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MOTOR OPERATED CIRCUIT BREAKERS

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FIG. 1

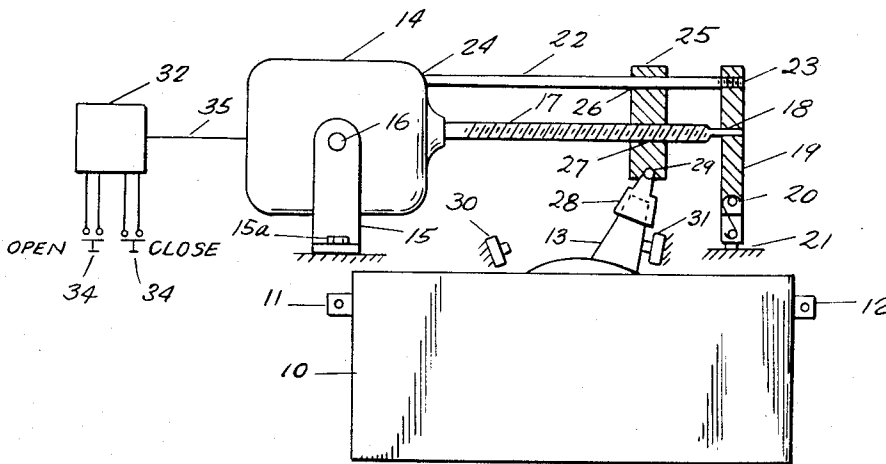


FIG. 2

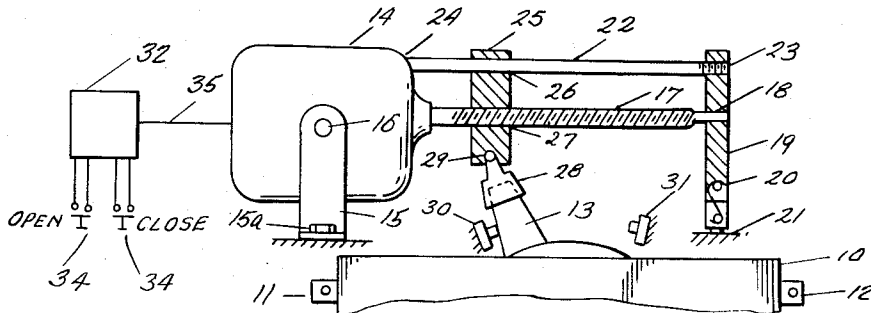
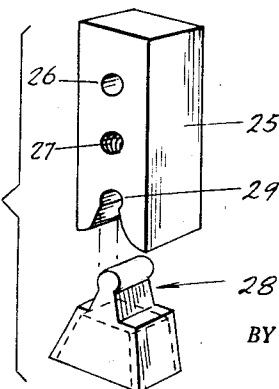


FIG. 3



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MOTOR OPERATED CIRCUIT BREAKERS

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Application June 23, 1955, Serial No. 517,521

10 Claims. (Cl. 200—92)

My invention relates to a motor operated mechanism for circuit breakers, and more specifically to the use of a reversible and torque limited motor for the energization of an operating handle of a circuit breaker.

Circuit breakers of the type to which my novel motor operated mechanism can be applied are typically shown in U. S. Patent No. 2,574,093 which is assigned to the assignee of the instant application.

In circuit breakers of this type, a pair of cooperating contacts are operatively connected to the operating handle to be engaged and disengaged responsive to the position of an operating handle to a first and second extreme position. The mechanism which operatively connects the operating handle and cooperating contacts usually has the following characteristics:

(1) Engagement or disengagement of the contacts is effected just before the operating handle assumes its corresponding extreme position. It should be noted, however, that my novel motor operated mechanism can be applied to circuit breakers in which the motion of the contacts either into or out of engagement is a direct function of the motion of the operating handle.

(2) A means is provided to maintain the contacts in the engaged or disengaged position after they assume this position. This maintaining means can be embodied in devices such as over center toggle systems, latches and many others which are well known in the art.

(3) The mechanism can have trip free properties to allow separation of the contacts when engaged on a fault condition independently of the operating handle position.

(4) Means are provided within the mechanism to allow contact operation independently of the position of operating handle which are responsive to fault or predetermined conditions. In most cases, the operating handle will also be biased to assume a tripped position upon contact operation responsive to the fault sensing means.

(5) An extremely important feature common to most circuit breakers is that the operating handle cannot move beyond either of its two extreme positions without breakage of either the handle, the casing, upon which the handle is mounted, the mechanism connecting the operating handle to the contacts, or any of the associated components of the circuit breaker.

In view of the above properties, the motor operated mechanism of my invention has the following features:

(1) Rotation of the reversible motor in a first direction will cause motion of the operating handle to a first extreme position for contact engagement of the circuit breaker contacts and rotation of the reversible motor in a second direction will cause motion of the operating handle to a second direction for contact disengagement. In each case the rotation of the motor will transmit sufficient torque to overcome the forces maintaining the contacts in the engaged or disengaged position.

(2) When the circuit breaker operating handle assumes an extreme position the motor, which is limited in torque

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capacity, will be stopped since it cannot deliver the force required to break any of the circuit breaker components limiting the travel of the operating handle to this extreme position.

(3) Upon automatic operation of the circuit breaker contacts due to fault conditions, the motor mechanism can be operated to bring the circuit breaker handle to an extreme position to reset the operating mechanism and then rotated in a reverse direction to reclose the circuit breaker contacts.

Motor operated circuit breakers and mechanisms are well known in the art, and in each case a motor having a single direction of rotation is connected through a complex oscillatory linkage to energize the operation of a circuit breaker handle. Since the circuit breaker will go through another operating sequence if the motor is allowed to continue rotating, elaborate electrical circuits and brake mechanisms are required to de-energize the motor rotation after operation of the circuit breaker handle to a desired position.

The devices of the prior art also require elaborate clutching mechanisms to attach the motor to the circuit breaker handle in order to allow a convenient means of disconnection for subsequent manual operation. These devices are typically shown in United States Patents 2,192,046, 2,228,466 and 2,354,135.

If a motor having only a unidirectional rotation is used to be the prime mover for the motor operated circuit breaker operation, there is an inherent need for a brake on the motor to prevent the circuit breaker handle or circuit breaker casing from breakage due to the inherent energy in the motor rotor after operation of the circuit breaker handle, and a complicated electric circuit to assure de-energization of the motor to prevent the continued motor rotation from causing a subsequent operation of the circuit breaker.

Clearly, if there is a failure in the electric circuit which de-energizes the motor rotation, then the circuit breaker will be reoperated which could cause the destruction of the circuit breaker or any number of dangerous conditions on the line being protected by the circuit breaker. Furthermore, if the complex linkage which transforms the unidirectional rotary motion of the motor to the oscillatory motion required by the circuit breaker handle fails, then it would either be impossible to operate the circuit breaker or the circuit breaker handle or casing would be fractured.

The principle of my invention is to use a reversible motor having a limited torque which is directly connected to a circuit breaker handle. The direct connection between the motor and the circuit breaker handle is now made possible since the rotary motion of the motor in either direction can be easily linked to the circuit breaker handle to cause motion in a first or second direction. That is, there is no need, in view of the use of a motor which can rotate in two directions, to convert a unidirectional rotary motion to the oscillatory motion required by the circuit breaker handle.

Breakage of the circuit breaker handle or the casing upon which the circuit breaker handle is mounted, now can be easily prevented by using a reversible motor in which the maximum torque delivered by the motor is only slightly greater than that required to overcome the biasing forces within the circuit breaker proper on the operating handle.

The maximum force however, will be small compared to the forces which the circuit breaker handle or its mounting can withstand without breakage. It is therefore impossible to break either the circuit breaker handle or its casing.

If desired, limit switches which would automatically

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de-energize the motor in response to the position of the circuit breaker handle, can be provided, but it would be sufficient to de-energize the motor by merely releasing the switch which an operator would use to initiate energization of the motor. Obviously, the features of my novel invention can be applied to the operation of any pivotally mounted lever or any member which is to be moved between extreme positions.

It is now clear that each of the above mentioned difficulties occurring in the prior art devices are now overcome with this novel motor operating mechanism. The complex brake is now abandoned in view of the torque limited feature of the motor. Furthermore, the complex linkages required to change the unidirectional motion of the motor to the oscillatory motion required for the circuit breaker handle is avoided since the motor can now be easily removably connected to the circuit breaker handle to drive the handle in a first direction in response to rotation of the motor in a first direction, and to drive the circuit breaker handle in a second direction in response to a rotation of the motor in an opposite direction in response to a rotation.

A further simplification provided with my novel motor operated mechanism is that the devices can be easily disconnected from the circuit breaker handle to allow manual operation in view of the simple linkage required to connect the motor to the circuit breaker handle.

The clutch used in the prior art devices to allow either manual or motor operation can now be either eliminated or simplified in view of the simple linkage required to connect the reversible motor to the operating handle.

This simple and inexpensive connection between the motor and the circuit breaker handle provides the still further advantage of offering a clear visual indication of the position of the circuit breaker handle, whereas in the more complex devices using unidirectional motors a visual indication was often obstructed by the complex linkages connecting circuit breaker handle and unidirectional motor.

Accordingly, a primary object of my invention is the use of a reversible motor having a limited torque which is removably connected to a circuit breaker handle for operation thereof to any position.

Another object of my invention is to provide a reversible torque limited motor wherein a rotation on one direction moves a circuit breaker handle in one direction and rotation in a second direction moves a circuit breaker handle towards a second position, to thereby avoid a complex oscillatory linkage which would be required as the motor had only one direction of rotation.

Another object of my invention is the use of a torque limited motor for the operation of a circuit breaker handle wherein the maximum motor torque is sufficient to operate the circuit breaker handle, but is insufficient to cause breakage of the circuit breaker handle or of the circuit breaker housing.

A still further object of my invention is to provide a motor operated circuit breaker wherein the linkage between the circuit breaker handle and the motor is simple enough to afford easy visual observation of the position of the circuit breaker handle.

Still another object of my invention is to provide a motor operated circuit breaker having simple linkage between a reversible motor and the circuit breaker handle which provides simple disconnection between the circuit breaker handle and the motor to afford manual operation of the circuit breaker.

These and other objects of my invention will become apparent when taken in connection with the drawings, in which:

Figure 1 shows a side view of a reversible motor having torque limited features directly connected to the operating handle of the circuit breaker, wherein the circuit breaker handle is in a first position.

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Figure 2 is similar to Figure 1, and shows the position of the circuit breaker handle after the reversible motor has been rotated to place it in this second position.

Figure 3 shows an exploded perspective view of a portion of the linkage connecting the reversible motor shaft to the circuit breaker handle.

Referring now to Figures 1 and 2, circuit breaker 10 has an internal contacting mechanism, which is not shown herein, to either connect or disconnect the terminals 11 and 12. This contact mechanism is energized for engagement or disengagement by means of the operating handle or circuit breaker handle 13. Circuit breaker 10 can have an internal construction such as that shown in United States Patent No. 2,574,093 to William Harold Edmunds, and assigned to assignee of the instant application.

Circuit breaker handle 13 is then connected directly to a reversible motor 14 in which is pivotally mounted in a U-shaped bracket 15, which is in turn rigidly attached to a housing by means of bolt 15a.

Motor 14 can be of the electric drill type which can be controlled to run forward and backward, and also has the overload feature in which the torque can be limited to take care of the heaviest load required.

The pivotal connection between motor 14 and bracket 15 is located at pivot point 16. The shaft 17 of reversible motor 14 has a worm gear threaded thereon, and is fastened in a bearing 18 of support 19. Support member 19 is then latched by means of a latch 20 to a ground member 21.

Supporting guide member 19 has threadably engaged shaft 22 threaded in the recess 23. Shaft guide unit 22 is further attached at the other end to the motor housing of the reversible motor 14 at the point 24. It is understood, of course, that this guide member 19 could be supported between the motor 14 and the member 19 in any desired manner and the fastening shown in Figures 1 and 2 illustrate just one method of fastening.

An operating link is then provided for removably attaching the motor shaft 17 to the circuit breaker handle 13, and comprises a member 25, which is more clearly shown in the exploded perspective view of Figure 3.

As shown with reference to both Figures 1 and 3, member 25 has a hole 26 through which shaft 22 is positioned. A threaded hole 27 is then provided to threadably engage the worm gear of motor shaft 17. Bell shaped member 28 is then provided to removably connect member 25 to circuit breaker handle 13. The internal cross section of bell shaped member 28 is such that it will enclose a portion of the circuit breaker handle 13 as shown in Figures 1 and 2. If desired, bell shaped member 28 can be pivotally fastened in slot 29 of member 25, or it can be fastened directly to the circuit breaker handle 13. If desired, this member could be replaced by any type of linkage to connect member 25 and circuit breaker handle 13 and bell shaped member 28 is representative of only one possible linkage for this purpose.

The operation is now taken in conjunction with Figures 1 and 2, assuming that the mechanism is initially in the position of Figure 1, and that the circuit breaker handle 13 is in the position at the extreme right.

It is now desired to move the circuit breaker handle 13 to a second position which is that of Figure 2 to the extreme left. The energizing circuit is shown diagrammatically as comprising an energizing source 32 which is controlled by switches 33 and 34 to energize motor 14 over the connecting circuit shown simply as a single line 35. When switch 33 is closed, the motor 14 will be energized to operate the circuit breaker to the open position, and when switch 34 is operated the motor will be energized for a reverse rotation to operate the circuit breaker to the closed position. Both switches 33 and 34 can be of the normally open type thereby energizing motor operation only as long as an operator holds the switch closed. This circuit of course, is only typical of

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the many well known circuits available for the energization of a reversible motor.

The reversible motor 14 is first energized to thereby cause rotation of worm gear 17. Worm gear 17 engages the cooperating thread 27 of member 25, and causes movement of the member 25 in a direction toward the motor 14. Member 25 cannot rotate about the shaft 17 as an axis, since it is guided along the shaft 22 which engages the cooperating hole 26 in the member 25. Hence, only a transverse motion along the shaft 27 is possible for the member 25.

After sufficient rotation of shaft 17, the member 25 which is engaged to the circuit breaker handle 13 through the bell shaped member 28, will bring the circuit breaker handle 13 to the extreme left position shown in Figure 2.

If the operator does not release the energizing switch to stop motor rotation the instant that the circuit breaker handle 13 engages the housing of circuit breaker 10, then neither the circuit breaker handle 13 nor the housing of circuit breaker 10 will be broken, since the motor can only deliver a limited amount of torque which is sufficient only to cause motion of circuit breaker handle 13 against the biasing forces within the circuit breaker 10. Clearly, this very small force will be insufficient to cause breakage in the relatively rigid materials comprising the circuit breaker handle 13 and the casing of the circuit breaker 10.

If desired, limit switches such as the limit switches 30 and 31 can be provided in a position to automatically de-energize the reversible motor operating circuit in response to the position of circuit breaker handle 13. It should be noted, however, that this is not a necessary feature of the device, since the motor will automatically be de-energized when the operator opens the energizing circuit of the motor. Clearly, continued energization of the motor after operation of the circuit breaker would not cause breakage of any parts in view of the torque feature of the motor.

If it is desired to operate the circuit breaker handle 13 manually rather than by the motor control, the simple linkage between the reversible motor 14 and circuit breaker handle 13 afford extremely easy disconnections.

In the embodiment of Figures 1 and 2, this disconnection comprises the removal of latch 20 from the rigid ground body 21 and a subsequent rotation of the complete mechanism about the point 16. That is, the motor 14, the shafts 22 and 17, the members 25, 28 and 18 will all rotate about the pivot point 16 as though they were comprised of one body, thereby completely freeing the circuit breaker handle for manual operation.

As further shown in both the Figures 1 and 2, the extremely simple linkage connecting the motor 14 and circuit breaker handle 13 afford a very clear and unobstructive visual indication of the position of circuit breaker handle 13.

In the case of automatic tripping of circuit breaker 10 under fault conditions, it is now obvious that motor rotation in a first direction will move circuit breaker handle to a reset position and a subsequent energization of motor 14 for rotation in an opposite direction will move the circuit breaker from the reset position to an on position.

In the foregoing I have described my invention solely in connection with specific illustrations and embodiments thereof, since any variations and modifications of my invention to those skilled in the art, I prefer to be bound not by the specific disclosure herein but only by the appending claims.

I claim:

1. A mechanism for operating a pivotally mounted member between two extreme positions; means associated with said pivotally mounted member to prevent motion of said pivotally mounted member beyond either of said two extreme positions; said mechanism comprising a reversible motor removably connected in direct driving engagement to said pivotally mounted member to move

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said pivotally mounted member toward its first extreme position responsive to rotation in a first direction and to move said pivotally mounted member towards said second extreme position responsive to rotation in a second direction; said reversible motor being constructed to deliver a maximum torque which is insufficient to cause breakage of said pivotally mounted member or said means to prevent motion of said pivotally mounted member beyond said two extreme positions, said reversible motor having its rotation stopped by said means preventing motion of said pivotally mounted member beyond either of said two extreme positions when said pivotally mounted member moves into either of said two extreme positions, and switching means to de-energize an electrical power source causing rotation of said reversible motor which are responsive to the position of said pivotally mounted member.

2. In combination, a circuit interrupter and an operating means; said circuit interrupter comprising a pair of cooperating contacts and an operating handle, said operating handle being operatively connected to said cooperating contacts, said operating handle being movable to a first and second position for operating said cooperating contacts to an engaged and a disengaged position; means to prevent motion of said operating handle past said first or second position; said operating means being removably connected in direct driving engagement to said operating handle and comprising a reversible motor and a connecting means; said connecting means being constructed to move said operating handle in a first direction to said first position to operate said cooperating contacts to said engaged position responsive to rotation of said reversible motor in a first direction and to move said operating handle in a second direction or in a direction opposite to said first direction to said second position to operate said cooperating contacts to said disengaged position responsive to rotation of said reversible motor in a direction opposite to said first direction of rotation; said reversible motor rotation being stopped at said first or second position by said means to prevent motion of said operating handle past said first or second position, said reversible motor being constructed to deliver a torque insufficient to overcome said motion preventing means or to break said operating handle.

3. In combination, a circuit breaker and an operating means; said circuit breaker comprising a pair of cooperating contacts and an operating handle, said operating handle being operatively connected to said cooperating contacts, said operating handle being movable to a first and second position for operating said cooperating contacts to an engaged and a disengaged position; means to prevent motion of said operating handle past said first or second position; said operating means being removably connected in direct driving engagement to said operating handle and comprising a reversible motor and a connecting means; said connecting means being constructed to move said operating handle in a first direction to said first position to operate said cooperating contacts to said engaged position responsive to rotation of said reversible motor in a first direction and to move said operating handle in a second direction or in a direction opposite to said first direction to said second position to operate said cooperating contacts to said disengaged position responsive to rotation of said reversible motor in a direction opposite to said first direction of rotation; said reversible motor rotation being stopped at said first or second position by said means to prevent motion of said operating handle past said first or second position, said reversible motor being constructed to deliver a torque insufficient to overcome said motion preventing means or to break said operating handle, and switching means responsive to the position of said operating handle to de-energize an electrical power source causing rotation of said reversible motor.

4. In an interrupter having cooperable contacts movable with respect to each other, a manual member for operating said contacts into and out of engagement, an electric motor having a driving end, said motor being pivotally mounted to a fixed pivot, means for removably connecting said driving end to said manual member for permitting either manual operation or motor operation of said contacts into and out of engagement, a latch means engageable with said driving end, said latch means when latched retaining said driving end in direct driving engagement with said manual member and when unlatched permitting said motor to rotate about said pivot and thereby disengage said driving end from said manual member to permit manual operation of said manual member; means for driving said motor in one direction to effect engagement of said contacts and for driving said motor in the opposite direction to effect disengagement of said contacts, said motor having a power output capacity such that the engagement of said contacts effectively brakes said motor to bring it to a stop.

5. An operating mechanism for a circuit breaker, said circuit breaker having an operating handle which is movable between two extreme positions and means to prevent said operating handle from moving beyond either of said two extreme positions; said operating mechanism comprising a reversible motor and a connecting means; said connecting means constructed to removably connect said reversible motor to said operating handle; said operating handle being moved toward a first of said two extreme positions responsive to rotation of said reversible motor in a first direction, said operating handle being moved toward a second of said two extreme positions responsive to rotation of said reversible motor in a direction opposite to said first direction of rotation, said reversible motor having a torque output small enough for its rotation to be stopped by said means to prevent said operating handle from moving beyond either of said two extreme positions when said operating handle is moved to either of said two extreme positions, said connecting means being comprised of a gear, a follower member, a guide member, a bell shaped member; said gear operatively connected to said reversible motor to be driven thereby; said follower member being operatively connected to be driven by said gear member along a path defined by said guide member; said bell shaped member being operatively connected between said follower member and said operating handle so that said reversible motor is in direct mechanical driving engagement with said operating handle.

6. An operating mechanism for a circuit interrupter, said circuit breaker having an operating handle which is movable between two extreme positions and means to prevent said operating mechanism from moving said operating handle beyond either of said two extreme positions; said operating mechanism comprising a reversible motor and a shaft and a connecting means; said connecting means being operatively connected in direct driving engagement to said circuit interrupter handle; said motor shaft and said connecting means being operatively connected by a gear means; said operating handle being moved toward a first of said two extreme positions responsive to rotation of said reversible motor in a first direction, said operating handle being moved toward a second of said two extreme positions responsive to rotation of said reversible motor in a direction opposite to said first direction of rotation, said reversible motor having a torque output small enough for its rotation to be stopped by said means to prevent said operating handle from moving beyond either of said two extreme positions when said operating handle is moved to either of said two extreme positions.

7. In combination, a circuit interrupter and an operating means; said circuit interrupter comprising a pair of cooperating contacts and an operating handle, said operating handle being operatively connected to said cooperating contacts, said operating handle being movable to

a first and second position for operating said cooperating contacts to an engaged and a disengaged position; means to prevent motion of said operating handle past said first or second position; said operating means being removably connected to said operating handle and comprising a reversible motor and a connecting means; said connecting means being constructed to move said operating handle in a first direction to said first position to operate said cooperating contacts to said engaged position responsive to rotation of said reversible motor in a first direction and to move said operating handle in a second direction or in a direction opposite to said first direction to said second position to operate said cooperating contacts to said disengaged position responsive to rotation of said reversible motor in a direction opposite to said first direction of rotation; said reversible motor rotation being stopped at said first or second position by said means to prevent motion of said operating handle beyond said first or second positions, said reversible motor being constructed to deliver a torque insufficient to overcome said motion preventing means or to break said operating handle; said connecting means being comprised of a gear, a follower member, a guide member, a bell shaped member; said gear operatively connected to said reversible motor to be driven by said gear member along a path defined by said guide member; said bell shaped member being operatively connected between said follower member and said operating handle so that said reversible motor is in direct mechanical driving engagement with said operating handle.

8. A mechanism for operating a pivotally mounted member between two extreme positions; means associated with said pivotally mounted member to prevent motion of said pivotally mounted member beyond either of said two extreme positions; said mechanism comprising a reversible motor removably connected to said pivotally mounted member to move said pivotally mounted member toward its first extreme position responsive to rotation in a first direction and to move said pivotally mounted member towards said second extreme position responsive to rotation in a second direction; said reversible motor being constructed to deliver a maximum torque which is insufficient to cause breakage of said pivotally mounted member or said means to prevent motion of said pivotally mounted member beyond said two extreme positions, said reversible motor having its rotation stopped by said means preventing motion of said pivotally mounted member beyond either of said two extreme positions when said pivotally mounted member moves into either of said two extreme positions; said motor being pivotally mounted to a fixed point; a latch means engageable with said driving end, said latch means when latched retaining said driving end in direct driving engagement with said pivotally mounted member and when unlatched permitting said motor to rotate about said pivot and thereby disengage said driving end from said pivotally mounted member to permit manual operation of said pivotally mounted member.

9. A mechanism for operating a pivotally mounted member between two extreme position; means associated with said pivotally mounted member to prevent motion of said pivotally mounted member beyond either of said two extreme positions; said mechanism comprising a reversible motor removably connected to said pivotally mounted member by a connecting means to move said pivotally mounted member toward its first extreme position responsive to rotation in a first direction and to move said pivotally mounted member towards said second extreme position responsive to rotation in a second direction; said reversible motor being constructed to deliver a maximum torque which is insufficient to cause breakage of said pivotally mounted member or said means to prevent motion of said pivotally mounted member beyond said two extreme positions, said reversible motor having its rotation stopped by said means preventing motion of said pivotally mounted member beyond either

of said two extreme positions when said pivotally mounted member moves into either of said two extreme positions; said connecting means being comprised of a gear, a follower member, a guide member, a bell shaped member; said gear operating connected to said reversible motor to be driven thereby; said follower member being operatively connected to be driven by said gear member along a path defined by said guide member; said bell shaped member being operatively connected between said follower member and said pivotally mounted member so that said reversible motor is in direct mechanical driving engagement with said pivotally mounted member.

10. In combination, a circuit interrupter and an operating means; said circuit interrupter comprising a pair of cooperating contacts and an operating handle, said operating handle being operatively connected to said cooperating contacts, said operating handle being movable to a first and second position for operating said cooperating contacts to an engaged and disengaged position; means to prevent motion of said operating handle past said first or second position; said operating means being removably connected to said operating handle and comprising a reversible motor and a connecting means; said connecting means being constructed to move said operating handle in a first direction to said first position to operate said cooperating contacts to said engaged position responsive to rotation of said reversible motor in a first direction and to move said operating handle in a second direction or in a direction opposite to said first direction to said second position to operate said cooperating contacts to said disengaged position responsive to rotation of said reversible motor in a direction opposite to said first direc-

tion of rotation; said reversible motor rotation being stopped at said first or second position by said means to prevent motion of said operating handle past said first or second position, said reversible motor being constructed to deliver a torque insufficient to overcome said motion preventing means or to break said operating handle; said motor being pivotally mounted to a fixed point; a latch means engageable with said driving end, said latch means when latched retaining said driving end in direct driving engagement with said operating handle and when unlatched permitting said motor to rotate about said pivot and thereby disengage said driving end from said operating handle to permit manual operation of said operating handle.

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