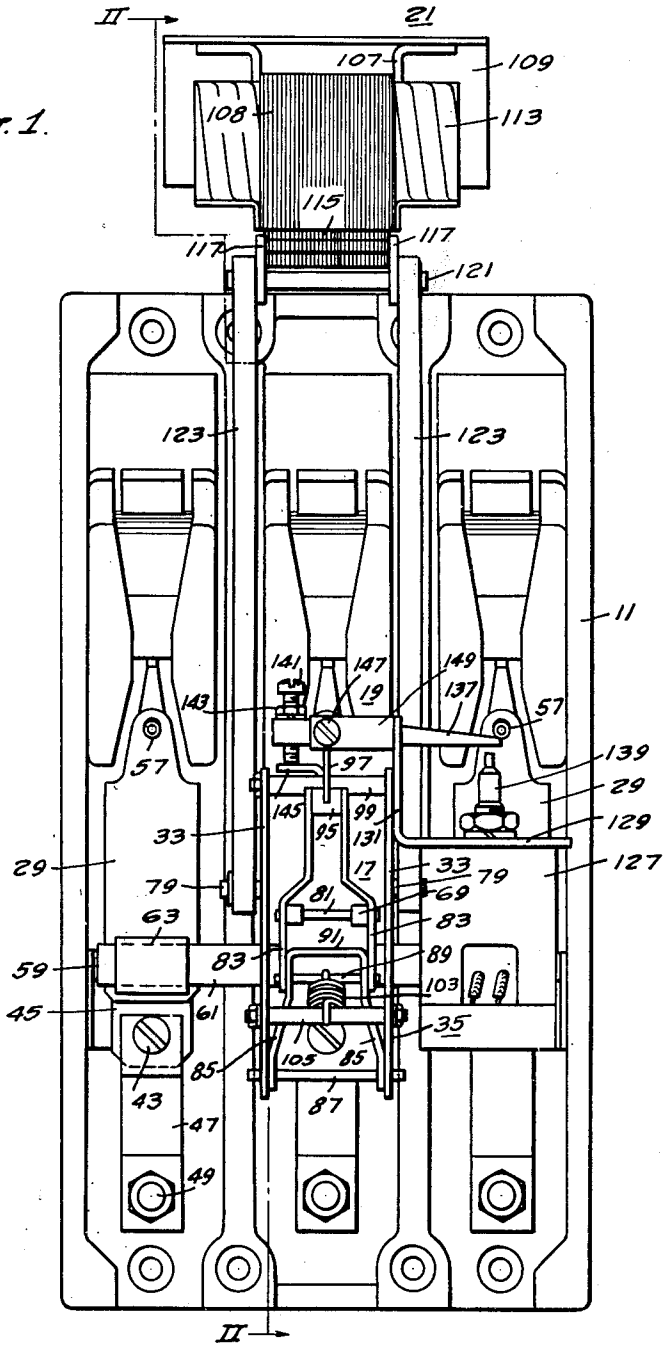
Nov. 20, 1951 G. G. GRISSINGER ET AL 2,575,709

CIRCUIT BREAKER

Filed Oct. 30, 1946 2 SHEETS—SHEET 1

Fig. 1.



WITNESSES:

E. A. McCaskey

Paul H. Harkins.

INVENTORS

George G. Grissinger and

Bernard G. Tremblay.

BY

Walter E. Mueller

ATTORNEY

Nov. 20, 1951 G. G. GRISSINGER ET AL 2,575,709

CIRCUIT BREAKER

Filed Oct. 30, 1946 2 SHEETS—SHEET 2

Fig. 2.

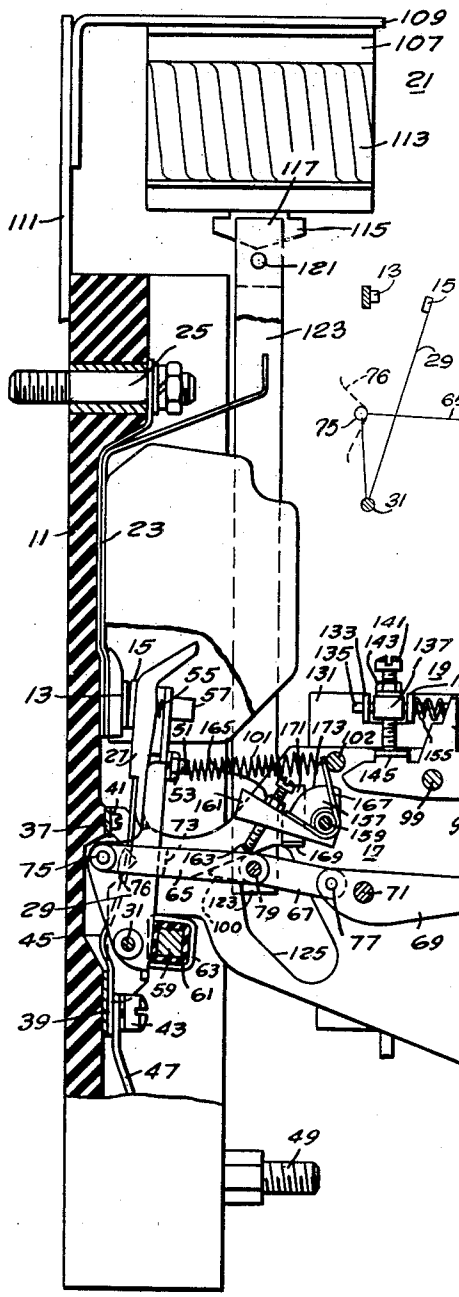
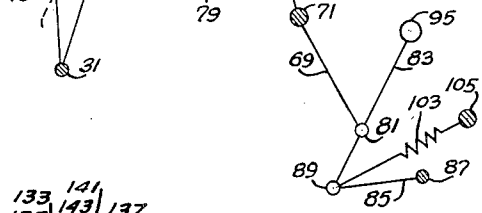


Fig. 3.



WITNESSES:

E. A. McCloskey.

Paul O. Harlow.

INVENTORS

George G. Grissinger and

Bernard G. Tremblay.

BY

Walter E. Mueller

ATTORNEY

Patented Nov. 20, 1951

2,575,709

UNITED STATES PATENT OFFICE

2,575,709

CIRCUIT BREAKER

George G. Grissinger and Bernard G. Tremblay, Wilkinsburg, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 30, 1946, Serial No. 706,736

15 Claims. (Cl. 200—109)

1

The invention relates to circuit breakers and, more particularly, to the type of circuit breaker used for controlling and protecting alternating-current network distribution circuits.

In order to provide for tripping over a wide voltage range of circuit breakers used as network protectors, sensitive trip means having very light trip loads are utilized to trip the circuit breaker. When closing such circuit breakers by means of an alternating-current solenoid, trouble has been experienced due to the shock produced by the speed and sudden force with which the alternating-current solenoid operates its armature causing the light-load latch mechanism to move to unlatching position thereby effecting false opening of the breaker.

It is an object of this invention to provide an improved circuit breaker having a solenoid closing mechanism and a light-load trip means with means for preventing operation of the trip mechanism in response to shock produced by the closing mechanism.

Another object of the invention is to provide an improved circuit breaker having a light-load trip means and a solenoid closing means with means set in motion by the closing mechanism and operable when set in motion to prevent tripping operation of the trip means in response to shocks produced by the closing means.

Another object of the invention is to provide an improved circuit breaker having a light-load latch means and a solenoid operated closing means with means comprising means set in motion by the closing means and operable when set in motion to prevent tripping movement of the latch means for a predetermined time interval in response to sudden shocks produced by the closing means.

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 an embodiment thereof when read in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of a three-pole circuit breaker embodying the principles of the invention.

Fig. 2 is a vertical sectional view taken substantially along line II—II of Fig. 1.

Fig. 3 is a single line diagram showing the mechanism in the tripped position, just before the main toggle has collapsed and the mechanism has been reset.

Referring to the drawings, the circuit breaker is of the three-pole type and comprises, generally, a base 11 of molded insulating material, stationary contact means 13 and movable contact

2

means 15 for each pole, a common operating mechanism indicated generally at 17, a trip device 19 and a solenoid closing means 21.

The stationary contact 13 for each pole is secured to a conductor 23 which, in turn, is rigidly secured to the base 11 by suitable means (not shown). The conductor 23 extends upwardly from the contact 13 and is secured at its upper end to the inner end of a bolt 25 which extends through the base 11 to form a terminal connector for connecting the breaker in an electrical circuit. The movable contact 15 for each pole is secured to a contact member 27 which is loosely mounted on a channel-shaped switch arm 29 pivotally mounted on a pivot pin 31. The pivot pin 31 is mounted in the two side members 33 of a U-shaped main frame 35 which is mounted on and projects outwardly from the central portion of the base 11. Cross members 37 and 39 integrally connecting the side members 33 ad acent the base 11 are secured to the base by means of screws 41 and 43. The contact member 27 is connected to a flexible shunt conductor 45 having its lower end secured to the base 11 and to the upper end of a conductor 47 by means of the screw 43. The lower end of the conductor 47 is secured to the inner end (not shown) by a bolt 49 secured to the base 11 and extending forwardly therefrom to form a terminal connector.

The contact member 27 is mounted on the channel-shaped switch arm 29 by means of a bolt 51 threadedly engaging an opening in the switch arm and locked in place by means of a lock nut 53. The bolt 51 is provided with a head (not shown) which is engaged in a flanged recess (also not shown) in the contact member to loosely support the contact member. A spring 55 seated in a spring seat 57 and compressed between the spring seat and the contact member provides contact pressure when the contacts are closed.

It will be understood that there is a stationary contact 13, movable contact 15, contact member 27 and channel-shaped switch arm 29 provided for each of the three poles of the breaker. Only the switch arm 29 for the center pole is mounted on the pivot pin 31 but all of the switch arms are connected together for unitary movement to simultaneously move all of the switch arms to open and closed positions. The means for connecting the switch members comprises a metal tie bar 59 which extends across all of the switch members adjacent the pivot pin 31. A sheath 61 of insulating material surrounds the tie bar 59 to insulate the several switch arms from each other. The tie bar is secured to each of the switch arms by means of metal clamps 63 which surround the insulating sheath 61 and are clamped to the switch arms.

The operating mechanism 17 comprises a main

toggle consisting of toggle links 65 and 67 and a lever 69 pivotally mounted on a fixed pivot pin 71 supported in the side members 33 of the main frame. The toggle link 65 comprises a pair of spaced parallel links joined by an integral cross member 73. The two legs of the toggle link 65 straddle the switch arm 29 for the center pole of the breaker and are pivotally connected to the sides of the switch arm by means of a pivot pin 75 the ends of which extend laterally beyond the frame members 33 to limit the opening movement of the switch arm 29 by engagement with the frame members. One end of the toggle link 67 is pivotally connected by means of a pin 77 to the inner end of the lever 69 and the toggle links 65 and 67 are pivotally connected together by means of a knee pivot pin 79.

The outer end of the lever 69 is pivotally connected by means of a pin 81 to a tripping toggle comprising toggle links 83 and 85. The lower end of the toggle link 85 is pivoted on a fixed pivot comprising a pin 87 supported in the side member 33 of the main frame 35. The toggle links 83 and 85 are pivotally connected together by means of a knee pivot pin 89.

Reference to Fig. 1 discloses that the toggle link 85 comprises spaced links connected at their upper ends by an integral cross member 91, also that the toggle link 83 comprises spaced links joined at their upper ends by means of a pin 93 upon which is mounted a latch roller 95 which is engaged by a latch member 97 pivoted on a fixed pivot pin 99 supported in the main frame.

Referring to Fig. 2, it will be seen that the main toggle 65—67 is overcenter above a line drawn through the center of the pins 75, 71, the overcenter position of the toggle being limited by a projection 100 of the link 67 engaging the cross member 73 of the link 65. Thus the switch arm 29, which is biased in a clockwise direction by means of springs 101 tensioned between the switch arm and a rod 102 supported in the main frame, and the main contact springs 55, acts through the toggle 65—67 to bias the lever 69 also in a clockwise direction about its pivot 71. Such clockwise movement of the lever 69 is normally prevented by the tripping toggle 83—85. The tripping toggle is slightly underset to the left of a line drawn through the centers of pins 81, 87. The force of the springs 101 and 55 is applied through the main toggle 65—67 and the lever 69 to the tripping toggle in a downward direction urging collapse of the tripping toggle 83—85. In order that the tripping toggle may collapse, it is necessary that the link 85 rotate counterclockwise about the fixed pivot 87 and the link 83 rotate clockwise about the pivot 81 on the lever 69. Since the tripping toggle 83—85 is underset to the left of the line 81—87, the clockwise bias of the lever 69 by the springs 101 biases the link 85 of the tripping toggle in a counterclockwise direction about its pivot 87 and biases the link 83 of the tripping toggle in a clockwise direction about the pivot pin 81 on the lever 69. Collapse of the tripping toggle 83—85 is normally prevented by engagement of the latch 97 with the latch roller 95.

Upon operation of the trip device 19 in response to predetermined abnormal conditions in the circuit of any one of the three poles, the latch member 97 is operated to unlatching position, whereupon the springs 101 and 55 act through the switch arm 29 and the main toggle 65—67 and lever 69, to effect immediate collapse of the tripping toggle 83—85 and opening of the contacts 13—15. During the opening movement, the pin 75 connecting the toggle link 65 to the switch arm 29 is arrested by striking a portion 76 of the frame 35. This removes the biasing force of the spring 101 from the main toggle 65—67 and from the lever 69. When this occurs the main toggle 65—67 collapses overcenter below the line through 75, 77 and the weight of the parts aided by a spring 103 tensioned between the knee pin 89 of the tripping toggle and a rod 105 supported in the main frame, quickly resets and relatches the tripping toggle and rotates the lever 69 counterclockwise to the position shown in Fig. 2 in preparation for a contact closing operation.

The contacts are closed by means of the solenoid 21 which may be energized by suitable control means (not shown) connected across two phases of the three-phase alternating-current circuit controlled by the breaker. The solenoid 21 is mounted by means of brackets 107 secured to the fixed core member 108 (Fig. 1) of the solenoid and to an angle bracket 109 which, in turn, is secured to a plate 111. The plate 111 may be secured to the base 11 of the breaker or to the mounting structure (not shown) upon which the circuit breaker is rigidly supported. The solenoid 21 comprises the fixed core member 108, an energizing coil 113 and an operating armature 115. A pair of ears 117 one disposed on each side of the armature are secured thereto by any suitable means preferably by welding.

The ears 117 are pivotally connected, by means of a pivot pin 121, to the upper ends of a pair of closing links 123. The closing links 123 extend downwardly beside the frame members 33 of the main frame and have their lower ends connected to the knee pin 79 of the main toggle, the knee pin 79 extending laterally through clearance openings 125 (only one being shown) in the side members 33 of the main frame.

After the circuit breaker has been tripped open and the tripping toggle reset and relatched in the previously described manner, the circuit breaker may be closed by energization of the solenoid 21 which may be effected by any suitable means (not shown). When energized, the solenoid 21 attracts its armature 115 and through the links 123 pulls the knee pin 79 of the main toggle upwardly. Since, at this time, the lever 69 including the pivot pin 77 is held in a fixed position by the tripping toggle 83—85 and the latch 97, the force applied by the solenoid to straighten the main toggle 65—67 operates the switch arm 29 to simultaneously close the contacts of all of the poles of the breaker.

The trip device 19 comprises a tripping solenoid 127 (Fig. 1) which may be energized preferably by low voltage current through suitable control means (none being shown) upon the occurrence of predetermined abnormal conditions such as a phase-to-phase or phase-to-ground fault involving any one or more of the phase circuits controlled by the breaker. The solenoid 127 is rigidly supported by an angle bracket 129 having one leg 131 rigidly secured as by welding to one of the side members 33 of the main frame 35. Secured to the leg 131 of the bracket 129 is a pair of spaced arms 133 (Fig. 2) which between them support a pivot pin 135 upon which is pivotally mounted a trip lever 137 the right-hand end (Fig. 1) of which lies above a trip rod 139 adapted to be thrust upwardly by the armature (not shown) of the tripping solenoid 127. The left-hand end (Fig. 1) of the trip lever 137 carries an adjusting screw 141

which is locked in its adjusted position by a lock nut 143. The lower end of the adjusting screw 141 is adapted to engage an ear 145 formed laterally from the latch member 97.

The latching position of the latch member 97 is adjustable by means of an adjusting screw 147 mounted in an arm 149 of the bracket 129 and locked in its adjusted position by a lock nut 151. A projection 153 of the latch member 97 is biased against the end of the screw 147 by means of a spring 155 compressed between one of the arms 133 and the projection 153.

When the tripping solenoid 127 (Fig. 1) is energized the trip rod 139 is thrust upwardly and engages and rocks the trip lever 137 counterclockwise about its pivot 135, causing the screw 141 to rock the latch member 97 also in a counterclockwise direction (Fig. 2) This action releases tripping toggle 83—85 which collapses and effects opening of the breaker as previously set forth.

The speed and sudden force with which an alternating-current solenoid when energized picks up and operates its armature is common knowledge. The sudden force with which the alternating-current solenoid picks up and starts the movement of the armature and the operating mechanism in closing direction creates a shock of sufficient magnitude to start the light-load latch in releasing or tripping direction. Also the sudden stopping of the armature and the operating mechanism, when they arrive at the closed circuit position, creates a very heavy shock to the framework and mechanism of the circuit breaker which, at times, results in moving the light-load latch member 97 to unlatching position, and since the circuit breaker is trip-free of the closing solenoid, causes false opening of the contacts. A desirable feature of circuit breakers for controlling and protecting network systems in relatively light-load density areas is to effect tripping out of the circuit breakers by the use of low-voltage current. This, however, necessitates the retention of the light-trip load tripping mechanism which is susceptible to actuation in response to the shock created by closing of the breaker.

In order to prevent tripping the breaker in response to the shock of the solenoid pick up and slam, means is provided which is set in motion by the closing mechanism during a closing stroke to prevent movement of the latch to unlatching position for a predetermined time interval immediately before and after the closing means is arrested in the closed position. This means comprises an unbalanced mass or weight 157 (Fig. 2) which is pivotally mounted on a rod 159 supported in the main frame 35. A projection 161 of the weight 157 carries an adjusting screw 163 which is locked in its adjusted position by means of a lock nut 165. The lower end of the screw 163 is biased into engagement with the main toggle 65—67 adjacent the knee thereof by means of a spring 167 coiled about the rod 159 and having one end bearing against the rod 102 and the other end hooked over the projection 161.

When the circuit breaker is tripped open and the main toggle 65—67 breaks overcenter below the line 75, 77 the spring 167 rotates the weight 157 counterclockwise until it is arrested by engagement with the angle portion 169 of a bracket 171 secured to one of the side members 33 of the frame. During a closing stroke of the closing mechanism, the toggle 65—67 strikes the screw 163 and rotates the weight 157 clockwise to move an arcuate surface 173 of the weight into the path of tripping movement of the latch member 97

thus blocking unlatching movement of the latch in response to the terminal shock of the closing mechanism when the armature 115 seats. The reaction of the latch member 97 to the starting shock of the solenoid is slower than the movement of the operating mechanism. If the latch member 97 starts in unlatching direction in response to the starting shock of the closing solenoid, it will not reach the unlatching position before the toggle 65—67 engages and drives the weight 157 toward its blocking position. The weight 157 will, therefore, engage the rounded end of the latch member and drive it back to latching position. The inertia of the mass or weight 157 causes it to continue its clockwise movement until the head of the screw 163 strikes the rod 102 whereupon the weight rebounds and moves counterclockwise to the position shown in Fig. 2. The time interval required for the weight 157 to complete its oscillation is sufficient not only to prevent unlatching movement of the latch 97 at the instant the armature seats, but also prevents unlatching in response to secondary or reactive shocks occurring within a predetermined time interval following completion of the closing movement of the mechanism.

Having described a preferred embodiment of the invention in accordance with the patent statutes, it is to be understood that various changes and modifications may be made in the particular embodiment disclosed without departing from some of the essential features of the invention.

We claim as our invention:

1. A circuit breaker comprising power operated means for closing the breaker, said power operated means causing a shock at the end of the closing operation, tripping means including a latch operable to effect automatic opening of the breaker, and means engaged and actuated by said closing means prior to the end of said closing operation to a position to block tripping operation of said latch during the terminal movement of said closing means.

2. A circuit breaker comprising power operated closing means for closing the breaker, said closing means causing a shock at the end of the closing stroke, tripping means including a latch operable to effect automatic opening of the breaker, and means actuated by said closing means near the end of the closing stroke and prior to the occurrence of said shock to block tripping operation of said latch for a predetermined time interval.

3. A circuit breaker comprising power operated closing means for closing said breaker, said closing means generating a shock at the end of the closing operation, tripping means including a latch operable to effect automatic opening of said breaker, and means engaged and actuated by said closing means before the end of the closing operation for blocking tripping operating movement of said tripping means in response to sudden shocks generated by the terminal movement of said closing means.

4. A circuit breaker comprising power operated means for closing said breaker, said closing means creating a shock at the end of the closing operation, tripping means operable to effect automatic opening of said breaker, and means comprising an unbalanced mass engaged by said closing means and moved to a position to block tripping operation of said tripping means during the terminal movement of said closing means and before the occurrence of said shock.

5. In a circuit breaker comprising power oper-

ated closing means for closing said breaker, said closing means generating a shock at the end of the closing stroke, tripping means operable to effect automatic opening of said breaker, and means comprising an unbalanced mass set in motion by said closing means near the end of the closing movement but before the occurrence of said shock and moved to a position to block tripping operating movement of said tripping means in response to sudden shocks or jarring forces generated by the terminal movement of said closing means.

6. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising an operating toggle and power operated closing means for operating said toggle to close said contacts, said closing means causing a shock at the end of the closing stroke, a tripping toggle releasably restraining said operating toggle, tripping means operable to release said tripping toggle to cause automatic opening of said contact means, and means engaged and moved by said operating toggle during a closing operation and before the occurrence of said shock to a position to block operation of said tripping means and prevent release of said tripping toggle during the terminal closing movement of said operating mechanism.

7. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising an operating toggle and power operated closing means for operating said toggle to close said contacts, tripping means including a latch releasably restraining said operating toggle, said tripping means being operable to release said operating toggle to cause automatic opening of said contact means, and means comprising an unbalanced mass engaged by said operating toggle during a closing operation but before the end of said operation and moved to a position to block releasing operation of said latch during the terminal closing movement of said operating mechanism.

8. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising an operating toggle and power operated means for actuating said toggle to close said contact means, tripping means comprising a tripping toggle releasably restraining said operating toggle in operative position, latch means releasably restraining said tripping toggle in restraining position, said tripping toggle being operable to release said operating toggle to thereby effect automatic opening of said contact means, and means engaged and actuated by said operating mechanism before the end of a closing operation to a position to oppose operation of said latch means for a predetermined time interval.

9. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising an operating toggle and power operated means for actuating said toggle to close said contact means, tripping means comprising a tripping toggle releasably restraining said operating toggle in operative position, latch means restraining said tripping toggle in restraining position, said tripping toggle being operable to release said operating toggle to thereby effect automatic opening of said contact means, and means comprising a mass engaged and set in motion by said operating mechanism before the end of a closing operation to prevent operation of said latch means for a predetermined time interval.

10. In a circuit breaker comprising relatively movable contact means, operating means therefor comprising a main operating toggle and power operated means for operating said main toggle to close said contact means, a second toggle releasably restraining said main toggle in operative position and operable to release said main toggle to effect automatic opening of said contact means, restraining means releasably restraining said second toggle in restraining position, means for operating said restraining means to release said second toggle, and means disposed to be engaged and actuated by said main toggle during a closing operation to prevent operation of said restraining means for a predetermined time interval.

11. In a circuit breaker comprising relatively movable contact means, operating means therefor comprising a main operating toggle and power operated means for operating said main toggle to close said contact means, a second toggle releasably restraining said main toggle in operative position and operable to release said main toggle to effect automatic opening of said contact means, restraining means releasably restraining said second toggle in restraining position, means for operating said restraining means to release said second toggle, and means comprising a mass engaged and set in motion by said main toggle during a closing operation to prevent operation of said restraining means for a predetermined time interval.

12. In a circuit breaker comprising relatively movable contact means, operating means therefor comprising a main toggle and power operated means for operating said main toggle to close said contact means, a second toggle releasably restraining said main toggle in operative position and operable to release said main toggle to effect automatic opening of said contact means, latch means releasably restraining said second toggle in restraining position, means for operating said latch means to release said second toggle, and means comprising an unbalanced mass engaged and set in motion by said main toggle during a closing movement to prevent operation of said latch means for a predetermined time interval.

13. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising a main toggle, power operated means for operating said main toggle to close said contact means, a tripping toggle releasably restraining said main toggle in operative position, a light-load latch member releasably restraining said tripping toggle in restraining position, tripping means actuating said light-load latch member to effect release of said tripping toggle, a pivoted mass, and means operable by said main toggle near the end of a closing operation for moving said mass into the path of tripping movement of said light-load latch member to thereby prevent tripping movement of said latch member in response to sudden shocks generated by the final closing movement of said mechanism.

14. In a circuit breaker comprising relatively movable contact means, operating mechanism therefor comprising a linkage, power operated means for operating said linkage to close said contact means, a toggle for releasably restraining said linkage in operative position, a light-load latch member for releasably restraining said toggle in restraining position, tripping means for actuating said light-load latch member to effect opening of said contact means, a

pivoted mass disposed to be moved to a position for blocking tripping movement of said latch member, and means on said linkage for engaging and moving said mass to blocking position near the end of a closing operation to prevent tripping movement of said latch in response to the shock of the closing operation.

15. In a circuit breaker comprising relatively movable contact means, operating mechanism for said contact means comprising a linkage, power operated means for operating said linkage to close said contact means, a light-load latch member for releasably restraining said linkage in operative position, tripping means for actuating said latch member to release said linkage and effect opening of said contact means, a pivoted member disposed to be moved to a blocking position for blocking movement of said latch member in tripping direction in response to the shock of the terminal closing movement of the operating mechanism, means on said linkage for engaging and moving said blocking member to blocking position, and adjustable

means for adjustably determining the point during the closing operation at which the linkage will engage said blocking member.

GEORGE G. GRISSINGER.
BERNARD G. TREMBLAY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,231,367	Jacobs	June 26, 1917
1,983,188	Pittman	Dec. 4, 1934
2,152,453	Atwood et al.	Mar. 28, 1939
2,162,511	May	June 13, 1939
2,337,565	May	Dec. 28, 1943
2,353,406	Kouyoumjian	July 11, 1944
2,382,995	Immel et al.	Aug. 21, 1945
2,385,292	Logan	Sept. 18, 1945
2,385,293	Logan	Sept. 18, 1945
2,399,336	Ellis et al.	Apr. 30, 1946
2,467,200	Favre	Apr. 12, 1949