Oct. 19, 1965 S. W. SOOS, JR 3,213,235

FRICTION-CLUTCH TYPE MECHANISM FOR OPERATING CIRCUIT INTERRUPTERS

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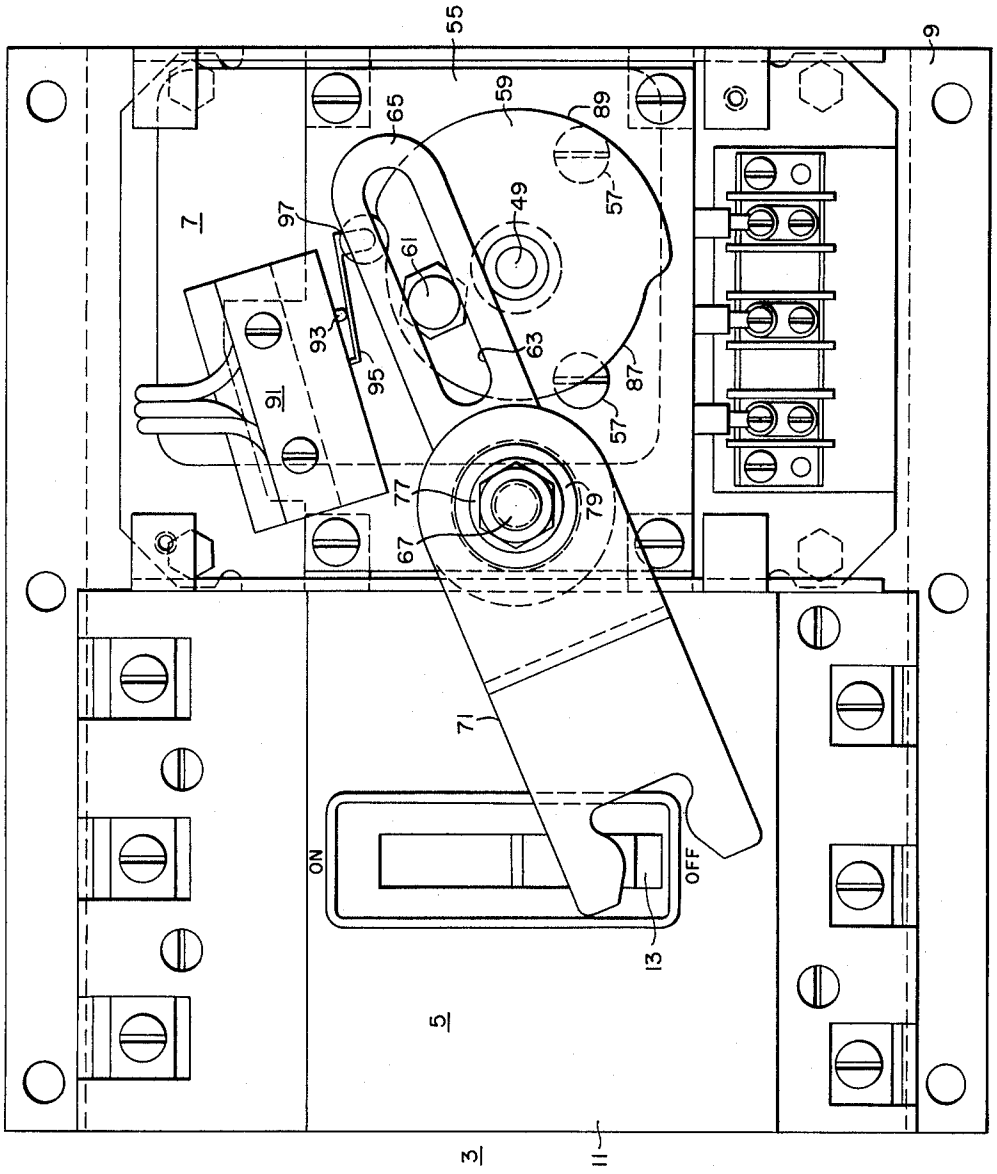


Fig. 1.

WITNESSES

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Fig. 5.



Fig. 2.

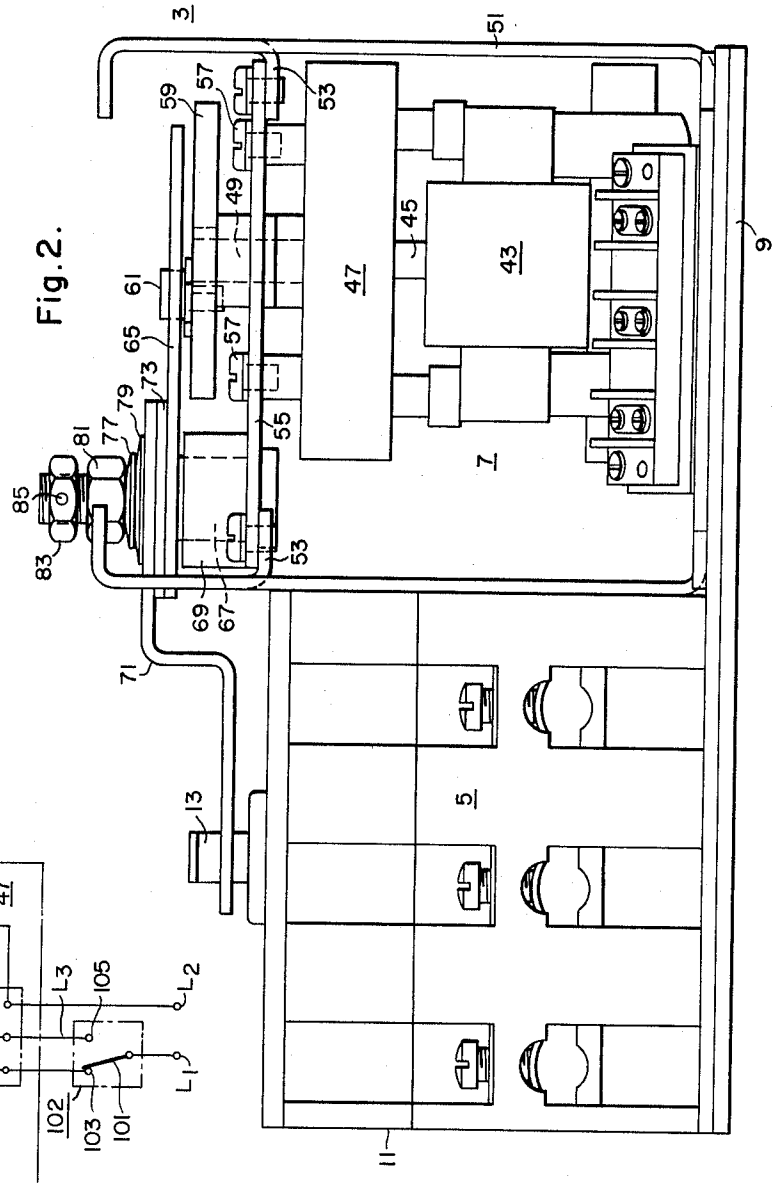


Fig. 3.

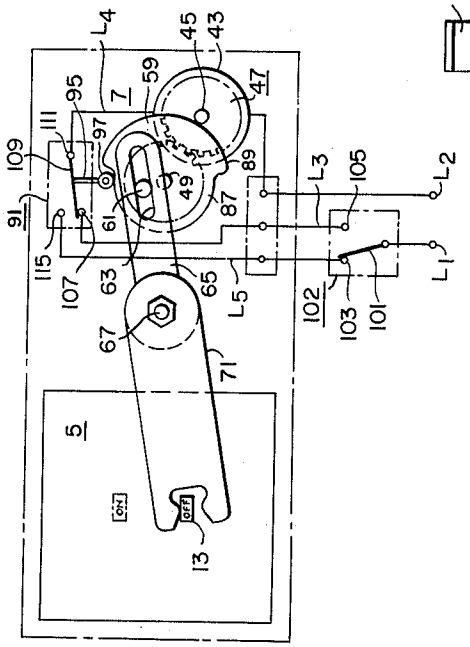
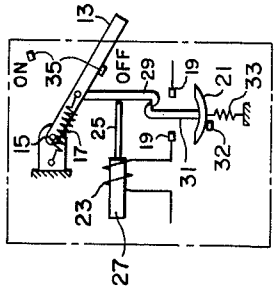


Fig. 4.



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FRICTION-CLUTCH TYPE MECHANISM FOR OPERATING CIRCUIT INTERRUPTERS

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This invention relates generally to mechanisms for operating circuit interrupters and more particularly to motor operating mechanisms for operating circuit interrupters.

A general object of this invention is to provide an improved mechanism for operating circuit interrupters.

Another object of this invention is to provide an improved friction type motor operating mechanism for operating circuit interrupters.

Another object of this invention is to provide an improved motor operating mechanism that can be connected to actuate the operating member of a circuit interrupter, which mechanism comprises a friction type driving means and has means for permitting adjustment of the frictional force characteristics, whereby the mechanism can be used to effectively operate various types of circuit interrupters without damaging the operating members of the interrupter.

A further object of this invention is to provide an improved motor operating mechanism with improved means for operating a circuit breaker of the molded-case type without damaging the external operating handle of the circuit breaker.

Another object of this invention is to provide an improved motor operating mechanism that can be mounted along side of a standard molded-case type circuit breaker which mechanism is not substantially longer, wider or higher than the molded-case circuit breaker, whereby the mechanism can be conveniently mounted in a standard panel board or enclosure.

A further object of this invention is to provide an improved motor operating mechanism for operating a circuit interrupter which mechanism comprises means permitting manual operation of the circuit interrupter without requiring an operation disconnecting the driving means from the driven means.

A further object of this invention is to provide an improved combination comprising a circuit interrupter and a mechanism for operating the circuit interrupter.

The novel features that are considered characteristic of this invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description of a preferred embodiment thereof when read in conjunction with the accompanying drawings, in which:

FIGURE 1 is a plan view of a circuit interrupting apparatus constructed in accordance with principles of this invention;

FIG. 2 is an end elevational view of the apparatus seen in FIG. 1;

FIG. 3 is a diagrammatic view of the apparatus seen in FIG. 1, illustrating the control circuits for the apparatus;

FIG. 4 is a schematic view of part of the circuit breaker seen in FIGS. 1–3; and

FIG. 5 is a perspective view of one of the spring washers seen in FIG. 2.

Referring to the drawings, and particularly to FIGS. 1 and 2, there is shown therein a circuit interrupting apparatus 3 comprising a circuit breaker 5 and a motor operating mechanism 7, both of which structures are suitably supported on a supporting plate 9. The circuit interrupter 5 is of the type known in the art as a molded-case type circuit breaker since it comprises an insulating housing 11 of molded insulating material and an external handle 13 extending from the housing 11 and manually movable between two operating positions to open and close the contacts within the housing 11. The circuit breaker 5 may be of the type shown in the patent to E. J. Walker et al., Pat. No. 2,989,606. Since the circuit breaker is fully described in the above-mentioned patent, only a schematic drawing and a brief description thereof is given herein. As is shown schematically in FIG. 4, the handle 13 is moved about a pivot 15 to move a spring 17 overcenter to effect opening and closing of the contacts 19, 21 in a well known manner. When the contacts 19, 21 are in the closed position and an overload current passes through the coil 23, a plunger 25 of a solenoid 27 is moved to the right (FIG. 4) to pivot a latch member 29 to unlatch a contact arm 31 that carries the movable contact 21, whereupon a spring 33 operates to open the contacts 19, 21. The contact 21 is stopped in the open position by means of a stop 32. The circuit breaker is reset by moving the handle 13 to the "off" position to relatch the latch member 29 with the contact arm 31. The circuit breaker is trip-free in that even if the handle 13 is held in the closed position, the circuit breaker will still be tripped open upon the occurrence of an overload current through the breaker. Stop means 35 are provided to limit movement of the handle 13 in both directions.

The circuit breaker 5 is operated by means of the motor operating mechanism 7. The motor operating mechanism 7 comprises a uni-directional motor 43 operating through an output shaft 45 to drive a gear mechanism 47 to rotate a main shaft 49. The motor 43 is supported on a generally U-shaped supporting bracket 51 having internal flanges 53 on which is secured a plate 55. Screws 57 connect the motor 43 and the gear mechanism 47 to the plate 55. A cam-and-drive member 59 is secured to the main shaft 49 to rotate with the shaft 49. A drive pin 61 is secured to the cam-and-drive member 59. The drive pin 61 is positioned in a slot 63 in a drive member 65 that is rotatably connected to a second shaft 67. The shafts 49 and 67 are disposed such that their center-lines or axes are generally parallel to each other and generally perpendicular to the plane of the generally flat top surface of the housing 11 of the circuit breaker 5. As is seen in FIG. 2, a bushing 69 is positioned between the plate 55 and the drive member 65. A connecting member or arm 71 is secured at one end thereof to the shaft 67 to rotate with the shaft 67. The other end of the connecting member 71 is generally claw-shaped to straddle the operating member or handle 13 of the circuit breaker 5. As is best seen in FIG. 2, a friction disc 73 of asbestos or other suitable material, is disposed between the connecting member 71 and the drive member 65. Two similarly constructed spring washers 77 and 79 are disposed over the shaft 67, and a nut 81 is threadedly engaged on the shaft 67 and rotated to flex the spring washers 77 and 79 to apply a force biasing the members 71, 73 and 65 downward, which movement is prevented by engagement of the member 65 on a shoulder portion of the shaft 67, so that the force of the washers 77, 79 forces the members 71, 73 and 75 together. One of the spring washers 77 is shown in perspective in FIG. 5. As can be seen in FIG. 5, one side of the washer 77 is convex and the opposite side is concave. The spring washer 79 is a little larger than the spring washer 77. A second nut 83 is threaded onto the shaft 67 and locked, to prevent relative rotation of the nut 83 with respect to the shaft 67, by means of a pin 85 that extends through a suitable opening in the

nut 83 and shaft 67. Thus, rotation of the nut 83 will rotate the shaft 67.

As is best seen in FIG. 1, the cam-and-drive member 59 has a cam surface, one half of which comprises an inner cam surface 87 and the other half of which comprises an outer cam surface 89. A switch indicated generally at 91 is mounted on the plate 5 and has an actuating plunger 93 extending therefrom to be operated by means of a resilient arm 95 having a roller 97 at the free end thereof. The bias of the resilient arm 95 holds the roller 97 in engagement with the cam surface 87, 89.

The circuit interrupting apparatus 3 is shown in FIGS. 1–4 in the "off" or contact-open position. Referring to FIG. 3, when the circuit interrupting apparatus 3 is mounted and wired for operation, two lines L1 and L2 are connected to a suitable power source. In order to close the circuit breaker 5, a switch arm 101, of a switch 102, is moved out of engagement with a contact 103 and into engagement with a contact 105. This closes a circuit from L1, through the switch arm 101, a line L3, a contact 107, of the switch 91, a switch arm 109, a contact 111, a line L4, through the motor 43 to the line L2. This energizes the uni-directional motor 43 to rotate the output shaft 45 in a direction that will cause the main shaft 49 to rotate clockwise (FIGS. 1 and 3). This rotates the cam-and-drive member 59 clockwise whereupon the drive pin 61 moves within the slot 63 of the drive member 65 to rotate the drive member 65 clockwise about the axis of the shaft 67. During this movement, because of the frictional engagement of the members 65 and 71 with the friction disc 73, the connecting member 71 and the shaft 67 to which the member 71 is secured, are rotated clockwise to move the handle 13 from the "off" to the "on" position to close the contacts of the circuit breaker 5.

Near the end of this movement, the roller 97 is moved from the inner cam surface 87 to the outer cam surface 89 whereupon the arm 95 forces the plunger 93 (FIG. 1) of the switch 91 inward to move the contact arm 109 (FIG. 3) out of engagement with the contact 107 and into engagement with a contact 115. This breaks the closing or "on" circuit deenergizing the motor 43, whereupon the breaking action of the motor 43, gear mechanism 47 and other moving parts of the circuit interrupting apparatus operate to brake the movement of the moving parts and bring them to a stand still. This movement of the switch arm 109 also prepares an opening or "off" circuit.

Thereafter, if it is desired to open the circuit breaker, the switch arm 101 (FIG. 3) of the switch 102 is moved out of engagement with the contact 105 and into engagement with the contact 103. This closes a circuit from the line L1 through the contact arm 101, the contact 103, a line L5, the contact 115, the contact arm 109, the line L4, the motor 43, to the line L2. This energizes the motor 43 to rotate the output shaft 45 is a direction that will move the main shaft 49 and cam-and-drive member 59 clockwise. During this movement, the drive pin 61 moves in the slot 63 of the drive member 65 to rotate the drive member 65 counter-clockwise about the axis of the shaft 67. This movement of the drive member 65 operates through the friction clutch 71, 73, 65, to move the connecting member 71 and shaft 67 counter-clockwise moving the operating handle 13 of the circuit breaker 5 from the "on" to the "off" position to open the contacts of the circuit breaker. Near the end of this movement, the cam-and-drive member 59 is moved to a position where the roller 97 of the switch 91 moves off of the outer cam surface 89 and back on to the inner surface 87 to release the plunger 93 whereupon the plunger 93 moves back out moving the contact arm 109 (FIG. 3) out of engagement with the contact 115 and back into engagement with the contact 107. This breaks the opening circuit deenergizing the motor 43 whereupon the drag of the motor and gears and other moving parts operates to brake and stop the moving parts. This movement of the switch arm 109 into engagement with the contact 107 prepares the "on" or closing circuit for another operation.

When the circuit breaker 5 trips automatically in response to an overload current condition above a predetermined amount, the circuit breaker is reset by moving the switch arm 101 into engagement with the contact 103 to operate the motor operating mechanism 7 from the "on" to "off" position to move the handle 13 of the circuit breaker to the "off" position to reset and relatch the breaker. Thereafter, the circuit interrupting apparatus 3 can be operated in the same manner hereinbefore described.

In order to provide for the most effective operation, the linkage and parts of the motor operating mechanism are constructed so that the travel of the drive member 65 is slightly more than the travel that is required to operate the breaker from one to the other position. In order to avoid damaging the handle 13 that is stopped at each operating position, the clutch 71, 73, 65 slips to permit the member 65 and the other driving parts to move relative to the stopped handle 13 and connecting member 71. Because the friction disc 73 is not attached to either of the members 71 or 65, the exact nature of how the clutch 71, 73, 65 slips can vary. The disc 73 could move with the member 65, in which case the upper surface of the disc 73 would slip relative to the stopped member 71. The disc 73 could stop with the member 71 in which case the lower surface thereof would slip relative to the member 65. Another possibility is that the disc could partially move with the member 65 in which case the upper and lower surfaces of the disc 73 would slip relative to the friction surfaces that they engage. The friction surface of the members 71 and 65 are merely the flat portions, of the metallic members 71 and 65, that engage the friction disc 73. The friction disc 73 could be attached to either of the members 73 or 65; or the disc 73 could be eliminated and either of the members 73 or 65 could be formed with an asbestos or other suitable surface to provide a friction type clutch.

The clutch 71, 73, 65 can be adjusted in order that there will be enough friction for effective operation; but not so much friction that the handle 13 will be broken or the motor 43 will be stalled during operation. The adjustment feature also provides that the motor operating mechanism 7 can be used with different circuit interrupters wherein a different amount of operating force may be required for effective operation. The adjustment is made merely by tightening or loosening the nut 81 to either put more or less compression on the spring washers 77, 79 to provide more or less force biasing the members 71, 73, 65 together. It is well known that the amount of friction between engaging surfaces is proportional to the amount of force biasing the surfaces together. Thus, the friction of the clutch 71, 73, 65 can be adjusted to provide for positive action of the circuit interrupting apparatus when any one of a variety of different circuit interrupters are used in the combination.

The circuit breaker 5 can be manually operated without requiring any operation disconnecting the driving mechanism from the driven mechanism. When it is desired to manually operate the circuit breaker 5, a tool is applied to the nut 83, and the shaft 67 is rotated to override the clutch 71, 73, 65 and rotate the connecting arm 71 relative to the drive member 65 to move the handle 13 of the circuit breaker from one to the other position. If the handle is manually operated to a position and then back to the original position, the circuit interrupting apparatus 3 is prepared for a subsequent motor operation. However, if the circuit breaker 5 is manually operated from one to the other position, and not manually operated back to the original position, the motor operating mechanism 7 must be operated once to catch up to the position of the arm 71 and handle 13 of the circuit

breaker **5** and to move the switch arm **109** of the switch **91** into position for the subsequent operation. Thereafter, the circuit breaker **5** can be operated by means of the motor operating mechanism **7** in the same manner hereinbefore described.

The motor operating mechanism **7** has been illustrated and described in combination with a molded-case type circuit breaker having an external operating handle **13**. The mechanism has an additional advantage when used in this combination because it can be readily connected to the circuit breaker handle **13**, and because when it is mounted beside the circuit breaker for operation, the motor operating mechanism is not substantially longer, wider, or higher than the circuit breaker **5**. Thus, the combination can readily fit within a standard panelboard or enclosure without requiring any significant reconstruction of the panelboard or enclosure. It is to be understood, however, that the motor operating mechanism can also be advantageously used in combination with many other types of circuit breakers and switches, and also with various other forms of circuit interrupters.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structure or details thereof may be made without departing from the spirit and scope of the invention. It is desired, therefore, that the language of the appended claims be given the broadest reasonable interpretation permissible in the light of the prior art.

I claim as my invention:

1. A motor-operating mechanism for operating a circuit interrupter, said motor-operating mechanism comprising a driven operator movable between two operating positions, a uni-directional motor, drive means comprising a drive member operatively connected to said motor, a friction disk disposed between said driven operator and said drive member, means biasing said driven operator and drive member toward each other squeezing said disk therebetween to form a friction type clutch, upon successive energizing operations of said motor said motor operating through said friction type clutch to operate said driven operator from a first of said operating positions to the second of said operating positions and then to said first operating position, and said friction type clutch being adapted to slip to limit the amount of driving force that will be transmitted through said friction clutch.

2. A motor-operating mechanism for operating a circuit interrupter, said motor-operating mechanism comprising a driven operator movable between two operating positions, said driven operator being stopped at each of said operating positions, said motor-operating mechanism comprising a motor having an output shaft, a drive structure rotatable about an axis and having a generally flat portion adjacent said axis which portion is movable in a first plane, means operatively connecting said drive structure to said output shaft, said driven operator being rotatable about said axis and having a generally flat portion adjacent said axis which portion is movable in a second plane that is generally parallel to said first plane, spring-washer means effecting a bias of said drive structure and said driven operator toward each other to form a friction type clutch that comprises at least said generally flat portions of said drive structure and said driven operator, upon successive energizing operations of said motor said drive structure operating to reciprocate said driven operator from a first of said operating positions to the second of said operating positions and then back to said first operating position, said driven operator being stopped at each of said operating positions, and said clutch slipping to permit said drive structure to move relative to said driven operator when said driven operator has reached each operating position to thereby limit the amount of force transmitted through said friction clutch to said driven operator.

3. A motor-operating mechanism for operating a circuit interrupter, said motor-operating mechanism comprising a driven operator movable between two operating positions, a motor having an output shaft, a drive member operatively connected to said output shaft, a friction member disposed between said driven operator and said drive member, spring-type washer means effecting a bias of said driven operator and drive member toward each other, upon successive energizing operations of said motor said drive member operating through said friction member to move said driven operator to reciprocate said driven operator between said operating positions, said driven operator being stopped at each of said operating positions, and said drive member slipping relative to said driven operator when said driven operator has been stopped at each of said operating positions to thereby limit the amount of force that will be transmitted from said drive member to said driven operator.

4. A mechanism for operating a circuit interrupter, said mechanism comprising a driven operator movable between two operating positions, said mechanism comprising a motor having an output shaft, a drive structure rotatable about an axis and having a generally flat portion adjacent said axis which portion is movable along a first plane, means operatively connecting said drive structure to said output shaft said driven operator being rotatable about said axis and having a generally flat portion adjacent said axis which portion is movable along a second plane that is generally parallel to said first plane, resilient means effecting a bias of said drive structure and said driven operator toward each other to form a friction type clutch that comprises at least said generally flat portions of said drive structure and said driven operator, upon successive energizing operations of said motor said drive structure being moved to move said driven operator therewith to reciprocate said driven operator between said operating positions, said driven operator being stopped at each of said operating positions, and said friction type clutch being adapted to slip to permit said drive structure to move relative to said driven operator when said driven operator has been stopped at each of said operating positions to thereby limit the amount of force that will be applied to said driven operator through said friction type clutch.

5. An operating mechanism and a molded case type circuit breaker, said circuit breaker comprising an insulating housing and cooperable contacts disposed generally within said housing, said housing comprising a generally planar top wall having an opening therein, a handle extending out through said opening and being movable between two operating positions to open and close said contacts, said operating mechanism being mounted beside said circuit breaker and comprising a main shaft extending generally perpendicular to the plane of said top wall, a first drive member rotatable with said main shaft, a second shaft generally perpendicular to the plane of said top wall, a second drive member rotatably mounted on said second shaft, a driven member operatively connected to said handle and being secured to said second shaft, a friction type clutch connecting said second drive member with said driven member, and said clutch being adapted to slip when the torque required to move said driven member exceeds a certain amount.

6. In combination an operating mechanism and a molded case type circuit breaker, said circuit breaker comprising an insulating housing and cooperable contacts disposed generally within said housing, said housing comprising a generally planar top wall having an opening therein, a handle extending out through said opening and being movable between two operating positions to open and close said contacts, said operating mechanism being mounted beside said circuit breaker and comprising a main shaft extending generally perpendicular to the plane of said top wall, a first drive member rotatable with said main shaft, a second shaft generally perpen-

dicular to the plane of said top wall, a second drive member rotatably mounted on said second shaft, a driven member operatively connected to said handle and being secured to said second shaft, a friction type clutch connecting said second drive member with said driven member, said clutch being adapted to slip to prevent the application of a damaging force to said handle, and said circuit breaker being manually operable merely by rotating said second shaft to over-ride said clutch and move said connecting member to thereby move said handle from one to the other of said positions during which movement said clutch slips.

7. An operating mechanism and a circuit interrupter, said circuit interrupter comprising cooperable contacts and an operating member movable between two operating positions to open and close said contacts, said operating mechanism comprising a main shaft, a first drive member secured to said main shaft, a second shaft generally parallel to said main shaft, a second drive member rotatably mounted on said second shaft, a driven member secured to said second shaft and operatively connected to said operating member, a first generally flat surface on said second drive member, a second generally flat surface on said driven member, means biasing said second drive member and said driven member toward each other to effect a friction type clutch comprising at least said generally flat surfaces, a slot-and-pin type connection between said first drive member and said second drive member, a uni-directional motor, upon energization of said motor said first drive member being rotated about said first shaft to rotate said second drive member and said driven member as a unit about said second shaft to move said operating handle from one to the other of said operating positions, stop means stopping said operating handle and said driven member at said other position, and said clutch slipping to permit said second drive member to move gradually to a stopped condition after said operating handle and driven member are stopped at said other operating position.

8. In combination, an operating mechanism and a molded case type circuit breaker, said circuit breaker comprising an insulating housing and cooperable contacts disposed generally within said housing, said housing comprising a generally planar top wall having an opening therein, a handle extending out through said opening and being movable between two operating positions to open and close said contacts, said operating mechanism being mounted beside said circuit breaker and comprising a main shaft extending generally perpendicular to the plane of said top wall, a first drive member rotatable with said main shaft, a second shaft generally perpendicular to the plane of said top wall, a second drive member rotatably mounted on said second shaft, said second drive member having a first generally flat surface thereon in proximity to said second shaft, a driven member operatively connected to said operating handle and being secured to said second shaft, said driven member having a second generally flat surface thereon in proximity to said second shaft, a generally flat friction member disposed between said driven member and said second drive member and engaging said flat surfaces to form a friction type clutch, upon energization of said motor, said first drive member being rotated to move said second drive member and said driven member to thereby move said handle from one to the other of said operating positions, and said friction clutch being adapted to slip when the resistance to movement of said operating handle exceeds a predetermined amount.

9. In combination, a motor-operating mechanism and a circuit interrupter, said circuit interrupter having an operating member movable between two operating positions, said motor-operating mechanism comprising a driven member operatively connected to said operating member, a unidirectional motor, drive means operatively connected to said uni-directional motor, a friction type clutch operatively connecting said drive means to said driven member, said clutch being adapted to slip when the force exerted against said operating member exceeds a certain value, and means manually operable to move said driven member to override said clutch to reciprocate said operating member between said operating positions.

10. A motor-operating mechanism and a circuit interrupter, said circuit interrupter having an operating member movable between two operating positions and stop means stopping said operating member at each of said operating positions, said motor-operating mechanism comprising a driven member operatively connected to said operating member, a motor, drive means operatively connected to said motor, a friction type clutch comprising generally flat engaging friction surfaces and operatively connecting said drive means to said driven member, said motor operating mechanism being operable to move said operating handle from one to the other of said positions, when said operating handle engages said stop means at said other operating position said friction type clutch slipping to prevent the application of a damaging force to said operating member, and manually operable means for operating said driven member to over-ride said clutch and reciprocate said operating member between said operating positions.

11. A motor-operating mechanism and a circuit interrupter, said circuit interrupter having an operating member movable between two operating positions, said mechanism comprising a driven member operatively connected to said operating member, a uni-directional motor, drive means operatively connected to said uni-directional motor, a friction type clutch operatively connecting said drive means to said driven member, said clutch being adapted to slip to prevent the application of a damaging force to said operating member, upon successive energizing operations of said motor, said motor operating through said drive means said friction type clutch and said driven member to operate said operating member from a first of said operating positions to the second of said operating positions and then to said first operating position, and manually adjustable means operable to adjust the frictional force characteristics of said clutch.

12. In combination, a motor-operating mechanism and a circuit interrupter, said circuit interrupter having an operating member movable between two operating positions and stop means stopping said operating member at each of said operating positions, said motor-operating mechanism comprising a driven member operatively connected to said operating member, a motor, drive means operatively connected to said motor, a friction type clutch comprising generally flat engaging friction surfaces and resilient means applying a force to bias said friction surfaces towards each other, said motor operating mechanism being operable to reciprocate said operating handle between said operating positions, when said operating handle engages said stop means at each of said operating positions said friction type clutch slipping to prevent the application of a damaging force to said operating member, and means for adjusting said resilient means to adjust the amount of force biasing said friction surfaces toward each other.

13. In combination, an operating mechanism and a molded-case type circuit breaker, said circuit breaker comprising an insulating housing and cooperable contacts disposed within said housing, said housing comprising a generally planar top wall having an opening therein, a handle extending out through said opening and being movable between two operating positions to open and close said contacts, said mechanism being mounted beside said circuit breaker and comprising a main shaft generally perpendicular to the plane of said top wall, a first drive member rotatable with said main shaft, a second shaft generally perpendicular to the plane of said top wall, a second drive member rotatably mounted on said sec-

ond shaft, a driven member operatively connected to said handle and being secured to said second shaft, a friction member disposed between said driven member and said second drive member, resilient means biasing said driven member and said second drive member toward each other squeezing said friction member therebetween, means for adjusting said resilient means to thereby adjust the amount of biasing force of said resilient means, said driven member said friction member and said second drive member comprising a clutch adapted to slip when the force of said driven member operating against handle exceeds a certain amount.

14. In combination, a circuit breaker comprising a molded housing and cooperable contacts disposed within said housing, said housing comprising a generally planar top wall having an opening therein, an operating handle extending out through said opening and being movable between two operating positions to open and close said contacts, a motor-operating mechanism mounted adjacent said circuit breaker and comprising a main shaft generally perpendicular to the plane of said top wall, a first drive member rotatable with said main shaft, a second shaft generally perpendicular to the plane of said top wall, a second drive member rotatably mounted on said second shaft and having a generally flat surface in proximity to said shaft, a driven member operatively connected to said handle and being secured to said second shaft, said driven member having a generally flat surface in proximity to said shaft, resilient means biasing said driven member and said second drive member toward each other to bias said generally flat surfaces toward each other to form a friction type clutch comprising at least said generally flat surfaces, means for manually adjusting the biasing force of said resilient means, said clutch being adapted to slip to prevent the application of a damaging force to said handle, and said clutch slipping to permit manual operation of said handle without requiring an operation disconnecting said clutch.

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