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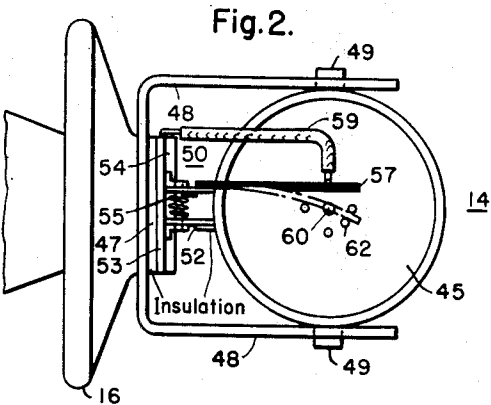
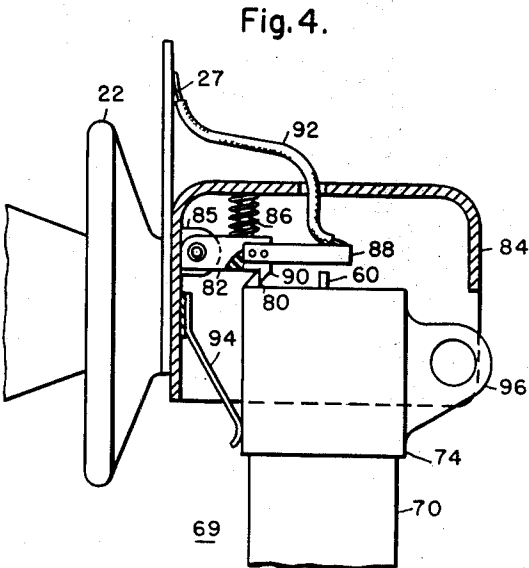
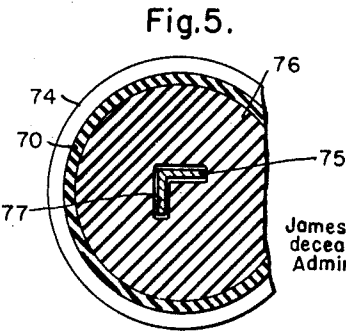
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AUTOMATIC RECLOSING CIRCUIT BREAKER

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2 Sheets-Sheet 2



WITNESSES:

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2,763,749

AUTOMATIC RECLOSING CIRCUIT BREAKER

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14 Claims. (Cl. 200—89)

Our invention relates generally to automatic reclosing circuit breakers, and it has reference in particular to automatic reclosing circuit breakers of the air break type.

One object of our invention is to provide a compact and inexpensive reclosing circuit breaker.

Another object of our invention is to provide in a reclosing circuit breaker for utilizing energy from an overload condition to introduce a normal gap in the circuit for a predetermined number of operations, and then effect lockout with a greater than normal gap in the circuit.

Yet another object of our invention is to provide an automatic reclosing air circuit breaker construction in which a movable contact is actuated in a predetermined path for a predetermined number of times to open the circuit in response to an overload, whereupon releasable means is operated to introduce a greater than normal gap in the circuit.

It is also an object of our invention to provide a large clearance across the open gap of a reclosing circuit breaker in the lockout position by means of releasable lockout means.

We also provide as one aspect of our invention, for utilizing a bimetallic latch element as part of a latch mechanism for releasing the operating mechanism of a reclosing circuit breaker from a normal position so as to provide an increased air gap in the circuit.

It is also an important object of our invention to provide a reclosing circuit breaker construction wherein a movable contact element operates to release the operating mechanism from a normal position to a lockout position.

Another important object of our invention is to provide in an automatic reclosing air circuit breaker, for utilizing thermally responsive means for releasing the operating mechanism to a lockout position after a predetermined number of circuit interrupting operations.

A further object of our invention is to provide in a reclosing circuit breaker of the air break type, for utilizing a solenoid to operate a movable contact member for interrupting the circuit a predetermined number of times and then utilizing the movable contact member for releasing the reclosing mechanism to a lockout position.

Another object of our invention is to provide in a circuit breaker of the air break type, for utilizing a movable contact member with an angularly-shaped section which moves in an angularly-shaped slot in a gas generating arc interrupter, so as to provide as narrow an arc extinguishing slot as possible while providing sufficient rigidity for the contact member.

It is also an object of our invention to provide for pivotally supporting the operating mechanism of a reclosing circuit breaker so that it may be released to a non-circuit completing position.

Other objects will, in part, be obvious and will, in part, be explained hereinafter.

For a more complete understanding of the nature and the scope of our invention, reference may be made to the following detailed description, which may be read in connection with the accompanying drawings, in which:

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Figure 1 is a side elevational view partly in section, of a reclosing circuit breaker embodying the invention in one of its forms;

Fig. 2 is a bottom plan view of the circuit breaker shown in Fig. 1;

Fig. 3 is a side elevational view in section of a reclosing unit for a reclosing circuit breaker embodying the invention in a different form;

Fig. 4 is a partial side elevational view of a circuit breaker showing one method of mounting for the upper end of the circuit breaker reclosing unit shown in Fig. 3; and

Fig. 5 is a sectional view taken along the line V—V of Fig. 3.

Referring to Fig. 1, the reference numeral 10 may designate generally an automatic reclosing air circuit breaker comprising a movable contact member or rod 12 and an operating mechanism 14 disposed to be mounted on an insulating support 16 for engaging a stationary contact jaw 18 mounted in an arc interrupter 20 supported by an insulating support 22. The insulating supports 16 and 22 are insulators, preferably of porcelain or the like, and may be mounted on a suitable base (not shown) such as a channel base commonly used for disconnecting switches.

The interrupter 20 may comprise a metal cap 24 which may be fixedly mounted on the insulating support 22 by means of a suitable bracket 26. A terminal 27 may be secured to the bracket 26 for making electrical connection with the stationary contact member 18, which may be mounted inside the cap 24. In order to provide for extinguishing an arc which may be drawn between the movable contact member 12 and the stationary contact member 18, the interrupter 20 may comprise a body of fiber or similar gas generating material 28 having a central passage 29 therein for receiving the moving contact rod member 12. The body member 28 may be mounted in the cap 24 in any suitable manner being, for example, threaded thereto.

The operating mechanism 14 may comprise a cylindrical case 30 of a magnetic material such as iron or steel, within which may be disposed an operating coil 32 for actuating the movable contact member 12 to effect a circuit interrupting operation. The contact rod member 12 may, for example, comprise a cylindrical rod at least the lower portion of which may be of a magnetic material and which may be slidably disposed in an insulating tube 34 positioned within the operating coil 32. An extension 35 may be provided on the lower end of the rod 12, and an opening 33 may be provided adjacent the upper end, for purposes to be explained hereinafter. A spring 36 may be disposed within the tube 34 for normally biasing the contact member 12 into engagement with the stationary contact jaws 18. Spring contact fingers 37 may be provided for effecting an electrical connection between the coil 32 and the contact member 12 being, for example, mounted on the upper end of the coil 32 and connected thereto by means of a conductor 38. The tube 34 may be partially closed at its lower end, being, for example, provided with an orifice 39, which may be normally closed by means of a valve member 40 biased by means of a spring 42 so as to close the orifice 39 against the movement of air therethrough into the tube 34. A plurality of metered orifices 43 may be provided in a plate 45, otherwise closing the lower end of the case 30 and the tube 34 for controlling the rate of escape of air from within the tube 34, and hence the rate of downward movement of the contact rod member 12, which may be disposed to provide a relatively snug fit within the tube. An annular shoulder 46 may be provided around the contact member 12 for engagement with the contact fingers 37 so as to limit upward movement of the contact member 12.

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The case 30 may be pivotally supported on the insulating support 16 by means of a trunnion mounting 48 which may be supported on the insulator support 16 in insulated relation to a terminal 53, being separated therefrom by insulation 47, and pivots 49 disposed on opposite sides of the casting 30 at its lower end, as shown in Figs. 1 and 2. In order to provide for normally securing the operating mechanism 14 with the contact member 12 in alignment with the stationary contact member 18, releasable latch means 50 may be provided. As shown in Figs. 1 and 2, the latch means 50 may comprise a latch member 52 of insulating material, which may be pivotally supported on a terminal 53 mounted on the insulating support 16 and insulated from the trunnion mounting 48 by insulation 54. A spring 55 may be utilized to normally bias the latch member 52 to the position shown in which it engages the adjacent edge of the case 30. A bimetallic operating member 57 comprising laminations of metals having different coefficients of expansion may be secured to the latch member 52 and connected in circuit relation with the case 30 by means of a metallic contact member 58 mounted on the latch member 52. A shunt 59 may be provided for connecting the end of the operating member 57 which is remote from the latch member to the connector 53.

The operating member 57, as shown in Fig. 2, may be normally disposed to one side of an extension 60 on the valve member 40. After a plurality of circuit interrupting operations, the operating member 57 will be sufficiently deflected by the heat generated by the flow of fault current therethrough, so as to deflect away from the material having the greater coefficient of expansion, and thus engage a stop 62, whereupon it will be positioned in the line of movement of the extension 60, so as to be engaged thereby when the contact member 12 is pulled downwardly during a circuit interrupting operation, and the extension 35 engages the valve member 40 for rotating the latch member 52 in a clockwise direction. A spring 64 will thereupon be rendered effective to rotate the operating mechanism in a clockwise direction about the pivots 49, so that the contact member 12 will no longer be effective to complete a circuit making operation when it is biased upwardly by the spring 36.

With the reclosing circuit breaker in the normal operating position, as shown, an electric circuit may be traced therethrough, extending from terminal 27 through bracket 26, cap 24, stationary contact jaws 18, movable contact rod member 12, spring contact fingers 37, conductor 38, operating coil 32, conductor 66, case 30, latch contact member 58, bimetallic operating member 57, and shunt 59 to terminal 53.

While the circuit breaker conducts current below the normal rating, the operating coil 32 has no appreciable effect on the movable contact rod 12. Should the current carried by the circuit breaker exceed the normal rating, the operating coil 32 will be effective to draw the contact rod 12 downwardly against the force of the biasing spring 36 sufficiently to clear the lower end of interrupter body 23, thus interrupting the circuit to the contact member 18. Any arc drawn between the moving contact member 12 and the stationary contact member 18 will be drawn into the relatively narrow passage 29 in the interrupter 20. Gases generated from the surface walls of the opening 29 of the interrupter as a result of heat from the arc, blast through the opening 29 and assist in rapidly extinguishing the arc, thus effectively interrupting the circuit. During the flow of current in excess of the normal rating, the bimetallic operating element 57 will be affected by the heat therefrom and warped in the direction of the path of movement of the extension 60. Downward movement of the contact member 12 will be limited only by the rate of flow of air through the orifice 43, since the valve member 40 operates to release air from the tube 34. Upward movement of the contact member 12 will, however, be delayed, since the valve member 40 seals off

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the lower end of the tube 34 and upward movement of the contact rod member 12 will be determined by the rate of leakage of air between the contact member and the walls of the tube.

Should the fault continue, greater than normal current will again flow upon engagement of the contact rod member 12 with the stationary contact member 18, and the operating coil 32 will again be rendered effective to draw the contact rod member 12 downwardly to interrupt the circuit. The bimetallic operating member 57 will again be heated by the fault current and will be warped further into the path of movement of the extension 60. After a predetermined number of operations of the circuit breaker in interrupting the circuit, for example, upon the fourth circuit interrupting operation, the bimetallic operating member 57 may engage the stop 62. Just before the contact member 12 reaches its furthest downward position, in which it clears the lower end of fiber block 28, the valve member 40 will be actuated by the extension 35 thereof, and the extension 60 will strike the deflected operating member 57, so as to rotate the latch member 52 in a clockwise direction. The operating mechanism 14 will thereupon be free to rotate in a clockwise direction under the influence of the spring 64, so as to move the contact rod member 12 out of alignment with the stationary contact jaws into the lockout position. This renders the movable contact member ineffective to complete the circuit when it is returned to its uppermost position by the spring 36, and places a relatively large air gap between the contact members 12 and 18 when the operating mechanism is in the lockout position.

The recloser may be reset by inserting a hook stick in the opening 33, and pulling the contact rod 12 downwardly, while urging it pivotally in a counter-clockwise direction. When the upper end of the rod 12 is aligned with the opening 29, the hook stick may be withdrawn, and the spring 36 will urge the rod into engagement with stationary jaws 18, to reclose the breaker.

Referring to Fig. 3, it will be seen that the operating mechanism 14' and the interrupter 26', instead of comprising separate structures, may comprise a single recloser unit 69, being mounted in a common case 70, comprising for example, a cylindrical case of insulating material which may be threaded adjacent opposite ends to receive metallic terminal caps 72 and 74. The cap 72 may be provided with stationary contact jaw member 73 disposed to engage the lower end of a movable contact member 75 disposed to be actuated by an armature 12'. The movable contact member may be normally biased into engagement with the stationary contact member by means of a spring 36 and may be withdrawn from engagement therewith by means of an operating coil 32 which actuates the armature 12'.

In order to provide the maximum arc interrupting effect, the contact member 75 may, as shown in Figs. 3 and 5, have an angularly-shaped cross-section, and the body 76 of fiber or other gas-generating material surrounding the contact member may be provided with a relatively snugly fitting angularly-shaped slot 77 therein for receiving the contact member so as to provide as narrow a slot as possible and yet maintain a sufficiently rigid contact member.

The operating coil may be connected in series circuit relation with the contact member 75 by means of a sliding spring contact finger 78 mounted on the lower end of the operating coil 32 and a conductor 79. The lower cap 72 may be provided with pivot lugs 49 on the opposite sides thereof for mounting in a trunnion bracket similar to the bracket 48 of Fig. 1, except for the insulation 47 and 54 which may be omitted, so as to pivotally mount the reclosing circuit breaker unit. The upper cap 74 may, as shown in Figs. 3 and 4, be provided with a projection 80 disposed to be engaged in locking relation with a releasable latch member 82, which may be

pivotaly mounted in a sleet hood 84 on the upper insulating support 22 by means of a bracket 85. The latch member 82 may be normally biased into engagement with the projection 80 by means of a spring 86 and may have a bimetallic operating member 88 comprising laminations of metals having different coefficients of expansion disposed side by side, mounted thereon. The latch member 82 may, for example, comprise a block of insulating material having the operating member 88 secured thereto on a contact member 90 which is disposed to engage the projection 80. A suitable shunt 92 may be provided for connecting the free end of the operating member to the connector 27. A spring 94 may be provided for biasing the cap 74 in a clockwise direction when it is released by the latch member 82.

Referring to Figs. 3 and 4, a circuit may be traced through the reclosing circuit breaker extending from the terminal 27 through shunt 92, bimetallic operating member 88, contact member 90, projection 80, cap 74, spring contact member 93, operating coil 32, conductor 79, contact spring member 78, armature 12', contact member 75, stationary contact member 73 and the cap 72 to the pivots 49 by means of which connection may be made to trunnion bracket 48 and the lower connector 53.

So long as normal current flows through the circuit breaker, the movable contact member 75 remains in contact with the stationary contact member 73. Should the current exceed the normal value, the operating coil 32 will be effective to retract the armature 12' and movable contact member 75, thus interrupting the circuit at the stationary contact member 73. The arc will be drawn into the relatively narrow angular slot in the body member 76 and the gases generated from the walls of the slot 77 by the heat of the arc will be effective in rapidly extinguishing the arc.

Upward movement of the contact member will be limited only by the rate of passage of air through the metering orifices 43 in the upper cap, since the valve member 40 readily permits escape of air from within the tube 34. Downward movement of the contact member 75 to reclose the circuit will be limited by the dashpot action of the armature 12' in the tube 34, since the valve member 40 closes to prevent the admission of air to the tube. The rate of movement of the contact member 75 in reclosing the circuit will thus be determined by the rate of leakage of air between the armature and the tube.

Upon the flow of fault current, the bimetallic operating member 88, which is normally positioned to one side of the extension 60 of the valve member 42, will be deflected towards the path of the extension. After a predetermined number of reclosures, for example, three reclosures, the bimetallic operating member will be deflected into the path of the projection 60. Thus, when the contact member 75 interrupts the circuit for the fourth time, the valve member 40 will be actuated there by the extension 35 thereof to engage the operating member 88. The latch member 82 will thereby be actuated in a counterbalance direction so as to release the projection 80. The reclosing circuit breaker unit in the casing 70, including the interrupter and operating mechanism, will therebetween be actuated by the spring 94 in a clockwise direction so as to introduce a relatively large air gap between the end cap 74 and the connector 27, so that upon the return of the contact member 75 into engagement with the stationary contact member 73 the circuit breaker is no longer effective to complete the circuit, and is disposed in its lockout position. The breaker may be reclosed by inserting a hook stick in an eye 96 and urging the unit 69 in a counterclockwise direction to re-engage latch member 82 and projection 80.

From the above description and the accompanying drawings, it will be apparent that we have provided in a simple and effective manner for interrupting an electric circuit by means of a reclosing air circuit breaker. We have provided for normally introducing a predetermined

gap in the circuit when it is interrupted, and for increasing the amount of the gap when the circuit breaker has operated a predetermined number of times and operates to its lockout position. By releasably supporting the operating mechanism of the reclosing circuit breaker on a lower support in a circuit completing position, and releasing it from this position to a position in which it is no longer effective to complete the circuit, a simple and inexpensive reclosing circuit breaker construction is provided. By utilizing the moving contact member to effect release of the operating mechanism from its normal operating position to the lockout position, positive protection is provided against operation of the mechanism to the lockout position, except when the circuit breaker is in the open position.

Since certain changes may be made in the above-described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the above description and shown in the accompanying drawings, shall be considered as illustrative and not in a limiting sense.

We claim as our invention:

1. An automatic reclosing circuit breaker comprising, spaced terminals, means separably connecting said terminals including an operating mechanism having an elongated longitudinally movable contact member normally biased to a circuit making position between said terminals and electroresponsive means energizable to actuate the movable contact member longitudinally to a circuit opening position, support means for supporting said operating mechanism for movement relative to one of said terminals, a latch releasably securing said operating mechanism in predetermined relation to said one terminal, and operation counting means operable to cause release of said latch in response to a predetermined operation of the electroresponsive means, said counting means being mounted on one of the terminals independently of the operating mechanism.
2. In an automatic reclosing circuit breaker, a pair of terminals, means connecting said terminals including a longitudinally movable contact rod, electromagnetic means operable to move said rod to effect interruption of the connection between the terminals in response to an overload condition, support means for supporting said electromagnetic means and rod for pivotal movement relative to one of the terminals, releasable means disposed to secure the electromagnetic means and rod in predetermined aligned relation to said one terminal, and electrothermal means movable in response to an overload condition to provide an operative connection between the electroresponsive means and the releasable means in response to a predetermined number of operations of the electroresponsive means and cause operation of the releasable means to release said electroresponsive means for movement relative to said one terminal.
3. An automatic reclosing circuit breaker comprising, spaced terminal members, means separably connecting the terminal members including relatively movable contact means normally biased into contact making position to complete a circuit between the terminal members, electroresponsive means including a solenoid operable to effect separation of said contact means to interrupt the circuit between the terminals in response to predetermined circuit conditions, a housing for the electroresponsive means, support means pivotally supporting said housing and electroresponsive means including the solenoid on one of the terminal members for movement relative thereto, releasable means normally operable to maintain said housing and electroresponsive means in predetermined positional relation with said one terminal member means, and operating means for said releasable means disposed to be actuated only after a predetermined number of separations of said contact means to

release said electroresponsive means from said predetermined positional relation.

4. A circuit interrupter comprising, spaced apart terminals, means separably connecting said terminal members including movable contact means, arc extinguishing means including a gas evolving material having a passage through which the movable contact means moves, electromagnetic means operable to actuate the movable contact means to withdraw it from said passage and interrupt the circuit between the terminals in response to an overload in said circuit, means for effecting return of said contact means following an interruption, support means disposed to mount said electromagnetic means and said contact means on one of said terminals for predetermined movement relative thereto, releasable means normally securing said electromagnetic means in predetermined positional relation with said one terminal, and means providing an operative connection between the electroresponsive means and the releasable means for at times causing the electromagnetic means to actuate said releasable means to release said electromagnetic means.

5. A circuit interrupter comprising, a stationary contact, a longitudinally movable contact, support means pivotally supporting the movable contact for pivotal movement, electroresponsive means operable to move the movable contact longitudinally away from the stationary contact to effect a circuit interrupting operation, means normally biasing the movable contact into engagement with the stationary contact to effect engagement of the contacts following a separation, releasable means normally operable to maintain the movable contact in predetermined alignment with said stationary contact, and counting means actuating said releasable means to release said movable contact from alignment with said stationary contact only in response to a predetermined number of circuit interrupting operations of said electroresponsive means.

6. In an automatic reclosing circuit breaker, a pair of terminals, a longitudinally movable contact, means biasing said contact longitudinally in one direction into circuit making relation with one of said terminals, electroresponsive means operable to move the movable contact longitudinally in the opposite direction out of circuit making relation with said terminal in response to an overload condition, support means pivotally supporting said movable contact, a latch normally operable to maintain the movable contact in predetermined longitudinal alignment with said terminal, and operating means disposed to release said latch in response to operation of said movable contact after it has operated a predetermined number of times.

7. A circuit interrupter comprising, a movable contact rod normally biased to a circuit completing position, electromagnetic means operable to move said contact rod longitudinally to a circuit interrupting position, said contact normally returning to the circuit completing position following a circuit interrupting operation, releasable means normally operable to maintain the movable contact in an aligned position in which it can effectively complete a circuit following an interruption, said releasable means having a part movable in response to a predetermined number of such circuit interrupting operations of the movable contact member to provide an operative connection between the electroresponsive means and the releasable means for permitting said electroresponsive means to actuate said releasable means to release the moving contact member from said circuit completing aligned position whereby it is prevented from completing said circuit.

8. An automatic reclosing circuit breaker comprising, a housing, pivotal support for said housing, contact means disposed in said housing including a movable contact member operable in one position of the housing to complete an electric circuit with a fixed contact, electroresponsive means operable in response to an overload in said circuit to actuate the movable contact member to inter-

rupt said circuit, biasing means opposing said electroresponsive means, releasable means normally operable to retain said housing and contact member aligned for completing the circuit, and means operable in response to a predetermined number of such circuit interrupting operations to permit the electroresponsive means to actuate said releasable means to release the housing and movable contact member from circuit completing alignment whereby the biasing means is ineffective to effect completion of the circuit.

9. An interrupter comprising, a stationary contact, an elongated contact member movable longitudinally to engage the stationary contact member, electroresponsive means operable to actuate the movable contact member longitudinally away from the stationary contact member and interrupt a circuit in response to an overloaded condition, support means pivotally supporting the movable contact member for movement away from said stationary contact about a transverse axis, latch means normally operable to retain the movable contact in alignment with the stationary contact during a circuit interrupting operation, and electroresponsive operating means operable to effect release of the latch means after a predetermined number of circuit interrupting operations.

10. A circuit interrupter comprising, a pair of contacts, one of said contacts being movable relative to the other, a gas evolving material having an opening to receive a portion of the movable contact member, electroresponsive means operable to actuate said member and withdraw it from said opening in a circuit interrupting operation, means actuating said movable contact member in one positional relation to engage the other contact following a circuit interrupting operation, releasable means normally operable to maintain the movable contact member in alignment with said opening for said one positional relation, and means operable in response to a predetermined number of circuit interrupting operations to operate said releasable means whereby the movable contact member is released from said aligned positional relation.

11. A circuit interrupter comprising, a first support, stationary contact means mounted on said support, a body of gas evolving material mounted on said support and having a passage therethrough aligned with said contact, a second support in spaced relation with said first support, elongated contact means, guide means slidably supporting the elongated contact means for longitudinal movement, latch means operable to maintain the guide means with the elongated contact means aligned with the stationary contact means, means pivotally supporting the guide means for pivotal movement about an axis transverse of the elongated contact means, electroresponsive means operable to effect longitudinal movement of said elongated contact means away from the stationary contact means in response to predetermined circuit conditions, and operating means operable to release said latch means after a number of circuit opening operations.

12. In an automatic reclosing breaker, separable contact means, a casing having guide means supporting one of said contact means for movement along a predetermined path, means biasing said contact means together, electromagnetic means operable to separate said contact means to effect a circuit interruption, latch means normally operable to retain the casing in a predetermined position in which the movable contact is effective to perform a circuit closing operation, means biasing the casing away from said position, and operating means for the latch means including an overload responsive member movable to a position such that the electromagnetic means engages and operates the latch means through the overload responsive member to release the casing from said position after a predetermined number of circuit interrupting operations.

13. A circuit interrupter comprising, an insulating container having conducting cap means adjacent each end, a movable contact, guide means locating the mov-

able contact within the container for circuit making connection with one of said cap means at the end of the container, means biasing the movable contact into contact with said one cap means, a solenoid disposed in the container to actuate the movable contact out of circuit making connection with said cap means, support means pivotally supporting the container at one of said cap means, a connector, releasable means disposed to secure the other cap means in circuit making relation with said connector, and operating means having a bimetallic element actuated by an over-current to effect release of the releasable means by movement of the movable contact to release said cap means from circuit making connection with said connector.

14. In a circuit interrupter, an operating mechanism including a movable contact member and electro-responsive means energizable to actuate the movable contact member to a circuit opening position, a casing for said operating mechanism, support means for said operating mechanism, releasable means disposed to secure said casing in predetermined operating relation to said support means, and operation counting means having a part movable to a position where it is actuated by the electro-responsive means for causing release of said releasable

means disposed on said support means externally of said casing.

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