

Nov. 6, 1956

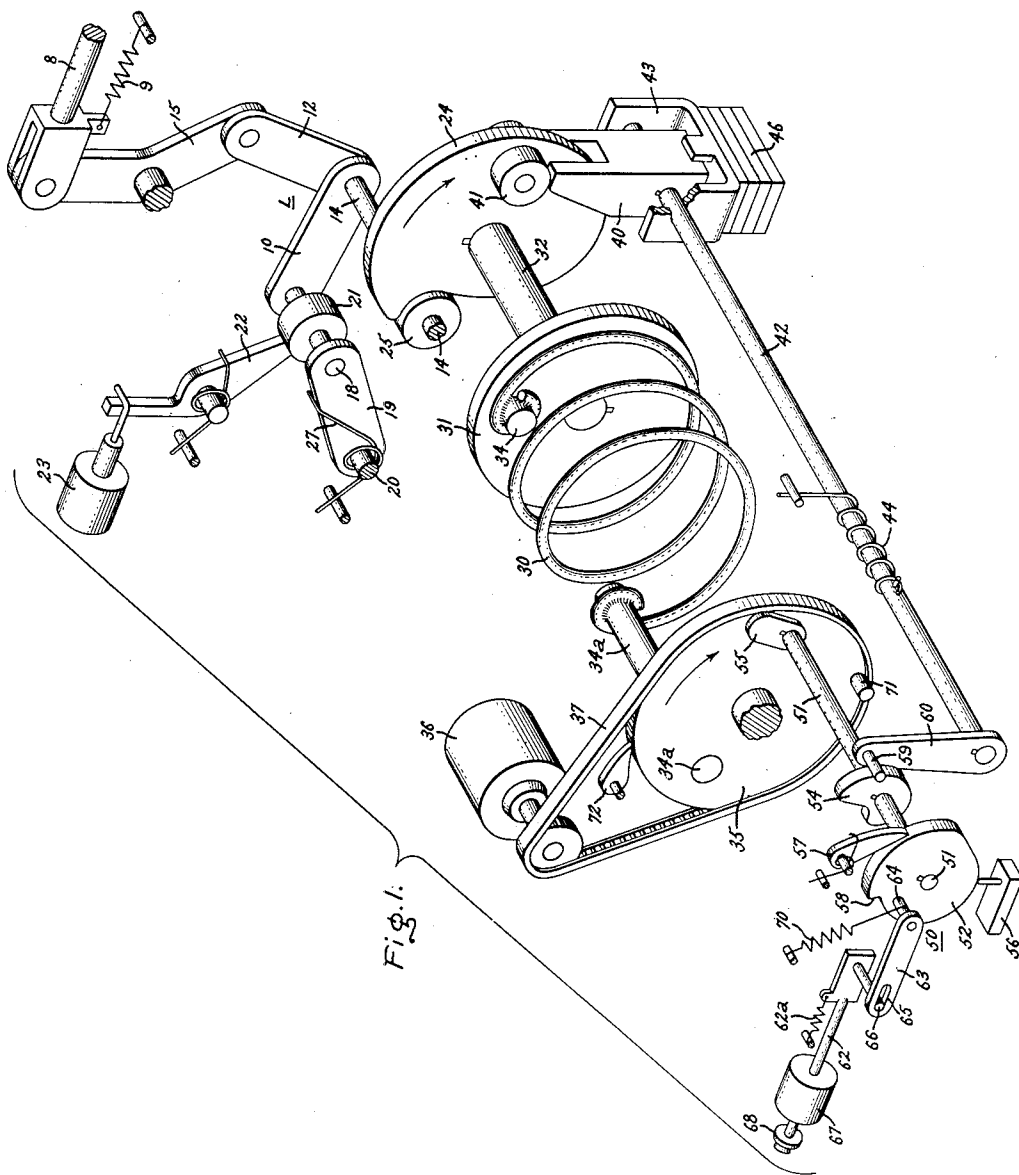
T. R. COGGESHALL ET AL

2,769,874

CLOSING MECHANISM FOR AN ELECTRIC CIRCUIT BREAKER

Filed June 2, 1955

3 Sheets-Sheet 1



Inventors:

Thellwell R. Coggeshall,
Ugo R. Tognella,

by

J. Wesley Hawburn
Their Attorney.

Nov. 6, 1956

T. R. COGGESHALL ET AL

2,769,874

CLOSING MECHANISM FOR AN ELECTRIC CIRCUIT BREAKER

Filed June 2, 1955

3 Sheets-Sheet 2

Fig. 2.

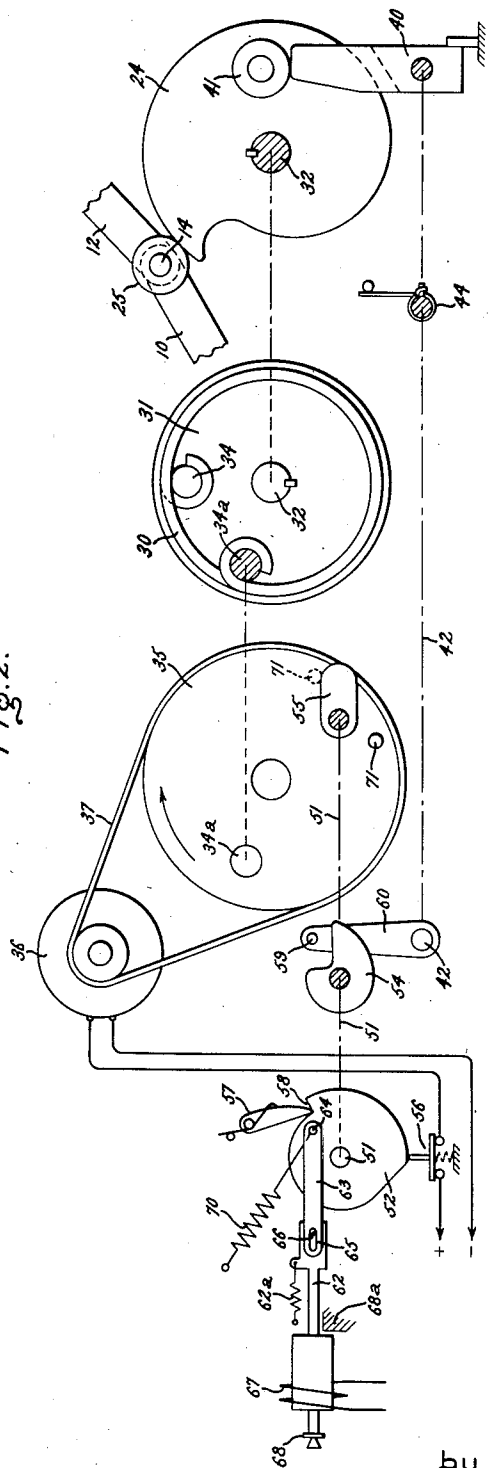
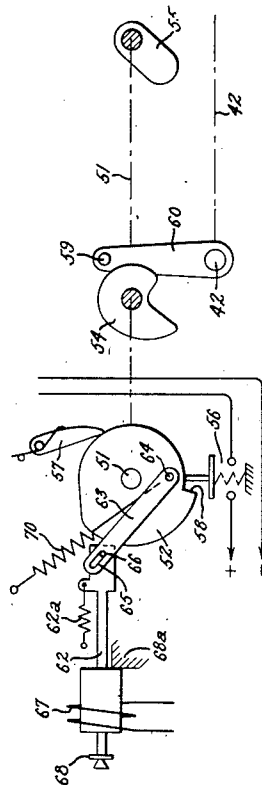


Fig. 3.



Inventors:
 Thellwell R. Coggeshall,
 Ugo R. Tognella,
 by *J. Wesley Faulkner*
 Their Attorney.

1

2,769,874

CLOSING MECHANISM FOR AN ELECTRIC
CIRCUIT BREAKER

Thellwell R. Coggeshall, Cynwyd, and Ugo R. Tognella,
Philadelphia, Pa., assignors to General Electric Com-
pany, a corporation of New York

Application June 2, 1955, Serial No. 512,638

17 Claims. (Cl. 200—89)

This invention relates to a closing mechanism for an electric circuit breaker and, more particularly, to a control arrangement for controlling the operation of such a mechanism. The control arrangement is particularly, though not exclusively, applicable to the stored-energy type of closing mechanism.

A typical form of stored-energy closing mechanism comprises a stored-energy device, such as a spring, which is held in a charged condition by suitable holding means. By releasing the holding means, the spring can be discharged to drive the breaker toward closed position. In such mechanisms, it is quite important that this releasing operation should not take place before the spring has sufficient energy stored therein to complete a fully-rated closing operation. Otherwise, the breaker might stall or close at such a low speed that excessive arcing and resultant contact-burning would occur.

Accordingly, it is an object of our invention to provide a simple closing control scheme which operates to insure that the stored-energy closing device will not be released until sufficient energy is stored therein to complete a fully-rated closing operation.

Another object of our invention is to provide for a circuit breaker closing mechanism a simple control arrangement which is operative to prevent "pumping," i. e., repeated reclosing operations in the event that the breaker is closed on a fault and fails to remain closed. For example, where the closing mechanism is controlled by a manual-operable control member, only a single breaker closing operation should be initiated by movement of the control member into closed position. Even if the control member is then held in closed position and the breaker reopens, say, in response to a fault, no further closing operations should take place, unless, however, the control member first is moved out of the closed position and is subsequently returned thereto.

Another object is to insure that once an operator initiates a closing operation by moving a control member into its closed position, this operation will be carried through to completion irrespective of whether the control member is released instantly by the operator. In other words, the control arrangement should be "anti-flip."

Still another object is to provide a simple control arrangement which performs all of the above desired functions, i. e., one which shall be pump-free and anti-flip, without the need for the usual closing control relays, which are quite involved and expensive.

In accordance with one form of our invention a circuit breaker having a chargeable spring which is releasable to effect closing of the breaker is provided with a selectively-operable rotatable control member. For releasing and thereafter restraining the spring so as to effect a single circuit breaker closing operation, we provide means which is operable in response to rotation of the control member through a fraction of a revolution. This releasing means is ineffective to again release the spring until the control member is returned through one full

2

revolution to its initial position. After the spring is released, it is recharged by suitable charging means. Resetting means operable in response to a predetermined operation of this charging means is provided for completing rotation of said control member back to its initial position, whereby another closing operation can be initiated after the spring has been charged.

In accordance with another feature of our invention, a selectively-operable actuating member is provided for operating said control member. This actuating member is movable out of a normal position to effect the above-described fractional rotation of the control member and, thus, to initiate a breaker-closing operation. The actuating member when displaced from its normal position is arranged to block return of the control member to its initial position, whereby restoration of the actuating member to its normal position is a prerequisite to initiating another closing operation. This relationship effectively prevents circuit breaker pumping.

For a better understanding of our invention reference may be had to the following specification taken in connection with the accompanying drawing wherein Fig. 1 is a diagrammatic perspective view of a closing mechanism embodying our invention with the parts thereof shown in the breaker-open position. Fig. 2 is a similar view showing the parts of the mechanism in closed position. Fig. 3 is a detailed view of a portion of Fig. 2 illustrating the manner in which our closing control arrangement operates to prevent circuit breaker pumping. Fig. 4 is a schematic illustration of a second embodiment of our invention with the parts thereof shown in the breaker-open position. Fig. 5 illustrates the position of the parts of this second embodiment at an instant during a breaker-closing operation.

Referring now to Fig. 1, the circuit breaker shown therein comprises a reciprocable contact-actuating rod 8 which is biased to the open-circuit position shown by means of a suitable opening spring 9. For transmitting closing thrust to the actuating rod 8, there is provided a conventional trip-free linkage L which comprises a pair of toggle links 10 and 12 pivotally joined together at a knee 14. One of the toggle links 12 is pivotally connected at its opposite end to a bell-crank 15, which, in turn, is pivotally connected to the reciprocable contact-actuating rod 8. The other toggle link 10 is connected by a pivot pin 18 to the upper end of a guide link 19. This guide link 19 is pivotally supported at its lower end on a fixed fulcrum 20. The pivot pin 18 carries a latch roller 21 which cooperates with a suitable trip latch 22, which is arranged to be operated in response to predetermined circuit conditions by means of a suitable conventional tripping solenoid 23. So long as the trip latch remains in the latched position shown in Fig. 1, the toggle 10, 12 is capable of transmitting thrust to the movable contact-actuating rod 8. Thus, when the knee 14 is lifted from the position shown in Fig. 1, the toggle 10, 12 is extended and drives the contact-actuating rod 8 to the left toward closed position against the bias of opening spring 9.

This lifting of the knee 14 is accomplished by the action of a rotatable cam 24 cooperating with the usual roller 25 which is mounted at the knee 14. When the cam 24 is rotated clockwise through a complete revolution by means soon to be described, it moves from the position of Fig. 1 to the position of Fig. 2 and lifts the knee 14, thereby extending the toggle 10, 12 and closing the breaker. Fig. 2 shows this toggle portion of the breaker mechanism in closed position, where it is held by the force of the cam acting through the knee 14 to maintain the toggle 10, 12 extended.

Should the trip latch 22 (Fig. 1) be tripped when the breaker is closed, or even during the closing stroke, the

toggle 10, 12 will be rendered inoperative to transmit closing thrust to the contact-actuating rod 8. As a result, the opening spring 9 will be free to drive the contact-actuating rod 8 to its open-circuit position. A suitable resetting spring 27 cooperates with the guide link 19 to reset the mechanism L to the latched position (shown in Fig. 1) after it has been tripped.

For rotating the cam 24 to drive the circuit breaker closed, we have provided a stored-energy closing device which comprises a torsion spring 30 suitably coupled at one end to the cam 24 as shown in Fig. 1, this coupling comprises a disc 31 attached to the cam shaft 32 and carrying a pin 34 to which the forward end of the spring is suitably anchored. The rear end of the spring is anchored by a suitable pin 34a to a rotatable sprocket 35.

Charging of the spring 30 is accomplished by rotating the sprocket 35 in a clockwise direction by means of a suitable charging motor 36 coupled to the sprocket 35 by means of a conventional chain drive 37. The manner in which this charging motor is controlled will appear more clearly hereinafter.

For controlling the rotation of the cam 24, we provide a latch or closing release prop 40 which cooperates with an abutment such as the roller 41 suitably secured to the cam 24. This prop 40 is keyed to an actuating shaft 42 which is journaled within a U-shaped bracket 43. The prop is biased into its holding position shown in Fig. 1 by means of a prop-resetting spring 44 surrounding the shaft 42. When the prop 40 is released, i. e., moved clockwise out of the path of the abutment 41, the main spring 30 is free to drive the cam 24 clockwise at high speed from the breaker-open position of Fig. 1. The prop 40 is reset to its holding position immediately and in ample time to arrest the movement of the cam 24 after it has rotated through a complete revolution to drive the breaker into the closed position shown in Fig. 2. The forces produced by the abutment 41 impacting against the prop 40 during this arresting action are effectively absorbed by a stack of yieldable buffers 46 mounted beneath the prop supporting bracket 43.

For releasing the prop 40 to effect closing of the breaker, as described above, we provide, in accordance with our invention, a novel control arrangement 50. This control arrangement 50 comprises a rotatable countershaft 51 to which a rotatable control member 52, a releasing cam 54, and a reset trigger 55 are secured in spaced-apart relationship. The periphery of the rotatable control member 52 is shaped to act as an operating cam for a normally-open switch 56 which controls the operation of the charging motor 36 in a manner which will soon be described in greater detail. Also cooperating with this periphery is an interference member 57 in the form of a pawl which is biased against the periphery. This pawl falls in to a holding position behind a shoulder 58 formed on the periphery when the control member 52 is sufficiently rotated in a clockwise direction from its initial position of Fig. 1, as will soon appear more clearly.

The releasing cam 54 cooperates with a pin 59 carried by a crank 60 secured to the prop-actuating shaft 42. When the countershaft 51 is rotated in a clockwise direction from the position of Fig. 1, the releasing cam 54, acting through the pin 59, rotates the crank 60 in a clockwise direction and thereby releases the prop 40. The releasing cam 54 is so shaped that as soon as it effects this releasing action, its high point moves beneath the pin 59 and permits the crank 60 to be returned to its original position by means of the prop-resetting spring 44. This, of course, results in the prop 40 being immediately reset in time to arrest the movement of the main cam 24 after it has been spring-driven through a complete revolution to effect breaker closing.

This prop-releasing movement of the releasing cam 54 is produced by means of a selectively-operable closing-control rod, or actuating member, 62 which is coupled to the rotatable control member 52 by means of a connect-

ing link 63. The closing-control rod 62 is shown, in Fig. 1, biased into its normal or neutral position by means of a tension spring 62a. At one of its ends, the connecting link 63 is pivotally-mounted on a crank pin 64 secured to the rotatable control member 52, whereas at its other end the connecting link 63 is provided with a lost motion slot 65 receiving a pin 66 secured to the control rod 62. The control rod 62 can be operated either electrically, as by a suitably controlled closing-release coil 67, or manually, as by applying a force to a push button 68 secured to its outer end. A limit stop, such as 68a (Fig. 2), is provided for affording a definite travel for the control rod 62 which insures that the pawl 57 will drop in behind the cam step 58.

In case of either manual or electrical operation, if the rod 62 is moved through its full stroke to the right from the normal position shown in Fig. 1, it acts through the connecting link 63 to rotate the control member 52 through a predetermined fraction of a complete operating revolution. This fractional rotation takes place against the bias of compression spring 62a and also against the bias of a resetting spring 70, which is a tension spring tending to maintain the actuating member 52 in the dead centered normal position of Fig. 1. The position of the various parts after this fractional revolution is shown in Fig. 2. It will be apparent from Fig. 2 that this rotational movement of control member 52 resulted in the following operations: fractional rotation of the releasing cam 54 to cause releasing and subsequent resetting of the prop 40, as described above; closing of the switch 56 which energized the charging motor 36; and latching of the control member 52 by the pawl 57 in its fractionally-rotated position against the bias of resetting spring 70. The parts are so proportioned that the prop 40 is released and the switch 56 is closed at about the same instant that the pawl 57 drops in behind the cam shoulder 58. Thus, in the solid line position of Fig. 2, the breaker has been closed, by discharge of the spring 30 and operation of the charging motor 36 has just been initiated by closing of the switch 56.

As the charging motor rotates the sprocket 35 clockwise to charge the main spring 30, a trigger pin 71 projecting from the sprocket face moves clockwise from the solid line position of Fig. 2 to the dotted line position shown therein. Continued charging of the spring 30 by the motor 36 causes the trigger pin to engage the reset trigger 55 and to drive the trigger 55 together with cam 54 and the control member 52 clockwise so that the latter is overcenter with respect to the reset spring 70. The lost motion slit 65 permits this through-center movement of the control member 52 to take place irrespective of the position of actuating rod 62. When the control member 52 is thus driven overcenter, the reset spring 70 then immediately becomes effective to continue this clockwise movement of the control member 52 toward the original position shown in Fig. 1.

If, in the meantime, the actuating rod 62 has been released, either electrically or manually, and permitted to return to its original position of Fig. 1 under the influence of tension spring 62a, then the resetting spring 70 will quickly complete rotation of the control member 52 back into the initial position of Fig. 1. The mechanism will then be completely reset and in a condition to effect another closing operation.

If, however, instead of immediately releasing the actuating rod 62, the operator inadvertently continues holding the actuating rod in the position of Fig. 2 at the time the reset spring 70 takes over, the control member 52 is blocked from returning to its initial position of Fig. 1. The position of the parts when this blocking action occurs is shown in Fig. 3. Since it is not possible to initiate another closing operation until the control member 52 does return to its initial position of Fig. 1, it will be apparent that this blocking action of actuating rod 62 prevents the circuit breaker from pumping. That

is, only a single circuit breaker closing operation can result from a single movement of the actuating member 62 into its closed position. No additional closing operations can result from the actuating member 62 being held in its closed position. As is well-known, this feature is quite important because, in its absence, if the breaker should be closed on a fault and immediately reopen before the operator had an opportunity to release the closing-control, or actuating, member, then the breaker would again close, and this cycle of opening and closing operations could be repeated over and over again until the actuating member was released. Such recurrent operations, commonly termed "pumping," can result in serious damage to the breaker, or the system, as is well-known.

In the disclosed arrangement, as will be evident from Fig. 3, once the actuating member 62 is released, it is no longer effective to block resetting movement of the control member 52. As a result, the resetting spring 70 is then free to return the control member 52 into its original position of Fig. 1, thereby permitting another closing operation to be initiated if desired.

Deenergization of the motor 36 to prevent further charging of the main spring 30 was accomplished during the above series of operations by opening the motor switch 56 during resetting of the rotatable control member 52. More particularly, after the trigger pin 71 had driven the reset trigger 55 overcenter but before the position of Fig. 3 had been reached, the cam step 58 on the periphery of control member 52 permitted the biased-open switch 56 to open, thereby deenergizing the charging motor 36. Unwinding of the spring at its rear end by possible back-tracking of the sprocket 35 is prevented by means of a suitable holding pawl 72.

An important feature of our control arrangement is that it serves as an interlock which insures that the main spring will not be released to attempt breaker-closing before the spring has been fully charged. This is the case because only after the spring has been substantially fully charged does the trigger pin 71 initiate resetting movement of the reset trigger 55 and the control member 52, as described above. Resetting in an opposite, or counterclockwise, direction during spring-charging is effectively prevented by means of the pawl 57. Thus, this pawl 57 also serves to prevent the initiation of an additional breaker closing operation before the spring 30 is fully charged.

Our closing control arrangement has a number of features which can be readily utilized for types of circuit breaker closing devices other than the charged-spring type described above. For example, in Figs. 4 and 5 we have shown a solenoid-operated type of closing device controlled by an arrangement similar to that shown in Figs. 1-3. Those parts of the arrangement of Figs. 4-5 which correspond to similar parts in Figs. 1-3 have been given corresponding reference characters. Thus, it will be seen that the rotatable control member 52, its operating means 62-63, the pawl 57 and the resetting spring 70 correspond in each of the embodiments. The control member 52 instead of controlling a switch which controls a charging motor, however, controls a switch 75 which is utilized to effect energization and deenergization of a closing solenoid designated 76. This solenoid has an armature 77 which moves upwardly to extend the toggle 10, 12, thereby to close the breaker in the same general manner as shown in Figs. 1-3. Preferably in Figs. 4-5, the toggle is driven slightly overcenter against a suitable stop 76a to hold the breaker closed when the solenoid armature 76 is returned to its deenergized, or lower, position.

Thus, when the rotatable control member 52 of Fig. 4 is rotated clockwise into the position of Fig. 5 the switch 75 is closed to effect energization of the solenoid 76. Fig. 5 shows the solenoid at the instant that it has been first energized but before its armature has begun to move upwardly to effect circuit-breaker closing. The

armature is provided with a hook-shaped member 73 which is arranged to engage the reset trigger 55 when the armature is driven upwardly. After this engagement occurs and the armature 77 continues in its upward movement, it drives the reset trigger 55 clockwise. This driving relationship is maintained until the trigger 55 drives the control member 52 into an overcenter position with respect to the reset spring 70. The reset spring 70 then immediately assumes control and drives the control member 52 toward its original position shown in Fig. 4.

If in the meantime the actuating rod 62 has been released and permitted to return to its original position of Fig. 4, then the resetting spring 70 will quickly complete rotation of the actuating member 52 back into the initial position of Fig. 4.

If, however, the operator is still holding the actuating rod 62 in the position of Fig. 5 at the time the reset spring takes over, the control member 52 is blocked from returning to its initial position of Fig. 4 in the same manner as illustrated in Fig. 3. Since it is not possible to initiate another breaker-closing operation until the control member 52 does return to its initial position, it will be apparent that this blocking action of the actuating rod prevents the breaker from pumping in essentially the same manner as explained in connection with Figs. 1-3.

Similarly, in Figs. 4-5, once the closing control, or actuating member 62 is released by the operator, it is no longer effective to block resetting movement of the control member 52. As a result, the reset spring 70 is then immediately free to return the control member 52 into its original neutral position of Fig. 4.

Deenergization of the solenoid 76 to permit resetting of the armature 77 to its initial position of Fig. 4, was accomplished during the above series of operations by opening the switch 75 during resetting of the rotatable control member 52. More particularly, after the hook-shaped member had driven the reset trigger 55 overcenter but before the previously-described blocking position had been reached, the cam step 53 on the periphery of the control member 52 permitted the biased-open switch 75 to open thereby deenergizing the solenoid 76.

The interference member or pawl 57 of Figs. 4-5 assures that once the solenoid switch 75 is closed to energize the solenoid and initiate a closing operation, that this switch 75 will not be reopened prior to the instant at which completion of the closing operation is assured. This is the case because the step 53 on the control member 52 is so located that the pawl 57 falls in therebehind at about the same instant that the control member 52 first effects closing of the solenoid control switch 75. Thus, even if the push button 63 is immediately released by the operator after closing control switch 75, the pawl 57 will hold the switch closed and thereby will assure that the solenoid will not be deprived of power prior to the instant at which completion of the closing operation is assured. This is most desirable because if the solenoid were deprived of power prior to this instant, serious damage to the breaker contacts could result from excessive arcing during this ineffectual attempt to positively close the contacts.

It will be perceived that the step 53 of the control member cam 52 performs a dual function by constituting a holding surface for the pawl 57 as well as defining the cam drop-off point for effecting precise cut off for the control switches 56 and 75. If desired, these functions can be separated, e. g., the pawl 57 could be applied to the cam 54 or the pin 59 on the crank 60 could constitute the interference means for preventing backward rotation of the cam shaft 51. Obviously, adjustable means may be provided for the cam, pawl and switch for obtaining precise timing among these components.

While we have shown and described particular embodiments of our invention, it will be obvious to those skilled in the art that various other changes and modifications may be made without departing from our invention in its broader aspects. For example, it will be apparent that

7

the switch 75 of Figs. 4-5 could be used for controlling a fluid-motor closing device instead of the solenoid-type closing device shown.

We, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. In an electric circuit breaker, a chargeable spring which is releasable to effect closing of the breaker, a selectively-operable rotatable control member having an initial position, means responsive to rotation of said control member from its initial position through a fraction of a revolution for releasing and thereafter restraining said spring thereby to effect a circuit breaker closing operation, said means being ineffective to again release said spring until said control member is returned to its initial position, charging means for automatically recharging the spring after its release, and resetting means operable in response to a predetermined operation of said charging means for completing rotation of said control member back to its initial position whereby another closing operation can be initiated after said spring has been charged.

2. The apparatus of claim 1 in combination with interference means operable after said fraction of a revolution has been completed for blocking reverse rotation of said control member back to said initial position, whereby to prevent said spring from being again released before said resetting means has operated.

3. In an electric circuit breaker, a chargeable spring which is releasable to effect closing of the breaker, a rotatable control member having an initial position, a selectively-operable actuating member movable out of a normal position to rotate said control member from its initial position through a fraction of a revolution, means responsive to said fractional rotation for releasing and thereafter restraining said spring thereby to effect a circuit breaker closing operation, said means being ineffective to again release said spring until said control member is returned to its initial position, charging means operable upon release of said spring for recharging the spring after its release, and resetting means operable in response to a predetermined operation of said charging means for completing rotation of said control member back to its initial position, said actuating member when displaced from its normal position being arranged to block return of said control member to its initial position, whereby restoration of said actuating member to its normal position is necessary in order to initiate another closing operation.

4. In an electric circuit breaker, motive means operable to effect closing thereof, a rotatable control member having an initial position, means for initiating operation of said motive means in response to rotation of said control member from its initial position through a fraction of a revolution, said initiating means being ineffective to initiate another operation of said motive means until said control member is returned to said initial position, a selectively-operable actuating member movable out of a normal position to rotate said control member through said fraction of a revolution thereby to initiate operation of said motive means, and resetting means operable in response to said initiation for further rotating and returning said control member to its initial position, said actuating member when displaced from its normal position being arranged to block the return of said rotatable control member to its initial position.

5. In an electric circuit breaker, motive means operable to effect closing thereof, a rotatable control member having an initial position, means for initiating operation of said motive means in response to rotation of said control member from its initial position through a fraction of a revolution, said initiating means being ineffective to initiate another operation of said motive

8

means until said control member is returned to said initial position, a selectively-operable actuating member movable out of a normal position to rotate said control member through said fraction of a revolution thereby to initiate operation of said motive means, and resetting means operable in response to said initiation for further rotating and returning said control member to its initial position.

6. In a closing mechanism for a circuit breaker, a spring dischargeable at one end to close the breaker, a holding member operable in a holding position to prevent discharge of said spring and releasable out of said holding position to permit said spring to discharge, charging means coupled to the other end of said spring and operable to charge said spring, actuating means for releasing and thereafter resetting said holding member thereby permitting said spring to perform a single circuit breaker closing operation, means controlled by said actuating means for producing operation of said charging means after said holding member has been released, an interference member operable to temporarily mechanically block said actuating means from re-releasing said holding member, and resetting means operable in response to a predetermined operation of said charging means for rendering said interference member ineffective to prevent said re-releasing and for rendering said actuating means again operable to effect said re-releasing whereby another closing operation can be initiated after the spring has been charged.

7. The combination of claim 6 in which said actuating means comprises a selectively-operable controlling member which is movable out of a normal position to initiate said breaker-closing operation, said controlling member when displaced from its normal position being arranged to block said resetting means from rendering said actuating means again operable, whereby to prevent circuit breaker pumping.

8. In a closing mechanism for a circuit breaker, a chargeable spring which is releasable to effect closing of the breaker, a rotatable cam controlling the release of said spring, a selectively-operable actuating member for said cam, actuating mechanism for rotating said cam from an initial position through a fraction of a revolution in response to movement of said actuating member out of its normal position, means responsive to said fractional rotation for releasing said spring to effect closing of said breaker, interference means for temporarily preventing said cam from returning to its initial position, charging means for charging said spring after it has been released, resetting means operable in response to a predetermined charging of said spring by said charging means for overcoming the action of said interference means and for returning said cam to its initial position, said actuating member when displaced from its normal position being operable to block return of said cam into its initial position whereby restoration of said actuating member to its normal position is necessary in order to render the actuating member again capable of releasing the spring.

9. In a closing mechanism for a circuit breaker, a chargeable spring which is releasable to effect closing of the breaker, a rotatable cam for controlling the release of said spring, a selectively-operable actuating member for said cam, means for rotating said cam from an initial position through a fraction of a revolution in response to movement of said actuating member out of its normal position, means responsive to said fractional rotation for releasing said spring to effect closing of said breaker, charging means for automatically recharging said spring after it has been released, resetting means operable in response to a predetermined charging of said spring by said charging means for further rotating said cam and returning it to its initial position, said actuating member when displaced from its normal position being operable to block return of said cam into its initial position, whereby restoration of said actuating member to its normal

position is necessary in order to render the actuating member again capable of releasing the spring.

10. In a closing mechanism for a circuit breaker, a chargeable spring which is releasable to effect closing of the breaker, a rotatable cam for controlling the release of said spring, a selectively-operable actuating member for said cams, means for rotating said cam from an initial position through a fraction of a revolution in response to movement of said actuating member out of its normal position, means responsive to said fractional rotation for releasing said spring to effect closing of said breaker, charging means for automatically recharging said spring after it has been released, resetting means operable in response to a predetermined charging of said spring by said charging means for further rotating said cam and returning it to its initial position.

11. In a closing mechanism for a circuit breaker, a driven member operable to effect closing of the breaker, a driving spring having one end coupled to said driven member, a movable holding member operable in a holding position to restrain movement of said driven member and releasable out of said holding position to permit said driven member to be operated by said spring to close the breaker, charging means coupled to the other end of said spring and operable to charge said spring, a cam for controlling said holding member, operating means for moving said cam from a first to a second position, means responsive to said cam movement for releasing and thereafter resetting said holding member thereby permitting said spring to operate said driven member through a single breaker-closing operation, means including a switch controlled by said operating means for producing operation of said charging means after said holding member has been released, and resetting means operable in response to a predetermined charging of said spring by said charging means to return said cam to said first position.

12. In a closing mechanism for a circuit breaker, a driven member operable to effect closing of the breaker, a driving spring having one end coupled to said driven member, a movable holding member operable in a holding position to restrain movement of said driven member and releasable out of said holding position to permit said driven member to be operated by said spring to close the breaker, charging means coupled to the other end of said spring and operable to charge said spring, a cam for controlling said holding member, operating means for moving said cam from a first to a second position, means responsive to said cam movement for releasing and thereafter resetting said holding member thereby permitting said spring to operate said driven member through a single breaker-closing operation, means including a switch controlled by said operating means for producing operation of said charging means after said holding member has been released, and resetting means operable in response to a predetermined charging of said spring by said charging means to return said cam to said first position, and means for maintaining said holding member in its holding position during said return movement of said cam.

13. In an electric circuit breaker, motive means operable to effect closing thereof, a rotatable control member for said motive means, a resetting spring biasing said control member into an initial dead center position with respect to said spring, means for initiating operation of said motive means in response to rotation of said control member from said initial position through a fraction of a revolution toward a second dead center position, said initiating means being ineffective to initiate another operation of said motive means until said control member

is returned to said initial position, and resetting means operable in response to initiation of operation of said motive means for further rotating said control member through said second dead center position whereby said resetting spring is rendered effective to continue rotation of said control member toward said initial position.

14. The apparatus of claim 13 in combination with interference means operable after said fraction of a revolution has been completed for blocking reverse rotation of said control member back to said initial position.

15. In an electric circuit breaker, motive means operable to effect closing thereof, a rotatable control member for said motive means, a resetting spring biasing said control member into an initial dead center position with respect to said spring, means for initiating operation of said motive means in response to rotation of said control member from said initial position through a fraction of a revolution toward a second dead center position, said initiating means being ineffective to initiate another operation of said motive means until said control member is returned to said initial position, a selectively-operable actuating member movable out of a normal position to rotate said control member through said fraction of a revolution thereby to initiate operation of said motive means, and resetting means operable in response to said initiation for further rotating said control member through said second dead center position whereby said resetting spring becomes effective to continue rotation of said control member toward said initial position, said actuating member when displaced from its normal position being arranged to block the return of said control member to its initial position whereby to prevent pumping.

16. In an electric circuit breaker, motive means operable to effect closing thereof, a control member having an initial position, means for initiating operation of said motive means in response to movement of said control member out of its initial position, said initiating means being ineffective to initiate another operation of said motive means until said control member is returned to its initial position, a selectively-operable actuating member movable out of a normal position to move said control member out of its initial position thereby to initiate operation of said motive means, an interference member operable to temporarily mechanically block said control member from returning to its initial position, resetting means controlled by said actuating member for rendering said interference member ineffective and for returning said control member to its initial position, said actuating member when displaced from its normal position being arranged to block the return of said control member to its initial position.

17. In an electric circuit breaker, motive means operable to effect closing thereof, a control member having an initial position, means for initiating operation of said motive means in response to movement of said control member out of its initial position, said initiating means being ineffective to initiate another operation of said motive means until said control member is returned to its initial position, a selectively-operable actuating member movable out of a normal position to move said control member out of its initial position thereby to initiate operation of said motive means, an interference member operable to temporarily mechanically block said control member from returning to its initial position, resetting means controlled by said actuating member for rendering said interference member ineffective and for returning said control member to its initial position.

No references cited.