DEFEATER LOCK FOR ELECTRICALLY OPERATED CIRCUIT BREAKER

ABSTRACT: A circuit breaker having provisions for electrically powered as well as manual operation is provided with a coupling mechanism that is selectively operable to connect the circuit breaker for manual or powered operation. The coupling mechanism is biased toward its power-operating position. Cooperating-aperture arrangement, brought into alignment when the coupling mechanism connects the circuit breaker for manual operation, receive a padlocking arrangement for rendering the electrically powered circuit breaker inoperative.
DEFEATER LOCK FOR ELECTRICALLY OPERATED
CIRCUIT BREAKER

The instant invention relates to circuit breaker-operating mechanisms and more particularly relates to a padlocking means for selectively rendering an electrically powered operating mechanism ineffective to operate the circuit breaker.

U.S. Pat. No. 3,009,087, issued to W. W. Poulton Jr. for an "Electrically Operated Automatic Presetting Circuit Breaker Mechanism" discloses a motor-operated mechanism for operating a circuit breaker, as well as a manual operator for the breaker. In order to couple the manual operator in driving engagement with the circuit breaker, the driving connection between the motor and circuit breaker is broken. However, as soon as manual operation is complete, the motor is again drivingly coupled to the circuit breaker. This has often proven unsatisfactory when the unit is being serviced.

In particular, with prior art devices of this type, when service procedures were being performed, an unauthorized person could accidentally or intentionally use the electric motor to close the circuit breaker, thereby jeopardizing the safety of the serviceman.

In order to overcome this difficulty, the device of the instant invention includes aperture-means portions for receiving a padlock which maintains the mechanism in a position such that the driving connection between the motor and circuit breaker is broken. The aperture-means portions are normally misaligned, in which case the mechanism is in position for the motor to operate the circuit breaker. However, when the mechanism is conditioned for manual operation, the aperture-means portions are moved into alignment, and in this position are adapted to receive the shackle of a padlock. As previously noted, when the mechanism is conditioned for manual operation, the driving connection between motor and circuit breaker is broken.

Accordingly, a primary object of the instant invention is to provide a simplified lockable defeater for preventing power operation of a circuit breaker.

Another object is to provide a lockable defeater for a circuit breaker mechanism that will operate both manually and by motor.

These as well as other objects of the instant invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIG. 1 is a side elevation of a first embodiment of my novel mechanism shown mounted to a molded-case circuit breaker.

FIG. 2 is a plan view of the mechanism of FIG. 1.

FIG. 3 is a cross section taken through line 3-3 of FIG. 2 looking in the direction of the arrows 3-3.

FIGS. 4 and 5 are cross sections taken through line 4-4 of FIG. 3 looking in the direction of the arrows 4-4. In FIG. 4 the circuit breaker handle is illustrated in the On position and in FIG. 5 the circuit breaker handle is illustrated as being in the Reset position.

FIG. 6 is an enlarged fragmentary side elevation of the elements containing the aperture-means portions for receiving a padlock shackle. In FIG. 6, the aperture-means portions are shown in misalignment.

FIG. 7 is a view similar to FIG. 6, with the aperture-means portions aligned, and a padlock shackle extending therethrough.

FIGS. 8A and 8B are cross sections taken through line 8-8 of FIG. 7, showing the aperture portions of the sleeve and its cooperating shaft, respectively.

FIG. 9 is a schematic diagram illustrating the electrical connections necessary to achieve automatic resetting.

Now referring more particularly to the figures, mechanism 10 is secured to circuit breaker 11 by studs 12, which extend from circuit breaker 11 through openings in the bottom surface 14 of housing 15 and are engaged by nuts 13. Bottom surface 14 is bowed in region 16, thereby creating pressure between other regions of surface 14 and the top of the circuit breaker housing to achieve a firm seating of mechanism 10 upon circuit breaker 11.

Mechanism 10 comprises motor 20, which drives gear train 21, whose output shaft 22 drives pinion 23. The teeth of pinion 23 are in mesh with the teeth of drive gear 24 rotatably mounted on sleeve 25. Shaft 26 is mounted within sleeve 25 with one end 27 thereof being positioned within bearing opening 28 of block 29. Extension 30, the outer edge of which is peened over, extends from block 29 through an opening in bottom surface 14, thereby securing block 29 to housing 15.

End 27 of shaft 26 is provided with a pair of flat opposed surfaces entered into complementary-shaped opening 31 of cam 32. Spring retainer 33 engages shaft end 27 thereby securing shaft 26 to cam 32 for rotation in unison therewith. Drum 34 is adjacent top surface of cam 32 and is arranged coaxially with shaft 26. Coil spring 35 is disposed about shaft 26 in the region of brake drum 34. Drum 34 is provided with a square shaft opening 37 at the center thereof. Polygonal nut 36, in the shape of a square, is disposed within opening 37 and is biased upwardly by coil spring 35 toward engagement with drive gear 24, which is also provided with a squareopening 38. The bottom surface 39 of sleeve 25 is positioned adjacent to the top of nut 36.

Arms 50 and 51, formed of structural sections, are pivotally mounted at 52, 53, respectively, to cam 32. Shoes 54, 55, including friction linings 56, 57, respectively, are pivotally mounted at 58, 59 near one of the ends of the arms 50, 51, respectively. The other ends of arms 50, 51 are interconnected by members 60, 61, respectively, which are pivoted at 62, 63, respectively. Member 60 engages a pin 64 which is disposed within a central opening 65 of member 61. Compression spring 66 is disposed about member 60 and 61 and 60 and 61 away from each other. Thus, spring 66 urges linings 56, 57 against the peripheral surface of drum 34.

Rollers 67, 68 are pivotally mounted to cam 32 in spaced-apart relationship forming gap 69 therebetween. Circuit breaker operating handle 70 extends through opening 70a in the bottom surface 14 of housing 15 and is disposed within gap 69 when operated in its On position (FIG. 4) will engage switch 71 secured to housing 15 by means of bracket 72. Another switch 73 is secured to the bottom surface 14 of housing 15 and is positioned for operation by means of pins 74 and 75 which project downwardly from cam 32.

It is to be noted that when the circuit breaker handle 70 is in the On position of FIG. 4 there is a substantial gap between handle 70 and roller 67. Thus, when circuit breaker 11 is automatically tripped due to the occurrence of a fault current, the spring-loaded toggle mechanism of circuit breaker 11 will move handle 70 against roller 67, as indicated in phantom in FIG. 4. In this position, handle 70 is disengaged from switch 71 so that the switch 71 is now in the closed position.

Motor 20 is of a universal type having a field winding 77 for rotation of the motor 20 in a reverse direction. By depressing on control 78 with switch 73 thrown to the dotted line position of FIG. 9, motor 20 will rotate in a forward direction so as to rotate drive gear 24 counterclockwise with respect to FIG. 5. At this time, nut 36 is disposed within opening 38 so as to form a driving connection between drive gear 24 and drum 34. Linings 56, 57 in engagement with drum 34 form a driving connection which, acting through pins 52 and 53, transmits a counterclockwise rotation to cam 32 thereby moving rollers 67, 68 counterclockwise about shaft 26. Thus, roller 67 engages handle 70 to move handle 70 from the Reset position of FIG. 5 toward the On position of FIG. 4.

At the point where the toggle mechanism (not shown) of circuit breaker 11 crosses over center to rapidly move the cooperating contacts (not shown) of circuit breaker 11 into engagement, handle 70 moves away from roller 67 toward roller 68. Cam 32 will continue to move counterclockwise until the inertia energy of motor 20 and the elements of gear box 21 has been spent or until such time as surface 79 of cam 32 strikes the wall 80 of housing 15. Under the latter circumstances the force required to rotate cam 32 in the clockwise
direction exceeds the breakaway torque of the coupling mechanism, comprising drum 34 and shoes 54, 55, thereby causing the coupling mechanism to slide without damage to the closing mechanism 10 or circuit breaker 11.

In moving from the Reset position of FIG. 5 to the On position of FIG. 4 pin 74, carried by cam 32, has engaged arm 82 of switch 73, thereby throwing switch 73 to the solid line position illustrated in FIG. 9. In this position of switch 73, motor 20 is conditioned for rotation in the reverse direction and cannot be operated in the forward direction by depressing the on control 78. That is, upon the closing of automatic reset switch 71 or the closing of Off control 83, winding 76 will be energized and a rotation of motor 20 in a direction such that drive gear 24 will rotate clockwise with respect to FIG. 4. If the mechanism is in the On position of FIG. 4, depressing switch 83 will cause motor 20 to operate cam 32 clockwise about shaft 26 with roller 68 engaging handle 70 to operate the circuit breaker to the Reset position of FIG. 5.

Since contacts 84 of automatic reset switch 71 are connected in parallel with Off switch 83, as soon as handle 70 has become disengaged from switch 71, mechanism 10 will continue to move handle 70 to the Reset position even though Off switch 83 is released before handle 70 has reached the Reset position. Before handle 70 has reached the Reset position, pin 75 will have engaged arm 82 of switch 73, thereby throwing switch 73 to the dotted-line position 73a and deenergizing winding 77 and condition motor 20 for the rotation in the forward direction. This operation of switch 73 usually takes place before handle 70 has been driven to the reset position by roller 68. However, the inertia energy of motor 20 and the elements of gear box 21 is sufficient to cause continued rotation of drive gear 24 so as to move handle 70 completely to the Reset position, with the torque-limiting features of the clutching mechanism 34, 54, 55 preventing any damage to handle 70 as well as other elements of the circuit breaker mechanism 11. Automatic resetting takes place in a similar manner. That is, when circuit breaker 11 is opened due to an overload condition, the toggle mechanism thereof will cause handle 70 to move from the solid line position of FIG. 4 to the phantom position of FIG. 4, thereby permitting the contacts 84 of automatic reset switch 71 to move to the closed position. Since switch 73 is in the solid line position of FIG. 9, motor 20 is conditioned for operation in the reverse direction. Thus, when contacts 84 are closed, winding 76 is energized and mechanism 10 will operate handle 70 to the reset position of FIG. 5.

Lamps 91–93 (FIG. 9) provide an indication of the condition of circuit breaker 11. That is, if lamp 91 is lighted circuit breaker 11 has been tripped, and if lamp 93 is lighted circuit breaker 11 has been operated to the Off position.

Upper end 44 of sleeve 25 is usually positioned (FIGS. 3 and 6) above the upper end 45 of shaft 26, which is of a square cross section and reduced in size from the central portion of shaft 26. Manual-operating crank 46 includes a transverse head 47 at one end thereof which is provided with a recess having a circular portion 48 of approximately the same diameter as sleeve 25 and a square portion 49 of approximately the same size as the end portion 45 of shaft 26. By mounting head 47 on sleeve 25, sleeve 25 may be depressed to move nut 36 downward against the force of spring 35 thereby disengaging nut 36 from drive gear 24.

Upper portion 85 of nut 36 is tapered as is the bottom portion of opening 38, thereby facilitating the disengagement of nut 36 from drive gear 24. Simultaneously, the square end portion 45 of shaft 26 will nest in recess 49 so that rotation of crank 46 will cause a corresponding rotation of cam 32. Thus, when sleeve 25 is depressed manual rotation of shaft 26 by crank 46 will cause rotation of cam 32 about shaft 26 as a center to effectuate operation of a circuit breaker handle 70.

Even though motor 20 should be energized at this time, the rotation drive gear 24 will not be transmitted to drive drum 34 since nut 36 is disengaged from driving gear 24. Thus, the operator will not be injured by an accidental energization of motor 20 while he is attempting a manual operation of the mechanism.

When handle 46 is removed from the remainder of the mechanism 10, spring 35 will force nut 36 upwardly toward drive gear 24. At this time, opening 38 of drive gear 24 may not be in the correct angular position to receive nut 36. However, upon energization of motor 20 and rotation of drive gear 24, spring 35 will force nut 36 to enter opening 38 when opening 38 and nut 36 are in corresponding angular positions, thereby once again establishing the driving connection between motor 20 and drum 34.

Sleeve 25 and shaft 26 are provided with cooperating aperture-means portions which, when aligned, receive shackle 101 of padlock 100 (FIG. 7), to maintain mechanism 10 in a condition wherein a motor 20 is ineffective to operate circuit breaker 11. More particularly, such cooperating aperture-means comprises slot 102 in shaft 26 and holes 103, 104 in sleeve 25. When sleeve 25 is in its normal or raised position of FIGS. 3 and 6, the driving connection from motor 20 to circuit breaker 11 is complete. At this time holes 103, 104 are positioned above slot 102. When hub portion 47 of handle 46 is depressed for engagement with the squared upper portion 45 of shaft 26, sleeve 25 moves axially downward on shaft 26, moving nut 36 downward to break the driving connection between motor 20 and circuit breaker 11.

In this lowered position of sleeve 25, holes 103, 104 are aligned with slot 102 (FIG. 7) and cooperate to provide an aperture means which receives lock shackle 101.

Lock shackle 101, extending through aperture means 102–104, prevents spring 35 from raising nut 36 to the position wherein the driving connection between motor 20 and circuit breaker 11 is completed. Thus, with lock shackle 101 extending through aperture means 102–104, energization of motor 20 is ineffective to operate circuit breaker 11. Under these circumstances, inspection and/or servicing of circuit breaker 11 may be undertaken without fear of motor operation of circuit breaker 11 by an unauthorized person.

Although there have been described preferred embodiments of this novel invention, many other variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited not by the specific disclosure herein, but only by the appended claims.

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

1. The combination including a switch device, a driving means for power operation of said switch device, a handle for manual operation of said switch device, a coupling means for selectively providing an operative connection from said driving means and said handle to said switch device, an operating means movable between a first and a second position for controlling operative connections made by said coupling means, with said operating means in said first position the operative connection between said driving means and said switch device being completed and said driving connection between said handle and said switch device being broken, with said operating means in said second position the operative connection between said handle and said switch device being completed and said operative connection between said driving means and switch device being broken, and releasable locking means for maintaining said operating means in said second position while permitting movement of said handle to operate said switch device, said operating means being maintainable in said second position while said locking means is released.

2. A combination as set forth in claim 1, also including a biasing means urging said operating means to its said first position.

3. A combination as set forth in claim 1, in which said coupling means includes a clutch-type driving connection constructed to slip when force required to operate said switch device exceeds a predetermined value.

4. A combination as set forth in claim 1, in which there is a sleeve and a shaft, one of which constitutes part of said operating means and the other of which constitutes a part of said coupling means, said sleeve being fitted over said shaft for relative axial movement therebetween, said locking means comprising transversely extending aperture-means portions in
said shaft and said sleeve and a lock having a shackle extendable through said aperture-means portions when the latter are aligned, said aperture-means portions being aligned when said operating means is in said second position.

5. A combination as set forth in claim 4, also including a biasing means urging said operating means to its said first position.

6. A combination as set forth in claim 5, in which shaft provides an axis about which said handle is pivotable, said operating means is moved from said first to said second position by an axially directed force applied thereto through said handle.

7. A combination as set forth in claim 5, in which said coupling means includes a clutch-type driving connection constructed to slip when force required to operate said switch device exceeds a predetermined value.