound therefrom, and means for causing collapse of said toggle links by movement of said operating member and causing said contact member to move to open position, and means responsive to the current in the circuit for initiating movement of said contact member from closed position to open position.

30. In a circuit interrupter, a pair of butt contacts, a contact arm carrying one of said butt contacts and being movable for opening and closing the circuit, an operating member movable from "off" to "on" position, means for storing a portion of the energy imparted to said operating member during a portion of its movement to "on" position, said means for storing energy thereafter releasing said stored energy to move said contact arm to closed position with a snap action, said contact arm when in closed position being biased toward open position, and rigid means including a pair of toggle links in substantially straightened position for positively holding said contact arm in closed position against any force applied to said contact arm to open said butt contacts, said toggle links being collapsible to permit movement of said contact arm to open position upon movement of said operating member toward "off" position.

31. In a circuit interrupter, a pair of butt contacts, a contact arm carrying one of said butt contacts and being movable for opening and closing the circuit, an operating member movable from "off" to "on" position, a pair of toggle links movable from collapsed to straightened position upon each movement of said operating member to "on" position, means for storing a portion of the energy imparted to said operating member during a portion of its movement to "on" position, said means for storing energy thereafter releasing said stored energy to move said toggle links to straightened position and said contact arm to closed position with a snap action, and said toggle links forming part of rigid means for positively holding said contact arm in closed position against any force applied to said contact arm to open said butt contacts, and means for causing collapse of said toggle links upon the occurrence of predetermined conditions in the circuit and also upon movement of said operating member toward "off" position, said collapse of the toggle links upon the occurrence of predetermined conditions in the circuit taking place irrespective of the position in which said operating member may be held.

32. In a circuit interrupter, means movable for opening and closing the circuit, an operating member oscillatable between "on" and "off" positions for actuating said means for opening and closing the circuit, a pair of toggle links pivoted together to form the knee of a toggle linkage, one end of said toggle linkage being connected to said means for opening and closing the circuit, a main operating spring through which force is transmitted from said operating member to said toggle linkage for actuating said means for opening and closing the circuit to closed position with a snap action, said toggle linkage being collapsed when actuated by movement of said operating member to open circuit position and being more nearly straightened when in closed circuit position with stop means preventing the knee of the toggle moving over center, a supplementary spring biasing said means for opening and closing the circuit and said toggle links to open position, and current responsive means for initiating collapse of said toggle and movement of said means for opening and closing the circuit to open position.

33. In a circuit interrupter, means movable for opening and closing the circuit, an operating member oscillatable between "on" and "off" positions for actuating said means for opening and closing the circuit, a pair of toggle links pivoted together to form the knee of a toggle linkage, one end of said toggle linkage being connected to said means for opening and closing the circuit, a main operating spring through which force is transmitted from said operating member to said toggle linkage for actuating said means for opening and closing the circuit to closed position with a snap action, said toggle linkage being collapsed when actuated by movement of said operating member to open circuit position and being more nearly straightened when in closed circuit position with stop means preventing the knee of the toggle moving over center, a supplementary spring biasing said means for opening and closing the circuit and said toggle links to open position, and current responsive means for initiating collapse of said toggle and movement of said means for opening and closing the circuit to open position, said movement to open position initiated by said current responsive means taking place irrespective of the position of said operating member.

34. A manually and automatically actuable switch having fixed and movable contacts, said movable contact being pivoted about an axis fixed relative to said fixed contacts, a single member movable to actuate manually said movable contact to both open and closed positions, a member which is movable to actuate automatically said movable contact, said member which is movable to actuate automatically said movable contact being carried by said manual actuating member but capable of movement independent thereof upon occurrence of overload.

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