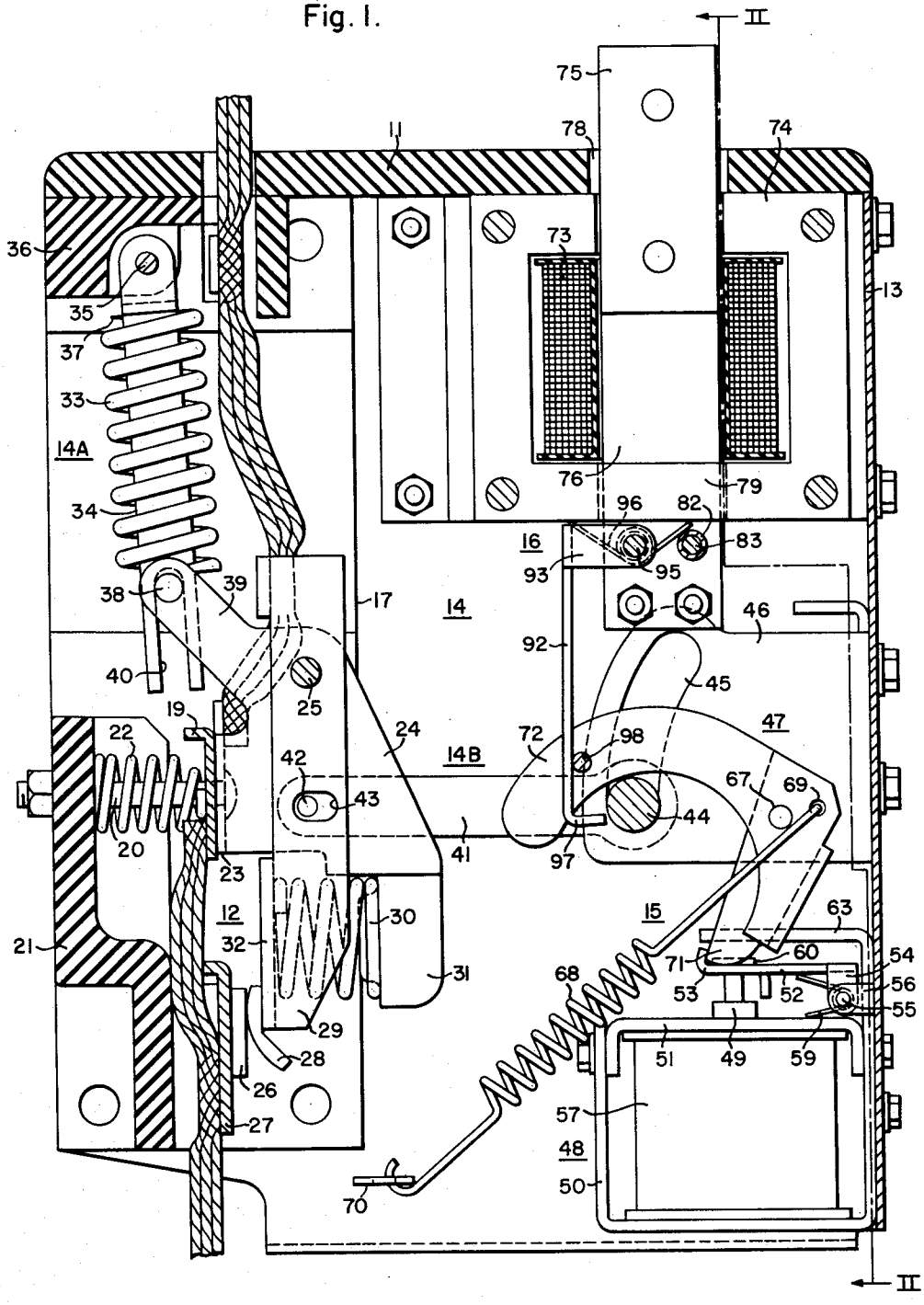
Aug. 1, 1961 J. J. ASTLEFORD, JR., ET AL 2,994,753

CIRCUIT BREAKER

Filed March 25, 1959 4 Sheets-Sheet 1

Fig. 1.

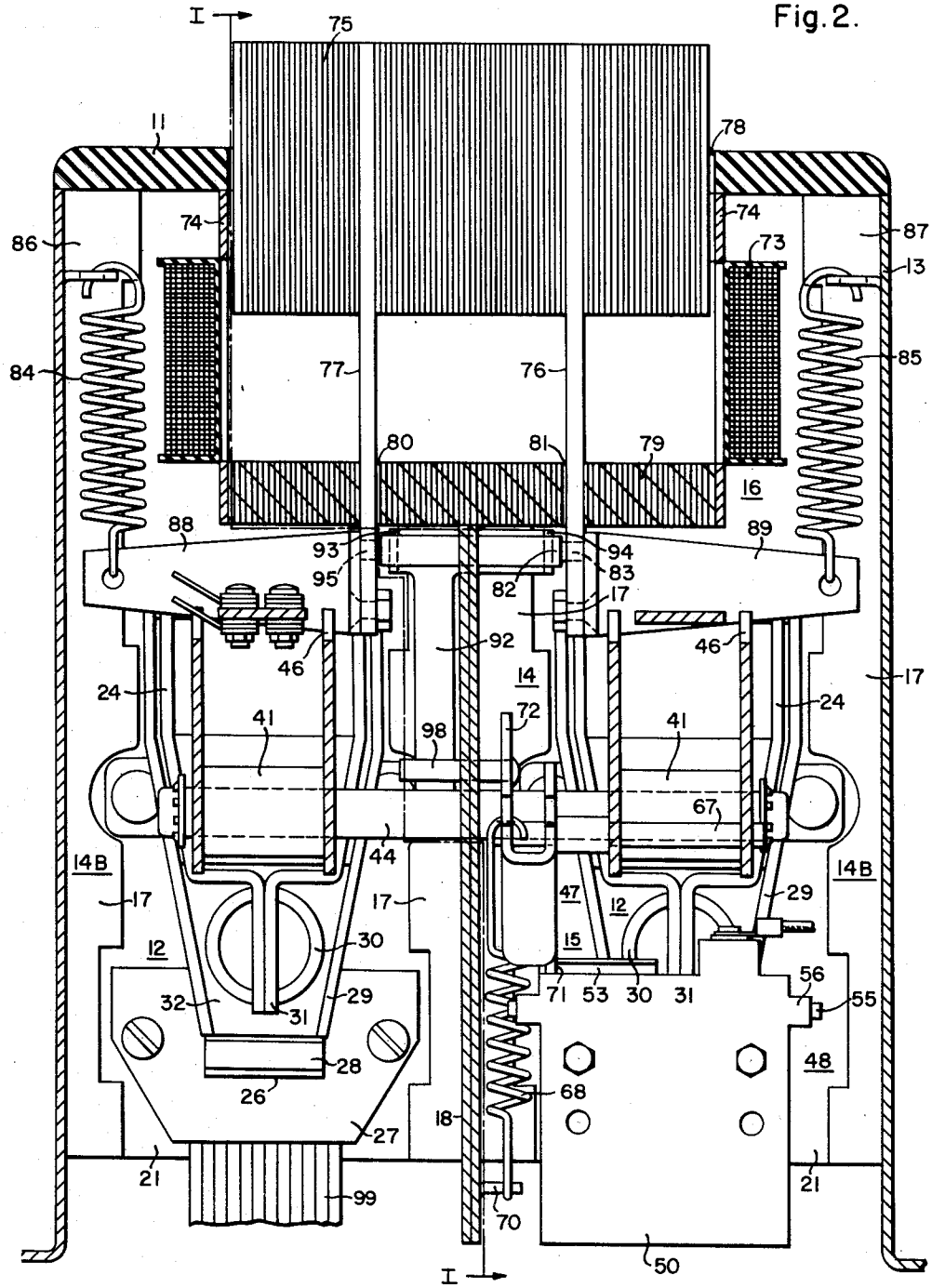


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CIRCUIT BREAKER

Filed March 25, 1959 4 Sheets-Sheet 2

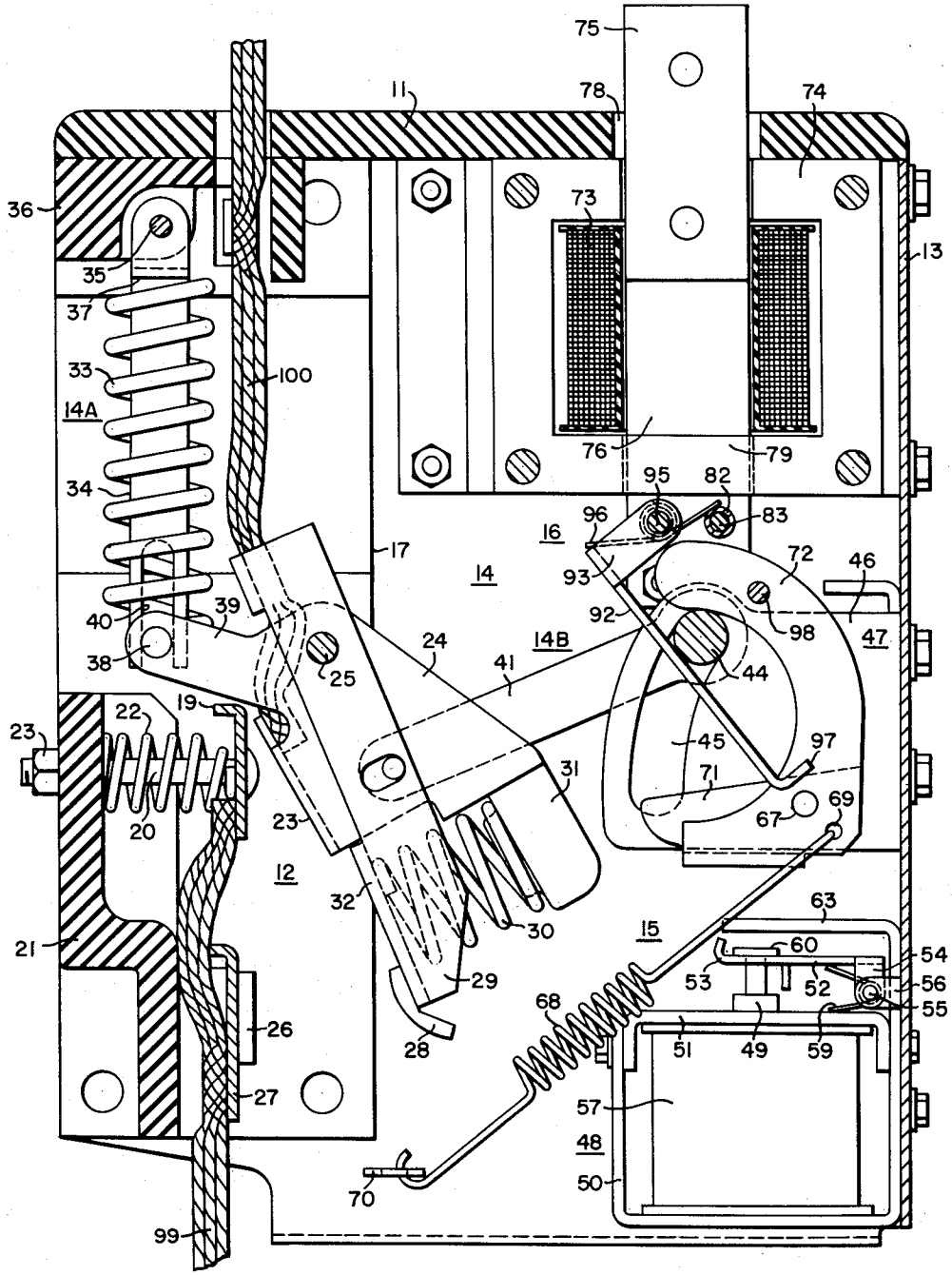
Fig. 2.



CIRCUIT BREAKER

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Fig. 3.



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CIRCUIT BREAKER

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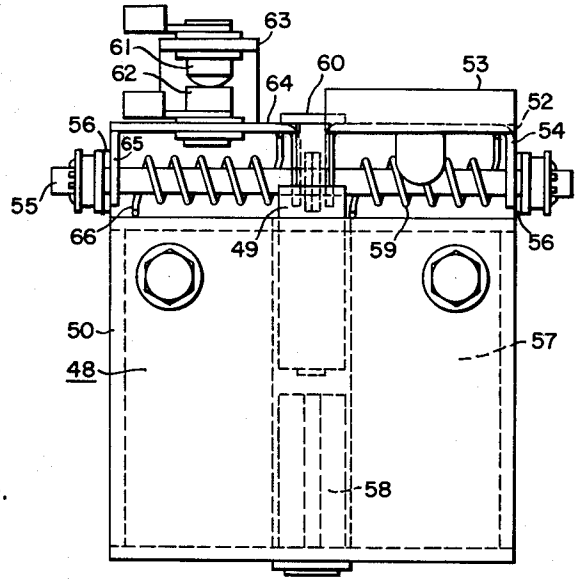


Fig. 4.

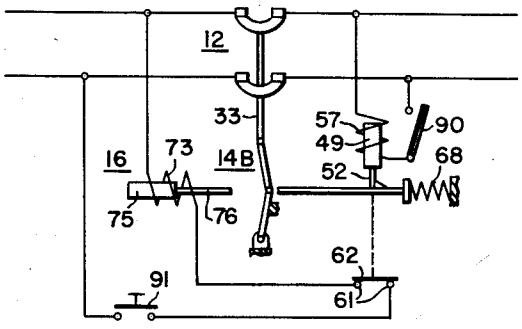


Fig. 5.

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CIRCUIT BREAKER

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18 Claims. (Cl. 200—106)

This invention relates generally to circuit breakers, and, more particularly, to operating, tripping and closing mechanism therefor.

An object of the invention is to provide in a circuit breaker operating mechanism a simple, reliable toggle mechanism having a minimum number of moving parts and comprised of a pair of toggle members wherein only one of the toggle members is movable.

It is desirable to construct a circuit breaker mechanism so that when the manually operated electrical closing mechanism closes the contacts on a trip condition, the contacts will be tripped open automatically even though the manual operation is still in progress. Heretofore, such trip-free construction required relatively complicated mechanism. Accordingly, it is another object of this invention to provide in a circuit interrupter a simplified trip-free operation of the operating, tripping and closing mechanism.

Another object of this invention is to provide in a circuit interrupter an electrical interlock means for rendering trip-free a non trip-free operating, tripping and closing mechanism.

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

FIG. 1 is an elevational sectional view taken substantially along line I—I of FIG. 2 looking in the direction of the arrows and showing a circuit breaker embodying the invention, the breaker being shown in closed position;

FIG. 2 is a sectional view taken substantially along line II—II of FIG. 1 and looking in the direction of the arrows;

FIG. 3 is an elevational view similar to FIG. 1 but showing the breaker in the tripped-open position;

FIG. 4 is a fragmentary view of part of the circuit breaker showing portions of the electrically-operated trip mechanism; and

FIG. 5 is a schematic diagram of the circuit breaker combined with the trip circuit and the closing circuit.

Referring to FIGS. 1 and 2 of the drawings, the two-pole circuit breaker comprises a base **11** of insulating material to which is connected two identical breaker contact mechanisms, each being indicated generally at **12** (only one shown in FIG. 1) and separated by a divider **18** (FIG. 2) integral with metal housing **13** secured to the base **11**. Also in the metal housing are an operating mechanism indicated generally at **14**, a trip mechanism indicated generally at **15**, and a reclosing mechanism indicated generally at **16**. The trip mechanism **15**, the reclosing mechanism **16** and portions of the operating mechanism **14** are common to both poles of the breaker, therefore, to simplify the description and promote a better understanding of the invention, the breaker will first be described as a single-pole circuit interrupting apparatus.

A pair of support members **17** (FIG. 2) integral with the cover **11**, are provided to mount the contact mechanism **12** and a portion of the operation mechanism **14** in the housing **13**, one of the support members being attached to the housing **13**, and the other support member being attached to the divider **18**, and both comprised of insulating material. The divider is integral with the housing **13**.

The contact structure **12** comprises a main stationary contact **19** connected to flexible conductor **99** rigidly mounted on the inner end of a rod **20** slidably mounted in the contact support **21** constructed of insulating material integral with the base **11** and mounted between the support members **17**. A coil spring **22** surrounds the rod **20** and is compressed between the contact support member **21** and the main stationary contact **19**. A limit nut **23** is threadedly mounted on the rod **20** outside the contact support **21**. A cooperating movable main contact **23** is rigidly mounted on a channel-shaped main switch arm **24** pivotally mounted on a pivot pin **25** supported by the pair of supports **17**, and is attached to flexible conductor **100**.

The contact structure **12** also comprises a stationary arcing contact **26** rigidly mounted on a conducting support member **27** riveted to the contact support **21**, and a cooperating movable contact **28**. The flexible conductor **99** is attached to conducting support member **27**. The movable arcing contact **28** is rigidly mounted on a channel-shaped switch member **29** which straddles the main switch arm **24** and is pivoted on the pin **25**. A compression spring **30** disposed between an extension **31** of the main switch arm **24** and the yoke portion **32** of the arcing contact switch arm **29** provides contact pressure for holding the arcing contacts in closed position until after the main contacts **19** and **23** have separated upon the occurrence of an opening operation.

The operating mechanism **14** is generally comprised of a biasing mechanism **14A** for biasing the main contacts **19—23** and arcing contacts **26—28** toward an open condition, and a toggle mechanism **14B** for preventing the contacts from assuming the open condition until the operating mechanism **14B** is operated in response to operation of the trip mechanism **15**.

More specifically, the biasing mechanism **14A** is comprised of a spring **33** which surrounds a spring guide **34** pivotally connected at one end by means of a pivot pin **35** to a support element **36** integral with the cover **11** and mounted between and attached to the pair of supports **17**. The other end of spring guide **34** is slidably and pivotally connected by means of a bifurcated portion **40** in the guide **34** to a pin **38** mounted between extensions **39** (only one extension **39** being shown in FIG. 1) on main switch arm **24**. The spring **33** is compressed between a shoulder **37** on the spring guide **34** and the pin **38**. The pivot pin **38** is offset with respect to a straight line between pivot pin **35** and pivot pin **25** so that spring **33** biases the contacts **19—23** and **26—28** in a counterclockwise direction toward an open condition.

The toggle mechanism **14B** is comprised of a movable toggle link **41** operatively associated with a fixed cam element **46**. The toggle link **41** is constructed of insulating material and is pivotally connected to the main switch arm **24** by means of a pivot pin **42**. The pivot pin **42** projects beyond the side members of the switch arm **24** and through elongated slots **43** (only one being shown in FIG. 1) in the side members of the arcing contact switch arm **29**. The other or outer end of the toggle link **41** is pivotally connected to a toggle shaft **44** extending through guiding cam slots **45** disposed in parallel alignment in the side members of the channel-shaped toggle cam element **46** rigidly attached to the metal housing **13**. The cam slots **45** are arcuate in form and are positioned with respect to the toggle link pivot **42** so that one extremity of the slots is closer to the pivot **42** than any

other portion of the slots and so that a tangent to the curvature of the slot at the extremity nearest the pivot 42 is perpendicular to the line of force provided by the toggle link 41 through pivot 42, which force is initially provided by the biasing mechanism 14A in the manner previously described. Thus, when toggle shaft 44 is in the lower extremities of the parallel slots 45, as illustrated in FIG. 1, the toggle link 41 transfers all of the force of the biasing means 14A perpendicularly against the cam 45 so that no component of the biasing force exists in a lateral direction to trip the toggle means. Under these conditions, the toggle link 41 is in a dead-center reset position, thus preventing an opening movement of the contact arms 24 and 29. However, when the toggle shaft 44 is in any other position along cam 45, as illustrated in FIG. 3, the cam slopes away from the perpendicular, thus providing a lateral component of the biasing force to move the toggle link along the cam. Thus, when the toggle link 41 is in any position other than that shown in FIG. 1, toggle link 41 is in an off-center or broken position with respect to cam 45 and pivot 43 and cannot oppose the contact opening force provided by the biasing mechanism 14A. It is seen that the slidable connection between the toggle shaft 44 and the cam slots 45 effectively comprises a movable knee portion between the fixed cam element 46 and the toggle link 41. As will be more fully described hereinafter, the arcuate curvature of the slots also assist in providing a reset operation.

The trip mechanism 15 is generally comprised of a combined toggle latch and trip member 47 for holding the toggle mechanism in the dead-center position and for tripping the toggle shaft 44 off dead center in response to operation of a catch 52 by a trip solenoid 48. A condition responsive switch 90 (FIG. 5) is preferably a bimetallic device responsive to current in a transformer (not shown) and ambient temperature, in the oil immersing the transformer and operates to energize the trip solenoid 48 in response to abnormal conditions. More specifically, the trip solenoid 48, shown in detail in FIG. 4, is comprised of a coil 57 surrounding a core 58 and a plunger 49. The plunger 49 is normally in an extended condition with respect to the deenergized coil 57, as illustrated in FIGS. 1, 3 and 4. The solenoid 48 is rigidly connected to the housing 13 by interconnected frame members 50 and 51. The toggle latch catch 52, having a catch lip 53, is pivotally attached at one end to the bracket arm 50 by means of a pin 55 extending through a pair of ears 54 on the latch catch 52 and extending through ears 56 on the bracket arm 50. A torsion spring 59 surrounding pin 55 has one end abutting the latch catch 52 and has the other end abutting frame member 51 to thus bias the latch catch in a clockwise direction in the position illustrated. A flange 60 on the upper end of plunger 49 engages the top surface of latch catch 52 adjacent the catch lip 53 so that a downward movement of the plunger 49 in response to energization of the trip coil 57 will pull down the catch lip 53 to release the latch or trip member 47 for operating the toggle mechanism 14B in a manner hereinafter described.

A pair of normally closed trip-free contacts 61—62 (FIG. 4) are connected to the frame member 50 for operation in response to energization of the trip coil 57 to deactuate the reclosing mechanism 16 in a manner hereinafter described. Specifically, the trip-free contact mechanism comprises a fixed contact 61 rigidly attached to and insulated from extension 63 of frame member 50 and a movable contact 62 rigidly mounted on and insulated from contact arm 64 which is pivotally connected to pin 55 by means of ear portions 65. A torsion spring 66 encircling pin 55 biases the contacts 61—62 in the closed position, as shown, while the flange 60 on the plunger 49 engages the upper part of contact arm 64 to pivot the movable contact 62 downwardly and away from the fixed contact 61 when the trip coil 57 is energized.

The toggle latch or trip member 47 is pivotally connected to the toggle cam element 46 by means of a pin 67 and is biased to move from its normal or cocked position in a clockwise or tripping direction by a spring 68 having one end hooked in an aperture 69 in the toggle latch and the other end hooked in an apertured stud 70 rigidly attached to the housing 13. A tripping arm 71 on latch or trip member 47 is adapted to be engaged by the catch lip 53 to prevent the spring 68 from rotating the latch about the pivot 67 when the trip coil is deenergized and the toggle mechanism is in the dead-center position. A latch arm 72 on the latch 47 is angularly fixed with respect to extension 71 and slidably engages toggle shaft 44 to prevent the toggle mechanism from moving away from the dead-center position in cam slots 45 when the tripping arm 71 is engaged with catch lip 53, as illustrated in FIG. 1. The latch arm serves as a safety device to prevent accidental tripping of the toggle means 14B that might result from external shock or other causes. The effective length of the tripping arm 71 from pivot 67 is selected to be at least as great as the distance between the pivot 67 and the toggle shaft 44 so that the action of the spring 68 in rotating latch 47 about pivot 67 in response to disengagement of the tripping arm 71 by the catch lip 53 will cause tripping arm 71 to strike the toggle shaft 44 with a force sufficient to knock it off dead center, thus initiating operation of the operating mechanism 14 to open the contact mechanism 12 in the manner previously described.

The reclosing solenoid mechanism 16 is electrically operated to reset the operating mechanism 14 and reclose the contact mechanism 12 after a trip operation has occurred. A reclosing coil 73 is rigidly attached to housing 13 immediately adjacent cams 46 by means of a frame member 74. A plunger 75 comprised of magnetic, cold-rolled, steel laminations separated by insulating coatings, includes a pair of reclosing members comprised of non-magnetic steel push plates 76 and 77 integral therewith. The plunger 75 is slidably mounted in the coil to extend through an aperture 78 in cover 11 when the coil 75 is deenergized. A core 79, having apertures 80 and 81, for slidably receiving the push plates 77 and 76, respectively, is rigidly attached to the frame 74, as best seen in FIG. 2 and has surface contours coincident with the frame 74, as seen in FIGS. 1 and 3, so that the core encompasses the solenoid 73 in a vertical direction. The core 79 is attached to the housing 13 by means of the frame 74. The push plates 76 and 77 extend through the apertures 80 and 81 in core 79 when the reclosing coil 73 is deenergized and abut the toggle shaft 44 when it is in the trip position at the upper extremity of cam slots 45, as illustrated in FIG. 3. When the reclosing coil 73 is energized, the plunger 75 is drawn downwardly into the coil causing the push plates 76 and 77 to bear downwardly against the toggle shaft 44. The toggle shaft 44, restrained by the cam slots 45, is pushed down by the push plates 76 and 77 to the lower extremity of the cam slot 45 as the reclosing core 75 completes its downward stroke. In this manner, the toggle shaft is returned to the dead-center position, the operating mechanism 14 is reset, and the contacts 19—23 and 26—28 are reclosed.

A latch reset means, comprised of a roller 82 on a pin 83 carried by push plates 76 and 77, engages the latch arm 72 to rotate the latch 47 in a counterclockwise or reset direction about pin 67 when the reclosing coil is energized, whereupon lip 53 of catch 52 engages tripping arm 71 of latch 47 to reestablish the latched condition of the trip mechanism 15. When the reclosing coil 73 is deenergized at the end of a reclosing operation, the plunger 75 is pulled upwardly to the normal position by means of a pair of plunger return springs 84 and 85, each having one end hooked to a pair of studs 86 and 87, respectively, connected to the housing 13, and each having the other end hooked to one of a pair of brackets 88 and 89, respectively, rigidly riveted to the push plates 77 and 76, respectively, below the core 79.

Referring now to FIG. 5, it is seen that the normally closed trip-free contacts **61**—**62** are connected in series with a manually operable reclosing switch **91** and the reclosing solenoid **73** to thus provide interruption of the reclosing circuit when the trip solenoid operates in response to an abnormal condition as detected by the condition responsive switch **90**. This circuitry provides for trip-free operation of the previously described breaker mechanism in the event operation of the reclosing solenoid **73** in response to closing of switch **91** after a trip operation should reclose the contact mechanism **12** on an abnormal condition.

If the breaker should close on an abnormal condition, the condition responsive switch **90** will energize the trip coil **57** to simultaneously release the latch **47** and open the trip-free contacts **61**—**62** when the plunger **75** and push plates **76** and **77** are at the end of the reclosing stroke and ready to begin their upward movement toward their normal positions. The plunger **75** is many times more massive than the latch **47**. Therefore, the upward movement of the plunger upon deenergization of the closing circuit by the operation of the trip-free contacts, is relatively slower than the movement of the latch **47** about pivot pin **67** when the catch releases the tripping arm **71**. Accordingly, as the reclosing plunger **75** moves upward in response to the action of plunger return springs **84** and **85**, the latch arm **72** of latch **47** continuously bears against roller **82**, diverting the energy of latch spring **68** to the plunger **75**, thus reducing the speed of rotation of latch **47** about pin **67**. Consequently, tripping arm **71** may fail to achieve sufficient momentum to knock toggle link **41** and toggle shaft **44** off the dead center position.

A trip-free means, generally serving as an auxiliary trip means, is provided to assure a tripping action of the toggle means **14B** when the contacts are reclosed on a tripping condition. The trip-free means is comprised of a trip-free link **92** attached between push plates **76** and **77** by means of ear portions **93** and **94** on the upper end of the trip-free link **92** pivotally attached to a pin **95** journalled in the plates **76** and **77**. A torsion spring **96** surrounds the pin **95** and includes end portions bearing against the roller **82** and the trip-free link **92** to bias the hooked lower end **97** of the trip-free link in a counterclockwise direction under the toggle shaft **44**, in the manner illustrated in FIG. 3. The effective length of the trip-free link between the pivot pin **95** and the hooked end **97** is selected so that the hooked end **97** is engageable with the toggle shaft **44** when the plunger **75** is near the end of the upward stroke or reset stroke. In this manner, the full energies of the plunger return springs **84** and **85** and the latch spring **68** are combined to provide sufficient force for tripping toggle shaft **44** off dead center. A tubular rivet **98** on the latch arm **72** slidably engages the trip-free link **92** to prevent rotation of the hooked end **97** under the toggle shaft **44** only when the latch **47** is in the cocked position, as illustrated in FIG. 1. Therefore, during a normal closing operation wherein energization of the closing solenoid **73** causes the plunger to move downward to cock the latch **47** and reset the operating mechanism **14** at the lower extremity of the closing stroke and wherein deenergization of the closing solenoid **73** thereafter permits the plunger return springs **84** and **85** to raise the plunger **75**, the rivet **98** serves as a guide means and prevents the trip-free link **92** from rotating under the toggle shaft **44**. Alternatively, during a closing operation wherein the plunger **75** closes the contact mechanism on an overcurrent condition, so that the latch arm **72** follows the push plates **76** and **77** in their upward movement, as previously described, the clockwise rotation of the latch arm about pivot pin **67** removes the rivet **98** from the path of rotation of the trip-free link **92**. The hooked end **97** of the trip-free link then engages toggle shaft **44** in the manner previously described to trip it off the dead-center position when the plunger **75** nears the end of the plunger reset stroke.

Referring particularly to FIG. 2 of the drawing, it is readily seen that the structure of the second pole of the breaker, shown to the left of FIG. 2, is identical to that of the pole to the right of FIG. 2, as described above. Accordingly, corresponding parts have been given the same reference numerals. The previously described toggle shaft **44** is common to both poles so that the operation of the single trip mechanism **15** simultaneously opens both contact mechanisms **12** while operation of the single closing mechanism **16** closes both contact mechanisms **12**.

It is obvious, if desired, that the two-pole circuit breaker as described above may be converted to a single pole breaker by merely removing one of the poles, no other change in structure being necessary for the remaining apparatus to function in the same manner as previously described.

Having described a preferred embodiment of the invention, it is to be understood that various changes and modifications may be made in the structural details thereof without departing from the essential features of the invention. It is intended, therefor, that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. In a circuit breaker: a support means; a switch attached to and movable with respect to the support means to open and close a circuit; means biasing the switch toward the open position; a toggle means for releasably restraining the switch in the closed position and including a first toggle member rigidly fixed to the support and a second toggle member connected to the switch; a slide surface on one of the toggle members, and a guide surface on the other one of the toggle members for slidably engaging said slide surface to guide said second toggle member on a predetermined path between a dead-center position when the switch is closed and an off-center position when the switch is opened; means including condition responsive means for moving the second toggle member away from the dead-center position; and closing means for returning the second toggle member to the dead-center position after a trip operation.

2. A circuit breaker: separable contacts; means biasing the contacts toward separation; operating means including a toggle means for separating and closing the contacts; a tripping member biased toward tripping engagement with the toggle means; a catch operable to releasably restrain the tripping member from engagement with the toggle means; a latch portion rigidly fixed to said tripping member to hold the toggle means in a contact-closing position when the tripping member is restrained by the catch; means including condition responsive means for rendering the catch inoperable to restrain the tripping member; and means for resetting the toggle means and the tripping means after a contact separation.

3. In a circuit breaker: separable contacts; operating means operable to open and to close said contacts; trip means including condition responsive means for providing a tripping force, and means including a trip member responsive to the tripping force to move from a cocked position to a trip position to actuate the operating means to open the contacts; electrically responsive means operable to provide a reclosing force; a closing member responsive to said reclosing force to move from a rest position to a reclosing position to actuate the operating mechanism to close the contacts and to return the trip member to the cocked position; biasing means for returning the closing member to the rest position upon cessation of operation of the means providing the closing force; auxiliary trip means carried by the closing member and operable to actuate the operating means to open the contacts when the closing member is return-

ing to the rest position after a closing operation; and means carried by the trip member for preventing operation of the auxiliary trip means when the trip member is cocked.

4. In a circuit breaker: separable contacts; operating means operable to open and to close said contacts; trip means including condition responsive means for providing a tripping force, and means including a trip member responsive to the tripping force to move from a cocked position to a trip position to actuate the operating mechanism to open the contacts; electrically responsive means operable to provide a closing force; a closing member responsive to said closing force to move from a rest position to a closing position to actuate the operating mechanism to close the contacts and to return the trip member to the cocked position; biasing means for returning the closing member to the rest position upon cessation of operation of the means providing the closing force; means responsive to the operation of the condition responsive means to render inoperative the means for providing a closing force; auxiliary trip means carried by the closing member and operable to actuate the operating mechanism to open the contacts when the closing member is returning to the rest position after a closing operation; and means carried by the trip member for preventing operation of the auxiliary trip means when the trip member is cocked.

5. In a circuit breaker: separable contacts; means biasing the contacts toward separation; a contact operating mechanism releasably restraining the contacts in a closed condition; condition responsive trip means operable to release the contact operating mechanism; closing means operable to simultaneously reset the contact operating mechanism and the trip means; means operable to reset the closing means after a closing operation; auxiliary trip means operable in response to resetting of the closing means after a closing operation to release the contact operating mechanism; and means for preventing operation of the auxiliary trip means only when the trip means is reset.

6. In a circuit breaker: separable contacts in a circuit; operating means operable to separate and to close the contacts; primary trip means responsive to the occurrence of a predetermined condition to actuate the operating means to separate the contacts; closing means operable to reset the trip means and to actuate the operating means to close the contacts; means operable to reset the closing means after a closing operation; auxiliary trip means operable in response to resetting of the closing means after a closing operation to actuate the operating means to separate the contacts; and means for preventing operation of the auxiliary trip means when the primary trip means is reset.

7. In a circuit breaker: separable contacts; operating means operable to open and to close the contacts; a catch means spaced from said operating means; a tripping arm releasably engaged by said catch means and biased to operate the operating mechanism to open the contacts, a latch member rigidly fixed on said tripping member and operable to oppose operation of the operating means when the tripping arm is engaged by the catch; condition responsive means for operating the catch means to release the tripping arm; closing means operable to operate the operating means to close the contacts and including means for bearing against the latch member to reset the tripping arm; means operable to reset the closing means after a closing operation; auxiliary trip means responsive to a reset operation of the closing means to actuate the operating means to open the contacts; and means for preventing operation of the auxiliary trip means when the tripping member is reset.

8. In a circuit breaker: separable contacts; operating means operable to open and to close the contacts; a catch means spaced from said operating means; a tripping arm releasably engaged by said catch means and biased to operate the operating means to open the contacts; a latch member rigidly fixed on said tripping arm and operable to oppose operation of the operating means when the tripping arm is engaged by the catch; condition responsive means for operating the catch means to release the tripping arm; electroresponsive means; a closing member movable in response to operation of the electroresponsive means to operate the operating means to close the contacts; means carried by the movable closing member for bearing against the latch member to reset the tripping arm; circuit means for controlling operation of the electroresponsive means and a switch responsive to operation of the condition responsive means to prevent operation of the electroresponsive means; biasing means for resetting the closing member when the electroresponsive means is inoperative; auxiliary trip means operable to respond to a reset operation of the closing member to actuate the operating means to open the contacts; and means for preventing operation of the auxiliary trip means when the tripping member is reset.

9. In a circuit breaker: separable contacts; operating means operable to open and to close the contacts; a catch means spaced from said operating means; a tripping arm releasably engaged by said catch means and biased to operate the operating means to open the contacts; a latch member rigidly fixed on said tripping arm and operable to oppose operation of the operating means when the tripping arm is engaged by the catch means; condition responsive means for operating the catch means to release the tripping arm; electroresponsive closing means including a closing member movable in response to operation of the electroresponsive means to operate the operating means to close the contacts; means carried by the movable closing member for bearing against the latch member to reset the tripping arm; electrical interlock means responsive to operation of the overcurrent responsive means to terminate operation of the electroresponsive means; biasing means for resetting the closing member when the electroresponsive means is inoperative; auxiliary trip means operable to respond to a reset operation of the closing member to actuate the operating means to open the contacts; and means for preventing operation of the auxiliary trip means when the tripping member is reset.

10. In a circuit breaker: separable contacts; means biasing the contacts toward separation; a toggle means releasably restraining the contacts in a closed condition; a latch having a tripping arm and a latch arm and pivoted at a point intermediate the arms; means biasing the latch about the pivot toward tripping engagement with the toggle means; catch means releasably engaging the tripping arm at a point remote from the toggle means to position the latch arm to hold the toggle means in an unbroken condition when the tripping arm is engaged by the catch; condition responsive means for operating the catch to release the tripping arm; closing means having a member movable to reset the toggle means after a tripping operation; means on the movable member for bearing against the latch arm to reset the tripping arm.

11. A circuit breaker comprising: contacts including a member movable to separate and close the contacts; means biasing the movable member to separate the contacts; toggle means connected to the movable member and having a dead-center position for restraining said contacts in a fully closed position and operable to be tripped toward an off-center position to release the contacts; a tripping member biased toward tripping engagement with the toggle means; a catch operable to releasably restrain the tripping member from engagement with the toggle means; a latch portion rigidly fixed to said tripping member to hold the toggle means in said dead-center position while the tripping member is restrained by the catch; means including condition responsive means for rendering the catch inoperable to restrain the tripping member; and means for resetting the toggle means and the tripping means.

12. A circuit breaker comprising: a support; a switch member on the support and operable to open the circuit; spring means biasing said switch member to the open position; a toggle mechanism having a knee portion movable in a first direction from a full break position to reset the toggle mechanism to releasably restrain the switch in the closed position and movable in the reverse direction from the reset position to break the toggle mechanism to release the switch; a catch means spaced from said toggle mechanism; a tripping arm releasably engaged by said catch means and engageable with said toggle mechanism to move the knee in said reverse direction; biasing means operable when the catch is released to accelerate the tripping arm in said reverse direction into engagement with the toggle member with sufficient tripping velocity to move the knee in said reverse direction; means operable to release the catch in response to predetermined abnormal conditions in the circuit; a latch member rigidly fixed on said tripping arm and engageable with the toggle mechanism in its reset position; a reclosing member for moving the knee portion of the toggle in said first direction to reset position, a surface on the reclosing member for engaging the tripping arm and returning it to engage said catch means; means for resetting said reclosing member by movement in the reverse direction with a speed preventing achievement of said tripping velocity by said tripping arm; a trip link pivotally mounted on said reclosing member and extending beyond the engaging surface of the reclosing member and having a hooked portion engageable with the toggle mechanism to move the knee portion in said reverse direction when the reclosing member has substantially completed its resetting movement in said reverse direction; means biasing the link about said pivot point into engagement with the toggle mechanism; and stop means on said latch arm engageable with said link only when the trip arm is held in the catch to prevent engagement of the hook with the toggle mechanism when the reclosing member is being reset.

13. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, a fixed cam surface guiding said outer end of the link, said link when moved laterally at said outer end in one direction along said cam surface moving to a position generally perpendicular to the switch arm and being locked there by said cam surface to hold the switch arm in closed position against the bias of said spring means, a solenoid mounted opposite one end of said cam surface and having a plunger movable along an axis extending generally laterally of said link and generally in line with said cam surface, said solenoid when energized moving said outer end of the link along said cam surface and moving said switch arm to the closed position, a current responsive device mounted opposite the other end of said cam surface and having a member movable from a normal position to apply a force to move said outer end of the link out of said locked position and initiate movement of the switch arm to open position under bias of said spring means.

14. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, a fixed cam surface guiding said outer end of the link, said link when moved laterally at said outer end in one direction along said cam surface moving to a position generally perpendicular to the switch arm and being locked there by said cam surface to hold the switch arm in closed position against the bias of said spring means, a solenoid mounted opposite one end of said cam surface and having a plunger movable along an axis extending generally laterally of said link and generally in line with said cam surface, said solenoid when energized moving said outer end of the link along said cam surface and moving said switch arm to the closed position, a current responsive device mounted opposite the other end of said cam surface and having a member movable from a normal position to apply a force to move said outer end of the link out of said locked position and initiate movement of the switch arm to open position under bias of said spring means, means actuated by said solenoid to return said movable member to its normal position, and contact means actuated by said current responsive means to prevent energization of said solenoid when the current responsive means is actuated.

15. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, said link when moved laterally at said outer end in one direction moving to a position generally perpendicular to the switch arm to hold the switch arm in closed position against the bias of said spring means, a solenoid having a plunger movable along an axis extending generally laterally of said link, said solenoid when energized moving said outer end of the link and moving said switch arm to the closed position, a movable latch normally holding the outer end of said link and said switch arm in closed position, current responsive means for causing release of said latch, and tripping means actuated upon release of said latch applying a force to and positively moving said link and the switch arm toward open position.

16. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, said link when moved laterally at said outer end in one direction moving to a position generally perpendicular to the switch arm to hold the switch arm in closed position against the bias of said spring means, a solenoid having a plunger movable along an axis extending generally laterally of said link, said solenoid when energized moving said outer end of the link and moving said switch arm to the closed position, a combined latch and tripping member having one arm normally holding the outer end of said link and another arm for moving the outer end of said link, biasing means for moving said combined latch and tripping member, and current responsive means for causing movement of said combined latch and tripping member by said biasing means to release the latch and positively initiate movement of said link and switch arm toward open position.

17. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, said link when moved laterally at said outer end in one direction moving to a position generally perpendicular to the switch arm to hold the switch arm in closed position against the bias of said spring means, a solenoid having a plunger movable along an axis extending generally laterally of said link, said solenoid when

energized moving said outer end of the link and moving said switch arm to the closed position, a movable tripping member biased to move in tripping direction, a latch normally holding said tripping member against its bias, current responsive means for causing release of said latch, and said tripping member upon release of said latch applying a force to and positively moving the outer end of said link in a direction laterally thereof and thus moving the switch arm toward open position, and means actuated when said solenoid is energized to engage the tripping member and return it against its bias to position where it is held by said latch.

18. A circuit breaker comprising: separable contacts, a switch arm carrying one of said contacts and movable between a closed and an open position to cause engagement and disengagement of the contacts, spring means biasing said switch arm to move to open position, a link pivoted at one end to the switch arm and having its outer end movable in a direction generally laterally of the length of the link, said link when moved laterally at said outer end in one direction moving to a position generally perpendicular to the switch arm to hold the switch arm in

closed position against the bias of said spring means, a solenoid having a plunger movable along an axis extending generally laterally of said link, said solenoid when energized moving said outer end of the link and moving said switch arm to the closed position, a movable tripping member biased to move in tripping direction, a latch normally holding said tripping member against its bias, current responsive means for causing release of said latch, and said tripping member upon release of said latch applying a force to and positively moving the outer end of said link in a direction laterally thereof and thus moving the switch arm toward open position, means actuated when said solenoid is energized to engage the tripping member and return it against its bias to position where it is held by said latch, and contacts actuated upon energization of said current responsive means to deenergize said solenoid.

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