Oct. 7, 1941. W. A. ATWOOD ET AL 2,258,232

CIRCUIT BREAKER OPERATING MECHANISM

Filed Feb. 23, 1939

Fig. 4.

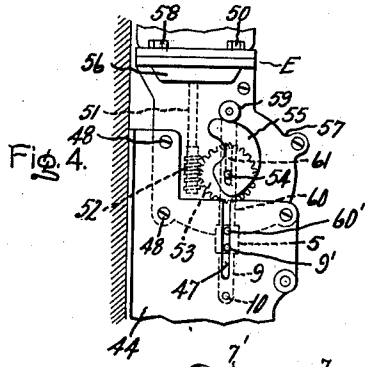


Fig. 1.

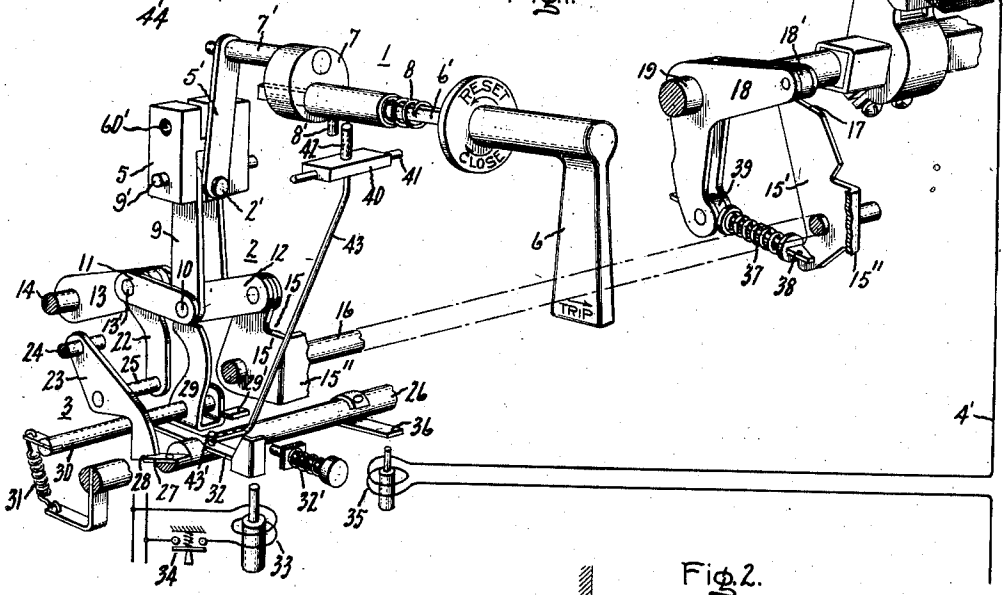


Fig. 2.

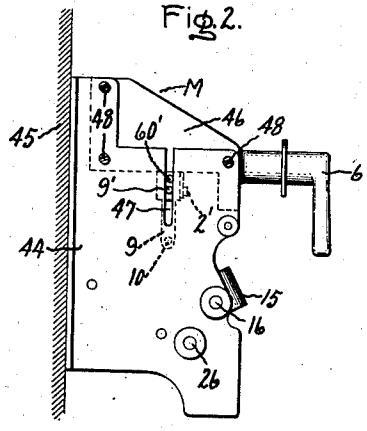
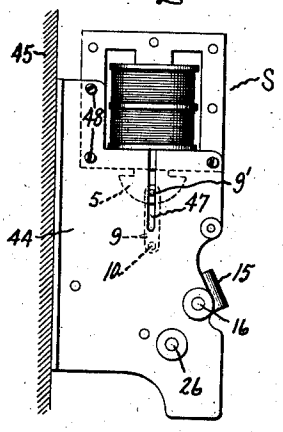


Fig. 3.



Inventors:
Winfield A. Atwood;
Joseph W. Seaman;
by Harry E. Dunham
Their Attorney.

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CIRCUIT BREAKER OPERATING MECHANISM

Winfield A. Atwood, Yeadon, and Joseph W. Seaman, Upper Darby, Pa., assignors to General Electric Company, a corporation of New York

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7 Claims. (Cl. 200—153)

Our invention relates to circuit breaker operating mechanisms, more particularly to operating mechanisms that can readily be adapted to either manual or electromagnetic, such as motor or solenoid, operation and has for its principal object the provision of an improved circuit breaker operating mechanism that is symmetrical and compact with respect to the actuating means, positive and efficient in operation, and suitable for operation by either a manual or electromagnetic actuating unit mounted in detachable interchangeable relation thereto.

In the operation of moderate capacity circuit breakers, such as air circuit breakers for example, the type of actuating means, such as manual, motor or solenoid, may be determined by conditions of use or by cost considerations and by the rating of the breaker. For example, conditions of use may include the distance of the breaker from the operator, the necessity of quickly restoring power, etc. In the range of overlapping applications of both types, it has been customary to provide separately designed manual or electromagnetic mechanisms as the case may be.

It has also been proposed to equip circuit breaker operating mechanisms with both manual and electromagnetic operating means. However, in such cases the mechanism is generally completely designed for one particular type, such as solenoid, and the manual means is added to provide auxiliary actuating means in the case of solenoid power failure. In one type of mechanism, a solenoid is combined with the mechanism proper so as to constitute a permanent part thereof, and the mechanism linkage is in addition adapted to be operated by manual crank or lever. In such cases where manual operation is preferred, the solenoid mechanism is unnecessarily expensive and inefficient. Also compactness is sacrificed unless the mechanism is completely redesigned solely for manual operation.

In accordance with our invention, the mechanism, including suitable thrust transmitting structure, is mounted in a frame or support that is adapted to receive in interchangeable detachable relation either a manual or electromagnetic actuating unit. The unit is detachably related to the thrust transmitting structure so that the aforesaid actuating units can be readily interchanged or replaced as desired without disassembly of the thrust transmitting structure. With this arrangement, two separate and complete types of mechanism are unnecessary for breakers than can be operated manually as well as by motor or solenoid since a single mechanism can assume either type and be efficiently operated by either a manual or electromagnetic actuating unit.

Our invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is a perspective view, partly in section and partly diagrammatic of an electric circuit breaker mechanism of the interchangeable manual operating type embodying the present invention, Fig. 2 is a side elevational view of the assembled mechanism unit of Fig. 1, Fig. 3 is a similar view of the mechanism with a solenoid actuating unit, and Fig. 4 is another view of the mechanism with a motor actuating unit.

The complete operating mechanism illustrated by way of example comprises an interchangeable actuating unit generally indicated at 1, a main operating toggle 2, and a tripping device for the toggle mechanism generally indicated at 3. The electric circuit breaker to be operated is shown at 4. Certain features of this mechanism are disclosed and claimed in Patent No. 2,152,453 issued March 28, 1939, to Atwood and Rudolph for "Operating mechanism," and assigned to the same assignee as the present invention.

The actuating unit 1, which is shown in Fig. 1 as of the manual type, comprises a reciprocally guided plunger or crosshead 5 that is connected through a link 5' and crank 7 to a manual operating handle 6. The manual handle 6 is rotatably mounted in the front wall of the casing of the manual unit M (Fig. 2), the handle shaft including an extension 6' or rectangular cross-section slidably guided in the circular crank arm 7. The crank 7 is operatively connected to the link 5' through the horizontal crank arm 7'. The link 5' and the crosshead 5 are detachably interconnected as by a removable pin 2' so that the manual handle and crank can be removed without disassembly of the linkage 2.

A spring 8 seated at one end on a shoulder of the shaft 6' and at the opposite end at the inner wall of the unit M tends to bias the handle 6 toward said unit. A tripping detent 8' secured to the shaft 6' causes tripping of the linkage 2 in a manner presently described when the handle 6 is drawn outwardly against the spring 8.

Referring more particularly to the thrust

transmitting structure, the main operating toggle at 2 comprises a pair of interconnected links 11 and 12 that are operatively connected to the crosshead 5 by a link 9 at the toggle joint or knee 10. The link 9 is detachably connected to the crosshead 5 by a pin 9' that extends beyond the crosshead for a purpose hereinafter described. The link 11 is connected to a guide link 13 having a fixed pivot at 14, and the link 12 to a crank 15 that is rotatable on a shaft 16.

The crank 15, which is operated by the toggle 2 in response to operation of the actuating unit, such as by rotation of the handle 6, comprises a generally U-shaped member having substantially parallel sides 15' through which the shaft 16 extends, interconnected by an integral transverse strip 15'' extending parallel to the shaft. The crank at one side is provided with a cam surface 17 adapted to coact with a circuit breaker crank 18 which is rigidly connected through a rotatable countershaft 19 to the movable arm 20 of the circuit breaker 4. When the crank 15 is rotated clockwise as viewed by straightening of the main toggle 11—12 in response to elevation of the crosshead 5, the cam face 17 bearing on the roller 18' of the breaker crank rotates the breaker shaft 19 in counterclockwise direction whereby the movable contact structure 20 of the circuit breaker 4 is moved into contact engagement with the stationary contact structure 21. This movement, or working stroke of the breaker structure 20 is generally in opposition to spring pressure tending to bias the breaker to open circuit position.

For the purpose of holding the toggle 11—12 at the pivot 13' in thrust-transmitting position with respect to the crank 15 the toggle guide link 13 is related to suitable latching and tripping means comprising a link 22 connected to the toggle pivot 13' and to a latch 23 having a fixed pivot at 24. The members 22 and 23 are suitably interconnected as at 25 for insuring a force-reducing connection. Coacting with the latch 23 is a rotatable tripping shaft 26 to which is secured a detent member 27 adapted to engage the latch 23 at the notched portion 28.

In the position shown collapse of the toggle 11—12, that is, counterclockwise rotation of the toggle pivot 13' and dropping of the knee joint, is restrained by the latch 23 and detent 27. Tripping movement, that is, counterclockwise rotation of the tripping shaft 26, effects release of the latch 23 so that it is free to rotate counterclockwise for releasing the pivot 13' and permitting opening movement or collapse of the toggle.

In the closed circuit or restraining position shown the tripping means 3 is latched and the toggle is held in an underset extended position by a prop 29 adapted to support the knee 10 of the toggle. The prop is shown as being secured to a rotatable shaft 30 that is resiliently connected by a spring 31, as illustrated, to the tripping shaft 26 so as to facilitate resetting of both the prop and the latching means after a circuit opening or releasing operation of the mechanism.

Referring more particularly to the tripping means, the tripping shaft 26 is provided with an offset portion or arm 32 for coacting with a tripping means 33 that is shown as a solenoid energized from a control source through a switch 34. The member 32 may also be engaged by manual tripping means indicated at 32'. Manual tripping by the handle 6 may also be provided as previously indicated. When the breaker is closed as shown in Fig. 1 and the handle 6 is in the lower position, tripping is accomplished by drawing the handle outwardly against the spring 8. During this operation, the detent 8' rotates the member 40 about its axis at 41 by engaging the alined lug 42. The tripping shaft 26 is thereupon rotated to trip the mechanism through a member 43 arranged to tilt a projection 43' secured to said shaft. The conventional overload tripping coil 35 shown as energized from the main circuit at 4' also coacts with the tripping shaft at 36, operation of any of the above described tripping means causing counterclockwise rotation of the tripping shaft and release of the main toggle.

The breaker crank 18 is also connected to the crank 15 by means of a compression spring 37 guided on a member 38 engaging one end of the crank 15' and having a guided sliding connection at 39 with an arm of the crank 18. In the closed circuit position shown the spring 37 is under compression so that immediately upon release of the tripping latch, opening movement of the toggle 11—12 is accelerated by the stored spring energy, resulting in rapid movement of the cam surface 17 away from the roller 18'. The circuit breaker crank 18 is also acted upon throughout the breaker opening stroke by the spring 37 tending to accelerate separation of the contacts 20 and 21. During the closing operation when the crank 15 is rotated clockwise the spring 37 is placed under compression by reason of the comparatively long lever arm of the crank 18 acting in the opposite direction on the spring.

When the toggle 11—12 is released in response to a tripping operation, the toggle pivot 13' is free to rotate counterclockwise about pivot 14 thereby causing shifting of the toggle knee 10 from the end of the prop 29 and permitting opening movement of the toggle. In the case of manual operation, complete collapse of the toggle and resetting of the mechanism is deferred until the handle 6 is rotated toward the "reset" position. When this occurs, the pivot 13' reverses its movement and drops so that the latch 23 can return to its initial position during which return movement it rides over the latch detent 27 and resets in the position illustrated. The prop 29 is suitably shaped, as illustrated, for permitting free movement of the toggle knee 10 alongside the prop.

The resilient connection 31 between the trip shaft 26 and the prop shaft 30 biases the tripping detent into latching engagement after the latch 23 in dropping pushes down on and passes by the latch detent 27, the latter snapping into reset position due to the bias of spring 31. At the same time the spring 31 exerts a counterclockwise bias on the prop 29 urging it against the side of link 9 so that when the links 11 and 12 are raised to toggle position in a subsequent closing operation, the prop 29 is snapped beneath the toggle knee 10 to hold the mechanism in closed position independently of the actuating means. A stop member 29' is provided for preventing movement of the prop beyond the toggle knee.

It will therefore be noted that the mechanism is trip-free in operation since at any time during the closing stroke, release of the toggle pivot 13' in response to a tripping operation causes freeing of the toggle and opening of the circuit breaker. The opening speed is very rapid due to the fact that the main toggle can simply shift laterally off the prop 29 to open the breaker, since complete collapse of the toggle is not required until the linkage is to be reset. Actual breaking of the toggle is therefore unnecessary

to initiate the opening movement. In the case of trip-free operation as the crosshead 5 is elevated by rotation of the handle 6 as indicated at "close," the toggle remains in the extended position shown during the opening stroke. The resetting operation then depends on lowering of the crosshead by the handle as indicated at "reset" in order that the latch 23 may drop to its latching position. This resetting operation is also followed for normal tripping. The circuit breaker can, if desired, have separate means such as springs for normally biasing the same toward open circuit position.

The mechanism proper above described, apart from the manual actuating unit, is permanently mounted in a frame 44 as shown by Figs. 2 and 3 comprising a pair of side plates suitably secured to a support or panel 45. The various shafts and pivots of the mechanism can be journalled in the side plates, as indicated, so that the mechanism proper is a compact and integral unit.

Referring now to the actuating units, the manual unit M comprises a compact casing or housing 46 having depending side walls and open at its lower end. The manual handle 6 is rotatably mounted in the front wall, as shown, and the crank 7 and the associated connections for the crosshead 5 are enclosed by the casing. The crosshead 5 is guided at 47 by the extensions of the laterally disposed pin 9' for vertical reciprocal movement in slots in the frame side walls extending from the upper edges thereof. The manual unit casing is designed to fit between the frame side walls as shown and to be detachably mounted, as by screws 48, to the frame so as to enclose the upper part of the mechanism. Accordingly when it is desired to interchange or replace the unit M, the screws 48 are simply removed, the pin 2' at the crosshead withdrawn, and the unit simply lifted from the frame.

Where a solenoid unit S, as indicated in Fig. 3, is preferred, the unit is simply inserted in the frame 44 in the manner above described and the screws 48 secured in position after the solenoid plunger or armature, which now serves as the crosshead 5, is operatively connected to the link 9. For simplifying the arrangement when changing from manual to solenoid operation, the pin 2' at the crosshead can be withdrawn as above described, after which the crosshead 5 is removed. The links 9 are then connected directly by the pin to the solenoid armature which is guided in the frame at 47 as illustrated. The mechanism then can function as a conventional complete solenoid device without further alteration.

Fig. 4 illustrates the application of another form of electromagnetic operating device, namely an electric motor unit generally indicated at E, to the above described mechanism. As illustrated, the electric motor unit E comprises a unitary structure that is secured, as in the case of the solenoid unit, at 48 to the mechanism frame 44. The motor unit includes a self-contained brake and cam operator, the specific details of which form no part of the present invention and are omitted in the interest of clearness. By way of example, the motor and brake structure can be of the character disclosed and claimed in Patent No. 2,034,145, granted March 17, 1936 to L. J. Linde for "Operating mechanism."

Referring more particularly to Fig. 4, the motor unit includes an electric motor 50, the rotor shaft 51 of which is vertically positioned and provided with a worm drive 52 for coacting with a worm gear 53 that is secured to the cam shaft 54. The cam 55, which is mounted on the shaft 54 is of suitable design and is actuated in clockwise direction upon energization of the motor 50. The cam and its associated shaft and operating gears, together with the self-contained brake unit indicated at 56, are suitably mounted on a unitary support 57 that is in turn secured as at 58 to the motor housing 50.

In a motor operated cam mechanism of the character above described, the motor is energized for predetermined rotation of the cam, after which the motor is deenergized and the rotating parts brought to a quick stop by the automatic brake indicated at 56. The cam follower, which generally comprises a roller or the like is suitably connected to the means to be operated, which in the present case comprises the crosshead 5 shown by Fig. 1. As illustrated, the crosshead 5 at 60' is connected to the cam follower or roller 59 through a link 60 that is slotted as indicated at 61 to receive cam shaft 54. Accordingly the link 60 is guided for reciprocal rectilinear movement both by the cam shaft and by the guided crosshead 5 so that the cam follower is limited to reciprocal rectilinear movement.

The operation of the mechanism when used in connection with the motor unit E is essentially the same as that previously described. That is, rotation of the cam 55 in clockwise direction causes elevation of the crosshead 5 and closing of the breaker. When the mechanism is to be reset, the cam is simply rotated beyond its "high" point so that the cam follower drops to the "low" point, thereby permitting collapse of the toggle and resetting of the mechanism in the manner above described.

It should be particularly noted that for motor, manual and solenoid operation the mechanism in the case of each is rugged and compact and symmetrical with respect to the actuating force. This is equivalent to three separate operating mechanism designs, each of which is highly efficient and particularly adapted to the particular operating problems in question. By avoiding unnecessary and complicated operating linkage and associated structure, the actuating force can be more effectively and efficiently applied, thereby securing a more compact and efficient design for a given power rating.

It should be understood that our invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of our invention.

What we claim as new and desire to secure by Letters Patent in the United States is:

1. Circuit breaker operating mechanism comprising a supporting frame including a pair of spaced plate-like side members, thrust transmitting linkage mounted in said frame between said plate members, a member guided for reciprocal movement between said plate members for actuating said linkage, said frame at its top portion being adapted to receive in interchangeable relation an actuating unit for reciprocating said member, means for detachably mounting said unit in said frame so that it can be lifted and replaced or interchanged independently of said thrust transmitting linkage, and means for directly connecting said unit to said guide mem-

ber without removal of said member from said frame.

2. Circuit breaker operating mechanism comprising a supporting frame, thrust transmitting linkage mounted in said frame, a member guided for reciprocal movement in said frame for actuating said linkage, said frame at its top portion being recessed to receive in interchangeable relation electromagnetic and manual actuating units, means for detachably mounting the actuating unit in said frame so that it can be readily lifted from or inserted therein, and means for detachably relating said unit to said guide member whereby the actuating unit can be replaced or interchanged without disassembly or removal of said thrust transmitting linkage.

3. Circuit breaker operating mechanism comprising a supporting frame including spaced plate-like side members, thrust transmitting linkage mounted in said frame, a crosshead member guided for longitudinal reciprocal movement between said plate members for actuating said linkage, the plate-like sides of said frame at the top portion being adapted to receive in detachable and interchangeable relation an actuating unit of electromagnetic or manual type so that said unit can be readily lifted from or seated on said plate members, and means for operatively relating said unit to said crosshead member whereby replacement or substitution of said unit can be effected without disassembly or removal of said thrust transmitting linkage.

4. Circuit breaker operating mechanism comprising a supporting frame, thrust transmitting linkage mounted in said frame, a member guided for reciprocal movement in said frame for actuating said linkage, an actuating unit adapted to be detachably mounted in said frame for ready replacement thereof, said actuating unit including a housing, a manually operated shaft rotatable in said housing, means for detachably connecting said shaft to said reciprocally guided member for permitting removal and replacement of said unit without disassembly of said thrust transmitting linkage, and means for causing tripping of said thrust transmitting linkage in response to longitudinal movement of said shaft in a direction away from said frame.

5. Circuit breaker operating mechanism comprising a supporting frame having spaced plate-like sides, thrust transmitting linkage including a toggle mounted in said frame between said plates, said frame at its top portion being adapted to receive in detachable interchangeable relation an actuating unit of the electromagnetic or manual types so that said unit can be readily lifted from or seated on said frame, a member connected to the knee of said toggle for operating the same in rectilinear movement, said member being guided in vertical slots in said plates, and means for operatively relating said member to said unit whereby said unit can be replaced or interchanged without disassembly or removal of said toggle.

6. In an operating mechanism for an electric switch having a movable circuit-controlling member, toggle actuating means for moving said circuit-controlling member to the circuit-closing position, means for maintaining said toggle actuating means in a position to hold said circuit-controlling member in the circuit-closing position, and a rotatably mounted operating member arranged for translatory movement operable upon translatory movement in one direction to release said toggle actuating means from the holding position and rotatable in one direction to reset said toggle actuating means and in the opposite direction to effect the movement of said circuit-controlling member to the circuit-closing position.

7. In an operating mechanism for an electric switch having a movable circuit-controlling member, toggle actuating means for moving said member to a predetermined circuit-closing position, means for maintaining said toggle actuating means in a position to hold said member in said circuit-controlling position, and a rotatably mounted operating member arranged for translatory movement operable upon translatory movement in one direction to release said toggle actuating means from the holding position and rotatable in one direction to reset said toggle actuating means and in the opposite direction to effect the movement of said circuit-controlling member to said circuit-controlling position.

WINFIELD A. ATWOOD.
JOSEPH W. SEAMAN.