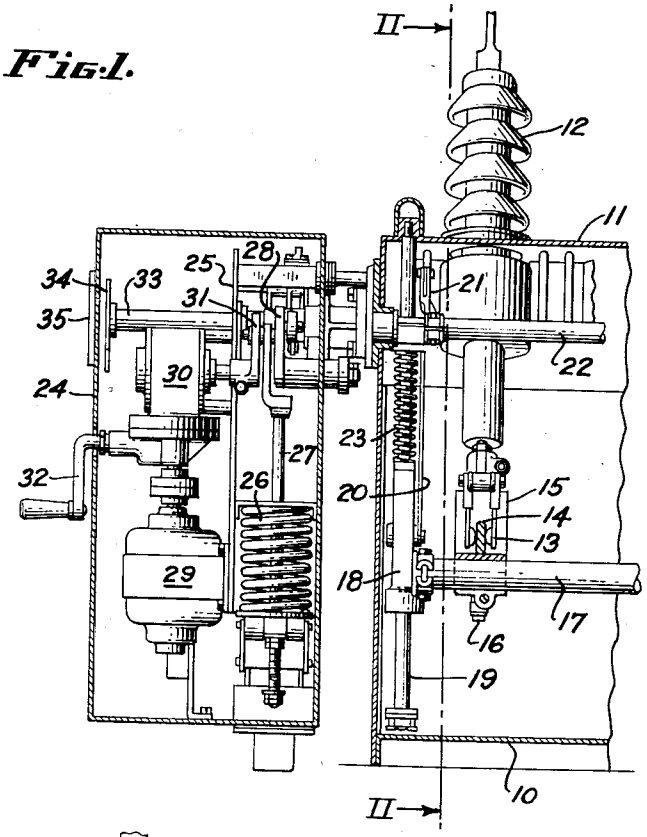
Jan. 13, 1942. A. C. SCHWAGER 2,269,604

CIRCUIT BREAKER OPERATING MECHANISM

Filed March 12, 1940 4 Sheets-Sheet 1

Fig. 1.



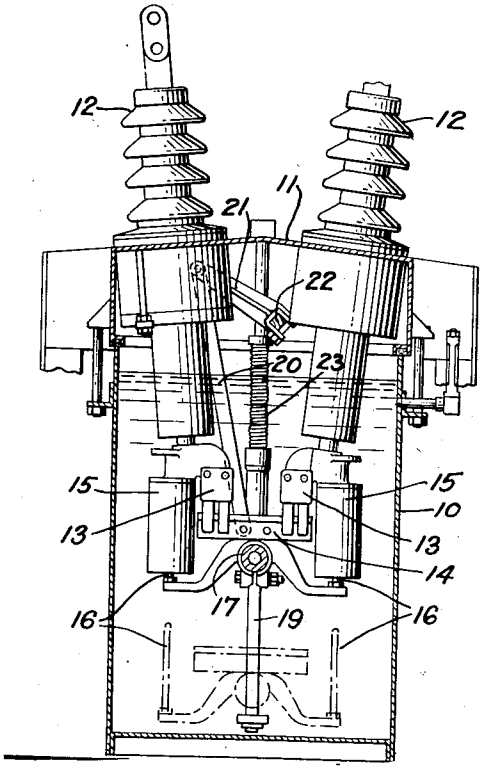


Fig. 2.

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CIRCUIT BREAKER OPERATING MECHANISM

Filed March 12, 1940 4 Sheets-Sheet 2

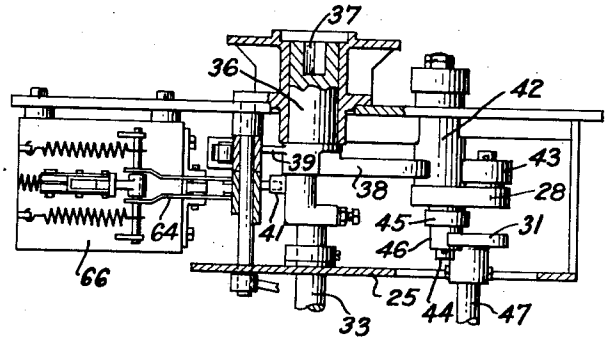


Fig. 3.

Fig. 4.

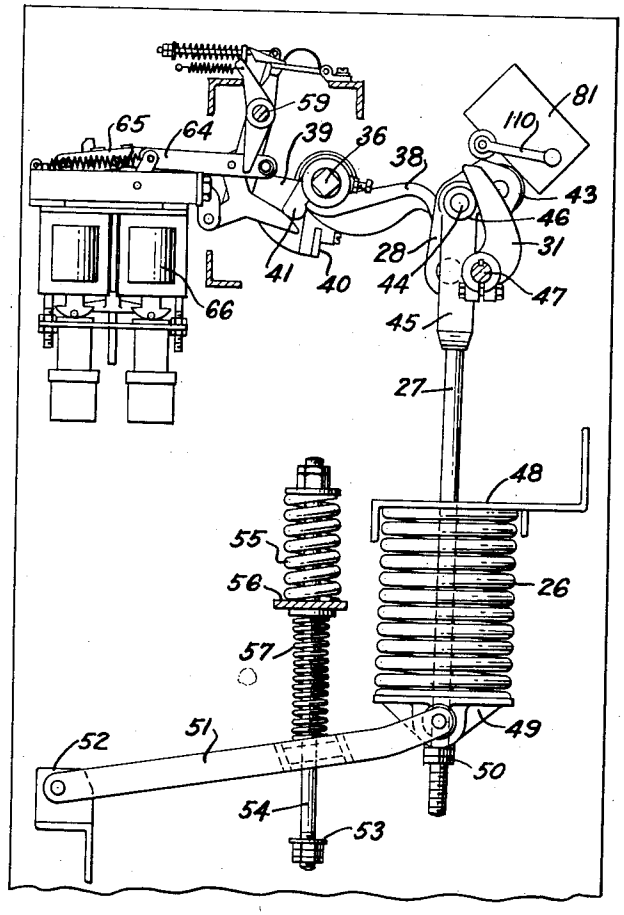
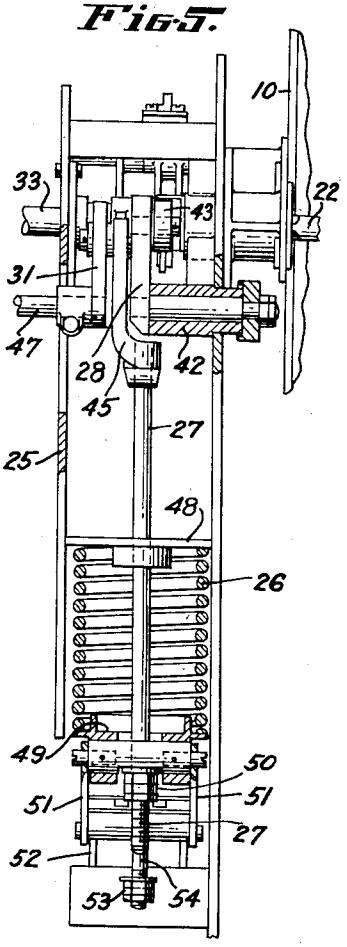


Fig. 5.



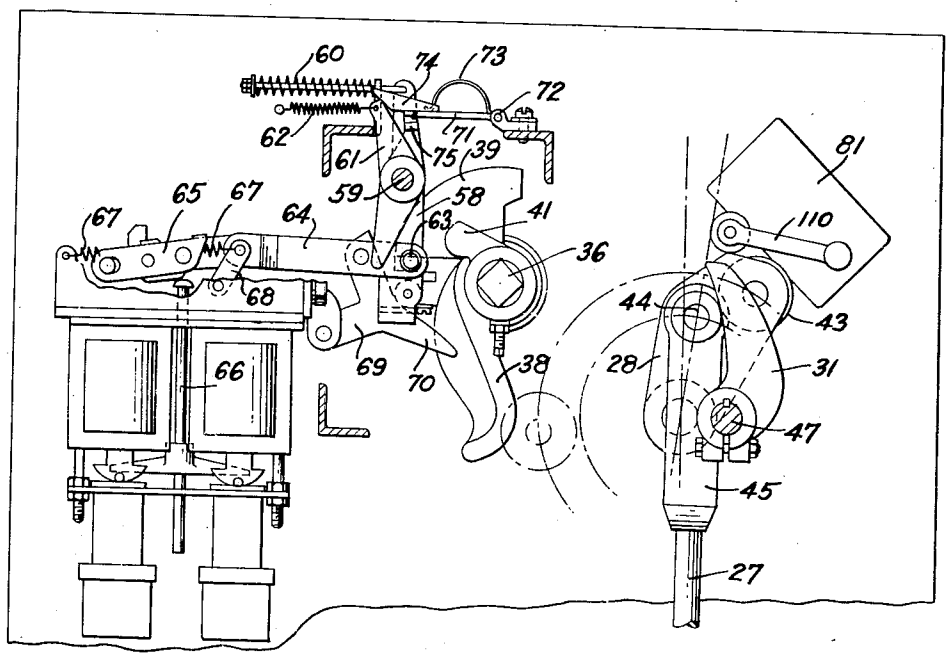
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CIRCUIT BREAKER OPERATING MECHANISM

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Fig. 6.



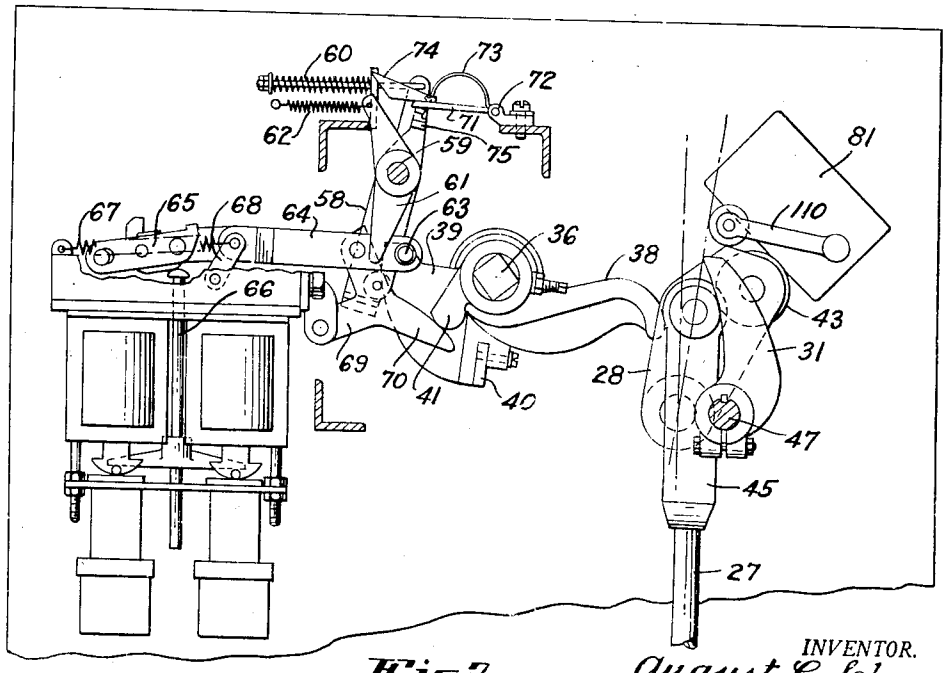


Fig. 7.

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CIRCUIT BREAKER OPERATING MECHANISM

Filed March 12, 1940 4 Sheets-Sheet 4

Fig. 9.

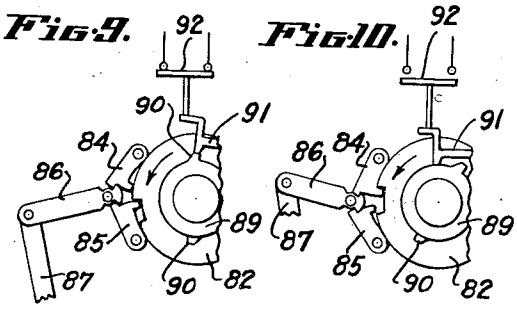


Fig. 10.

Fig. 8.

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Patented Jan. 13, 1942

2,269,604

UNITED STATES PATENT OFFICE

2,269,604

CIRCUIT BREAKER OPERATING MECHANISM

August C. Schwager, Millbrae, Calif., assignor to Pacific Electric Manufacturing Corporation, San Francisco, Calif., a corporation of California

Application March 12, 1940, Serial No. 323,547

10 Claims. (Cl. 200—89)

The present invention relates to automatic circuit breakers and more particularly to a circuit breaker and an operating mechanism therefor in which energy storing spring means under electrical control are adapted to operate the circuit breaker in an entirely automatic manner to effect a limited number of reclosing operations in the event of a continuing abnormal condition upon the circuit controlled by the circuit breaker.

An object of the invention is to provide a new and novel actuating and controlling mechanism for an automatic circuit breaker in which the opening and reclosing operations of the circuit breaker are accomplished by energy storing spring means under the control of electrical means that is responsive to conditions upon the circuit in which the circuit breaker is connected.

Another object of the invention is to provide a new and novel form of spring operating means for an automatic circuit breaker in which a predetermined amount of operating energy is successively stored in and exhausted from a single spring means as the circuit breaker is operated through a plurality of successive reclosing operations.

A further object of the invention is to provide a new and novel operating mechanism for an automatic reclosing circuit breaker in which spring means is relied upon to effect an immediate reclosing of the circuit breaker upon the occurrence of an abnormal condition upon the circuit controlled by the circuit breaker and which will permit an immediate reopening of the circuit breaker in the event that the abnormal circuit condition continues to exist upon the line at the time of said immediate reclosing operation of the circuit breaker.

The use of an automatic circuit breaker in a high potential circuit to protect other apparatus connected thereto against overload or current surges in the high potential circuit is now common practice. In the majority of cases these automatic circuit breakers are located at remote points and are, therefore, provided with means that will operate automatically to reclose the circuit breaker after an opening thereof due to an abnormal condition upon the power circuit. This obviates the necessity for a manual reclosing of the circuit breaker and where the abnormal current condition is of short duration, it serves to re-establish the circuit with a minimum loss of time. Various devices and arrangements have been proposed in the past for effecting this automatic operation of a circuit breaker. In some instances spring means have been relied upon entirely for effecting the reclosing operations, and in other cases motors have been used for this purpose. The spring type of operating means has been found particularly suitable where there is no source of electrical power, such as a battery, for operating the reclosing mechanism. While the motor type of operating mechanism has been found to be reliable when used with an auxiliary source of power, it has also been found that this type of operating mechanism is not as responsive and quick in action as is the spring type of operating mechanism. It is, therefore, a further object of the present invention to provide an operating mechanism in which the reliability of the motor controlled type of mechanism is combined with spring means to produce a mechanism having the quick acting characteristics of the spring type of operating mechanism.

Other objects and advantages of the invention will be in part evident to those skilled in the art and in part pointed out hereinafter in connection with the accompanying drawings, wherein there is shown by way of illustration and not of limitation preferred embodiments of the invention.

In the drawings, wherein like numerals refer to like parts throughout the several views;

Figure 1 is a fragmentary side elevation partially in section showing an operating mechanism constructed in accordance with one embodiment of the invention and as connected to a high potential circuit breaker,

Figure 2 is an end view partially in section taken along line II—II of Figure 1 looking in direction of arrows,

Figure 3 is a fragmentary plan view of the operating mechanism illustrated in Figure 1,

Figure 4 is an end elevation of the operating mechanism illustrated in Figure 1 with the electric motor mechanism omitted,

Figure 5 is a side elevation with parts in section of the device as illustrated in Figure 4,

Figures 6 and 7 are fragmentary detailed views showing respectively the positions of the mechanism when the circuit breaker is in its circuit closed and opened positions,

Figure 8 is a perspective diagram showing the mechanical and electrical control features of the present invention,

Figure 9 is a fragmentary detailed view showing the position of the timer mechanism illustrated in Figure 8 when the circuit breaker is in its normal circuit closed position, and

Figure 10 is a fragmentary detailed view showing the condition of the timer mechanism after it has operated to control a predetermined number of reclosing operations of the circuit breaker.

In Figure 1 of the drawings, the operating mechanism contemplated by the present invention is shown as constructed as a separate unit that can be mounted externally of and connected to the operating shaft of a circuit breaker of conventional design, and while the invention is here illustrated as a separate unit, it is to be understood that the operating mechanism may be embodied in the circuit breaker structure as an integral part thereof. In the present instance the circuit breaker is shown as enclosed in a housing 10 having a cover 11 through which terminal bushings 12 extend. As is more clearly illustrated in Figure 2 of the drawings, the terminal bushings 12 of the circuit breaker carry main contacts 13 between which a bridging conductor 14 is adapted to extend when the circuit breaker is in its circuit closed position. In addition to the main contacts 13, the terminal bushings 12 also support arc extinguishing contacts which are enclosed in arc expulsion chambers 15. The arcing contacts in the chambers 15 being adapted to cooperate with arcing contacts 16 that are carried by a suitable contact carrying member 17. The contact carrying member 17 is slidably mounted at its opposite ends by means of vertically extending bearing forming members 18 that slide vertically upon cooperating guide rods 19. With this arrangement the contact carrying member 17, the bridging conductor 14 and the contacts 16 carried thereby may be moved up and down with respect to the main contacts 13 and the arcing contacts within the expulsion chambers 15. The main contact bridging conductor 14 and the arcing contacts 16 are shown in their lowermost position by dot and dash lines in this figure of the drawings. In order to effect this up and down movement of the contact carrying member 17, this member is connected at its ends by means of links 20 to lever arms 21 which are arranged at the ends of an operating shaft 22. In addition to the links 20 the movable contact carrying member 17 is also responsive to a downward biasing means in the form of compression springs 23 which surround each of the guide rods 19 and are positioned between the upper ends of the bearing forming members 18 and a stationary abutment carried by the circuit breaker housing. In connection with the above described circuit breaker, it should be pointed out that the nature and construction of the circuit interrupting and establishing elements of the circuit breaker may take many forms, the only requirement being that the movable circuit controlling element thereof be normally biased to an open circuit position and operable into a circuit closed position by a lever means where it may be latched, as will hereinafter appear.

Now, referring back to Figure 1 of the drawings, it will be noted that the invention, and more particularly the circuit breaker reclosing mechanism thereof, comprises elements that are mounted in a separate housing 24 which is located at one end of the circuit breaker enclosing housing 10 where it may be connected to the operating shaft 22 of the circuit breaker, as will hereinafter appear. Before going into the details of the reclosing mechanism here illustrated, it will be noted that the housing 24 has a vertical partition 25 on one side of which there is mounted a relatively strong compression spring 26 that operates through a connecting rod 27 which is eccentrically connected to a crank arm 28 that is pivotally journaled upon the back wall of the housing 24. At the other side of and mounted upon the partition 25 there is also shown an electric motor 29 which operates through a suitable reduction gearing 30 to turn a radially extending lever arm 31 that is adapted to engage the crank arm 28 and move it against the action of the compression spring 26 and into its upper position, as here illustrated. A removable crank 32 is also here shown by means of which the mechanism may be operated manually, as in an emergency or during assembly and repair operations. For the purpose of indicating the condition of the circuit breaker contacts there is also provided an extending shaft 33 that carries an indicating plate 34 which is visible through a window 35 in the front of the housing 24.

Reference is now made to Figures 3, 4 and 5 of the drawings for a more detailed description of the operating mechanism. From an inspection of Figure 3 it will be noted that the operating mechanism here chosen for the purpose of illustrating the invention contemplates a short stub shaft 36 which has a squared or spline forming recess 37 into which a correspondingly formed end of the circuit breaker operating shaft 22 is adapted to be extended. At its inner end the stub shaft 36 is also shown as carrying a radially extending operating lever means 38 and an oppositely disposed latch controlling cam 39 which has a latching abutment 40. The stub shaft 36 also carries a radially extending toggle resetting member 41. It will also be noted that the extending shaft 33 which carries the indicating plate 34 is also connected to the stub shaft 36. This figure of the drawings also shows the pivotally mounted crank arm 28 as journaled within an elongated bearing 42 which is carried by the back wall of the housing 24. At its outer end and on one side thereof the pivotally mounted crank arm 28 is shown as having a roller 43 which is adapted to engage the operating lever 38 carried by the stub shaft 36. At its other side the pivotally mounted crank arm 28 is shown as having an eccentric shaft 44 with which an offset coupling member 45 connects. This provides an eccentric point of attachment for the connecting rod 27 which is placed under tension by means of the compression spring 26, as has been hereinbefore pointed out. In addition to forming a connection for the offset coupling member 45, the eccentric shaft 44 also carries a roller 46 which is adapted to be engaged by the radially extending lever arm 31 which is rotated through the reduction gearing 30 by means of the electric motor 29. In these figures of the drawings the radially extending lever arm 31 is shown as keyed upon a shaft 47 which extends from the reduction gearing 30. As is more clearly illustrated in Figures 4 and 5 of the drawings, the compression spring 26 engages an abutment 48 at its upper end and at its lower end it is carried by a spring seat 49. The spring seat 49 is here shown as held in an operative position with respect to the spring 26 by means of nuts 50 which are adjustable upon the end of the connecting rod 27. The spring seat 49 is also shown as secured between the ends of spaced links 51 which are pivotally secured at their other ends upon suitable supports 52 carried by the housing 24. Cooperating with the spaced links 51 to cushion the action of the compression spring 26 when it

operates to rotate the pivotally mounted crank arm 28 in its circuit reclosing direction, the spaced links 51 are provided with a connecting web which is arranged to engage a stop means 53 carried by a rod 54. The upper end of the rod 54 is shown as extending through and as suspended upon a compression spring 55 which is mounted upon a stationary support 56 formed within the housing 24. In addition to the compression spring 55 this cushioning means also includes a second but lighter compression spring 57 which is secured to the underside of the stationary support 55 where it will be engaged at its lower end by the links 51 when the compression spring 26 is in its compressed position, as shown in this figure of the drawings.

As is more clearly illustrated in Figures 6 and 7 of the drawings, the latch controlling cam 39 cooperates with a latching member 58 which is pivotally mounted upon a shaft 59. At its upper end the latching member 58 connects with spring means 60 that serves to bias it in an operative direction with respect to the latch controlling cam 39, and at its lower end the latching member 58 is adapted to move into latching relation with the latching abutment 40 carried by the latch controlling cam 39, as is illustrated in Figure 6 of the drawings, to thus latch the circuit controlling contacts of the circuit breaker in their circuit closed position. Associated with the latching member 58 the shaft 59 also carries a tripping lever 61 which is biased into an inoperative position by means of a spring 62. At its lower end the tripping lever 61 is shown as positioned in the path of an extending pin 63 that is carried by a floating link 64, the position of which is controlled by a collapsible toggle mechanism 65 that is responsive to an electromagnetic tripping device 66. The floating link 64 is also responsive to a pair of relatively stronger springs 67 which are placed under tension when the toggle mechanism 65 is extended, as illustrated in these figures of the drawings. As here shown, the floating link 64 is mounted at one end upon the electromagnetic tripping device 66 by means of a link 68 and at its other or outer end it is supported upon a pivotally mounted irregular link 69 which is provided with an extension 70. This extension 70 upon the link 69 is adapted to cooperate with the toggle resetting member 41 carried by the stub shaft 36, as illustrated in Figure 7, to effect a resetting of the toggle mechanism 65 when the circuit breaker contacts are moved to their circuit opened position. While the electromagnetic tripping device 66 is here shown as of a rather complicated construction, it will be understood that this device may be of any suitable type and may consist of a single coil having a movable armature which will operate when the coil is energized to collapse the toggle mechanism 65. When the latching member 58 is in its operative position with respect to the latching abutment 40 upon the latch controlling cam 39, it will operate to retain the circuit breaker contacts in their circuit closed position. Under these conditions the latching member 58 will be held against accidental displacement by means of a safety latch forming member 71 which is pivotally mounted upon a support 72 where it can be moved into and out of interfering relation with the upwardly extending end of the latching member 58. The safety latch forming member 71 is biased into its operative position by means of a bowed leaf spring 73. At its outer latch engaging end, the safety latch forming member 71 carries an overhanging extension 74 that is adapted to be engaged by the upper end of the latch tripping lever 61 when the latch tripping lever 61 is rotated by the pin 63 carried by the link 64, as when the toggle mechanism 65 is collapsed due to an abnormal condition upon the circuit being controlled by the circuit breaker. This engagement of the latch tripping member 61 with the overhanging extension 74 will serve to lift the safety latch forming member 71 and thus permit the latch tripping lever 61 to engage an extending finger 75 carried by the latching member 58 and move the latter member into its unlatched position with respect to the abutment 40, as shown in Figure 7 of the drawings. As soon as the latching member 58 is thus moved out of latching relation with the abutment 40 upon the latch controlling cam 39, the operating springs 23 of the circuit breaker will become operative to move the contact carrying member 17 downwardly to open the power circuit. At the same time the circuit breaker operating shaft 22 will be rotated in a circuit opening direction. This will cause the stub shaft 36 of the operating mechanism to rotate in unison therewith and as a result the circuit breaker operating lever arm 38 will be moved upwardly and into the position illustrated in this latter figure of the drawings. At the same time the toggle resetting member 41 which is also carried by the stub shaft 36 will engage the extension 70 upon the irregular link 69 and move the floating link 64 to reset the toggle mechanism 65. If the abnormal condition upon the power circuit is removed by this opening of the circuit breaker, the toggle mechanism 65 will remain in its extended position and thus the latching member 58 will be free to engage the abutment 40 carried by the cam 39 upon the next reclosing operation of the circuit breaker. However, if the abnormal condition upon the controlled circuit is not removed, the toggle mechanism 65 will be collapsed immediately upon a closing of the circuit breaker contacts and as a result the circuit breaker operating springs 23 will again operate to immediately reopen the circuit breaker.

The operation of the circuit breaker and the reclosing mechanism, through an initial circuit opening operation and a series of reclosing operations, will now be described in connection with Figure 8 of the drawings. As illustrated in this figure of the drawings, in addition to the elements above described, the invention also contemplates a simple electrical control circuit which employs a suitable timing device, designated generally by the numeral 76, for periodically timing and controlling the reclosing operations of the circuit breaker and also a circuit controlling relay 77, together with interlocking circuit forming contacts 80 which are responsive to the position of the main circuit breaker contacts and a circuit controlling switch 81 which is controlled by the position of the spring operated crank arm 28.

The timing device 76 may be of any suitable construction and is preferably one of the spring operated type which will operate for a predetermined interval of time after once being set in operation. In connection with the timing device here illustrated, it may be pointed out that the spring, not shown, of the timing device 76 is maintained in a wound condition through a slipping or friction drive connection with the motor operated shaft 47 of the reclosing mechanism.

However, it will be understood that this timing device may be wound in any other suitable manner; for example, by hand at the time the mechanism is reset after a series of reclosing operations. In the drawings, the timing device 76 is shown as having a disc 82 having a notch 83 into which opposed cooperating latches 84 and 85 are adapted to engage. The positions of the latches 84 and 85 are shown as controlled by a lever 86 which is connected through a link 87 to a crank arm 88 carried by the stub shaft 36. Associated with the disc 82 there is also a series of adjustable superimposed smaller discs 89, each of which carries an extending cam-like extension 90 that is adapted to cooperate with a pivotally mounted lever 91 that controls a circuit forming contact 92 which is also included in the electrical control circuit of the reclosing mechanism. In this diagram, the contacts 13 and 14 of the circuit breaker are shown as interposed in a main power circuit which is represented by the conductors 93 and 94. A current transformer 95 is shown as associated with the conductor 93 and as connected to the toggle collapsing trip coil 66 by means of conductors 96 and 97. With this arrangement, it will be understood that upon the occurrence of an abnormal current condition upon the power conductor 93, the trip coil 66 will be energized to collapse the toggle 65 of the reclosing mechanism, as is well understood in the art. As a further requirement, this figure of the drawings also shows a positive bus 98 and a negative bus 99 as a local source of low voltage power for the electric motor 29 and the relay 77.

In describing the operation of the circuit breaker it will be assumed that the circuit breaker and its operating mechanism have just responded to the occurrence of an abnormal condition upon the main power line in which the circuit breaker is connected and that the various parts of the mechanism are in the positions which they will assume with respect to each other at the instant the circuit breaker contacts 13 and 14 have reached their full circuit open position. It will also be assumed that by this opening of the circuit breaker the fault has been removed and that the toggle mechanism 65 will remain in its reset or extended position, as here illustrated. Under these conditions the opening of the main circuit breaker contacts 13 and 14 will cause the interlocking circuit forming contact 80 to establish a circuit from the positive power supply bus 98 through the operating coil of the relay 77, a conductor 100 to a conductor 102 and through a conductor 103 to the circuit forming contact 92 of the timing device 76 and then back to the negative power supply bus 99 through conductors 104 and 105. The completion of this circuit will cause the circuit controlling relay 77 to complete a circuit for the electric motor 29 through its contact 106 and conductors 107 and 108 which connect respectively with the positive and negative current supply busses 98 and 99. When this circuit is completed, the electric motor 29 will operate to rotate the shaft 47 and thus turn the lever arm 31 through the necessary angle to move the crank arm 28 to its overcenter position with respect to the action of the operating spring 26. As soon as the operating spring passes this overcenter position, the roller 43 carried by the crank arm 28 will be brought into engagement with the operating lever 38 upon the stub shaft 36 of the operating mechanism and as a result the main circuit controlling contacts 13 and 14 of the circuit breaker will be moved into their circuit closed position by the operating spring 26.

At this point it should be explained that the operation of the timing device 76 is such that upon an initial opening of the circuit breaker its circuit forming contact 92 will remain in its closed circuit position during the period required for the motor 29 to rotate the crank arm 28 through the short arc required to move the crank arm 28 to its overcenter position. This will serve to maintain the control circuit of the motor 29 until the spring 26 has become operative, at which time the circuit forming contact 92 of the timing device 76 will move to its open position. Simultaneously with or slightly in advance of the opening of the circuit forming contact 92, the circuit controlling switch 81 will move to its closed circuit position and establish a holding circuit which will maintain the control relay 77 in its energized condition and thus the motor 29 will continue to rotate independently of the timing device 76 until the circuit controlling switch 81 is again opened. The motor control circuit established by the closing of the controlling switch 81 may be traced from the positive bus 98 through the operating coil of the relay 77, along the conductor 100, a conductor 109 to the switch 81 and back through the conductor 105 to the negative bus 99. With this circuit it will be seen that immediately upon a return of the crank arm 28 into the position illustrated in the drawings, the control switch 81 will be opened and as a result the relay 77 will be deenergized. This will open the power circuit of the motor 29 and as a result the motor will stop and hold the crank arm 28 in the position shown in this figure of the drawings. As is here shown, the controlling switch 81 is arranged to be operated by a pivotally mounted lever 110 which carries a roller 111 that rides upon a roller supporting surface 112 provided at the outer end of the pivotally mounted crank arm 28.

The above describes the operation of the various elements of the reclosing mechanism and the circuits which are established to provide for an immediate reclosing of the circuit breaker after an opening thereof due to an abnormal condition upon the power line. Now, should it happen that the abnormal condition has not been removed by the initial opening of the circuit breaker, as has been assumed, it will be understood that immediately upon a closing of the circuit breaker contacts 13 and 14 the coil of the electromagnetic tripping device 66 will be again energized and as a result the toggle mechanism 65 will be tripped into its collapsed condition. This will move the tripping lever 61 into its latch tripping position and move the latching member 58 out of engagement with the latching abutment 40 of the latch controlling cam 39 and as a result the springs 23 of the circuit breaker will operate to immediately move the circuit breaker bridging member 14 out of circuit establishing relation with the contacts 13 of the circuit breaker. At the same time the timing device 76 will continue to operate and when the next succeeding cam-like extension 90, upon one or the other of the smaller superimposed discs 89, comes into engagement with the pivotally mounted lever 91, the circuit forming contact 92 will be moved into its circuit closed position and reestablish the circuit above described. Should it happen, upon this second reclosing of the circuit breaker, that the abnormal condition still

exists, the above reclosing operation will be repeated for the third and last time. As illustrated, the timing device **76** is provided with three (3) cam-like extensions and as a result it will operate to provide for one (1) immediate and two (2) delayed reclosings, as above described, after which the disc **82** will be locked against further counter-clockwise movement by the latch **84**, as illustrated in Figure 10 of the drawings. In connection with the latching operation of the latch **84**, it will be noted that this will occur when the circuit breaker operating mechanism is in a position corresponding to the circuit open condition of the circuit breaker contacts **13** and **14**. After the circuit breaker has been thus operated through a series of three (3) such reclosings, as would occur in the advent of a permanent abnormal condition upon the power line, it will be necessary for an operator to manually reclose the circuit breaker, it being understood of course that this manual reclosing of the circuit breaker will not be undertaken until it has been ascertained that the abnormal condition has been removed from the main power line. When the circuit breaker is thus manually reclosed, the latch **84** of the timing device **76** will be moved into its disc releasing position and the disc **82** of the timing device **76** will be permitted to move through a short arc where the latch **85** will become operative to stop the disc **82** of the timing device **76** in its initial position with the circuit breaker in its circuit closed position. At this point the circuit forming contact **92** of the timing device **76** will be in its circuit closed position where, upon the next reopening of the circuit breaker, as in the event of an abnormal circuit condition upon the power line, the lever **86** will become operative to move the latch **85** of the timing device **76** into its inoperative position, as illustrated in Figure 8 of the drawings. This will permit the timing device **76** to again become operative to repeat the hereinbefore described reclosing operations of the circuit breaker.

At this point the question may be raised as to what is the operation of the timing device **76** in the event that the circuit breaker remains in its circuit closed position after a first, second or third reclosing operation. On this point it may be explained, assuming that the circuit breaker remains in its circuit closed position upon one of the reclosing operations, that the disc **82** of the timing device **76** will continue to rotate in a counterclockwise direction and operate the circuit forming contact **92** until the disc **82** is stopped by the latch **85** in the position in which it is shown in Figure 9 of the drawings. During this continued operation of the timing device **76**, it will be understood that the operation of the circuit forming contact **92** thereof will have no effect upon the control circuit of the relay **77**, as the interlocking circuit forming contact **89** will be in its circuit open position. It is important here to also note that after the timing device **76** has operated as above and the parts thereof have assumed positions illustrated in Figure 9 of the drawings, the timing device **76** will then be in a position to provide for a complete cycle of an immediate and two (2) subsequent reclosings of the circuit breaker without requiring any manual attention, such as has been hereinbefore referred to as requisite when the timing device has been permitted to run down through a series of reclosing operations which have not resulted in eliminating the abnormal condition upon the power line.

While I have, for the sake of clearness and in order to disclose the invention so that the same can be readily understood, described and illustrated specific devices and arrangements, I desire to have it understood that this invention is not limited to the specific means disclosed, but may be embodied in other ways that will suggest themselves to persons skilled in the art. It is believed that this invention is new and it is desired to claim it so that all such changes as come within the scope of the appended claims are to be considered as part of this invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In an automatic circuit breaker of the reclosing type having circuit controlling contacts normally biased to an open circuit position, the combination of an operating lever arm adapted to move said circuit controlling contacts against the action of said bias and into a circuit closed position, a pivotally mounted crank arm disposed in spaced relation with said lever arm having means at the end thereof adapted to operatively engage said lever arm, a radially operating spring means connected eccentrically to the pivotal axis of said crank arm adapted when in an overcenter position with respect to the axis of said crank arm to exert an operating force upon said crank arm and cause the means carried thereby to engage and move said operating lever arm through an arc sufficient to effect a movement of the circuit controlling contacts of the circuit breaker into their circuit closed position, a motor operated means freely engaging said pivotally mounted crank arm adapted to rotate said crank arm about its pivotal axis and against the action of said radially operating spring means, means for stopping said motor operated means when said pivotally mounted crank arm reaches a point approaching an overcenter position with respect to the effective operating center of said radially operating spring means and where said radially operating spring means will be held in an energy storing position, and means operative upon movement of the circuit controlling contacts of the circuit breaker to their open circuit position for rendering said last means inoperative, whereby said motor operated means will operate to move said crank arm through said overcenter position where said radially operating spring means will cause the means at the end of said crank arm to engage said operating lever arm and effect a quick movement of said circuit controlling contacts into their circuit closed position independently of said motor operated means.

2. In an automatic circuit breaker of the reclosing type, the combination of an operating lever arm adapted to move the circuit controlling contacts of a circuit breaker into a circuit closed position, a pivotally mounted crank arm disposed in spaced relation with said lever arm having means at the end thereof adapted to operatively engage and operate said lever arm, an overcenter spring means connected eccentrically to the pivotal axis of said crank arm adapted when in an overcenter position with respect to the axis of said crank arm to exert an operating force upon said crank arm and cause the means carried thereby to engage and move said lever arm through an arc sufficient to effect an operation of the circuit controlling contacts into their circuit closed position, a motor operated lever means engaging said pivotally mounted crank arm adapted to rotate said crank arm about its pivotal axis and against the action of said over-

center spring means, means adapted to stop said motor operated lever means when said pivotally mounted crank arm reaches a point approaching an overcenter position with respect to the effective operating center of said overcenter spring means, whereby said spring means will be held in an energy storing position, and means responsive to an opening of the circuit breaker contacts adapted to start said motor operated means, whereby upon an opening of the circuit breaker due to an abnormal circuit condition said overcenter spring means will become operative to reclose the circuit breaker independently of said motor operated lever means after said crank arm is rotated by said motor operated lever means to its overcenter position.

3. In an automatic circuit breaker of the reclosing type, the combination of an operating lever arm adapted to move the circuit controlling contacts of a circuit breaker into a circuit closed position, a latching means for retaining said circuit breaker contacts in a circuit closed position, a pivotally mounted crank arm disposed in spaced relation with said lever arm having means at the end thereof adapted to operatively engage and move said lever arm into latched relation with said latching means, a radially operating spring means connected eccentrically to the pivotal axis of said crank arm adapted when in an overcenter position with respect to the axis of said crank arm to exert an operating force upon said crank arm and cause the means carried thereby to engage and move said lever arm through an arc sufficient to effect a latching of the circuit controlling contacts of the circuit breaker in their circuit closed position, a motor operated lever means engaging said pivotally mounted crank arm adapted to rotate said crank arm about its pivotal axis and against the action of said radially operating spring means, means for stopping said motor operated lever means when said pivotally mounted crank arm reaches a point approaching an overcenter position with respect to the effective operating center of said radially operating spring means, whereby said radially operating spring means will be held in an energy storing position by said motor operated lever means, and means responsive to an opening of said circuit breaker adapted to render said last means inoperative, whereby upon an opening of the circuit breaker due to an abnormal condition said motor operated lever means will rotate said pivotally mounted crank arm to its overcenter position where said radially operating spring means will operate independently of said motor operated lever means to effect a reclosing of the circuit breaker contacts.

4. In an automatic circuit breaker of the reclosing type, the combination of circuit controlling contacts normally biased to an open circuit position, lever means movable through a short arc for operating said circuit controlling contacts into their closed circuit position, a latch for holding said lever means in a position to retain said circuit controlling contacts in a circuit closed position, a second lever means movable in an arc intersecting the arc of movement of said first lever means adapted when in engagement with said first lever means to operate same through its circuit contact closing arc and into latched relation with said latching means, a spring means connected eccentrically to said second lever means operative when in an overcenter position to apply an operating force to said second lever means sufficient to overcome the circuit contact biasing means and close the circuit controlling contacts, means for rotating said second lever means into a position where said spring means will be held in an energy storing condition, and means operative upon an opening of said circuit controlling contacts adapted to cause said last means to impart a further rotation of said second lever means through an overcenter position with respect to said spring means, whereby said spring means will operate independently of said last means and move said second lever means into cooperating relation with said first lever means and effect a quick acting reclosure of the circuit controlling contacts.

5. In an automatic circuit breaker of the reclosing type, the combination of circuit controlling contacts normally biased to an open circuit position, lever means movable through a short arc for operating said circuit controlling contacts into their closed circuit position against the action of the biasing means, a latch for holding said lever means in a position to retain said circuit controlling contacts in a circuit closed position, lever engaging means movable in an arc intersecting the arc of movement of said lever means adapted when in engagement with said lever means to operate said lever means through a circuit contact closing arc and into latched relation with said latching means, a spring means for operating said lever engaging means and supplying an operating force sufficient to overcome the circuit breaker biasing means and close the circuit controlling contacts, means for positioning said spring means where it will be held in an energy storing condition, and means operative upon an opening of said circuit controlling contacts adapted to move said spring means into a position where it will become operative to move said lever engaging means into cooperating relation with said lever means and effect a reclosing of the circuit controlling contacts.

6. In an automatic circuit breaker of the reclosing type having circuit controlling contacts, the combination of an operating lever arm adapted to move said circuit controlling contacts into a circuit closed position, a pivotally mounted crank arm disposed in spaced relation with said lever arm having means at the end thereof adapted to operatively engage said lever arm, a radially operating spring means connected eccentrically to the pivotal axis of said crank arm adapted when in an overcenter position with respect to the axis of said crank arm to exert an operating force upon said crank arm and cause the means carried thereby to engage and move said lever arm through an arc sufficient to effect a movement of the circuit controlling contacts of the circuit breaker into their circuit closed position, a motor operated lever means engageable with said pivotally mounted crank arm adapted to rotate said crank arm about its pivotal axis and against the action of said radially operating spring means, a means for stopping said motor operated lever means when said pivotally mounted crank arm reaches a point approaching an overcenter position with respect to the effective operating center of said radially operating spring means, whereby said radially operating spring means will be held in an energy storing position by said motor operated lever means, a second means responsive to an opening of said circuit breaker contacts adapted to render said first means inoperative, whereby upon an opening of the circuit breaker contacts

said motor operated lever means will rotate said pivotally mounted crank arm through its overcenter position where said radially operating spring means will operate independently of said motor operated lever means to effect a reclosing of the circuit breaker contacts.

7. In an automatic circuit breaker of the reclosing type having circuit controlling contacts, the combination of an operating lever arm adapted to move said circuit controlling contacts into a circuit closed position, a pivotally mounted crank arm disposed in radially spaced relation with said lever arm having means at the end thereof adapted to operatively engage said lever arm, a radially operating spring means connected eccentrically to the pivotal axis of said crank arm adapted when in an overcenter position with respect to the axis of said crank arm to exert an operating force upon said crank arm and cause the means carried thereby to engage and move said lever arm through an arc sufficient to effect a movement of the circuit controlling contacts of the circuit breaker into their circuit closed position, a motor operated lever means engaging said pivotally mounted crank arm adapted to rotate said crank arm about its pivotal axis and against the action of said radially operating spring means through a predetermined arc to store energy in said spring means, and means responsive to an opening of said circuit breaker adapted to cause said motor operated lever means to rotate through a predetermined additional arc, whereby upon an opening of the circuit breaker contacts said motor operated lever means will rotate said pivotally mounted crank arm through its overcenter position where said radially operating spring means will operate independently of said motor operated lever means to effect a quick reclosing of the circuit breaker contacts.

8. In an automatic circuit breaker of the reclosing type, the combination of circuit controlling contacts normally biased to a circuit open position, an operating shaft having a radially extending lever means for moving said contacts into their circuit closed position, a second shaft disposed parallel with said first shaft having a radially extending lever means movable through an arc intersecting the arc of movement of the lever means upon said operating shaft and engaging said first lever means during said arc of movement, spring means for rotating said second shaft through said arc of movement, means for placing said spring means under an energy storing stress and holding said spring means in said condition when the circuit controlling contacts are in a circuit closed position, and means responsive to an opening of the circuit controlling contacts adapted to release said spring means and render it operative to rotate said second shaft and move the radially extending lever means carried thereby into engagement with the radially extending lever means upon said operating shaft and effect a quick reclosing of the circuit controlling contacts.

9. In a reclosing mechanism for a circuit breaker of the character described, the combination of a circuit breaker operating shaft adapted to turn through an arc sufficient to operate the circuit breaker, a crank arm pivotally mounted in spaced relation and upon an axis extending parallel to said operating shaft, a spring means disposed radially to the axis of said crank arm and connected to the outer end thereof, a shaft disposed substantially coaxial to the axis of said crank arm, lever means carried by said shaft and engageable with said crank arm through a predetermined arc of its rotation, a motor for intermittently rotating said shaft in a unidirectional manner, whereby said crank arm will be turned first by said lever means through said predetermined arc of rotation to store energy in said spring means and subsequently turned through a further arc by said spring means as it gives up said stored energy, a lever arm carried by said circuit breaker operating shaft operable in a plane parallel to the plane of movement of said crank arm, and means carried by said crank arm intersecting the arc of movement of said lever arm as said crank arm is turned by said spring means, whereby said circuit breaker operating shaft will be turned by said spring means to operate the circuit breaker into its closed circuit position independently of said motor.

10. In a reclosing mechanism for a circuit breaker of the character described, the combination of a circuit breaker operating shaft adapted to turn through an arc sufficient to operate the circuit breaker, a crank arm pivotally mounted in spaced relation and upon an axis extending parallel to said operating shaft, a spring means disposed radially to the axis of said crank arm and connected to the outer end thereof, a shaft disposed substantially coaxial to the axis of said crank arm, lever means carried by said shaft and engageable with said crank arm, a motor for rotating said shaft in a unidirectional manner, whereby said crank arm will be turned first by said lever means through a substantially 180° arc of rotation to store energy in said spring means and subsequently turned by said spring means through a further arc of substantially 180° as said spring means gives up said stored energy, a lever arm carried by said circuit breaker operating shaft operable in a plane parallel to the plane of movement of said crank arm, and means carried by said crank arm intersecting the arc of movement of said lever arm as said crank arm operates under the influence of said spring means, whereby said circuit breaker operating shaft will be turned by said spring means to operate the circuit breaker into its closed circuit position independently of said motor.

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