United States Patent

[11] **3,585,330**

[72] Inventor **Fred Bould**
Pittsburgh, Pa.

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[73] Assignee **Westinghouse Electric Corporation**
Pittsburgh, Pa.

[54] **MOTOR-OPERATED SPRING-CLOSING CIRCUIT BREAKER**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **200/153SC,** 74/142, 185/40
[51] **Int. Cl.** **H01h 3/26**
[50] **Field of Search** 200/153, 23; 185/37, 40; 74/22, 24, 84, 142, 128; 310/37, 49

[56] **References Cited**

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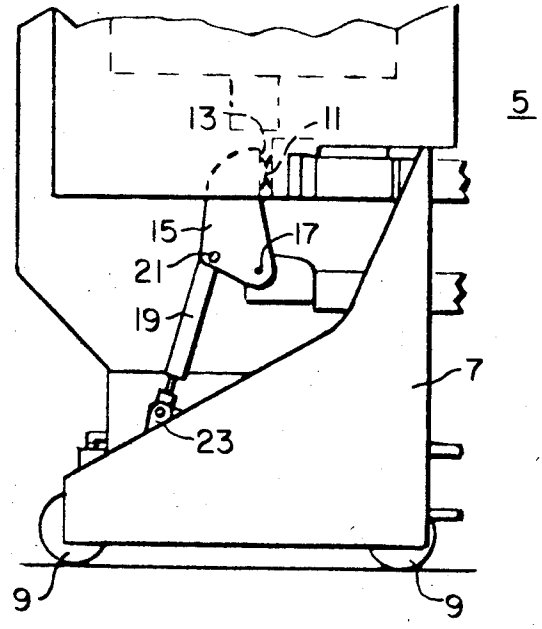
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Primary Examiner—Milton O. Hirshfield
Assistant Examiner—B. A. Reynolds
Attorneys—A. T. Stratton, Clement L. McHale and W. A. Elchik

ABSTRACT: A circuit breaker comprises a crankshaft, a closing spring connected to the crankshaft and an improved motor-operating structure for driving the crankshaft to charge the closing spring. The motor-operating structure comprises a ratchet wheel mounted on the crankshaft, a reciprocating pawl structure supported to drive the ratchet wheel, and a motor comprising an output shaft and cam means or driving means on the output shaft operable upon each revolution of the output shaft to operate the pawl structure to advance the ratchet wheel to thereby charge the closing spring. The motor is positioned alongside the closing spring with the axis of the output shaft thereof normal to a plane in which the axis of the crankshaft is located.



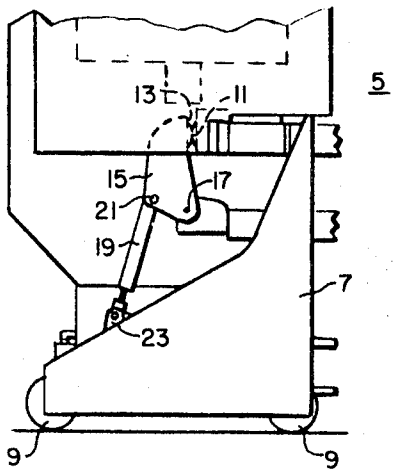


FIG. 1.

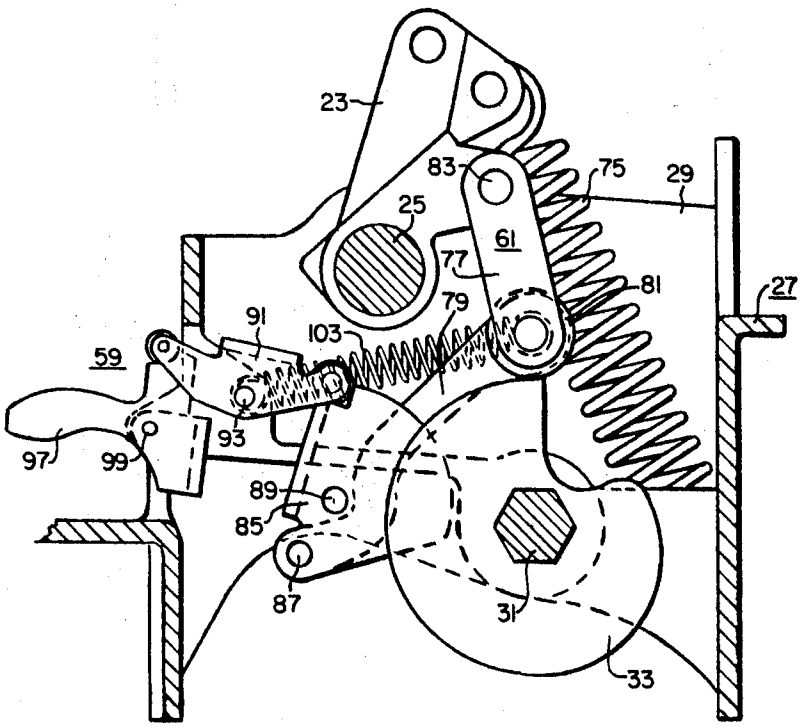


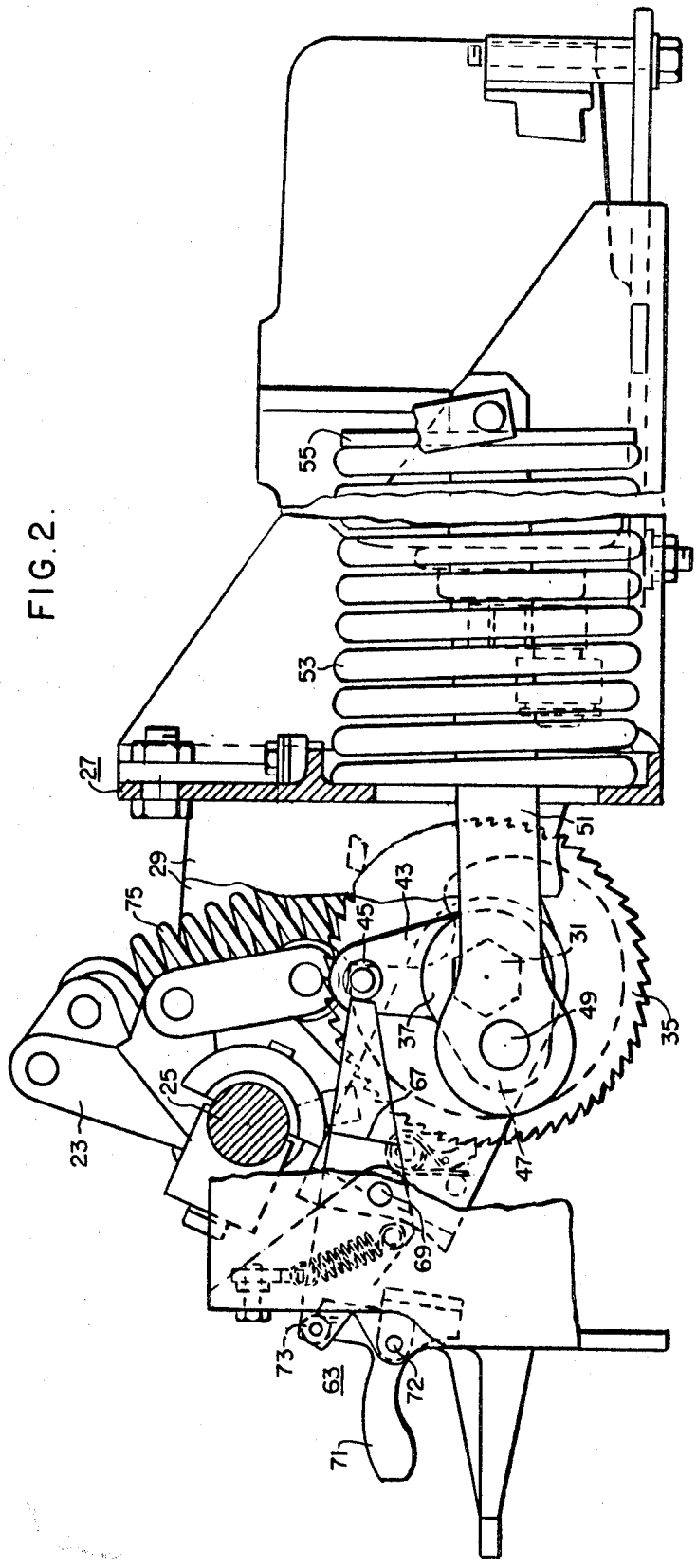
FIG. 3.

INVENTOR
Fred Bould

BY
William L. Clark

ATTORNEY

FIG. 2.



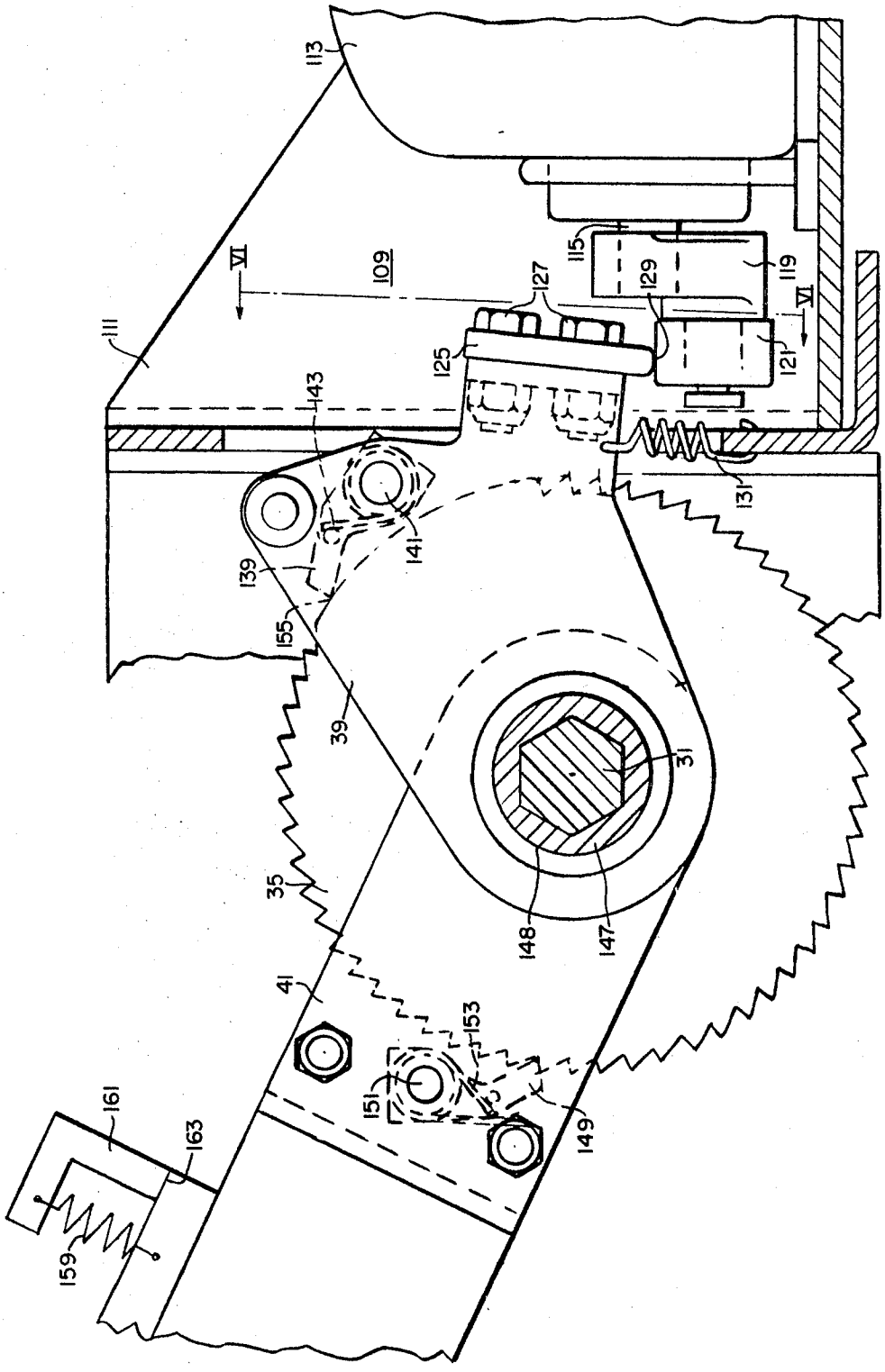

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FIG. 4.

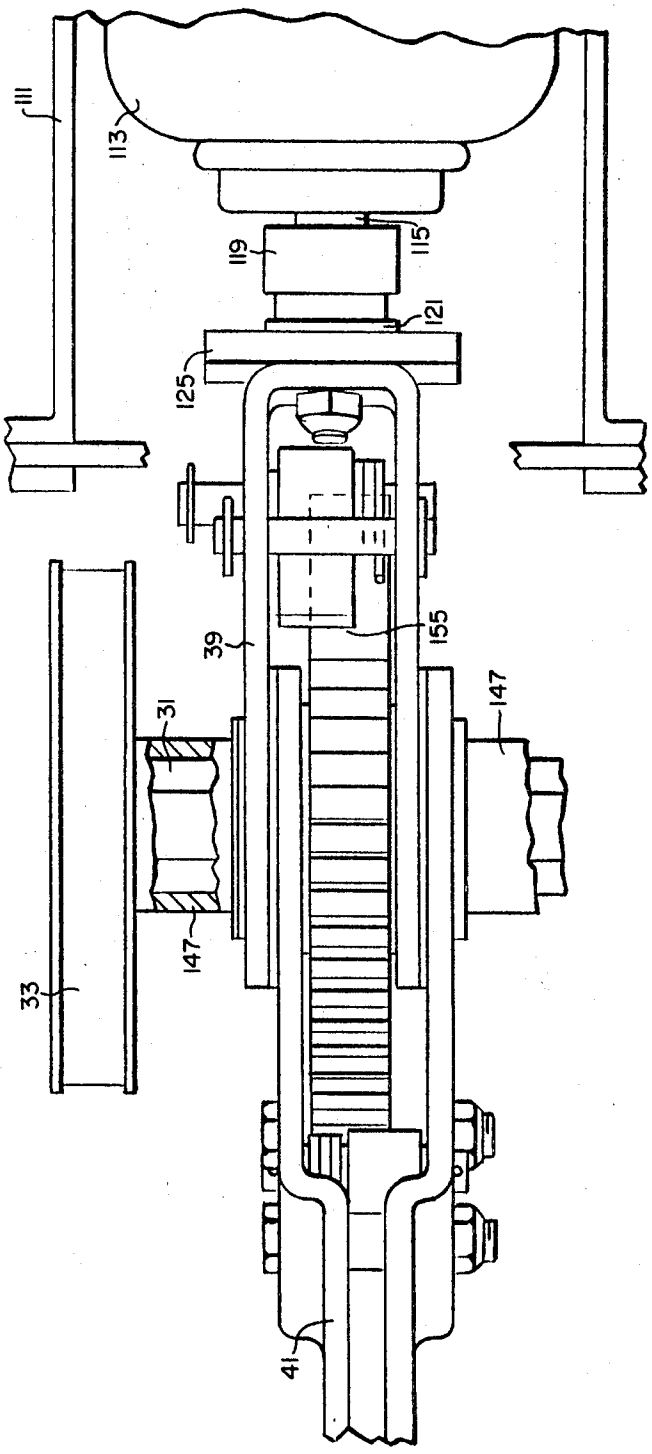


FIG. 5.

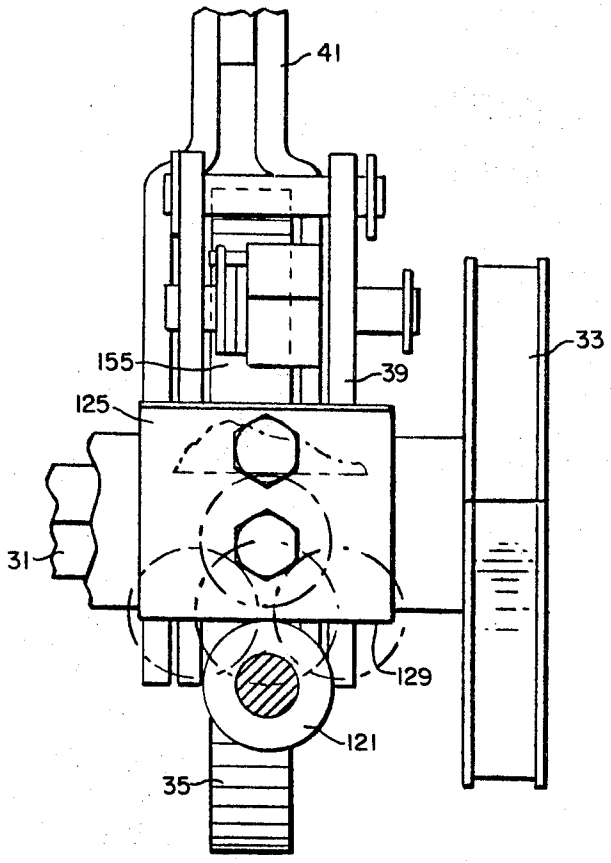


FIG. 6.

MOTOR-OPERATED SPRING-CLOSING CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

Motor-operated spring-closing circuit breaker.

2. Description of the Prior Art

In the patent to W. H. Fischer, No. 3,254,186 issued May 31, 1966, there is disclosed a motor-operated spring-closing circuit breaker comprising a crankshaft having a closing spring connected thereto, a ratchet wheel supported thereon for charging the closing spring and a closing cam thereon operable to close the breaker upon release of the charged closing spring. The ratchet wheel is operated by means of a driving pawl that is pivotally connected to an eccentric on the output shaft of the motor. The motor is positioned such that the output shaft thereof extends parallel to the axis of rotation of the crankshaft. Upon each revolution of the output shaft of the motor the driving pawl is operated to advance the ratchet wheel to thereby move the crankshaft to charge the closing spring.

SUMMARY OF THE INVENTION

A circuit breaker comprises a crankshaft, a closing spring having one end thereof operatively connected to a crank arm or eccentric on the crankshaft, a ratchet wheel fixedly supported on the crankshaft for rotation with the crankshaft, and a closing cam fixedly supported on the crankshaft and rotatable upon discharge of the charged closing spring to effect a closing operation of the circuit breaker. A reciprocating member, having a driving pawl supported thereon, is supported on the crankshaft for reciprocal movement, relative to the crankshaft, about an axis concentric with the axis of the crankshaft. A motor is supported alongside the closing spring with the axis of the output shaft thereof normal to a plane in which the axis of the crankshaft is disposed. An operating arm, having a roller thereon, is mounted on the motor output shaft for rotation with the motor output shaft. The reciprocating member is spring-biased toward the roller and comprises a curved surface that cooperates with the roller. Upon each revolution of the motor output shaft the roller is operated against the curved surface of the reciprocating member to advance the reciprocating member which operates through the driving pawl to advance the ratchet wheel one tooth. The ratchet wheel is provided with a missing-tooth portion so that the motor may overrun past the spring-charged position of the crankshaft. The circuit breaker of this invention has the advantages over the circuit breaker of the above-mentioned U.S. Pat. No. 3,254,186 in that the motor-operated structure is simple and compact; a standard drill-type motor can be utilized in the combination; the motor can overrun past the spring-charged position without applying damaging forces to the mechanism; and the operative connection between the motor and crankshaft, which converts motion about one axis to motion about another axis which is disposed in a plane normal to the one axis, is a simplified operative connection.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view, with parts broken away, of a multipole circuit breaker constructed in accordance with the principles of this invention;

FIG. 2 is a side sectional view, on an enlarged scale relative to FIG. 1, and with parts broken away, illustrating part of the operating mechanism of the circuit breaker of FIG. 1;

FIG. 3 is a side sectional view, with parts broken away, illustrating the closing cam and linkages of the mechanism seen in FIG. 2;

FIG. 4 is a side sectional view, with parts broken away and on an enlarged scale relative to FIG. 2, of the motor-operating structure for operating the crankshaft to charge the closing spring seen in FIG. 2;

FIG. 5 is a top view, with parts broken away, of the motor-operating mechanism seen in FIG. 4 with the closing cam shown on the crankshaft; and

FIG. 6 is a sectional view, with parts broken away, taken generally along the line VI–VI of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown, in FIG. 1, a circuit breaker 5 comprising a supporting frame 7 mounted on wheels or rollers 9. The circuit breaker 5 is a three-pole circuit breaker comprising a stationary contact 11 and a movable contact 13 cooperating with the stationary contact 11. The movable contact 13 is supported on a contact arm 15 that is pivoted on a pin 17 and driven by means of an elongated rod structure 19 that is pivotally connected to the contact arm 15 at 21. The elongated rod structure 19 is pivotally connected to a lever 23 that is fixedly supported on a jack shaft 25 (FIGS. 2 and 3) that is supported for rotation about an axis normal to the paper as seen in FIGS. 2 and 3. The jack shaft 25 is common to all three poles of the circuit breaker and rotatable to simultaneously move the movable contacts 13 of the three poles between open and closed positions. The circuit breaker 5 is a roll-out metal-clad-type circuit breaker having a general construction that is well known in the art.

The circuit breaker 5 comprises an internal supporting frame structure 27 (FIGS. 2 and 3) comprising a pair of spaced frame members 29. The jack shaft 25 is supported on suitable bearings on the frame members 29. A hexagonal shaped crankshaft 31 is supported on suitable bearings on the frame members 29 for rotational movement about the elongated axis thereof which is normal to the plane of the paper as seen in FIGS. 2 and 3. A closing cam 33 (FIG. 3) is fixedly secured to the crankshaft 31. In addition to the closing cam 33, a ratchet wheel 35 and a crank arm 37 are each fixedly secured to the crankshaft 31. A reciprocating member 39 (FIG. 4) is mounted on the crankshaft 31 for movement relative to the crankshaft 31 about the axis of the crankshaft 31, and a reciprocating member 41 is mounted on the crankshaft 31 for movement relative to the crankshaft 31 about the axis of the crankshaft 31. The operation of the members 39 and 41 will be hereinafter more fully described.

The crank arm 37 (FIG. 2) comprises a first leg 43 having a roller 45 mounted thereon and a second leg 47 having a pin 49 thereon that extends through an opening in an elongated rod 51. The rod 51 extends through a coil closing spring 53 and is connected to a spring-retaining plate 55 at the one end thereof. The spring 53, at the left-hand (FIG. 2) end thereof engages the supporting frame structure 27.

The operating mechanism comprises a tripping latch assembly 59 (FIG. 3), a toggle linkage 61, and a closing latch assembly 63 (FIG. 2). The tripping latch assembly 59, toggle linkage 61, closing latch assembly 63, closing cam 33 and closing spring 53, along with the operations thereof, are of the type more specifically described in the above-mentioned U.S. Pat. No. 3,254,186. Thus, only a brief description of the construction and operation of those parts is provided herein.

The operating mechanism is shown in FIGS. 2 and 3 in the contact-closed position with the closing spring 53 in the spring-charged position. The closing spring 53 is latched in the spring-charged position by a latch member 67 that is pivotally supported on the frame 29 by means of a pin 69 and that engages the roller 45 of the crank-arm 37. A trigger latch 71 engages a roller 73 supported on the latch member 67 to latch the latch member 67. The circuit breaker is latched in the contact-closed position against the bias of an opening spring 75 by the tripping-latch assembly 59 (FIG. 3). The toggle linkage 61 comprises a toggle link 77 and a toggle link 79 pivotally connected together by a knee pivot having a roller 81 thereon. The toggle link 77 is pivotally connected to the lever 23 by means of a pin 83 and the toggle link 79 is pivotally connected to a latch member 85 by means of a pin 87. The latch member 85 is supported for pivotal movement on a pin 89. The latch

member 85 is latched against counterclockwise (FIG. 3) movement by means of a latch member 91 pivotally supported intermediate the ends thereof on a pin 93. As can be seen in FIG. 3, the latch member 91 is provided with a separate roller at each of the opposite ends thereof. The latch member 91 at one end thereof engages the latch 85 to prevent counterclockwise movement of the latch 85, and the latch member 91 is engaged by a trigger latch 97, pivotally supported on a pin 99, that latches the latch member 91 in latching position. When it is desired to open the circuit breaker, the tripping latch 97 may be rotated in a clockwise (FIG. 3) direction about the pin 99. This movement releases the latch member 91 which can then move counterclockwise about the pin 93 to release the latch 85. Upon release of the latch 85, the latch 85 is free to move counterclockwise about the pin 89 to thereby permit the toggle link 79 to move to the right with the roller 81 moving off of the high surface of the cam 33. The opening spring 75 then operates to rotate the lever 23 and jack shaft 25 in a clockwise (FIG. 3) direction to permit movement of the rods 19 (FIG. 1) downward to permit counterclockwise movement of the contact arms 15 about their associated pivots 17 to the open position. During the tripping movement, a resetting spring 103 (FIG. 3) pulls the toggle 61 to move the roller 81 into the notch-portion of the cam 33. The circuit breaker may then be closed by release of the closing latch assembly 63 (FIG. 2). The circuit breaker is closed by pivoting the closing latch 71 in a clockwise (FIG. 2) direction about the pin 72 to release the latch member 67 permitting the latch member 67 to rotate in a counterclockwise direction about the pin 69 to move the latch end thereof off of the roller 45 to release the crank arm 37 and crankshaft 31. Upon release of the crank arm 37, the compressed closing spring 53 discharges moving the plate or spring support 55 to the right to move the rod 51 to the right to operate through the crank arm 37 to rotate the crankshaft 31 in a counterclockwise (FIGS. 2 and 3) direction. Upon counterclockwise movement of the crankshaft 31 the closing cam 33 forces the roller 81 upward to force the levers 23 and jack shaft 25 in a counterclockwise direction to thereby move the rods 19 (FIG. 1) upward to pivot the contact arms 59, about their respective pivots 17, to the closed position seen in FIG. 1. The closing spring 53 may then be charged by operating the ratchet wheel 35 in a counterclockwise direction in a manner to be hereinafter more specifically described. Upon rotation of the ratchet wheel 35 in a counterclockwise direction the rod 51 is pulled to the left to pull the plate 55 to the left (FIG. 2) to compress the closing spring 53 during the first half of a 360° revolution of the crankshaft 31. As the pin 49, to which the arm 51 is connected, passes over center the closing spring 53, which is fully charged at that point, expands slightly moving the crankshaft 31 in a counterclockwise direction, and the closing latch 67 engages the roller 45 to again latch the spring 53 and crankshaft 31 in the spring-charged position seen in FIG. 2. In this position, the roller 81 (FIG. 3) is maintained on the high point of the closing cam 33 to maintain the contacts in the closed position.

Improved means is provided for operating the ratchet wheel 35 to move the crankshaft 31 in order to charge the closing spring 53. A motor-operating mechanism 109 (FIG. 4) comprises a supporting frame 111 having a motor 113 fixedly supported thereon with the axis of the output shaft 115 of the motor extending in a direction that is normal to the direction of extension of the axis of the crankshaft 31. The axis of the output shaft 115 is normal to a plane in which the axis of the crankshaft 31 is disposed. As can be understood with reference to FIG. 2, the axis of the crankshaft 31 is normal to the planes of the spaced parallel planar supporting plates 29 and the axis of the motor output shaft is parallel to the planes of the supporting plates 29. Referring to FIGS. 4 and 5, an operating arm 119, having a roller 121 on the free end thereof, is fixedly secured to the output shaft 115 to rotate with the output shaft 115. The operating arm 119 and roller 121 serve as cam means or driving means for driving the reciprocating member 39. A plate 125 is fixedly secured to the reciprocating member 39 by bolt means 127. The plate 125 is provided with an arcuate bottom surface 129 that is engaged by the roller 121. A spring 131 is provided to bias the reciprocating member 39 downward which downward movement is limited by the engagement of the reciprocating member 39 with the roller 121. A pawl 139 is pivotally mounted on the reciprocating member 39 by means of a pin 141 and biased in a counterclockwise (FIG. 4) direction by means of a torsion spring 143. The reciprocating member 39 is mounted on a bearing member 147 that is fixed to the hexagonal crankshaft 31 with the reciprocating member 39 being pivotally movable against a surface 148 of the bearing 147 relative to the crankshaft 31. A handle-operating reciprocating member 41 is also mounted on the bearing 147 for reciprocal pivotal movement on the bearing relative to the crankshaft 31. A pawl member 149 is pivotally mounted on the reciprocating member 41 by means of a pin 151 and biased in a counterclockwise (FIG. 4) direction by means of a torsion spring 153. The ratchet wheel 35 is provided with a missing-tooth portion 155 that is adjacent the pawl 139 when the closing spring is fully charged so that continued operation of the motor 113 after the spring is fully charged will not apply damaging forces to the parts of the circuit breaker. Thus the motor can overrun past the spring-charged position of the crankshaft 31 until the motor slows to a stop position. A tension spring 159 is connected between a stationary part 161 of the circuit breaker frame and the reciprocating member 41 to bias the reciprocating member 41 in a clockwise (FIG. 4) direction into engagement with a stop surface 163 on the stationary part 161.

The parts are shown in FIGS. 2—4 in the contact-closed position with the closing spring 53 in the charged position. In this position, it will be noted that the pawl 139 is adjacent the missing-tooth portion 155 of the ratchet wheel 35 so that as the motor 113 slows to a stopped position after the spring is charged the reciprocating member 39 can reciprocate without applying damaging forces to the parts of the circuit breaker. When the breaker is tripped open and the closing latch structure 63 is then operated to close the breaker in the manner hereinbefore described, the crankshaft 31 will be moved approximately 180° as the spring 53 discharges to close the breaker. This will move the missing-tooth portion 155 approximately 180° and away from the driving pawl 139. With the closing spring 53 discharged, the motor 113 is energized to operate the ratchet wheel 35 to charge the spring 53. Upon energization of the motor 113, the output shaft 115 thereof is rotated to move the roller 121 from the position seen in full lines in FIG. 6 through the positions seen in broken lines in FIG. 6 with the axis of the roller 121 moving in a circle as the output shaft 115 of the motor is rotated. During each revolution of the output shaft 115, the roller 121 will be moved to operate against the plate 125 to drive the reciprocating member 39 in a counterclockwise (FIG. 4) direction during the first 180° of movement of the roller 121 during which movement the driving pawl 139 will advance the ratchet wheel 135 by one tooth. During the second 180° of the full 360° movement of the roller 121 the holding pawl 149 (FIG. 4) will hold the ratchet wheel 135 in the advanced position and the reciprocating member 39, under the bias of the spring 131, will be returned clockwise to the lowermost position seen in FIG. 4. This sequence will occur during each revolution of the motor output shaft 115 until the rod 51 (FIG. 2) moves overcenter past the 180° position whereupon the spring 53 will bias the rod 51 to the right (FIG. 2) tending to move the crankshaft 31 counterclockwise which movement is limited by the latch member 67 which engages the roller 45 on the crank arm 37 to latch the crankshaft 31 in the spring-charged position seen in FIG. 2. With the spring 53 in the charged position seen in FIG. 2, the ratchet wheel 35 is positioned such that the missing-tooth portion 155 thereof is opposite the driving pawl 139 so that upon continued rotation of the motor 114, as the motor slows to a stop, the reciprocating member 39 will reciprocate harmlessly without applying damaging forces to

the parts. The motor 113 may be automatically started and stopped by suitable limit switch means operated by the mechanism parts in a well-known manner. As can be understood with reference to FIG. 4, the arcuate surface 129 of the plate 125 permits the plate 125 to move across the face of the roller 129 as the reciprocating member 39 reciprocates against the roller.

The ratchet wheel 35 may be manually operated by manual reciprocation of the reciprocating member 41 during which movement the pawl 149 serves as the driving pawl with the pawl 139 serving as the holding pawl. The member 41 is provided with a pocket at the end thereof for receiving a handle-extension that can be inserted into the pocket to permit manual cranking operation of the reciprocating member 41.

I claim:

1. A circuit breaker comprising a stationary contact, a movable contact, a crankshaft rotatable about a first axis that extends in a first direction, a closing spring operatively connected to said crankshaft, a ratchet wheel on said crankshaft rotatable with said crankshaft about said first axis, a reciprocating member having a pawl thereon and being supported on said crankshaft for reciprocating pivotal movement to operate said pawl to advance said ratchet wheel upon reciprocation thereof, a motor comprising an output shaft and being supported with the output shaft rotating about a second axis normal to a plane in which said first axis lies such that said second axis extends in a direction generally normal to the direction of extension of said first axis, driving means on said output shaft, said driving means being separate from said reciprocating member and operable upon rotation of said output shaft to operate against said reciprocating member to advance said ratchet wheel to thereby charge said closing spring.

2. A circuit breaker according to claim 1, said driving means comprising an operating arm movable upon rotation of said output shaft through 180° to move said reciprocating member to thereby move said pawl against a tooth of said ratchet wheel to advance said ratchet wheel, and spring means operating to return said reciprocating member to position said pawl means adjacent another tooth of said ratchet wheel upon the second 180° of a full revolution of said output shaft.

3. A circuit breaker according to claim 2, said reciprocating member being a first reciprocating member and said pawl being a first pawl, a second reciprocating member supported on said crankshaft for reciprocating movement, said second reciprocating member having a second pawl thereon, and during the return of said first reciprocating member to position said first pawl against said other tooth of said ratchet wheel said second pawl on said second reciprocating member holding said ratchet wheel in the advanced position thereof.

4. A circuit breaker according to claim 3 and for manual operations of said ratchet wheel said first pawl on said first reciprocating member serving as a holding pawl and said second pawl on said second reciprocating member serving as a driving pawl, said second reciprocating member being manually operable to move said second pawl against said ratchet wheel to advance said ratchet wheel to thereby charge said closing spring.

5. A circuit breaker according to claim 2, said crank arm on said output shaft having a roller thereon cooperable with said first reciprocating member, and said reciprocating member having an arcuate surface thereon engaged by said roller to facilitate movement of said arcuate surface across the face of said roller as said roller is operated to drive said first reciprocating member.

6. A circuit breaker comprising a stationary contact, a movable contact, a supporting frame structure comprising a pair of spaced planar generally parallel plates, a crankshaft supported for rotation about a first axis generally normal to the planes of said plates, a closing spring operatively connected to said crankshaft, a ratchet wheel fixedly supported on said crankshaft for rotation with said crankshaft about said first axis, a reciprocating member having a pawl thereon and being supported on said crankshaft for reciprocating pivotal movement about the axis of said crankshaft to operate said pawl to advance said ratchet wheel upon reciprocation thereof, a motor comprising an output shaft and being supported with the output shaft rotatable about a second axis generally parallel to the planes of said plates, driving means on said output shaft separate from said reciprocating member, upon rotation of said output shaft said driving means moving with said output shaft to operate against said reciprocating member to advance said ratchet wheel to thereby charge said closing spring.

7. A circuit breaker according to claim 6, said driving means comprising an operating arm movable upon rotation of said output shaft through 180° to move said reciprocating member to thereby move said pawl against a tooth of said ratchet wheel to advance said ratchet wheel, and spring means operating to return said reciprocating member to position said pawl adjacent another tooth of said ratchet wheel upon a second 180° movement of a full revolution of said output shaft.

8. A circuit breaker according to claim 7, said reciprocating member being a first reciprocating member and said pawl being a first pawl, a second reciprocating member supported on said crankshaft for reciprocating pivotal movement about the axis of said crankshaft relative to said crankshaft, said second reciprocating member having a second pawl thereon, and during the return of said first reciprocating member to position said first pawl against said other tooth of said ratchet wheel said second pawl on said second reciprocating member holding said ratchet wheel in the advanced position thereof.

9. A circuit breaker according to claim 8, and for a manual operation of said ratchet wheel said first pawl on said first reciprocating member serving as a holding pawl and said second pawl on said second reciprocating member serving as a driving pawl, said second reciprocating member being manually operable to move said second pawl against said ratchet wheel to advance said ratchet wheel to thereby charge said closing spring.

10. A circuit breaker according to claim 7, said crank arm on said output shaft having a roller thereon cooperable with said first reciprocating member, and said reciprocating member having an arcuate surface thereon engaged by said roller to facilitate movement of said arcuate surface across the face of said roller as said roller is operated to drive said first reciprocating member.