Dec. 30, 1958 W. W. TURNER 2,866,872

OPERATING MECHANISM FOR AN ELECTRIC CIRCUIT BREAKER

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Fig. 1.

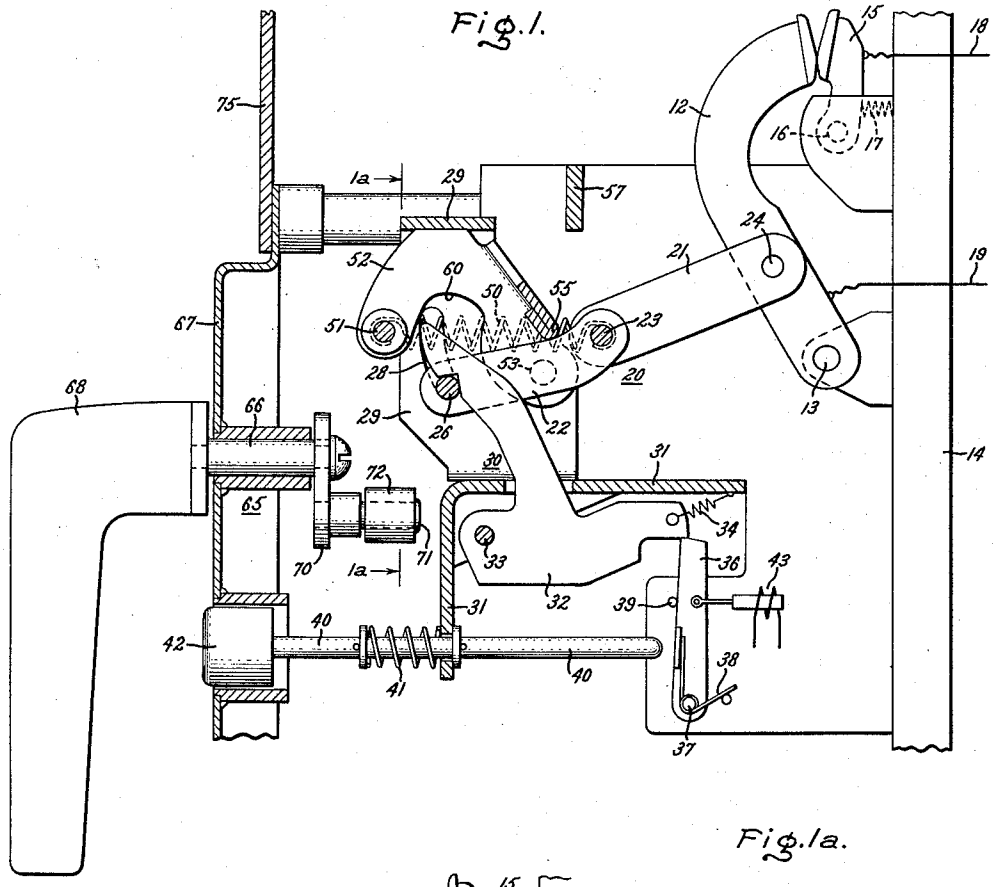


Fig. 1a.

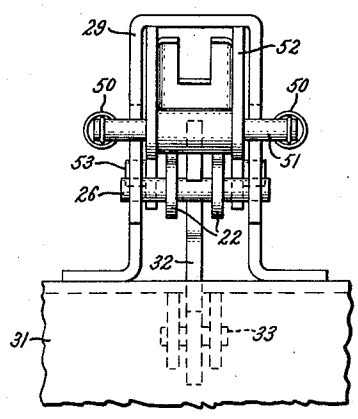
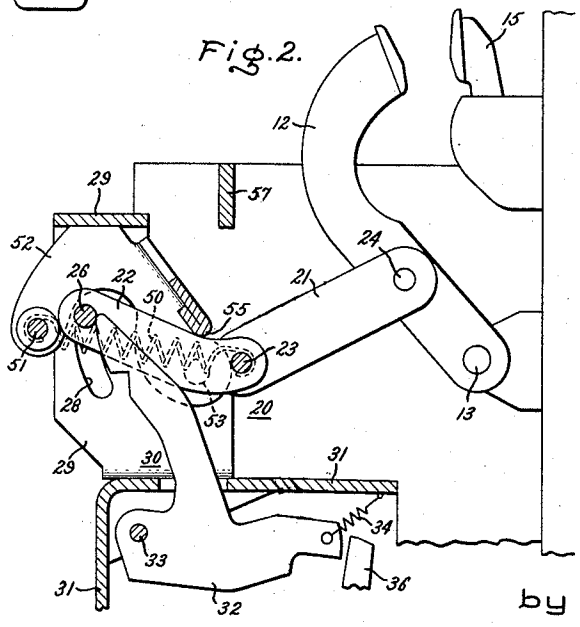


Fig. 2.



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Fig. 3.

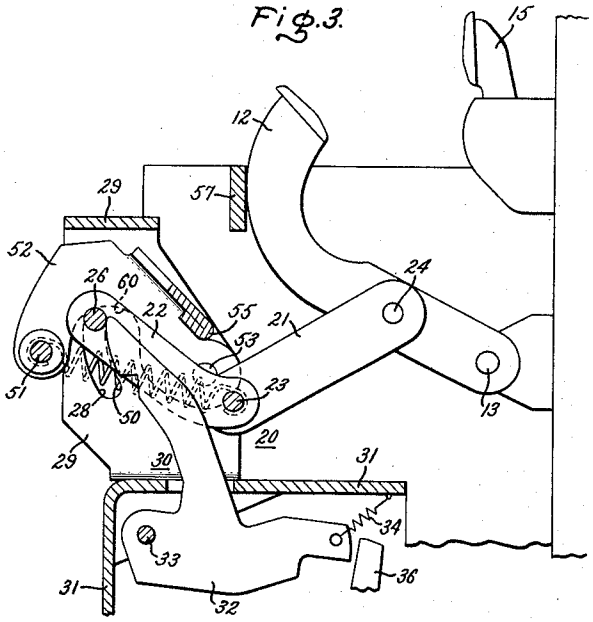


Fig. 4.

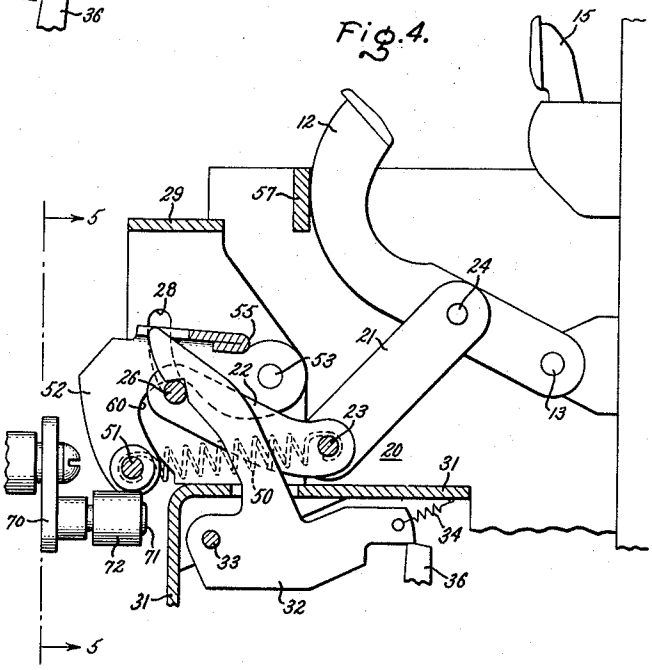
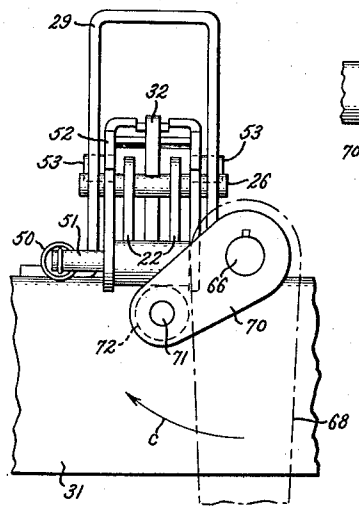


Fig. 5.



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2,866,872

OPERATING MECHANISM FOR AN ELECTRIC CIRCUIT BREAKER

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Application October 18, 1956, Serial No. 616,857

8 Claims. (Cl. 200—106)

This invention relates to an operating mechanism for an electric circuit breaker and, more particularly, to the type of operating mechanism which relies upon an over-center spring for imparting quick-closing motion to the movable contact of the circuit breaker.

One commonly-used form of mechanism of the above type comprises a toggle linkage having one of its ends connected to the movable contact and its other end connected to a carrier or guide member which is releasably latched in place. As long as the guide member is latched in place, the toggle is capable of transmitting closing thrust to the movable contact, but if the guide member is unlatched, the toggle is rendered ineffective to transmit such thrust. Thus, if the guide link is unlatched when the breaker is in closed position, the toggle is rendered ineffective to hold the movable contact closed, and the overcenter spring responds to drive the movable contact to open position. In order to reclose the breaker after such opening, it is necessary first to reset the guide member to its latched position so as to again render the toggle capable of transmitting closing thrust.

One of the objects of the present invention is to accomplish such resetting action without the need for additional resetting springs and by relying upon the overcenter spring itself for returning the guide member to its latched position. By achieving this object, it is possible to effect considerable reductions in the cost of the mechanism and the space required therefor.

Another object is to assure that the overcenter spring will act to open the contacts at essentially the same speed whether the opening action is electrically-initiated or is initiated by any manual means available to the operator.

It is customary in this general type of circuit breaker to construct the carrier or guide which supports the outer end of the toggle as a pivotally-mounted link. Such pivotally-mounted links require considerable space and add appreciably to the cost of the mechanism. It is, therefore, another object of my invention to design the mechanism in such a manner that it does not require the usual pivotally-mounted carrier link.

In carrying out my invention in one form, I provide a toggle which has one end connected to a movable contact or switch member and its other end releasably held in a latched position by suitable latching means. A tension-type overcenter spring is connected at one of its ends to the toggle and at its other end to a pivotally-mounted operating member. The spring operates in response to movement of the operating member from a first to a second position to produce closing of the switch member. Upon release of the latching means, the overcenter spring produces opening of the switch member by displacing said other end of the toggle from its latched position. This opening action, in turn, causes the overcenter spring to initiate return movement of the operating member toward said first position. This return movement of the operating member is utilized for returning the other end of the toggle to its latched position, thus resetting the mechanism. Return movement of the operating member is also utilized for shifting the toggle-connected end of the overcenter spring in a path which progressively converges with respect to a path followed by the other end of the spring. This convergence is continued until the operating member is fully returned to its first position, and, as a result, the tension spring is able to progressively shorten and thereby impart return-motion-producing energy to the operating member throughout its entire return travel.

For a better understanding of my invention, reference may be had to the following specification taken in connection with the accompanying drawings, wherein:

Fig. 1 is a side elevational view, partly in section, showing a circuit breaker constructed in accordance with one form of my invention with the operating mechanism for the breaker being shown in closed position.

Fig. 1*a* is a sectional view along the line 1*a*—1*a* of Fig. 1.

Fig. 2 is a view similar to that of Fig. 1 but with the parts of the mechanism being shown in a position through which they pass shortly after being tripped toward open position.

Fig. 3 shows the mechanism in the fully open position at a time when resetting has just been initiated.

Fig. 4 shows the mechanism in the fully open position at a time when the resetting operation has been completed.

Fig. 5 is a cross-sectional view taken along the line 5—5 of Fig. 4.

Referring now to Fig. 1, the mechanism shown therein comprises a movable contact **12** mounted for pivotal movement about a stationary pivot **13** suitably supported on a base **14**. Cooperating with the movable contact **12** is a generally stationary contact **15** which is mounted for slight pivotal movement by means of a stationary pivot **16** suitably supported on the base **14**. A compression spring **17** biases the stationary contact **15** into current-carrying engagement with the movable contact **12** and allows for wiping action between the two contacts in a well-known manner. As will be apparent from Fig. 1, the circuit through the breaker extends from a terminal **18**, through the cooperating contacts **15** and **12**, to an opposite terminal **19**.

Coupled to the movable contact **12** is a toggle linkage **20** comprising a pair of toggle links **21** and **22** pivotally joined together at a knee **23**. The toggle linkage **20** is pivotally connected at one of its ends to the movable contact **12** by means of a pivot pin **24** extending between the toggle link **21** and the movable contact **12**. The other toggle link **22** carries a guide pin **26** which is mounted for sliding movement in a cam-like slot **28** formed in a stationary frame member **29**. When the breaker is in the closed position of Fig. 1, this guide pin **26** is releasably held at the lower end of the slot **28** by suitable latching means **30** soon to be described.

Each of the toggle links comprises a pair of spaced-apart sections between which the various pivot pins laterally extend. For example, referring to Fig. 1*a*, the guide pin **26** can be seen extending laterally between the spaced-apart sections of the toggle link **22**. It will also be noted from Fig. 1*a* that the frame member **29** is a channel-shaped member suitably anchored to a framework **31** fixed to the base **14**.

The latching means **30** comprises a catch **32** which is pivotally mounted at **33** upon the framework **31** and is biased in a counterclockwise direction by a small reset spring **34**. The upper end of the catch **32** is notched to receive the guide pin **26** and acts to hold the guide pin **26** at the lower end of slot **28** so long as the catch **32** is held in its position of Fig. 1. For releasably holding

the catch 32 in the position of Fig. 1, there is provided a prop 36 which is pivotally mounted at 37. The prop 36 is biased into the latching position of Fig. 1 by means of a spring 38 urging the prop 36 in a counterclockwise direction into engagement with a stop 39.

The prop 36 can be operated to trip the breaker either manually or in a well-known electrical manner. Manual tripping is provided for by means of a reciprocable trip rod 40 slidably mounted upon the framework 31 and having a push button 42 secured to its outer end. The trip rod 40 is biased into the normal position of Fig. 1 by means of a compression spring 41 urging the trip rod toward the left. When push button 42 is depressed to move the trip rod 40 from its normal position toward the right, the right hand end of the trip rod abuts against the prop 36 and moves it clockwise to effect unlatching or tripping of the breaker in a manner soon to be described in greater detail. For electrically tripping the breaker, a solenoid 43, energized in any suitable conventional manner, is utilized for displacing the prop to the right out of its latched position of Fig. 1 in response to predetermined electrical conditions.

The toggle 20 is held in its extended position of Fig. 1 by means of a tension-type overcenter spring 50 which is connected at one end to the knee 23 of the toggle. At its other end, the overcenter spring 50 is connected through pin 51 to an operating member 52, which is mounted for angular movement about a stationary pivot 53. In the position of Fig. 1, the pin 51 is so located in relation to the toggle that the line of action of the spring force intersects the cam slot 28 as shown. It will be observed that the overcenter spring 50 acts to hold the toggle link 22 in engagement with a stop 55 carried by the operating member 52, thus holding the toggle 20 extended. The overcenter spring 50 also acts when in the position of Fig. 1 to urge the operating member 52 clockwise about its pivot 53 and into engagement with the top wall of the channel-shaped frame member 29. Thus, the overcenter spring 50 cooperates with the frame member 29 to restrain the operating member 52 in the position of Fig. 1.

Having pointed out these basic components of the mechanism, an opening operation for the circuit breaker will not be described. Assume first that the breaker is in the closed position of Fig. 1 and that the prop 36 is moved clockwise out of its latching position of Fig. 1 by either the manual means 40, 42 or the electrical means 43. The prop 36 in moving out from under the catch 32 frees the catch for clockwise rotation about its own pivot 33, and this frees the guide pin 26 for movement in its slot 28. When the guide pin 26 is so freed, then the charged overcenter spring 50, aided by the contact spring 17 and by magnetic forces tending to separate the contacts 12, 15, becomes effective to drive the guide pin 26 upwardly along the slot 28. The small resetting spring 34 on the catch 32, offers only negligible opposition to this upward movement of the guide pin 26. This upward movement of the guide pin 26 tends to rotate the toggle link 22 clockwise about the stop 55, thus moving the toggle links 22 and 21 out of line with respect to each other to break the toggle 20 and also tends to allow the overcenter spring to begin separating the contacts.

When this action has progressed to the stage illustrated in Fig. 2, the guide pin 26 has passed across the line of action of the discharging overcenter spring 50 and has come to rest at the top of the guide slot 28. The overcenter spring 50 as it continues to discharge, then acts to pivot the toggle link 22 clockwise about the axis of guide pin 26 and toward the position shown in Fig. 3. This further opens the movable contact 12 until it reaches its fully-open position against the stop 57.

As the toggle link 22 moves into the position of Fig. 3, the line of action of the overcenter spring 50 is shifted from one side to the other of the pivot 53 for the operating member 52. When this occurs, the overcenter spring begins to pivot the operating member 52 counterclockwise about its pivot 53 and through the position shown in Fig. 3. As will soon appear, this counterclockwise motion of the operating member 52 continues until the operating member has reached a final, or reset, position which is shown in Fig. 4.

In passing through the position of Fig. 3 toward the position of Fig. 4, the operating member 52 engages the guide pin 26 and drives the pin 26 downwardly in the slot 28. When the guide pin reaches the bottom of the slot 28, it again registers with the notched portion of catch 32 and allows the catch under the bias of its small reset spring 34 to reset to its latched position. When this occurs, the prop 36 falls in behind the catch 32 and holds the catch and the guide pin in their latched positions of Fig. 4. The mechanism is then reset.

The above-described driving action between the operating member 52 and the guide pin 26 takes place through a cam surface 60 located on the lower side of the operating member 52. This cam surface 60 and the guide slot 28 are so shaped that as the guide pin 26 is driven downwardly by the cam surface 60, the knee 26 of the toggle is shifted in a path which progressively converges with respect to the path followed by the pin 51 of the operating member 52. In other words, the distance between the pin 51 and the toggle knee 23 progressively shortens as the operating member 52 moves through the position of Fig. 3 and into the position of Fig. 4. This is an important relationship inasmuch as the opposite ends of the overcenter tension spring 50 are connected to these two pins 51 and 23. Since the distance between the opposite ends of the tension spring 50 progressively shortens, it will be apparent that the spring 50 progressively discharges during the entire resetting movement of the operating member 52, and, thus, the spring 50 is alone capable of resetting the outer end of the toggle 20 to its latched position of Fig. 4. No additional resetting springs are required for accomplishing this function, as has heretofore been the case.

When the mechanism has been reset to the position shown in Fig. 4, the toggle 20 is capable of transmitting closing thrust to the movable contact 12 inasmuch as the outer end 26 of the toggle is latched in a stationary position. Closing is accomplished merely by pivoting the operating member 52 clockwise about its pivot 53 from the position of Fig. 4 toward its position shown in Fig. 1. This carries the pin 51 upwardly and, in so doing, shifts the line of action of the spring 50 up to and then above the guide pin 26. As the line of action of spring 50 moves up to the guide pin 26, the spring 50 is being extended or charged, but when the line of action moves above the guide pin 26, then the spring is free to quickly contract, or discharge. In so discharging, the spring 50 quickly lifts the knee 23 of the toggle 20, extending the toggle and forcing the movable contact 12 quickly into the closed position of Fig. 1. As the toggle knee is lifted by the spring 50, it shifts the line of action of the spring 50 above the pivot 53 of the operating member 52. When this occurs, the spring 50 completes the upward movement of the operating member 52 and thereafter holds the operating member 52 in engagement with the top wall of frame member 29 as shown in Fig. 1.

For lifting the operating member 52 to produce the above-described closing action, there is provided a handle mechanism 65 which cooperates with an enlarged portion of the pin 51 on the operating member 52. Referring to Fig. 1, this handle mechanism 65 comprises a shaft 66 which is journaled in a stationary escutcheon plate 67. Anhcored to the outer end of the shaft 66 is a handle member 68 which is manually-operable to effect limited rotation of the shaft 66. Anchored to the inner end of the shaft 66 is a crank 70 carrying at its radially outer end an axially-extending crankpin 71. An antifriction roller 72 is loosely mounted on this crankpin 71.

When the mechanism is in the reset position of Figs. 4 and 5, the pin 51 of the operating member is positioned immediately above the crank roller 72. When the handle

68 is operated in the direction of the arrow C of Fig. 5, it rotates the shaft 66 and through the crank parts 70 and 71 lifts the roller 72. The roller 72, in turn, engages the pin 51 and lifts the operating member 52 to effect circuit breaker closing in the manner described above. Since the overcenter spring 50 holds the operating member in the position of Fig. 1, the handle mechanism 65 can be returned to its original position without affecting the operating member or any other parts of the breaker mechanism. Fig. 1 shows the handle mechanism after having been so returned. Since the handle mechanism 65 can be returned to its normal position independently of the operating member 52, the parts 71, 72 and 51 can be thought of as constituting a type of one-way driving connection which allows the handle mechanism to raise the operating member but not to lower it.

It is common in circuit breakers of the general type shown to connect some form of handle non-releasably to an operating member such as 52. In such arrangements, when the handle is returned to its original, or lower, position, it shifts the usual overcenter spring (such as 50) back across the pivot for toggle link 22, and, thus, causes the spring 50 to break the toggle and open the breaker contacts. During this opening the outer end of the toggle would remain latched. Opening the contacts in this manner, that is, with the outer end of the toggle latched, can produce contact-opening speeds which are appreciably different from those produced by unlatching the outer end of the toggle in the manner previously-described. Such variations in contact-opening speed are objectionable in certain applications, and one of the objects of my invention is to assure that the contacts will always be opened at essentially the same speeds.

This is accomplished in the disclosed breaker by constructing the operating member 52 and the handle mechanism 65 as separable components interconnected by the above-described one-way driving connection which renders the handle operable to drive the operating member 52 only in a circuit-breaker closing direction. Return of the handle mechanism to its normal position of Fig. 1 does not affect the operating member 52 as it remains held in its upper position by the overcenter spring 50. A casing 75 encloses the mechanism and renders the operating member 52 inaccessible for externally-controlled operation by means other than the handle mechanism 65. Thus, the operating member 52 can be returned from its position of Fig. 1 to that of Fig. 4 only as a result of unlatching the breaker, as previously described. Hence, the breaker can be opened only by unlatching the guide pin 26. This unlatching, or tripping, is performed from outside the escutcheon plate 67 by depressing the push button 42, as previously described.

It will be apparent that the disclosed operating mechanism is capable of tripping to the open position even if the handle operated crank pin 71, 72 is held in its uppermost position. This is the case because when the guide pin 26 is unlatched, the mechanism is free to move from the position of Fig. 1 to open position of Fig. 3 even though the roller 72 might be blocking downward movement of the operating member past the position of Fig. 3. Thus, the mechanism is mechanically trip-free.

It will be apparent that the mechanism disclosed hereinabove does not require the usual pivotally-mounted carrier or guide link for supporting the outer end of the toggle. The guide pin 26 and its slot 28 cooperate to support the outer end of my toggle 20 without reliance upon such a guide link. This enables me to materially reduce the space required for the mechanism. This feature also removes certain design limitations in that it allows me to guide the outer end of the toggle in a path which may be one other than the arc of a circle, whereas with a pivotally-mounted carrier, the designer would be limited to this latter type of path.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects, and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a circuit breaker, a movable switch member, a toggle having one end connected to said switch member, latching means for releasably restraining the other end of said toggle in a latched position, an operating member movable between first and second positions at opposite ends of its normal range of movement, an overcenter tension spring coupled at one end to said operating member and at its other end to said toggle and operable in response to movement of said operating member from said first to said second position to produce closing of said switch member, means for restraining said operating member in said second position when said switch member is in closed position, means operable upon release of said latching means for causing said overcenter spring to produce opening of said switch member by displacing said other end of the toggle from its latched position, means operable in response to said opening action for causing said overcenter spring to initiate return movement of said operating member toward said first position, and means controlled by said return movement of the operating member for shifting the toggle-connected end of said spring in such a path that the distance between said toggle-connected end and the other end of the spring progressively shortens until said operating member reaches said first position, said return movement also acting to return the other end of said toggle to said latched position.

2. In a circuit breaker, a movable switch member, a toggle having one end connected to said switch member, latching means for releasably restraining the other end of said toggle in a latched position, a movable operating member having first and second positions at opposite ends of its normal range of movement, an overcenter tension spring coupled at one end to said operating member and at its other end to said toggle and operable in response to movement of said operating member from said first to said second position to produce closing of said switch member, means for restraining said operating member in said second position when said switch member is in closed position, means operable upon release of said latching means for causing said overcenter spring to produce opening of said switch member by displacing said other end of the toggle from its latched position, means operable in response to said opening action for causing said overcenter spring to initiate return movement of said operating member toward said first position, and means controlled by said return movement of the operating member for shifting the toggle-connected end of said spring in a path which progressively converges with respect to the path followed by the other end of the spring until said operating member reaches said first position thereby enabling said overcenter spring to impart return-motion-producing energy to said operating member throughout its entire return travel, said return movement also acting to return the other end of said toggle to said latched position.

3. In a circuit breaker, a movable switch member, a toggle having one end connected to said switch member, latching means for releasably restraining the other end of said toggle in a latched position, a movable operating member, an overcenter tension spring coupled at one end to said operating member and at its other end to said toggle and operable in response to movement of said operating member from a first to a second position to produce closing of said switch member, means operable upon release of said latching means for causing said overcenter spring to produce opening of said switch member, means operable in response to said opening action for causing said overcenter spring to return said operating member from said second to said first position, means controlled by said return movement of the operating mem-

ber for resetting the other end of said toggle to its latched position, the end of said overcenter spring which is connected to said operating member following throughout said return movement a path which progressively approaches the toggle-connected end of said spring thereby enabling said spring to drive said operating member throughout its entire return travel.

4. In a circuit breaker, a movable switch member, a toggle having one end connected to said switch member, cam means for movably mounting the other end of said toggle, latch means for releasably restraining the other end of said toggle in a latched position with respect to said cam means, a movable operating member, an overcenter tension spring coupled at one end to said operating member and at its other end to said toggle and operable in response to movement of said operating member from a first to a second position to produce closing of said switch member, said spring being operable upon release of said latch means to shift said other end of the toggle along said cam means so as to allow for opening of said switch member, means operable in response to said opening action for causing said overcenter spring to return said operating member from said second to said first position, means controlled by said return movement of the operating member for returning the other end of said toggle along said cam means to its latched position, said cam means having a configuration such that the toggle-connected end of said spring follows throughout the entire return movement of said operating member a path which is progressively approached by the other end of said spring thereby enabling said spring to drive said operating member throughout its entire return travel.

5. In a circuit breaker, a movable switch member, a toggle having one end connected to said switch member, a guide pin connected to and supporting the other end of said toggle, means forming a cam slot for receiving said guide pin, latching means for releasably holding said guide pin in a predetermined latched position at one end of said slot, and an overcenter tension spring connected between said toggle and a predetermined point so located in relation to the toggle that the line of action of the spring force intersects said slot intermediate its ends, said spring being operable upon release of said latching means for driving said guide pin along said slot from its latched position to a position at the opposite end of said slot so as to allow for opening movement of said switch member.

6. In a circuit breaker comprising an enclosing casing, a movable switch member mounted within said casing, a toggle mounted within said casing and having one end connected to said switch member, latching means for releasably restraining the other end of said toggle in a latched position, a movably-mounted operating member located within said casing, an overcenter spring interconnecting said operating member and said toggle and operable in response to movement of said operating member from a first to a second position to produce closing of said switch member, means for restraining said operating member in said second position when said switch member is in closed position, a handle mechanism extending through said casing and manually operable from outside said casing, one-way drive means located within said casing between said handle mechanism and said operating member for moving said operating member from said first to said second position in response to movement of said handle mechanism out of a normal position, said one-way drive means permitting said handle mechanism to be returned to its normal position

independently of said operating member, said overcenter spring being operable to drive said switch member into open position in response to release of said latching means, and means operable in response to opening of said switch member for returning said operating member to said first position.

7. In a circuit breaker comprising an enclosing casing, a movable switch member mounted within said casing, a toggle mounted within said casing and having one end connected to said switch member, latching means for releasably restraining the other end of said toggle in a latched position, a movably-mounted operating member located within said casing, an overcenter spring interconnecting said operating member and said toggle and operable in response to movement of said operating member from a first to a second position to produce closing of said switch member, a handle mechanism extending through said casing and operable to move said operating member from a first to a second position to produce closing of said switch member, means operable when said switch member is closed for rendering said handle mechanism incapable of initiating opening of said switch member by returning said operating member from said second to said first position, said overcenter spring being operable to drive said switch member into open position in response to release of said latching means, and means operable in response to opening of said switch member for allowing said operating member to be returned to said first position.

8. In a circuit breaker, a movable switch member, a toggle comprising two links pivotally joined to form a knee, one end of the toggle being connected to the switch member and the other end of the toggle being supported for movement between first and second predetermined positions, latching means for releasably restraining said other end of the toggle in its first position, a pivotally mounted operating member having a laterally extending pin disposed for movement along a predetermined arcuate path, an overcenter tension spring interconnecting said pin and the toggle knee and operable in response to movement of the operating member from a reset position to another position to effect quick closing of the switch member, said overcenter spring being operable upon release of the latching means to drive said other end of the toggle to its second position while effecting opening of the switch member and being effective with said other end in said second position and the switch member open to initiate return movement of the operating member toward its reset position, and means controlled by said return movement of the operating member for driving said other end to its first position, the toggle and the operating member being disposed in relation to each other so that the path along which the toggle knee moves as said other end is being driven to said first position progressively converges with respect to the arcuate path followed by said pin during said return movement, whereby the overcenter spring progressively shortens while the operating member is returning to its reset position and said other end is being driven to said first position.

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