April 27, 1937. G. D. GAMEL ET AL 2,078,657

AUTOMATIC RECLOSING CIRCUIT INTERRUPTER

Filed May 11, 1933 5 Sheets-Sheet 1

Fig. 1.

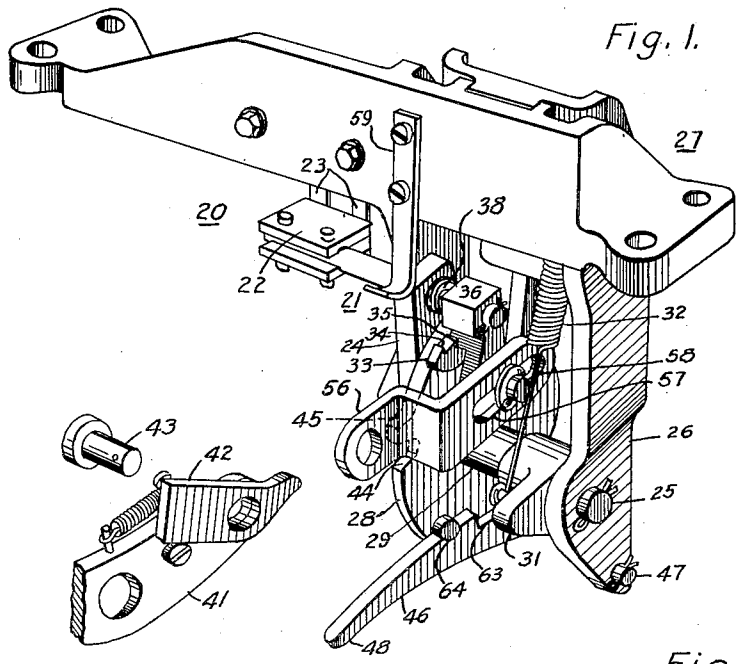
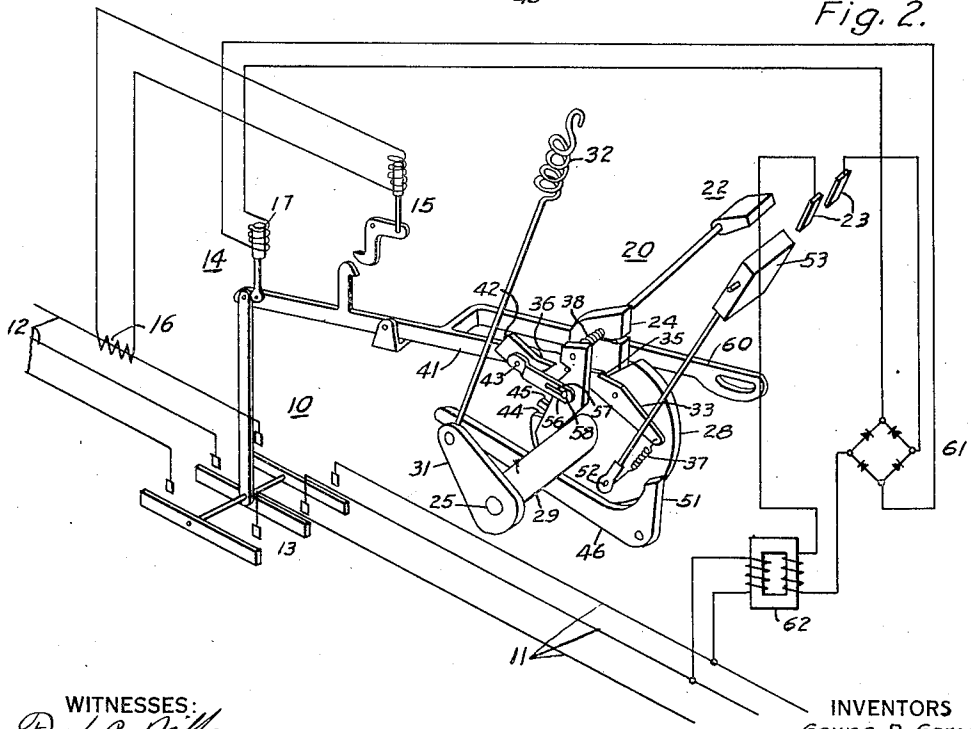


Fig. 2.



WITNESSES:
Fred C. Williams.
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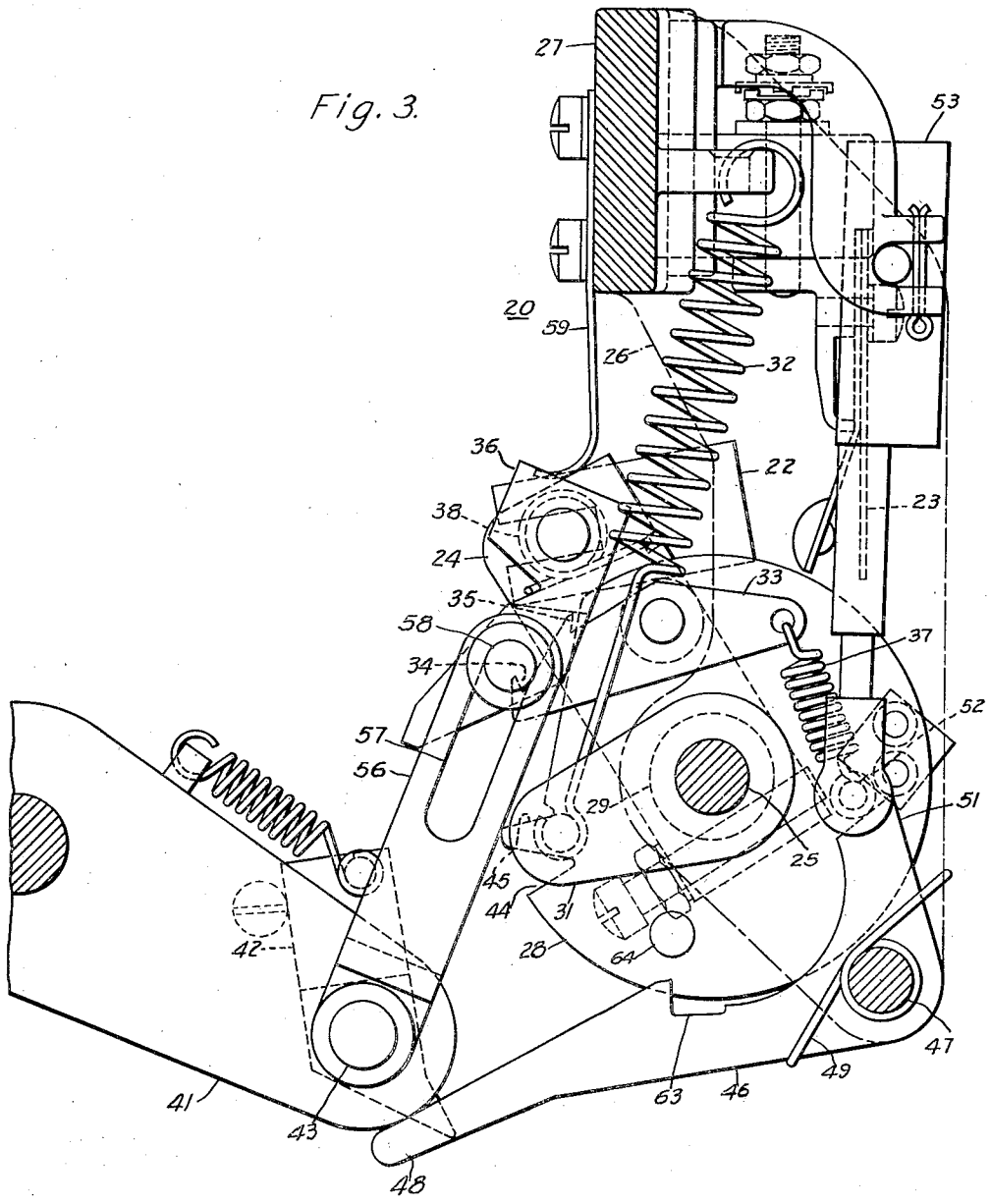
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AUTOMATIC RECLOSING CIRCUIT INTERRUPTER

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Fig. 3.



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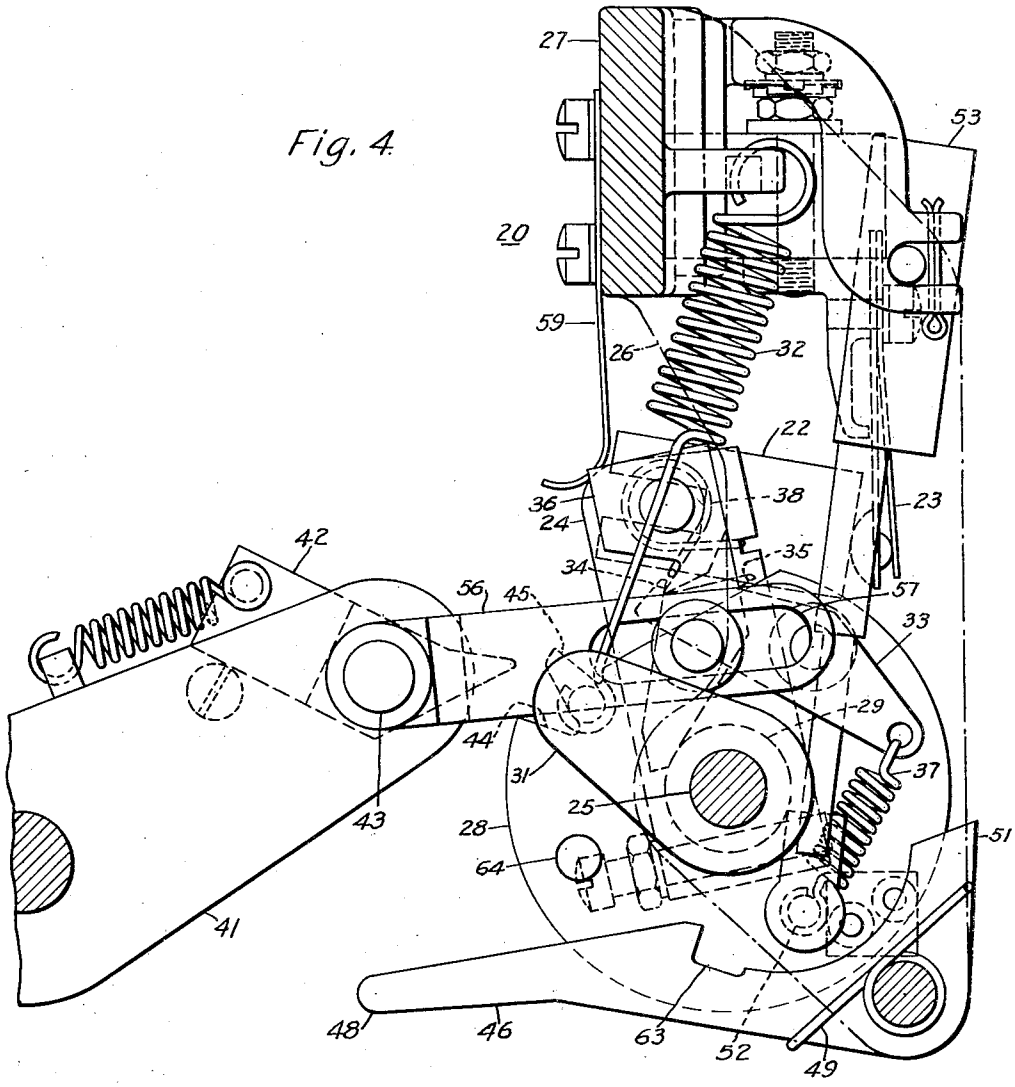
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AUTOMATIC RECLOSING CIRCUIT INTERRUPTER

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Fig. 4.



WITNESSES:
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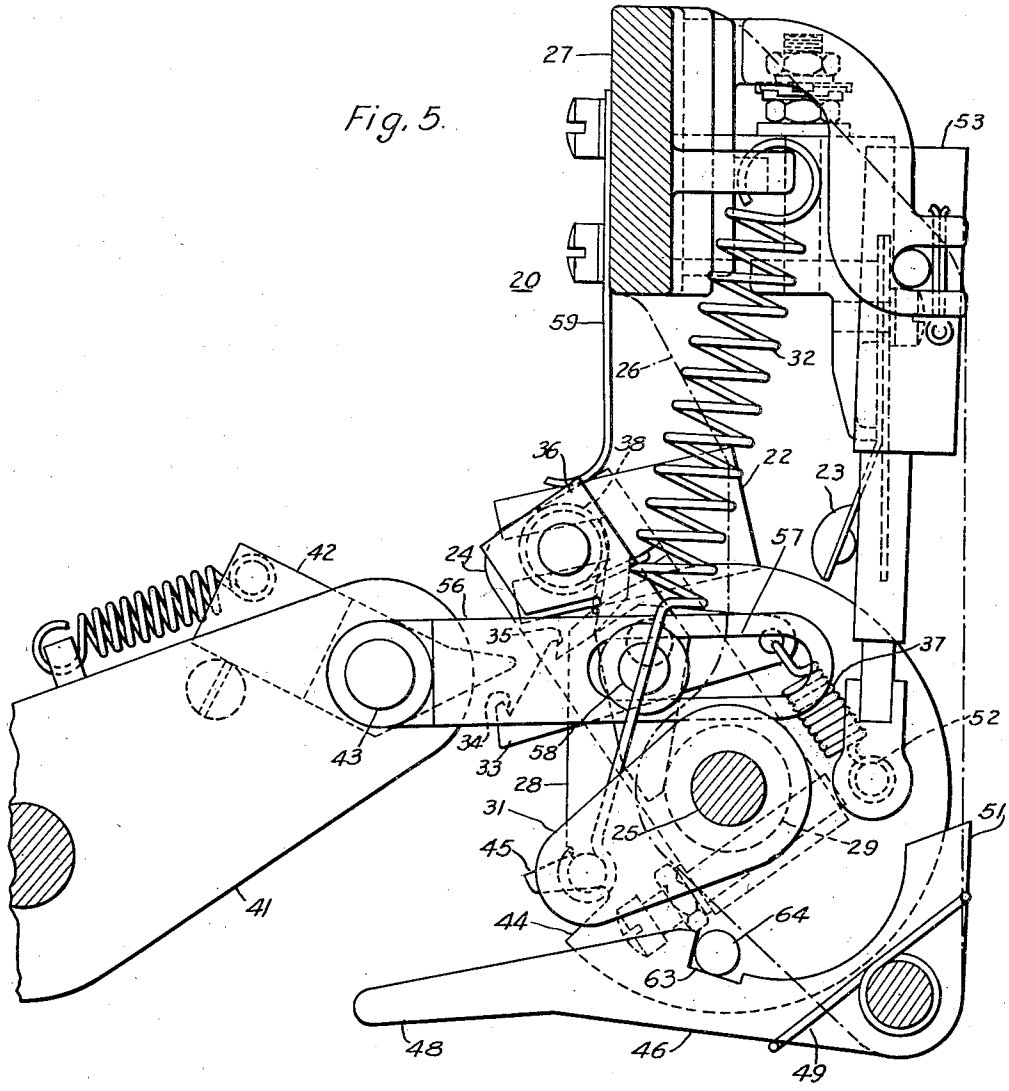
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AUTOMATIC RECLOSING CIRCUIT INTERRUPTER

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Fig. 5.



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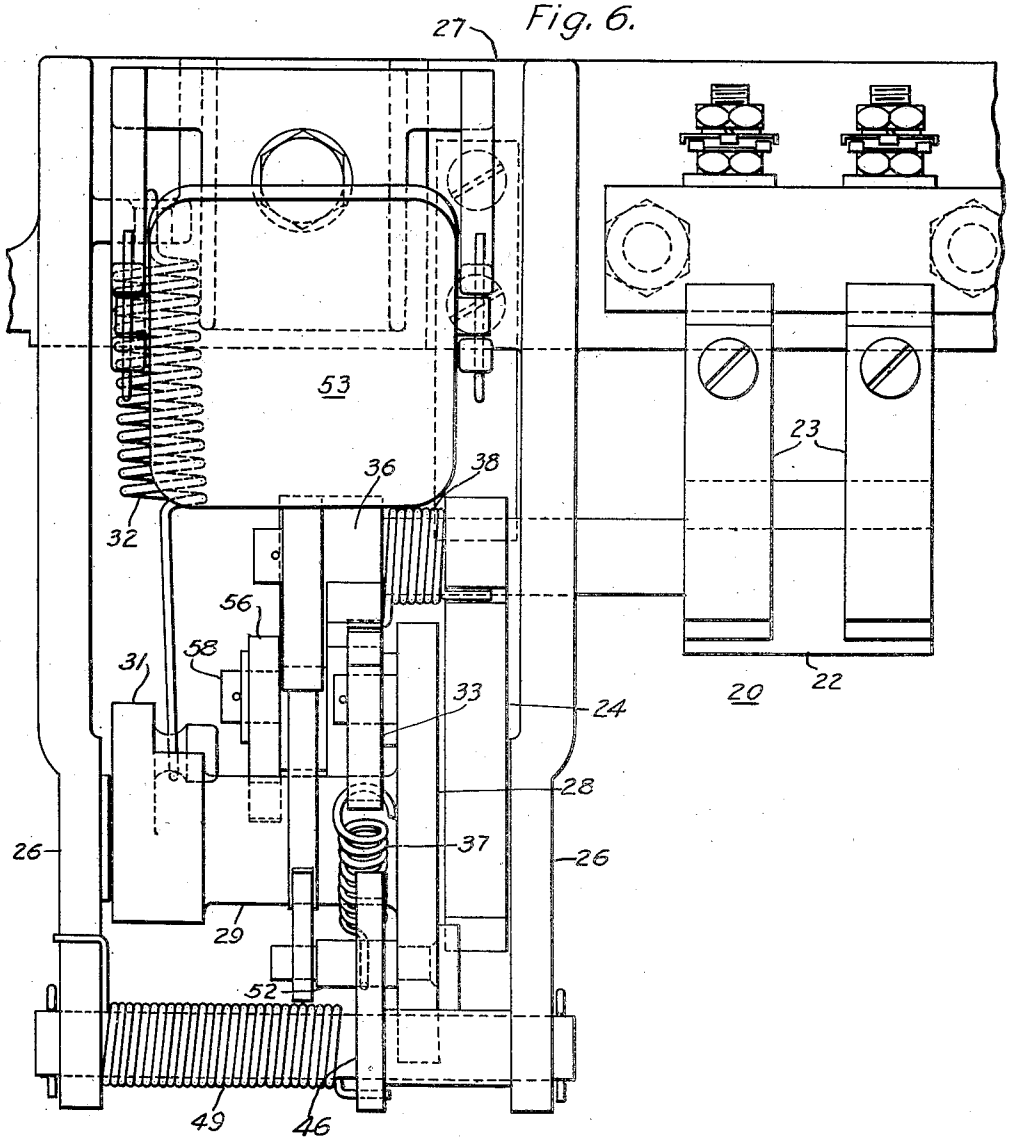
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Fig. 6.



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UNITED STATES PATENT OFFICE

2,078,657

AUTOMATIC RECLOSING CIRCUIT INTERRUPTER

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Application May 11, 1933, Serial No. 670,460

20 Claims. (Cl. 200—89)

Our invention relates, generally, to circuit interrupting apparatus and systems, and, more particularly, to automatic reclosing circuit interrupting apparatus adapted to effect a predetermined number of reclosures of a circuit at predetermined time intervals.

Heretofore, it has been the usual practice to control the reclosing operations of a circuit interrupter by means of an electrical system comprising timing relays and auxiliary control relays of various kinds as distinguished from a mechanical system or device.

Electrical reclosing systems, while satisfactory, have proved to be expensive to build and cannot readily be embodied in the circuit breaker structure so as to provide an integral reclosing unit. Because of the fact that such electrical reclosing systems are expensive to build, the use of automatic reclosing circuit breaker systems has been limited, generally, to such applications as would justify the necessary investment, however, there has existed for some time a considerable field for the application of reclosing apparatus which would not justify any great expense but in which such apparatus could be used to great advantage to both the power company and the consumer of electrical power.

Recognizing the ever growing need for reclosing apparatus of a more economical type, it is the object of our invention, generally stated, to provide an automatic reclosing circuit interrupter which shall be of simple construction and effective in operation and which shall be economical to manufacture and install.

A more specific object of our invention is to provide for automatically controlling the reclosing operations of a circuit interrupter by means of a mechanical timing and counting device which may be readily incorporated in the circuit interrupter structure, attached thereto or located in close proximity thereto.

A further object of our invention is to provide for automatically reclosing a circuit interrupter a predetermined number of times by means of a mechanical timing and counting device, the functioning of which is mechanically controlled directly by the operations of the interrupter.

Another object of our invention is to provide a mechanical timing and counting device for controlling the energization of a breaker closing solenoid or motor which may be readily attached or built into the breaker structure and controlled mechanically in response to the opening and closing movements of the mechanism.

A further object of our invention is to provide a mechanical recloser for circuit interrupters which will function automatically in response to successive openings of the interrupter to reclose it at predetermined intervals for a predetermined number of times and then become inoperative to produce further reclosures until reset and to reset automatically should the interrupter remain closed for a predetermined time on any reclosure prior to the last.

A still further object of our invention is to provide for automatically effecting a predetermined number of timed reclosures of the main switch element of a circuit interrupter by means of a mechanical reclosing device adapted to be conditioned for operation in response to closures of the main switch element and released for timed automatic operation in response to an opening of the main switch element and adapted to reclose a main switch element a predetermined number of times at predetermined timed intervals in response to successive openings thereof and to reset for a subsequent operation in the event the main switch element remains closed before the predetermined number of reclosures have been made.

Other objects of our invention will, in part be obvious, and, in part, appear hereinafter.

Our invention, accordingly, is disclosed in the embodiment hereof shown in the accompanying drawings and comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of our invention, reference may be had to the following detailed description taken in conjunction with the drawings, in which:

Fig. 1 is a perspective view of the mechanical counting and timing device embodying the principal features of our invention.

Fig. 2 is a diagrammatic view showing how the mechanical counting and timing device may be combined with a circuit interrupting mechanism in order to produce our novel automatic reclosing circuit interrupter.

Fig. 3 is a side elevational view of the counting and timing device of Fig. 1, certain parts being broken away to illustrate its normal non-operating position when the circuit interrupter is in the closed position.

Fig. 4 is a similar view showing the counting and timing device in its closed position.

Fig. 5 shows the counting and timing device in its lock-out position, and

Fig. 6 is a front elevational view of the counting and timing device showing the relative locations of its elements.

In practicing our invention in the preferred manner, we utilize a circuit interrupter comprising a main switch element and a mechanism for controlling the movements thereof and attach the mechanical counting and timing device to the interrupter in such manner as to form an automatic reclosing interrupter. The mechanical counting and timing device is disposed to be controlled by the movement of the mechanism which actuates the main switch element of the interrupter and functions to control the energization of the electromagnetic device which functions to operate the switch element and its actuating mechanism.

Referring now to the drawings and to Fig. 2 in particular, the numeral 10 designates generally a circuit interrupter which may be used to control the flow of current in a feeder circuit comprising conductors 11 connected to a source of power and conductors 12 connected to a load.

The interrupter 10 comprises a main switch element 13 and an actuating mechanism 14 comprising an electro-responsive trip or opening device 15 which may be connected to the load circuit 12 by means of a current transformer 16 to effect an opening operation of the interrupter in response to an abnormal circuit condition and an electro-responsive closing device 17 which, in this instance, is illustrated as a solenoid although it may take the form of a motor or any other suitable device.

In order to provide for automatically reclosing the interrupter a predetermined number of times at predetermined time intervals in response to an opening operation thereof, there is provided a mechanical counting and timing device 20 of such construction that it may be mounted in close proximity to the circuit interrupter either by a separate mounting or by attaching it directly to the interrupter so that the movements of the operating mechanism 14 may be utilized to control the operation of the mounting and timing device as will be described more in detail hereinafter.

The counting and timing device 20 comprises, generally, a control switch element 21 comprising a movable contact member 22 disposed to bridge stationary contact members 23. The movable contact member 22 may be supported or carried by an arm 24 loosely mounted on a main shaft 25 which is supported by depending portions 26 of the frame casting 27.

In this embodiment of the invention, the switch element 21 is actuated in the closing direction by means of a spring-biased or spring-actuated disc element comprising a disc 28 secured to a hollow shaft 29 rotatably mounted on the main shaft 25. An arm 31 is attached to the hollow shaft and a suitable spring 32 attached to the arm 31 for continually biasing the disc in a clockwise or closing direction. It is to be understood, however, that any other form of biasing means may be used and also that the whole spring biased element may be constructed in any other suitable form.

In order to render the disc element 28 effective to operate the control switch element 21 in the closing direction, there is provided a pawl and ratchet connection between the arm 24 and disc 28 comprising a spring-biased ratchet 33 pivotally mounted on the disc 28 provided with a plurality of notches 34 and 35 disposed to engage a pawl 36 on the arm 24 when this arm is in the open position and the disc is rotated by the biasing spring 32. As shown the notched end of the ratchet is urged toward the pawl 36 by means of spring 37 while the pawl is also urged toward the ratchet by means of a suitable biasing spring 38, thereby insuring engagement when the disc rotates clockwise and disengagement when it rotates counter-clockwise.

In order to provide for controlling the operation of the counting and timing device in accordance with the movements of the circuit interrupter or the actuating mechanism thereof, an actuating arm 41 is utilized. The arm 41 may be operated in any suitable manner as by securing it to a shaft which is moved through a predetermined angle of rotation in accordance with the closing and opening movements of the circuit interrupter under the influence of its closing solenoid or motor, or in any other suitable manner so long as its movements correspond to the opening and closing movements of the main switch element 13.

In this instance, the actuating arm 41 is provided with a spring-biased pawl 42 pivotally mounted at 43, which, when the arm is rotated downwardly in accordance with a closing operation of the interrupter, engages either of slots 44 and 45 in the peripheral surface of the disc to rotate the disc in a counterclockwise direction through a predetermined angle of rotation against the force of its biasing spring 32.

As will be readily understood when the actuating arm 41 is moved through a predetermined portion of its angle of rotation, the pawl 42 disengages the slot in the disc 28 and the disc immediately reverses its direction of rotation because of the force exerted by its biasing spring 32. In order to catch the disc and retain it in its normal non-operating position or initial starting position, as shown in Fig. 3, there is provided a bell-crank lever 46 pivotally mounted on the frame at 47. The end 48 of this lever is disposed in the plane of movement of the arm 41 and is engaged thereby and actuated to a holding position against the force of a biasing spring 49. This movement of the bell crank positions its other end 51 so that it will be engaged by a pin 52 on the disc 28 which stops and retains the disc in its normal non-operating position so long as the circuit interrupter is closed.

In order to control the speed of rotation of the disc 28 under the influence of its biasing spring when released by the bell crank 46, there is provided a time-delay element connected between the pin 52 on the disc and the frame as shown. Any suitable time-delay element may be utilized such, for example, as an escapement device 53 as shown, a dash pot or the like in order to control the time required to effect a reclosure of the interrupter, and it should preferably be adjustable.

In order to effect the opening of the switch element 21 of the counting and timing mechanism to deenergize the closing solenoid at the time the interrupter is being latched closed and also to position the arm 24 and the pawl 36, so that it may be subsequently picked up by the ratchet 33 on the disc, there is provided a link 56 pivotally connected to the actuating arm 41 at 43 and having a slot 57 engaging a pin 58 on the pawl 36. This provides a lost motion connection which, as shown in Fig. 3, opens the switch element 21 when the interrupter is closed

and, as shown in Fig. 4, releases it for closure by the disc 28 when the interrupter has opened.

The switch 21 is given an overcenter action by means of a spring finger 59 adapted to engage the upper end of arm 24 and retain it in either of two positions as shown in Figs. 3 and 4.

In order that a more comprehensive understanding of our invention may be obtained, a detailed description of its operation under various conditions will now be set forth.

Assuming that the main switch element 13 of the interrupter has been actuated to its closed position which may be effected by means of a handle 60, the mechanical counting and timing device will be actuated to its normal non-operating position, as shown in Fig. 3. As will be observed, the actuating arm 41, which moves through a predetermined angle of rotation in response to the closing and opening movements of the main switch element, has now been actuated to its lower position where it engages the end 48 of the bell-crank lever 46 to retain the disc element 28 in the position as shown against the force of the biasing spring 32.

As will also be observed, the link 56 has also functioned to actuate the contact-carrying arm 24 to the open position, thereby holding the pawl 36 in such position that it cannot engage the ratchet member 33.

Assuming now that the circuit interrupter is tripped in response to an overload condition or the like, the arm 41 moves to its upper position, as shown in Fig. 4, thereby releasing the holding lever 46 and moving the link 56 into such position that the contact-carrying arm 24 is now released.

Upon the release of the holding lever 46, it is actuated to its normal position, as shown in Fig. 4, by its biasing spring 49, thereby releasing the disc element for operation.

As soon as the disc 28 is released, it starts to rotate in a clockwise direction under the influence of its biasing spring 32, and when in a certain angular position, the pawl 36 is picked up in the first notch 34 of the ratchet 33. The disc continues to rotate, now carrying the contact arm 24 with it toward the closed position, as shown in Fig. 4.

Since the disc 28 is being retarded in its movement by the time delay device 53, it is apparent that the contact members 23 are bridged by the movable element 22 to effect the energization of the closing solenoid 17 at the expiration of a predetermined time interval following the automatic opening of the main switch element 13.

The energizing current for the closing solenoid 17 may be obtained from any suitable source, which, in this instance, is illustrated as a rectifier 61 having its output terminals connected to the solenoid 17, and its input terminals connected through contact members 23 to the secondary winding of a transformer 62, the primary winding of which is connected to the supply conductors 11.

When the closing solenoid 17 is energized, as described, the main switch element 13 is reclosed and the arm 41 is again actuated to its lower position, as shown in Fig. 3. It will be observed, however, that since the pawl 36 on the arm 24 has engaged the first notch 34 of the ratchet, the disc is stopped in a predetermined angular position when the contact member 22 is fully closed. This position is shown in Fig. 4. When the arm 41 moves downwardly, the pawl 42 now engages the notch 44 in the disc and rotates it in a counter-clockwise direction through a predetermined angle of rotation. The arm also engages the end 48 of the bell-crank lever 46 and actuates it to a holding position. The design of the mechanism is such that this counter-clockwise movement of the disc carries the pin 52 to a point above its normal non-operating position, so that by an operation of the lever 46 the disc, when it is released by the pawl 43, reverses its direction of rotation and may be caught and retained in its non-operating position as described hereinbefore.

This operation occurs only in the event that the circuit interrupter remains in the closed position after the first reclosure, since when such occurs the arm 41 remains in the lower position, as shown in Fig. 3, thereby retaining the lever 46 in a position to catch the disc during its unwinding operation. It will also be understood that the link 56 functions again to actuate the contact-carrying arm 24 to the open position, thereby deenergizing the closing solenoid 17 when the main switch element is closed.

In the event the circuit interrupter reopens immediately, the arm 41 is again returned to its upper position, thereby releasing the retaining lever 46 which permits the disc 28 to continue its rotation in a closing direction.

In this instance, the pawl 36 will be picked up by the second notch 35 in the trigger for the reason that the disc was actuated through such an angle in the counter-clockwise direction when the pawl 46 engaged notch 44 as to position the notch 35 ahead of the pawl 36, so that when it was released by the operation of the link 56, it would be directly in the path of the second notch 35.

As described before, the disc continues to rotate in the counter-clockwise direction for a predetermined time interval, as determined by its time delay element 53, at which time the contact members 23 are bridged to effect a second reclosure of the main contact element 13.

As will be readily understood, the disc is now retained in a different angular position because of the engagement of the pawl 36 with the second notch in the ratchet, thereby permitting the pawl 42 on the arm 41 to engage the second notch 45 in the disc. This causes the disc to be rotated in a counter-clockwise direction through a greater angle than formerly. However, should the circuit interrupter remain closed, thereby causing the arm 41 to hold the retaining lever 46 in such position as to catch the disc as it starts to unwind when the pawl 42 disengages from the notch 45, it makes no difference to what angular position the disc is rotated.

In the event, however, that the circuit interrupter reopens immediately, the retaining arm 46 is moved to its normal position, thereby positioning its notch 63 in the path of a pin 64 on the disc 28. As will be readily understood, this securely locks the disc 28 against further rotation in the clockwise direction, and thereby prevents a further reclosing operation of the main switch element. This position is known as the "lock-out" position, and the lock-out may be made to occur after any desired number of reclosing operations.

In order to reset the mechanism after a lock-out has been effected, the main switch element 13 may be closed manually by means of the handle 60, as shown in Fig. 2, which causes the arm 41 to again engage the end of the retaining lever 46, thereby actuating it downwardly until the locking pin 64 has become disengaged from the

notch 63. This permits the disc 28 to rotate in a clockwise direction until the pin 52 again engages the lever 46 to retain the disc in its normal non-operating position, as shown in Fig. 3.

It is to be understood that the reclosing mechanism automatically resets to its normal non-operating position should the interrupter remain closed on either the first or second reclosures. This is because of the fact that whether the pawl 43 engages notch 44 or 45 the disc is always rotating to an angular position such that when it is released the pin 52 will engage the retaining arm 46, provided it is held in a downward position, as would be the case when the interrupter is closed.

In view of the foregoing it is apparent that we have provided an automatic reclosing circuit interrupter of simple construction which may be formed by associating a suitable mechanical counting and timing device with an ordinary circuit interrupter in such manner that the movements of its main switch element may be utilized to control the operation of the mechanical counting and timing device. This device may be attached to, or built into, the circuit interrupter structure in any desirable manner, the only requirement being that they are mechanically associated.

It is apparent that the counting and timing mechanism may be constructed in a number of different ways, so long as there is a switch element for controlling the closing solenoid and a self-actuating member, operated by means of a spring or otherwise, which may be retained in a certain position normally and released from such position in response to an opening of the interrupter to effect a timed closure of the contact members. The only other necessary requirement is the lock-out feature which might also be obtained in other ways from that illustrated.

Therefore, while we have illustrated a specific embodiment of our invention in order to clearly disclose its novel features, we do not wish to be limited to the exact details of construction as shown, since modifications may be made without departing from the spirit of the invention as defined in the appended claims.

We claim as our invention:

1. An automatic reclosing device for a circuit interrupter having a main contact element, means for opening said element and electro-responsive means for closing the main contact element, comprising, a control switch element for controlling the energization of the closing means and a self-actuated mechanical notching device having a normal starting position and disposed to be mechanically actuated to different starting positions and released for operation in accordance with the successive closing and opening movements of the main contact element of the interrupter for operating the control switch, said notching device being disposed to automatically become inoperative to effect further operations of the control switch and closure of the main contact element after a predetermined number of operations.

2. An automatic reclosing mechanism for a circuit interrupter having a main switch element, means for closing said switch element and means for opening said element, comprising a control switch operable to control the energization of the closing means, and a counting and timing device comprising a single spring-driven rotatable element for mechanically actuating the control switch to energize the closing means, said device being operated to a starting position each time the main switch element closes and released in response to the opening of the main switch element and disposed to automatically lock out after a predetermined number of operations in the event that the main switch element continues to reopen.

3. The combination with a circuit interrupter having a main switch element, electro-responsive means for closing the switch element and means for automatically opening the switch element, of a self-operating mechanical counting and timing device for controlling the energization of the closing means, said device comprising a control switch for controlling the energization of the closing means and a single rotating actuating element therefor mechanically operated to and released from a starting position in accordance with the closing and opening operations of the main switch element to effect a predetermined number of successive timed reclosures of the main switch element.

4. The combination with a circuit interrupter having a main switch element, electro-responsive means for closing the switch element and means for automatically opening the switch element, of a control switch having open and closed positions for controlling the energization of the electro-responsive closing means, a single rotatable element normally held in a starting position mechanically when the circuit interrupter is closed and disposed when released to operate the control switch from its open position to the closed position, driving means for actuating the rotating element in a closing direction when the circuit interrupter opens, means for controlling the speed of rotation of said element and means actuated into engagement with the rotating element during the closing operation of the main switch element for mechanically actuating the rotatable element to a starting position and for effecting its release from said starting position in response to the opening of the main contact members, thereby to provide successive timed reclosures of the main switch element.

5. The combination with a circuit interrupter provided with electro-responsive closing means and means for automatically opening the interrupter, of switch means operable to control the energization of the closing means, mechanical means actuated in response to the closure of the interrupter for opening the switch means, mechanical timing means including a rotatable element having a non-operating position and self-operable when released from said position to actuate the switch means to close the interrupter, mechanical means actuated by the interrupter disposed to engage the rotatable element only during the closing of the interrupter for actuating the rotatable element to its non-operating position in response to each closure of the interrupter, and latch means cooperating with said mechanical means for holding the rotatable element in its non-operating position when the interrupter is closed.

6. In a mechanical reclosing device for circuit interrupters having electro-responsive closing means, in combination, a switch element for controlling the energization of the closing means, means including a spring-actuated driving element for actuating the switch element, releasable latch means mechanically actuated by the interrupter for holding said spring-actuated driving element in a normally non-operating position when the interrupter is closed, said spring-actu-

ated driving element being automatically operable when released to close the switch element and adapted for a predetermined number of successive operations, and means on said spring-actuated driving element disposed to cooperate with said releasable holding means to preclude further operation of the spring-actuated driving element after said predetermined number of successive operations in the event that the interrupter opens within a predetermined time following the last of said predetermined number of successive operations.

7. The combination with a circuit controlling device provided with automatic tripping means and electro-responsive means for closing the circuit controlling device, of a switch for controlling the energization of the closing means and a mechanical counting and timing device comprising a single spring-actuated driving element having a normal starting and non-operating position and successively operable to mechanically actuate said control switch to its closed position to reclose the circuit controlling device a predetermined number of times at predetermined intervals, said driving element being mechanically released for operation and reset to different starting positions by means responsive to the successive opening and closing operations of the circuit controlling device.

8. The combination with a circuit interrupter having a closing solenoid and means for automatically opening the interrupter, of a switch for controlling the energization of the closing solenoid, a self-actuated successively-operable timing device for actuating the switch to its closed position, said device having a normal starting and non-operating position and a lockout position and being reset to different starting positions toward the lockout position in response to successive closing operations of the interrupter, and means responsive to the closed condition of the interrupter for holding the timing device in its normal starting position and responsive to an opening operation of the braker for initiating the operation of the timing device, said timing device being inherently disposed to become inoperative to close the control switch after a predetermined number of successive opening and closing operations of the interrupter.

9. In a mechanical reclosing device for circuit interrupters, in combination, a switch element, means including a rotatable disc for actuating the switch element to its closed position, spring means for constantly exerting a rotating force on said disc, means for controlling the speed of rotation of the disc, and mechanical means adapted to be actuated by the circuit interrupter for retaining the disc in a normal non-operating position against the force of the spring means when the interrupter is closed and releasable to initiate the operation of the disc when the interrupter opens, said means being adapted to lock the disc against further rotation after it has functioned to close the switch a predetermined number of times and the interrupter fails to remain closed for a predetermined time.

10. A mechanical reclosing device for circuit interrupters comprising a rotatably mounted disc element, means for biasing the disc to rotate in one direction, a switch element for controlling the closing operations of the circuit interrupter, ratchet means interposed between the switch element and disc to provide for actuating the switch element to its closed position, said ratchet means being disposed to stop the disc in different positions depending upon the starting position of the disc, ratchet means interposed between the disc and the circuit interrupter to actuate the disc to different starting positions in response to successive closures of the interrupter, and means disposed to render the disc ineffective to produce further closures of the switch element after a predetermined number of operations thereof.

11. In combination, a circuit controlling switch comprising a movable contact member, a rotatably mounted member, spring means for constantly exerting a force to rotate said member, ratchet means interposed between the movable contact member of the switch and the rotatably-mounted member, whereby the switch is actuated to the closed position in response to the rotation of the rotatably-mounted member by the spring means, means for releasably retaining the rotatably mounted means in an initial starting position against the force of the spring means to provide upon the release of the rotatably-mounted means for closing the switch, said ratchet means being disposed to stop the rotatably-mounted means in different predetermined positions dependent upon its starting position and means operable to actuate the rotatably-mounted means to different starting positions dependent upon its position determined by the ratchet means as the result of successive operations thereof.

12. In a mechanical reclosing device for circuit interrupters, in combination, switch means for controlling the closing of the circuit interrupter, a pivotally-mounted arm for actuating the switch means, a rotatable disc for actuating the arm to close the switch means, a ratchet connection between the arm and the disc whereby the arm may be actuated in a contact closing direction, means for driving the disc in one direction to close the switch means, means disposed to be actuated in accordance with the closing and opening movements of the circuit interrupter and adapted to rotate the disc in the opposite direction to a predetermined position when the interrupter is closing, and means disposed to be engaged by said last-named means for releasably holding the disc in a starting or non-operating position.

13. In a mechanical recloser for effecting a predetermined number of timed reclosures of a circuit interrupter, in combination, switch means for effecting closing operations of the interrupter, rotatably-mounted means for actuating the switch to the closed position, a ratchet connection between the switch means and the rotatably-mounted means whereby upon successive closures of the switch means the rotatably-mounted means is stopped in different positions, driving means for the rotatably-mounted means, means actuated in accordance with the closing movements of the interrupter for actuating the rotatably-mounted means to different starting positions, means dependent upon the circuit interrupter being in a closed position for retaining the rotatably-mounted means in a non-operating position, said means being disposed to release the rotatably-mounted means in response to an opening operation of the interrupter and to lock said rotatably-mounted means against further operation at the expiration of a predetermined number of reclosures of the interrupter.

14. In a mechanical recloser for effecting a predetermined number of timed reclosures of a circuit interrupter, in combination, switch means for effecting closing operations of the interrupter, a rotatably-mounted spring-biased disc element for actuating the switch means to the closed

position, means disposed to be actuated by the opening of the circuit breaker for opening the switch element, ratchet means interposed between the disc and the switch means, whereby successive operations of the disc from different starting positions effects successive closures of the switch means, means for retaining the disc in a predetermined non-operating position, and means actuated in accordance with the closing operation of the circuit interrupter disposed to actuate the disc to different starting positions, said means being disposed to engage the disc retaining means when the circuit interrupter is in the closed position for retaining the disc in its non-operating position.

15. The combination with a circuit interrupter having means for opening the interrupter and electro-responsive means for closing the interrupter, of a mechanical counting and timing switch for controlling the energization of the closing means, said counting and timing switch comprising a contact element and a single self-actuated element for closing the contact element having a lockout position and disposed when released from different starting positions to stop in different positions, means actuated by the interrupter for operating the actuating element from the different stopping positions to different starting positions progressively toward the lockout position during successive closing operations of the interrupter, and latching means rendered effective in response to the open condition of the interrupter and the actuating element reaching its lockout position for rendering said element ineffective.

16. The combination with a circuit interrupter having means for opening the interrupter and electro-responsive means for closing the interrupter, of switch means for controlling the energization of the closing means, a mechanical timing and counting device for actuating the switch means, said device comprising a self-operated rotating element having a normal starting and non-operating position and a lockout position, latch means for holding the rotating element in its normal starting and non-operating position, and means actuated by the circuit interrupter disposed to actuate the rotating element progressively toward the lockout position during successive closing operations of the interrupter and to engage the latch means to actuate it to a holding position when the circuit interrupter is closed, said latch means being effective to lock the rotating element against further rotation when it is actuated to the lockout position.

17. A mechanical reclosing device for a circuit breaker provided with automatic tripping means and an electro-responsive closing means comprising a switch for controlling the energization of the closing means, a rotatable actuator for the switch, a ratchet device carried by the actuator adapted to engage the switch to close it and to stop the actuator in different positions on successive operations from different starting positions, said actuator being provided with a plurality of spaced notches on the outside thereof, and means disposed to be mechanically actuated by the closing operations of the circuit breaker for engaging said notches dependent upon the stopping position to successively return the actuator to different starting positions.

18. A mechanical reclosing device for a circuit breaker provided with automatic tripping means and an electro-responsive closing means comprising a switch for controlling the energization of the closing means, a rotatable actuator for the switch, a ratchet device carried by the actuator adapted to engage the switch to close it and to stop the actuator in different positions on successive operations from different starting positions, said actuator being provided with a plurality of spaced notches on the outside thereof, and means disposed to be mechanically actuated by the closing operations of the circuit breaker for engaging said notches dependent upon the stopping position to successively return the actuator to different starting positions, and means disposed to be mechanically controlled by the position of the circuit breaker for retaining the actuator in a normal non-operating position dependent on the circuit breaker remaining closed for a predetermined time and for engaging the actuator to preclude further operations thereof after it has operated a predetermined number of times successively.

19. A mechanical reclosing device for circuit breakers provided with automatic tripping means and electro-responsive closing means comprising, a switch for controlling the energization of the closing means, mechanical means disposed to be actuated by the circuit breaker for opening the switch in response to the closure of the breaker and for releasing the switch for subsequent operation in response to the opening of the breaker, normally non-operating rotatable means for actuating the switch, means for constantly exerting a rotating force on said rotatable means, means disposed to be mechanically controlled by the circuit breaker for holding the rotatable means in a predetermined position against its rotating force when the breaker is closed and for releasing it when the breaker opens, and means disposed to be mechanically actuated by the closure of the circuit breaker for returning the rotatable means to its normal non-operating position.

20. A mechanical reclosing device for circuit breakers provided with automatic tripping means and electro-responsive closing means comprising, a switch for controlling the energization of the closing means, mechanical means disposed to be actuated by the circuit breaker for opening the switch in response to the closure of the breaker and for releasing the switch for subsequent operation in response to the opening of the breaker, normally non-operating rotatable means for actuating the switch, means for constantly exerting a rotating force on said means, means disposed to be mechanically controlled by the circuit breaker for holding the rotatable means in a predetermined position against its rotating force when the breaker is closed and for releasing it when the breaker opens, ratchet means interposed between the switch and the rotatable means whereby the actuating means closes the switch and is stopped thereby in different positions during successive operations dependent upon its starting position, and means disposed to be mechanically actuated by the closing operations of the circuit breaker for returning the actuating means to different starting positions during successive operations.

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