July 18, 1950 J. D. FINDLEY, JR., ET AL 2,515,994

OPERATING MECHANISM FOR CIRCUIT BREAKERS

Filed Dec. 13, 1946 2 Sheets-Sheet 1

Fig. 1.

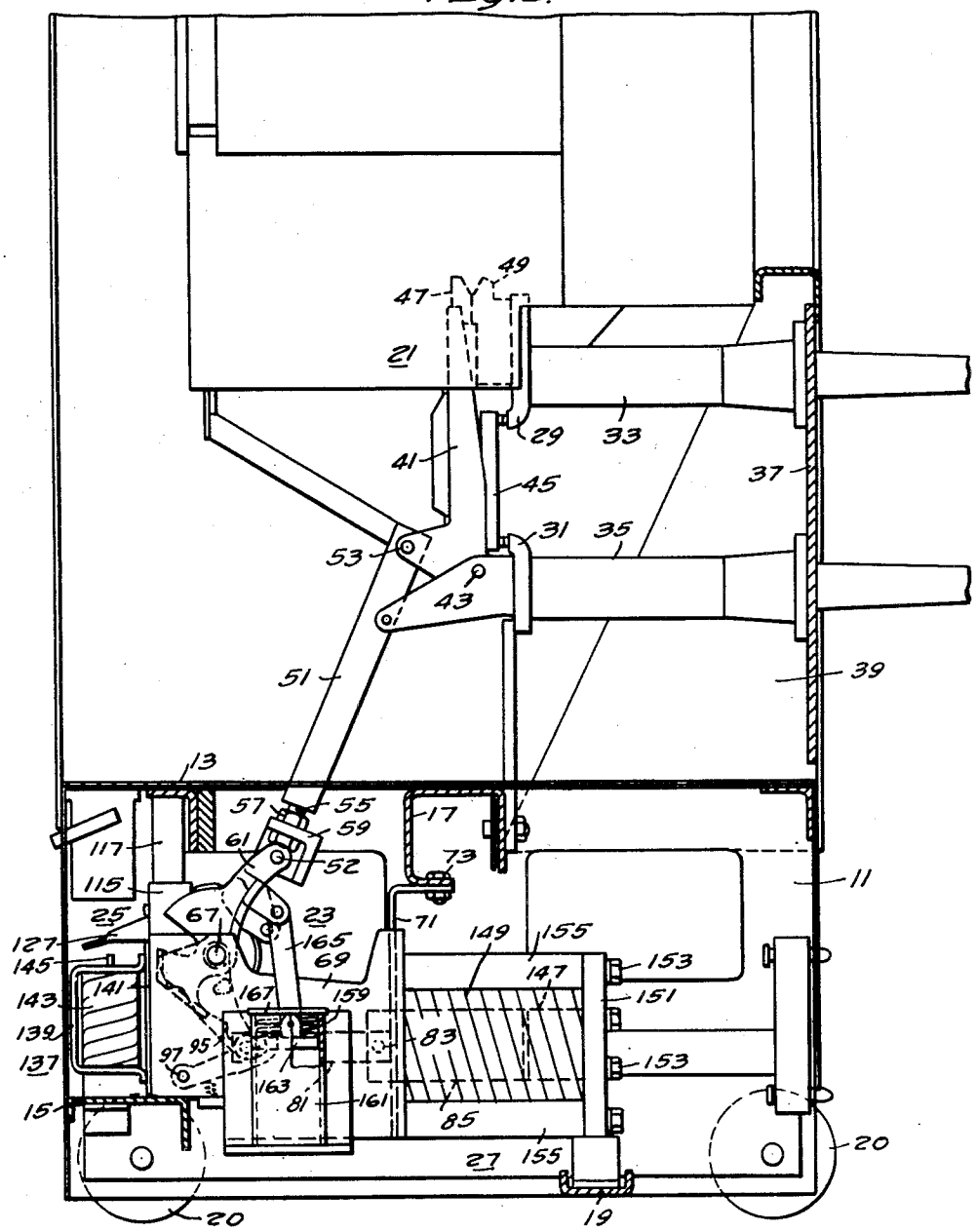

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Fig. 2.

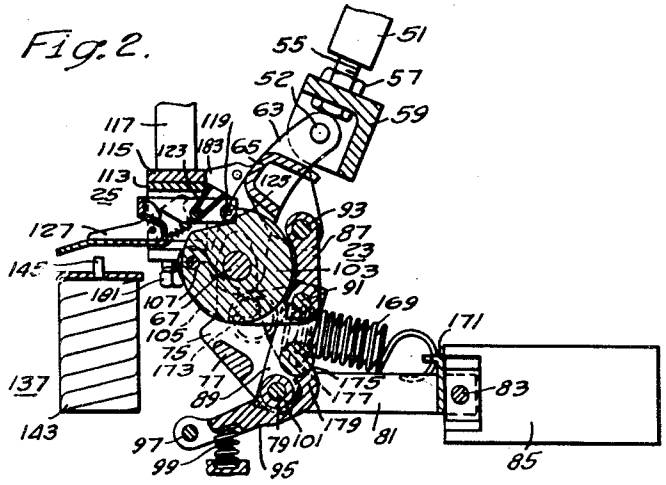


Fig. 3.

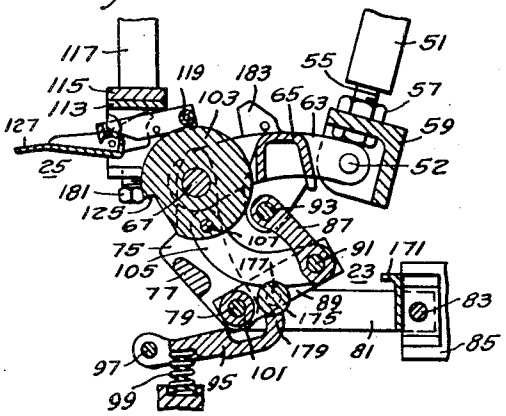


Fig. 4.

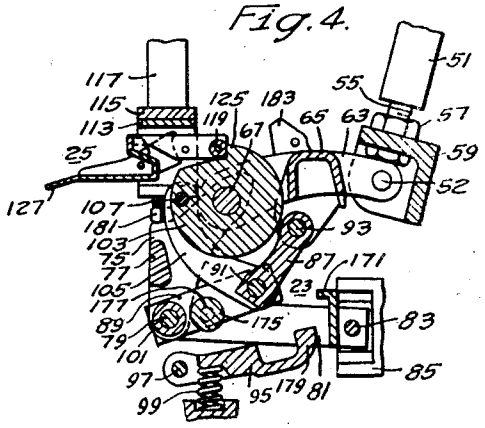
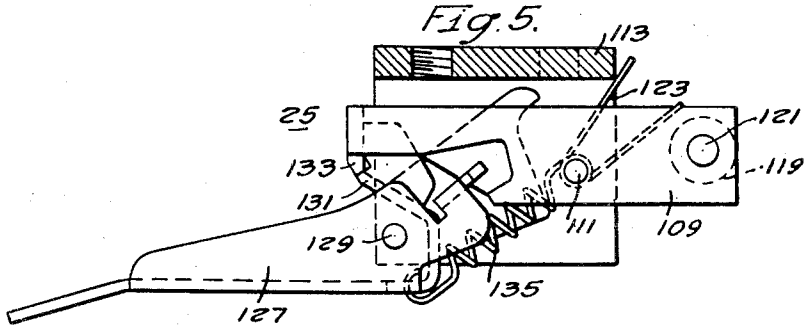


Fig. 5.



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OPERATING MECHANISM FOR CIRCUIT BREAKERS

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8 Claims. (Cl. 200—89)

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This invention relates to circuit breakers and more particularly to operating mechanisms for circuit breakers.

An object of the invention is to provide a circuit breaker with an improved high-speed operating mechanism wherein the breaker contact means are trip-free of the closing means.

Another object of the invention is to provide a circuit breaker with an improved operating mechanism having a few parts, the elements of which are arranged in compact form to improve the efficiency of operation.

Another object of the invention is to provide a circuit breaker with an improved operating mechanism which is simple in construction, reliable and efficient in operation and inexpensive to manufacture.

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

Fig. 1 is a side elevational view, partly in section, of a circuit breaker embodying the principles of the invention;

Fig. 2 is a detailed sectional view taken through the operating mechanism showing the mechanism in the closed circuit position.

Fig. 3 is a sectional view similar to Fig. 2 but showing the operating mechanism in the tripped position just before the mechanism is reset;

Fig. 4 is a sectional view taken through the operating mechanism showing the mechanism in the automatically reset position; and

Fig. 5 is an enlarged detail view of the latching mechanism.

Referring to Fig. 1 of the drawings, the circuit breaker is of the roll-out type and is mounted on a truck comprising a pair of side plates 11 (only one being shown) which are rigidly joined by cross members 13, 15, 17 and 19 to form a rigid framework for supporting the circuit breaker. The truck is mounted on wheels 20 to facilitate rolling the circuit breaker into and out of a cubicle in order to connect and disconnect the breaker in an electrical circuit.

The circuit breaker is of the multi-pole type (only one pole being shown) and comprises a plurality of pairs of separable contact means (only one pair being shown) indicated generally

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at 21, a common operating mechanism indicated at 23, a trip device 25 and a closing means 27.

The contact means comprises stationary contacts 29 and 31 mounted respectively on terminal members 33 and 35 which are, in turn, rigidly supported on a back plate 37. The back plate 37 is rigidly supported by angular brackets 39 (only one being shown) rigidly secured to the side plates 11 of the truck. A switch arm 41 pivotally mounted at 43 on the terminal member 35 carries a bridging contact member 45 for cooperating with the stationary contacts 29 and 31 to open and close the circuit. The switch arm also carries a movable arcing contact 47 which cooperates with a stationary arcing contact 49 mounted on the terminal 33 for drawing an arc upon opening movement of the switch arm 41.

The switch arm 41 for each pole of the breaker is operatively connected by means of an insulating operating rod 51 to the operating mechanism 23. The upper end of the rod 51 is pivotally connected by means of a pivot pin 53 to the switch arm 41 and the lower end of the rod 51 is connected by means of a screw 55 and a lock nut 57 to an angular cross bar 59 common to all of the poles of the breaker. The cross bar 59 is pivotally connected by means of pivot pins 52 at its ends to an operating lever comprising a pair of spaced levers 61 (Fig. 1) and 63 (Figs. 2, 3 and 4). The operating levers 61 and 63 are rigidly connected by an integral U-shaped cross member 65 and are pivotally supported on a shaft 67. The shaft 67, in turn, is mounted in the side members of a generally U-shaped frame 69 (Fig. 1) supported on the cross members 13, 15 and 17, the right hand end of the frame 69 being secured to a bracket 71 which is secured by means of bolts 73 to the cross member 17.

In addition to the operating lever 63, the operating mechanism comprises a closing lever 75 (Figs. 2, 3 and 4) also pivotally mounted on the shaft 67. The closing lever 75 comprises a pair of spaced levers (only one being shown) rigidly connected by an integral cross bar 77. The closing lever 75 is connected by means of a pivot pin 79 to one end of a link 81 a pair of spaced links which has its other end connected by means of a pin 83 to the movable armature 85 of the closing solenoid 27 (Fig. 1). The operating lever 63 and the closing lever 75 are operatively connected by means of a thrust transmitting toggle comprising toggle links 87 and 89 pivotally connected together by means of a knee pivot pin 91. The toggle link 87 is pivotally connected to the operating lever by means of a pivot pin 93 and the toggle link 89

which comprises a pair of spaced parallel links is pivotally connected by means of the pivot pin 79 to the closing lever 75. The closing lever 75 is held in closed position (Fig. 2) by means of a latch 95 pivotally mounted on a rod 97 supported in the side members of the frame 69 (Fig. 1). The latch 95 is biased by means of a spring 99 to latching position wherein a shoulder formed by a recess therein engages a roller 101 mounted on the pin 79.

The toggle 87—89 is normally held in a slightly underset position by means of a latch member 103 pivotally mounted on the shaft 67 and connected to the knee of the toggle by means of a pair of links 105 (only one being shown). The links 105, disposed one on each side of the latch member 103, have one end pivotally connected by means of a pivot pin 107 to the latch member 103 and the other end connected to the knee pin 91 of the toggle 87—89. The latch member 103 is normally releasably restrained in latching position by means of the latching and tripping mechanism 25 which is more clearly shown in Fig. 5.

The latching and tripping mechanism comprises a U-shaped trip member 109 pivoted on a pivot pin 111 mounted in the side members (only one being shown) of a U-shaped bracket 113. The bracket 113 is rigidly secured to a bracket 115 which, in turn is rigidly secured to the side members of the frame 69. The bracket 115 is also secured to the cross members 13 (Fig. 1) by means of spacers 117. The trip member 109 carries a latch roller 119 pivoted on a pin 121 in the side member of the trip member, which roller is biased by means of a spring 123 into engagement with a shoulder 125 on the latch member 103 to restrain this member and the toggle 87—89 in the closed or thrust transmitting position.

The trip member 109 is so constructed that it will not, of itself, restrain the latch member 103 against releasing operation. For this reason a trigger latch comprising a channel-shaped latch member 127 is provided. The latch member 127 is pivotally supported on a pin 129 mounted in the U-shaped bracket 113 and is provided with a latching projection 131 which normally engages a latching projection 133 on the trip member 109 to restrain the roller 119 in latching engagement with the shoulder 125 on the latch member 103. The latch member 127 is biased by means of a spring 135 to latching position and is adapted to be operated either manually or automatically to unlatching position to effect release of the operating mechanism and opening of the circuit breaker by means of a tripping electromagnet indicated generally at 137 (Figs. 1 and 2).

The tripping electromagnet comprises a yoke member 139 (Fig. 1) secured to a plate 141 rigidly mounted on the left-hand end of the U-shaped frame 69. In addition to the yoke member 139, the tripping electromagnet includes an energizing coil 143, a movable armature (not shown) and a trip rod 145 attached to the movable armature.

The closing solenoid 27 (Fig. 1), in addition to the movable armature 85, also comprises a fixed core member 147 and an energizing coil 149. The closing solenoid 27 is supported between the frame 69 (Fig. 1) and an end plate 151 which is secured to the frame 69 by means of bolts 153 and spacers 155.

Referring particularly to Fig. 2 of the drawings, the operating mechanism is shown in the closed and latched position. In the closed position, the operating lever 61—63 (Figs. 1 and 2) is biased in a clockwise or opening direction by means of a coil spring 159 disposed in a cylinder 161 (Fig. 1) rigidly mounted on the frame 69. A piston 163 disposed for reciprocal movement in the cylinder is connected by means of a link 165 to the arm 61 of the operating lever and the spring 159 is compressed between the piston 163 and a plate 167 secured to the upper end of the cylinder. The cylinder 161 and the piston 163 also serve as a dash pot to absorb the shock of the final opening movement of the operating mechanism. The spring 159 acting through the piston 163 and the link 165 biases the operating lever 61—63 in a clockwise direction. The biasing force of the spring 159 is transmitted by means of the underset toggle 87—89 to the closing lever 75 which is normally restrained in the position shown in Fig. 2 by the latch 95. The force of the spring 159, therefore, tends to cause the toggle 87—89 to collapse toward the right (Fig. 2) which is prevented by the link 105 and the latching mechanism. A component of the force tending to collapse the toggle 87—89 is applied through the link 105 to the latch member 103 tending to rotate this member in a counterclockwise direction. The latch member 103 is restrained from tripping rotation by the slip-off type latch 119—125 and this latch, in turn, is restrained by the latch 131—133 (Fig. 5).

Upon the occurrence of an abnormal condition, such for instance as an overload current in the circuit controlled by the breaker, the tripping electromagnet 137 (Figs. 1 and 2) is energized by well known means such, for instance, as a fault relay. When the tripping electromagnet is energized, the movable armature (not shown) thrusts the trip rod 145 upwardly to engage and operate the trip member 127 in a clockwise or tripping direction. Clockwise movement of the latch member 127 disengages the latch projection 131 from the latch projection 133 to unlatch the trip member 109. When this occurs, the force tending to collapse the toggle 87—89, a component of which is applied to the latch member 103, forces the roller latch 119 out of the path of counterclockwise movement of the shoulder 125 whereupon the latch member 103 is free to rotate in tripping direction and no longer maintains the toggle 87—89 in its underset position. Upon release of the latch member 103, the toggle 87—89 immediately collapses under the influence of the spring 159 which immediately rotates the operating lever 61—63 to the position in which it appears in Fig. 3 to effect opening of circuit breaker contacts.

The toggle 87—89 is reset to its underset position and the latch member 103 is reset and relatched during the opening operation. The resetting of the toggle 87—89 and relatching of the latch member 103 is effected by means of a pair of springs 169 (only one being shown) tensioned between a bracket 171 secured to the armature 85 of the closing solenoid and projections 173 on the closing lever 75. During the collapse of the toggle 87—89, a roller 175 mounted on a pin 177 supported between the links comprising the toggle link 89 engages a projection 179 of the latch 95 and moves the latch downward to release the closing lever 75. The closing lever 75 is pivoted for rotary movement and is connected at 79 to the link 81 forming a toggle therewith. The springs 169 are tensioned between the lever 75 and link 81 and urge these members together to

decrease the obtuse angle therebetween. This movement can be effected only by movement of the link 81 to the left which is normally prevented by the latch 95. Upon release of the latch 95, there is no longer any restriction to this movement of link 81 and the springs 169 act to move the link 81 to the left rotating the lever 75 clockwise until it strikes a stop stud 181. Clockwise rotation of the lever 75 straightens the toggle 87—89 and moves the armature 85 to the left to its unattracted position. Straightening of the toggle 87—89 thrusts the link 105 to the left thereby rotating the latch member 103 clockwise to its latching position at which time the trip member 109 is moved by the spring 123 to reengage the roller 119 with the shoulder 125 and the spring 135 reengages the latch 131 with the latch 133. The parts are shown in the reset and relatched position in Fig. 4.

After the mechanism is reset and relatched following an automatic opening operation, the contacts are closed by energization of the closing solenoid 27. The solenoid 27 may be energized from any suitable source either automatically or by means of a manually operated switch means. When energized, the solenoid 27 attracts its armature 85 and through the link 81 rotates the closing lever 75 in a counterclockwise direction about the shaft. Since, at this time, the latch member 103 is restrained in latched position, the toggle 87—89 is held by the link 105 in thrust transmitting position. The counterclockwise or closing movement of the closing lever 75 is, therefore, transmitted through the toggle 87—89 to the operating lever 61—63 to rotate the operating lever counterclockwise to its closed position to operate the switch arms 41 for all of the poles of the breaker to closed position. As the operating mechanism arrives at its closed position, the latch, 95, urged by the spring 99, reengages the latch roller 101 to restrain the operating mechanism and the contact means in the closed position. The final closing movement of the operating mechanism is retarded by the spring 159 which is compressed during the latter portion of the closing operation, the operating mechanism being finally arrested in the fully closed position by the movable armature 85 of the closing solenoid striking the stationary core 147. The toggle compressing the operating lever 61—63 and the rods 51 is prevented from going over center to the left of a line drawn through the pivots 53—67 by means of a projection 183 on the operating lever engaging the bracket 115.

The contact means of the breaker are trip-free of the closing means. That is, if, when the circuit breaker is operated to the closed position, the overload current condition has been cleared the breaker will remain in the closed contact position. However, should the overload current still persist the tripping electromagnet 137 will be energized upon closure of the contacts and operate the trip mechanism 25 in the previously described manner to effect immediate release of the latch member 103 and collapse of the toggle 87—89. This permits the breaker mechanism, including the switch arms 41 for all of the poles of the breaker, to go to the open position even though the closing solenoid 27 remains energized, or irrespective of the position of the closing lever 75. During such a trip-free operation, the collapse of the toggle 87—89 causes the roller 175 to engage and move the latch 95 to unlatching position. If, at this time, the closing solenoid 27 is still energized the mechanism will be held in

the Figure 3 position, but, upon deenergization of the closing solenoid, the springs 169 will immediately reset the parts to the Figure 4 position causing the latch member 103 to be relatched preparatory to a subsequent closing operation.

From the foregoing description it will be apparent that there is provided an extremely compact circuit breaker operating mechanism comprising relatively few parts and wherein all of the main elements of the operating mechanism are mounted on a common shaft.

Having described the invention in accordance with the patent statutes, 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.

We claim as our invention:

1. In a circuit breaker comprising relatively movable contact means, operating means for said contact means comprising an operating lever operable to effect opening of said contact means, a closing lever for operating said operating lever to close said contact means, thrust transmitting means connecting said levers, releasable means normally restraining said thrust transmitting means in thrust transmitting position, a single pivot upon which said operating lever, said closing lever and said releasable means are concentrically pivoted, and trip means operable in response to overload currents to release said releasable means to thereby cause collapse of said thrust transmitting means and opening of said contact means.

2. In a circuit breaker comprising relatively movable contact means, operating means for said contact means comprising an operating lever operable to effect opening of said contact means, a closing lever operable to close said contact means, a single shaft pivotally supporting both of said levers, a thrust transmitting toggle operatively relating said levers, a releasable member also pivotally mounted on said shaft but independently of said levers, means operatively relating said toggle and said releasable member to normally maintain said toggle in thrust transmitting position, and trip means operable to release said releasable means to thereby permit collapse of said toggle and opening of said contact means.

3. In a circuit breaker comprising relatively movable contact means, operating means for said contact means comprising an operating lever operatively related to said contact means and operable to effect opening of said contact means, a closing lever for actuating said operating lever to close said contact means, a shaft pivotally supporting said levers, latch means releasably restraining said closing lever in closed position, a thrust transmitting toggle operatively relating said levers, a releasable member pivoted on said shaft for restraining said toggle in thrust transmitting position, trip means operable to release said releasable member to permit collapse of said toggle and opening of said contact means, and means operable upon collapse of said toggle to cause said latch means to release said closing lever to thereby reset said toggle to thrust transmitting position.

4. In a circuit breaker comprising relatively movable contact means, operating mechanism for said contact means comprising an operating lever operable to effect opening of said contact means, a closing lever for operating said operating lever to close said contact means, thrust transmitting

means operatively relating said levers, a releasable member normally restraining said thrust transmitting means in thrust transmitting position, a single shaft upon which both of said levers and said releasable member are concentrically pivoted, trip means operable to release of said releasable means to thereby effect collapse of said thrust transmitting means and opening of said contact means, means operable by said thrust transmitting means upon collapse thereof for effecting resetting of said thrust transmitting means to thrust transmitting position, and power means for operating said levers to close said contact means.

5. In a circuit breaker comprising relatively movable contact means, operating mechanism for said contact means comprising an operating member operable to effect opening of said contact means, a closing member for operating said operating member to close said contact means, common pivot means for pivotally supporting said operating member and said closing member, thrust transmitting means operatively relating said operating member and said closing member, releasable means pivoted on said common pivot means for normally restraining said thrust transmitting means in thrust transmitting position, and trip means operable to release said releasable means to cause said thrust transmitting means to permit opening movement of said operating member and said contact means.

6. In a circuit breaker comprising relatively movable contact means, power operating means for actuating said contact means to closed position comprising a closing lever, power means for actuating said closing lever, an operating lever operatively related to said contact means, a pivot common to both of said levers for pivotally supporting said lever for independent movement, a thrust transmitting toggle operatively relating said closing lever and said operating lever for transmitting the movement of said closing lever to said operating lever to close said contact means, latch means pivoted on said common pivot releasably restraining said toggle in thrust transmitting position, and trip means operable to effect release of said toggle and opening of said contacts irrespective of the position of said closing lever.

7. In a circuit breaker comprising relatively movable contact means, operating mechanism for said contact means comprising a pivoted member

operatively related to said contact means and operable to effect opening of said contact means, a pivoted closing member, a pivot common to both of said members for pivotally supporting said members, power means for actuating said closing member, a thrust transmitting toggle operatively relating said operating member and said closing member for normally restraining said operating member in closed position, and means pivoted on said common pivot independently of said members for causing said toggle to permit opening movement of said operating member irrespective of the position of said closing member.

8. In a circuit breaker comprising a movable switch member biased to open circuit position, operating mechanism therefor comprising an operating lever movable about a fixed pivot and operatively related to said movable switch member, a closing lever movable about said fixed pivot, an operating toggle operatively relating said levers, a first holding means also movable about said fixed pivot for releasably holding said operating toggle in an underset position to hold said movable switch member in closed position, a second holding means for holding said closing lever in closed positions, trip means operable in response to overload currents for causing said first holding means to release said operating toggle to thereby permit opening movement of said operating lever and said movable switch member, means on said toggle operable during an opening movement thereof for actuating said second holding means to effect release of said closing lever, and means for operating said closing lever to reset said toggle and said first holding means.

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