

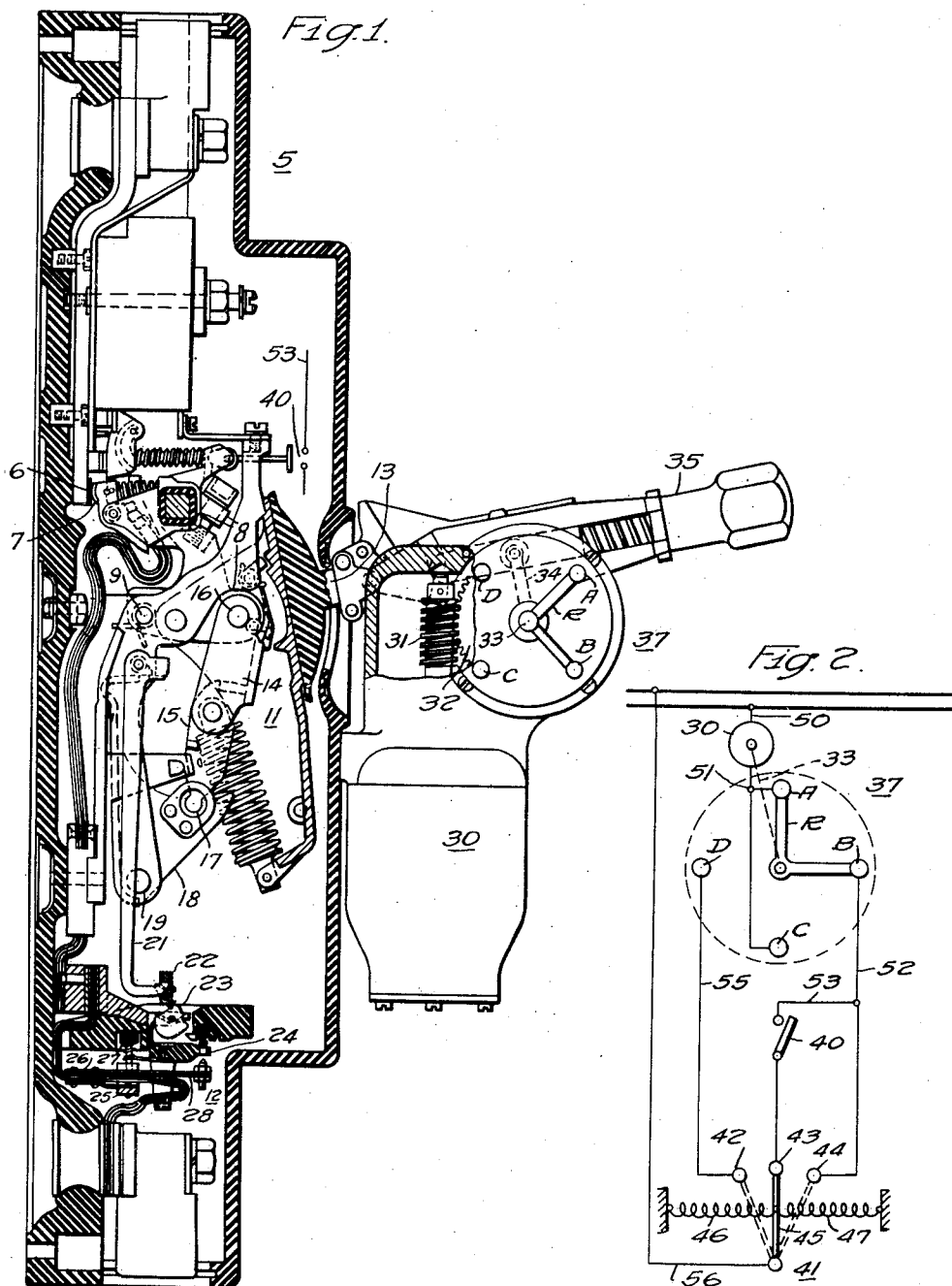
Dec. 2, 1941.

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2,264,990

CONTROL MECHANISM FOR CIRCUIT BREAKER OPERATING MOTORS

Filed June 28, 1940



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2,264,990

CONTROL MECHANISM FOR CIRCUIT
BREAKER OPERATING MOTORS

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Application June 28, 1940, Serial No. 342,886

11 Claims. (Cl. 175—294)

Our invention relates to automatic operating-mechanisms for both opening and closing the operating-mechanisms of circuit breakers, or for performing either the opening operation or the closing operation.

Although our invention, in its broadest aspects, is not limited to any particular use or application, the present invention was primarily designed for the operation of air-type circuit-breakers.

One of the objects of our invention is to utilize an ordinary four-position snap-switch, or an adaptation thereof, for the control of a motor which continuously turns a shaft in the same direction a half-revolution at a time, the motor being automatically cut off at the end of each half-revolution, and the snap-switch being operated twice, during said half-revolution, and being so connected as to finally deenergize the motor.

A further object of our invention is to provide means which is responsive to a non-motor-operated tripping-operation of the circuit-breaker, for automatically effecting an opening operation of the motor-control mechanism, in order that the motor-control mechanism shall be in a position ready for a circuit-breaker closing-operation without necessitating an actuation of the manual control-switch to the "open" position for the purpose of "resetting" the breaker, before the breaker can be closed.

With the foregoing and other objects in view, our invention consists in the apparatus, combination, circuits, and methods hereinafter described and claimed, and illustrated in the accompanying drawing, wherein:

Figure 1 is a somewhat simplified and somewhat diagrammatic side-elevational view of a circuit-breaker including our motor-actuated operating-mechanism, with parts broken away and parts in section to better illustrate the construction; and

Fig. 2 is a diagrammatic view of circuits and apparatus illustrating our motor-control circuits.

Our invention is illustrated as being applied for the operation of an air-break circuit-controlling device or circuit-breaker 5 which is of the type shown and claimed in Lindstrom Patents Nos. 2,083,304 and 2,186,251 granted June 8, 1937, and January 9, 1940, and in a Sandin Patent No. 2,043,306, granted June 9, 1936, although, in the broader aspects of our invention, such circuit-breaker illustration may be regarded simply as typical of any circuit breaker having a stationary main contact 6, a movable main contact 7 carried by a movable arm 8 pivoted at 9, an operat-

ing mechanism 11, a trip-device 12, and an operating-lever 13 which may be moved or oscillated in one direction to close the breaker, and in the other direction to open the breaker.

In the particular breaker which is illustrated, the operating mechanism 11 includes a spring-held toggle-linkage 14—15 which is connected between a point 16 on the movable contact-arm 8 and a point 17 on a bell-crank lever 18 which is pivoted at 19 and which cooperates with a latching lever 21. The lower end 22 of the latching-lever 21 is in cooperative position with respect to the tripping-mechanism 12, which includes a latching-device 23 which is released by a trip-bar 24 which is actuated by a U-shaped single-turn magnetic circuit 25, encircling one of the leads 26 of the circuit-breaker, and attracting an armature 27, so as to be responsive, on predetermined over-currents, to trip the circuit-breaker. A thermally responsive bimetallic trip-device 28 is also shown.

Our invention particularly relates to the mechanism which is utilized to open and close the operating-arm 13 of such a circuit-breaker, or of any other circuit-breaker. Certain aspects of our invention, as illustrated, are by way of improvement over the motor-driven operating-mechanism which is described and claimed in an application of Leon R. Ludwig and Ture Lindstrom, Serial No. 168,204, filed October 9, 1937, Patent No. 2,228,466, granted January 14, 1941, and assigned to the Westinghouse Electric & Manufacturing Company. The illustrated motor-mechanism consists of a motor 30, the shaft of which carries a worm gear 31 which drives a worm wheel 32 which is mounted on a slow-speed shaft 33 carrying a crank-arm 34, or suitable equivalent mechanism for actuating, or imparting operating-thrusts to, an extension 35 which is attached to the circuit-breaker operating-arm 13. With a motor-mechanism of such a type, the motor 30 always turns in the same direction, both during the circuit-breaker closing-operation and during the circuit-breaker opening-operation, the crankshaft 33 turning one-half of a revolution for each operation.

The particular novel features of our invention relate to the control-means for a motor-mechanism of the type just described. In accordance with our invention, we mount a 4-position snap-switch 37 in operative relation to the crankshaft 33, so as to be actuated thereby. The snap-switch 37 is provided with four stationary contacts, A, B, C and D, disposed at 90-degree intervals, and a 90-degree rotating-contact R which

operates, with a snap action, from the illustrated position in which it spans the contacts A—B, to the B—C position, and thence, in successive operations, to the C—D position, to the D—A position, and back to the A—B position, turning, with sudden snap-actions, in response to the slow, steady movement of the crankshaft 33.

In accordance with our invention, we also equip the circuit-breaker operating-mechanism 11 with a suitable type of auxiliary switch 40 which is very diagrammatically indicated as being open when the circuit-breaker is closed and closed when the circuit-breaker is open.

The control-circuit of our motor 30 also includes a three-position, manually operated switch 41 having three stationary contacts 42, 43 and 44 which are disposed in operative relation to a movable contact-arm 45 which is biased to its central position by a suitable spring-means which is diagrammatically indicated at 46—47.

The motor-operating circuits are so arranged that one terminal 50 of the motor is connected to one line-terminal, while the other motor-terminal 51 is connected to two diametrically opposite stationary contacts A and C of the snap-switch 37. The stationary contact B of the snap-switch is connected, by a conductor 52, to the right-hand stationary contact 44 of the manual switch 41. The aforesaid stationary contact B of the snap-switch 37 is also connected, through a conductor 53 and the mechanism-operated switch 40, to the central stationary contact 43 of the manual switch 41. The remaining stationary contact D of the snap-switch 37 is connected, by a conductor 55, to the left-hand stationary contact 42 of the manual switch 41. The movable contact-arm 45 of the manual switch 41 is connected, by a conductor 56, to the other line-terminal.

In operation, when the circuit-breaker 5 is closed, and it is desired to open the same, the manual control-switch 41 is moved to the right, so as to cause the movable switch-arm 45 to connect the line-terminal 56 to the contact 44. This switch-operation completes the motor-circuit from the said contact 44, through the conductor 52, the contact B, the crankshaft-operated bellcrank-shaped switch-arm R, the contact A, and the conductor 51, to the motor 30 and thence to the other line-terminal 50. The motor then turns, slowly driving the crankshaft 33, which is indicated in dotted lines in Fig. 2. As the crankshaft turns, the crank 34 moves the handle-extension 35 downwardly, or in a direction necessary for opening the circuit-breaker 5. When the crankshaft has rotated approximately a quarter of a revolution, or 90°, the snap-switch 37 suddenly moves its contact-arm R through 90°, thus connecting the contact B to the contact C, instead of being connected to the contact A. Since the contacts A and C are electrically connected through the conductor 51, the motor 30 remains energized without any noticeable break in its energization when the crankshaft-operated snap-switch suddenly changes from the position A—B to the position B—C.

When the crankshaft has completed approximately a half-rotation, or a 180° movement, the circuit-breaker 5 and its operating-mechanism 11 will be in their open positions, and the four-position snap-switch will be again suddenly actuated, to change from its position B—C to the position C—D. The conductors 51 and 52 are now no longer connected by the rotatable or snapping switch-arm R, and the motor is ac-

cordingly automatically stopped by the crankshaft operated snap-switch 37. The manual switch-arm 45 may now be released, whereupon it will automatically return to its mid-position under the influence of the centering-spring 46.

During this opening-movement of the operating-mechanism 11 the operating-lever 13 is moved downwardly. In the initial portion of this downward movement of the operating-lever 13, the spring-biased toggle 14—15 is broken, so that the movable contact-arm 8 of the breaker opens, with a sudden snap-action, without waiting for the slower-moving parts of the operating-mechanism 11. When the operating-mechanism 11 completes its opening-operation, the breaker automatically "resets," so that the toggle-link 14—15 and the operating-lever 13 again become tied together, ready for a closing-operation.

The circuit-breaker 5 and the motor-mechanism are now in their open positions. If it is desired, now, to close the circuit-breaker 5, the manual control-switch is moved to the left, whereupon the switch-arm 45 connects the line-terminal 56 to the contact 42, which is joined to the contact D by the conductor 55. Since the mechanism-operated snap-switch is now in the position C—D, a motor-energizing circuit will be completed from the contact D, through the snap-switch arm R, to the contact C, and thence through the conductor 51 to the motor 30. The motor 30 thereupon operates again, turning in the same direction as before, and swinging the crank 34 around so that it now moves upwardly in a closing direction, carrying the handle-extension 35 upwardly with it, so as to begin to close the breaker. When the crankshaft has made about half of its closing movement, or a quarter-turn, the snap-switch suddenly changes from its position C—D to its position D—A, and the motor continues to be energized because the contact D is now joined to the contact A, which is, in turn, connected to the motor-lead 51. At the completion of the 180° closing-movement of the motor-mechanism, the snap-switch returns to its initial position A—B, and the breaker-closing circuit 55 of the motor is deenergized. The manual switch 41 may now be released, whereupon it returns to its central position through the action of its center-spring 47.

In case the circuit-breaker 5 should move automatically to its open position, as by an overload response of the tripping-mechanism 12, independently of the motor-mechanism, it is very desirable for the motor-mechanism to be automatically actuated to its open position in order to "reset" the breaker so that it will be ready for a closing-operation in response to a single movement of the manual switch-arm 45. To this end, the self-centering function of our manual switch 41 comes into play, in conjunction with the auxiliary switch 40 which is closed when the circuit breaker opens. When the circuit-breaker is tripped open, the opening movement of the breaker-arm 8 closes the auxiliary switch 40, which thereupon completes a motor-energizing circuit which can be traced from the line-terminal 50, through the motor 30, to the conductor 51, the snap-switch contacts A—B, the conductors 52 and 53, the auxiliary switch 40, the contact 43, the centrally positioned switch-arm 45, and the other line-terminal 56. The motor thereupon goes through with a 180° opening-movement, as previously described, until the snap-switch 37 moves to the position C—D, whereupon the motor is deenergized, and the mechanism is in a posi-

tion ready for another breaker-closing operation whenever the operator or station-attendant shall move the manual control-switch to the left.

The provision of a three-position manual switch 41, and the utilization of the central position 43 to complete the opening-circuit of the auxiliary switch 40 provides an effective "anti-pumping" system, making it unnecessary to resort to special auxiliary switches for this purpose, as in many previous breakers. Thus, if the manual switch 41 is moved to its "close" position 42, and held there for a while after the breaker is closed, if the breaker immediately trips open, on its automatic control, as by overload-operation, for example, the breaker will not reclose until the handle or movable switch-arm 45 is released, because the central switch contact 43 is in series with the "resetting" switch 40. Thus, there can be no "pumping" action, or repeated closings of the breaker in response to a single closing-operation of the manual switch 41.

While we have shown our breaker-operating mechanism applied to a single form of circuit-breaker, and while we have shown a single form of motor-controlling means therefor, we wish it to be understood that such showing, and the accompanying description, are only by way of illustration and explanation, and that our invention, in its broader aspects, is susceptible of other applications or uses, and other embodiments as to specific circuits and apparatus. We desire, therefore, that our appended claims shall be accorded the broadest construction consistent with their language.

We claim as our invention:

1. In combination; a circuit breaker having main contacts including a movable contact-member; opening-means operative, at times, to cause an opening movement of the movable contact-member; and closing-mechanism operative, at times, to perform an operation tending to cause a closing movement of the movable contact-member; said closing-mechanism including a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for imparting a closing-thrust to said movable contact-member, and energizing and controlling means for said motor; said energizing and controlling means being characterized by including a four-position snap-switch actuated by said shaft and operative, with a quick snapping action, to successively join each of four stationary contacts with the next adjacent stationary contact in response to each quarter-revolution of said shaft, a separate closing-switch, and circuit-means for utilizing said closing-switch and two successive quarter-revolution positions of said snap-switch for energizing the motor during the closing movement of the mechanism and for automatically deenergizing the motor at the completion of said closing movement.

2. In combination, a circuit breaker having main contacts including a movable contact-member; operating-mechanism including an operating-lever which is movable in one direction to close the breaker and which is movable in the other direction to open the breaker; motor-mechanism for mechanically actuating said operating-lever; and control-means for said motor-mechanism; said motor-mechanism comprising a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for moving said operating-lever in the closing

direction and effective during approximately the other half-rotation of said shaft for moving said operating-lever in the opening direction; and said control-means being characterized by including a four-position snap-switch actuated by said shaft and operative, with a quick snapping action, to successively join each of four stationary contacts with the next adjacent stationary contact in response to each quarter-revolution of said shaft, a closing-circuit means operative, when energized, to utilize two successive quarter-revolution positions of said snap-switch for energizing the motor during the closing movement of the motor-mechanism and for automatically deenergizing the motor at the completion of said closing movement, and an opening-circuit means operative, when energized, to utilize the remaining two successive quarter-revolution positions of said snap-switch for energizing the motor during the opening movement of the motor-mechanism and for automatically deenergizing the motor at the completion of said opening movement.

3. In combination; a circuit breaker having main contacts including a movable contact-member; motor-actuated mechanism operative, at times, to perform an operation tending to cause a closing movement of the movable contact-member; trip-means operable independently of said motor-actuated mechanism to cause an opening movement of the movable contact-member; and an auxiliary switch-contact member operatively associated with the breaker so as to close its contact when the breaker opens and so as to open its contact when the breaker closes; said motor-actuated mechanism including a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for imparting a closing-thrust to said movable contact-member, and energizing and controlling means for said motor; said energizing and controlling means being characterized by including a switch-controlling means operatively associated with said shaft in such manner that it energizes a first motor-circuit conductor during said half-rotation of said shaft and automatically deenergizes said first motor-circuit conductor at approximately the completion of said half-rotation, said switch-controlling means being further operative to energize a second motor-circuit conductor during a second half-rotation of said shaft and to automatically deenergize said second motor-circuit conductor at approximately the completion of said second half-rotation, a closing-circuit means operative, when energized, to utilize said first motor-circuit conductor for energizing the motor during the closing movement of the mechanism and for automatically deenergizing the motor at the completion of said closing movement, and an opening-circuit means including said auxiliary switch-contact member and said second motor-circuit conductor for automatically actuating said mechanism to an open position when the circuit breaker is tripped open independently of said motor-actuated mechanism and for automatically deenergizing the motor at the completion of the opening movement of the mechanism.

4. In combination; a circuit breaker having main contacts including a movable contact-member; motor-actuated mechanism operative, at times, to perform an operation tending to cause a closing movement of the movable contact-member; trip-means operable independently of said motor-actuated mechanism to cause an opening movement of the movable contact-member; and

auxiliary switch-contact member operatively associated with the breaker so as to close its contact when the breaker opens and so as to open its contact when the breaker closes; and a manual switch normally biased to a predetermined position; said motor-actuated mechanism including a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for imparting a closing-thrust to said movable contact-member, and energizing and controlling means for said motor; said energizing and controlling means being characterized by including a switch-controlling means operatively associated with said shaft in such manner that it energizes a first motor-circuit conductor during said half-rotation of said shaft and automatically deenergizes said first motor-circuit conductor at approximately the completion of said half-rotation, said switch-controlling means being further operative to energize a second motor-circuit conductor during a second half-rotation of said shaft and to automatically deenergize said second motor-circuit conductor at approximately the completion of said second half-rotation, a closing-circuit means including an actuated position of said manual switch and said first motor-circuit conductor for energizing the motor during the closing movement of the mechanism and for automatically deenergizing the motor at the completion of said closing movement, and an opening-circuit means including said predetermined biased position of the manual switch and further including said auxiliary switch-contact member and said second motor-circuit conductor for automatically actuating said mechanism to an open position when the circuit breaker is tripped open independently of said motor-actuated mechanism and for automatically deenergizing the motor at the completion of the opening movement of the mechanism.

5. In combination, a circuit breaker having main contacts including a movable contact-member; operating-mechanism including an operating-lever which is movable in one direction to close the breaker and which is movable in the other direction to open the breaker; motor-mechanism for mechanically actuating said operating-lever; trip-means operable independently of said motor-actuated mechanism to cause an opening movement of the movable contact-member; and control-means for said motor-mechanism; said motor-mechanism comprising a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for moving said operating-lever in the closing direction and effective during approximately the other half-rotation of said shaft for moving said operating-lever in the opening direction; and said control-means being characterized by including a switch-controlling means operatively associated with said shaft in such manner that it energizes a first motor-circuit conductor during said first-mentioned half-rotation of said shaft and automatically deenergizes said first motor-circuit conductor at approximately the completion of said half-rotation, said switch-controlling means being further operative to energize a second motor-circuit conductor during said other half-rotation of said shaft and to automatically deenergize said second motor-circuit conductor at approximately the completion of said other half-rotation, a three-position manual switch normally biased to its central posi-

tion, an auxiliary switch-contact member operatively associated with the breaker so as to close its contact when the breaker opens and so as to open its contact when the breaker closes, a closing-circuit means including one end-position of said manual switch and said first motor-circuit conductor for energizing the motor during the closing movement of the mechanism and for automatically deenergizing the motor at the completion of said closing movement, an opening-circuit means including the other end-position of said manual switch and said second motor-circuit conductor for energizing the motor during the opening movement of the mechanism and for automatically deenergizing the motor at the completion of said opening movement, and an auxiliary opening-circuit means including said biased central position of the manual switch and further including said auxiliary switch-contact member and said second motor-circuit conductor for automatically actuating said mechanism to an open position when the circuit breaker is tripped open independently of said motor-actuated mechanism and for automatically deenergizing the motor at the completion of the opening movement of the mechanism.

6. In combination, a circuit breaker having main contacts including a movable contact-member; operating-mechanism including an operating-lever which is movable in one direction to close the breaker and which is movable in the other direction to open the breaker; motor-mechanism for mechanically actuating said operating-lever; trip-means operable independently of said motor-actuated mechanism to cause an opening movement of the movable contact-member; and control-means for said motor-mechanism; said motor-mechanism comprising a rotating shaft, an electric motor for driving said shaft, thrust-imparting means effective during approximately one half-rotation of said shaft for moving said operating-lever in the closing direction and effective during approximately the other half-rotation of said shaft for moving said operating-lever in the opening direction; and said control-means being characterized by including a four-position snap-switch actuated by said shaft and operative, with a quick snapping action, to successively join each of four stationary contacts with the next adjacent stationary contact in response to each quarter-revolution of said shaft, a three-position manual switch normally biased to its central position, an auxiliary switch-contact member operatively associated with the breaker so as to close its contact when the breaker opens and so as to open its contact when the breaker closes; a closing-circuit means including one end-position of said manual switch and operative, when energized, to utilize two successive quarter-revolution positions of said snap-switch for energizing the motor during the closing movement of the mechanism and for automatically deenergizing the motor at the completion of said closing movement, an opening-circuit means including the other end-position of said manual switch and operative, when energized, to utilize the remaining two successive quarter-revolution positions of said snap-switch for energizing the motor during the opening movement of the mechanism and for automatically deenergizing the motor at the completion of said opening movement, and an auxiliary opening-circuit means including said biased central position of the manual switch and further including said auxiliary switch-contact member

and the aforesaid remaining two successive quarter-revolution positions of said snap-switch for automatically actuating said mechanism to an open position when the circuit breaker is tripped open independently of said motor-actuated mechanism and for automatically deenergizing the motor at the completion of the opening movement of the mechanism.

7. In combination; a circuit breaker having contact-means movable between an open position and a closed position; contact-operating mechanism movable between an open position and a closed position for normally controlling the movement of said contact-means between its corresponding positions; means responsive to predetermined conditions for causing an automatic opening-movement of said contact-means without a corresponding movement of said contact-operating mechanism; an electric actuating-mechanism for normally moving said contact-operating mechanism between its open and closed positions at will; and means responsive to an automatic opening-movement of said contact-means to cause said electric actuating-mechanism to move said contact-operating mechanism toward an open position.

8. In combination; a circuit breaker having contact-means movable between an open position and a closed position; contact-operating mechanism movable between an open position and a closed position for normally controlling the movement of said contact-means between its corresponding positions; means responsive to predetermined conditions for causing an automatic opening-movement of said contact-means without a corresponding movement of said contact-operating mechanism; a first switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its open position; a second switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its closed position; and means responsive to an automatic opening-movement of said contact-means to cause said contact-operating mechanism to move to its open position.

9. In combination; a circuit breaker having contact-means movable between an open position and a closed position; contact-operating mechanism movable between an open position and a closed position for normally controlling the movement of said contact-means between its corresponding positions; means responsive to predetermined conditions for causing an automatic opening-movement of said contact-means without a corresponding movement of said contact-operating mechanism; a first switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its open position; a second switch-controlled circuit-means operative, when

suitably energized, to cause said contact-operating mechanism to move to its closed position; and means responsive to an automatic opening-movement of said contact-means to energize said first switch-controlled circuit-means.

10. In combination; a circuit breaker having contact-means movable between an open position and a closed position; contact-operating mechanism movable between an open position and a closed position for normally controlling the movement of said contact-means between its corresponding positions; means responsive to predetermined conditions for causing an automatic opening-movement of said contact-means without a corresponding movement of said contact-operating mechanism; a first switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its open position; a second switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its closed position; manually operated switch-means for initiating the energization of either said first or second circuit-means at will; and automatically operated switch-means for cutting-off the energization of said first and second circuit-means, respectively, at approximately the end of the corresponding movement of the contact-operating mechanism, said automatically operated switch-means including a four-position snap-switch, and means for actuating said snap-switch twice during each opening movement of the contact-operating mechanism and twice during each closing movement of the contact-operating mechanism.

11. In combination; a circuit breaker having contact-means movable between an open position and a closed position; contact-operating mechanism movable between an open position and a closed position for normally controlling the movement of said contact-means between its corresponding positions; means responsive to predetermined conditions for causing an automatic opening-movement of said contact-means without a corresponding movement of said contact-operating mechanism; a first switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its open position; a second switch-controlled circuit-means operative, when suitably energized, to cause said contact-operating mechanism to move to its closed position; manually operated switch-means for initiating the energization of either said first or second circuit-means at will; and means responsive to an automatic opening-movement of said contact-means and to a non-actuated condition of said manually operated switch-means for automatically energizing said first switch-controlled circuit-means.

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