ABSTRACT: An electric circuit breaker having springs which discharge to close the circuit breaker contacts is provided with a motor to recharge the springs. A one-way ratchet device connected to the motor shaft prevents reverse motor rotation in the event of power loss to the motor due to spring discharge and thereby prevents the partially charged springs from discharging to cause slow closing of the contacts.
CIRCUIT BREAKER ARRANGEMENT FOR PREVENTING SLOW CLOSING OF BREAKER CONTACTS

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates generally to circuit breaker operating mechanisms and, particularly, to those which employ stored energy contact operating springs which are chargeable by electric motors.

2. Description of the Prior Art
Circuit breaker operating mechanisms of the aforesaid character are well known and in wide use. In some, however, accidental loss of electric power to the motor while the contact closing springs are being charged allows reverse motor rotation and the springs discharge slowly thereby effecting unintentional slow closing of the circuit breaker contacts.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a circuit breaker having a support, relatively movable contacts mounted thereon and movable to open and closed position, operating means to effect relative movement of said contacts, chargeable stored energy spring means dischargeable to effect movement of said operating means and movement of said contacts to one of said positions, charging means including an electric motor for charging said stored energy spring means, and means comprising a one-way ratchet mechanism to prevent discharge of said charging means and operation of said contacts in the event the motor is deenergized before said spring means are fully charged.

OBJECTS OF THE INVENTION

It is an object of the invention to provide improved circuit breaker operating mechanisms.

Another object is to provide such operating mechanisms which employ motor chargeable stored energy contact operating springs and which employ means to prevent discharge of the springs and slow closing of the contacts in the event of failure of the power supply to the motor.

Another object is to provide means of the aforesaid character which comprise a ratchet mechanism for preventing reverse rotation of the motor shaft.

Another object is to provide a ratchet mechanism which is mounted on the circuit breaker support frame and connected to the motor shaft.

Another object is to provide means of the aforesaid character which are reliable in use, economical to fabricate and easy to apply to a wide variety of circuit breaker operating mechanisms.

Other objects and advantages of the invention will hereinafter appear.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate a preferred embodiment of the invention but it is to be understood that the embodiment illustrated is susceptible of modifications with respect to details thereof without departing from the scope of the appended claims.

In the drawing:
FIG. 1 is a front end elevational view of a circuit breaker in accordance with the present invention;
FIG. 2 is a side elevational view of the circuit breaker shown in FIG. 1 with the stationary contacts shown in phantom lines;
FIG. 3 is an enlarged view of a portion of the operating mechanism shown in FIGS. 1 and 2;
FIG. 4 is a cross-sectional view taken along line IV-IV of FIG. 3; and
FIG. 5 is a perspective view of a portion of the circuit breaker shown in FIG. 4 and illustrates another aspect of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 shown portions of a circuit breaker of a low voltage type commonly used in draw out switchgear installations. The circuit breaker comprises a support or frame 10 on which stationary contacts 12a, 12b and 12c are mounted and which cooperate with a movable contact 14 also mounted on frame 10. Movable contact 14, shown in open position in FIG. 2, is movable to closed position by a double toggle 'trip-free' operating mechanism, hereinafter described, which is mounted on frame 10 and comprises contact opening springs 16 and stored energy contact closing springs 18. All references to direction and rotation hereinafter made are with respect of FIG. 2.

Closing Mechanism

FIGS. 1 and 2 shown the operating means or mechanism in the open position with the springs 18 fully charged. The springs 18 can be released either manually or electrically to cause the operating mechanism to effect closure of the relatively movable contacts 12a, 12b and 12c and contact 14. In either case, a prop gate 20 is rotated clockwise to release a connecting rod 22. The connecting rod 22 is attached to closing springs 18 through a link 24 and a bar 26 and to a bell crank 28 by a pin 30. Release of prop gate 20 permits the closing springs 18 to move connecting rod 22 clockwise to the left about a fixed center 32 and bell crank 28 clockwise about a fixed center 34. Clockwise rotation of bell crank 28 drives a link 36 to rotate a closing cam 38 which acts against a toggle roll 40 moving a toggle linkage 42 to the right about releasable center 44 thus closing breaker contact 14. When the full closed position is reached, the toggle linkage is propped over center against the toggle stop 46 and is supported through a toggle gate 48, a trip latch 50 and a trip shaft 52. The closing cam 38 will remain in the up, or closed, position until the closing springs 18 are charged. Charging of the closing springs will rotate bell crank 28 in the counterclockwise direction thereby drawing the closing cam 38 down into position for another closure.

Opening of the breaker contacts is accomplished by the release of trip latch 50. Trip shaft 52 is rotated counterclockwise by action of the various trip devices (not shown). This rotation of the trip shaft permits trip latch 50 to rotate counterclockwise about a fixed center 56. Thus, toggle latch 48 is released and permitted to rotate about a center 58. Releasable center 44 is not free to rotate with the toggle latch 48 permitting the force of the stationary main contact spring as well as the opening springs to move cranks 60 and 62 counterclockwise to collapse the toggle linkage. The rotation of cranks 60 and 62 and movement of a link 64 to the left thereby opens the breaker contacts. The resetting sequence of the tip latch, toggle latch and toggle linkage is entirely dependent on the position of the stored energy springs 18. With the springs charged, the latches and toggle mechanism will immediately reset. With the springs discharged and the breaker open, the closing cam will hold the toggle mechanism trip free until the charging sequence is started at which time the closing cam will be withdrawn permitting the toggles and latches to reset.

As to the trip-free position, when latches 50 and 48 are released, center 44 is not restrained as in a normal closing operation, but is released to pivot about pin 58 as a center. Thus, when closing energy is delivered to the toggle linkage through the closing cam, the toggle linkage through the closing cam, the toggle latch 48 rotates clockwise about the new center 58 permitting the closing cam to go through its complete cycle without moving link 64 and, therefore, the breaker contacts will not close. This action can take place during any part of the closing stroke causing movable contact 14 to immediately return to the open position even though the stored energy springs are to close the mechanism.

Stored Energy Mechanism
When the spring 18 are discharged, energization of a motor 70 by actuation of a suitable switch causes the motor shaft 72 to rotate a pinion gear 73 which drives a gear 74. Gear 74 is provided with a driving pin 76 positioned to engage with a corresponding pin 78 on an eccentric 80. The eccentric 80 is revolved clockwise about fixed center 32 driving the connecting rod 22 to the right. The motion of connecting rod 22 to the right compresses the pair of stored energy springs 18 that function as a unit through links 24 and 26. At the instant the springs 18 are fully charged, latch roll 82 affixed to connecting rod 22 engages prop latch 20 thus holding the fully charged springs latched and ready to be discharged to close the breaker either by manual release of the prop latch 20 through a mechanical closing button, or by electrical release through the solenoid release plunger.

To guard against accidental overloading of the charging system, gear 74 that is driven by the pinion gear 73 is shaped to disengage from the pinion shaft at the full charged position of the stored energy springs. As FIG. 3 shows, this disengagement is accomplished by the removal of a segment of the teeth from the periphery of gear 74. Flexible teeth 84 are provided at the end of the open segment to facilitate reengagement.

Spring Charging Mechanism

When motor 70 is energized, it rotates pinion gear 73 in a counterclockwise direction which in turn rotates gear 74 clockwise and also rotates eccentric arm 22, so as to compress stored energy springs 18. When the cycle is complete and springs 18 are fully charged, the breaker is ready to receive a close signal. When this signal is received, the breaker contacts, through a system of linkages, will close rapidly.

Slow Close Prevention Mechanism

The purpose of the present invention is to prevent the circuit breaker contacts 12 from slow closing, in the event that motor 70 loses its power during a spring charging cycle before springs 18 are fully charged. For example, if the power is lost to motor 70 and the stored energy springs 18 are partially charged, the springs are strong enough to rotate the motor shaft 72 in a reverse direction, which in turn would permit the circuit breaker contact to slow close.

As FIGS. 1, 2, 3 and 4 show, motor 70 is mounted on frame 10 and comprises shaft 72 which extends through a plate 86 which is comprised in frame 10. As FIG. 4 shows, shaft 72 carried pinion gear 73 which is rigidly secured thereto and which cooperates with gear 74. Shaft 72 is provided with an adapter 88 which has hexagonal exterior configuration and which is secured against rotation on the shaft by a pin 90. A one-way ratchet means 92 is provided which comprises an elongated fixed member 94 and a rotatable member 96 (normally rotatable in one direction only). The fixed member 94 of ratchet 92 means 92 is thus secured in position for operation to permit rotation of motor shaft 72 in one direction (counterclockwise) but not in the opposite direction (clockwise).

If preferred, ratchet means 92 could take the form of a type of commercially available ratchet wrench of appropriate size with the handle thereof suitably modified to adapt it for securing to frame 10. Thus, of motor 70 is deenergized while it is in the process of charging springs 18, the springs cannot effect reverse rotation of gear 74, gear 73 and motor shaft 72 (with subsequent slow close of the breaker contacts) because the ratchet means 92 prevents reverse rotation of the motor. Furthermore, ratchet means 92 may be provided with releasing means 102 whereby its one way operating characteristic can be selectively reversed to permit intential slow close of the breaker contacts as during testing or for other purposes.

In accordance with another aspect of the invention, as shown in FIG. 5, adapter 88 on motor shaft 72 is accessible for engagement by a manually operated standard ratchet wrench 104 to permit manual movement of the circuit breaker mechanism and contacts.

The embodiments of the invention in which we claim an exclusive property or privilege are defined as follows:

1. In an electric circuit breaker, a support, relatively movable contacts mounted on said support and movable to open and closed positions, contact operating means on said support to effect relative movement of said contacts, chargeable stored energy spring means mounted on said support and dischargeable to effect movement of said contact operating means and movement of said contact to one of said positions, charging means mounted on said support for charging said stored energy spring means, said charging means comprising an electric motor, and means mounted on said support to prevent discharge of said charging means from effecting movement of said contacts in the event said motor is deenergized before said spring means are fully charged, said means to prevent discharge of said charging means comprising one-way ratchet means which is connected to and prevents reverse rotation of the shaft of said motor, said one-way ratchet means comprising releasing means whereby reverse rotation of said shaft of said motor can be accomplished.